European Commission

European Research on Climate Change

Funded by the Seventh Framework Programme

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate I – Environment
Unit I.4 – Climate Change & Natural Hazards

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2013 Directorate-General for Research and Innovation

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Climate change is arguably among the most pressing societal challenges of our times, and now certainly the most well-known amongst the public. From initial observations of global warming and proposed ideas about the root causes, a steady consensus has built up that climate change is one of the most serious threats facing the world in the near future. It is very clearly stated in the recently released 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) on the physical science basis, that global warming is mostly caused by human activities.

Climate change research: its European roots

Climate sciences have an illustrious European history. In the 19th century, Germany's Wladimir Köppen laid the foundations for climatology, while the French mathematician Joseph Fourier (1768 – 1830) postulated the natural greenhouse warming effect and speculated that human behaviour could change a regions climate. Swedish Nobel Prize winner Svante Arrhenius made the first, and amazingly realistic, calculations in 1896 on how changes in the levels of carbon dioxide (CO2) in the atmosphere could alter the temperature of the Earth's surface. In the 1930s the British scientist Guy Stewart Callendar demonstrated that global land temperatures had increased over the previous 50 years and showed that this could have been caused by anthropogenic CO2 emissions.

Research into the Earth's climate system has been present in the EU's Framework Programmes from the beginning. In the 1980s the focus was on the ozone depletion in the stratosphere and EU-projects played an important role for the global ban of the production of Chlorofluorocarbons (CFCs) and other ozone depleting substances (Montreal protocol). Meanwhile, the increasing concentration of greenhouse gases raised concerns about climate change and lead to the establishment of the IPCC in 1988. Since then, European research provided essential contributions to its regularly published assessment reports.

Climate change research has grown considerably in size and complexity. FP5 (1998–2002) supported a large number of projects within the specific 'key action' on 'Global Change, Climate and Biodiversity'. FP6 (2003-2008) supported 31 large projects on climate change, with research areas ranging from atmospheric pollutants to the prediction of climate change and its impacts..

Climate change in the Seventh Framework Programme for research (FP7, 2007-2013)

Climate research has been one of the main research themes of FP7 with one of its 'Theme', i.e. 'Environment (including climate change)' which includes it explicitly in the title. Actions have supported research projects that analyse pressures on the environment (oceans, atmosphere, and ecosystems) and improve our understanding of the complex climate system, also through Earth System modelling. Another key research area included assessing impacts, vulnerabilities and solutions for adapting to climate change, developing strategies for disaster risk reduction and analysing pathways for a smooth transition to a low-carbon society. While some calls are still open and a final figure cannot yet be given, a rough estimation indicates that from 2007 to 2013 in FP7 over 800 Million Euro were spent on supporting climate change research. The majority of the funding was provided for collaborative research projects within the *'Cooperation' programme*[1] , complemented by other funding for research infrastructures for climate observations and modelling and for investigator-driven 'frontier' research awarded by the *European Research Council*[2] (ERC).

1 = http://cordis.europa.eu/fp7/cooperation/home_en.html
2 = http://erc.europa.eu/

Research activities on climate change represents only a relatively minor part of what we can name as "climate-related" research. In fact, much more has been done in view of developing a low carbon economy, through activities funded by the Framework Programme notably in the areas of energy, transport, agriculture, industrial and information technologies which contribute to the identification and development of mitigation options through progress on energy efficiency, renewable energy, low carbon manufacturing processes and more environmentally friendly transport systems.

International cooperation has been an important element of FP7. Participation in FP7 was in fact open to all countries worldwide, with many Third countries (especially developing ones and those with economies in transition) also eligible for funding. For the projects presented in this catalogue, participation of institutions from non-European countries amount to approximately 9,5% of the total number of project partners, while financial contribution from FP7 to these countries represent even 14% of total spending. Key participating countries in this domain include China, India, Brazil, Russia, USA, Canada, South Africa, and Japan.

Six research areas have been covered in this catalogue:

1. Climate observation, processes and projections
2. The carbon and nitrogen cycles and greenhouse gas emissions
3. Atmospheric pollution and climate interactions
4. Climate change impacts
5. Climate related natural hazards and extreme events
6. Climate change adaptation, mitigation and relevant policies

Climate observation, processes and projections

Climate observations and modelling have been the main research pillars in FP7. Research has focused on the observations and simulation of Earth System processes at different scales, determining and understanding climate variations of the past, as well as on the production of reliable projections of future change. The results were used in the IPCC reports and other assessments supporting decision-making and have provided information of great value for many socio-economic sectors across Europe. Studies of single or combined critical ocean/atmosphere/land interactions have been conducted in different climate regions (e.g. Arctic, Mediterranean, North Atlantic) in Europe and worldwide. Whenever significant, focus has been given to processes affecting reversibility and triggering abrupt changes. Substantial improvements in the Earth system models have allowed to obtain more accurate climate projections at seasonal-to-decadal time scales, and to reduce uncertainties in the prediction of climate change for future decades.

Robust and long-term climate observations are crucial to the production and validation of reliable predictions. It is an essential part of the EU's research policy to support infrastructures and their European and global integration. Networks of autonomous (**EURO-ARGO**) or manned monitoring platforms (**EURO-Fleets, ACTRIS**) provide baseline climate data as well as process studies. Support for networking, trans-national access and joint research has improved the performance of distributed stations like **InterAct**, a circumpolar net of research facilities for monitoring change in Arctic terrestrial ecosystems. FP7 also supported the preparation and implementation of essential infrastructures identified in the *ESFRI*[3] roadmap, like **IAGOS** (In-service Aircraft for a Global Observing System), **ICOS**, the Integrated Carbon Observing System, and the Svalbard Integrated Observing System (**SIOS**). These efforts, as well as dedicated projects focussing for example on the oxygen depletion in the ocean (**HYPOX**) or capacity building (**GEONETCAB**), have contributed to the setup of the Global Earth Observation System of Systems (**GEOSS**).

The ERC grants support frontier research projects related to climate science, with

3 = European Strategy Forum on Research Infrastructures

focus on various aspects like biosphere-climate interaction or the formation of small particles (aerosol) and clouds in the atmosphere. Several ERC projects attempt to improve the reconstruction of atmospheric CO2 concentrations, carbon cycling or temperatures thousands - or even millions - of years back in time which are fundamental for better projecting future change.

Critical aspects of climate modelling such as missing or lacking understanding of key processes in the atmosphere and the ocean have been successfully addressed via projects such as **COMBINE** (inclusion of processes such as C-and N-cycle, sea-ice and permafrost) and **EUCLIPSE** (cloud modelling), respectively. They offered new evaluation tools and climate simulations in support of the IPCC Fifth Assessment Report (AR5). These projects, as well as the climate modelling community in general, profited from the EU support to the e infrastructure for the European Network for Earth System Modelling (**IS-ENES**).

Ocean acidification is one of the most critical aspects of the continuously increasing CO2 concentrations in the atmosphere, due its severe impacts on the ocean ecosystem. The **EPOCA** project, a major contributor to AR5, has generated key information on ocean acidification including the rate at which it proceeds and the hotspots where critical pH values will be reached first. It assessed the consequences of ocean acidification in terms of biodiversity, ecosystem services, biogeochemical processes and feedbacks on the climate system, and identified the most vulnerable ecosystems.

Another major achievement is the launch of "European climate observations, modelling and services" (**ECOMS**) initiative focusing on seasonal-to-decadal predictions and the delivery of trustworthy climate information to stakeholders. **ECOMS** integrates three major projects respectively dealing with observations (**NACLIM**), climate modelling (**SPECS**) and climate services (**EUPORIAS**) and is a key European contribution to the WMO Global Framework for Climate Services (**GFCS**).

The carbon and nitrogen cycles and greenhouse gas emissions

Research on carbon cycle and other greenhouse gases has been an important component in FP7 in order to fill key knowledge gaps. Research actions have mainly focused on providing an improved quantitative assessment of the sources and sinks of carbon and/or nitrogen in terrestrial ecosystems in Europe and the Atlantic Ocean, assessing their vulnerability to climate change and human activities and better quantifying the impact of elevated carbon concentrations to ecosystems, such as ocean acidification. This effort led to the establishment of high-quality, long-term observation systems and to the development of state-of-the-art models that accurately capture carbon-climate interactions. Results have contributed to key international scientific assessments (e.g. IPCC) and programmes (Global Carbon Project). Furthermore, particular emphasis was given to vulnerable ecosystems with high carbon and/or nitrogen content such a permafrost soils and tropical forests.

Another lighthouse project is **NITROEUROPE** which addressed the major question of what is the effect of reactive nitrogen (Nr) supply on net greenhouse gas budgets for Europe. The project provided key elements to answer this question:

- A comprehensive new European Nitrogen Budget (for EU27);
- A more accurate estimate of the various war ming and cooling effects of Nr management in Europe;
- A comprehensive cost-benefit analysis;
- An assessment of management options for more efficient management of the nitrogen cycle, with recommendations to reduce the climate warming effects of Nr losses and the provision of evidence base for the design of environmental policies.

Atmospheric pollution and climate interactions

FP7 has significantly contributed to advance the understanding of the complex changes in the composition of the atmosphere and the impact they have on the environment. Research efforts have focussed on providing sound scientific basis to combat the adverse effects we are facing, namely the warming of the climate and the negative impact on health and ecosystems associated to air pollution. Results have contributed to the revision and implementation of EU Air policy and to reduce the uncertainties in the climate models, in particular by better understanding the role of atmospheric aerosols and other short lived pollutants and their precursors (including nitrogen oxides, volatile organic compounds, sulphate, and black carbon). Particular attention has also been given to the development of integrated assessment tools for the design of emission abatement strategies taking into consideration relevant socio-economic aspects.

The **RECONCILE** project is studying the depletion of ozone layer through dedicated laboratory and field measurements, working to improve model representations which can simulate and predict current and future Arctic stratospheric ozone loss. This project contributed to the observation and explanation of the first ever Arctic ozone hole in 2011 when an area of very low stratospheric ozone concentration, comparable to the loss observed every year over Antarctica, occurred over the Arctic.

Air quality and climate change have traditionally been viewed separately by scientists and politicians alike. Breaking with this tradition, the FP7 **PEGASOS** project assesses the impacts of European air pollution on climate change and vice versa by combining field measurements at different heights with state of the art atmospheric and climate models. Thanks to the unique flight characteristics of the Zeppelin airship used by the project, the scientists had an unprecedented view of how pollution is distributed in the lowest one or two kilometers of the atmosphere over Europe. It is in this layer of the atmosphere that most pollutants emitted on the ground react with other atmospheric compounds.

PEGASOS, with other 20 projects related to air quality, provided a very valuable contribution to the review of the EU's air policies due in 2013 through the publication of a summary of policy-relevant findings that was presented at the '2013 Green Week' in Brussels.

Climate change impacts

Climate projections indicate that our environment and society can be significantly affected in the medium to long-term. Impacts across the globe will be diverse, posing severe challenges but also sometimes creating opportunities. They can span a variety of sectors, including agriculture, the water cycle, land cover and vegetation, ecosystems, the marine environment, health, etc. Climate change impacts concern not only the natural environment, but also peoples' livelihoods, and will challenge our socio-economic system and structures. Relevant research seeks to assess the level and magnitude of potential impacts, to help us identify the extent and likelihood of expected changes. On the one hand, this information helps us understand our vulnerabilities and adaptation needs; on the other, it also informs climate policies, by identifying critical thresholds and tipping points for our ecosystems and economies.

The **Impact2C** project integrates the expertise of top climate scientists, impact specialists with both scientific and economic backgrounds, and local specialists from specific regions under study. All are working to deliver maximum support on the development of sectoral and cross-sectoral pan-European strategies for adapting to a 2°C global temperature rise.

In addition to global impact assessments, several FP7 projects have dealt with climate change impacts on specific sectors and vulnerability hotspots. Among these, the **CLIWASEC** cluster, formed by the **CLIMB**, **WASSERMed** and **CLICO** projects, focused on water security in the Mediterranean region. The projects have provided a better understanding of the hydrological budget and potential changes in the water balance of specific catchments, and of more global impacts on key economic sectors and activities. The **ACQWA** project focused on changes in the water cycle of mountain regions, which can have huge implications both for local economies and for downstream areas. In Europe, the project studied the Rhone (CH/FR) and the Po catchment (IT). Results from the project indicate a future decline in alpine snow cover, as well as an increase in extreme precipitation events. Relevant impacts, in terms of climate-driven hazards, forests, hydropower generation, agriculture, tourism and aquatic ecosystems were studied extensively to provide a comprehensive overview of future risks.

The **Ice2sea** project set the challenge of reducing uncertainty in the contribution of glaciers and ice-sheets to sea-level rise, which the last IPCC report identified as a key problem in projections. Over the past four years a team of scientists from 24 institutions have worked together to find out how i.e. the Greenland ice-sheet responds to global warming. Based on observations and advanced computer simulations they forecasted how much ice the Greenland and Antarctic glaciers will release to the ocean within the next 200 years. The project provided a detailed global map of the non-uniform contribution of the glaciers to sea level rise and thus a sound scientific foundation for policy development surrounding sea-level rise and the best possible basis for European coastal defense planning.

Climate related natural hazards and extreme events

Managing future risks related to climate change and developing strategies for disaster risk reduction need to take into account the possible risk drivers. Anticipating, preventing, limiting the impacts and managing these threats will contribute to a safer and more resilient society. The projects presented in this publication illustrate some examples of the on-going interdisciplinary research collaboration that is addressing the challenges societies and populations will have to face with climate-related hazards.

Urban areas of European countries face increasing flood risks due to urbanisation and the effects of climate change. The **STAR-FLOOD** project focuses on the development and implementation of appropriate and resilient flood risk governance arrangements in Europe, whereas **FLOODCHANGE** investigates the drivers of flood generation. This is assumed to require a diversification of Flood Risk Management Strategies – including flood defence, pro-active spatial planning, flood mitigation, flood preparation and recovery.

Flash floods present a challenge for early warning systems, since heavy rainfalls are hard to be forecasted with high accuracy and enough anticipation to allow efficient decision and risk management support. Research carried out under the European project **IMPRINTS** has, however, produced the first Early Warning operational platform able to provide hydrological warnings based on the rainfall forecasted by meteorological models (few days in advance) and by weather radar networks (few hours in advance). The platform is able to transform the anticipation provided by the rainfall forecasts into hydrological forecasts, and also to combine these hydrometeorological forecasts with the available information about vulnerability and flooding risks, providing a full Early Warning System for Flash Flood and Debris Flow risk management.

The enhanced understanding of drought processes and their impacts is another key area where FP7 funded research contributes. Relevant early warning indicators, assessment of drought risks and potential damages are particularly challenging to address, given the complexity of the phenomenon, such as slow onset, the diverse impacts depending on the geoclimatic region and socio-economic context, and the very different levels of preparedness and coping capacity. The **Drought-R&SPI** project seeks to better characterise past and future droughts in Europe, both as natural hazards and in terms of their impacts. It actively works for developing a successful science-policy interface, which is providing support to a number of EU policies.

Climate change adaptation, mitigation and policies

The majority of greenhouse gas emissions is generated by five key sectors: energy, industry, transport, food and agriculture, and households/buildings. The nature and drivers of these emissions, the policy instruments which have been developed to address them, and the issues, problems and market imperfections and failure which they seek to tackle, differ greatly and several FP7 projects have been focusing on these research areas.

Research projects addressing the economics of mitigation and mitigation policy have developed scenarios and models to understand the magnitude of the change that is required in key sectors, to quantify the expected effects of policy instruments and their interaction, and also to understand the sectoral, economy-wide, and cross-cutting impacts of the current policy instrument mix for climate change mitigation. To mention some, the **LIMITS** project has defined emission reduction pathways consistent with the 2°C target at global level, assessing the investment requirements to implement these transformation pathways, and the changes in the energy infrastructure and land use which major economies need to implement to attain stringent climate policies. The projects **ADVANCE** and **COMPLEX** are preparing the new generation of modelling tools and decision-support systems which are needed also to support communities across Europe working to make the transition to a low-carbon economy. The modelling results of these projects will inform the international policy debate at UNFCCC level, in the Durban Action Platform, with an open and rigorous assessment of the climate policies in the EU, US, China and India.

The achievement or not of climate change mitigation goals set at global level is linked with the manifestation of corresponding levels of climate change and the need for adaptation.

As adaptation to climate change becomes a pressing decision-making priority, there is increasing need for good quality information, assessment methodologies and new tools that can enable decision and policy makers to plan adaptation measures and adapt effectively. The issues of scale (local, regional, and national) but also of uncertainty, cost-effectiveness of adaptation measures and policies, and synergies or conflicts with mitigation goals and other policies have been a focal point in the FP7 climate research agenda.

In this context, **ClimateCost** provided a comprehensive estimate of the costs of climate change in Europe. Research focused on quantifying impacts and economic costs for different sectors, such as agriculture, health, energy, and considered several risks, such as river flooding and sea level rise in coastal zones. This quantification showcased that adaptation is generally very effective at reducing impacts at low cost, but also identified the need for robust and flexible adaptation strategies to cope with the inherent uncertainty associated with climate change projections.

Projects such as **CLIMSAVE** and **MEDIATION** have developed web-based tools and knowledge bases to help policy makers and local actors explore alternative adaptation solutions in different sectors. The outputs of these projects will be made available through the EU Climate-Adapt platform, with the aim to provide the much needed resources to local actors faced with the challenges of adaptation in different sectors. **RAMSES** takes a particular focus on adaptation needs in cities worldwide, providing tools and models easily transferable to diverse urban environments and socio-economic contexts. **FUTURESOC** is about changes in future society which will influence the capabilities to adapt to climate change. Education levels, demographic trends and global long-term projections of human capital will be investigated to build scenarios of long term societal changes. Economic aspects relating to adaptation are further tackled through the **ToPDAd** project which develops a new second generation toolset for assessing the socio-economic impacts of adaptation with a particular focus on the transport, energy and tourism sectors in different regions of Europe. At the same time, knowledge on adaptation is being enhanced by

BASE: through the analysis of over 20 cases, the project improves adaptation knowledge, integration and utilisation, strengthens stakeholder participation in adaptation decisions and policies, and supports coherent, multi-level and multi-sector policy development.

Some concluding remarks

The growing body of scientific knowledge produced through successive Framework Programmes for research helped to define a robust research roadmap and provided very valuable information to policy makers for the development and implementation of the EU Climate Policy and for supporting international negotiations within the UN Framework Convention on Climate Change (UNFCCC).

European research in climate change is leading globally, as acknowledged by its contribution to the IPCC Assessment Reports.

With the view of sustaining this leadership in climate change science and of developing suitable options and solutions for mitigation and adaptation, the up-coming Horizon 2020 – the Framework Programme for Research and Innovation 2014-2020 – will broadly support research and innovation in this field.

Across the three pillars of Horizon 2020 – Excellent Science, Industrial Leadership and Societal Challenges – at least 35% of its 70 billion Euro funding for research and innovation will be spent in climate-related actions spanning from climate change research to the development of low carbon technologies and adaptation solutions.

This FP7 catalogue is therefore intended as a summary of what has been and is being carried out at the edge of the start of the Horizon 2020 Framework Programme.

It is the baseline on which the new Programme will build in the next seven years.

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Climate observations, processes and projections

AIRSEA

At a glance
Title: Air-Sea Exchanges driven by Light
Funding scheme: ERC Advanced Grants
ERC funding: 2 370 000 €
Duration: 60 months
Start date: 01/04/2012
Host institution: Centre National de la Recherche Scientifique, FR
Principal investigator: Christian George
Project website: http://www.marine.ie/home/research/ProjectsDatabase/CurrentProjects/AIRSEA.htm
Key words: air-sea interactions, photochemistry

The challenge

The scientific motivation of this project is the significant presence of organic compounds at the surface of the ocean. They form the link between ocean biogeochemistry through the physico-chemical processes near the water-air interface with primary and secondary aerosol formation and evolution in the air aloft and finally to the climate impact of marine boundary layer aerosols. However, their photochemistry and photosensitizer properties have only been suggested and discussed but never fully addressed because they were beyond reach. This project suggests going significantly beyond this matter of fact by a combination of innovative tools and the development of new ideas.

Project objectives

This project is therefore devoted to new laboratory investigations of processes occurring at the air sea interface to predict emission, formation and evolution of halogenated radicals and aerosols from this vast interface between oceans and atmosphere. It progresses from fundamental laboratory measurements, marine science, surface chemistry, photochemistry and is therefore interdisciplinary in nature.

Methodology

It will lead to the development of innovative techniques for characterising chemical processing at the air sea interface (e.g., a multiphase atmospheric simulation chamber, a time-resolved fluorescence technique for characterising chemical processing at the air-sea interface). It will allow the assessment of new emerging ideas such as a quantitative description of the importance of photosensitized reactions in the visible at the air/sea interface as a major source of halogenated radicals and aerosols in the marine environment.

Emerging results

This new understanding will impact on our ability to describe atmospheric chemistry in the marine environment which has strong impact on the urban air quality of coastal regions (which by the way represent highly populated regions) but also on climate change by providing new input for global climate models.

ATP

At a glance

Title: Arctic Tipping Points

Instrument: Collaborative project

Total cost: 6 545 776 €

EC contribution: 4 998 098 €

Duration: 36 months

Start date: 01/02/2009

Consortium: 13 partners from 11 countries

Project coordinator: Paul Wassmann

Project website: www.eu-atp.org

Key words: Climate change, Arctic marine ecosystems, time-series, ecological thresholds, regime shifts, early warning indicators, socio-economic impacts, EU policy integrated management

The challenge

There is mounting evidence that ecosystem response to certain types of external pressures (climate, human impacts, etc.) is often abrupt and non-linear, leading to significant reorganisation of system properties and processes. These ecosystem changes are known as regime shifts. Regime shifts arise, for instance, from introduction of alien species or the loss of key species in ecosystems. These changes can result in alterations of the most basic ecosystem parameters, including food-web structure, the flow of organic matter and nutrients through the ecosystem, or the patterns of space occupation, leading to a cascade of ecosystem changes.

The term tipping point commonly refers to a critical threshold at which minor perturbations can qualitatively alter the state or development of a system. Because the Arctic is warming about two times faster than the global rate, Arctic ecosystems are likely to encounter climate driven thresholds or tipping points that lead to abrupt changes much sooner than other ecosystems.

Project objectives

Investigate the existence of climate-driven tipping points for key species and ecosystem processes through analysis of available time-series data and coordinated experimental evaluations. These experimental evaluations will be used to validate the thresholds identified from time-series analysis, and to postulate new climate-driven tipping points. Ecosystem models will test these, and help to formulate future trajectories of Arctic marine ecosystems under climate change scenarios that consider the possibilities of tipping points.

Methodology

Compilation of historical records of Arctic climate change and projections of future changes in Arctic sea climate (physical oceanography and ice systems).

Time series of Arctic ecosystem analysis using novel statistical tools to detect regime shifts and ecological thresholds and tipping points, and evaluate their sensitivity to climatic forcing.

Experimental manipulations and comparative analyses across broad climatic ranges to detect climatic thresholds and tipping points of Arctic organisms and ecosystems. Genome-wide analysis to develop genomic markers of climate-driven stress useful as early warning indicators of the proximity of tipping points.

Application of a biological-physical coupled 3D model to generate future trajectories of Arctic ecosystems under projected climate change scenarios (regional climate model REMO, scenarios B1, A1, A1B) and to identify their consequences for the Arctic ecosystem.

Evaluation of socio-economic opportunities and risks emerging from climate-driven impacts (activities of strategic importance for the European Arctic, employment and income). Assessment of possible policies and legislative frameworks to adapt and mitigate these impacts.

Emerging results

Identified climate thresholds and tipping points for key Arctic marine ecosystem components and processes.

Modelled future trajectories, tipping points and regime shifts through coupled physical/biological and regional climate models.

Development of early-warning indicators of climatic thresholds for major phytoplankton taxa.

Evaluation of expected changes in relationships between a) climate forcing and biological responses and b) ecosystem components and their inter-relationships during regime shifts.

Assessments of the implications of changes in the Arctic for socio-economic activities and governance of Arctic resources.

White paper evaluating different policy options in avoiding exceeding tipping points for Arctic ecosystems.

Project partners	
University of Tromsø	NO
Consejo Superior de Investigaciones Cientificas	ES
Akvaplan-niva AS	NO
SINTEF Fisheries and Aquaculture AS	NO
University of Aarhus,	DK
Institute of Oceanology, Polish Academy of Sciences	PL
Department of Applied Matematics and Theoretical Physics, University of Cambridge	UK
Université de Pierre et Marie Curie, Paris 6	FR
Centre of Marine Sciences	PT
Shirshov Institute of Oceanology, Russian Academy of Sciences	RU
Greenland Institute of Natural Resources	GL
Swedish Academy of Science, Beijer Institute for Ecological Economics	SE
Max-Planck-Gesellshaft zur Förderung der Wissenshaften, Institut für Meteorologie	DE

CACH

At a glance
Title: Reconstructing abrupt Changes in Chemistry and Circulation of the Equatorial Atlantic Ocean: Implications for global Climate and deep-water Habitats
Funding schemes: ERC Starting Grants
ERC funding: 1 998 833 €
Duration: 60 months
Start date: 01/10/2011
Principal investigator: Laura Robinson
Host institution: University of Bristol, UK
Project website: http://tropics.blogs.ilrt.org/
Key words: deep-sea coral, paleoclimate, sediment core

The challenge

Ice-core records show that glacials had lower atmospheric CO2 and cooler temperatures than today and that the last deglaciation was punctuated by large, abrupt millennial-scale climate events. Explaining the mechanism controlling these oscillations remains an outstanding puzzle. The ocean is a key player, and the Atlantic is particularly dynamic as it transports heat, carbon and nutrients across the equator. This project is a focused study of present and past ocean chemistry in the Equatorial Atlantic designed to address how the oceans modulate climate, as well as assess the impact of ocean chemistry on fragile deep-sea ecosystems.

Project objectives

There are three major objectives in the project, designed to test vital climate and ecosystem hypotheses:

- Determine the major controls on the past and present distribution of cold-water corals
- Develop and test new geochemical proxies in deep-sea corals and sediments
- Determine the chemistry and circulation of the abyssal and intermediate Equatorial Atlantic during the Last Glacial Maximum and during past rapid climate change events

Methodology

This is a multidisciplinary investigation involving oceanography, geochemistry, palaeobiogeography and palaeoclimate in a field-based project in the Equatorial Atlantic combined with geochemical analyses to reconstruct the history and dynamics of past climate change.

Emerging results

Thus far the project has focussed on planning and organising the field-based component of the research, together with preparations in the laboratory to facilitate the analytical component of the research. The research cruise will take place in October through to November 2013 on the RV James Cook with the remotely operated vehicle Isis. During the cruise we will map, image and collect seafloor samples that will allow us to address our project objectives.

The results of the cruise, and of subsequent laboratory analyses will be of benefit to those who seek to understand both modern and past oceanographic processes. The two major components of the project will relate to the interactions between the ocean and climate, and between ocean chemistry and deep-water ecosystems. As a result the projects outcomes are likely to be of interest to a broad scientific community as well as the wider public.

CAPRI

At a glance
Title: Clouds and Precipitation Response to Anthropogenic Changes in the Natural Environment.
Funding scheme: ERC Consolidator Grants.
ERC funding: 1 428 169 €
Duration: 60 months
Start date: 01/09/2012
Host institution: Weizmann Institute of Science, IL
Principal investigator: Ilan Koren
Project website: http:// www.weizmann.ac.il/EPS/People/Ilan
Key words: Climate, Clouds, Precipitation, Ahntropogenic effects

The challenge

Clouds and precipitation play a crucial role in the Earth's energy balance, global atmospheric circulation and the water cycle. Despite their importance, clouds still pose the largest uncertainty in climate research. As in many dynamical systems, cloud fields` response to anthropogenic changes in the natural environmental conditions will not be linear. Some of the effects can be damped by negative feedbacks, resulting in relatively small changes in the average cloud properties, while others can result in a migration of the cloud system into a different state, resulting in dramatic changes in lifetime, coverage, morphology and precipitation. The challenge is to recognize and separate the main governing processes and to understand the outcomes of key anthropogenic effects on radiation and water budgets.

Project objectives

The aim of this work is to provide a fundamental new understanding of the coupled surface-aerosol-cloud fields-rain system, with a new insight about the sensitivity of various cloud types to anthropogenic changes in land, ocean and atmosphere. It will offer better, more realistic cloud characteristic parameters to be used in climate models in order to predict future climate responses to man-made actions. Moreover, it will add new dimensions to cloud and climate research by introducing new insights gained by pattern recognition and texture analyses. Such approach will allow the extraction of cloud field morphological properties and will establish a direct link between the theories of systems approach and cloud physics.

Methodology

We will use a new approach for studying anthropogenic effects on cloud fields and rain, combining both scientific ends: reductionism and systems approach. Ideas from several different disciplines such as cloud physics, remote sensing, radiative transfer, pattern recognition, computer vision and systems approach are merged, in order to distil new physical insights.

Observations and models are used interactively allowing us to "peel apart" detailed physical processes. In parallel, a systems view of the field is developed, looking for emergent behaviour rising out of the complexity, as the end result of all the coupled processes. A better understanding of key processes in a detailed (reductionist) manner enables us to formulate the important basic rules that control the cloud system and look for the end net effect.

Our research program is based on interactions between four components: 1) Surface and satellite observations and meteorological data 2) Cloud resolving numerical modelling, in scales of clouds and cloud fields 3) Morphological analysis of cloud fields for detection of cloud patterns and following their evolution in time, using satellite and model data, and 4) a systems analysis component, in which general rules that dictate the behaviour of the whole cloud field and are the outcome of all processes, are detected and analysed. Those 4 components are used interactively to study feedbacks between anthropogenic effects and cloud properties.

Emerging results

The outcome of this work will be a new understanding of how we affect our climate and the availability of fresh water. This work will emphasize the consequences of human actions on the environment, and how we are changing our climate and hydrological cycle as we input pollutants and transform the Earth's surface. It will open new horizons in cloud research by enabling the employment of knowledge from theories of complexity, networking and self-organization to cloud-climate studies. We propose a long-term, open-ended program of study that will have great scientific importance, as long as human-caused influence on the environment continues to evolve and change.

As a proof of concept we have recently shown how the aerosol-cloud-precipitation system can be simulated as a collection of complex oscillators, each coupled with adjacent clouds. The equations describing the individual clouds are predator-prey like, based on the interplay between rain that consumes the clouds and aerosols that affect cloud and rain formation. Solutions of such system allowed us to predict few possible stats of real cloud system, which were later verified using observational data.

COMBINE

At a glance

Title: Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection

Instrument: Collaborative project

Total cost: 11 423 157 €

EC contribution: 7 922 679 €

Duration: 48 months

Start date: 01/05/2009

Consortium: 23 partners from 14 countries

Project coordinator: Marco Giorgetta, Max Planck Institute for Meteorology, Max-Planck-Gesellschaft, DE

Project website: www.combine-project.eu

Key words: Earth system model, processes, initialization, decadal climate prodiction, climate projection, impacts, scenarios, climate policies

The challenge

One of the most pressing questions of the current time is to predict the future of the Earth environment. This question arises from the realization that human activities have a sizable impact on our planet, the Earth. The COMBINE project brings together leading European modelling centres to face the challenge of building the next generation of Earth System Models (ESMs), to advance the capabilities of climate prediction and projection. COMBINE follows previous European Commission large—scale projects, such as ENSEMBLES from FP6, on being a strong European effort. In COMBINE, model development aims at incorporating our most advanced knowledge of the Earth System. Pioneering applications of ESMs in new areas of research, such as decadal climate prediction, are a core aspect of the project.

Project objectives

The overarching objectives of the COMBINE project are:

- To advance the prediction capabilities of ESMs by including critical physical and biogeochemical processes ("new components") into the models.
- To represent more accurately the forcing mechanisms and the feedbacks determining the magnitude of climate change in the 21st century.
- To assess, improve and implement new strategies of ocean and sea-ice initialization techniques for decadal climate prediction.
- To combine ESMs and integrated assessment models to find revised CO2 emission scenarios, including those scenarios constructed on the basis of climate policy.
- To assess climate change impacts on water availability and agriculture, globally and more specifically in three selected regions: The Arctic, the Eastern Mediterranean and the Amazon basin, where different feedbacks are important.

Methodology

The project workflow is subdivided in 8 work packages (WPs). WP1 to 4 are dedicated to development and validation of new components: Carbon and nitrogen cycles, the coupling of aerosols, cloud microphysics and chemistry, stratospheric dynamics, and cryospheric processes. Ocean and sea-ice initialization techniques are tackled in WP5. The effects of combined new components are investigated systematically by means of dedicated numerical experiments in WP6 and 7. Respectively, WP6 analyses the effect of the new components on decadal climate prediction, thus also incorporating the methods developed in WP5. WP7 uses simulations of centennial climate projections to investigate the effect of the new components on climate related feedbacks. WP8 explores the outputs of climate predictions and projections for impact analyses, at the global and regional scales. WP8 also combines the ESM outputs and integrated assessment modelling to find revised CO2 emission scenarios.

Emerging results

The COMBINE partners have advanced significantly on developing the scientific and technical foundations for incorporating new components in ESMs. The first phase of the COMBINE numerical experiments has been completed. The main results achieved so far are:

- Implementation and testing of land use changes and wildfire impacts, processes for the terrestrial and oceanic nitrogen cycles, and processes related to methane emissions from permafrost and wetland changes.
- Evaluations of cloud-radiation and aerosol-cloud effects and land use impacts on tropospheric chemistry.
- Incorporation of tropical and polar stratospheric dynamical variability in ESMs.
- Improved understanding of processes regulating ice-sheet surface energy and mass balances; increased realism of the representation of surface snow processes in both ice-sheet and sea-ice models.
- A new ocean re-analysis has been conducted using up-to-date quality-controlled ocean observation data sets and atmospheric forcing fluxes, with significant progress in sea-ice assimilation.
- Decadal prediction and centennial projection following the Coupled Model Inter-comparison Project phase 5 (CMIP5) protocols completed with the relevant COMBINE ESMs. The decadal experiments have been initialized using observation based ocean state estimates. The combined results of the new ESMs and integrated assessment models will provide new information to the policy makers on the necessary reduction in CO2 emissions for reaching defined targets in global warming, with implications for international climate negotiations. The results obtained will contribute not only to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, but also directly to European climate policies. Harmonisation and standardisation of climate simulations and model data will contribute to further strengthen the European climate modelling community and the European voice in international climate negotiations.

Project partners	
Max-Planck-Gesellschaft, DE	University of Exeter, UK
Met Office, UK	Instituto Nacional de Pesquisas Espaciais, UK
Centre National de la Recherche Scientifique, FR	Cyprus Research and Educational Foundation, CY
Centro Euro-Mediterraneo per i Cambiamenti Climatici, IT	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubheer (Planbureau voor de leefomgeving), NL
Météo-France-Centre National de Recherches Météorologiques, FR	Eidgenössiche Technische Hochschulen Zürich, CH
Het Koninklijk Nederlands Meteorologisch Instituut, NL	Technical University of Crete, EL
University of Bergen, NO	University of Kassel- Centre for Environemental Systems Research (CESR), DE
Danish Meteorological Institute, DK	University of Bristol, UK
European Center for Medium-Range Weather Forecast, UK	European Centre for Research and Advances Training in Scientific Computation, FR
Finnish Meteorological Institute, FI	Université Catholique de Louvain, BE
University of Helsinky, FI	

DARECLIMED

At a glance
Title: Data repositories and computational infrastructure for environmental and climate studies in the eastern Mediterranean
Instrument: Coordination action
Total cost: 555 681 €
EC contribution: 500 000 €
Duration: 30 months
Start date: 01/02/2011
Consortium: 7 partners from 6 countries
Project coordinator: Manfred A. Lange, The Cyprus Institute, CY
Project website: www.cyi.ac.cy/dareclimed-welcome.html
Key words: MENA region, Climate data, Water sector, Energy Sector, Regional climate modeling, Data repository

The challenge

Recent climate projections have highlighted the Eastern Mediterranean, the Middle East and North Africa (MENA) as a "climate change hot spot". This will result in increased summer temperatures, heat wave intensities and duration, decreasing precipitation and prolonged drought periods. The environmental and socio-economic consequences of such impacts will be significant. Climate research requires data records for at least several decades. While the Eastern Mediterranean offers a significant range of documentary information, climate data for longer time spans with adequate spatial and temporal coverage are scarce. Given the interconnections between climate, water availability and energy consumption, data on all three sectors are highly desirable in order to map out the possible future of the MENA region. However, the cultural background, the history of science and the recent political transitions in parts of the MENA region accentuate the issue of data scarcity and the significant challenges to be met.

Project objectives

The main objectives of the project are to favour and prepare the creation of a regional data infrastructure devoted to climate, water, energy and related topics, and to engage relevant entities into an integrated study of regional climate change, its impact and the associated policy issues related to mitigation and adaptation. To this end the project will set up expert groups and carry out studies and networking activities aimed at regional climate stakeholders (research institutions, public authorities, relevant state agencies, NGOs, etc.), in order to raise their awareness and engage key actors into (i) creating the appropriate conditions for the formation of a regional data infrastructure devoted to climate, energy and water related data; (ii) contributing to a climate change impact study that will integrate results obtained by multiple research organizations in the region; (iii) capacity building prospective and incubation activities for future collaborative climate research.

Methodology

In order to reach the goals of the proposed project, the following activities will be carried out:

1. Organization of local stakeholder meetings and scientific workshops in the study region; major purpose: take stock of available data and their accessibility, understand methodologies for data gathering; explore data homogeneity issues; specify policies for the quality control and harmonization of the relevant data
2. Creation of a Task Force for preparing the creation of a regional data infrastructure covering

climate, energy and water related data

3. Coordination and cooperation with other European and international projects with related and possibly overlapping objectives
4. Creation of a regional repository of climate and air quality models and simulation results
5. Organization of an International Conference which will showcase the progress made with regard to creating a data infrastructures as a basis for climate change impact assessments and the scoping of adequate adaptation/mitigation studies in the Mediterranean

Emerging results

DARECLIMED will make a significant contribution to the development of a coordinated policy for research infrastructures in the field of climate research and climate data, for the South-Eastern part of the European Research Area. It will address specific needs for international cooperation, in relation to the fact that actions fostering the development of climate data infrastructures need to conducted at the regional scale. The pooling and coordination of resources will be ensured on the regional scale, thanks to the stakeholder meetings, and to other networking and outreach activities. Moreover, the project will identify and promote best practices, as well as foster a culture of cooperation within the regional climate science community and with regional stakeholders. While this effort will originate within the regional scientific community, it will gradually involve additional stakeholders. The project will thus not only have an impact on climate science but also be beneficial to specifying policy issues at the regional scale.

Project partners	
The Cyprus Institute (CY)	Panepistimio Kritis (University of Crete) (EL)
Biomedical Research Foundation, Academy of Athens (EL)	Istanbul Teknik Universitesi (TR)
Tel Aviv University (IL)	Ministry of Transport (JO)
Weizmann Institute of Science (IL)	

DESERT STORMS

At a glance
Title: Desert Storms – Towards an Improved Representation of Meteorological Processes in Models of Mineral Dust Emission
Funding scheme: ERC Starting Grants
ERC funding: 1 360 000 €
Duration: 60 months
Start date: 01/10/2013
Host institutions: University of Leeds, UK
Principal investigator: Peter Knippertz
Project website: www.see.leeds.ac.uk/research/icas/working-groups/knippertz/projects/desert-storms/
Key words: Earth system models, aerosols, dust, haboobs, low-level jets, dust devils, wind, turbulence, boundary layer, turbulence, roughness, Sahara, Sahel

The challenge

Dust particles, lifted from the world's deserts and transported around the globe, significantly affect weather and climate through their influences on solar and thermal radiation, cloud droplets and ice particles, chemical reactions in the atmosphere and the carbon cycle via the fertilization of ecosystems. Recently, increasing efforts have been made to include effects of dust into weather and climate models. Quantitative estimates of dust emission and deposition, however, are highly uncertain. This is largely due to the lack of sufficient observational data and the strongly nonlinear dependence of emissions on peak winds, which are often underestimated in models.

Project objectives

- Compile the most comprehensive observational dataset of peak winds and dust emission to date.
- Improve the understanding of physical mechanisms of peak wind generation in dust emission regions.
- Assess the relative importance of single processes for total dust emission.
- Evaluate the representation of these processes in state-of-the-art regional and global models.
- Determine model sensitivities with respect to horizontal and vertical resolution and model physics.
- Improve the representation of crucial processes in models by identifying optimal configurations and by developing new parameterizations.

Methodology

Desert Storms is undertaking:

(A) A detailed analysis of observations including station data, measurements from recent field campaigns, gridded global analysis data and novel satellite products. For example, 30 years of surface station data across northern Africa were carefully quality controlled and analysed with regard to the frequency of dust emission and the occurrence of peak winds speeds and their diurnal and seasonal variations. The analysis also allows determining emission thresholds as a function of time and space.

(B) A comprehensive comparison between output from a wide range of global and regional dust models, including new continental-scale, high-resolution simulations over northern Africa.

(C) Extensive case and sensitivity studies with regional and large-eddy simulation models in realistic and idealized set-ups.

In contrast to previous studies, all evaluations are made on a process level concentrating on specific meteorological phenomena, which are identified by specifically designed objective identification algorithms.

Emerging results

Desert Storms has discovered a large downward trend in wind and dust emission in the Sahel, which was attributed to an increase in vegetation-related surface roughness due to a recovery of rainfalls.

Many models struggle to realistically represent key meteorological features involved in dust emissions. For example, nocturnal low-level jets tend to be underestimated in many models, leading to a too flat diurnal cycle in surface wind, which is sensitive to the treatment of the atmospheric boundary layer. Desert Storms demonstrated that cold outflows from thunderstorms are one of the main drivers of dust uplift over summertime northern Africa, but that these are essentially missing in global models.

In the long run, Desert Storms will use these results to provide guidelines and new tools to dust model developers, which will substantially advance our quantitative understanding of the global dust cycle and reduce uncertainties in predicting climate, weather and many impacts.

DINOPRO

At a glance
Title: From Protist to Proxy: Dinoflagellates as signal carriers for climate and carbon cycling during past and present extreme climate transitions
Funding scheme: ERC Starting Grant
ERC funding: 1 498 800 €
Duration: 60 months
Start date: 01/09/2010
Host institution: Utrecht University, NL
Principal investigator: Appy Sluijs
Project website: www.uu.nl/faculty/geosciences/EN/research/institutesandgroups/researchgroups/MP/people/AppySluijs/Pages/default.aspx
Key words: paleoclimate, reconstruction, carbon cycle, dinoflagellates, geochemistry, culturing experiments, tipping points, climate sensitivity, biotic change

The challenge

Improve projections of future climate change and the response of biology to ocean acidification resulting from CO2 emissions by looking at selected target episodes in the geological past. Past analogues of rapid carbon injection can aid in the quantification of climate change and identification of vulnerable biological groups, critical to identify 'tipping points' in system Earth.

Project objectives

Primary objective: to develop a new method to reconstruct CO2 concentrations in the past. Secondary objective: to quantify the response of dinoflagellates, important unicellular organism in marine ecosystems, to rising CO2 concentrations and resulting ocean acidification.

Methodology

Using culturing experiments, the project will quantify the physiological and biogeochemical response of dinoflagellate species to varying CO2 concentrations. This response can also be measured in fossil dinoflagellates and can then be used to reconstruct past CO2 concentrations.

Emerging results

The extensive experiments have confirmed the basic assumption that the biogeochemistry of dinoflagellates changes systematically as a function of sea water CO2 concentration. This provides the fundament to reconstructing past CO2 concentrations and thereby the integrated reconstruction of climate and carbon cycling for better projecting future change.

DRIHM

At a glance
Title: Distributed Research Infrastructure for Hydro-Meteorology
Instrument: Collaborative project – coordination and support actions
Total cost: 4 809 838 €
EC contribution: 3 500 000 €
Duration: 42 months
Start date: 01/09/2011
Consortium: 10 partners from 8 countries
Project coordinator: Antonio Parodi CIMA Research Foundation, IT
Project website: www.drihm.eu
Key words: Hydrometeorology, grid computing, high-performance computing, data, models

The challenge

Predicting weather and climate and its impacts on the environment, including hazards such as floods and landslides, is still one of the main challenges of the 21st century with significant societal and economic implications. At the heart of this challenge lies the ability to have easy access to hydrometeorological data and models, and to facilitate the collaboration between climatologists, meteorologists, hydrologists and Earth science experts for accelerated scientific advances in hydrometeorological research (HMR). DRIHM is developing a prototype e-Science environment to facilitate this collaboration and provide end-to-end HMR services (models, datasets and post-processing tools) at the European level, with the ability to expand to global scale.

Project objectives

The DRIHM partners aim to formulate a common long-term strategy, to foster the development of new HMR models and observational archives for the study of severe hydrometeorological events, to promote the execution and analysis of high-end simulations, and to support the dissemination of predictive models as decision analysis tools.

This ambition has been translated into four main technical objectives for the DRIHM collaborative environment:

1. The provision of integrated HMR services (such as meteorological models, hydrological models, stochastic downscaling tools, decision support systems, and observational data);
2. The design, development and deployment of user-friendly interfaces enabling multidisciplinary and global collaboration between meteorologists, hydrologists and other Earth scientists (e.g. climatologists) for fostering research, including the impacts of Climate Change ;
3. The support of an HMR e-Science environment enabling user-driven "composition" of virtual facilities in the form of hydro-meteorological forecasting chains, composed of different HMR resources (models, post-processing tools, decision support system models and data);
4. The establishment of HMR e-Science support centres and corresponding training activities to attract a broad end-user audience comprising of scientists and non-specialists including relevant European Strategy Forum on Research Infrastructures (ESFRI) communities.

Methodology

The interaction between HMR and ICT scientists within DRIHM focuses on three suites of experiments, as described below, designed to prove the full extent of the DRIHM e-Science environment capability. These address the interdisciplinary and international challenges of HMR in forecasting severe hydrometeorological events over complex orographic areas and assessing their impacts.

They also provide laboratories for the integration of new ICT infrastructure and development of new working practices in the

DRIHM e-Science environment. These are:

1) Experiment Suite 1 — Rainfall:

Combination of different Numerical Weather Prediction (NWP) models to form a high-resolution multi-model ensemble together with stochastic downscaling algorithms to enable the production of more effective quantitative rainfall predictions for severe meteorological events;

2) Experiment Suite 2 — Discharge:

Fusion of rainfall predictions (potentially from experiment suite 1) with corresponding observations, which forms the input for multiple hydrological models to enable the production of more accurate river discharge predictions;

3) Experiment Suite 3 — Water Level, Flow and Impact:

Execution of hydraulic model compositions in different modes to assess the water levels, flow and impact created by flood events. Indeed, this process can be driven from data produced by experiment suite 2.

Emerging results

DRIHM has been running for more than 20 months and it is at the middle of its life.

A first version of the e-Infrastructure is now available with some Meteorological and Hydrological models (e.g. WRF, MESO-NH, RainFARM, RIBS, DRiFt and HBV). This version of the e-Infrastructure is oriented towards improved modelling and better understanding of severe hydrometeorological events; however, at the same time it also enables us to run complex forecasting chains to increase our understanding of the on-going Climatic Changes and its impacts in terms of hazards.

For this reason, the Climate Change community is becoming one of the targets of the DRIHM e-Infrastructure. Systems such as those developed in DRIHM can help to advance research on Climate Impacts, especially at the regional and local levels.

Project partners
CIMA Research Foundation, IT
Ludwig Maximilians University Munich Department for Informatics, DE
Deutsches Zentrum Fuer Luft und Raumfahrt, DE
Institute of Applied Mathematics and Information Technology – National Research Council, IT
Universidad Politecnica de Madrid – UPM, ES
Centre National de la Recherche Scientifique – CNRS, FR
Republic Hydro-Meteorological Service of Serbia, RS
Stichting Deltares, NL
HR Wallingford, UK
Consortium of Universities for the Advancement of Hydrologic Science, US

DRIHM2US

At a glance
Title: Distributed Research Infrastructure for Hydro-Meteorology to United States of America
Instrument: Coordination and support action
Total cost: 884 737 €
EC contribution: 500 000 €
Duration: 24 months
Start Date: 01/11/2012
Consortium: 8 partners from 5 countries
Project coordinator: Antonio Parodi –CIMA Research Foundation, IT
Project website: www.drihm2us.eu
Key words: Hydrometeorology, grid computing, high-performance computing, data, models, interoperability

The challenge

Hydro-Meteorology Research (HMR) is an area of critical scientific importance and of high societal relevance. It plays a key role in guiding predictions relevant to the safety and prosperity of humans and ecosystems from highly urbanized areas to agricultural landscapes and coastal zones. Of special interest and urgency within HMR is the problem of understanding and predicting the changing impacts of severe hydro-meteorological events, such as flash-floods and landslides in complex orography areas, on humans and the environment, under the varying conditions of the global Climate Change.

The DRIHM2US project aims to improve the interoperability in the use of e-Infrastructures for advancing scientific collaboration in Earth Sciences in general and Climate Change studies in specific on both sides of the Atlantic.

Project objectives

Scientific progress in the Earth Sciences is heavily based on the ability to share, analyze and archive extreme amounts of data, which are often collected dynamically from widely distributed sources, as well as complex and computationally demanding models/post-processing tools. Sharing, analyzing and archiving these data and model outputs are crucial and challenging tasks. Providing an integrated computing and data e-Infrastructure able to support application requirements in a scalable, extensible and interoperable fashion is the primary need and challenge. The DRIHM2US objectives are:

1. Analyze requirements of the HMR community towards common e-Infrastructures within the EU and the US;
2. Investigate common ICT infrastructure approaches (such open standards, middleware and methodologies) and stimulate their adoption in order to lower access barriers;
3. Invite, in dedicated workshops, selected experts from both the HMR and ICT communities to perform tests between current EU and US e-Infrastructures;
4. Summarize the results of these workshops and provide an outlook into the future based on the respective findings.

Methodology

DRIHM2US is a Coordination and Support Action. Consequently, DRIHM2US aims at coordinating research activities and related policies with special emphasis on the research topic (HMR also under the effect of climate change) and on the geographic scale (Europe and the USA). In order to achieve the DRIHM2US objectives the project is organized in five work packages: Project Management (WP1); Architecture Harmonization Analysis and Planning (WP2);

Joint Prototypes and Experts Networking Sessions (WP3); Dissemination (WP4); and Sustainable International Research Infrastructure (WP5).

While WP4 (Dissemination) focuses on creating awareness and educating stakeholders on achieved results, WP2 (Architecture Harmonization Analysis and Planning) and WP3 (Joint Prototypes and Experts Networking Sessions) prepare the ground technically by analysing current approaches (WP2), deriving requirements (WP2), and specifying prototypes adhering to these requirements (WP3).

WP5 (Sustainable International Research Infrastructure) advances the results achieved in other work packages by providing a sustainable framework, which supports a long-term vision of joint prototypes on EU and US scientific data infrastructures.

Emerging results

DRIHM2US aims at fostering collaboration between the two sides of the Atlantic in the field of the use of e-Infrastructures for Hydro Meteorological Research (HMR) under Climate Change effects. However, it will also strengthens the link between leading HMR and ICT initiatives/institutions via close interaction with other European projects such as DRIHM (Distributed Research Infrastructure for Hydro-Meteorology), HyMeX (HYdrological cycle in the Mediterranean Experiment), CLIMB (Climate induced changes on the hydrology of Mediterranean basins: Reducing uncertainty and quantifying risk through an integrated monitoring and modelling system), ICORDI (International Collaboration on Research Data Infrastructure), and EUDAT (EUropean DATa). All these projects have already expressed interest in collaborating with the DRIHM2US activities.

Project partners	
CIMA Research Foundation	IT
Ludwig Maximilians University Munich, Department for Informatics	DE
Institute of Applied Mathematics and Information Technology – National Research Council	IT
HR Wallingford	UK
Stichting Deltares	NL
Consortium of Universities for the Advancement of Hydrologic Science	US
National Center for Atmospheric Research	US
Rutgers University	US

EARLYHUMANIMPACT

At a glance
Title: How long have human activities been affecting the climate system?
Funding schemes: ERC Advanced Grant
ERC funding: 2 370 767 €
Duration: 60 months
Start date: 01/07/2011
Principal investigator: Carlo Barbante
Host institution: University of Venice, IT
Project website: www.earlyhumanimpact.eu
Key words: biomass burning, paleoclimate, human impact, ice core, lake sediment

The challenge

Human activities are currently altering the global climate system at rates faster than ever recorded in geologic time. Ample observational evidence exists for anthropogenic climate change including measured increased in atmospheric carbon dioxide, associated temperature and sea level rise, and changes in ocean and atmospheric circulation. Anthropogenic aerosols may have altered the global climate system for thousands of years as suggested by comparing late-Holocene greenhouse-gas concentrations to those from previous interglacials. The decrease in the spatial extent of forests beginning ~7000 years BP may be related to early agricultural activity including forest clearance through burning which should leave a quantifiable signal in climate proxies.

Project objectives

We aim to quantify the temporal and spatial changes in Holocene biomass burning in ice and lake core records from seven continents which correspond with centres of the origin of agriculture. The proposed research incorporates continuous ice and lake core climate records from seven continents with parallel histories of fire activity. These fire histories can provide essential insight into the interplay between climate and human activity, especially with the advent of agriculture, as well as the role of aerosols through time. Key objectives to be answered include:

1. How does biomass burning change through time and space?
2. How do climate parameters respond to or correlate with changes in biomass burning?
3. Did fires increase ~7000 and/or ~5000 years ago?
4. Can natural and anthropogenic fires be differentiated? If so, how do fires and associated climate change ascribed to human activity differ from natural biomass burning?

Methodology

My research group has pioneered a groundbreaking technique based on high-performance liquid chromatography with triple quadrupole tandem mass spectrometric detection, for measuring a globally present molecular marker of biomass burning (levoglucosan, 1,6-anhydro-β-D-glucopyranose) which can quantify past fire as recorded in ice cores and lake sediments.

We will supplement pyrochemical analyses with palynological evidence of the impact of past fire regimes. The combination of ice and sediment cores are the only scientific approach to fire history that provides data across all possible time scales and types of information on fire, yet this combination has never been utilized. These fire histories can provide essential insight into the interplay between climate and human activity as well as the role of aerosols through time.

Emerging results

We used several international collaborations that gave us the opportunity to access to several set of ice cores and lake sediments. We had the opportunity to drill a series of ice cores to bedrock at Ortles in the Eastern Italian Alps. Through collaborations with the Russian and Chinese Academy of Sciences, we obtained ice cores from the Caucasus and the Tibetan Plateau, which will be very helpful to understand the past fire variability and impact of anthropogenic aerosols in those regions. We already analysed several ice core samples collected in Greenland and Antarctica dating back to 10 kyr before present. The quantification of a pre-industrial biomass burning signal in these samples, can test the hypothesis of an early detectable human impact on the climate system. The negation or confirmation of this hypothesis will have an important interdisciplinary impact on both climate science and anthropology.

EMBRACE

At a glance
Title: Earth system Model Bias Reduction and assessing Abrupt Climate change
Instrument: Large-scale integrating project
Total cost: 9 530 409 €
EC contribution: 6 999 730 €
Duration: 48 months
Start date: 01/11/2011
Consortium: 18 partners from 8 countries
Project coordinator: Colin Jones, Sveriges Meteorologiska och Hydrologiska Institut, SE
Project website: www.embrace-project.eu
Key words: Earth system model, Climate, Environment, Sustainability

The challenge

Policy makers must make important decisions with respect to future climate change. On one hand working to ensure long term environmental sustainability while on the other aiming to minimise negative impact such decisions may have on their country's people, industry and economy in the short term. Such decisions are easier to make if reliable projections of the future climate are available. By the end of the EMBRACE project, it is envisaged that improvements made within the project Earth System Models will lead to a more informed picture of future climate, helping policy makers make more informed decisions on how to best limit, and adapt to, future climate change.

Project objectives

EMBRACE brings together the leading Earth System Models (ESMs) in Europe around a common set of objectives to improve our ability to (i) simulate the Earth System and (ii) make reliable projections of future global change. EMBRACE builds on existing European networks of collaboration in Earth System Modelling and is presently the main European input to international efforts in this field.

The project has a number of key goals;

1. to reduce the main, known biases in existing European ESMs,
2. to fully evaluate ESM simulation quality and improvements made in the project,
3. to increase the realism of interactions between the physical and biogeochemical components of ESMs,
4. to assess future risks of abrupt or irreversible changes in key components of the Earth system, in response to increasing greenhouse gas emissions and land-use change.

Methodology

The primary ESM biases targeted for improvement include, (i) the representation of moist atmospheric convection and links to coupled tropical variability and precipitation, (ii) equatorial and coastal ocean upwelling and their impact on the climate system and carbon cycle, (iii) coupled processes controlling physical and biogeochemical mixing in the Southern ocean, (iv) soil hydrology and its coupling with the atmosphere and (v) the representation of terrestrial carbon cycle,.

Model improvements will be evaluated following the CMIP5 historical simulation protocol, with CMIP5 forming the basis for climate projections made to assess the risk of abrupt changes. A cross-cutting theme is the impact of improved process description, combined with increased model resolution, in reducing ESM biases and improving the reliability of future projections.

Emerging results

Key advances likely to be delivered are the:

- improved representation of the global carbon cycle;
- improved simulation of tropical deep convection and its links to important modes of tropical climate variability;
- improved representation of vegetation and soil processes, leading to greater reliability of projections of summer drought and heat wave risk.
- improve the representation of equatorial and ocean upwelling; regions of high ocean biological productivity as well as being key components of the physical climate system.

EMBRACE will make a considerable contribution to improving the representation of key climate processes in European ESMs, thereby increasing the reliability of future projections made with these models, providing greater insight into the future climate for national and international decision makers. This will allow mitigation and adaptation measures to be developed that ensure the impact of a changing climate on the world's population and environment is minimised.

Project partners	
Sveriges Meteorologiska och Hydrologiska Institut	SE
Koninklijk Nederlands Meteorologisch Instituut	NL
European Centre for Medium-Range Weather Forecast	UK
Karlsruher Institut für Technologie	DE
Max-Planck-Gesellschaft	DE
Deutsches Zentrum für Luft- und Raumfahrt	DE
Finnish Meteorological Institute	FI
Eidgenössische Technische Hochschule Zürich	CH
University of East Anglia	UK
University of Exeter	UK
Met Office	UK
Université catholique de Louvain	BE
Centre National de la Recherche Scientifique	FR
Natural Environment Research Council	UK
Wageningen Universiteit	NL
Sveučilište u Splitu	HR
Imperial College	UK
Vrije Universiteit Amsterdam	NL

EMIS

At a glance
Title: An Intense Summer Monsoon in a Cool World, Climate and East Asian monsoon during interglacials with a special emphasis on the Interglacials 500 000 years ago and before
Funding scheme: ERC Advanced Grant
ERC funding: 893 880 €
Duration: 60 months
Start date: 01/11/2008
Host institution: Université Catholique de Louvain, BE
Principal investigator: André Berger
Project website: www.climate.be/erc-emis
Key words: interglacials, monsoon, astronomical theory, greenhouse gases, paleoclimate modeling

The challenge

A recent discovery that loess and soil climate proxy records from China show an exceptionally strong East Asian Summer Monsoon (EASM) during the relatively cool interglacial MIS 13 (500 000 years ago), invited us to revise our current understanding of the relationship between monsoon, ice sheets, insolation and greenhouse gases concentration mainly during warm climates using climate models of different complexities and proxy records.

Project objectives

The objectives were therefore to investigate in depth the climate of MIS-13 for discovering what has created its exceptional East Asian Summer Monsoon among all possible causes and why it is the strongest over the last one million years. Moreover we had also to question the interpretation of the soils imbedded into the Chinese loess sequences in terms of this East Asian summer monsoon. A by-product was not only to find possible analogues of our present-day interglacial climate and of its future over the next centuries, but also to use the improvement gained in the understanding of the functioning of the climate system during the past warm periods to improve the IPCC projections of climate and monsoons over the next centuries.

Methodology

This has been done using first a model of intermediate complexity (LOVECLIM) to achieve a number of sensitivity experiments to the astronomical forcing, the Eurasian and North American ice sheets, the Tibetan Plateau and the Ocean. Ocean-atmosphere coupled general circulation models have then be used to confirm the main processes underlined by LOVECLIM, in particular those related to the wave train topographically induced by an Eurasian ice sheet, to the sea-surface temperature, in particular over the North Atlantic and the tropical Pacific, and their role in reinforcing the East Asian summer monsoon. The climate and monsoons of MIS-13 have been compared with those of the interglacials of the upper Pleistocene and of the Holocene (about the last 800 000 years). All model results have been compared with the available proxy records, in particular-but not exclusively-those coming from the loess-soil sequences in China.

Emerging results

At MIS-13, the strong insolation forcing imposed a strong land-ocean thermal contrast, resulting in a particularly strong East Asian summer monsoon (EASM) which ccould further be reinforced by a possible Eurasian ice sheet. A warmer warm tropical Pacific pool enhanced the summer precipitation in South China but reduced it in North China. The temperature anomaly over the tropical Pacific also helped to reinforce EASM through atmospheric teleconnection.

Finally, the long duration of MIS-13 seems to be critical for explaining its unusually strong EASM recorded in the loess of China.

Over the interglacials of the last 800 000 years, the relative importance of CO2 and of insolation differs in regions and in climatic variables. In response to insolation changes only, climatic feedbacks lead to the Mid-Brunhes Event appearing to have been a series of individualistic interglacial responses to various combinations of insolation conditions. MIS-5 and MIS-9 are ineffective analogues of peak MIS-1 climate given their relatively large astronomical and greenhouse forcing. Conversely, MIS-11 and MIS-19 are in much closer agreement with MIS-1. All these results are expected to help better understanding the relationship between past climates and proxy records and improving future climatic projections.

EPOCA

At a glance
Title: European Project on Ocean Acidification
Instrument: Large-scale integrating project
Total cost: 15 945 582 €
EC contribution: 6 548 995 €
Duration: 48 months
Start date: 01/05/2008
Consortium: 32 partners from 10 countries
Project coordinator: Centre National de la Recherche Scientifique, FR
Project website: epoca-project.eu
Key words: ocean acidification, biological response, biogeochemistry, modelling

The challenge

Besides global warming, another consequence of man's use of fossil fuels is receiving increased attention from the marine scientific community. Ocean acidification has been referred to as "the other CO2 problem", a much less known but potentially as dramatic result of the approximately 90 million tons of carbon dioxide (CO2) released into the atmosphere every day from human activities. Over the past 250 years, the world's oceans have absorbed about one third of the CO2 released. Whereas the chemical consequences of this CO2 uptake are well understood, the biological impacts of ocean acidification are only poorly known.

Project objectives

The overall goal of EPOCA is to fill the numerous gaps in our understanding of the effects and implications of ocean acidification. More specifically, the project aims to:

- improve the understanding of the past and present spatio-temporal changes of ocean acidification;
- determine the impacts of ocean acidification on marine biota, their physiology, ecosystems, the potential for acclimation and adaptation, the impacts on elemental cycling and production of climate-relevant gases;
- improve our understanding of future changes in ocean chemistry and biogeochemical feedbacks in terms of hotspots, uncertainties, and thresholds; EPOCA also seeks to improve the description of the carbon cycle in coupled ocean-climate models. The key element cycles investigated are carbon, nitrogen, sulfur and iron;
- synthesise information on tipping points.

Methodology

The overall strategy of EPOCA is to cover the crucial areas of ocean acidification and its consequences. A variety of technical approaches are used, including monitoring as well as laboratory, mesocosms, field and modeling studies. Scales from the organism to the ecosystem level and the Earth system are investigated. Molecular to biochemical, physiological and ecological approaches are used to quantify biological responses to ocean acidification, assess the potential for acclimation and adaptation, and determine the consequences for biogeochemical cycling and climate feedbacks. Laboratory experiments focus on key organisms selected on the basis of their ecological, biogeochemical or socio-economic importance. Field studies are carried out in areas deemed most sensitive to ocean acidification. Two major EPOCA experiments have been carried out in the Arctic Ocean. Offshore mesocosms were successfully deployed for the first time in Arctic waters in the summer of 2010, with the goal to determine the effects of ocean acidification on Arctic plankton.

Results

EPOCA has already generated key data published in time for consideration in the Fifth Assessment Report of the IPCC. These results cover new information on:

- the rate at which ocean acidification proceeds and the hotspots where critical pH values will be reached first;
- the consequences of ocean acidification in terms of biodiversity, ecological services provided by marine ecosystems, biogeochemical processes and feedbacks on the climate system and the ecosystems which are most vulnerable to ocean acidification.
- EPOCA scientists have contributed to the publication of a book on ocean acidification published in 2011. Additionally, key dissemination products were created and include:
- the EPOCA web site, ocean acidification blog and database;
- the "Guide to best practices for ocean acidification research and data reporting";
- guides for the general public and policymakers produced by the EPOCA Reference User Group.

Project partners	
Centre National de la Recherche Scientifique, FR	Koninklijke Nederlandse Akade van Wetenschappen, NL
Universitetet i Bergen, NO	Sir Alister Hardy Foundation for Ocean Science, UK
Helmholtz-Zentrum für Ozeanforschung Kiel, DE	Universität Bern, CH
Natural Environment Research Council, UK	Université Libre de Bruxelles, BE
Alfred-Wegener-Institut für Polar und Meeresfosrchung, DE	Helmholtz-Zentrum Geesthacht Zentrum für Material - und Küstenforschung GmbH, DE
The Chancellor, Masters and Scholars of the University of Cambridge of the Old Schools, UK	Philippe Saugier International Educational Projects, FR
Plymouth Marine Laboratory, UK	Eidgenoessische Technische Hochschule Zuerich, CH
Commissariat à l'Energie Atomique et aux Energies alternatives, FR	Hafrannsóknastofnunin–Marine Research Institute, IS
Max-Planck-Gesellschaft zur Förderung der Wissenschaften E.V., DE	Vereniging voor Christelijk Hoger Onderwijs Wetenschappelijk Onderzoek en Patientenzorg, NL
Göteborgs Universitet, SE	University of Southampton, UK
The Marine Biological Associationof the United Kingdom, UK	University of Plymouth Higher Education Corporation, UK
Stitchting Koninklijk Nederlands Instituut voor Zeeonderzoek, NL	Intergovernmental Oceanographic Commission of UNESCO, FR
Universiteit Utrecht, NL	University of Bristol, UK
Scottish Association for Marine Science, UK	

ERA-CLIM

At a glance
Title: European Reanalysis of Global Climate Observations
Instrument: Collaborative project
Total cost: 4 897 537 €
EC contribution: 3 499 607 €
Duration: 36 months
Start date: 01/01/2011
Consortium: 9 partners from 8 countries
Project coordinator: European Centre for Medium-Range Weather Forecasts, UK
Project website: www.era-clim.eu
Key words: Climate observations, reanalysis, climate services

The challenge

Integrating the instrumental record of the twentieth century into global gridded data sets suitable for climate studies and climate change services.

Project objectives

The ERA-CLIM project is preparing accurate and detailed estimates of the global evolution of the climate system during the previous century, based primarily on observations. A large portion of the project is dedicated to the recovery, digitisation, and quality control of early 20th-century meteorological data from remote and sparsely observed regions of the globe. ERA-CLIM also engages with satellite agencies and climate data centres to obtain recently reprocessed and recalibrated earth observations from satellites, including many data sets that have not previously been used for climate analysis.

Together with other climate data from existing archives, observations are combined with global models into gridded data products, by using modern data assimilation techniques originally developed for numerical weather prediction. Data products will include estimates for several essential climate variables, providing a consistent description of the evolution of physical and dynamical properties of the global atmosphere, extending from the surface to the upper stratosphere, together with the underlying ocean- and land-surface conditions.

Methodology

In-situ observations from around the world made with various instruments at meteorological land stations, on ships, buoys, or aircraft, are combined with earth observations from satellites using reanalysis techniques. Reanalysis applies state-of-the-art modelling and data assimilation tools to estimate the past evolution of the climate system. Reanalysis products are global gridded data sets comprising a large number of physical and dynamical parameters, which together provide a comprehensive view of the climate system at any point in space and time. The most advanced reanalysis systems and the computational infrastructure required to implement them have been developed during the last few decades at major numerical weather prediction centres, such as the European Centre for Medium-Range Weather Forecasts. From the early 1980's ECMWF has had a leading role in the development of successive generations of increasingly accurate global reanalysis products, most recently ERA-40 (spanning the years 1957-2002) and ERA-Interim (from 1979 onward, and continuing in near-real time).

Emerging results

The ERA-CLIM project is generating approximately 1 petabyte of high-quality global data sets suitable for studying atmospheric, oceanic, and terrestrial processes, suitable for assessing climate variability and change, and for supporting the development of improved climate prediction models.

ERA-CLIM data products are an essential resource for newly emerging climate change services in Europe, providing global information for planners and decision makers in areas such as agriculture, energy, health, and security. In addition, these products constitute a fundamental contribution to climate science by substantially improving the early 20th century instrumental record, and by providing open access to many newly uncovered observations from remote regions of the globe.

All ERA-CLIM gridded data products, as well as the observations used to produce them, will be made available via the internet.

Project partners
European Centre for Medium-Range Weather Forecasts, UK
Met Office Hadley Centre, UK
Institut für Meteorologie und Geophysik, Universität Wien, AT
Oeschger Centre for Climate Change Research, Universität Bern, CH
Russian Research Institute for Hydrological Information, RU
Fundação da Faculdade de Ciências, Universidade de Lisboa, PT
European Organisation for the Exploitation of Meteorological Satellites, DE
Météo-France, FR
Universidade Pacífica, CL

ERICON-ABSTRACT

At a glance
Title: The European Polar Research Icebreaker Consortium Aurora Borealis
Funding instrument: Collaborative project and Coordination and support action
Start date: 01/03/2008
Duration: 48 months
Total project cost: 5 283 880 €
EC contribution: 4 498 243 €
Coordinating organisation: European Science Foundation, Polarboard Strasbourg, FR
Coordinator: Paul Egerton
EC office: European Research Area: research programmes and capacity Directorate
Project website: www.eri-aurora-borealis.eu/en/home/

Abstract

The ERICON-AB project will generate the strategic, legal, financial and organisational frameworks required from National Governments and the European Commission to commit financial resources to the construction and running of the European Polar Research Icebreaker AURORA BOREALIS. Scientific management frameworks will be assessed including mechanisms to handle dedicated large-scale multi-year or special mission specific research programmes. The strategic integration of the facility into the fabric of the European Research Area shall be achieved by connecting the national research priorities and the demand of ship time of the stakeholder countries with a European level facility. The relevance of the facility in promoting science and technology cooperation with EU strategic partner countries such as the Russian Federation will be specifically analysed. Deliverables will focus on moving the project from the preparatory phase to the construction phase by addressing key barriers especially in relation to engineering initial financial models that allow the mixed participation of EU member states and Non-EU partner countries. Consortium Beneficiaries and legal experts will develop the environment for frameworks for joint ownership and operation of a multi-country research facility. A dedicated legal implementation structure for managing and operating the AURORA BOREALIS will be proposed and its connection with other existing research assets such as Polar Stations, air support and supporting satellite assets will be analysed. The final deliverables of this project will be concerned with reaching a decision point and agreement with nations ready to move forward with the construction phase. It is anticipated that a series of natural decision points for agencies/governments to pass on their individual degree of integration into the project will be programmed in to the ERICON–AB Stakeholder councils meetings.

Objectives

The European Polar Research Icebreaker Facility AURORA BOREALIS will be the most advanced Polar Research Vessel in the world with a multi-functional role of drilling in deep ocean basins and supporting climate/environmental research and decision support for stakeholder governments for the next 35-40 years. The new technological features will include azimuth propulsion systems, satellite navigation and ice-management support and the deployment and operation of Under-water autonomous vehicles from the twin moon-pools* (opening in the ships hull for deployment of equipment). The most unique feature of the vessel is the permanent deep drilling rig, which will enable sampling of the ocean floor and sub-sea up to 4000 m water and 1000 m penetration at the most inhospitable places on earth. The drilling capability will be deployed in both Polar Regions and AURORA BOREALIS will be the only vessel worldwide that could undertake this type of scientific investigation. The possibility to flexibly equip the ship with laboratory and supply containers, and the variable arrangement of other modular infrastructure (in particular, winches, cranes, etc.), free deck-space and separate protected deck areas, will allow the planned research vessel to cover the needs of most disciplines in marine research.The ship can be deployed as a research icebreaker in polar seas because it will meet the specifications of the highest ice-class for polar icebreakers. A large fuel capacity is required because of the excessive power requirements for drilling and maintaining station in the central Arctic (or other severely ice infested waters) during what are envisaged to be long expeditions. This factor is decisive for the large size of the ship. The construction of AURORA BOREALIS requires several new technical solutions and will provide an extended technical potential and knowledge for marine technologies and the ship building industry. The research vessel would be an example for the qualification of the European maritime industry and would help to explore future markets in special ships and marine technology. This is especially relevant in the light of the recent move by the European Union to develop a maritime policy and the responsibilities that this incurs on member states.

Partners		
N°	Organisation	Country
1.	Fondation Européenne de la Science (Coordinator)	FR
2.	Alfred Wegener Institute for Polar und Marine Research in the Helmholtz Association	DE
3.	Consiglio Nazionale delle Ricerche	IT
4.	Programme Nazionale di Ricerche in Antartide	IT
5.	Centre National de la Recherché Scientifique-Institut National des sciences L'Univers	FR
6.	Arctic and Antarctic Research Institute	RU
7.	Institut Polaire Français Paul Emile Victor	FR
8.	Merentutkimuslaitos (Finnish Institute Marine Research)	FI
9.	Netherlands Organisation for Scientific Research	NL
10.	University of Bergen	NO
11.	Bundesministerium für Bildung und Forschung	DE
12.	Fonds National de la Recherche Scientifique	BE
13.	Bulgarian Antarctic Institute	BG
14.	Fundatia Antarctica Romana	RO
15.	Aker Arctic technology Inc	FI

ERMITAGE

At a glance
Title: Enhancing Robustness and Model Integration for The Assessment of Global Environmental Change
Instrument: Collaborative project
Total cost: 4 355 868 €
EC contribution: 3 383 456 €
Duration: 36 months
Start date: 01/12/2010
Consortium: 8 partners from 4 countries
Project coordinator: The Open University, UK
Project website: ermitage.cs.man.ac.uk/
Key words: modelling framework, climate, sustainability, energy economics, agriculture, water, uncertainty, policy

The challenge

Deriving environmental policies that account for society's conflicting demands on energy, agriculture, land and water resources in the face of global change requires the use of modelling tools from a wide range of natural science and socio-economic disciplines. For the resulting analyses to account for natural-societal feedbacks and regional disparities, whilst consistently and robustly taking account of high levels of uncertainty, requires a new level of integration between models. ERMITAGE addresses this gap by building on existing modelling tools and platforms to develop a flexible and transparent sustainability modelling framework.

Project objectives

- Build a transparent modular framework for the coupling and analysis of diverse models based on divergent paradigms and programming languages, with an accessible, web-based interface.
- Develop simplified forms of complex models of both natural and socio-economic systems that facilitate coupling between models as well as statistical analysis of model projections.
- Analyse and quantify feedbacks between the natural and socio-economic systems, paying particular attention to climate and heating and cooling, bioenergy, hydroelectricity and other energy sources.
- Analyse the options for burden-sharing in the context of international environmental agreements and quantify the strategic implications of international cooperation vs non-cooperation.
- Engage with policymakers and relevant stakeholders to ensure the relevance of results for global and regional policy.
- Develop robust scenarios for the sustainable use of land, energy and water, taking account of climate change impacts, mitigation actions, population growth, bioenergy demand, and ecosystem conservation.

Methodology

- Flexible and modular coupling approaches involving the automatic generation of computer source code are used to isolate the processes in individual models from the details of coupling and deployment.
- Statistical techniques are used to construct simpler versions of complex models, based on the analysis of large numbers of model simulations performed with different values of input parameters.
- Meta-modelling techniques are used to link together models based on disparate paradigms, in particular Oracle-Based Optimisation, which treats individual models as 'oracles' that receive and return queries corresponding to individual simulations.
- Game theoretic approaches are used to analyse the robustness of international environmental agreements.
- A range of different scenarios are considered to compare the effects of a variety of sustainable policy options, and to analyse the sensitivity of the results to uncertain modelling choices.

Emerging results

- Framework coupling tools have been extended to cope with new, high-level languages and meta-models.

- Statistical emulation methods have been developed that rapidly reproduce the results of complex climate, land-surface and economic models.
- A climate model emulator has been coupled with an energy system model to determine regionally varying impacts on heating and cooling demands.
- A hybrid energy-economy model has been coupled with an agricultural land allocation model to quantify feedbacks involving bioenergy and trade.
- Integrated modelling has permitted the consistent comparison of climate and economic uncertainties affecting crop yields.
- Game-theoretic modelling has demonstrated the benefits of cooperation and permit trading between countries with shared environmental and economic interests.
- Analysis of energy futures has revealed the variable power of oil producing states to influence world markets in the presence of a global climate agreement.
- Web-based portals have been developed to display a wide range of future projections and policy options.

Project partners	
The Open University	UK
ORDECSYS s.a.r.l.	CH
Ecole Polytechnique Fédérale de Lausanne	CH
University of East Anglia	UK
ENERIS Environment Energy Consultants S.L.	ES
Potsdam Institut für Klimafolgenforschung	DE
University of Manchester	UK
STFC Daresbury Laboratory	UK

EUFAR

At a glance
Title: European Facility for Airborne Research in environmental and geoscience
Instrument: Collaborative project and coordination and support action
Total cost: 9 657 391 €
EC contribution: 8 000 000 €
Duration: 60 months
Start date: 1/10/2008
Consortium: 32 partners (14 operators of airborne facilities, and 18 experts in airborne research)
Project coordinator: Jean-Louis Brenguier, Météo-France, FR
Project website: www.eufar.net
Key words: Airborne research, Measurement campaign, Environmental and Geo-sciences, Instrumental research, Climate Change, Air Quality, Land Use, Air Pollutant Emissions, Atmosphere-Biosphere Interactions, Model Parameterisations

The challenge

The integration of the European actors involved in airborne research for environmental and Geo-sciences is crucial to ensure that European researchers have access to a diverse fleet of instrumented aircraft and can select the facility the most suited to their their research objectives in term of performance and costs, irrespective of the location of the infrastructure. A direct consequence of this challenge is that the European research community benefits from a highly efficient and cost effective technology base that underpins solutions to a wide range of scientific and environmental problems. Such an integrated and collaborative infrastructure is unique and represents a world-class capability.

Project objectives

To provide scientists with access to the most complete range of research infrastructures, EUFAR:

1. develops transnational access to national infrastructures;
2. reduces redundancy and fills the gaps;
3. improves the service by strengthening expertise through exchange of knowledge, development of standards and protocols, constitution of databases, and joint instrumental research activities;
4. promotes the use of research infrastructures, especially for young scientists from countries where such facilities are lacking.

Methodology

The consortium contributes to 9 Networking Activities, Trans-national Access to 26 installations (20 instrumented aircraft and 6 specialised instruments) and 3 Joint Research Activities. A Scientific Advisory Committee, constituted of eminent scientists, contributes to a better integration of the users with the operators to tackle new user driven developments.

Transnational Access coordination aims at providing a wider and more efficient access to the infrastructures. The working group for the Future of the Fleet fosters the joint development of airborne infrastructures in terms of capacity and performance. The Expert Working Groups facilitate a wider sharing of knowledge and technologies across fields.

The activity for Education and Training provides training courses to new users.

The working group on Standards and Protocols contributes to better structure the way research infrastructures operate. The development of a distributed data base for airborne activities improves the access to the data collected by the aircraft. All these activities rely on a unique web portal to airborne research in Europe. The working group on the Sustainable Structure aims at promoting solutions for the long term sustainability of EUFAR. Among the JRA, one is developing and characterising airborne hygrometers, the second is developing and implementing quality layers in the processing chains of hyperspectral imagery and the third one is developing an airborne drop spectrometer based on a new principle.

Emerging results

EUFAR will provide:

1. Improved access to – and use of – the pool of research infrastructures through (i) the unique portal to all airborne research activities in environmental and geosciences in Europe; (ii) the coordinated implementation of access activities amongst the operators; (iii) the exchange of knowledge via the expert working groups; (iv) the education and training activities; (v) the improvement and harmonization of standards and protocols; (vi) the archive of data generated and easy access to users.
2. Optimum development of research infrastructures through (i) the independent overview of EUFAR progress by experienced and eminent researchers; (ii) the collect of scientific demand and the exploration of solutions; (iii) the three joint research activities.
3. Collaborative arrangements and perspectives for the long-term sustainability of EUFAR.

Project partners	
Météo-France (FR)	The Chancellor, Masters and Scholars of the University of Cambridge (UK)
Met Office (UK)	University of Warsaw (PL)
Forschungszentrum Juelich GmbH (DE)	Cosine Research B.V.(NL)
Vlaamse Instelling voor Technologisch Onderzoek (BE)	Institut de Radioprotection et de Sûreté Nucléaire (FR)
Deutsches Zentrum für Luft-und Raumfahrt (DE)	COMAT (FR)
Science and Technology Facilities Council (UK)	The University of Manchester (UK)
Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NL)	Von Karman Institute for Fluid Dynamics (BE)
enviscope GmbH, Messtechnik für Umweltforschung (DE)	Universität Zürich (CH)
Centre National de la Recherche Scientifique (FR)	Wageningen Universiteit (NL)
Natural Environment Research Council (UK)	Institute of Systems Biology and Ecology AS CR, v.v.i. (CZ)
Instituto Nacional de Técnica Aeroespacial "Esteban Terradas" (ES)	Tel Aviv Univesity (IL)
Freie Universität Berlin (UK)	Deutsches GeoForschungsZentrum (DE)
Karlsruhe Institute of Technology (DE)	Plymouth Marine Laboratory (UK)
Alfred Wegener Institute for Polar and Marine Research (DE)	Universität Leipzig (DE)
Consiglio Nazionale delle Ricerche (IT)	Physikalische Technische Bundesanstalt (DE)
University of Szeged (HU)	Office National d'Etudes et Recherches Aérospatiales (FR)

EUGENE

At a glance

Title: Improving coordination, visibility and impact of European GEOSS contributions by establishing a EUropean GEoss NEtwork (EUGENE)

Instrument: Support action

Total cost: 925 409 €

EC contribution: 735 038 €

Duration: 24 months

Start date: 01/10/2009

Consortium: 3 Partners

Project coordinator: Helmut Staudenrausch DEUTSCHES ZENTRUM FUER LUFT–UND RAUMFAHRT EV, DE

Project website: www.eugene-fp7.eu

Key words: GEO, GEOSS, Earth Observations, Climate Monitoring, Disasters, Water, European Coordination, GMES, INSPIRE

The challenge

International cooperation is not an end in itself; it requires additional efforts and resources. In the domain of Earth Observation (EO), requirements, systems and applications are often global by nature, and sharing the burden is reasonable. This is why Europe – its member states and the EC – has made a commitment to the objectives of the international Group on Earth Observations (GEO). By using its strengths, capabilities and investments to substantially contribute to the build-up and successful operation of the Global Earth Observation System of Systems (GEOSS) for the benefit of humankind, Europe is one of the cornerstones of this global endeavour.

Project objectives

To foster collaboration between pan-European organisations in the field of EO and to strengthen the coordination of national and regional programmes and organisations in their work towards the Group on Earth Observations (GEO).

To start a process in three selected domains (Climate, Water, Disasters) that should eventually lead to GEO oriented collaboration fora or mechanisms. The ultimate target of this process is to build a coordinated and sustained European EO system component as part of GEOSS.

Methodology

The current status and challenges of European EO for three areas of European political priority (Climate, Disasters, and Water) have been thoroughly analysed. In general, Europe is well advanced in many areas and even a world leader in various respects. However, sustained operation of the necessary EO infrastructure and improved access to and exchange of data and information is of paramount importance for the societal benefit from EO.

Based on the analyses conducted for Climate, Disasters, and Water, respectively, and on numerous discussions held with European experts and EO stakeholders, proposals for a European approach to GEO were derived. Concrete recommendations are provided, either related to topic-specific issues or cross-cutting aspects, such as appropriate user engagement, European coordination etc..

Results

From a European perspective, there is a need to contribute to the solution of both the domain-specific (Climate, Water, Disasters) challenges and the challenges posed by cross-cutting issues, as defined by GEO, in order to achieve a strong and sustained European GEOSS component. A number of recommendations could be derived to better respond to those challenges, based on Europe's substantial capabilities and strengths, to contribute effective earth observation systems to a global system of systems, and to support the establishment of GEOSS with sophisticated infrastructures, scientific knowledge, and experience with user-driven approaches and capacity building.

Additionally, there is a general need to intensify coordination and outreach measures within Europe to effectively foster the fulfilment of the GEO strategic targets and to achieve a strong and sustained European role and visibility within GEO. Enhanced coordination structures and intensified communication activities are needed, and the political profile of GEO should better be leveraged to strengthen European political support for GEO and thus raise the efficiency and effectiveness of the European GEOSS contribution.

The Copernicus programme (also known as GMES) is expected to be a critical framework for achieving a strong European contribution to GEOSS. This is valid not only for satellite-based observations, where ESA and EUMETSAT provide suitable mechanisms, but also for ground-based networks through the GMES in-situ component coordinated by EEA.

The full and timely implementation of Copernicus will contribute considerably to the successful realisation of GEOSS. Additionally, the best use of GEOSS for Europe can be made within Copernicus. Thus, it is important to carefully define their relationship.

The European Meteorological Infrastructure (EMI) also contributes considerably to GEOSS, by its own programmes, and by bringing its vast experience and infrastructure into Copernicus. For achieving sustained in-situ observations, the European Strategy Forum on Research Infrastructures (ESFRI) is another important framework, and the INSPIRE directive sets associated geodata interoperability specifications and data access conditions highly relevant to GEOSS.

Project partners	
Deutsches Zentrum für Luft-und Raumfahrt e.V.	DE
EUMETSAT	DE
Bundesanstalt für Gewässerkunde	DE
University Bonn	DE

EURO ARGO

At a glance
Title: Global Ocean Observing Infrastructure
Funding instrument: Collaborative project and coordination and support action
Start date: 01/01/2008
Duration: 30 months
Total project cost: 4 210 105 €
EC contribution: 2 995 859 €
Coordinating organisation: Institut Français de Recherche pour l'Exploitation de la MER (IFREMER) Brest, FR
Coordinator: Pierre-Yves LE TRAON
EC Office: European Research Area: research programmes and capacity Directorate
Project website: www.ifremer.fr/euro-argo/

Abstract

The main objective of the Euro-Argo preparatory phase is to undertake the work needed to ensure that by 2010 Europe will be able to:

- Deploy, maintain and operate an array of 800 floats. This will require Europe to deploy 250 floats perannum worldwide.
- Provide a world-class service to the research (climate) and environment monitoring (e.g. GMES) communities.

The main expected outcome of the preparatory phase proposal is an agreement between member states and other funding agencies for long term (> 10 years) operation of Euro-Argo (financial, governance, organisation, technical). To reach such an agreement, it will be necessary to work on several key technical (float technology, data management and delivery system) and organizational (logistics for deployment, coordination of national contributions) issues, to consolidate and broaden the user community and to demonstrate further the impact and utility of the infrastructure for Europe.

The preparatory phase proposal workpackages will inter alia focus on:

- The consolidation and strengthening of existing national contributions to the infrastructure.
- The development of a direct EC-wide contribution through GMES.
- The development of legal and governance arrangements for the Euro-Argo infrastructure.
- Evaluation and improvement of the European contribution to the Argo data management and delivery system.
- Enhancing European float technological capabilities (performances, sensors, communication systems) and working towards using Argo to study aspects of ocean biogeochemistry
- The development of a vigorous European Argo user community.
- Exploiting the open access to Argo data as an educational "window" on the oceans and their role in climate.
- Developing new partnerships between European Argo nations, new European countries and nations outside Europe.
- Integrating the European observing array into the international system.
- Developing a ten year implementation plan.

Partners		
N°	Organisation	Country
1.	Ifremer/Institut Français de Recherche pour l'Exploitation de la Mer	FR
2.	BSH/Federal Maritime and Hydrographic Agency	DE
3.	KDM/ Konsortium Deutsche Meeresforschung	DE
4.	NERC/Natural Environment Research Council	UK
5.	UKMO/Met Office	UK
6.	KNMI/Royal Netherlands Meteorological Institute	NL
7.	IEO/Instituto Español de Oceanografia	ES
8.	OGS/Istituto Nazionale di Oceanografia e di Geofisica Sperimentale	IT
9.	MI/Marine Institute	IE
10.	IMR/Institute of Marine Research	NO
11.	SHOM/Service Hydrographique et Océanographique de la Marine	FR
12.	FFCUL/Fundacao da Faculdade de Ciencias da Universidade de Lisboa	FR
13.	HCMR/Hellenic Centre for Marine Research	EL
14.	IOPAS/Institute of Oceanology Polish Academy of Sciences	PL
15.	USOF/University of Sofia	BG

EURO-BASIN

At a glance

Title: European Union Basin-scale Analysis, Synthesis and Integration

Instrument: Collaborative project

Total cost: 9 652 000 €

EC contribution: 6 996 407 €

Duration: 48 months

Start date: 31/12/2010

Consortium: 24 partners from 9 countries

Project coordinator: Danish Technical University, Institute for Aquatic Resources, DK

Project website: www.euro-basin.eu/

Key words: Climate and anthropogenic forcing, ecosystem, key species, biological carbon pump, ecosystem based manage-ment, marine, international co-operation

The challenge

The North Atlantic Ocean and its contiguous shelf seas are crucial for the ecological, economic, and societal health of both Europe and North America. North Atlantic eco-systems support major fisheries as well as being important for the sequestration of greenhouse gases. The dynamics of these ecosystems are driven by the interplay of climatically determined bottom up forcing driving the flux of nutrients to lower trophic levels and anthropo-genically driven top down controls as influenced by the exploitation of marine fish stocks.

At present there is a significant lack of knowledge regarding how these modes of forcing impact North Atlantic marine populations and how impending climate changes may alter the ecology and biogeochemical cycling of the basin. Consequently the challenge for EURO-BASIN is, in collaboration with US and Canadian partners, to better understand the basin scale processes impacting upon these ecosystems, to be able to predict likely future ecosystem states due to climate change, and to be able to integrate from the basin scale to the local scales the economically important dynamics of basin and shelf ecosystems for the advancement of ecosystem based management strategies.

Project objectives

The overarching objectives of the EURO-BASIN initiative are to understand and predict the population structure and dynamics of broadly distributed, biogeochemically and trophically important plankton and fish species of the North Atlantic and shelf seas, and assess the impacts of climate variability on North Atlantic marine ecosystems and their goods and services including feedbacks to the earth system. The project will develop understanding and strategies that will ultimately contribute to improve and advance management of North Atlantic marine ecosystems following the ecosystem approach.

Methodology

EURO-BASIN will use a range of approaches. The project will use existing data, but will also fill data gaps through targeted laboratory and field studies as well as the application of integrative modelling techniques. The modelling approaches will range from simple to complex coupled ecosystem models (e.g. N,P,Z,D type), mass balance (e.g. ECOPATH & ECOSIM), dynamic higher trophic levels models (e.g. GADGET), fully coupled lower and higher trophic level models including fisheries and size spectrum models, as well as integrated assessment approaches.

These models will be used to create an ensemble approach to assess ecosystem responses that, through an extension of the Integrated Ecosystem Assessment approach, will be used to further our understanding of the impacts of climate variability on marine ecosystems and the feedbacks to the earth system.

Expected results

EURO-BASIN activities will enable us to assess the ramifications of climate and fisheries activities on the population structure and dynamics of broadly distributed, biogeochemically and trophically important plankton and fish species, producing the enhanced predictive capacities necessary to develop understanding and strategies that will improve and advance ocean management.

EURO-BASIN is expected to contribute to the realization of an ecosystem-based approach to the management of the North Atlantic basin, a major objective outlined in the revision of the European Common Fisheries Policy (CFP, COM(2009)163). It will also contribute to advance the ecosystem approach for marine management, by contributing to the implementation of the Marine Strategy Framework Directive (MSFD, Directive 2008/56) and the Maximum Sustainable Yield (MSY) concept (Green Paper; COM (2006) 360) as agreed upon by the World Summit on Sustainable Development (2002).

Project partners	
Technical University of Denmark, National Institute of Aquatic Resources, DK	Institut pour Recherche du Développement, FR
University of Bremen, DE	Centre National de la Recherche Scientifique, FR
University of Hamburg, Institute for Hydrobiology and Fisheries Science, DE	Université Pierre & Marie Curie – Paris VI, FR
Fundacion AZTI, ES	The Secretary of State for the Environment, Food and Rural Affaires, UK
Natural Environment Research Council, UK	Uni Research AS, NO
Hafronnsoknastofnunin, IS	University of Nordland: NO
Morski Instytut Rybacki w Gdyni, PL	University of Strathclyde, UK
Plymouth Marine Laboratory, UK	Sir Alister Hardy Foundation for Ocean Science, UK
University of East Anglia, UK	Instituto Español de Oceanografia, ES
Aarhus Universitet, DK	Collecte Localisation Satellites SA, FR
Havforskningsinstituttet, NO	Swansea University, UK
Institut Français de Recherche pour l`Exploitation de la Mer, FR	Middle East Technical University, TK

GEONETCAB

At a glance
Title: GEO Network for Capacity Building
Instrument: Coordination action
Total cost: 1 206 483 €
EC contribution: 999 988 €
Duration: 43 months
Start date: 01/11/2009
Consortium: 9 partners from 6 countries
Project coordinator: Faculty ITC, University of Twente, NL
Project website: www.geonetcab.eu
Key words: Earth Observation, capacity building, marketing, environment, climate change

The challenge

Some parts of space technology are not very well understood and therefore it not used to its full potential. This especially applies to earth observation, which deals with images captured by satellites. The application of earth observation can provide considerable added value, but at the moment this is not realized. Partly, this has to do with technical issues, such as access to and reliability of data, and compatibility and user-friendliness of systems. But for a part also the lack of familiarity with solutions and knowledge of products and services of the potential users of earth observations plays a role. In addition to this, the earth observation community (the providers) needs to learn how to improve outreach to potential clients.

Project objectives

The purpose of the GEO Network for Capacity Building (GEONetCab) project is to create the conditions for the improvement and increase of the GEO (Group on Earth Observations) capacity building activities and framework, with special emphasis on developing countries, new EU member states (and EU neighbouring states). This applies particularly to climate monitoring and increasing the effectiveness and efficiency of GEO capacity building for application in the GEO societal benefit areas. Coinciding with this purpose, successful brokerage with (potential) clients for earth observation products and services will be facilitated.

Methodology

The project uses four models as theoretical background: a business process model, a database on earth observations capacity building, products and services, the expert system development life cycle and the GEO societal benefit areas (including the tasks of the different GEO committees). By processing existing information, the bottlenecks and opportunities are identified that are crucial for a better use of earth observation. This analysis is then connected to look into what kind of capacity building is most needed to address the situation. And of course, there are already existing success stories. These stories are put together and rephrased in terms that are understandable to non-technical users. Together they will serve to convince potential clients of the added value of earth observation and to enable them to make a selection or seek advice on what kind of product of service works best for them. The project then facilitates a dialogue between the providers and the potential clients of earth observations products and services.

To make all this more concrete, four regions are selected worldwide to provide practical examples and showcases that underline the difference that earth observation already makes in the business processes of public and private organizations. The regions are: Southern Africa, French-speaking countries in Africa, Poland and the Czech Republic. In these regions, pilots are implemented to connect providers and clients and to facilitate capacity building for earth observation. A GEO capacity building web portal, linked to the GEOSS (Global Earth Observations System of Systems) clearing house, provides insight of the different practical cases and outreach to the public worldwide. The portal also functions as a guide to help people find the tools for capacity building.

Decision makers are an important target group of the project. To arrive at balanced and justified decisions and to compare alternatives, decision makers need to know how earth observation can benefit them. For this purpose the project develops dissemination packages (toolkits) and organizes a number of workshops for decision-makers and potential clients. The perspective of the end user is a key element for the design and implementation of project interventions.

The experience and feedback gained from the interaction with clients and decision-makers is used to improve promotion and capacity building methods, and to advise the GEO community on earth observation products and services that have most potential and on the best way to approach clients.

Expected results

The project produces a number of reports on marketing and connecting with clients, both from a general point of view, and with respect to the selected regions. Although valuable themselves, the reports are meant as a starting point or accelerator to establish the dialogue between providers and clients on earth observation solutions and to facilitate the capacity building that is needed for a better understanding and application. The web portal, marketing toolkits dedicated to societal benefit areas, workshops and other types of promotional activities support this process. After the end of the project, results are maintained by, and embedded in the regular marketing operations of the project partners and the GEO community.

Project partners	
Faculty ITC, University of Twente	NL
Centre National d'Études Spatiales	FR
Institut de Recherche pour le Développement	FR
Space Research Centre, Polish Academy of Sciences	PL
Charles University	CZ
Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française	MA
South African National Space Agency	ZA
Umvoto	ZA
HCP international	NL

GREENSEAS

At a glance

Title: Development of global plankton data base and model system for eco-climate early warning

Instrument: Collaborative project.

Total cost: 4 483 906 €

EC contribution: 3 476 469 €

Duration: 36 months

Start date: 01/01/2011

Consortium: 9 partners from 6 countries

Project coordinator: Nansen Environmental and Remote Sensing Center, NO

Project website: www.greenseas.eu

Key words: Environment

The challenge

The GreenSeas project aims to advance the knowledge and predictive capacities of how marine ecosystems will respond to global change. This is needed in order to understand the consequences of changes in climate, biogeochemical cycles and human resource use, and mitigate their impacts on the marine ecosystem. GreenSeas combines of observation data, numerical model simulations and a cross-disciplinary analysis at ocean basin scales to develop a global, high quality, harmonized and standardized plankton and plankton ecology data inventory and information service. GreenSeas will deliver contemporary and historical plankton data and information products, focusing on the Atlantic and Southern oceans.

Project objectives

To assess the current state of the marine planktonic ecosystem by providing benchmarks of its present state for the future assessment of climate change; to improve the knowledge base and understanding of the impacts of climatic and anthropogenic change on planktonic ecosystem structure and function; to improve the ability to model and project future marine ecosystem states; to apply the ecosystem approach to GreenSeas data to derive a suite of indicators of which describe changes in ecosystem function; to improve the technology for accessing historical plankton and associated environmental data sets, along with earth observation data and simulation outputs; to enhance international cooperative links with other plankton monitoring and analysis surveys around the globe.

Methodology

GreenSeas acquires historical plankton data from the Arctic, Atlantic and Southern Ocean, preparing them for rigorous statistical analysis. This will provide a benchmark of the current status of the planktonic ecosystem and relationships for use in the development of indicators and the testing and validation of models. From existing surveys in the Atlantic and Southern Ocean new measurements better characterize the spatial and temporal structure and functioning of pelagic oceanic microbial ecosystems. From this, a planktonic ecosystem database is being developed, including a data delivery system which will allow free and open access to all data types.

Global models are validated against the new data base. A regional model is used to assimilate GreenSeas data to improve model state variables and parameters.

A suite of ecosystem indicators developed from remotely sensed data is built, and will be mapped where possible onto model outputs and the predictive skill for key indicators will be assessed.

Expected results

The expected results of GreenSeas include: a benchmark of the current status of the planktonic ecosystem and relationships; consistent and harmonized historical and contemporary plankton data sets; a planktonic ecosystem database and data delivery system which will allow free and open access to plankton data products; validated and error-quantified global model simulations and projections; recommendations on the future development of plankton models; expansion of the range of marine environmental indicators; contributions to the global plankton monitoring and modelling and user communities.

A Summer School was held in Capetown, ZA, Jan-Feb 2013 to educate the next generation of plankton scientists.

These results will provide the European Commission with an increased understanding of the impacts of climate change on planktonic ecosystems in the context of services and policy-relevant information. They will contribute to the establishment of the European Marine Observation and Data Network (EMODNET) and to the Global Climate Observing System (GCOS).

Project partners	
Nansen Environmental and Remote Sensing Center	NO
Plymouth Marine Laboratory	UK
Uni Research	NO
National Oceanography Center, Southampton, National Environment Research Council	UK
Murmansk Marine Biological Institute	RU
University of Capetown	ZA
Council of Scientific and Industrial Research	ZA
Centro Euro-Mediterraneo sui Cambiamenti Climatici	IT
Universidade Federal do Rio Grande	BR

GROOM

At a glance

Title: Gliders for Research, Ocean Observation and Management
Instrument: Collaborative project
Total cost: 4 938 338 €
EC contribution: 3 500 000 €
Duration: 36 months
Start date: 01/10/2011
Consortium: 19 partners from 9 countries
Project coordinator: Laurent Mortier, UNIVERSITE PIERRE-ET- MARIE CURIE, FR
Project website: www.groom-fp7.eu
Key words: Underwater gliders, Marine Research Infrastructure, Ocean Observing System

The challenge

Underwater gliders offer new ways to monitor with high resolution most of the Essential Ocean Variables (EOV) as well as other parameters thanks to an increasing number of smart sensors. Their potential for ocean research can help scientists to develop completely new ocean research areas. Gliders can also improve the cost-effectiveness of ocean observations for the regional ocean observing systems, for applications related to climate change, marine ecosystems, and resources. The challenge now is to insert the gliders as a new component in the existing ocean observing systems, and to facilitate their use for the marine research communities.

Project objectives

The objective of the GROOM project is to design a new European Research Infrastructure (RI) that uses underwater gliders for collecting oceanographic data for research applications and oceanic monitoring. This infrastructure will be based on a distributed architecture of gliderports around the European seas and overseas, working in close coordination. This architecture is the required and cost-effective way to operate fleets gliders in combination with other existing observing systems. This infrastructure must be suitable to deploy, maintain and operate individual as well as fleets of gliders continuously for operational monitoring to the benefit of the regional and global ocean observing systems and for a wide range of marine research fields. As an overall objective, the GROOM project will propose a roadmap for a ten year implementation plan of a global glider program.

Methodology

GROOM work programme provides an assessment and proposes solutions on the issues raised by the gliders and on the methods and tools to operate them. This includes:

- New sensor capabilities for gliders in particular for biology,
- The definition of strategic locations for a full network perspective and coordination with existing observation activities,
- The integration of gliders into the existing global and regional ocean observing systems,
- Integration of the proposed RI in an international network of similar capacities,
- Adaptation and strengthening of the existing data management e-infrastructure framework to gather and make available consistent and quality controlled data sets,
- The Law of the Sea and maritime traffic issues that such platforms raises,
- Framework for joint funding and management of the proposed RI in relation to similar ones, such as EuroArgo,
- Exploiting the open access to glider data as an educational "window" on the oceans and their role in climate, resources, etc.

Expected results

The expected results of GROOM will comprise:

- Consolidation of the fragmented infrastructure into one coherent system, but keeping the individual Member States identity and responsibility,
- Increase of the scientific benefit for users of the infrastructure by, for example, defining protocols and standards, ensuring interoperability, opening the infrastructure for outside users, establishing an adequate data distribution system,
- Provision of the basis for establishing the detailed plans for a new glider legal infrastructure by evaluating the existing legal and financial models against the requirements of a glider infrastructure,
- Communication to European stakeholders and international bodies active with marine research infrastructure and observing systems via publications in respective journals and via international oversight committees.
- Tests and operations at sea of tools and methods, as well as of new research strategies (new sensors, fleet deployments). The existing national RIs will manage these tests in European seas and overseas, resulting in an early stage of a future European RI.

Project partners	
University Of Cyprus (CY)	Nato Undersea Research Centre (IT)
Helmholtz Zentrum Fur Ozeanforschung Kiel (DE)	Istituto Nazionale Di Oceanografia E Di Geofisica Sperimentale – Ogs (IT)
Helmholtz-Zentrum Geesthacht Zentrum Fur Material- Und Kustenforschung Gmbh (DE)	Universitetet I Bergen (NO)
Alfred-Wegener-Institut Fuer Polar- Und Meeresforschung (DE)	Stiftelsen Nansen Senter For Fjernmaaling (NO)
Universitaet Trier (DE)	Agencia Estatal Consejo Superior De Investigaciones Cientificas (ES)
Ilmatieteen Laitos (FI)	Consorcio Para El Diseno, Construccion, Equipamiento Y Explotacion De La Plataforma Oceanica De Canarias (ES)
Centre National De La Recherche Scientifique (FR)	The Scottish Association For Marine Science (UK)
Universite Pierre-Et- Marie Curie (FR)	University Of East Anglia (UK)
Institut Francais De Recherche Pour L'exploitation De La Mer (FR)	Natural Environment Research Council (UK)
Hellenic Centre For Marine Research (EL)	

HYPOX

At a glance

Title: In situ monitoring of oxygen de-pletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies

Instrument: Collaborative project

Total cost: 4 665 281 €

EC contribution: 3 499 711 €

Duration: 36 months

Start date: 01/04/2009

Consortium: 16 partners plus 4 affiliated partners from 13 countries

Project coordinator: Antje Boetius, Felix Janssen, Christoph Waldmann

Project website: www.hypox.net

Key words: Oxygen depletion, climate change, in situ water cycle monitoring, GEOSS, aquatic ecosystems, marine, freshwater, global ocean observation, eutrophication, biodiversity

The challenge

All higher aquatic life depends on oxygen. It is, thus, an alarming finding that hypoxic (low oxygen) conditions in aquatic ecosystems increase in number, duration and extent due to global warming and eutrophication. Warming leads to degassing of oxygen, increased stratification, reduced deep-water circulation and changes in wind patterns affecting transport and mixing. Ob-served and projected increases in hypoxia (e.g., exponential growth of "dead zones") are accompanied by enhanced emission of greenhouse gases and losses in biodiversity, ecosystem functions and services such as fisheries, aquaculture and tourism. These drastic threats call for strong efforts to investigate and monitor present and past hypoxia in order to understand causes and consequences, and to be able to predict future hypoxia and its impact on ecosystem functions and services.

Project objectives

A better understanding of global changes in oxygen depletion requires a global observation system. Oxygen and associated parameters need to be monitored at high resolution, including the assessment of physical mixing and of the role of the seafloor in controlling ecosystem sensitivity and recovery. Within HYPOX, oxygen depletion and associated processes were monitored in a broad range of aquatic systems that differ in oxygen status and sensitivity towards change: oxygen-rich open ocean with high sensitivity to global warming (Arctic), semi-enclosed basins with permanent anoxia (Black Sea, Baltic Sea) and land-locked systems with seasonal or local oxygen depletion (fjords, lagoons, lakes). The results were combined with information on past hypoxia and state-of-the-art numerical modelling to predict future hypoxia and its effect on aquatic ecosystems and to decide on appropriate oxygen monitoring efforts in the future.

Methodology

In-situ observatories were set up by the installation of new systems and by implementing reliable sensors to existing platforms. These observatories monitored oxygen and associated parameters (e.g., hydrodynamics, temperature, Salinity, other gases) at high frequency. In addition, state-of-the art autonomous and towed equipment was used during repeated surveys for in situ studies and sampling of sediments and the water column. Biological processes in the water column and the sediment were studied in order to understand their role in hypoxia development and the changes in biodiversity and function when aquatic systems shift towards oxygen depletion. HYPOX further included the compilation and analysis of existing monitoring data and investigations of past hypoxia in the sedimentary record using fossils, biomarkers, and geochemical proxies. Modelling tools that couple physical and biogeochemical processes were developed and used to predict oxygen availability in aquatic systems that are subject to global warming and eutrophication. All project data were kept in compliance to the standards of the Global Earth Observation System of Systems (GEOSS) and made available through a web portal run by the state-of-the-art world data centre WDC MARE (www.wdc-mare.org).

The results

HYPOX carried out pioneering work to build capacities for state-of-the-art oxygen monitoring. An increased demand for oxygen observations is foreseen in the context of the Marine Strategy Framework Directive and in response to the expected increase in the use of marine resources. HYPOX knowledge contributes to a conclusive oxygen observation strategy to monitor global change effects and to ensure sustainability of the envisaged maritime activities. This represents a major impact generated by the project that will extend into the future. HYPOX deployed stand-alone or cabled observatories that are able to perform long-term continuous measurements of oxygen and associated parameters. The adopted monitoring strategies account for temporal and spatial scales of oxygen depletion that are inadequately addressed by previous oxygen observation approaches. Ecosystem responses with a special focus on biogeochemical processes and element cycling were included as well as the investigation of past hypoxic conditions based on faunal patterns and organic as well as inorganic proxies from the sediment record. Based on generalized findings achieved by careful analysis of the data from observatories and field campaigns as well as application of data assimilation and modelling techniques, hypoxia ecosystems were classified and recommendations for future oxygen monitoring defined.

The results obtained in HYPOX are highly relevant to GEOSS objectives from ecosystem, water management, and climate points of view. Four HYPOX services compliant with GEOSS accepted standards have been registered at the GEOSS registry. A standardized and GEOSS compliant data flow from the observatories to the end users was established. Through these activities, HYPOX substantially improved the interoperability of observation systems for oxygen depletion in different systems. All observations and measurements obtained by observatories and during targeted field campaigns are disseminated through the HYPOX data portal. The project web site (www.hypox.net) provides access to the data portal as well as to reports, presentations and public outreach material including brochures, policy briefs, posters, images, and video footage.

Project partners	
Max Planck Institute for Marine Microbiology (DE)	Istanbul Technical University (TR)
Alfred Wegener Inst. f. Polar & Marine Research (DE)	MARUM at Bremen University (DE)
Swiss Fed. Inst. of Aquatic Science & Technology (CH)	Scottish Association for Marine Science (UK)
Kovalevsky Inst. of Biology of the South. Seas (UA)	University of Gothenburg (SE)
GEOMAR Helmholtz Centre for Ocean Research (DE)	University of Patras (GR)
French Research Inst. for Exploitation of the Sea (FR)	Helmholtz Centre Geesthacht (DE)
National Institute of Geophysics and Volcanology (IT)	Nat. Inst. of Marine Geology and Geoecology (RO)
Leibniz Institute for Baltic Sea Research (DE)	Royal Netherlands Institute for Sea Research (NL)
Affiliated Partners	
Norwegian Institute for Water Research (NO)	Museum of Natural History Berlin (DE)
Climate and Environment Sciences Laboratory (FR)	Center f. Marine Research Liège University (BE)

HYRAX

At a glance
Title: Rock Hyrax Middens and Climate Change in Southern Africa during the last 50 000 years
Funding scheme: ERC Starting Grant
ERC funding: 1 484 046 €
Duration: 60 months
Start date: 01/11/2010
Host institution: Centre Nationale de Recherche Scientifique, FR
Principal investigator: Brian M. Chase
Project website: www.hyrax.univ-montp2.fr
Key words: palaeoclimate, palaeoenvironment, southern Africa, rock hyrax, climate change, environmental change

The challenge

In stark contrast to the abundance of high quality palaeoenvironmental records obtained from other parts of the world, the little data we have from Southern Africa's drylands comes largely from discontinuous, poorly dated records of ambiguous palaeoclimatic significance. Confronted with the possibility of future environmental and social disruption as a result of climate change, the need for reliable records from southern Africa has never been so acute. This project seeks to develop rock hyrax middens as a means to investigate long-term climate change, and understand how changes in the earth's climate system impact local environments in this sensitive region.

Project aims

The goal of HYRAX is to revolutionise our understanding of environmental change in southern Africa, developing sites, proxies and methods that will lead to the procurement, analysis and integration of palaeoenvironmental datasets spanning the last 50 000 years. Additionally, corollary projects will: 1) use the aggregate African hyrax midden dataset to carry out detailed data-model comparisons to evaluate, modify and improve GCM performance, and 2) use GCMs to study the drivers and dynamics of long-term climate change as observed in the hyrax midden data. HYRAX will address a series of major unsolved questions regarding past, present and future climate change research that are critical not only for southern Africa, but for our understanding of global climate change as well.

Objectives

In order to reach its goal, HYRAX will:

- Use stable isotopes and fossil pollen to determine the environmental history and dynamics at a series of sites across Southern Africa.
- Calibrate δ15N records to instrumental climate records and use statistical analyses and vegetation models to produce quantitative estimates of climate parameters from fossil pollen data at each site.
- Assess the spatial and temporal variability of environmental change across Southern Africa during the last 50 000 years as evidenced in the records obtained.
- Use high resolution palaeoenvironmental data from hyrax middens to integrate data from less well resolved records to achieve a more complete understanding of environmental change in the region.
- Compare findings with the GCM simulations to both evaluate model performance, and conduct sensitivity experiments to explore the climate system dynamics that are most likely to account for the variations observed in the palaeoenvironmental record.

Emerging results

Preliminary data from sites across Southern Africa show coherent patterns of change that can be linked with local, regional and global climatic events and forcing mechanisms.

These data indicate significant, rapid changes in water availability and vegetation as responses to, amongst other factor, trends in regional and global temperatures. Tentative conclusions that can be drawn from the available data include an apparent anti-phase relationship between summer and winter rainfall regimes in southwestern Africa, with warmer conditions inducing increased precipitation in regions experiencing predominantly summer rainfall and drier conditions in regions experiencing predominantly winter rainfall. Ongoing work is helping us to determine the precise nature and mechanisms underlying these observations. This will not only allow for a substantially refined understanding of earth system dynamics, but it will also provide a more robust basis upon which appropriate land-use and environmental management strategies can be based.

ICE

At a glance

Title: Laboratory and modelling studies of ice nucleation and crystallisation in the Earth's atmosphere
Funding scheme: ERC Starting Grant
ERC funding: 1 690 000 €
Duration: 60 months
Start date: 11/2009
Host institution: University of Leeds, UK
Principal investigator: Ben Murray
Project website: www.see.leeds.ac.uk/BJM/
Key words: Ice nucleation, ice nuclei, clouds, aerosol-cloud interactions, aerosol properties, glassy aerosol, structure of ice, stacking disordered ice.

The challenge

The formation of ice particles in the Earth's atmosphere strongly affects the properties of clouds and their impact on climate. However, our basic understanding of ice nucleation and crystallisation is still in its infancy.

Project objectives

Establish a laboratory dedicated to improving our fundamental understanding of ice nucleation and crystallisation and use this information to better represent physical processes in models.

Methodology

1. rate at which various mineral dusts nucleate ice when immersed in supercooled water droplets will be quantified.
2. role of glassy solids and ultra-viscous liquids in cloud formation will be investigated.
3. structure of ice that forms under atmospheric conditions will be examined with cryo-X-ray diffraction.
4. laboratory data will be used to constrain ice nucleation in numerical clouds.

Emerging results

Key high impact papers

We have shown that the feldspar component of desert dust is most important for this important ice nucleating aerosol.

> *Atkinson, Murray et al. The importance of feldspar for ice nucleation by mineral dust in mixed-phase clouds,* ***Nature****, DOI 10.1038/nature12278.*

When water droplets freeze we have shown that the ice does not have a standard crystal structure:

> *Malkin, Murray, et al. Structure of ice crystallized from supercooled water,* ***Proc. Nat. Acad. Sci.*** *(2012).*

In collaboration with the AIDA cloud chamber team we have shown that aqueous glassy organic aerosol are important ice nuclei in the atmosphere:

> *Murray et al. Heterogeneous nucleation of ice particles on glassy aerosols under cirrus conditions,* ***Nature Geosci.*** *(2010).*

We have made a major reassessment of the literature data for heterogeneous ice nucleation:

> *Murray et al. Ice nucleation by particles immersed in supercooled cloud droplets,* ***Chem. Soc. Rev.****, (2012)*

In addition, our collaboration with Asymptote Ltd has resulted in a Patent application for the control of ice nucleation in cryopreservation.

ICEMASS

At a glance
Title: Global Glacier Mass Continuity
Funding scheme: ERC Advanced Grants
ERC funding: 2 395 320 €
Duration: 60 months
Start date: 01/03/2013
Host institution: University of Oslo, NO
Principal investigator: Andreas Kääb
Project website: www.mn.uio.no/icemass
Key words: global, glacier mass change, glacier flow dynamics

The Challenge

For the first time in history satellite data and their archives are now sufficient in terms of spatial and temporal resolution, and their accuracy, to measure volume changes, velocities and changes in these velocities over time for glaciers and ice caps other than ice sheets on a global scale.

Project objectives

The ICEMASS project derives and analyses glacier thickness changes globally and converts these to a global glacier mass budget. These results are combined with global-scale glacier dynamics.

Methodology

The ICEMASS project combines a variety of different satellite data. Glacier thickness changes are derived using satellite laser and radar altimetry, and satellite-derived and other digital elevation models. For quantifying glacier flow a global set of repeat optical and radar satellite images is processed to measure displacements due to glacier flow and their annual to decadal-scale changes.

Emerging results

The analysis of these data will enable several major steps forward in glacier and Earth science, in particular: constrain current sea-level contribution from glaciers; complete climate change patterns as reflected in glacier mass changes; quantify the contribution of glacier imbalance to river run-off; allow the separation of glacier mass loss from other components of gravity changes as detected through satellite gravimetry; progress the understanding of glacier response to climate and its changes; provide new insights in processes underlying spatio-temporal variability and instability of glacier flow on decadal scales; improve understanding of dynamic thickness change effects; allow the estimation of global calving fluxes; progress understanding of transport in glaciers and their role in landscape development; and help to better assess potentially hazardous glacier lakes.

ICEPROXY

At a glance
Title: Novel Lipid Biomarkers from Polar Ice: Climatic and Ecological Applications
Funding instrument: Support for Frontier Research
Starting date: 01/10/2008
Total cost: 1 888 593 €
Duration: 60 months
EC Contribution: 1 888 593 €
Coordinating organisation: Centre National de la Recherche Scientifique, FR
Coordinator: Liliane Flabbée
EC Office: Implementation of the "Ideas" Programme Directorate

Abstract

It is widely acknowledged that polar sea ice plays a critical role in global climate change. As such, sea ice reconstructions are of paramount importance in establishing climatic evolution of the geological past. In the current project, some well characterised organic chemicals (biomarkers) from microalgae will be used as proxy indicators of current and past sea ice in the Arctic and Antarctic regions. These biomarkers, so-called highly branched isoprenoids (HBIs), possess a number of characteristics that make them attractive as sea ice proxies. Firstly, some HBIs are unique to sea ice diatoms, so their presence in polar sediments can be directly correlated with the previous occurrence of sea ice. Secondly, they are relatively resistant to degradation, which extends their usefulness in the geological record. Thirdly, their relative abundance makes them straightforward to measure with a high degree of geological resolution.

One component of this project will consist of performing regional calibrations of the proxies. Concentrations of selected biomarkers in recent Arctic and Antarctic sediments will be correlated with the sea ice abundances determined using satellite technology over the last 30 years. The successful calibration of the proxies will then enable reconstructions of past sea ice extents to be performed at unprecedented high resolution. Sediment cores will be obtained from key locations across both of the Arctic and Antarctic regions and the data derived from these studies will be used for climate modelling studies.

As a complement to these physico-chemical studies on sea ice, a second component of the project will investigate the use of these biomarkers for studying sea ice-biota interactions and, by examining the transfer of these chemicals through food chains, new tools for determining the consequences of future climate change on polar ecosystems will be established.

Partners		
N°	Organisation	Country
1.	Centre National de la Recherche Scientifique (CNRS)	FR

INDO-MARECLIM

At a glance
Title: Indo-european Research Facilities for Studies on Marine ecosystem and climate in India
Instrument: Coordination and support action
Total cost: 2 500 000 €
Ec contribution: 1 900 000 €
Duration: 36 months
Start date: 01/02/2012
Consortium: 6 partners from 6 countries
Project coordinator: Nerci, IN
Project website: www.indomareclim_nerci.in
Key words: monsoon, climate change, marine ecosystem, coastal zone management

The challenge

INDO-MARECLIM aims at analyzing and understanding some of the challenges (e.g. changes in the monsoon, sea level rise, coastal erosion, changes in primary production, fisheries and biodiversity) of the Indian Ocean and the Indian sub-continent under past, current and future global change processes. The project and cooperation will contribute to building strategic R&D partnerships between institutions in Europe and India. Infrastructure and expertise at NERCI will provide a platform for interaction with European partners, initially from the UK, France, Italy, the Netherlands and Norway and expanding the European partnership of NERCI.

Project objectives

1. To establish scientific cooperation focusing on:
   - a Monsoon and ocean variability, climate
   - b change and sea level variations, Marine ecosystem studies, including algae blooms and
   - c Coastal zone management and impact on society.
2. expanding Indo-European cooperation through workshops and summer school for the project partners.
3. To define, prepare and submit competitive new joint scientific research projects in cooperation between Indian and European research institutions to national and international funding agencies, including EU.
4. To prepare the way for institutional arrangements at NERCI to include research organizations from additional Member States and Associated Countries.

Methodology

INDO-MARECLIM comprises three related, but complementary, scientific fields of research of interest to India and Europe;

- a Monsoon and ocean variability, climate change and sea level variations: Data records, satellite Earth observation data, global oceanic reanalysis and coupled numerical ocean and atmosphere models will be used to study the variability of the monsoon system and the Indian Ocean.
- b Marine ecosystem studies, including algae blooms: Cataloguing the data available on the algal blooms based on the sea truth data would be very meaningful for comparative studies employing ocean colour data available.
- c Coastal zone management and impact on society. Assessment of impacts of human activities on the marine ecosystem and the development of integrated management measures. A detailed digitised inventory based on secondary data would be a suitable step to analyse changes that are likely to occur in the plant and animal communities of the Indian coast.

Expected results

- Scientific network involving European and Indian institutions and forming of new Practical solutions to enhance scientific research monitoring and training relevant to marine environmental events.
- A numerical ocean circulation-ecosystem model

- Guidelines to policy makers in the fishery sector
- Inventory of marine bio-resources
- Forewarning and adaptation actions for sea level rise
- Introduction of new academic programmes
- Improved commitment to conserve the sea.
- Providing excellence in higher education Improvement in the scientific knowledge on the Indian marine ecosystem
- Scientific co-operation
- Validation of the EU technologies
- The project will exchange knowledge between scientists and students through summer schools, workshops, seminars and conferences. The project will thereby strengthen and widen the scientific transfer activities within the EU, India and other countries.

Completed Milestones

- Project Review meeting during 29oct-31oct-2012.
- INDOMARECLIM network building, Two technical sessions chaired by INDOMARECLIM during PORSEC -2012-NOV.05-09 2012 KOCHI
- Signing of MoU with KUFOS in March 2013.
- Participation at the EU-INDIA STI Cooperation 8-9 November, 2012 at National Geophysical Research Institute, Hyderabad.
- India-EU Workshop on Marine Primary Production March 12 – 15, 2013.
- Exchange of scientists between PML, NERSC, ALTERRA & NERCI were part of the project. Ten such exchange programs are completed.
- New tie-up with Indian Navy.

Project partners	
Nansen Environmental Research Centre (India) Ltd (Nerci)	IN
Stiftelsen Nansen Senter For Fjernmaaling (Nersc)	NO
Plymouth Marine Laboratory (Pml)	UK
Centro Euro-Mediterraneo Per I Cambiamenti Climatici Scarl (Cmcc)	IT
Institut Francais De Recherche Pour L'exploitation De Lamer (Ifremer)	FR
Stichting Dienst Landbouwkundig Onderzoek (Alterra)	NL

INTERACT

At a glance
Title: International Network for Terrestrial Research and Monitoring in the Arctic
Instrument: Research Infrastructures for Polar research
Total cost: 9 362 620 €
EC contribution: 7 300 000 €
Duration: 48 Months
Start date: 01/01/2011
Consortium: 32 partners from 12 countries and 20 Observer Stations
Project coordinator: Terry Callaghan
Project website: www.eu-interact.org
Key words: Climate change, changes in the cryosphere, biosphere, feedback mechanisms, trans-national access to the whole Arctic, research station's managers forum, improving monitoring technology, improving data access and outreach

The challenge

World attention is focused on the Arctic because of its rapidly changing climate, cryosphere and concurrent changes in land use, socio-economics and globalisation of economies and cultures. The environmental changes in the Arctic affect not only the Arctic, but also the rest of the world.

Environmental observing and predictive capacities are limited in the Arctic compared to those in most other latitudes. The major environmental observing systems in the Arctic are research stations. Together they host thousands of scientists each year, they support long-term environmental monitoring, research, outreach to stakeholders and data for environmental assessments that feed into policy decisions.

Project objectives

INTERACT has a main objective to build capacity for identifying, understanding, predicting and responding to diverse environmental changes throughout the wide environmental and land-use envelopes of the Arctic. Implicit is the aim to build capacity for monitoring, research, education and outreach.

Detailed objectives include sustaining the current observing capacity of existing infrastructures and their networking activities throughout the Arctic, expanding this observing capacity by responding to new needs from the research, assessment and wider stakeholder communities, improving the efficiency of observing by developing and deploying new observing technologies implemented with standard protocols, and making archived and new observations more accessible to a wide range of users. Furthermore, INTERACT aims to generate increased research activity by increasing access to the Arctic for researchers and to provide legacy by engaging the next generation of researchers in collaborative educational activities. INTERACT aims to provide outreach to relevant local, regional and global stakeholders.

Methodology

INTERACT has developed 8 major Work Packages. WP1 coordinates the overall project, WP2 operates a Station Managers' Forum, WP3 networks INTERACT with other regional and global inititives, WP4 operates Trans-national Access, WP5 is enhancing wireless networking of environmental monitoring sensors, WP6 is improving monitoring and facilitating research into climate feedbacks, WP7 is improving data storage and access and WP8 is informing and interacting with the public, local and other stakeholders including students. INTERACT brings together managers of over 50 research stations, researchers, stakeholders, technology developers and major arctic organisations.

Expected results

INTERACT has already increased the capacity for monitoring, research, education and outreach in the Arctic. INTERACT has grown from 33 to over 50 research infrastructures (and is still growing) in all arctic countries. Almost all the major northern terrestrial infrastructures in the North will be collaborating within INTERACT. The INTERACT Stations are strategically sampling the environmental space of the Arctic. The one-stop-shop provides immediate and simple access to terrestrial facilities, activities and information from the whole environmental envelope, as well as a rapid response system to record extreme events with potentially large impacts. Within the first two years 360 researchers have received access to 20 research stations.

INTERACT has become a major initiative recognised at local, regional and global levels. It is a task within SAON and is contributing to GEO. It has been endorsed by all major Arctic initiatives.

Project partners	
The Royal Swedish Academy of Sciences (SE)	Natural Environmental Research Council (UK)
Agricultural University of Iceland (IS)	Norwegian Inst. for Agricultural and Environ (NO)
Alfred Wegener Institute for Polar and Marine Research (DE)	Norwegian Polar Institute (NO)
Arctic Institute of North America (CN)	Lomonosov Moscow State University (RU)
Arctic Monitoring and Assessment Programme Secretariat	Stockholm University (SE)
ATHENA (GR)	Swedish Polar Research Secretariat (SE)
Barrow Arctic Science Consortium (US)	Swedish University of Agricultural Sciences (SE)
Centre for Northern Studies (CN)	University of Alaska Fairbanks (US)
CLU srl IT)	University of Copenhagen (DK)
Faroe Islands Nature Investigation (FO)	University of Helsinki (FI)
Finnish Forest Research Institute (FI)	University of Oslo (NO)
Greenland Institute of Natural Resources (GL)	University of Oulu (FI)
IT University of Copenhagen (DK)	University of Turku (FI)
The Inst. for Biological Problems of Cryolithozone SB RAS (RU)	Uppsala University (SE)
Lund University(SE)	World Wide Fund for Nature
National Environmental Research Institute (DK)	Yugra State University (RU)

IS-ENES2

At a glance
Title: Infrastructure for the European Network for Earth System Modelling – Phase 2
Instrument: Collaborative project and coordination and support action
Total cost: 11 175 385 €
EC Contribution: 7 999 941 €
Duration: 48 months
Start date: 01/04/2013
Consortium: 23 partners from 11 countries
Project coordinator: Sylvie Joussaume
Project website: is.enes.org
Key words: Earth system modelling, climate change, model data archives, high-performance computing

The challenge

IS-ENES is the Infrastructure for the European Network for Earth System Modelling, ENES. It gathers the European community developing and applying climate models of the Earth system. This community aims to better understand present and past observed climates and predict future changes under given boundary conditions of anthropogenic and natural forcing. It is strongly involved in the assessments of the Intergovernmental Panel on Climate Change and provides the predictions on which EU mitigation and adaptation policies are based.

Project objectives

IS-ENES2 has four main objectives:

- To foster the integration of the European Climate and Earth system modelling community,
- To enhance the development of Earth System Models,
- To support high-end simulations enabling to better understand and predict climate variations and change,
- To facilitate the application of Earth system model simulations to better predict and understand climate change impacts on society by enhancing the dissemination of model results from both global and regional model experiments.

IS-ENES2, builds on the outputs of IS-ENES and the FP7 METAFOR project. It encompasses both global and regional models and supports the data and metadata infrastructure as well as international standards for the WCRP CMIP5 and CORDEX experiments. It further supports developments to ease the use of climate model data by the climate impact research community. It strengthens the ENES community capacity to provide more reliable decadal predictions at regional scale for society.

Methodology

IS-ENES2 implements the recommendations of the ENES infrastructure strategy for 2012-2022. It encompasses networking, service and joint research activities serving the 4 project objectives.

Integration of the community is mainly achieved through activities on governance, strategy and community building. Service provides access to modeller expertise, models and tools.

The development of Earth system models is enhanced through networks to progress options for code convergence and to investigate sharing of best practices in software development.

Support for high-end simulations includes strategy for future exascale architectures, the preparation of future high-end experiments and improved workflow solutions.

Dissemination of model data is facilitated through service on data and metadata for CMIP5 and CORDEX (Europe and Africa) and generation of requirements and tools.

Expected results

Networking activities will increase the cohesion of the European ESM community and advance a coordinated European Network for Earth System modelling.

Joint research activities will improve the efficient use of ESMs, high-performance computers, access to model results in terms of data and metadata and will contribute to the development of international databases and standards.

Finally, IS-ENES2 will provide services on models and model data and metadata both to climate modelling groups and to the users of model results, including the impacts community.

IS-ENES2 will mainly benefit to the climate modeling and climate impact communities. It will also enhance innovation through collaboration with ICT technologies and through use of model results for emerging European Climate Services and corporations.

Project partners	
Centre National de la Recherche Scientifique *With* Commissariat à l'Energie Atomique et aux Energies Alternatives *&* Université Pierre et Marie Curie as third parties	FR
Deutsches Klimarechenzentrum GmbH	DE
Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique	FR
Centro Euro-Mediterraneo per i Cambiamenti Climatici	IT
The University of Reading	UK
The Met Office	UK
Science and Technology Facilities Council	UK
Sveriges Meteorologiska och Hydrologiska Instituut	SE
Koninklijk Nederlands Meteorologisch Instituut	NL
Max-Planck-Gesellschaft zur Förderung der Wissenschaften	DE
University of Cape Town	ZA
University of Manchester	UK
Institutul National de Hidroligie si Gospodarire a Apelor	RO
Wageningen Universiteit	NL
Linköpings Universitet	SE
Barcelona Supercomputing Centre	ES
Universidad de Cantabria	ES
Deutsches Zentrum für Luft – und Raumfahrt in der Helmholtz Gemeinshaft	DE
Danmarks Meteorologiske Institut	DK
Fundacio Institut Catala de Ciencies del Clima *With* Institut Català de Recerca i Estudis Avançats as third party	ES
Météo France–Centre National de Recherches Météorologiques	FR
Universitetet I Bergen With Uni Research AS as third party	NO
Meteorologisk Institutt	NO

ITOP

At a glance
Title: Integrating Theory and Observations over the Pleistocene
Funding scheme: ERC Starting Grants
ERC funding: 1 047 600 €
Duration: 60 months
Start date: 01/08/2009
Host institution: Université Catholique de Louvain, BE
Principal investigator: Michel Crucifix
Project website: www.uclouvain.be/itop
Key words: climate, palaeoclimates, dynamics, statistics

The challenge

One of the most dramatic manifestations of past climate changes is the succession of glacial interglacial cycles, which have paced climate over the last 3 million years. Glacial-interglacial cycles involve all the components of the climate system, including ice sheets, ocean dynamics, the hydrological cycle and the biosphere. It is recognised that the timing of glacial-interglacial cycles is controlled by changes in Earth's orbit and obliquity, but important questions remain about the mechanisms of this control, and how it interacts with the internal climate dynamics to produce the variations documented in natural climate archives.

Project objectives

The objective of ITOP is to bring state-of-the-art statistical and modelling methodologies into palaeoclimate research, and act as a pilot-project to establish how palaeoclimate data and models may be combined to address the following problems :

1. Do glacial-interglacial cycles emerge from an internal limit cycle in the climate system or do they emerge as a phenomenon dominantly driven by the astronomical forcing?
2. How stable are glacial-interglacial oscillations? Can rapid and unpredictable climate fluctuations substantially alter the length of a glacial cycle?
3. What are the individual and combined controls of the forcing, ice sheets and CO2 concentration on regional climate phenomena, such as monsoon systems and multi-annual variability modes?
4. Which factors may explain changes in oscillations regimes documented in palaeoclimate data, such as the Mid-Pleistocene transition that occurred about 800 000 years ago ?

Methodology

The project is organised around the concept of causal dynamical networks. The important components of climate (essentially the atmosphere, continental ice, CO2 and ocean circulation) are represented by small-dimensional variables connected by non-linear relationships. The structure and underlying parameters of these connections are informed by a combination of three approaches:

1. state-of-the-art statistical techniques are being applied to calibrate low-dimensional, stochastic dynamical systems on paleoclimate data. The techniques are adapted to account for dating uncertainties inherent to the sedimentation process ;
2. plans of experiments are carried out with general circulation models, and post-processed with the aid of Gaussian process statistics to measure and visualise the global sensitivity of different climatic components to the astronomical forcing;
3. system identification techniques are applied to physical models of the slow components of climate
4. The methodology draws particular emphasis on the quantification of uncertainties of both models and observations, the robustness of methods, and the analysis of system stability.

Emerging Results

1. Calibration methodology. Given the context of high structural and dating uncertainties, the calibration of dynamical paleoclimate models on paleoclimate data is best carried out by splitting

the state-estimation and parameter estimation steps. A software package for general use for calibration of palaeoclimate data is being developed.

2. Stability of ice ages. Analysis of current ice age models consistently show a 'strange non-chaotic attractor' structure. The implication is that ice ages dynamics, if correctly described by these models, almost certainly present episodes of instability. Therefore, even small stochastic dynamics may significantly alter the duration of ice ages.
3. Forcing-response phase relationships to astronomical forcing. Global sensitivity analysis of general circulation model output has allowed us to estimate the response phase of different climate variables (monsoon precipitation, ocean circulation, boreal vegetation…) to precession, obliquity, CO_2 and ice volume, providing for the first time a general-circulation-model-based information to interpret phase leads-and-lag relationships identified in long palaeoclimatic data series.

JPI CLIMATE CSA

At a glance

Title: Joint Programming Initiative Connecting Climate Knowledge for Europe
Instrument: Coordination and support action
Total cost: 2 400 000 €
EC contribution: 2 000 000 €
Duration: 36 months
Start date: 01/01/2013
Consortium: 18 partners from 12 countries
Project coordinator: German Aerospace Center (DLR), DE
Project website: www.jpi-climate.eu
Key words: Climate knowledge, alignment of National Research Programmes, decadal prediction; climate services, societal transformation under climate change, development of decision-making Tools

The challenge

Climate change generates new challenges and the need to protect European citizens, business and nature from climate risks. Research, knowledge dissemination and innovation are crucial in helping to confront these challenges and generate new opportunities for sustainable development. Understanding and responding to climate change requires coordinated and large-scale European efforts, in research, innovation and governance.

The JPI Climate provides the platform where these objectives can be met, aligning national research priorities according to a jointly agreed Strategic Research Agenda with the aim of complementing and supporting initiatives at the European level. JPI Climate facilitates the coordination, collaboration and exploitation of synergies while working against fragmentation and duplication of efforts. Coordination of the research base secured through national resources will help underpin European efforts to confront climate change. JPI Climate aims to respond to the needs of policy and decision makers.

Project objectives

The main objective of this programme is to provide integrated climate knowledge and decision support services for societal innovation.

- Identify, coordinate and integrate national climate research funding programme
- Put forward and provide input to climate research programmes and policies of the EU
- Establish a strategic collaboration with global programmes, neighbouring countries, climate policy actors at the international level (JPI Climate as fireplace)
- Identify, coordinate and integrate national climate research funding programme
- Put forward and provide input to climate research programmes and policies of the EU
- Establish a strategic collaboration with global programmes, neighbouring countries, climate policy actors at the international level

Methodology

The JPI Climate is built upon four modules: 1) improving climate projections, 2) climate services, 3) societal transformation, and 4) decision-support tools. It is innovative in its interdisciplinary approach in connecting natural- with socio-economic sciences and it is guided, coordinated and managed through a flexible collaborative governance mechanism.

Within the CSA project there are 5 work packages (WP). The first one is for coordinating and managing the project in the whole. The second WP includes the four modules and further a task with the aim to integrate the activities of the four different modules to provide integrated climate knowledge and implement JPI Climate activities. WP 3 creates a platform where research policies and programmes between the JPI Climate member countries and European institutions (notable the EC) are streamlined and the liaison with other initiatives on European and international level will pushed ahead.

Expected results

- Extend the partnership of the JPI Climate to other EU member states, with special focus on eastern European countries.
- Develop an effective communication and dissemination strategy
- Develop a detailed implementation plan which includes time plan and action plan
- Elaborate an update of the Strategic Research Agenda
- Elaborate and apply concepts and mechanisms on how to best integrate activities of the four different modules to provide integrated climate knowledge.

JPI Climate aims to support policy and decision-making processes by governments, businesses, citizens and non-governmental organisations at different levels. JPI Climate is a joint programming initiative that integrates European climate change science and connects it to efforts in Europe to be both climate-friendly (through mitigation) and climate-proof (through adaptation).

Project partners	
German Aerospace Centre	DE
National Centre for Scientific Research, French National Research Agency	FR
Finnish Meteorological Institute, University of Helsinki	FI
University of Natural Resources and Life Sciences	AT
Research Institute Alterra, Free University of Amsterdam	NL
University of Oxford, Univeristy of Reading	UK
Euro-Mediterranean Centre for Climate Change	IT
Belgian Science Policy Office	BE
The Research Council of Norway	NO
Aarhus University	DK
Swedish Meteorological and Hydrological Institute, Swedish Research Council	SE
Environmental Protection Agency of Ireland	IE
Royal Netherlands Meteorological Institute	NL

MATRICS

At a glance
Title: Modern Approaches to Temperature Reconstructions in polar Ice Core
Funding scheme: ERC Advanced Grant
ERC funding: 2 100 100 €
Duration: 72 months
Start date: 01/01/2009
Host institution: University of Bern, CH
Principal investigator: Hubertus Fischer
Project website: www.climate.unibe.ch/~hfischer/Projects.html
Key words: paleoclimate, ice cores, temperature, isotopes, diffusion, methane cycle, noble gases

The challenge

Past climate reconstructions using natural climate archives rely in most cases on proxy data (for example environmental or ecological parameters correlated to temperature) and often provide only very local temperature information. Moreover, the synthesis of climate information from different archives is hampered by the incompatibility of the age scales of individual records and by the site-specific nature of the proxy temperature reconstructions. The challenge of MATRICs was, therefore, to develop new quantitative ice core recorders of climate change representative of major components in the climate system to provide an integrative view of climate change in the past.

Project objectives

MATRICs' goal is to provide novel quantitative information on climate changes over the last 800 000 years using polar ice cores. To this end, new physical paleo-thermometers have been developed, which allow us (i) to derive mean ocean temperature using only one ice core measurement and (ii) to quantitatively reconstruct temperatures in both polar regions. Moreover, the impact of global climate on terrestrial ecosystems is being investigated by isotopic ice core studies of the global methane cycles. Together with previously derived proxy information from polar ice cores, this allows us to gain a comprehensive picture of global climate and environmental changes and - by using data all derived from the same ice core - avoiding critical cross-dating issues. Ultimately, this will provide robust quantitative information of past global changes and a substantially improved understanding of the forcings and responses of climate change in the past and in the future.

Methodology

Three novel analytical techniques have been developed in MATRICs and are being applied to existing polar ice core samples:

1. A physical thermometer for mean ocean temperature based on the temperature-dependent solubility of noble gases in the ocean. To this end, a new gas extraction for air bubbles enclosed in ice cores and a mass spectrometric technique for high-precision noble gas ratios and their isotopic signatures have been developed.
2. A physical ice-sheet thermometer using the temperature-dependent diffusion of stable water isotopes in the snow and ice. To this end, a continuous high-resolution laser spectroscopic analysis of stable water isotopes on polar ice cores has been developed.
3. Novel mass spectrometric analysis of carbon and hydrogen isotopes in methane extracted from air bubbles in ice cores to quantify the response of methane sources (such as tropical and boreal wetlands, biomass burning etc.) on past climate change.

Emerging results

Methane isotopes have been extensively used in MATRICs to quantify the contributions of individual sources on rapid and slow methane changes in the past. This allowed us to exclude an influence of marine clathrates on rapid CH4 increases in the past. In contrast, seasonal tropical wetland sources appear to be the main driver of past methane changes.

Moreover, our data indicate a strong effect of atmospheric carbon dioxide levels on methane emitting ecosystems. Using our isotope diffusion thermometer, we were able to quantify glacial temperatures on the Antarctic ice sheet, supporting previous proxy information. Usage of the novel noble gas thermometer has just started, but first results indicate an approximately 2.5-3 °C colder mean global ocean during the last glacial age.

MEDSEA

At a glance
Title: Mediterranean Sea Acidification in a Changing Climate (MedSeA)
Instrument: Specific Targeted Research Project
Total cost: 4 820 000 €
EC contribution: 3 490 000 €
Duration: 36 months
Start date: 02/2011
Consortium: 16 partners from 10 countries (with 13 institutes from the Mediterranean countries)
Project coordinator: Patrizia Ziveri
Project website: medsea-project.eu
Key words: Ocean acidification, Mediterranean Sea, ocean warming, CO2 emissions, climate change

The challenge

As carbon emissions increase and carbon dioxide levels (CO2) in the atmosphere rise, so does the concentration of CO2 in the ocean. At present, we know that the ocean is responsible for the uptake of around 25% of the CO2 added to the atmosphere from human activities each year. This has decreased the accumulation of carbon dioxide in the atmosphere and thus reduced the potential warming effect on our climate. However, the ocean uptake of atmospheric CO2 is changing the seawater chemistry resulting in a decrease of pH (ocean acidification). This poses a threat to the fundamental chemical balance of ocean and coastal waters, marine ecosystems and biogeochemical cycles.

- The semi-enclosed Mediterranean Sea is already under environmental pressure by increased temperature, overfishing, invasion of alien species, pollution and eutrophication.
- A healthy Mediterranean is societally and economically important.
- 22 countries surround its coasts with total population of >400 million people and 150 million living in coastal regions.
- The Mediterranean Sea is considered a small-scale ocean with high environmental variability. It is both too complex and too small to be adequately simulated in global-scale climate and biogeochemical models.

Project objectives

- Identifying areas of high impact of ocean acidification and warming, focusing on ocean chemistry and marine life – how will ocean acidification impact marine life and, in turn, affect the way we live and work?
- Projecting the potential changes in the chemistry of the Mediterranean Sea and provide assessments of risks and sustainability of ecological and economically important species – how can we ensure that livelihoods are sustained?
- Collecting key data around this enclosed sea to feed ecosystem models to help project future changes – what can Europe do to adapt to changes?

Methodology

Laboratory experiments, to study the impacts of acidification and temperature increase on selected pelagic and benthic organisms, including the study of biodiversity and biogeochemistry of endemic and keystone species Mediterranean coastal ecosystems.

Mesocosm experiments, to determine the biogeochemical and community responses to elevated CO2 conditions.

Field studies of target planktic and benthic organisms at selected time-series stations and in oceanographic cruises to characterize present conditions.

Field studies and transplantations of benthic endemic and keystone Mediterranean species in areas of naturally acidified seawater (CO2 vents) to determine the short and long-term effects of acidification across multiple generations (ex. natural CO2 vents in Vulcano island, Italy).

Expected results

- Diagnosis of the current state of Mediterranean Sea acidification.
- Assessment of the changes in habitat suitability of relevant ecological and economically-important species.
- Science-based projections of Mediterranean acidification under the influence of climate change as well as associated economic impacts.
- Provision of new data on chemical conditions as well as observational and experimental data on the responses of key organisms and ecosystems to ocean acidification and warming.
- Providing the best advice to policymakers who must develop regional strategies for adaptation and mitigation.
- Examination of marine habitat loss due to ocean acidification.
- Projections of combined effects of acidification and warming.
- Assessments of socioeconomic impacts of ocean acidification.
- Recommendations on adaptation tools and policy responses.

Scientific findings will be communicated to a wide audience, including key stakeholders, such as marine managers, conservation organisations, industry, policy makers and the public.

Project partners	
1. Universitat Autònoma de Barcelona	ES
2. Université de Perpignan	FR
3. Bar Ilan University	IL
4. Hellenic Centre for Marine Research	EL
5. Centro Euro-Mediterraneo per i Cambiamenti Climatici	IT
6. Université Pierre et Marie Curie	FR
7. Plymouth Marine Laboratory	UK
8. Agencia Estatal Consejo Superior de Investigaciones Científicas	ES
9. University of Plymouth	UK
10. Alfred Wegener Institut für Polar und Meeresforschung	DE
11. Conzorcio Nazionale Interuniversitario per le Scienze del Mare	IT
12. Insitut National de Recherche Halieutique	MA
13. National Institute of Oceanography and Fisheries	EG
14. Sfax University	TN
15. Instituto Nazionale di Oceanografia e di Geofisica Sperimentale	IT
16. Commisariat a l'Energie atomique et aux Energies alternatives	FR

MESOAQUA

At a glance

Title: Network of leading MESOcosm facilities to advance the studies of future AQUAtic ecosystems from the Arctic to the Mediterranean
Instrument: Collaborative project and coordination and support action
Total cost: 4 559 470 €
EC contribution: 3 500 000 €
Duration: 48 months
Start date: 01/01/2009
Consortium: 5 partners from 5 countries
Project coordinator: University of Bergen, NO
Project website: mesoaqua.eu and http://mesocosm.eu
Key words: Marine ecosystems, Pelagic food web

The challenge

Mesocosms are confined volumes of water where real-life ecosystems are enclosed to allow manipulation of environmental factors. These research tools offer significant potential in the study of aquatic ecosystems. MESOAQUA has established a network of European marine mesocosm facilities to advance the studies of future aquatic ecosystems. The network extends from the Arctic to the Mediterranean, meeting the urgent need for a better understanding of the lower echelons of the marine food web and its response to global problems such as climate change, pollution and the introduction of alien species.

Project objectives

Mesocosm science requires a relatively costly and complex infrastructure that has only been developed in a limited number of almost exclusively land-based and inshore locations around the world. Transfer of know-how, data and training between these facilities has been limited and mainly dependent on personal contacts. To meet this shortfall, MESOAQUA worked in synergy to strengthen experimental ecology as a discipline within European and international marine science. The overall objectives of MESOAQUA are to: offer researchers access to a range of leading mesocosm facilities in contrasting environments from the Arctic to the Mediterranean; develop and test new technologies that allow access to off-shore environments; improve the services of the facilities through the exchange of technology and experience; facilitate cross-disciplinary fertilisation, transnational network building and a better coordination of mesocosm research; train young scientists in the use of experimental ecosystem research.

Methodology

The overall strategy of MESOAQUA was to offer top quality Transnational Access, to build the first Transnational Network and to integrate it with closely coordinated Transnational Joint Research. To organize and integrate science, training, development, use and management of the leading European pelagic mesocosm research infrastructures. The various activities were closely integrated with one another.

Expected results

During four years, MESOAQUA offered to more than 150 European and not-European marine scientists, access to its mesocosm facilities where they were leading or contributing to 23 different mesocosm experiments. MESOAQUA advanced the state-of-the-art of mesocosm technology and expanded the range of environments in which they can be used, collaborating to the development and test of two state-of-the art mesocosm platforms that can be used for open ocean research. MESAQUA has tremendously increased the research standard of the European mesocosm facilities through an inter-facility transfer of technology and dissemination of knowledge. MESOAQUA has successfully optimized the effectiveness and enhanced the exchange of information and dissemination of knowledge about mesocosm research, by creating a mailing list (≈ 500 contacts) and a web portal (http://mesoaqua.eu) that function as an international information hub for establishing new contacts and for coordination of research activities.

MODES

At a glance
Title: Modal analysis of atmospheric balance, predictability and climate
Funding scheme: ERC Starting Grant
ERC funding: 500 000 €
Duration: 48 months
Start date: 01/12/2011
Host institution: University of Ljubljana, SI
Principal investigator: Nedjeljka Zagar
Project website: www.fmf.uni-lj/~zagarn
Key words: unbalanced circulation, reanalyses, climate models, normal modes

The challenge

Despite large progress in modelling of atmospheric processes and computing capabilities, and concentrated efforts to increase complexity of the atmospheric models, the assessment of accuracy of natural atmospheric climate variability and its predictability is far from well understood. In particular, the unbalanced component of atmospheric circulation is not well understood and remains un-quantified. At the same time, observational coverage and assimilation methods have reach a stage that the large-scale unbalanced circulation is well analyzed and can be used for the verification of the climate models.

Project objectives

The overall objectives of this project are to provide a picture of general circulation and its predictability in terms of balanced and inertio-gravity motions and to verify the unbalanced circulation in the state-of-the-art climate models. The project is also producing a user-friendly software tool for the modal decomposition of atmospheric circulation.

Methodology

Methodology applied in the project is the normal-mode function representation. It allows to study the atmospheric unbalanced circulation and predictability in terms of the variance percentage which is associated with various types of motions.

Emerging results

A software tool for the modal analysis is developed and applied to reanalysis datasets.

NACLIM

At a glance

Title: North Atlantic Climate: Predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability and change

Instrument: Collaborative project

Total cost: 11 046 614 €

EC contribution: 8 598 407 €

Duration: 48 months

Start date: 01/11/2012

Consortium: 18 partners from 10 countries

Project coordinator: University of Hamburg

Project website: www.naclim.eu

Key words: Climate change, environment and health, marine environment

The challenge

The North Atlantic Ocean is one of the most important drivers for the global ocean circulation and its variability on time scales beyond inter-annual. Global climate variability is to a large extent triggered by changes in the North Atlantic sea surface state. The quality and skill of climate predictions depends crucially on a good knowledge of the northern sea surface temperatures (SST) and sea ice distributions. On a regional scale, these parameters strongly impact on weather and climate in Europe, determining precipitation patterns and strengths, as well as changes in temperature and wind patterns. Knowledge of these factors, and of their development in the years to come, is of paramount importance for society and key economic sectors, which have to base their planning and decisions on robust climate information.

Project objectives

We aim at investigating and quantifying the predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability on seasonal to decadal time scales. SST and sea-ice forcing have a crucial impact on weather and climate in Europe. We will analyze the multi-model decadal prediction experiments currently performed as part of the CMIP5 Project and assess the quality of predictions of the near-future state of key oceanic and atmospheric quantities relevant to the SST and sea-ice distribution and the related climate. Long-term observations of relevant ocean parameters will be carried out, for assessing the forecast skill of the model-based prediction results. We will identify observations that are key to the quality of the prediction and optimize the present observing system. We will quantify the impact of North Atlantic/European climate change on oceanic ecosystems and urban societies.

Methodology

The project is organized in four closely interconnected core themes (CTs). CT1 and CT4 will build on the multi-model decadal prediction ensemble experiments currently performed as part of the CMIP5 project. CT1 and CT3 will enhance the CMIP5 database with dedicated process-oriented modelling studies. CT2 will derive reference time series of integrated key North Atlantic Ocean quantities using observational data for assessing to what extent climate models are capable of simulating observed variations within the North Atlantic Ocean system. CT4 will evaluate the impact of predicted North Atlantic/ Arctic Ocean variability on oceanic ecosystems and urban societies, and assess the hindcast predictive skill and the reliability of such forecasts. The resulting urban climate forecasts will be coupled to socio-economic data focusing on human health. CT5 will assess the suitability of climate forecast parameters for use by end-users.

Expected results

We expect to be able to:

- quantify the uncertainty of state-of-the-art climate forecasts by evaluating the ability to model the most important oceanic and atmospheric processes in the North Atlantic and Arctic Oceans, and by comparing key quantities with observations,
- optimize the present North Atlantic observation system by evaluating the impact of its components on the quality and quality control of model forecasts, and their value in determining the present ocean state and its past variability,
- quantify the impact on oceanic ecosystems and on European urban societies of predicted North Atlantic/Arctic Ocean variability,
- critically assess the use of climate forecast parameters for use by stakeholders in society, politics and industry.

Project partners	
UNIVERSITAET HAMBURG	DE
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	DE
UNIVERSITE PIERRE ET MARIE CURIE–PARIS 6	FR
UNIVERSITET I BERGEN	NO
UNI RESEARCH AS	NO
HELMHOLTZ ZENTRUM FUR OZEANFORSCHUNG KIEL	DE
DANMARKS METEOROLOGISKE INSTITUT	DK
HAVSTOVAN	FO
ILMATIETEEN LAITOS	FI
HAFRANNSOKNASTOFNUNIN	IS
STICHTING KONINKLIJK NEDERLANDS INSTITUUT VOOR ZEEONDERZOEK	NL
THE SCOTTISH ASSOCIATION FOR MARINE SCIENCE	UK
NERC/ NATIONAL OCEANOGRAPHY CENTRE SOUTHAMPTON	UK
VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
G.I.M. GEOGRAPHIC INFORMATION MANAGEMENT N.V.	BE
DANMARKS TEKNISKE UNIVERSITET	DK
THE SCOTTISH MINISTERS ACTING THROUGH MARINE SCOTLAND	UK
CONSEIL NATIONAL DE RECHERCHE SUPERIEURE	FR

NAMASTE

At a glance
Title: Thermodynamics of the Climate System
Funding scheme: ERC Starting Grant
ERC funding: 1 393 440 €
Duration: 60 months
Start date: 01/09/2010
Host institution: University of Hamburg
Principal investigator: Valerio Lucarini
Project website: www.mi.uni-hamburg.de/NAMASTE.7164.0.html
Key words: Thermodynamics, climate response, statistical mechanics, parametrizations, extreme events, climate models, tipping points

The challenge

The investigation of the global structural properties of the climate system is crucial for providing a unifying picture of climate variability and climate change on a large variety of scales. The overarching challenge NAMASTE tackles is to develop new theoretical approaches for climate science, based upon the phenomenological theory of non-equilibrium thermodynamics and upon recent developments of non-equilibrium statistical mechanics. NAMASTE aims at shedding light on complex problems like those related to climate tipping points, climate response to forcing, extreme events in geophysical flows, and at defining methods for auditing climate models and for developing parametrizations of unresolved processes.

Project objectives

- Advances in the thermodynamic description of the climate system and planetary bodies, re-analysis of the hydrological cycle and of the atmosphere-ocean interaction;
- Thermodynamic re-examination of mechanisms involved in past, present and future climate variability and change with climate models of various degrees of complexity;
- Definition and implementation of a new generation of diagnostic tools for auditing climate models;
- Application of the response theory and Kramers-Kronig relations to climate models for analysing generalized climate sensitivities and climate response to periodic forcings;
- Analysis of the impact of stochastic perturbations on the statistical properties of the forced and free fluctuations of simplified climate models;
- Study of the climatic tipping points and feedbacks by analysis of the resonances and divergence of the climatic response, and by investigation of the fluctuations of the large-scale thermodynamical properties;
- Statistical Mechanical analysis of geophysical extreme events.

Methodology

NAMASTE combines theoretical methods of nonequilibrium statistical mechanics and thermodynamics, dynamical systems theory, theory of stochastic processes, geophysical fluid dynamics, with an extensive usage of numerical simulations for systems ranging from few to several million degrees of freedom, covering the range extending from the celebrated Henon map and Lorenz system, to simplified geophysical fluid models, up to fully comprehensive climate models.

Thermodynamics is providing new ways for characterising large-scale properties of the climate system and for analysing its tipping points. Statistical mechanics and dynamical systems theory are instrumental for developing a unifying approach for investigating the climate response to forcings, and, together with the theory of stochastic processes, are leading to advances on the theory of extremes for and for the development of parametrizations of unresolved processes in geophysical systems. The numerical simulations are crucial for testing the theories and veryfing their relevance in systems of various degrees of complexity.

Emerging results

- Thorough assessment of the energy budget of the current generation of climate models and individuation of inaccuracies that may create large uncertanties when simulating of climate change; this is of direct interest for climate modelling;
- Introduction of new methods for studying and computing the climate response to external forcings; this outcome is of general relevance for the climate community;
- Development of a new thermodynamical point of view on a fundamental tipping point of the Earth system, i.e. the snowball-snowfree instability; this is relevant for paleoclimatological studies and for investigations of exoplanets;
- Introduction of new methods for deriving in a rigorous way parametrizations for unresolved processes for general multi-level systems; these results are relevant for complex system science and climate science;
- Derivation of new general laws for extreme events in chaotic dynamical systems; these findings are also relevant in complex systems science and climate science.

PACEMAKER

At a glance
Title: Past Continental Climate Change: Temperatures from Marine and Lacustrine Archives
Funding instrument: ERC Advanced Grant
Starting date: 01/01/2009
Duration: 60 months
Total cost: 2 498 040 €
EC contribution: 2 498 040 €
Coordinating organisation: Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek (NIOZ) AB Den Burg (Texel), NL
Coordinator: Maarten A. van Arkel
Project website: www.noiz.nl
EC office: Implementation of the "Ideas" Programme Directorate

Abstract

Global climate change is a topic of major interest as it has a large impact on human societies. Computer models used to predict directions of future climate change are validated by means of retrospective analysis of past climate changes. Detailed reconstruction of past climates, especially temperature, is, therefore, of considerable importance. Several tools (proxies) are available to reconstruct absolute sea surface temperatures. Continental temperature reconstructions, however, are hampered by a lack of quantitative temperature proxies and, consequently, are often qualitative rather than quantitative.

Recently, the research group discovered a new quantitative continental temperature proxy, the MBT index, which is based on the distribution of membrane lipids of soil bacteria. Their composition is a function of annual mean air temperature (MAT). These lipids are transported by rivers to the ocean and deposited in marine sediments. Determination of the MBT index in cores from river fans can, thus, potentially be used to reconstruct continental, river basin-integrated, temperatures from a marine record in front of large river outflows.

We will study the mechanisms of transport of the soil bacterial membrane lipids to the ocean in many river systems and compare the downcore changes in their composition with conventional MAT proxies. We will also investigate the potential of lake sediments as archives of continental climate change using our new MBT palaeothermometer and apply this thermometer in the assessment of continental climate change during the transition from a hothouse to an icehouse Earth in the last 100 million years. This project that combines aspects of microbiology, molecular ecology, lipid biogeochemistry and paleoclimatology will bring this novel continental palaeothermometer to maturity. If we can ground-truth the use of the MBT-proxy, it will open up new windows in palaeoclimatological research and thus contribute to improvement of current climate models.

Partners	Country
Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek (NIOZ)	NL
Universiteit Utrecht	NL

PAGE21

At a glance

Title: Changing Permafrost in the Arctic and its Global Effects in the 21st Century
Instrument: Collaborative project
Total cost: 9 269 927 €
EC contribution: 6 951 895 €
Duration: 48 months
Start date: 01/11/2011
Consortium: 18 partners from 11 countries
Project coordinator: The Alfred Wegener Institute for Polar and Marine Research, DE
Project website: page21.eu
Key words: permafrost, arctic, climate change, carbon

The challenge

The northern permafrost region contains approximately 50% of the estimated global belowground organic carbon pool and more than twice as much as is contained in the current atmospheric carbon pool. The sheer size of this carbon pool, together with the large amplitude of predicted arctic climate change implies that there is a high potential for global-scale feedbacks from arctic climate change if these carbon reservoirs are destabilized.

Nonetheless, significant gaps exist in our current state of knowledge that prevent us from producing accurate assessments of the vulnerability of the arctic permafrost to climate change.

Project objectives

The key objectives of PAGE21 are to:

- Improve our understanding of the processes affecting the size of the arctic permafrost carbon and nitrogen pools through detailed field studies and monitoring, in order to quantify their size and their vulnerability to climate change,
- Produce, assemble and assess high-quality datasets in order to develop and evaluate representations of permafrost and related processes in global models,
- Improve these models accordingly,
- Use these models to reduce the uncertainties in feedbacks from arctic permafrost to global change, thereby providing the means to assess the feasibility of stabilization scenarios, and
- Ensure widespread dissemination of our results in order to provide direct input into the ongoing debate on climate-change mitigation.

Methodology

The PAGE21 directly addresses research questions through a close interaction between monitoring activities, process studies and modeling on the pertinent temporal and spatial scales. Field sites have been selected to cover a wide range of environmental conditions for the validation of large scale models, the development of permafrost monitoring capabilities, the study of permafrost processes, and for overlap with existing monitoring programs.

PAGE21 breaks down the traditional barriers in permafrost sciences between observational and model-supported site studies and large-scale climate modeling. Our concept for the interaction between site-scale studies and large-scale modelling is to establish and maintain a direct link between these two areas for developing and evaluating, on all spatial scales, the land-surface modules of leading European global climate models taking part in the Coupled Model Intercomparison Project Phase 5 (CMIP5), designed to inform the IPCC process.

Expected results

The timing of this project is such that the main scientific results from PAGE21, and in particular the model based assessments will build entirely on new outputs and results from the CMIP5 Climate Model Intercomparison Project designed to inform the IPCC Fifth Assessment Report.

However, PAGE21 is designed to leave a legacy that will endure beyond the lifetime of the projections that it produces. This legacy will comprise:

- An improved understanding of the key processes and parameters that determine the vulnerability of arctic permafrost to climate change,
- The production of a suite of major European coupled climate models including detailed and validated representations of permafrost-related processes, that will reduce uncertainties in future climate projections produced well beyond the lifetime of PAGE21, and
- The training of a new generation of permafrost scientists who will bridge the long-standing gap between permafrost field science and global climate modeling, for the long-term benefit of science and society.

Project partners	
Alfred Wegener Institute for Polar and Marine Research, DE	University of Copenhagen, DK
The University Centre in Svalbard, NO	University of Hamburg, DE
Stockholms Universitet, SE	Commissariat à l'Energie Atomique et aux Energies Alternatives, FR
Vrije Universiteit Amsterdam, NL	Met Office, for and on behalf of the Secretary of State for the Defence of the United Kingdom, Great Britain and Northern Ireland, UK
Technische Universität Wien, AT	Finnish Meteorological Institute, FI
Université Joseph Fourier, Grenoble, FR	University of Eastern Finland, FI
University of Exeter, UK	Institute for Biological Problems of Cryolithozone, RU
Max-Planck-Gesellschaft zur Förderung der Wissenschaften, e.V., DE	Arctic Portal, IS
Lund University, SE	Moscow State University, RU

PAST4FUTURE

At a glance
Title: Climate change – Learning from the past climate
Instrument: Collaborative project
Total cost: 9 233 877 €
EC contribution: 6 647 909 €
Duration: 60 months
Start date: 01/01/2010
Consortium: 22 partners from 12 countries
Project coordinator: University of Copenhagen, DK
Project website: www.past4future.eu
Key words: Climate change, abrupt change, interglacial, sea level, sea ice, ocean circulation, thresholds, greenhouse gases, solar insolation, volcanic forcing, ice sheets.

The challenge

Paleo-climatic records contain a wealth of information on the stability and variability of climate and its ability to perform abrupt changes. The challenges for the multi-disciplinary Past4Future team are to better understand the climate system, to improve the prediction of future climate changes and to advance the knowledge on abrupt climate changes in interglacial periods.

The Past4Future program will address the following challenging key questions:

What is the risk of abrupt changes in interglacials?

Can we understand the greenhouse gas records of the interglacial periods?

- What is the risk of rapid collapse of ice sheets?
- Were there significant changes in ocean circulation during previous interglacial periods?

Project objectives

The key objective for Past4Future is to provide the answers to the following key questions:

- What are the dynamics of the climate over interglacial periods?
- What causes climate changes and abrupt changes over the course of interglacial periods?
- What causes climate changes and abrupt changes over the course of interglacial periods?
- Can we understand the greenhouse gas records of the interglacial periods?
- What can the past tell us about risks for climate changes/threats in the future?

Methodology

The majority of program resources is targeted towards science areas that will result in the greatest possible strengthening of the understanding and quantification of Earth system dynamics and feedback processes of potential relevance for climate change and possible abrupt changes in the coming centuries. Past4Future is designed to build on previous and nationally funded work in a synergistic fashion.

New investigations of already obtained paleo-material, use of existing paleo-archives, strong collaboration between European and international research programs with new paleo-records, and the inclusion of key experts to operate and develop climate and Earth system models, will result in a strong and integrating program.

Expected results

The project results will strengthen our understanding the responses of the Earth system in warmer climate, and will improve predictions of climate change risks and possible abrupt changes in the coming centuries.

Past4Future will deliver knowledge that is of particular relevance from a European perspective. The need to predict future climate change strongly influences the prospects of both citizens and policy makers of the European Union. The program will inform the international debate on climate system stability and the dissemination of results will be targeted to both citizens and governmental and non-governmental stakeholders. Past4Future will leave a legacy of improved understanding of past drivers of sea level and sea ice changes as well as of greenhouse gas concentrations.

Project partners	
Københavns Universitet, DK	Max Planck Gesellschaft zur Förderung der Wissenschaften E.V., DE
Unifob AS, NO	Vereniging voor Christelijk Hoger Onderwijs Wetenschappelijk Onderzoek en Patiëntenzorg, NL
Centre National de la Recherche Scientifique, FR	Commissariat à l'Énergie Atomique, FR
Aarhus Universitet, DK	University College London, UK
Universität Bern, CH	Consiglio Nazionale delle Richerche, IT
Agencia Estatal Consejo Superior de Investigaciones Cientifica, ES	Alfred-Wegener-Institut für Polar- und Meeresforschung, DE
Universitat Autònoma de Barcelona, ES	The Chancellor, Master and Scholars of the University of Cambridge, UK
Natural Environment Research Council, UK	PAGES Association, CH
University of Bristol, UK	Université du Québec à Montréal, CA
Université Catholique de Louvain, BE	East China Normal University ECNU, CN
Universität Bremen, DE	University of Ottawa, CA

PESM

At a glance
Title: Towards the Prototype Probabilistic Earth-System Model
Funding scheme: ERC Advanced Grant
ERC funding: 2 137 014 €
Duration: 60 months
Start date: 01/04/2012
Host institution: Oxford University, UK
Principal investigator: T. N. Palmer
Project website: www2.physics.ox.ac.uk/research/predictability-of-weather-and-climate
Key words: Probabilistic climate prediction, Earth-System model, stochastic modelling, approximate computing

The challenge

From a scientific point of view, Earth's climate is an exceptionally complex multi-scale, multi-phase chaotic system. As such, the prediction of future states of climate is inevitably uncertain. One of the key uncertainties in predicting future states of climate lies in the inevitable approximations that must be made to solve the mathematical equations which describe the physics of climate. However, if we are to make predictions of climate which are useful for decision making, it is essential that we are able to quantify the impact of these approximations.

Project objectives

The key objective of the project is to revolutionise the mathematical formulation of comprehensive Earth System models, potentially leading to a step-change improvement in the reliability of our predictions of climate change, both globally and regionally. This programme of research is intended to make climate simulations more consistent both with the multi-scale nature of climate, and with related scaling symmetries of the partial differential equations which govern climate. The aim of the project is to produce the world's first Probabilistic Earth-System Model. The consequences are potentially enormous: a comprehensive climate model with reduced biases against observations, a model which will be capable of producing estimates of uncertainty in its own predictions, and a model which can make use of emerging energy-efficient probabilistic computer processing hardware, key to practical success as we approach the age of the exascale supercomputer. In addition to this, development of the prototype Probabilistic Earth-System Model will initiate a new era of international scientific collaboration on climate model development, and has the potential to influence climate policy, on mitigation, adaptation and geoengineering, at the highest governmental and intergovernmental levels.

Methodology

The project objectives will be achieved through two separate methodological approaches. Firstly we move away from the traditional deterministic approach to the closure problem (sometimes known as the parameterisation problem) in computational fluid mechanics, and towards a more novel description of physical processes below the truncation scale of climate models, using contemporary nonlinear stochastic-dynamic mathematics. Secondly, we explore the use of approximate computing methods to develop highly efficient ultra-high resolution dynamical cores where small scale components and small-scale evolution are not represented with unjustifiable precision

Emerging results

Emerging results are four-fold:

1. We have developed a stochastic parametrisation scheme for the atmosphere which treats individual unresolved processes by separate independent stochastic pattern generators. We have shown that such a scheme leads to improved weather forecast skill and reliability.
2. We have incorporated stochastic representations of unresolved processes in an ocean general circulation model. This includes not only unresolved effects in the equations of motion, but also in the equations of state. Seasonal forecast studies are underway to assess the impact of these representations in short-range climate forecast mode.
3. The realisation that the closure schemes in weather and climate models must necessarily be considered stochastically, implies that the evolution of small-scale features in the dynamical cores of weather and climate models are also substantially influenced by inherent stochasticity. This raises the question as to whether the current generation of dynamical cores, which use double precision arithmetic and bit-reproducible computing, are overengineered and unnecessarily inefficient. We have developed an atmospheric model dynamical core with variable precision real number representations, and integrated it on an emulation of a superefficient stochastic processor, without significant degradation of results. We see this result as providing some support to the notion that it may be possible to develop a computational and energy efficient ultra-high resolution probabilistic earth-system model.
4. A new metric has been developed to assess the skill of probabilistic forecasts. This metric measures the extent to which the spread from an ensemble forecast is well calibrated against the skill of the forecast, over a range of different spread categories. The metric has been shown to be proper and can be decomposed into reliability and resolution components in the usual way.

PHOXY

At a glance
Title: Phosphorus dynamics in low-oxygen marine systems: quantifying the nutrient-climate connection in Earth's past, present and future
Funding schemes: ERC Starting Grant
Duration: 60 months
Total cost: EUR 1 498 000 €
EU contribution: 1 498 000 €
Start date: 01/01/2012
Principal investigator: Caroline P. Slomp
Host institution: Utrecht University, the Netherlands
Project website: www.uu.nl/staff/CPSlomp
Key words: phosphorus, climate, low-oxygen, ocean

The challenge

Phosphorus (P) is a key nutrient for phytoplankton in the ocean. A strong positive feedback exists between marine P availability, primary production and ocean anoxia: increased production leads to ocean anoxia, which, in turn, decreases the burial efficiency of P in sediments and therefore increases the availability of P and production in the ocean. This feedback likely plays an important role in the present-day expansion of low-oxygen waters ("dead zones") in coastal waters worldwide. Moreover, it contributed to global scale anoxia in ancient oceans. Critically, however, the mechanisms for the changes in P burial in anoxic sediments are poorly understood.

Project objectives

The proposed research combines new methods to measure P in sediments with state-of-the art modeling studies for the past and present ocean to unravel and quantify the link between the marine P cycle, ocean oxygenation and climate change. The key objective is to advance our understanding of ocean P dynamics, and contribute to improving the next generation of earth system models used to predict future ocean biogeochemistry and climate. Specific attention is being paid to elucidating how P is transformed in modern low-oxygen settings using novel geochemical analysis techniques. We also are studying sediment records from 4 key greenhouse periods in Earth's past to elucidate the role of P in the ancient ocean.

Methodology

New methods are being developed to determine the burial forms of mineral-P within its spatial context in modern sediments, such as those of the Baltic and Black Seas. The new analysis techniques include nano-scale secondary ion mass spectrometry (nanoSIMS), synchotron-based scanning transmission X-ray microscopy (STXM) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). This knowledge from modern sediments is being used to interpret sediment records of P for periods of rapid and extreme climate change in Earth's history. Using various biogeochemical models the role of variations in the marine P cycle in the development of low-oxygen conditions and climate change is being elucidated and quantified.

Emerging results

Our emerging results are showing that the controls on P burial in anoxic sediments are very different from what was previously thought.

For example, with our novel techniques, we can show that reduced Fe-P minerals play a key role in the burial of P in highly reducing sediments such those of the deep basins of the Baltic Sea and Black Sea. Our results also highlight the key role of enhanced P recycling under anoxic conditions for the occurrence of centennial scale periods of anoxia in the Baltic Sea during the Holocene and the development of anoxia in the North-Atlantic in the Cretaceous, 94 million years ago.

This information is crucial for our ability to predict the consequences of anthropogenically-enhanced inputs of nutrients to the oceans combined with global warming and thus is of major relevance to society.

PHYTOCHANGE

At a glance
Title: New Approaches to Assess the Responses of Phytoplankton to Global Change
Funding instrument: ERC Starting Grant
Contract starting date: 01/06/2008
Total project cost: 1 399 984 €
Duration: 60 months
EC contribution: 1 399 984 €
Coordinating organisation: Alfred-Wegener-Institut fuer Polar- und Meeresforschung Bremerhaven, DE
Coordinator: Catherine Audebert

Abstract

Phytoplankton are responsible for a major part of global primary production due to the immensity of the marine realm and are heavily implicated in global biosphere equilibriums by driving elemental chemistry in surface oceans, exporting massive amounts of C to sediments and influencing ocean-atmosphere gas exchange. Climate change will alter the marine environment within the next 100 years. Increasing atmospheric CO2 has already caused higher aquatic pCO2 levels and lower pH (ocean acidification) and rising temperature will impact ocean stratification, and hence light and nutrient conditions. Phytoplankton will be affected by these Earth system transformations in many ways, altering the complex balance of biogeochemical cycles and climate feedback mechanisms. Prediction of how phytoplankton may respond at the cellular and ecosystem levels is a key challenge in global change research.

The proposed project will investigate physiological reactions of 3 important phytoplankton groups (diatoms, coccolithophores, cyanobacteria) to environmental factors which will be affected by global change (pCO2/pH, light, nutrients). Using an innovative combination of cutting-edge mass-spectrometric and fluorometric techniques, a suite of in vivo assays will be applied in lab and field experiments to develop a process-based understanding of cellular responses. Specific biogeochemical issues will be addressed since diatoms are the main drivers of vertical organic C fluxes, coccolithophores regulate ocean alkalinity through calcification, and N2-fixing cyanobacteria control availability of reactive N. These are relevant in different marine zones, from Southern Ocean to equatorial oligotrophic waters. Data will significantly improve understanding of key processes in phytoplankton and will be exploited in multidisciplinary contexts ranging from molecular to ecological processes and, through cellular and ecosystem models, to predictions of marine biosphere responses to future global change.

Objectives

The overall aim of our research group is to quantify as well as to understand marine phytoplankton responses to the projected changes. Working on different phytoplankton groups and specific oceanic regions complementary issues are addressed. To develop a process-based understanding of observed responses, a combination of mass-spectrometric and fluorimetric techniques is applied.

Our research topics will include:

- Community shifts and productivity changes in the Southern Ocean
- The future of pelagic calcification
- The future of oceanic nitrogen fixation
- Competitive interactions of dinoflagellates under ocean acidification

PLIO-ESS

At a glance
Title: Pliocene Constraints on Earth System Senstivity (Plio-ESS)
Funding scheme: ERC Starting Grant
ERC funding: 1 420 000 €
Duration: 60 months
Start date: 01/12/2011
Host institution: University of Leeds, UK
Principal investigator: Alan M. Haywood
Project website: www.see.leeds.ac.uk/research/essi/palaeoleeds/current-research/plio-ess-pliocene-constraints-on-earth-system-sensitivity/
Key words: Pliocene, climate sensitivity, CO_2

The challenge

The magnitude of long-term global temperature rise due to an increasing concentration of carbon dioxide (CO_2) in the atmosphere is a question of relevance to policy makers and society. Previous studies addressed this issue on the basis of the equilibrium response of the climate system due to fast feedbacks, often referred to as Climate Sensitivity. Plio-ESS uses the new concept of Earth System Sensitivity that additionally includes slow feedbacks such as those derived from changes in ice sheets and vegetation. This has the potential to revolutionise the scientific debate on anthropogenic emissions of greenhouse gases and climate stabilisation targets.

Project objectives

Plio-ESS is calculating Earth System Sensitivity (ESS), including a full quantification of uncertainty in ESS estimates, through the merger of numerical models of climate with past environmental data. To do this successfully using the mid-Pliocene (an interval in Earth's geological history) as a natural laboratory a number of objectives are being achieved:

Objective 1 – Integrate new mid-Pliocene boundary conditions into the latest climate models

Objective 2 – Assess the plausible range of climate through greenhouse gas and ice sheet ensembles

Objective 3 – Quantify how model predictions of climate vary from one model to another

Objective 4 – Understand the impact of potential tipping elements in the climate system on ESS

Objective 5 – Determine the model skill and produce robust estimates of ESS with uncertainties)

Methodology

Plio-ESS is utilising climate models that compose the UK and international contributions to the IPCC Fifth Assessment Report (AR5), as well as a world leading ice sheet models, to deliver a discrete set of work packages:

1. Production of simulations using state-of-the-art high-resolution climate and Earth System models and robust estimates of uncertainties in climate simulations.
2. Multi-model ensemble tests of uncertainties in mid-Pliocene climate.
3. Pliocene tipping elements and climate variability. Five relevant tipping elements are being explored in this work package (ice sheets, sea-ice, ENSO behaviour, monsoons and thermohaline circulation)
4. Earth System Sensitivity. The estimation of ESS which will be achieved using the simulations from WP1, 2 and 3. Each calculation of ESS involves a climate model simulation of the mid-Pliocene so each estimate of ESS will have an associated mid-Pliocene climatology. These simulations of mid-Pliocene climate are being assessed relative to reconstructions of Pliocene climate.

Emerging results

An ensemble of model results indicates that Earth System Sensitivity is greater than Climate Sensitivity by a factor of 1.1 to 2 with a best estimate of 1.5

In the context of Pliocene climate the Amazon rainforest appears to be particularly sensitive and grows and decays rapidly.

In the context of Pliocene climate the North Atlantic appears to be particularly sensitive with models predicting sizable temperature variations over thousands of years.

Models predict a diversity of responses for the behaviour of the thermohaline circulation during the Pliocene but the majority indicate that its strength weakened relative to present-day.

The Asian monsoon was apparently enhanced during the mid-Pliocene – a result supported by geological data as well as climate model outputs.

SIOS-PP

At a glance
Title: Svalbard Integrated Earth Observing System - Preparatory Phase
Instrument: Construction of New Research Infrastructures - Preparatory Phase
Total cost: 6 675 481 €
EC contribution: 3 999 965 €
Duration: 48 months
Start date: 01/10/2010
Consortium: 26 partners from 14 countries, plus 23 associated partners from additional 5 countries
Project coordinator: Jon Børre Ørbæk
Project website: www.sios-svalbard.org
Key words: Arctic, Research Infrastructure, Earth System Science, Climate Change, Environmental Change, ESFRI Roadmap

The challenge

Global environmental change, and in particular climate change, is one of the most important challenges facing humankind and nature today. The Arctic region may experience the most severe climate change in the entire world, and the region must be prepared for a warming of four to eight degrees (annual average) and a significant increase in precipitation during the twenty-first century. Arctic processes significantly influence the global earth system as well, through important feedback mechanisms.

Svalbard is a region within the Arctic that provides physical barriers for at least some of the entities and processes that are particularly relevant for a system understanding. This makes it possible to formulate studies where one utilizes the boundaries to separate internal transformations within the region and external factors. Svalbard is consequently an important arena for the investigation and observation of environmental and climate change in the Arctic.

Project objectives

SIOS shall be a regional observational system for long term acquisition and proliferation of fundamental knowledge on global environmental change within an Earth System Science (ESS) perspective in and around Svalbard. SIOS aims to be the world's leading large-scale research infrastructure in the Arctic, and will provide state-of-the-art research services and observations to the international polar research community.

SIOS will:

- Improve collaboration and formalise scientific and observational integration between the extensive existing research infrastructures already in place in Svalbard.
- Provide a regional, world class, integrated observing system for long-term acquisition of fundamental data about global environmental change in an Earth System Science perspective.
- Provide better coordinated services for the international research community with respect to access to infrastructure, data and knowledge, sharing of data, logistics, training and education.
- Establish close coordination with other ESFRI projects with Arctic nodes, regional research networks in the European Arctic and contribute to the realisation of a pan-Arctic Observing Network (SAON), as endorsed by the Arctic Council.

Methodology

SIOS will establish a joint operational centre (Knowledge Centre) in Svalbard for the management, coordination and provision of world class research infrastructure. The SIOS Knowledge Centre will establish and manage shared resources and joint activities.

Research services:

The SIOS Knowledge Centre will set up new core services for the international polar research community. The centre's activities will lead to:

- coordinated open access to research facilities and observations
- better sharing of data
- efficient logistics based on shared resources
- scientific and observational integration
- knowledge management involving training programmes, education and meeting places

Observing system:

SIOS will enhance the development of the research infrastructure in an Earth System Science perspective. The centre's activities will lead to:

- elaboration and management of a joint research infrastructure development plan
- development of new methods for how observational networks are to be designed and implemented.
- enhanced use of remote and small foot-print methods of Earth observations.

Expected results

The fact that Svalbard is hosting a unique set of international research stations in all fields of natural science, contributes to better understand the multitude of environmental arctic change. The integration and structuring of coordinated observations with clear scientific goals, is the means of SIOS to achieve an understanding of the coupled and underlying processes in global change. SIOS thus supply added value to all the investors beyond what their own investments would provide in solitude, and the enhancements of the research infrastructure shall be made to achieve this.

SIOS will set an example for how to systematically construct observational networks in the Arctic. The joint services offered by SIOS will generate added value for all partners and benefit the international polar research community as a whole. SIOS will establish an experimental environment where it will be attractive to perform shorter term basic and applied research against the combined backdrop of both the core measurement program and the services provided by the Knowledge Center. The nature of such basic and applied research will not be restricted by SIOS but can potentially inform subsequent evolution of SIOS monitoring activities.

SIOS thus contributes to further develop the research infrastructure in and around Svalbard into the leading polar research infrastructure in the Arctic.

Project partners	
Research Council of Norway, NO	French Polar Research Institute, FR
Norwegian Polar Institute, NO	Korea Polar Research Institute, KR
University Centre in Svalbard, NO	Polar Geophys. Inst.–Russian Acad. of Sc., RU
Alfred Wegener Institute, DE	Institute of Oceanology–Polish Acad. of Sciences, PL
Institute of Geophysics–Polish Academy of Sciences, PL	Stockholm University, SE
National Research Council of Italy, IT	University of Bergen, NO
Natural Environment Research Council, UK	University of Tromsoe, NO
Arctic and Antarctic Res. Inst. of Roshydromet, RU	Norwegian Meteorological Institute, NO
Norwegian Space Centre, NO	Nansen Env. and Remote Sens. Center, NO
Aarhus University–National Environm. Res. Institute, DK	Institute of Marine Research, NO
Finnish Meteorological Institute, FI	Norwegian Institute for Air Research, NO
University of Groningen, NL	Andoya Rocket Range, NO
Polar Research Institute of China, CN	National Institute for Polar Research, JP

THOR

At a glance
Title: Thermohaline overturning - at risk?
Instrument: Large-scale integrating project
Total cost: 12 948 295 €
EC contribution: 9 274 427 €
Duration: 48 months
Start date: 01/12/2008
Project coordinator: Universitaet Hamburg, DE
Project website:
Key words: ThermoHaline Circulationn ocean, atmosphere, cryosphere

The challenge

Europe's climate is strongly influenced by the North Atlantic thermohaline ocean circulation (THC). Its variations in strength potentially drive non-linear and abrupt climate changes. Observational and model underpinning of these hypotheses is sketchy, making it difficult to draw firm conclusions. A major challenge in climate research therefore is a reliable quantification of the variability and stability of the THC and its atmospheric consequences for todays and a possibly warmer climate. Significant need for medium term regional climate forecasts arises to assess likelihood and detection of rapid climate change to be able to assist planning in public and private sectors.

Project objectives

THOR will establish an operational system that monitors and forecasts development of the North Atlantic THC on decadal time scales and assess its stability and risk of a breakdown in a changing climate. Together with pre-existing data sets, ongoing observations within the project will -for the first time–allow precise quantitative monitoring of the THC and its sources.

By identifying key processes manifested in paleo observations, THOR' models will be able to provide early identification of any systematic changes occurring.

The combined effect of various global warming scenarios and melting of the Greenland ice sheet will be thoroughly assessed in a coupled climate model. Through these studies and the assimilation of systematic observations at key locations into ocean models, THOR will be able to forecast the development of the Atlantic THC with emphasis on the European/North Atlantic region and its variability until 2025.

Methodology

THOR will implement a unique coupling between observations and models by:

- Assessing the climate implications induced by changes in the THC and the probability of extreme events
- Defining and operating an optimal ocean observing system for the Atlantic component of the THC
- Forecasting the Atlantic THC and its variability until 2025.

The basic tools for achieving these goals are moored, ship- and space-born instrumentation to collect the necessary field data, specific targeted palaeoclimate data and a suite of numerical simulation models: ocean only models with and without data assimilation and coupled atmosphere-ocean general circulation models. All tools, instruments and models, are state-of-the-art and will during the course of the project undergo further development. The work in THOR is organized under 5 Core Themes, that each includes modelling and observational approaches. All core themes are intimately linked to each other and build a tightly woven network, receiving and providing information from and to each of its elements.

Expected results

- Quantifying THC variability on time scales up to centennial and identification of the key processes and feed-back mechanisms responsible for this variability
- Quantifying ocean state uncertainties derived from combined model and data analysis
- Quantifying Atlantic THC flux variability on time scales up to decadal, providing benchmarks for model tests
- Quantifying the strength of the Nordic sources to the deep limb of the THC
- Quantifying the skill of coupled forecast models on decadal time scales
- Forecasting the THC variability on decadal time scales
- Near real time data transfer from deep sea moorings
- Assimilation techniques for coupled ocean-atmosphere general circulation models

Parties outside the consortium that will benefit from the dissemination of the results of THOR, and that will be able to exploit them, fall into a number of categories: other scientists, instrument manufacturers, meteorological organizations, policy makers, end users in general, and the general public.

Project Partners	
University of Hamburg	DE
Max-Planck Gesellschaft	DE
British Meteorological Office	UK
Université Pierre et Marie Curie	FR
University of Bergen	NO
The University of Reading	UK
European Centre for Medium-Range Weather Forecasts	UK
Leibniz-Institute of Marine Science at the University of Kiel	DE
Royal Netherlands Meteorological Institute	NL
Danish Meteorological Institute	DK
Fiskirannsóknarstovan	FO
Finnish Marine Institute	FI
Marine Research Institute	IS
Royal Netherlands Institute for Sea Research	NL
The Centre for Environment, Fisheries and Aquaculture Science	UK
Scottish Association for Marine Science	UK
Natural Environment Research Council	UK
Nansen Environmental and Remote Sensing Centre	NO
Centre National de la Recherche Scientifique	FR
Commissariat a l'Energie Atomique	FR

TITAN

At a glance
Title: Transition Into the Anthropocene
Funding scheme: ERC Advanced Grant
ERC funding: 2 445 546 €
Duration: 5 years
Start date: 02/2013
Host institution: University of Edinburgh, UK
Principal investigator: Gabriele Hegerl
Project website: www.geos.ed.ac.uk/homes/ghegerl
Key words: Climate change, climate variability, observed records

The challenge

Understanding of climate change largely draws on records of the past 60 years. However, now available longer records can provide better understanding of decadal climate variability, causes of climate extremes, and the transient sensitivity of climate

Project objectives

- We hope to estimate the transient climate sensitivity and the interdecadal climate variability based on the long-term record.
- We want to determine what caused the warm anomalies, particularly, the temperature extremes observed over the early 20th century warm period, and if early greenhouse gas increases or black carbon contributed to them.
- We want to determine the sensitivity of sea ice to warming prior to 1950, and the precipitation sensitivity to temperature.

Methodology

We use analysis of observed record across climate variables in conjunction with climate modelling, both with high resolution models and with a large ensemble of courser resolution models selected to match the observed record.

Emerging results

We are just starting, and are setting up simulations with high resolution models of the climate of the early 20th century. Analysis of observed records suggest that composite analysis of warm events is appropriate.

2
The carbon and nitrogen cycles and greenhouse gas emissions

AFRICA GHG

At a glance
Title: The role of African tropical forests on the Greenhouse Gases balance of the atmosphere
Funding scheme: ERC Advanced Grants
ERC funding: 2 406 950 €
Duration: 48 months
Start date: 01/04/2010
Host institution: CMCC
Principal investigtor: Riccardo Valentini
Project website: www.cmcc.it/research/research-projects/africa-ghg"projects/africa-ghg
Key words: Tropical rainforests, Carbon Cycle, Nitrous Oxide, Methane, Net primary productivity

The challenge

The role of the African continent in the global carbon cycle, and therefore in climate change, is increasingly recognized. Despite the increasingly acknowledged importance of Africa in the global carbon cycle and its high vulnerability to climate change there is still a lack of studies on the carbon cycle in representative African ecosystems (in particular tropical forests), and on the effects of climate on ecosystem-atmosphere exchange. The project main focus is to understand and quantify the role of African tropical rainforest and its coupling with human activities on the carbon cycle and greenhouse gases balance of atmosphere.

Project objectives

Understand the role of of African tropical rainforest on the GHG balance of the atmosphere and revise their role on the global methane and N2O emissions. Determine the carbon source/sink strength of African tropical rainforest in the pre-industrial versus the 20th century by temporal reconstruction of biomass growth with biogeochemical markers. Understand and quantify carbon and GHG fluxes variability across African tropical forests (west –east equatorial belt). Analyse the impact of forest degradation and deforestation on carbon and other GHG emissions

Methodology

Carbon, water, energy, methane and N2O emissions are continuously monitored in the first flux tower of this kind in Africa in order to understand the overall greenhouse gas budget of a tropical rainforest in Ghana. A new soil organic carbon fractionation methodology, the “High Gradient Magnetic Separation” implemented and validated for tropical soils is used across a transect from sierra Leone to Congo DRC to evaluate by radiocarbon measurements the importance of soil carbon in determining the carbon sink/source strengths of tropical forests. A database of allometric equations for estimating African tropical tree biomass with a web based interface for open access and use has been used in conjunction with LIDAR airborne campaigns to improve biomass estimation.

Emerging results

(Explain) Our project established for the first time a tropical rainforest flux tower in Africa (Ghana Ankasa National Park). We are estimating an annual carbon sink from -5 to -8 tC ha y-1 with inter and intra-annual variations due to climate. The annual N2O flux estimated from ongoing measurement at Ankasa National park (2.33 ± 0.20 Kg N-N2O ha-1 yr-1) show the importance of such ecosystems on the global natural background of N2O budget. As novel results we explored the potential of enhanced N2O emissions from deforestation, usually not considered in the discussion of the role of tropical land use changes in climate policy. We found that in deforested areas, the N released from mineralization of dead material, uncoupled with N uptake by forest vegetation, dramatically increases N2O emissions in the first years following forest clearing. A reanalysis of 38 case studies of chronosequences of land use change in tropics as provided an empirical relationship between N2O fluxes vs. years since land conversion.

Data indicate that during the first years after deforestation the average incremental emissions are in the order of more than twice the flux measured in the control sites, although values for specific studies indicate an incremental increase up to 15 times the control flux during the first year after conversion.

On average about 17 years are necessary to bring back the annual N2O emissions to the level of undisturbed sites. Methane show slight positive emission at ecosystem level, which is mostly due to below canopy processes, as confirmed by eddy covariance fluxes and soil chambers and the relative contribution of upland (methane sinks) and lowland (methane sources) areas. These results show the importance of integrating ecosystem/basin level fluxes in contrast to single point soil measurements, as they are generally used to classify tropical forest as methane sinks. LIDAR campaigns have been carried out in Sierra Leone, Ghana and Congo. Our study suggests that there is a persistent effect of selective logging on biodiversity and carbon stock losses in the long term (up to 30 years since logging) and after repeated logging. These effects, in terms of species richness and biomass, are greater than the expected losses from commercial harvesting, implying that selective logging in West and Central Africa is impairing long term (at least until 30 years) ecosystem structure and services.

AFRIVAL

At a glance
Title: African river basins: catchment-scale carbon fluxes and transformations
Funding scheme: ERC Starting Grant
ERC funding: 1 745 000 €
Duration: 60 months
Start date: 01/09/2009
Host institution: KU Leuven, BE
Principal investigator: Steven Bouillon (KUL), Alberto V. Borges (ULG)
Project website: ees.kuleuven.be/project/afrival
Key words: Tropical rivers, carbon, nutrients, biogeochemistry, greenhouse gas emissions, land-ocean fluxes.

The challenge

The vast majority of freshwater systems appear to be a net source of CO_2 to the atmosphere, which globally could be equivalent to approximately half the magnitude of the oceanic CO_2 sink. Recognition of terrestrial-aquatic linkages is fundamental in understanding ecosystem carbon budgets and balancing approaches, and to better constrain the impact of land use related changes in the carbon cycle. Data on the biogeochemical fluxes and functioning of tropical aquatic ecosystems remain scarce, despite the fact that they are thought to be disproportionately important in terms of, for example, riverine carbon transport.

Project objectives

AFRIVAL wishes to improve our fundamental understanding of how river catchments function from a biogeochemical point of view and how important they are in regional and global C budgets. Questions addressed include:

(i) What is the impact of catchment land-use and vegetation patterns on the inputs, origin and biogeochemical processing of organic matter in aquatic systems?

(ii) To which extent are the pool sizes, origin and age modified by biogeochemical processing during their transit from the terrestrial biome towards the coastal zone ?

(iii) How much of the lateral (terrestrial) C inputs in river networks is mineralized and outgassed as CO_2 before it reaches the coastal zone? What is the metabolic balance and CO_2 source/sink strength of tropical rivers, and its relationship to lateral inputs from the terrestrial biome? Which particular sites (headwaters, reservoirs, lowland rivers) are the primary hotspots for CO_2 evasion?

Methodology

Acquisition of new data is a key first step, for which extensive fieldwork is carried out in different African river basins. A key strategy is to study element concentrations and cycling along the river continuum from headwater streams, reservoirs and lower river courses down to the river outlet. To quantify fluxes and cover seasonality, a range of sites are being sampled at high temporal frequency, in collaboration with local scientists. We employ a combination of field measurements and state-of-the art analyses on samples collected, including a quantification of different C pools as well as their stable isotope and radiocarbon composition, nutrient concentrations, concentrations and water-atmosphere fluxes of dissolved greenhouse gases (CO_2, CH_4, N_2O), and measurements of aquatic metabolism (respiration, primary production). Work is conducted on a range of contrasting river basins (Congo, Zambezi, Tana, Sabaki, Niger, Ogooué, Betsiboka, Rianila, ...).

Emerging results

While AFRIVAL builds on longer-term and on-going data collection, preliminary data highlight some novel insights on the biogeochemical functioning of tropical rivers.

For example, our data across different systems suggest that CO_2 emissions from tropical rivers have been largely overestimated in the literature, mainly dealing with South American rivers.

Most rivers are only modest sources of N_2O to the atmosphere, with the exception of highly eutrophied systems such as the Sabaki, where local inputs of sewage-derived nutrients lead to high N_2O production. Our data confirm the important role of river networks in terms of processing of carbon and regulating the delivery of materials to the ocean, rather than being mere transport conduits. Reservoirs and floodplains, for example, can retain large quantities of sediment, C and nutrients. Since tropical river systems are under increasing anthropogenic stress through climate change, nutrient inputs, land-use change and flow regulation, our data will form an important basis to evaluate the effects of such disturbances to river functioning and nutrient delivery to the coastal zone.

AMOPROX

At a glance
Title: Quantifying Aerobic Methane Oxidation in the Ocean: Calibration and palaeo application of a novel proxy
Funding scheme: ERC Starting Grant
ERC funding: 1 498 992 €
Duration: 60 months
Start date: 01/11/2010
Host institution: Newcastle University, UK
Principal investigator: Helen Talbot
Project website: www.ncl.ac.uk/ceg/research/geoscience/biogeochemistry/amoprox/
Key words: Aerobic methane oxidation, methanotrophs, biomarkers, hopanoids, aminopentol, palaeoclimate

The challenge

Methane is a key atmospheric greenhouse gas with a wide range of natural and anthropogenic sources. With climate change, any mechanism which can potentially ameliorate the effects of greenhouse gas-produced radiative forcing is of significant interest. In marine systems, methane generated in sediments can be prevented from escaping to the atmosphere via two natural biological processes, anaerobic and aerobic methane oxidation (AMO). Research on the marine methane cycle has focused on anaerobic processes but recent biomarker data has provided compelling evidence that aerobic methane oxidation (AMO) may play a much more significant role in reducing the amount of methane emitted from sediments than previously considered. AMO in these settings is poorly understood and a more complete understanding of present and past methane fluxes requires novel proxies that can be applied to present day samples and linked to the sedimentary record.

Project objectives

The key questions at the centre of this research proposal are: (1) How quantitatively significant is marine AMO as a marine methane sink (both past and present)? (2) How will AMO be affected by and/or influence global climate change? In order to begin to investigate these wider objectives we proposed to calibrate novel proxies based on characteristic chemical compounds produced by the relevant organisms and preserved in sediments, which will allow us to identify the target process in the sedimentary record and crucially, for the first time attempt to quantify the extent of palaeo AMO activity. Specific objectives include: (a) Develop and ground truth proposed novel AMO proxies via laboratory studies of their biological sources and environmental drivers; (b) Calibration of proxy with measured methane concentrations and fluxes in modern systems; (c) Application to palaeo record - test the limits (age and depth) within which the proxy may be applied.

Methodology

We are targeting complex lipids called aminobacteriohopanepolyols (aminoBHPs) biosynthesised specifically by aerobic methane oxidising bacteria and subsequently preserved in the geological record. Controls on the regulation and expression of BHPs are under investigation using combined geochemical and microbiological methods. A sediment microcosms approach allows microbial community information and BHP signatures to be calibrated against controlled variables including temperature, pH, salinity, methane concentrations and also methane oxidation rate. DNA is extracted from sediment slurries and analysed for the particulate methane monoxygenase gene, a functional gene which produces the enzyme responsible for the oxidation of methane specific to methanotrophs. BHP compositions are elucidated in all samples using lipid extraction techniques and developing liquid chromatography-mass spectrometry methodology with state-of-the-art equipment purchased for the project. Calibrated signatures will then be tested in modern environmental settings known to have highly active methane cycles and finally applied to the investigation of the geological record.

Emerging results

Methanotrophic populations in estuary sediment microcosm studies show no changes in species composition at a wide range of methane concentrations, however, methane oxidation rates do increase significantly. Striking changes in dominant species composition were observed at different temperatures, pH and salinity levels demonstrating remarkable adaptability of the indigenous methanotroph population in response to environmental change. Analytical method development is ongoing but first indications show significant increases in AMO biomarkers at low pH supporting the premise that BHP signatures in Ancient sediments can provide a window on past methane cycling. Clear increases in AMO biomarker signatures are observed in sediments spanning interglacial (warm) periods relative to intervening glacial (cold) periods in sediments from the Congo deep-sea fan. This strongly suggests intensification of the methane cycle under warmer climate conditions, however, the source of the biomarkers in this setting (marine or continental), and hence the methane, is still under investigation.

CARBFIX

At a glance

Title: Creating the technology for safe, long-term carbon storage in the subsurface

Instrument: Collaborative project

Total cost: 2 257 008 €

EC contribution: 1 570 831 €

Duration: 36 months

Start date: 01/10/2011

Consortium: 6 partners from 5 countries

Project coordinator: Edda S.P. Aradottir

Project website: www.carbfix.com

Key words: Carbon capture and sequestration, carbon mineral sequestration in basalts, long-term carbon storage, carbon solubility storage

The challenge

The safe, long-term storage of anthropogenic carbon in subsurface formations has been widely advocated to reduce atmospheric CO2 levels. Once injected into subsurface formations, carbon storage proceeds through a sequence of four trapping mechanisms: structural/stratigraphic trapping, residual trapping, solubility trapping, and mineral trapping.

The dissolution of CO2 into water during its injection into the subsurface increases greatly the security of geologic carbon storage by avoiding the need to rely on structural/sedimentary trapping mechanisms. Long-term storage security can furthermore be enhanced by injecting dissolved CO2 into formations rich in divalent metal cations to facilitate carbonate mineral precipitation.

Project objectives

CarbFix is a combined industrial/academic research project which aims at developing and optimizing industrial methods for sequestering CO_2 in basaltic rocks through in situ mineral carbonation. The CarbFix consortium is furthermore developing and optimizing practical and cost-effective technology for alleviating the risk of leakage from the subsurface by dissolving CO2 into formations fluids and well water during injection.

The goals of CarbFix are:

1. To increase measurably our understanding of the long-term fate of CO2 injected into the subsurface.
2. To develop new technology to facilitate safe and permanent geologic carbon storage and sequestration.
3. To publicise the results of the research carried out within CarbFix allowing them to be applied internationally.
4. To generate the human capital and expertise to apply the advances made in CarbFix in the future.

Methodology

A combined research program consisting of a field scale injection of CO_2 charged waters into basaltic rocks, laboratory based experiments, study of natural analogues, and state of the art geochemical modelling is being carried out within CarbFix.

Unique to CarbFix is its connection to Hellisheidi geothermal power plant, allowing for capture of otherwise emitted CO2 in a pilot gas separation station. Captured CO2 is transported in pipelines towards the CarbFix injection site where the CO2 is dissolved in groundwater from the target reservoir during injection. The injection is monitored intensively in nearby wells, as well as with surface and atmospheric measurements, in order to assess to how efficiently injected CO2 mineralizes.

Monitoring results and results from laboratory experiments provide input for extensive geochemical modelling, allowing for critical validation of widely used geochemical and hydrological modelling tools. Model validation will furthermore be greatly aided by direct observation of reservoir rocks via drilling following CO2 injection.

Expected results

The results of this project are anticipated to contribute towards the understanding of the long term fate of CO2 when co-injected with water into the subsurface. The injection method developed and tested by this project minimizes pressure build-up in reservoirs as water used for co-injection is sourced from the reservoir itself. The method under development has the following potential main benefits which will be studied further through the duration of the project:

1. Solubility trapping is achieved within few minutes of injection hence minimizing the risk of buoyant CO2 floating to the surface.
2. During injection of supercritical CO2, brines are often pumped from reservoirs to prevent pressure build-up. The disposal of these brines elsewhere may be of environmental concern whereas the CarbFix method re-injects these brines to the subsurface.
3. Mineral trapping may be achieved within few months to years of injection.

Due to increased storage security, the method may be used as a demonstration to promote carbon storage as a safe method of reducing CO2 concentrations in the atmosphere.

Project partners
Reykjavik Energy, IS
CNRS, Université Paul Sabatier, FR
University of Iceland, IS
University of Copenhagen, DK
Amphos 21, ES
Columbia University, US

CARBOCHANGE

At a glance
Title: Changes in carbon uptake and emissions by oceans in a changing climate
Instrument: Large-scale integrating project
Total cost: 9 556 960 €
EC contribution: 6 989 906 €
Duration: 48 months
Start date: 01/03/2011
Consortium: 28 partners from 15 countries
Project coordinator: University of Bergen, NO
Project website: www.carbochange.eu
Key words: Climate, Environment

The challenge

Excess carbon dioxide in the atmosphere from human activities such as fossil fuel burning, land use change, and cement manufacturing is the main driver of anthropogenic climate change. CARBOCHANGE is devoted to the oceanic uptake of human produced carbon dioxide which amounts currently to about 25% of annual emissions. The varying ocean carbon sink is a small net flux on a large marine carbon background and thus difficult to determine accurately.

Project objectives

CARBOCHANGE provides the best possible process-based quantification of net ocean carbon uptake under changing climate conditions using past and present ocean carbon cycle changes for a better prediction of future ocean carbon uptake. The consortium improves the quantitative understanding of key biogeochemical and physical processes through a combination of observations and models. New process understanding is upscaled to large-scale integrative feedbacks of the ocean carbon cycle to climate change and rising carbon dioxide concentrations. The vulnerability of the ocean carbon sources and sinks are quantified in a probabilistic sense.

Methodology

The most actual observations of the changing ocean carbon sink are systematically integrated with the newest ocean carbon models, a coupled land-ocean model, an Earth system model of intermediate complexity, and fully fledged Earth system models through a spectrum of data assimilation methods as well as advanced performance assessment tools. The project contributes to international observational data syntheses on ocean carbon and puts these data collections to use for systematic model evaluation employing skill score metrics.

Expected results

Results will be optimal process descriptions and most realistic error margins for future ocean carbon uptake quantifications with models under the presently available observational evidence. The project will deliver calibrated future evolutions of ocean pH and carbonate saturation as required by the research community on ocean acidification.

The time history of atmosphere-ocean carbon fluxes past, present and future are synthesised globally as well as regionally. Observations and model results will merge into GEOSS/GEO through links with the European Research Infrastructure ICOS. The project is a key contributor to annual worldwide carbon budget updates. The results will be communicated to policy makers.

Project partners	
University of Bergen (coordinator)	NO
VitusLab Copenhagen, Denmark	DK
IFREMER	FR
CEA/LSCE	FR
Université Pierre et Marie Curie, Paris	FR
CLIMMOD	FR
Alfred Wegener Institute	DE
GEOMAR, Kiel	DE
Max-Planck-Society, Institute for Meteorology	DE
University of Bremen	DE
Hafrannsóknastofnunin - Marine Res. Inst. and Univ.	IS
National University of Ireland, Galway	IE
Institut National de Recherche Halieutique	MA
Netherlands Institute for Sea Research	NL
Nansen Environmental and Remote Sensing Center	NO
Uni Klima, UniResearch AS	NO
CSIC	ES
University of Las Palmas de Gran Canaria, QUIMA group	ES
University of Gothenburg	SE
Eidgenössische Technische Hochschule, Zürich	CH
University of Bern	CH
The Met Office, Hadley Centre for Climate Prediction and Research	UK
National Oceanography Centre Southampton	UK
Plymouth Marine Laboratory	UK
University of Bristol	UK
University of East Anglia	UK
Council for Scientific and Industrial Research	ZA
Princeton University	US
Dalhousie University, Halifax	CA

CARBO-EXTREME

At a glance

Title: The terrestrial Carbon cycle under Climate Variability and Extremes – a Pan-European Synthesis

Instrument: Collaborative project

Total cost: 4 677 523 €

EC contribution: 3 312 754 €

Duration: 48 months

Start date: 01/06/2009

Consortium: 25 partners from 12 countries

Project coordinator: Markus Reichstein, Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., DE

Project website: www.carbo-extreme.eu

Key words: climate change, extreme events, climate variability, terrestrial carbon cycle, carbon sink, carbon pools and fluxes, ecosystem manipulation experiments, long-term observations, process studies, carbon cycle modelling, model-data integration, model scenarios, carbon vulnerability analysis, policy interaction, drought, heat wave, heavy precipitation, forest ecosystems, agriculture, grasslands, soil process studies, tree-ring analysis, tree mortality, primary production, respiration, climate model, eddy covariance measurements, flux measurements, remote sensing, database, spatio-temporal patterns, uncertainty analysis.

The challenge

The future fate of European terrestrial biosphere´s acting as a net carbon sink is highly uncertain (depending on climate and land-use); so far only gradual climate and land-use change (e.g. slow warming) has been seriously considered in predictive carbon cycle studies; Climate variability and extremes will play an important role, but have not been sufficiently accounted for in modelling and experimental studies leading to a critical knowledge gap.

Project objectives

The overall objective is to obtain a better and more predictive understanding of European terrestrial carbon cycle responses to climate variability and extreme weather events. In particular the aim is to identify the most sensitive and vulnerable carbon pools and processes under different scenarios and to map the most likely trajectory of carbon pools in Europe over the 21st century, including uncertainties.

By building a consistent harmonized multi-source database on the European carbon cycle components for studying climate variability and extreme events and, performing a Bayesian model calibration and comparison, we aim to improve terrestrial carbon cycle predictions and their uncertainties in scenario analyses, giving advice to the European Commission and other stakeholders.

Methodology

We use an integrative approach with a strong model-data integration framework combining an observation component (soil process studies, network of ecosystem manipulation experiments, long-term observation data sets), a modelling component (model development, model-data integration, model experiments and scenario analysis) and an assessment component (carbon vulnera-

bility analysis, dissemination and policy interaction), synthesize and harmonise new experimental data, compile and adapt latest regional climate scenarios.
A harmonized European multi-scale data base of carbon cycle related observations is build.

Key results

Climate extremes strongly influence terrestrial ecosystems and their carbon cycle. Multiple evidence indicates that water-cycle extremes, in particular droughts, are a dominant threat to carbon cycle related ecosystem services. All land use types in Europe are vulnerable to climate extremes to some degree. Taken together, with both their large carbon stocks and long generation time, forests are expected to experience the largest, most diverse, and longest lasting consequences for carbon cycling from climate extremes compared to other land-cover types.

Project partners	
Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.	DE
Commissariat Energie Atomique	FR
Consiglio Nazionale delle Ricerche	IT
Eidgenössische Technische Hochschule Zürich	CH
Institut National de la Recherche Agronomique	FR
Potsdam-Institut für Klimafolgenforschung e.V.	DE
Universiteit Antwerpen	BE
The University Court of the University of Aberdeen	UK
Universitá degli Studi della Tuscia	IT
Centre National de la Recherche Scientifique	FR
Cranfield University	UK
Danmarks Tekniske Universitet	DK
Institutul de Cercetari si Amenajari Silvice	RO
Internationales Institut für Angewandte Systemanalyse	AT
Met Office	UK
Natural Environment Research Council	UK
Sveriges Lantbruksuniversitet	SE
Universität Innsbruck	AT
Vereniging voor christelijk hoger onderwijs wetenschappelijk onderzoek en patientenzorg	NL
Eidgenössische Forschungsanstalt WSL	CH
Gottfried Wilhelm Leibniz Universität Hannover	DE
Lunds Universitet	SE
Fundacion Centro de Estudios Ambientales del Mediterraneo	ES
Universite Paris-Sud XI	FR
Universidad de Alcalá	ES

CARBONSINK

At a glance
Title: Life Beneath the Ocean Floor: The subsurface Sink of carbon in the Marine Environment
Funding scheme: ERC Starting Grant
ERC funding: 1 945 696 €
Duration: 60 Months
Start date: 01/12/2012
Host institution: University of Cambridge
Principal investigator: Alexandra Turchyn
Project website:
Key words: Geomicrobiology, calcium, isotopes, carbon cycle

The challenge

The primary objective of this proposal is to resolve the fate of carbon deposited in marine sediments. The removal of carbon from the surface of the planet is a critical component of the long-term carbon cycle. Beneath much of the ocean floor exists the 'deep biosphere'; populations of bacteria and archaea that consume organic carbon that has fallen to the sea floor, producing an excess of dissolved inorganic carbon, the fate of which is largely unknown. I am working to satisfactorily constrain what impact the deep biosphere has on the surface carbon budget.

Project objectives

I will address my primary objective using a novel approach involving reconstruction of the subsurface calcium fluxes using calcium isotopes. Calcium is the cation used to precipitate carbonate in the marine subsurface (CaCO3). In organic-rich sediments, calcium isotopes remain out of equilibrium with carbonate minerals and instead track in situ carbonate precipitation. This simple but profound observation will allow us to resolve the mass balance of carbon oxidized versus carbonate precipitated in the marine subsurface. This is a timely question because manipulation of inorganic carbon in natural environments is being explored as a mechanism for mitigating global climate change. If we don't know the natural fate of dissolved inorganic carbon, should we inject excess inorganic carbon into the environment?

Methodology

My approach will be five-fold: 1) determine calcium isotope fractionation during in situ carbonate precipitation through batch experiments, 2) measure calcium isotopes in a range of subsurface environments, 3) use a reactive-transport model to determine the calcium, sulfate, and carbon fluxes into and out of the sediment, which, in turn, will determine their consequent impact on global ocean chemistry, 4) use calcium isotopes to understand carbon storage in altered ocean crust. Finally, I will apply this knowledge of the fate of carbon in the modern deep biosphere to understand how these processes were likely different in the Cretaceous, and ascertain how this played into the unique chemistry and climate at that time.

Emerging results

Our first results are pending submission to Nature Geoscience. In this work we explore the importance of the subsurface carbon cycle in the global long-term carbon cycle. We employed the entire Deep Sea Drilling Program, Ocean Drilling Program, and Integrated Ocean Drilling Program (DSDP, ODP, IODP) pore fluid database, in which we found 672 sites that have high quality aqueous calcium concentration profiles, and cover the world's ocean floor.

These profiles are used to calculate the flux of aqueous calcium across the sediment-water interface using Fick's first law. We calculate the global calcium flux into marine sediments at 1x1012 mol/yr, the vast majority of which is attributed to authigenic carbonate precipitation, making authigenic carbonates 10% of the modern global carbonate accumulation. These results indicate that the calcium flux across sediment-water interface is globally imbalanced and its regional heterogeneity is a non-negligible part of the carbon cycle studies.

CO2SOLSTOCK

At a glance
Title: Biobased geological CO2 storage
Instrument: Collaborative project
Total cost: 2 960 797 €
EC contribution: 2 283 345 €
Duration: 36 months
Start date: 01/04/2009
Consortium: 6 partners from 5 countries
Project coordinator: Bryne Ngwenya
Project website: www.co2solstock.eu
Key words: Climate Change, bio-assistance, mitigation strategies, atmosphere-biosphere interactions.

The challenge

Today's pace of CO2 emissions resulting from extraction and use of fossil fuel exceeds nature's ability to return carbon back into the lithosphere by orders of magnitude. Engineering solutions such as Carbon Capture & Storage (CCS) to achieve an accelerated return require considerable investment and possess significant technological challenges. A variety of natural processes, including biomass accumulation; continental weathering, ocean dissolution and biomineralisation potentially offer considerable long-term removal of CO2 from the atmosphere. CO2SolStock explored whether calcium carbonate precipitation by microbes could be developed into an efficient process for fixing CO2 emissions economically.

Project objectives

The project targeted bacterial metabolic pathways enabling significant carbonate precipitation. In particular, "CO2SolStock" specific objectives were:

1. To explore emerging alternative sustainable CO2 sequestration solutions related to microbiological pathways of carbonate precipitation;
2. To map out a scientific evaluation of the various routes spanning the surface to deep subsurface habitats;
3. To develop a tool-kit enabling scientific evaluation and economic feasibility of each pathway;
4. To validate the technology with at least 2 confirmed proof-of-concept tests for bacterial metabolism supporting CO2 sequestration.

Methodology

The project built on the diverse expertise of the partners, Greenloop as the sustainability entrepreneur; TU Delft Biotechnology, world leaders in microbial wastewater treatment; the University of Edinburgh, expert in geological microbial habitat and CCS; Universities of Lausanne and Neuchâtel, advanced in forestry soil processes; and University of Granada, expert in specific bacterial based precipitation in natural saline media. Research was structured along six scientific work packages ranging from joint bibliographical work (WPI), experimental and modelling investigations of different habitats (II,IV,V), and final demonstration of the best systems (WPVI), while building and maintaining a common evaluation toolkit (WP III). These were supported by two transversal work packages related to project management and the implementation of the dissemination plan.

The results

Four pathways underwent the closest scrutiny.

1. **Subterranean pathways** using salt-tolerant (halophilic) bacteria in deep saline aquifers were shown to be potentially complex and energy-intensive but might still prove to be of interest for

sealing of saline aquifers used to sequester supercritical CO_2 in some CCS schemes.

2. Using the same groups of halophilic bacteria, another approach sought to **combine two main sources of industrial by-products: desalination brines** as calcium source & **domestic wastewater** as carbon source. The potential for precipitation of calcium carbonate in terms of bacterial strains was demonstrated in the lab, but the correct wastewater recipe has yet to be worked out and needs further experimentation.
3. **Mineral carbonation of CO_2 in a two-stage anaerobic wastewater treatment system** involving a bacterial acid attack on silicate minerals frees up the necessary calcium needed to precipitate $CaCO_3$ in a second step with bacteria that produce the alkalinity. The process offers added value in the form of enriched biogas but the cost of providing silicate minerals will determine the potential implementation sites with a positive carbon balance for this method, which is **protected by a patent.**
4. An **ecosystem management** approach was developed based on **a triple symbiosis between some special trees, fungi and bacteria**, leading to the precipitation of limestone in acidic soils around and below the tree roots. If implemented through **reforestation projects**, this approach would **sequester** additional **carbon,** and also **correct soil pH** to make it more suitable for agriculture. Already known in dry areas of **West Africa**, the phenomenon was shown during the project to exist in other distant tropical countries (**Bolivia and India**). It is already being exploited in mineral **carbon fixing agro-forestry projects** in Haiti, adding specific benefits to the usual agro-forestry advantages of sustainable agriculture, biodiversity, soil maintenance, and water balance.

Major benefits

Paradigm shifting innovation opportunities were identified. Compared to CCS, CO2SolStock pathways are radically different:

- They could use all the industrial opportunities re-injecting organic carbon as a source of “fixable” CO_2.
- They can fix CO_2 as a stable solid that can be either stored or could potentially be used as a building material in various forms.
- They can fix past emissions, as the organic carbon is from photosynthetic origin.
- In the case of ecosystem-management pathways, they generate multiple beneficial socio-economical side benefits.

Project partners	
Organisation	**Country**
The University of Edinburgh, coordinator	UK
Biomim Greenloop SA	BE
Technische Universiteit Delft	NL
Universidad de Granada	ES
Université de LaUSnne	CH
Université de Neuchâtel	CH

CO2VOLC

At a glance
Title: Quantifying the global volcanic CO2 cycle
Funding scheme: ERC Consolidator Grant
ERC funding: 1 720 000 €
Duration: 60 months
Start date: 01/01/2012
Host institution: Istituto Nazionale di Geofisica e Vulcanologia, IT
Principal investigator: Mike Burton
Project website: co2volc.pi.ingv.it/
Key words: Volcanoes, CO2, magmatic degassing, carbon cycle, subduction

The challenge

Magmatic degassing through volcanic activity is the original source of CO2 in Earth's atmosphere, biosphere and oceans. Volcanic CO2 emissions play a key role in the carbon cycle on Earth and therefore climate. Notwithstanding this, our knowledge of the actual amounts of CO2 released by volcanoes into the atmosphere each year is very poorly constrained, because CO2 fluxes having been measured on only a small fraction of the world's active volcanoes.

Project objectives

There are three broad objectives within this project. The primary goal is to increase our knowledge of volcanic CO2 fluxes and the carbon cycle by performing direct measurements of CO2 fluxes and isotopic compositions on volcanoes. Results from these measurements will be integrated into subduction volatile recycling models.

Methodology

In order to meet the project objectives a series of instrumental initiatives are underway, to develop the tools we will use when performing fieldwork on volcanoes. These include systems for both CO2 flux quantification and isotopic analysis of volcanic gases, using novel laser techniques. The new instruments are designed from scratch to be low power and field-robust.

Emerging results

A full review of all recent measurements of volcanic CO2 fluxes has been published, and construction of prototype instruments is nearing completion.

COCOS

At a glance
Title: Coordination action Carbon Observing System
Instrument: Coordination action
Total cost: 1 876 367 €
EC contribution: 1 747 683 €
Duration: 36 months
Start date: 01/05/2008
Consortium: 11 partners from 6 countries
Project coordinator: VU University Amsterdam, the Netherlands
Project website: www.cocos-carbon.org/
Key words: Carbon, observations, ocean, land, international coordination, GEO, environment, climate change

The challenge

The big challenge is the understanding and managing the global carbon cycle. This can only be met through the development of a coordinated set of international activities – research, observations, and assessment.

Project objectives

1. Assess the status, and update where required, the essential carbon cycle variables of the IGCO list of core variables,
2. Improve the interoperability of a priori data sets that are used in global scale inversion studies through through joint activities between ecosystem and ocean bottom-up observation communities,
3. Perform integrated regional-scale multiple constraint assessments of the land and ocean carbon balance through the use of harmonized data sets,
4. Identify, narrow down uncertainties and decrease differences in emerging global data sets that are aimed at providing constraints on the vulnerability of the global carbon cycle,
5. Contribute to the implementation and improvement of the global observing systems by organizing a large international conference in light of monitoring requirements for GEO,
6. Through executing these objectives, demonstrate and strengthen European leadership in designing and operating systematic long-term carbon observations in critical regions of the globe.

Methodology

The project was firmly rooted in the two large Integrated Projects, CarboEurope and CARBOOCEAN, as well as IMMEC, GEOMON, GEMS funded under the 6-th Framework program. These projects supported most of the European efforts in carbon cycle observations. This proposal aims at linking land ocean and atmosphere by stepping up from the regional programs to the global level through collaboration activities with international projects (GTOS, GCOS, IOC-CP, IGOS, GCP) and with similar projects in other continents/countries (US Carbon Cycle Plan, Japan). We organized small to medium-scale workshops, and through initiation of joint research to develop and harmonize new global data sets of crucial carbon variables (e.g. such as fire emission, soil carbon, CO2 surface ocean partial pressures, ocean carbon inventories). Throughout the project we worked with international partners of the large continental and basin scale carbon programs.

Main results

Scientists have been brought together to pool their expertise, and design and implement common procedures for data collection, quality control and storage. To achieve this objective COCOS organised the series of workshops shown in the table. COCOS also organised a major international conference:

"Carbon in a Changing World".

The COCOS Data Portal provides access to the Carbon Cycle data. On the interpretation, particularly using so called inverse models, COCOS made significant progress. It has also evaluated the usefulness of a series of observations, including total column CO2 retrievals from space and from the surface.

COCOS has collaborated with the Global Carbon Project in a project to create regional-scale resolution maps of the world's carbon budget over both land and ocean. The project is known as RECCAP (REgional Carbon Cycle Assessment and Processes). More than 150 scientists from all over the world are working on RECCAP.

COCOS identified a number of emerging gaps in our knowledge of the carbon cycle, and provided new access for instance to ocean carbon data.

Through collaborating with international scientist we produced the GEO Carbon strategy report that is widely regarded as providing the blueprint for a Global Carbon Observing system, both in situ and from space.

COCOS has put the European Carbon Cycle Community at the forefront of global carbon monitoring science.

Project partners	
VU University Amsterdam	NL
Max Planck Institute for Biogeochemistry	DE
University of Bergen	NO
University of Tuscia	IT
University of Kiel	DE
University of Liege	BE
Laboratoire des Sciences du Climat et l'Environment	FR
Alfred Wegener Institute	DE
University of East Anglia	UK
IOC-UNESCO	UN/FR

DE-CO2

At a glance
Title: Quantifying CO2 emissions from tropical deforestation to 'close' the global carbon budget
Funding scheme: ERC Starting Grant
ERC funding: 1 500 000 €
Duration: 60 months
Start date: 01/11/2011
Host institution: VU University, NL
Principal investigator: Guido van der Werf
Key words: Deforestation, Global Carbon Cycle, CO2

The challenge

The land and oceans take about half of our CO2 emissions out of the atmosphere. The key question is whether they will continue to do so. An indirect approach to assess their CO2 uptake is based on an atmospheric mass balance approach which requires accurate CO2 emission estimates from deforestation. The DE-CO2 project will deliver those estimates in a consistent manner on a global scale

Project objectives

Assess the emissions and trends over the past 50 years in emissions estimates to better understand the global carbon cycle

Methodology

We use satellite data to monitor fires and deforestation and novel so-called proxy data to estimate emissions from fires and deforestation before the satellite era

Emerging results

Over the past decade, deforestation has declined mostly due to lower deforestation rates in Brazil. The total emission strength of deforestation from virgin rain forests is probably lower than often assumed, but neglected sources such as tropical peat degradation and fires in woodlands may add substantially to total emissions.

ECO2

At a glance
Title: Sub-seabed CO2 Storage: Impact on Marine Ecosystems
Instrument: Large-scale integrating project
Total cost: 18 062 600 €
EC contribution: 10 500 000 €
Duration: 48 month
Start date: 01/05/2011
Consortium: 27 partners from 9 countries
Project coordinator: GEOMAR Helmholtz Centre for Ocean Research Kiel, DE
Project website: www.eco2-project.eu
Key words: CCS, Carbon Dioxide, Marine Ecosystems, Leakage, Monitoring, Environmental Risk Assessment, Best Practice Guide

The challenge

At the European and international level Carbon dioxide capture and storage (CCS) is regarded as a key technology for the abatement of CO2 emissions from industrial sources for mitigating the impact of climate change caused by the increase of anthropogenic carbon dioxide in the atmosphere. Despite CO2 having been stored below the seabed in the North Sea and Barents Sea since several years, little is known about the potential short and long-term impacts of CO2 storage on marine ecosystems. In consequence of this lack of knowledge, ECO2 is assessing the likelihood of CO2 leakage from current and potential storage sites and the impact of CO2 leakage on marine ecosystems.

Project objectives

The ECO2 consortium defined the following five key objectives: (1) To investigate the likelihood of leakage from sub-seabed storage sites; (2) To study the potential effects of leakage on benthic organisms and marine ecosystems; (3) To assess the risks of sub-seabed carbon dioxide storage; (4) To develop a comprehensive monitoring strategy using cutting-edge monitoring techniques; (5) To define guidelines for the best environmental practices in implementation and management of sub-seabed storage sites.

Methodology

ECO2 studied the sedimentary cover at active and potential CO2 storage sites to better understand the mechanisms of CO2 migration using novel geophysical baseline studies, monitoring and modelling techniques. It investigated the effect of CO2 through the sediment at storage sites and natural analogues by means of sophisticated monitoring techniques; quantified the fluxes across the seabed and into the water column; and investigated the impact on benthic organisms, through experiments. All ECO2 field data is stored in the project database.

The environmental risks connected with CCS and how these risks may impact on the financial, legal, and political considerations have been elaborated. Trust and context were investigated as two influencing factors regarding public perception. Stakeholders and interested individuals continue to be informed about ECO2, its new findings and the progress of the project via the project webpage, press releases, articles and e.g. lunch briefings at the European Parliament.

Expected results

EU funding through “The Ocean of Tomorrow” facilitated bringing together leading European experts from three key disciplines: (i) ocean acidification, (ii) natural seepage, and (iii) CCS, form research and industry to jointly investigate, in a multidisciplinary way, the impact of sub-seabed CO2 storage on marine ecosystems.

Investigations by the consortium will result in the first comprehensive assessment of environmental risks associated with sub-seabed CO2 storage; a novel and comprehensive monitoring strategy for sub-seabed storage sites able to detect episodic events and prolonged low-flux leakage; and cost estimation for monitoring and potential leakage and mitigation programmes. The final product of the project, the best environmental practice guide of sub-seabed CO2 storage sites, will provide the EC, national policy makers as well as stakeholders on CCS and scientist with the relevant information needed to develop legislative actions, reliable estimates regarding the permanency, costs, safety, and acceptance of potential sub-seabed CO2 storage sites.

Project partners	
GEOMAR Helmholtz Zentrum für Ozeanforschung Kiel	DE
Plymouth Marine Laboratory	UK
Norsk Institutt for Vannforskning	NO
Natural Environment Research Council	UK
Universitetet i Bergen	NO
Max Planck Gesellschaft zur Förderung der Wissenschaften e.V.	DE
Universität Trier	DE
Universitetet i Tromsø	NO
Konsortium Deutsche Meeresforschung e.V.	DE
Alfred-Wegener-Institut für Polar- und Meeresforschung	DE
Institut für Ostseeforschung Warnemünde an der Universität Rostock	DE
Universita Degli Studi di Roma la Sapienza	IT
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale OGS	IT
Universität Stuttgart	DE
Statoil Petroleum AS	NO
Det Norske Veritas AS	NO
University of Southampton	UK
Institut für Weltwirtschaft	DE
The University of Edinburgh	UK
Universiteit Gent	BE
Heriot-Watt University	UK
Goeteborgs Universitet	SE
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek - TNO	NL
Stichting Energieonderzoek Centrum Nederland	NL
Institut Francais de Recherche pour l'Exploitation de la Mer	FR
Uniwersytet Gdanski	PL
GRUPA LOTOS Spolka Akcyjna	PL

EUROCHAR

At a glance
Title: Biochar for Carbon sequestration and large-scale removal of greenhouse gases (GHG) from the atmosphere
Instrument: Collaborative projects
Total cost: 3 600 000 €
EC contribution: 2 500 000 €
Duration: 36 months
Start date: 01/01/2012
Consortium: 8 partners from 4 countries
Project coordinator: Franco Miglietta
Project website: www.eurochar.org
Key words: Carbon sequestration, biochar, emission mitigation

The challenge

In the context of climate change mitigation, technologies for removing the CO2 from the atmosphere are key challenges. The transfer of carbon from the atmosphere into useful carbon deposits is currently one promising option. Transferring biomass to carbon-rich materials with potential mega-scale application is an option to sequester carbon from plant material, taking it out of the short-term carbon cycle and therefore binding CO2 efficiently and even in a useful, productive, way into longer term non-atmospheric carbon pools.

Project objectives

EuroChar investigates carbon sequestration potentials that can be achieved by transforming plant biomass into charcoal (or Biochar) and add that to agricultural soils. Biochar production is demonstrated using thermo-chemical (TC) or hydrothermal carbonization processes (HTC) that can produce energy and store 15 to 20% of the Carbon originally contained in the biomass. Detailed ISO-accredited whole Life Cycle Assessment is carried out according to the International Reference Life Cycle Data System (ILCD) Handbook on LCA.

Methodology

Detailed ISO-accredited whole Life Cycle Assessment of biochar production is carried out according to the International Reference Life Cycle Data System (ILCD) Handbook on LCA, for both TC and HTC production systems to evaluate the net Carbon sequestration capacity associated to Biochar production. Physico-chemical properties of Biochar are analysed in a series of laboratory studies using standardized analytical protocols and a specific phyto-toxicity test is made using molecular approaches involving a model plant. The short versus the long-term stability of Biochar is investigated using recently produced and aged charcoal samples coming from archaeological sites. Specific investigations are made to assess Biochar decomposition using CO2-efflux measurements from C labelled Biochar. Three large-scale field experiments are underway in Italy, France and UK to analyse "realistic scale" application of Biochar. Upscaling is considered by scenario analyses to consider both the potential C-sequestration actually achievable at the european scale and the climate warming balance associated to carbon sequestration and potential changes in the mean surface albedo.

Expected results

The production of Biochar was demonstrated with the two different technologies (HTC, Hydrothermal Carbonization (Participant CS) and TC-Thermochemical Carbonization enabling the treatment of wet and dry crop residues and agricultural wastes, respectively. Industrial processes, including the potential risks associated to environmental pollution have been highlighted. The Life Cycle Assessment (LCA) of biochar/energy production was made and published on a refereed journal (see publication list).

The functional unit, the goal and scope, system boundaries, data collection for the LCI, preliminary GHG calculations (LCIA) was made.

A Biochar data repository on chemical (structural), physical and biological properties of biochar from different feedstock and from different carbonization technologies has been created. Correlations between production technology and Biochar properties, toxicology impacts including genotoxicity have been assessed. Biochar degradation in soil during laboratory incubation experiments at optimum conditions for the microbial biomass has been studied. 13C labelled biochar was produced and used in field experiments. The Long Term Stability of biochar was investigated using charcoal from archaeological forest and grassland sites where charcoal production was accurately dated. A field site network was created in the UK, France and Italy, using non-food, second generation lignocellulosic energy crops and grassland; the stability of Biochar in a field-scale experiment was assessed using novel stable isotope labeling techniques.

Project partners	
Consiglio Nazionale Delle Ricerche	IT
Université Pierre et Marie Curie- Paris	FR
Martin Luther universitaet halle- Wittenberg	DE
University of Southampton	UK
Carbon Solutions Deutschland	DE
Libera Universita di Bolzano	IT
Advanced gasification Technology	IT
Imperial College of Sciencen Technology and Medicine	GB

FORESTPRIME

At a glance
Title: Predicting carbon release from forest soils through priming effects: a new approach to reconcile results across scales.
Funding scheme: ERC Starting Grant
ERC funding: 1 690 000 €
Duration: 60 months
Start date: 01/12/2012
Host institution: The Open University, UK
Principal investigator: Emma J. Sayer
Project website: www.forestprime.com
Key words: tropical forest, temperate woodland, carbon cycling, soil processes, plant-soil interactions, priming effects, scaling

The challenge

Forest ecosystems play a crucial role in the global carbon balance and forest soils represent a significant and relatively stable store of carbon. Global change is likely to alter the way plants and soil microorganisms interact, which will affect belowground carbon sequestration and the stability of stored carbon in the soil. We are currently unable to reliably predict these changes because we lack a clear understanding of the mechanisms involved. This is partly due to the enormous disparities in the scales and methods used to study microbial processes vs. forest productivity. In particular, scaling up laboratory experiments to predict the consequences of altered plant-soil interactions for ecosystem carbon cycling remains a major challenge.

Project objectives

FORESTPRIME aims to investigate how changes in forest growth will affect microbial processes and carbon cycling in the soil. The project compares soil carbon dynamics in different forests and across multiple scales to: i) identify patterns at different sites, ii) determine the mechanisms involved in plant-soil interactions, and iii) predict the consequences of global change for forest soil carbon dynamics. In addition, the project uses a new approach to determine how the measured processes change with experimental scale.

Methodology

Experiments are being established in different temperate and tropical forest stands and at different scales: field plots, mesocosms, and laboratory microcosms. Common experimental treatments will simulate altered plant productivity. Measurements across all sites and scales will be used to determine patterns across different forest types, and to establish scaling relationships for the processes involved (i.e. how they change with the spatial and temporal scale of the experiments). A large suite of measurements, including soil CO2 efflux, microbial activity and soil carbon pools, will deliver a comprehensive, comparative dataset on soil carbon dynamics under global change in different forest ecosystems.

Consultation with modellers will ensure that the data can be used to test and parameterize predictive models of ecosystem carbon cycling.

Emerging results

The project is still in the initial phase of establishment. First results are expected early in the second year.

GEOCARBON

At a glance
Title: Operational Global Carbon Observing System
Instrument: Collaborative project
Total cost: 8 672 736 €
EC contribution: 6 648 529 €
Duration: 36 months
Start date: 01/10/2011
Consortium: 25 partners from 11 countries
Project coordinator: Euro-Mediterranean Center on Climate Change, IT
Project website: www.geocarbon.net
Key words: climate change; carbon cycle; GHG budget; carbon observations; data assimilation; tropical forests; economic analysis.

The challenge

It is time that carbon observations move from science to policy! Systematic, consistent and traceable data, information and tools on carbon sources and sinks, and the related economic scenarios, are needed by decision makers to timely address mitigation and adaptation policies and to respect their commitments of emissions' reduction. In order to provide reliable carbon data, the spatial and temporal resolution of the observations should be increased and their uncertainty reduced. Coordination for a global integration of the current carbon monitoring efforts and their datasets is needed to address this challenge.

Project objectives

GEOCARBON aims at designing a coordinated and integrated Global Carbon Observation and Analysis System, addressing the climate targets of the Group on Earth Observations (GEO) toward building a operational Global Earth Observation System of Systems (GEOSS) for carbon. Specific objectives are: 1- Provide an aggregated set of harmonized global carbon (CO_2 and CH_4) data and information (integrating the land, ocean, atmosphere and anthropogenic component); 2- Develop improved Carbon Cycle Data Assimilation Systems (CCDAS); 3- Provide global annual budgets of CO_2 and CH_4 with reduced uncertainty; 4- Provide improved regional carbon budgets, with a focus on tropics (Amazon and Central Africa); 5- Define the specifications for an operational Global Carbon Observing System; 6- Provide an economic assessment of the value of an enhanced global carbon observing system; 7- Strengthen the effectiveness of the global carbon contribution to the GEO system.

Methodology

Observations from different monitoring networks (in situ, airborne and space based) and modelling analysis are combined to derive the full picture.

This is achieved through the following 8 complementary project's components (CMPs): CMP1 - Collecting, harmonizing and synthesizing global carbon observations; CMP2 - Integrating global carbon observations into improved carbon cycle data assimilation systems; CMP3 - Establishing the requirements for an integrated global carbon observing system and assessing its performance; CMP4 - Developing a tropical carbon cycle observatory for Amazon and Africa; CMP5 - Delivering global and regional carbon budgets annually, including their uncertainty; CMP6 - Improving the analysis of methane sources and sinks over the last decade and preparing for future monitoring; CMP7 - Assessing the economic value of an enhanced global carbon observation system, to estimate costs and emissions savings; CMP8 - Disseminating the project results, linking with GEO and producing policy relevant information.

Expected results

GEOCARBON is conceived to support the implementation of the GEO 2012-2015 Work Plan and the achievements of the GEOSS 2015 Strategic Targets on climate, and it is already contributing to these results. The ultimate expected outcome of the project is the provision of an aggregated and harmonized set of data and information on carbon pools, sources and sinks, ranging from regional to the global scale and with an increased resolution and accuracy, and a reduced uncertainty. This will improve the global understanding of carbon cycle, and its role in the climate change system, both from a scientific and policy perspective, and help scientists and policy makers better define the future targets on greenhouse gases reduction and the actions needed to mitigate and adapt to climate change. Finally, a strategy for a continued and sustained Global Carbon Observing and Analysis System will be delivered.

Project partners	
Euro-Mediterranean Center on Climate Change – CMCC	IT
University of East Anglia – UEA	UK
Swiss Federal Institute of Technology – ETH Zurich	CH
Wageningen University – WU	NL
University of Oxford – UOXF.AC	UK
VU University of Amsterdam – VUA	NL
University of Leeds – UNIVLEEDS	UK
Max Planck Institute for Biogeochemistry – MPG	DE
University of Versailles St Quentin-en-Yvelines – LSCE-UVSQ	FR
Netherlands Institute for Space Research – SRON	NL
Second University of Naples – SUN	IT
University of Edinburgh – UEDIN	UK
Nansen Environmental and Remote Sensing Center – NERSC	NO
University of Tuscia – UNITUS	IT
University of Bergen – UiB	NO
GAMMA Remote Sensing Research and Consulting AG – GAMMA	CH
Cameroon Biodiversity Conservation Society – CBCS	CM
FastOpt	DE
University of Bristol – UNIVBRIS	UK
International Institute for Applied Systems Analysis – IIASA	AT
Nuclear and Energy Research Institute – IPEN	BR
Food and Agriculture Organisation of United Nations – FAO	IT
Free University of Brussels – ULB	BE
French National Center for Scientific Research – CNRS	FR
University of Hamburg – UHAM	DE

GHG-EUROPE

At a glance
Title: Greenhouse gas management in European land use systems
Instrument: Large-scale Integrating Project
Total cost: 8 925 737 €
EC contribution: 6 648 703 €
Duration: 45 months
Start date: 01/01/2010
Consortium: 41 partners from 15 countries
Project coordinator: Johann Heinrich von Thünen-Institut, DE
Project website: www.ghg-europe.eu
Key words: greenhouse gas, land use management, climate change, carbon balance

The challenge

More than 50 % of the European land surface is used for agricultural and forestry production. Land management directly impacts the terrestrial sources and sinks of greenhouse gases (GHGs). In the view of climate change it is crucial to know the amount of GHGs released into the atmosphere by anthropogenic activities. But also natural drivers such as climate variability influence the GHG balance of European ecosystems. The attribution of GHG emissions to anthropogenic and natural drivers is the ultimate challenge tackled in the GHG-Europe project and is the precondition to assess the potential for GHG reduction from agriculture and forestry in Europe.

Project objectives

GHG-Europe aims to improve our understanding and capacity for predicting the European terrestrial carbon and greenhouse gas (GHG) budget by applying a systematic, comprehensive and integrative approach. GHG-Europe quantifies the annual to decadal variability of the carbon and GHG budgets of terrestrial ecosystems via data-model integration, diagnostic and predictive modelling. Ultimately, the scientific challenge is to determine how, and to what degree, the carbon cycle and GHG emissions in terrestrial ecosystems can be managed.

Methodology

Measurements from more than one hundred continental stations distributed across all European climatic regions and ecosystems are recorded in a database. Together with spatial data on climate, soil and land management they provide the basis for the integrated assessment.

Scientists will synthesize existing long-term data and initiate new measurements in regions which have been investigated only little so far - namely Eastern European forests and Mediterranean shrub lands.

The measurements from this network of stations will be used in complex models to simulate past, and to project future, GHG budgets under changing climate conditions. The models will also include socio-economic effects to address interactions between economic development, land use and GHG emissions.

Expected results

An important finding for forests was that the stimulatory effect of nitrogen deposition in most European forests does not stem from increased photosynthesis, but from increased carbon allocation to wood. This could increase forest vulnerability to extreme events.

Although afforestation is thought to sequester carbon it turned out that afforested grasslands accumulate labile soil organic carbon but the stable fractions are depleted. This makes the soil carbon pool more vulnerable to future disturbance and loss.

Croplands are the largest N2O source in Europe. Sensitivity analyses with models showed that there is some scope for mitigation by changes in the timing and forms of fertilizer applications.

Project partners	
Johann Heinrich von Thünen Institut, DE	Finnish Meteorological Institute,FI
Eidgenössische Technische Hochschule Zürich, CH	Universität Innsbruck, AT
Fundacion Centro de Estudios Ambientales del Mediterraneo, ES	Universität Heidelberg, DE
Federal Research and Training Centre for Forests, Natural Hazards, and Landscape, AT	Centre Tecnologic Forestal de Catalunya, ES
Commissariat à l´Energie Atomique LSCE, FR	Joanneum Research , AT
International for Applied System Analysis, AT	Autonomous Province of Bolzano/Bozen, IT
Max Planck Institute for Biogeochemistry, DE	University Groningen, NL
University of Aberdeen, UK	Swedish University of Agricultural Sciences, SE
Università degli Studi della Tuscia, IT	Finnish Environment Institute, FI
Vrije Universiteit Amsterdam, NL	University College Dublin, IE
Centre for Ecology and Hydrology, UK	University of Copenhagen, DK
Forest Research and Management Institute , RO	Alma Mater Studiorum - Università di Bologna, IT
Institut National de la Recherche Agronomique, FR	Universidad de Granada , ES
Poznan University of Life Science , PL	Wageningen University and Research Centre , NL
Universiteit Antwerpen, BE	Università degli Studi di Udine, IT
Technical University of Denmark, DK	Centre National de Recherche en Météorologie, FR
Energy research Centre of the Netherlands, NL	Potsdam-Institut für Klimafolgenforschung, DE
European Forest Institute, FI	Stichting DLO, NL
Hochschule Weihenstephan-Triesdorf, DE	Consiglio Nazionale delle Ricerche, IT
University of Helsinki, FI	Universidad de Castilla-La Mancha, ES
Fondazione Edmund Mach , IT	

GRACE

At a glance
Title: Genetic Record of Atmospheric Carbon Dioxide
Funding instrument: ERC Starting Grant
Starting date: 01/09/2008
Duration: 60 months
Total cost: 1 652 907 €
EC contribution: 1 652 907 €
Coordinating organisation: the Chancellor, masters and scholars of the University of Oxford, UK
Coordinator: Gill Halstead
Project website: oceanbug.earth.ox.ac.uk/projects/grace

Abstract

Two key variables, temperature and atmospheric carbon dioxide (pCO2), define the sensitivity of the Earth's climate system. The geological record provides our only evidence of the past climate sensitivity of the Earth system, but there is no direct quantitative measure of pCO2 or temperature beyond the 650 kyr extent of the Antarctic ice cores. The reconstruction of past climate, on timescales of millions of years, relies on the analysis of chemical or isotopic proxies in preserved shells or organic matter. Such indirect approaches depend upon empirical calibration in modern species, without understanding the biological mechanisms that underpin the incorporation of the climate signal. The intention of this ERC grant proposal is to establish a research team to investigate the "living geological record" to address this major gap in climate research. I hypothesise that direct climate signals of the past are harboured within, and can ultimately be deciphered from, the genetic make up of extant organisms. Specifically, I propose an innovative approach to the constraint of the evolution of atmospheric pCO2 during the Cenozoic. The approach is based on the statistical signal of positive selection of adaptation within the genetic sequences of marine algal Rubisco, the notoriously inefficient enzyme responsible for photosynthetic carbon fixation, but supplemented by analysis of allied carbon concentrating mechanisms. As a calibration, I will characterise the biochemical properties of Rubisco in terms of specificity for pCO2, isotopic fractionation and kinetics, from a range of marine phytoplankton. The prime motivation is a history of pCO2, but the project will yield additional insight into the feedback between phytoplankton and climate, the carbon isotopic signatures of the geological record and the mechanistic link between genetic encoding and specific

ICE&LASERS

At a glance
Title: Innovative Concepts for Extracting climate and atmospheric composition records from polar ice cores using new LASER Sensors
Funding scheme: ERC Advanced Grant
ERC funding: 2 986 718 €
Duration: 60 months
Start date: 01/03/2012
Principal investigator: Jérôme Chappellaz
Host institution: Centre National de la Recherche Scientifique, FR
Project website: www.iceandlasers.org
Key words: ice core, laser spectrometer, Quaternary climate, carbon cycle

The challenge

The ERC Advanced Grant ICE&LASERS project aims at developing new tools at the frontier between ice core science and laser physics, in order to address two major challenges in paleoclimate science : the causes of a large climate shift ~1 million years ago, and of natural greenhouse gas concentration changes.

Project objectives

The first project objective is to contribute to extend the Antarctic ice core records to 1.5 million years ago. This is critical to understand an unexplained climate shift from 40,000-year periodicities to 100,000-year ones, calling for a different climate sensitivity to orbital forcing. The second objective aims at better constraining why the atmospheric CO_2 and CH_4 concentrations varied by up to 40 and 100%, respectively, during glacial-interglacial cycles.

Methodology

ICE&LASERS tackles both scientific challenges, thanks to Optical-Feedback Cavity-Enhanced Absorption Spectroscopy (OFCEAS). We are building an innovative probe embedding an OFCEAS spectrometer, which will make its own way into the ice sheet within a single field season, to measure in situ the depth profile of H_2O isotopes in ice as well as greenhouse gas concentration in trapped gases, down to bedrock. It will allow us to rapidly qualify different "oldest ice" sites, and to immediately obtain the main climatic signals of interest. We are also developing new laboratory spectrometers combined with new extraction techniques to measure with unsurpassed accuracy and resolution the concentrations of CH_4, CO_2 and CO (a tracer related to the CH_4 cycle), and the isotopic ratios of CO_2 and CO in polar ice. With these new tools, we will provide more insight into possible natural feedbacks under a warming future.

Emerging results

Our innovative probe will save precious time and money to quality potential Antarctic sites for a future deep ice-core drilling operations focusing on 1.5 million year-old ice. It will provide the first signals of interest (climate and greenhouse gas concentration). The probe could also be used to characterize ice flow by rapidly dating ice layers notably in ice sheet "hotspots" (south Greenland, fast marginal ice streams in Antarctica). We may design an oceanographic version of the probe, with considerable scientific and commercial applications related with the study of dissolved gases in the oceans. The project results will be of major interest for the community working on climate / carbon cycle feedbacks.

ICOS

At a glance
Title: Integrated Carbon Observing System
Instrument: Collaborative project and coordination and support action
Total cost: 5 742 042 €
EC contribution: 4 299 996 €
Duration: 60 months
Start date: 01/04/2008
Consortium: 20 partners from 15 countries
Project coordinator: Alternative Energies and Atomic Energy Commission, FR
Project website: www.icos-infrastructure.eu
Key words: carbon, climate change, greenhouse gases

The challenge

Climate change is one the most challenging problems that humanity is facing. The Intergovernmental Panel on Climate Change (IPCC) attributes climate change to increasing greenhouse gases in the atmosphere, driven by man-made emissions of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Human activities including fossil fuel combustion and land use change have caused the level of CO2 to increase by 40% today relative to pre-industrial times.

The natural carbon cycle absorbs half of the anthropogenic emissions. It is not clear, however, if these CO2 sinks will operate in the future under a changing climate and increasing human impacts. Natural removal of CH4, the natural oxidizing power of the atmosphere cleans up almost all the CH4 injected by human and natural sources but expected increases of emissions will further raise CH4 mixing ratios.

Project objectives

ICOS is designed to provide the long-term observations required to understand the present state and predict future behavior of the carbon cycle and greenhouse gas emissions over Europe.

The huge uncertainty associated with the behavior of future natural CO2 sources and sinks, future anthropogenic emissions and the mitigation efforts creates the need to monitor CO2 with a substantially improved observing, analysis and forecast system.

The first objective of ICOS is to monitor greenhouse gases and provide effective access to these data to enable multi-scale research on GHG emissions, sinks and their drivers.

The second objective is to provide information on regional budgets of greenhouse gas sources and sinks, their human and natural drivers, and the controlling mechanisms. ICOS will permit to detect changes in regional greenhouse gas fluxes, early warning of negative developments and the response of natural fluxes to extreme climate events, to reduce uncertainties in Earth System models.

Methodology

The ICOS distributed research infrastructure is developed as three coordinated, complementary, observation networks:

- More than 50 atmospheric observatories of concentrations of CO2, CH4, N2O and other GHG's,
- More than 50 terrestrial flux tower sites to measure the local exchange of CO2, water vapour and energy,
- Oceanographic observation platforms including volunteer ships monitoring air-sea fluxes.

Operational monitoring by these networks will rely on several Central facilities:

- The Atmospheric thematic centre for data processing and R&D (based in France),

- The Ecosystem thematic centre for data processing and R&D (based in Italy),
- The Central analytical laboratory for the preparation of calibration material and flask sample analysis (in Germany),
- The Ocean thematic centre, for marine data and R&D.
- The Carbon portal will provide easy discovery of and access to ICOS data and complementary products (Sweden).

ICOS will be supported by a legal entity (ERIC) based in Finland.

Expected results

Europe is the third largest emitter of fossil CO2, after China and the USA. Europe has committed itself to reduce its emissions by 20% in 2020. In this context establishing the current baseline of the carbon balance and monitoring its changes independently is crucial and timely. ICOS will provide key data and information in this respect.

ICOS is part of the global carbon strategy of the Group on Earth Observation (GEO), where well-calibrated surface networks are strengthened by complementary observations of CO2 and CH4 from space.

ICOS also strengthens the European leadership for GHG research, and several FP7 programs ensure a wide usage for ICOS data.

Beyond scientists and international programmes (Global Carbon Project, WMO-GAW), users of ICOS include:

- pre-operational service providers in GMES/Copernicus (MACC-II, land services),
- Regional authorities and protocol verification bodies,
- The private sector
- Educational organizations, the media and the general public.

Project partners	
Alternative Energies and Atomic Energy Commission (FR)	SJ Berwin LLP (BE)
University of Helsinki (FI)	Joint Research Centre of the EU Commission
Max Planck Institute (DE)	University of Antwerp (BE)
University of Tuscia (IT)	Institute for Agriculture and Food Research (FR)
University of Heidelberg (DE)	Global Change Research Centre AS (CZ)
Vjije University Amsterdam (NL)	Centre for the study of the Mediterranean (SP) Environment
Swiss Federal Institute of Technology, Zurich (CH)	National Center for Scientific Research (FR)
University of Lund (SE)	RISOE National Laboratory (DK)
University of Edinburgh (GB)	Weizmann Institute of Sciences, (IL)
Uni-Research AS, (NO)	Posnan University (PL)

INGOS

At a glance

Title: Integrated Non-CO2 Greenhouse gas Observing System

Instrument: Collaborative project and coordination and support action

Total cost: 10 000 000 €

EC contribution: 8 000 000 €

Duration: 48 months

Start date: 01/10/2011

Consortium: 34 partners from 14 countries

Project coordinator: Alex Vermeulen

Project website: www.ingos-infrastructure.eu

Key words: Climate Change, Non-CO2 Greenhouse Gases, Monitoring, Inverse Modelling, Emissions.

The challenge

Increase of human induced atmospheric greenhouse gases (GHGs) since the industrial revolution is causing significant changes in the Earth's radiation balance. Increasing global atmospheric mixing ratios of carbon dioxide and the most important non-CO2 Greenhouse Gases (NCGHGs) have been fairly well monitored by various groups. A significant limitation is, however, that comparison of measurements from these different groups is difficult, due to e.g. calibration differences.

InGOS supports and integrates the observing capacity of Europe for NCGHGs and aims to improve the existing European observation system. This will provide insight into the concentration levels and through (inverse) modelling to improved estimates of European and extra-European emissions of the NCGHGs. This way spatial and temporal distribution of sources and changes in emissions due to mitigation and feedbacks with climate change can be detected. Data from the network will enable to better constrain emissions of NCGHGs within the EU and show whether emission reduction policies are effective.

Project objectives

The objective of InGOS is to integrate existing European facilities for monitoring of atmospheric NCGHGs, at ecosystem flux measurement sites and over the ocean, by developing common quality control and quality assurance procedures. New measurement techniques and instrumentation will be explored for preparing the integration of NCGHG measurements into ICOS, thus giving these observations an operational, long-term monitoring perspective.

Sub objectives are:

- Harmonize and standardize the measurements of NCGHGs
- Provide capacity building in new member states and countries with inadequate existing infrastructure
- Support existing observation sites and transfer of selected sites into supersites
- Integrate and further integrate marine observations of the NCGHGs with land-based observations
- Improve measurement methods by testing new innovative techniques and strategies
- Test advanced isotope techniques for application in the network to enable attribution of the atmospheric fractions to source categories
- Integrate data for network evaluation by using inverse modelling and data-assimilation methods and developments in bottom up inventories
- Link the network to remote sensing data of column abundances from in-situ and satellite observations
- Prepare for the integration of the NCGHG network with the Integrated Carbon Observation System

Methodology

The overall strategy to achieve the objectives of improved data quality, coverage and availability is based on **strengthening** (using network activities, NA), **out-reach/coopera-**

tion (using trans-national access, TNA) and **innovation** (using joint research activities, JRA). These activities are executed by 34 partners from all over Europe.

The relatively large number of participants is needed to have proper coverage of the European domain and to enable harmonization across different scientific fields of marine, terrestrial and remote sensing research. TNAs were designed to open up almost all available sites in Europe for visiting researchers, from boreal Finland down to Mediterranean Spain or Cyprus.

Expected results

- InGOS will lead to major advances in the following areas:
- Integrate European facilities for monitoring of NC-GHGs
- Improve the quality of historical, current and future NCGHG measurements
- Prepare expansion of the current network with new stations in under sampled regions
- Provide Near-Real Time access to atmospheric NCGHG data
- Improve analysis methods using innovative techniques and strategies
- Improve halocarbon measurements
- Link remote sensing data to the in situ network
- Attribute source categories by advanced isotope techniques
- Inverse Modeling of European NCGHG measurements
- Link to European flux towers
- Ocean observations
- InGOS Data Centre

Project partners	
Energy research Centre of the Netherlands (NL)	Goethe University of Frankfurt (DE)
Max-Planck Institute for Biogeochemistry (DE)	Norsk Institutt for Luftforskning (NO)
Eidgenoessische Materialpruefungs- und Forschungsanstalt (CH)	Karlsruhe Institute of Technology (DE)
Commissariat à l'énergie atomique et aux énergies alternatives (FR)	Lunds Universitet (SW)
University of Bristol (UK)	Institut National de la Recherche Agronomique (FR)
University of East Anglia (UK)	UK MetOffice (UK)
University of Heidelberg (DE)	AGH University of Science and Technology (PL)
Universiteit Utrecht (NL)	University of Leicester (UK)
Royal Holloway, University of London (UK)	Vrije Universiteit Amsterdam (NL)
Universitaet Bremen (DE)	Hungarian Meteorological Service (HU)
Helsingin yliopisto (FI)	University of Groningen, Centre for Isotope Research (NL)
Risoe DTU (DK)	Poznan University of Life Sciences (PL)
University of Edinburgh (UK)	Leibniz Institute of Marine Sciences (DE)
EU – Joint Research Centre (IT)	Consejo Superior de Investigaciones Científicas (ES)
National Environment Research Council (UK)	University of Bergen (NO)
Finnish Meteorological Institute (FI)	Wageningen University and Research Centre (NL)
University of Tuscia (IT)	Centro de Estudios Ambientales del Mediterráneo (ES)

PANACEA

At a glance

Title: Predicting and monitoring the long-term behavior of CO2 injected in deep geological formations

Instrument: Collaborative project

Total cost: 5 209 495 €

EC contribution: 3 685 771 €

Duration: 36 months

Start date: 01/01/2012

Consortium: 12 partners from 7 countries

Project coordinator: Jacob Bensabat

Project website: www.panacea-co2.org

Key words: CO2 storage, stability, long term behavior, trapping, dissolution, residual saturation, leakage, cement, well integrity, mixing, natural analogues, modeling, CO2 stream, chemical reactions.

The challenge

One of the key obstacles to the large scale deployment of CO2 geological storage is the confidence (particularly of the public) on our ability to predict and control the long-term behaviour of the stored CO2. CO2 injection projects are relatively recent and the collected data from them is can't, on their own, be used for understanding, estimating and validating the long-term behavior of the injected CO2. To overcome the paucity of long-term data, there is a need to combine **extensive modeling** and model development combined with **intensive data** and information gathering and analysis in a hierarchical manner.

Project objectives

1. Identify and quantify the **factors** responsible for the **long-term stability of the stored CO2**.
2. Provide **measures** for the assessment of the **integrity and vulnerability of the reservoir** (storage formation and cap-rock) and wells that penetrate it, to the CO2 stream. of leakage of
3. Quantify the **impact** of the stored CO2 on **adjacent subsurface reservoirs** as changes in the reservoir (in pressure, pH, and chemical reactions) may lead to unwanted migration of brines and release on pollutants trapped in the rock in freshwater reservoirs.
4. Identify and develop reliable **monitoring, measurement and verification (MMV) technologies** having the capacity to capture relevant information on the long-term behavior of the stored CO2 both at the near and far field.
5. Achieve an adequate degree of **cooperation with projects and initiatives** in order to allow the collection of data necessary for validating the investigations and to allow the dissemination of findings.

Methodology

PANACEA relies on two new experimental CO2 injection sites: Heletz (Israel) and Hontomin (Spain).

- Assembling the data and information required for validation and verification: from large scale CO2 injection projects.
- Understanding and quantifying fundamental mechanisms governing the interactions between the host formation (fluid and solid matrix) and the stored CO2: Dissolution, residual trapping, spreading and mixing, fingering evaporation and mineralization.
- Investigating leakage occurrence and its magnitude through cements, cap-rock and faults by means of natural (existing geological structures) and artificial analogues), laboratory experiments aimed at investigating cement integrity.
- Quantifying the impact of spatial variability (heterogeneity) and uncertainty.
- Far field impacts: In order to assess the safety and integrity of the CO2 storage as part of the certification process, investigate and quantify the indirect impacts of the storage such as the creation of an area (of size potentially much larger than the size of the CO2 body) in which a pressure build-up will occur and possible impacts on brine migration and mineral mobilization.

- Prediction and validation: fast robust and reliable computational models capable of simulating the behaviour of the stored CO2 during the injection and containment phases as well as the mechanical, thermal and geochemical interactions with the ambient fluid and the solid matrix represent a key integrating tool, that needs to be used at many phases of a CCS project such the design/planning phase and the monitoring phase.
- Safe and reliable monitoring: review a large number of monitoring technologies, which are implemented in the sites associated with PANACEA.
- Communication, dissemination and public acceptance: These are probably one of the most serious obstacles to expected in the way to the large deployment of CCS.

Expected results

PANACEA will contribute to:

- The large scale deployment of CCS, including selection of storage sites, exploration process, the preparation of applications for storage permits.
- An integrated methodological approach for the assessment of the long-term performance of CO2 reservoirs.
- An improved understanding of failure and leakage mechanisms: 1) through the well cements, determination of thresholds conditions for seal failure and fault reactivation. Improved cost-effective monitoring technologies and strategies to be tested and validated in field experiments.
- The development of an extensive data and information warehouse: 1) from natural analogues and 2) from contemporary injection sites. These could be used for the validation of computational models.
- An improved understanding of the environmental impacts induced by the injection of CO2, including delineation of the pressure buildup impact area, estimation of injection brine migration and release of hazardous compounds in freshwater reservoirs.
- Improved simulation technologies, particularly computationally efficient models.
- Contribution to improved public confidence on the safety/controllability of the CO2 storage process.

Project partners	Country
Environmental & Water Resources Engineering (**EWRE**)	IL
Uppsala University (**UU**)	SE
Technion – Israel Institute of Technology (**IIT**)	IL
University of Goettingen (**Goettingen University**)	GR
National Research Council (**CSIC**)	SP
Centre National de la Recherche Scientifique (**CNRS**)	FR
University of Edinburgh (**Edinburgh University**)	UK
University of Cambridge (**Cambridge University**)	UK
Statoil Petroleum ASA (**STATOIL**)	NO
University of Nottingham (**Nottingham University**)	UK
IMAGEAU (**IMAGEAU**)	FR
BUREAU VERITAS (**Bureau Veritas**)	FR

POPFULL

At a glance
Title: System analysis of a bio-energy plantation: full greenhouse gas balance and energy accounting
Funding scheme: ERC Advanced Grants
ERC funding: 2 500 000 €
Duration: 68 months
Start date: 01/03/2009
Host institution: University of Antwerp, BE
Principal investigator: Reinhart Ceulemans
Project website: webh01.ua.ac.be/popfull
Key words: bio-energy; life cycle assessment; environmental balance; renewable energy; poplar plantation; short-rotation culture

The challenge

One of the strategies for mitigation One of the strategies for mitigation of anthropogenic greenhouse gas emissions is the use of bio-energy as a replacement for fossil fuels. Among the different alternatives of bio-energy production the use of biomass crops – such as fast-growing woody crops under short-rotation coppice (SRC) regimes – is probably the most suited, in particular in the EU. Two issues need to be addressed before the efficacy of bio-energy for carbon mitigation can be conclusively assessed, i.e. (i) a full life cycle analysis (LCA) of the global warming contribution of SRC, and (ii) an assessment of the energy efficiency of the system.

Project objectives

The objectives of the POPFULL project are to make: (i) a full greenhouse balance; (ii) a complete energy and economic accounting; and (iii) a full life cycle assessment (LCA) of the bio-energy production chain. This is being done on an operational, large-scale short-rotation coppice plantation for the production of bio-energy from the cradle (establishment of the plantation) to the production plant (production of heat and/or electricity). For the greenhouse balance the most important greenhouse gases ($CO2$, $CH4$, $N2O$, $H2O$ and $O3$) are included. The LCA produces the global warming contribution of biomass culture, while the overall energy efficiency of the system is being assessed.

Methodology

Eddy covariance techniques are being used to monitor net fluxes of all greenhouse gases between the SRC plantation and the atmosphere. These greenhouse gas flux measurements are combined with common assessments of biomass pools (incl. the soil) and fluxes.For the energy accounting we use life cycle analysis (LCA) and energy efficiency assessments over the entire life cycle of the SRC plantation until the production of electricity and/or heat.

We compare two conversion technologies, i.e. combustion and gasification. All energy (and cost) inputs are quantified in detail and related to the produced output as well as to the financial return of the produced energy. A process based modeling component integrates the collected knowledge on the greenhouse gas and energy balances toward predictions and simulations of the net reduction of fossil greenhouse gas emissions (avoided emissions) of SRC over different rotation cycles.

Emerging results

The results thusfar are based on the first (two-year) rotation plus the first year after the harvest. Bioelectricity from short-rotation coppice culture (SRC) was energy efficient and yielded 3 times more energy than required to produce it over a two-year rotation. The associated land requirement was 0.9 m2 kW h-1 for the gasification and 1.1 m2 kW h-1 for the combustion technology. Converting agricultural land into SRC production released 2.8 t CO2 ha-1 which represented 89% of the total greenhouse gas emissions of bio-energy production. The greenhouse balance was highly favourable; greenhouse gas savings of bioelectricity relative to the EU non-renewable grid mix power was 53%. SRC on agricultural lands with low soil organic carbon stock offer encouraging prospects for the sustainable production of renewable energy with significant climate benefits. The economic balance, however, was not positive as the overall costs for the production of the bio-energy were higher than the financial return.

QUASOM

At a glance
Title: Quantifying and modeling pathways of soil organic matter as affected by abiotic factors, microbial dynamics, and transport processes
Funding scheme: ERC Starting grant
ERC funding: 946 800 €
Duration: 60 months
Start date: 01/09/2008
Host institution: Max-Planck Institute for Biogeochemistry, Jena, DE
Principal investigator: Markus Reichstein
Project website: www.bgc-jena.mpg.de/bgc-mdi/index.php/Main/Quasom
Key words: soil, carbon, biosphere-atmopshere interaction, climate change

The challenge

Soils are a very complex sub-system of the Earth system, containing gaseous, liquid and solid as well as dead and living constituents an intimate mixture. At the same time soils contain more than three times the amount of carbon than the atmosphere and soil respiration is a large flux of CO2 to the atmosphere. Thus it is challenging and important to understand how soils respond to climate variability and feedback to climate.

Project objectives

The overall objective of the projects is to improve the understanding of soil organic matter dynamics in response to climatic and biotic drivers. In particular, the aim is to develop models of soil organic matter turnover which take into account both the soil biota as active agents and transport processes and use these models globally to assess the sensitivity of the terrestrial carbon balance to climate and environmental change.

Methodology

We combine experimental and observational work with numerical system modelling in a model-data fusion approach. We study the fate of soil organic carbon both in the laboratory and in the field with 13C and 14C isotope labelling. A simulation model is developed which accounts for carbon flows between the solid and liquid soil phase and microbial biomass and the vertical transport. The model is calibrated via Bayesian parameter estimation approaches.

Emerging results

At ecosystem level the temperature sensitivity is lower than previously thought when we account for confounding biological factors.

On the other hand to influence of the water cycle (e.g. droughts) is very important for the carbon cycle, because it significantly influences both transport and biological processes. We also find that input of fresh carbon into the soil leads to a release of old soil carbon. This mechanism could release soil carbon after an increased carbon input caused by increasing CO2 levels.

RISCS

At a glance
Title: Research into Impacts and Safety in CO_2 Storage
Instrument: Collaborative project
Total cost: 5 300 000 €
EC contribution: 4 000 000 €
Duration: 48 months
Start date: 02/01/2010
Consortium: 22 partners from 12 countries
Project coordinator: British Geological Survey, UK
Project website: www/riscs-co2.eu
Key words: CO_2 Storage, Environmental impacts, Energy

The challenge

Carbon Capture and Storage (CCS) is one of a range of options for reducing greenhouse gas emissions and mitigating climate change. As the technology is developed, operators and regulators need to be able to assess the potential environmental impacts in the unlikely event of CO_2 leakage.

RISCS is developing the knowledge needed for this by investigating the potential impacts of CO_2 leaks on near surface ecosystems–both in terrestrial and marine environments. Such information will also support policy makers, politicians and the general public in assessing the feasibility, long-term benefits and consequences of large-scale CO_2 capture and storage deployment.

Project objectives

Although significant leakage from CO_2 storage sites is not expected, if it did occur there could be adverse environmental consequences, which are not well constrained. The objective of RISCS is to provide fundamental research on such environmental impacts to underpin frameworks for the safe management of CO_2 storage sites onshore and offshore. RISCS will help to meet the requirements of legislation, including the EC Directive on Geological Storage of CO_2, the OSPAR Convention and the London Protocol, both in ensuring environmental protection and the planning of near surface monitoring programmes.

RISCS will conduct experiments, make observations in areas of natural CO_2 leakage and extend these through modelling.

The research and its outcomes will be communicated in an accessible way to stakeholders and the public. A key output of the project (and other related research) will be a 'Guide for Impact Appraisal', which will be developed in consultation with stakeholders

Methodology

Field-scale experiments have simulated, under well-constrained conditions, the potential impacts from elevated CO_2 concentrations in the near-surface and surface, in both terrestrial and marine environments. Experiments have been made onshore in the UK and Norway and for offshore ecosystems in the Netherlands, UK, Italy and Norway. Investigations of natural CO_2 leakage have addressed key gaps. Observations were made at onshore sites in Greece, Italy and France, to study groundwater and near-surface impacts. Offshore observations have been made off Panarea, Italy. Enhancement of a range of modelling tools will allow the site-specific data obtained from the experimental programme to be more widely applied in developing environmental impact assessments for CO_2 storage sites. There has been consultation and discussion with a range of stakeholder groups, both within the project and externally. The stakeholders include electricity generators, oil and gas companies, environmental NGOs, policymakers and environmental protection regulators, as well as research groups.

Expected results

Terrestrial studies have shown that impacts are spatially restricted to areas that experience very high CO_2 concentrations in the soil. These tend to be of limited size in natural leakage occurrences. Plant and microbial responses are species or group specific, with some species/groups able to tolerate higher CO_2 levels. They also depend on how developed the plant is when exposed to CO_2.

At moderate levels of CO_2 plant and microbial responses can be masked by seasonal or year on year variability in other factors such as rainfall or soil moisture levels.

Marine impacts are also limited in spatial scale. Responses are species specific and impacts can be compounded by variations in other environmental factors such as temperature or the presence of other stressors. The effects of natural baseline variability are not well understood in the marine environment. Pelagic organisms are less sensitive to CO_2 impacts. The stage of development of the organism is also important.

Outputs will provide information necessary to:

- Enable a rigorous evaluation of the safety of storage sites;
- Carry out Environmental Impact Assessments for sites;
- Design storage sites to minimise the probability of hazardous scenarios;
- Help to design near surface monitoring strategies;
- Develop a framework to communicate impacts of storage to key stakeholders (regulators and the public).

Project partners		
NERC British Geological Survey (UK)	Vattenfall R & D AB (SE)	RWE Power AG (DE)
CERTH (GR)	E.ON New Build & Technology (UK)	Stichting DLO (NL)
OGS (IT)	ZERO (NO)	
Plymouth Marine Laboratory (UK)	CO2CRC Management Pty (AU)	
SINTEF Petroleumsforskning AS (NO)	University of Regina (CA)	
University of Nottingham (UK)	Montana State University (US)	
Università di Roma ‘La Sapienza’ (IT)	Stanford University (US)	
Quintessa Ltd (UK)	CO2GeoNet (FR)	
Enel Ingegneria e Ricerca S.p.A (IT)	Bioforsk (NO)	
Statoil Petroleum AS (NO)	BGR (DE)	

T - FORCES

At a glance
Title: Tropical Forests in the Changing Earth System
Funding scheme: ERC Advanced Grant
ERC funding: 2 500 000 €
Duration: 60 months
Start date: 01/06/2012
Principal investigator: Oliver Phillips
Host institution: University of Leeds, UK
Project website: under construction. (www.forestplots.net)
Key words: climate, drought, carbon, balance, sink

The challenge

Tropical forests still cover the largest forested area globally, store the largest reservoir of above-ground organic carbon, ~300 billion tonnes in trees alone, and are uniquely diverse. Under pressure through logging and conversion, they also face a changing climate and atmosphere. They annually process more than 40 billion tonnes of carbon - five times global fossil fuel emissions - so relatively small changes in the balance between growth and decay can significantly modify the global greenhouse gas burden. Some modelled scenarios suggest catastrophic release of carbon from tropical ecosystems due to heating and drying, which would accelerate climate change. While the role of tropical forests in the carbon cycle is of global importance, their actual behaviour remains extremely contentious. So far, the vast scale, diversity, and remoteness of most tropical forests has prevented robust evaluation of their global role.

Project objectives

The objectives of T-FORCES are to take a global approach to understand: (i) the current carbon-balance and fluxes of the world's tropical forests, (ii) what processes are driving changes, and (iii) the carbon danger that future temperature increases may pose.

Methodology

This ambitious research effort is designed to determine, from the ground up, the changing role of tropical forests in the earth system. With his team, Phillips is building a bottom-up Pan-Tropical Observatory of Forest Function to probe the dynamics of forest behaviour in the changing earth system. The project will: (1) deploy global- & continental-scale plot-based sampling across the tropics; (2) integrate the plot approach with complementary disciplines; (3) make intensive measurements to examine the individual sensitivities of forest carbon cycle components, and (4) assess the long-term sensitivity of forest carbon to temperature.

The project will apply continental-scale sampling in Amazonia and Africa, and install capacity in Asia, to investigate the transient responses to change drivers, and use natural experiments to assess long-term sensitivities to temperature. Both levels will be nested within a global framework.

Emerging results

The project is in the first stage of data collection. T-FORCES will help improve scientific understanding of the roles of tropical forests in the global carbon cycle, by developing a new and integrated knowledge of tropical forests, their likely responses to climate change and the consequences of this for the Earth's future climate. These advances will inform Earth System Models, which all urgently require access to authoritative, long-term data, and the process-based land surface parameterisation that only a project of this scope and ambition can provide. The Pan-Tropical Observatory of Forest Function is being built to last. This European initiative is intended to provide the global science community with the tools with which to investigate forest dynamics through this century.

URGENCHE

At a glance
Title: Urban Reduction of GHG Emissions in China and Europe
Instrument: Collaborative project
Total cost: 4 540 000 €
EC contribution: 3 500 000 €
Duration: 36 months
Start date: 01/09/2011
Consortium: 17 partners from 7 countries
Project coordinator: University of Exeter, UK
Project website: www.urgenche.eu
Key words: Climate Change, energy, Environment, GHG-Emissions, Urban

The challenge

The implementation of GHG-policies that would reduce the use of carbonaceous fuels in heat and power generation, heating and transport has some immediate health benefits. However, the exposure to, and health effects of urban air pollution are not distributed equally across the socio-economic strata. Burdens and benefits of different GHG policies may thus treat the different socio-economic groups differently, and so such effects should be directly assessed and considered in policy development, implementation and follow up. There is an urgent need to develop practical urban level climate mitigation policies that can be justified by local health, well-being, or economic benefits.

Project objectives

Urban areas in China and Europe are the focus of our study. For each urban area, the starting point for the assessment is the current GHG-emissions from fuel use, heat and power demand, traffic and urban development, and building construction. The future (up to 2020) urban population and development, energy supply and demand, housing, traffic scenarios are based on the actual population, environmental, economic and political realities and urban development and GHG-mitigation plans for each participating city. The policy assessments aim to assess the local, urban public health and well-being impacts of alternative urban-level GHG-mitigation policy packages, with each meeting nationally given or self-adopted GHG-reduction targets. An optimised policy package will be developed in and for each participating city – optimised for maximum net health and well-being benefits while meeting the GHG targets – and in each city a local roadmap will be created to realise this scenario.

Methodology

The methodological project objective is to develop a robust modelling platform (easily transportable to new cities) and a related database for urban impact assessment.

The topics covered are: urban energy generation and use, and GHG and other pollution release; urban spatial data including the urban spatial plan, building stock, transportation, and population; socio-economic, demographic, exposure, health and well-being of the population. Each participating city will evaluate the current contributions of the heat and power use in the urban building stock, urban traffic and transportation needs, and the overall spatial plan of the city with respect to GHG-emissions, other environmental stressors, environment quality, public health and well-being of the population. They will also evaluate the future public health and well-being impacts of the local implementation of alternative GHG-policies which would meet the locally applicable national, EU and/or international GHG-reduction targets specifically in each city.

Expected results

Our project will provide city-level health evaluation of GHG scenarios. We will disseminate assessment tools and databases, high level educational material and hands-on methodological training for exchange of experience about the development and assessment of urban level policy scenarios.

We will develop a network of cities and research institutions in Europe and China for the evaluation of the risks and benefits of alternative GHG-mitigation policies in different climatic, cultural and economic conditions and for the different urban sizes and structures. We will disseminate general guidance and assessment tools, as well as the overall experience, for city planners and decision makers as well as citizens organisations for the development of WIN-WIN GHG-mitigation policies in different urban areas.

Project partners	
University of Exeter	UK
City of Suzhou (Suzhou Municipal Government)	CN
City of Xi'an (Beida Institute of Environmental Health Science & Technology)	CN
City of Basel (Department Fuer Wirtschaft, Soziales Und Umwelt)	CH
City of Kuopio (Kuopion Kaupunki)	FI
City of Rotterdam (DCMR Milieudienst Rijnmond)	NL
City of Stuttgart (Landeshauptstadt Stuttgart)	DE
Peking University	CN
Nanjing University	CN
Centre for Research & Technology Hellas (CERTH)	UK
Institute of Occupational Medicine (IOM)	UK
Suomen Ymparistokeskus (SYKE)	FI
Terveyden Ja Hyvinvoinnin Laitos (THL)	FI
Nederlandse Organisatie Voor Toegepast	NL
Natuurwetenschappelijk Onderzoek (TNO)	NL
University of Stuttgart	DE
Swiss Tropical & Public Health Institute	CH
World Health Organisation	DE

3

Atmospheric pollution and climate interactions

ACCENT-PLUS

At a glance

Title: Atmospheric Composition Change: the European Network -Policy Support and Science

Instrument: Coordination and support action

Total cost: 1 372 728 €

EC contribution: 998 352 €

Duration: 48 months

Start date: 01/11/2010

Consortium: 9 partners from 6 countries

Project coordinator: Consiglio Nazionale delle Ricerche – Istituto di Scienze dell'Atmosfera e del Clima, IT

Project website: www.accent-network.org/

Key words: science-policy, global change, climate, air quality

The challenge

Fragmentation of research efforts, lack of a shared scientific vision and insufficient availability of research tools, shared databases, etc., is a major limitation for the understanding of atmospheric composition change over Europe under a changing climate, and the consequent inadequate transfer of prospects to the decision makers for future policies. The ACCENT-Plus project builds on the successful efforts of the NoE ACCENT, which has brought together the atmospheric science community engaged in global change and air pollution studies. ACCENT-Plus aims at extending the breath of the previous ACCENT phase to reach out to the policy community, facilitating the transfer of research results into policy/decision making.

Project objectives

The overarching question that ACCENT-Plus aims answering is: "How can Europe control the composition of its atmosphere under a changing climate?" A prerequisite to achieve this goal is to maintain the coordination and integration of the European science community in the field of atmospheric composition change and to strengthen the outreach from the science domain into the policy arena and, where possible, to wider global decision making activities, by producing integrated assessment and synthesis and connecting science and policy making by transferring to the decision makers the important links between air quality and climate change and the prospects and benefits of co-control policies. ACCENT-Plus also aims at preserving and enhancing the excellence of European global change and air quality research within the European Research Area context.

Methodology

ACCENT-Plus will continue and further improve the long-lasting co-operation and integration of European research institutions and will create links with the other international research projects in the field of atmospheric composition change and climate.

The project also will foster the two-way dialog with the policy community initiated within ACCENT. The overall objective here is to provide a synthesis of scientific results in a policy perspective on issues of primary importance for both air quality and climate: particulate matter, ozone, nitrogen cycle, methane. These topics are, in fact, closely related and efforts will be made to integrate the policy-related scientific findings, in a close dialogue with the relevant stakeholders. The integration of the science community will take place in areas as: i) research programming, ii) joint development and use of data bases, iii) training and mobility of researchers, iv) joint programming and use of infrastructures.

Expected results

As a result of a process involving the whole science community along the duration of the project, ACCENT-Plus will prepare four key synthesis papers presenting the latest understanding on four major topics of importance for policy: tropospheric ozone and its precursors at the regional and global scale; the global nitrogen cycle and its importance for society; the atmospheric methane budget now and through the current century; the particulate matter with emphasis on the formation and fate of particles and their role in air quality and climate.

The process will involve also policy makers and stakeholders, thus realising the promised two-way interaction between science and policy. Following this, ACCENT-Plus will deliver a synthesis document simple, authoritative and well articulated, appropriate for the readership, i.e. policy-makers involved in the development of environmental policy at the level of the European Union, the UN-ECE, national governments, environmental agencies, learned societies, city and industry managers, NGOs.

Project partners	
Consiglio Nazionale delle Ricerche	IT
Centre National de la Recherche Scientifique	FR
GKSS – Forschungszentrum Geesthacht GMBH	DE
University of Bremen	DE
Weizmann Institute of Science	IL
Università degli Studi di Urbino “Carlo Bo”	IT
Paul Scherrer Institut	CH
Natural Environment Research Council	UK
University of Leicester	UK

ACTRIS

At a glance
Title: Aerosols, Clouds, and Trace gases Research InfraStructure Network
Instrument: Collaborative project and coordination and support action
Total cost: 11 496 772 €
EC contribution: 7 800 000 €
Duration: 48 months
Start date: 01/04/2011
Consortium: 29 partners from 19 countries
Project coordinator: Gelsomina Pappalardo
Project website: www.actris.net/
Key words: Climate change, air quality, long-range transport of pollutants, aerosols, clouds, trace gases

The challenge

Climate change is for a large part governed by atmospheric processes, in particular the interaction between radiation and atmospheric components (e.g. aerosols, clouds, Greenhouse and trace gases). Some of these components are also those with adverse health effects influencing air quality. Strengthening the ground-based component of the Earth Observing System for these key atmospheric variables has unambiguously been asserted in the IPCC Fourth Assessment Report and Thematic Strategy on air pollution of the EU. However, a coordinated research infrastructure for these observations is presently lacking.

Project objectives

ACTRIS aims at integrating European ground-based stations equipped with advanced atmospheric probing instrumentation for aerosols, clouds and short-lived gas-phase species. ACTRIS has the essential role to support building of new knowledge as well as policy issues on climate change, air quality and long-range transport of pollutants. The main objectives are:

1. To provide long-term observational and high-quality data relevant to climate and air quality research on the regional scale produced with standardized or comparable procedures and access to high-quality information and services for the user communities;
2. To provide a coordinated framework to support transnational access to European advanced infrastructures and enhance training of new scientists in the field of atmospheric observation;
3. To develop new technologies and the use of multiple techniques at ground-based stations, particularly for the calibration/ validation/ integration of satellite sensors and improvement of parameterisations used in global and regional scale climate and air quality models.

Methodology

ACTRIS is building the next generation of the ground-based component of the EU observing system by integrating different research infrastructures for the key atmospheric variables into a single coordinated framework. The project is organized into:

1. Networking activities that deliver QC/QA products to the data centre and promote the integration of information into a higher level of products required by users in the modelling and satellite-validation communities, outreach, and sustainability;
2. Transnational access and service activities to conduct high-quality atmospheric research and calibrations at advanced infrastructures, train a new generation of scientists, and enhance access for end users to high-quality observations and service products via a centralized data centre;
3. Joint research activities to develop new technologies for monitoring activities to fully exploit and improve the parameterizations used in climate and air quality models, define new data products,

and transfer the technological and scientific outcomes to operational advanced instrumentation.

Expected results

The scientific community and many national, EU and international programmes and projects heavily rely on the high-quality atmospheric data as currently provided by ACTRIS.

The data products facilitate and enhance scientific exchange with user communities working on models, satellite retrievals, and forecast systems. The access opportunities to the high quality infrastructures strengthen and reinforce European collaboration, and training of the young research community are of great benefit to the research infrastructures through sharing of experience, knowledge, and human capital, and will promote atmospheric research and develop future research activities using best practices and innovative investments in atmospheric instrumentation. For the future, the development of new synergetic algorithms for advanced higher-level products will further improve the knowledge of atmospheric processes. It is expected that ACTRIS outcomes will be used to support decisions in a wide range of policy areas, including air quality, but also health, international protocols, and research requirements.

Project partners	
CONSIGLIO NAZIONALE DELLE RICERCHE, IT	FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS, EL
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, FR	JOINT RESEARCH CENTRE
NORSK INSTITUTT FOR LUFTFORSKNING, NO	DEUTSCHER WETTERDIENST, DE
HELSINGIN YLIOPISTO, FI	NATIONAL ACADEMY OF SCIENCES OF BELARUS / B. I. STEPANOV INSTITUTE OF PHYSICS, BY
TECHNISCHE UNIVERSITEIT DELFT, NL	BULGARIAN ACADEMY OF SCIENCES / INSTITUTE FOR NUCLEAR RESEARCH AND NUCLEAR ENERGY, BG
PAUL SCHERRER INSTITUT, CH	UNIWERSYTET WARSZAWSKI, PL
LEIBNIZ-INSTITUT FÜR TROPOSPHÄREN-FORSCHUNG, DE	CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE SCIENZE FISICHE DELLA MATERIA, IT
EIDGENÖSSISCHE MATERIALPRÜFUNGS- UND FORSCHUNGSANSTALT, CH	NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT FOR OPTOELECTRONICS, RO
UNIVERSITY OF READING, UK	LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN, DE
UNIVERSITAT POLITÈCNICA DE CATALUNYA, ES	CESKÝ HYDROMETEOROLOGICKÝ ÚSTAV, CZ
MAX-PLANCK-GESELLSCHAFT ZUR FÖRDERUNG DER WISSENSCHAFTEN, DE	PANNON EGYETEM, HU
LUNDS UNIVERSITET, SE	INSTITUT D'AÉRONOMIE SPATIALE DE BELGIQUE, BE
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS, ES	UNIVERSIDAD DE VALLADOLID, ES
NATIONAL UNIVERSITY OF IRELAND, GALWAY, IE	METEOROLOGISK INSTITUTT, NO
NATURAL ENVIRONMENT RESEARCH COUNCIL, UK	

APPRAISAL

At a glance
Title: Integrated assessment for regional and local air quality policies
Instrument: Coordination and support actions
Total cost: 999 990 €
EC contribution: 999 990 €
Duration: 36 months
Start date: 01/06/2012
Consortium: 15 partners from 11 countries
Project coordinator: University of Brescia, IT
Project website: www.appraisal-fp7.eu/
Key words: Integrated assessment modeling, policy support, health impact, regional and local air quality plan

The challenge

Exceedances of air quality limit values in urban areas in Europe remain widespread, particularly for PM, NOX and O3. This is not simply a compliance issue but has significant implications for the health and well being of European citizens. In responding to such concerns, many regions have designed air quality plans and developed integrated methodologies to assess their impacts. With the revision of the EU air quality policy, it is vital to consolidate and spread the results of work undertaken in the field of Integrated Assessment for Air Quality and Health Impacts, and make them accessible to policy makers.
APPRAISAL focuses on answering the following questions:

- What approaches are currently used to design and assess regional/local air quality plans?
- What are their strengths and weaknesses?
- What are the future research needs to improve these approaches?

Project objectives

APPRAISAL aims:

To undertake an overall review of Integrated Assessment (IA) methodologies currently used to assess regional and local scale impacts, from simple (scenario analysis) to more comprehensive ones (cost-benefit, cost-effectiveness analysis).

- To propose IA Modelling frameworks suited for different model complexities and levels of data completeness, to fulfil policy-maker needs.
- To draw guidelines to support the implementation of IA Modelling frameworks based on Member States (MS) best practice examples.
- To communicate to key stakeholders and policy-makers state-of-the-art methodologies.
- To deepen scientific knowledge on emission abatement assessment.

Methodology

The design of an Integrated Assessment Modeling framework addresses the challenge of answering to the requests of the European Commission in terms of Air Quality "Plans and Programmes", as first introduced in 96/62/EC Directive, then updated in 2008/50/EC Directive and in Commission Implementing Decision 2011/850.
The project provides a methodological approach to this issue, considering a DPSIR framework that allows for a detailed analysis of all the components to be used to design a plan. In particular, two decision pathways can be formalized:

- **Open-loop / scenario analysis.** This means selecting emission reduction measures based on expert judgment or source apportionment, and testing their effect through simulation of foreseen emissions. Though being the most commonly used at the moment, this approach does not guarantee that cost-effective measures are selected, and only allows for "ex-post analysis" of costs and other impacts (health effects, ecosystems exposure, climate change).
- **Closed loop / optimization.** This approach allows for the selection of cost-effective measures for air quality improvement, through an optimization approach. A "feedback" is provided on the "effec-

tiveness" of the measures, in terms of both costs and effects. This allows for the selection of the set of measures that can provide the best results in terms of health effects, ecosystems exposure, climate change or other target impacts.

The IAM framework design is based on the systematic review of the IA methodologies used in MS. A database of actual research and air quality plans has been organized around 5 main themes and distributed as a questionnaire:

- Synergies across spatial scales (from European to local one)
- Air quality assessment and Integrated Assessment approaches
- Health impact assessment
- Source apportionment
- Uncertainty and robustness

The systematic review of the answers by local environmental agencies and research institutions provides the state-of the art and identifies the limitations of the Integrated Assessment systems used in MS.

Expected results

The project will: provide insight on existing Integrated Assessment Modelling at regional and local scale within the EU; define decision frameworks for Air Quality plan design; support the implementation of local/regional Integrated Assessment methodologies; assess current research findings and future research needs; support the EU Air policy review.

Project partners	
UNIVERSITA DEGLI STUDI DI BRESCIA	IT
JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	IT
VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
SUOMEN YMPARISTOKESKUS	FI
INSTITUT NATIONAL DE L ENVIRONNEMENT ET DES RISQUES	FR
ARISTOTELIO PANEPISTIMIO THESSALONIKIS	EL
UNIVERSIDADE DE AVEIRO	PT
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	FR
SYSTEMS RESEARCH INSTITUTE OF THE POLISH ACADEMY OF SCIENCES IBS PAN	PL
TERRARIA SRL	IT
CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	ES
UNIVERSITE LIBRE DE BRUXELLES	BE
BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	ES
UMWELTBUNDESAMT	DE
LES WHITE ASSOCIATES Limited	UK

ARISE

At a glance

Title: Atmospheric dynamics Research Infrastructure in Europe
Instrument: Collaborative project
Total cost: 5 620 049 €
EC contribution: 4 400 000 €
Duration: 36 months
Start date: 01/01/2012
Consortium: 12 partners from 9 countries
Project coordinator: Elisabeth Blanc
Project website: arise-project.eu
Key words: Dynamics of the atmosphere, coupling of atmospheric layers, large scale atmospheric disturbances, extreme events

The challenge

For a long time, it was considered that there are negligible interactions between the upper layers and the troposphere. However, recent studies have demonstrated the role that dynamics in the middle and upper atmosphere can play in both tropospheric weather and climate. Atmospheric waves, particularly gravity and planetary waves, drive this interaction and much of the large-scale atmo¬spheric global circulation systems in the middle and upper atmosphere. Observations above the stratopause, where measurements are rare, could then provide crucial information for better description of the atmosphere and more accurate longer-term weather forecasts, on timescales up to several weeks ahead.

The challenge of the ARISE project is to integrate complementary measurements to provide updated 3D images of the atmosphere and unresolved disturbances from the ground to the mesosphere with unprecedented spatio-temporal resolution. The main idea is to probe the atmosphere using atmospheric disturbances produced by well identified sources. The considered time scales range from seconds for extreme events (volcanoes, thunderstorms, cyclones, avalanches, meteorites) to minutes or hours for gravity waves, days for planetary waves up to tens of years for long term mean trend studies. The observations cover areas with very different climatic regimes, extending over Europe and outlying regions, including polar and equatorial regions.

Project objectives

The ARISE infrastructure objectives are:

1. to improve the representation of gravity waves in stratosphere-resolving climate models, crucial to estimating the impact of stratospheric climate forcing on the troposphere, to monitor climate-related phenomena such as severe weather, thunderstorms and sudden stratospheric warmings, over large time periods, in order to characterize their intensity and evolution over time in relation with climate change,
2. to provide a near-real time and continuous monitoring of natural hazards such as large volcanic eruptions, cyclones, avalanches, and meteorites.

Methodology

The infrastructure will include the infrasound networks developed for verification of the Comprehensive Nuclear Test Ban Treaty, the Network for the Detection of Atmospheric Composition Change – using LIDAR (LIght Detection And Ranging) – and the Network for the Detection of Mesopause Change, dedicated to airglow layer measurements in the mesosphere.

The ARISE Design Study project aims to integrate and coordinate scientific communities that have never previously worked together, and to design a large infrastructure that adds significant value for understanding the atmosphere. A large part of the project is dedicated to defining the specifications of advanced data products that can be derived from the different measurement techniques. In addition, there will be a focus on integrated studies, based on simulations using data products obtained through the ARISE network. Topics of specific interest include numerical weather modelling and climate forecasting.

Measurement campaigns integrating co-localized instrumentation are organized at the Observatoire de Haute Provence (OHP) and at Mt Etna in Italy.

These campaigns that are helpful in the design of a prototype station, attract other teams providing additional complementary measurements. Similar stations could be installed at other sites in the future.

Expected results

The expected benefits are a better description of the atmosphere and an improved accuracy in short- and medium-range weather forecasts. The data will be used for monitoring the middle atmosphere dynamics, its long-term mean trends and also the evolution of extreme event characteristics with climate change. Furthermore, the benefits include civil applications related to monitoring of natural hazards. It concerns for example remote monitoring of volcanoes for civil aviation in case of ash injections in the atmosphere.

The demonstrator of the ARISE data base will use data from the 3 participating networks, the ARISE campaign measurements and additional satellite observations. It will be used as a platform for advanced products and simulations.

The success of ARISE is already visible through the increasing number of associated members and cooperation with international groups involved in climatological and environmental studies. Another indication is the large number of ARISE-funded presentations at the European Geosciences Union as well as the summer school organized at the project midterm. ARISE already promotes co-operation with several African countries. As the integrated networks are international, an impact beyond Europe is also expected.

Project partners	
Commissariat à l'Energie Atomique (FR)	Koninklijk Nederlands Meteorologisch Instituut (NL)
Deutsches Zentrum für Luft- und Raumfahrt (DE)	Stiftelsen Norwegian Seismic Array (NO)
Laboratoire Atmosphères-Milieux-Observations Spatiales (FR)	Ustav Fyziky Atmosfery (CZ)
Bundesanstalt für Geowissenschaften und Rohstoffe (DE)	Institutet för RymdFysik (SE)
University of Reading (UK)	Institut d'Aéronomie Spatiale de Belgique (BE)
Universita Degli Studi Di Firenze (IT)	Laboratoire Mécanique Fluides et Acoustique (FR)

ATMNUCLE

At a glance
Title: Atmospheric nucleation: from molecular to global scale
Funding scheme: ERC Advanced Grants
ERC funding: 2 000 000 €
Duration: 60 months
Start date: 01/01/2009
Host institution: University of Helsinki, FI
Principal investigator: Markku Kulmala
Project website: www.atm.helsinki.fi/m/atmnucle/
Key words: Atmospheric aerosol particles, aerosol formation, trace gases, climate change, air quality, numerical models

The challenge

Aerosol particles and their interaction with the climate systems remain the dominant uncertainty in predicting radiative forcing. The development of better aerosol parameterizations is perhaps the single most important challenge for the next generation of climate models. An important phenomenon associated with the atmospheric aerosol system is the formation of new atmospheric aerosol particles. Atmospheric aerosol formation consists of a complicated set of processes. Once formed, aerosol particles need to grow further to sizes >50-100 nm in diameter until they are able to influence climate. While aerosol formation has been observed to take place almost everywhere in the atmosphere, several gaps in our knowledge regarding this phenomenon still exist including the basic process-level understanding of atmospheric aerosol formation and the detailed molecular-scale processes.

Project objectives

The main scientific objectives of this project are 1) to quantify the mechanisms responsible for atmospheric new particle formation and 2) to find out how important this process is for the behaviour of the global aerosol system and, ultimately, for the whole climate system.

Methodology

In order to be able to meet our objectives, and to answer our research questions, we need to perform inter-, multi and cross-disciplinary research with a high level of technological and scientific innovation. To understand the complex, non-linear system requires a diverse range of scientific and technological expertise in the areas of chemistry, physics, biology, and meteorology, and involves laboratory studies, ground, ship, and airborne field studies, satellite remote-sensing and numerical modelling studies ranging from the molecular ab initio level to the global scale Earth system models.
Our research approach covers all those experimental and theoretical aspects.

Emerging results

ATMNUCLE has measured the first time the charged and neutral particles (1.1 nm in diameter) simultaneously. This has greatly improved our understanding of the role of sulphuric acid in atmospheric nucleation and cluster formation. Newly formed particles have been shown to give a larger contribution to the global aerosol load. Furthermore, effects on human health are related to particle size, as well as the toxicity of the material, as the size determines whether or not the particles are able to penetrate the lungs and enter blood circulation. ATMNUCLE has shown that volatile organic compounds, produced during photosynthesis, contribute greatly to the growth of newly formed particles up to CCN size. The project breakthroughs are expected as understanding of key areas such as the role of ions, particle clusters and biogenic emissions. New findings resulting from ATMNUCLE are quickly being integrated to climate and Earth System models.

ATMOGAIN

At a glance
Title: Atmospheric Gas-Aerosol Interactions – from Fundamental Theory to Global Effects
Funding scheme: ERC Starting Grant
ERC funding: 1 500 000 €
Duration: 60 months
Start date: 01/09/2011
Host institution: Stockholm University, SE
Principal investigator: Ilona Riipinen
Project website: www.itm.su.se
Key words: atmosphere, aerosols, climate, air quality

The challenge

Atmospheric aerosol particles impact the global climate and are among the main pollutants deteriorating air quality. According to the IPCC aerosols have been the most important, while also most uncertain, atmospheric cooling component in the industrial period. To pin down the effects of aerosols on climate and air quality, the processes governing their concentrations need to be understood and represented accurately in large-scale models. The fate and impacts of ultrafine (< 100 nm in diameter) aerosol particles are governed by mass transport between the gas and particulate phases. Correct representation of the aerosol growth/shrinkage by condensation/evaporation of atmospheric vapours is thus a prerequisite for capturing the evolution and impacts of aerosols.

Project objectives

The main goal of ATMOGAIN is to address the major current unknowns in atmospheric ultrafine particle growth and evaporation. The specific objectives are:

1. To develop a unified theoretical framework to describe the mass accommodation processes at aerosol surfaces.
2. To determine thermodynamic properties of atmospheric low-volatility organic compounds and their mixtures with water and inorganics.
3. To resolve the gas and particulate phase processes governing the growth of realistic atmospheric aerosol.
4. To parameterize ultrafine aerosol growth in chemical transport models, and quantify the impact of condensation and evaporation processes on global and regional aerosol budgets.

Methodology

Our core task is to understand the mass transport to/from atmospheric ultrafine aerosol, and provide a computationally efficient approach to model it in air quality and climate models. We approach this task from multiple angles and with varying level of detail, using novel computational models that combine the relevant physical (mass and heat transport, thermodynamics) and chemical (reactions in the gas and particulate phase) processes in the aerosol system. The scales of these models range from molecular dynamics simulations to coupled Earth system models. These models are constantly tested and, if needed, re-iterated using state-of-the-science observational data from both field and laboratory. The project has elements that will improve the fundamental understanding of mass transport to/from aerosol particles, but in parallel also elements that provide working solutions with the best available knowledge – even with incomplete mechanistic understanding of the processes.

Emerging results

The main outcome of this project is a quantitative description of atmospheric nanoparticle growth by organic vapour condensation, and its implications for climate and air quality. Besides completing the understanding of the atmospheric ultrafine particle evolution, the applications of our results extend from droplet and ice crystal growth in clouds to any industrial or scientific application that exploits generation and manipulation of nanoparticles by vapour condensation/evaporation.

C8

At a glance

Title: Consistent computation of the chemistry-cloud continuum and climate change in Cyprus
Funding scheme: ERC Advanced Grant
ERC funding: 2 196 000 €
Duration: 60 months
Start date: 01/01/2009
Host institution: Cyprus Institute of the Cyprus Research and Educational Foundation (CREF), CY
Principal investigator: Johannes Lelieveld
Project website: www.cyi.ac.cy/climatechangeandimpact-ongoing/item/202-c8-consistent-computation-of-the-chemistry-cloud-continuum-and-climate-change-in-cyprus.html
Key words: Mediterranean, Middle East, Earth System Model, air quality, climate change

The challenge

The C8 project contributes to the understanding of aerosol and cloud processes and their representation in regional and global climate models. We apply a new numerical method that allows for a direct coupling in climate models between aerosol chemical composition, being influenced by pollution emissions, and the continuum between hazes and clouds. The project focuses on the Mediterranean and the Middle East because it is a hot spot in climate change exposed to drying and air pollution. Within the project we also study aspects of impacts of regional air quality and climate change on human health.

Project objectives

The project aims to reduce uncertainty in the scientific understanding of physical and chemical properties of aerosols by applying a quantitative numerical method to predict the aerosol composition and interactions with clouds. Other project objectives include the investigation of the regional and global aspects and links with air pollution, increasing greenhouse gases, atmospheric circulation changes and perturbations of the water cycle. Furthermore, climate change and weather extremes are projected with relatively high spatial detail for the Mediterranean and Middle East region. The potential impacts of air quality degradation and heat extremes on human health are also assessed.

Methodology

As a major innovation the aerosol hygroscopic properties and formation of clouds will be computed explicitly as a function of chemical composition and ambient relative humidity with the earth system model EMAC, whereas presently it is common practice to model cloud formation based on simple condensation thresholds. New parametrisations are also developed and utilised, for example in relation to dust emissions. The EMAC model resolves global phenomena in the troposphere and stratosphere, and therefore is suitable for studying physical and chemical interactions on large scales. In addition, regional climate models are used to downscale the global climate model projections over the Mediterranean and the Middle East to provide input for climate change impact studies. New climate datasets are generated for the region and statistical methods are applied to derive trends and assess air quality and climate change.

Emerging results

A comprehensive aerosol microphysics and gas aerosol thermodynamics module for applications has been developed. It is computationally efficient and suitable for medium to long-term model simulations. A new high-resolution global anthropogenic emission inventory of gas and aerosol pollutants and two versions of a parameterization scheme to compute desert dust emissions have been incorporated into the EMAC model. The model simulations indicate that the Persian Gulf region is a global hot spot of photochemical smog where air quality standards are strongly violated.

On a regional scale our results do not support the recent hypothesis suggesting that dust particles, though their ability to act as cloud condensation nuclei, can invigorate storms and alter precipitation amounts, and we conclude that storm-related precipitation is predominantly controlled by dynamical rather than cloud microphysical processes. By analyzing long-term meteorological data, we revealed that the summer northerly flow and descent over the eastern Mediterranean are strikingly synchronous to the monsoon convection over North India. Analyses of meteorological data also corroborate significant upward temperature trends in the Mediterranean and Middle East in the past decades. In future, the annual number of heat wave days is expected to increase drastically. Furthermore, conditions in the region are conducive for photochemical air pollution, hence, our model projections suggest strongly increasing ozone formation. This adds to the high concentrations of aerosol particles from natural (desert dust) and anthropogenic sources. The increasing heat extremes and air pollution will significantly impact society and human health.

CITYZEN

At a glance
Title: megaCITY - Zoom for the ENvironment
Instrument: Collaborative project
Total cost: 3 959 272 €
EC contribution: 2 915 000 €
Duration: 36 months
Start date: 01/09/2008
Consortium: 16 partners from 10 countries
Project coordinator: Norwegian Meteorological Institute, NO
Project website: www.cityzen-project.eu

The challenge

Since 2007 more than half of the world's population have been living in cities, and the trend of urbanization is expected to continue. One important aspect is the rapid growth of so-called megacities, usually defined as agglomerations with 10 million inhabitants or more. Megacities are often characterized by extremely large population densities, high levels of social frag-mentation, and an infrastructure which does not keep pace with rapid population growth and changing life habits. Emissions from megacities are thus very different from rural emissions. Given their size and emission output, megacities not only affect their local environment but can have regional to global effects on air pollution, visibility, and climate.

Project objectives

The main aim of CityZen was to assess the environmental impacts of megacities or emission hot spots, both locally and globally. In particular, the project aimed to:

- quantify and understand current air pollution in and around selected megacities with focus on ozone and particulate matter;
- estimate how megacities influence air quality and climate locally, regionally, and globally;
- estimate how megacities will respond to climate change in the future;
- calculate the impact of future emission change and suggest mitigation options;
- provide technical underpinning of policy work through continuous contact with policy makers.

Rather than dealing with all megacities worldwide, CityZen selected four emission hotspots for detailed study: The Eastern Mediterranean, the Po Valley (Italy), the BeNeLux region, and the Pearl River Delta in Southeastern China.

Methodology

CityZen collected and analysed extensive sets of observations from both satellites and ground based instruments. Observational studies were complemented by detailed model calculations of the transport and chemical and physical conversion of air pollutants in the atmosphere. Emission data sets were generated for present and future conditions, assuming different air pollution and climate policy scenarios.

Interactions between air pollution and climate were studied based on extensive data sets from extreme episodes in the past, such as the hot European summers of 2003 and 2007. In addition, climate models simulated the response of climate to emission changes in the future, and chemical dispersion models were used to calculate changes in air pollution as a response to future climate change.

As megacities can affect the environment on both local and global scales, CityZen investigated methods to bridge the different spatial scales in state-of-the-art computer models of the atmosphere in consistent ways.

Key results

CityZen has generated large amounts of useful observational data and model results focussing on the environmental impact of large cities and agglomerations. The environmental footprint of megacities, including multi-year trends, has been detected from satellite for North American, European and Asian hotspots. Fluxes into and out of emission hotspots have been quantified by atmospheric models in order to compare imported versus indigenous air pollution in densely populated areas. The response of air quality in and around megacities to climate change was estimated in detailed model calculations for the future. For instance, ozone is assumed to increase in large parts of Southern Europe in a warmer and dryer climate, partly offsetting the benefits of planned reductions in ozone precursor emissions.

Novel techniques have been developed, inter alia to bridge the different spatial scales (from global to regional) in models, to combine observational data from different space-borne platforms into multi-year trends, to improve emission data based on satellite observations, etc.

Based on project results CityZen was able to make suggestions to policy makers in regard to mitigation options targeting both air quality and climate change, i.e. reducing short-lived climate forcers and air quality problems at the same time.

CityZen has generated more than 50 publications in the peer-reviewed literature and also made important contributions to major assessment reports (e.g. the recent WMO/IGAC report on Impacts of Megacities on Air Pollution and Climate). The contact to policy occurred mainly through concise leaflets that focussed on different aspects, e.g. climate-chemistry interactions, observational data and trends, ozone and particulate matter, etc.

Project partners	
Meteorologisk institutt	NO
Peking University	CN
Centre National de la Recherche Scientifique	FR
Institut National de l'Environnement Industriel et des Risques	FR
Universität Bremen	DE
Rhenish Institute for Environmental Research at the University of Cologne	DE
Forschungszentrum Jülich GmbH	DE
University of Crete	EL
Consiglio Nazionale Delle Ricerche	IT
Norsk Institutt for Luftforskning	NO
Universitetet i Oslo	NO
Institute of Marine Sciences-Middle East Technical University	TR
University of Leicester	UK
International Institute for Applied Systems Analysis	AT
National Observatory of Athens	EL
Cairo University Center for Environmental Hazard Mitigation	EG

COMBINISO

At a glance
Title: Quantitative picture of interactions between climate, hydrological cycle and stratospheric inputs in Antarctica over the last 100 years via the combined use of all water isotopes
Funding scheme: ERC Starting Grants
ERC funding: 1 869 950 €
Duration: 60 months
Start date: 01/01/2013
Host institution: Centre National de la Recherche Scientifique, FR
Principal investigator: Amaelle Landais
Key words: Ice cores, water isotopes, hydrological cycle, isotopic fractionation

The challenge

The mass balance budget of Antarctica is particularly scrutinized with respect to temperature and tropospheric water cycle evolution. Antarctica is also a very sensitive region within the polar vortex and thus affected by the ozone depletion through an important role of polar stratospheric clouds. Stratosphere has also a great role for understanding climate and atmospheric circulation in Antarctica. We thus aim to provide a quantitative picture of the evolution of temperature, tropospheric water cycle and stratospheric input over Antarctica documenting the recent trends and variability beyond the instrumental period and beyond the presence of the ozone hole.

Project objectives

The final objective of this project is a description of the links between climate, hydrological cycle and stratospheric inputs over the last 100 years in Antarctica. For this challenge, our approach combines the 5 major water isotopes through several objectives:

1. For a correct use of water isotopes in Antarctica ice cores for temperature, hydrological cycle and potential stratospheric input reconstructions, we will provide a correct determination of fractionation coefficients at solid precipitation, an improved description of cloud microphysics in isotopic models as well as evidences for a significant or not influence of stratospheric water input on 17O-excess of Antarctic snow.
2. For a quantification of the stratospheric input and tropospheric water cycle organization, we will implement all tracers (water isotopes, 10Be) in atmospheric general circulation models including a detailed description of the stratosphere and adaptation to Antarctica and combined analyses of aforementionned parameters in different Antarctic ice cores.

Methodology

Quantifying the water equilibrium fractionation coefficients will be performed using a controlled chamber inspired from existing experimental aerosols chamber with special attention to possible water exchange at the surface. In order to measure the isotopic composition of water vapor at very low water concentration, we will develop a home made laser spectrometer to measure δ17O with a precision less than 0.1‰ at water concentrations of 500 ppmv. For the modeling part, water isotopes (δD, δ18O) are already incorporated in the coupled Laboratoire de Météorologie Dynamique (LMDZ) General Circulation Model: LMDZ-iso. In order to improve the description of stratosphere, we will use the version LMDZ-iso with 39 layers. Regarding tritium and 10Be, terms for stratospheric production and for radioactive decay will be added in the LMDZ-INCA model. Finally, we will measure the 5 major water isotopes and 10Be in two neighbor cores covering the last 100 years in remote

East Antarctica and in two different sites in coastal East Antarctica to decipher the regional and global signals.

Emerging results

The work for developing the laser spectrometer measuring δ17O with high accuracy in the water vapor will lead to important instrumental development which will influence future efforts toward other applications of laser spectroscopy that are exponentially growing today. Moreover, if the instrument reveals to be robust enough, it opens new perspective for measuring 17O-excess on field and directly also in the stratosphere through balloon experiments or airplane campaigns.

The correct determination of water fractionation coefficients and an improved description of the cloud microphysics influence at very low temperature is essential for the quantitative interpretation of ice cores records. On the modeling side, we will provide the first AGCM fully equipped with all water isotopes and 10Be input, hence combining water cycle and aerosols expertises. Finally, demonstrating a stratospheric water signature in the new tracer 17O-excess would be a unique tool for reconstructing past stratospheric input on long timescales.

COPAL

At a glance
Title: COmmunity heavy-PAyload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences
Instrument: Collaborative project and coordination and support action
Total cost: 1 066 578 €
EC contribution: 1 000 000 €
Duration: 48 months
Start date: 01/11/2007
Consortium: 13 partners from 9 countries
Project coordinator: Météo-France, FR
Project website: www.eufar.net
Key words: Climate change, air quality, land use, air pollutant emissions, atmosphere-biosphere interactions, model parameterizations.

The challenge

Parallel with the development of Earth simulators in numerical modeling, experimental research in environmental and Geo-sciences is evolving towards multidisciplinary studies of the atmospheric and climate systems at the global scale. Consequently, research aircraft instrumentation must now include in-situ measurements of turbulence, atmospheric state parameters, and cloud microphysics, sampling inlets for gas and aerosol analysis, and a combination of passive and active remote sensing systems. The endurance must be sufficient for long range studies over remote area such as the oceans, the Polar Regions and continental areas with limited ground infrastructures, such as the Sahara desert or the Amazon.

Project objectives

COPAL has the objective of providing the European scientific community in the field of environmental and Geo-sciences, with a unique research aircraft platform, capable of reaching and operating in any remote area in the world, i.e. an endurance greater than 10 hours, and a heavy payload greater than 10 tons to integrate a comprehensive multidisciplinary instrumentation. It will offer an unprecedented opportunity to countries that are not yet operating research aircraft to develop expertise in airborne measurements and participate to international multidisciplinary experiments.

Methodology

To refine user requirements and translate into specifications for aircraft performance and modifications for research. To precisely quote the acquisition, modification, and maintenance costs of the community aircraft. To define procedures for the selection of the aircraft and data management operators. To constitute a network of academic centres of excellence and SMEs will for the development and airborne certification of innovative instruments for the community aircraft. To elaborate new scientific governance schemes for evaluation of access proposals and allocation of time slots, which reconcile the Pan-European use of the aircraft, with national authority in term of scientific programming. These activities will be coordinated with EUFAR, with the operators of community research aircraft in the USA, and with the other Preparatory Phase studies, especially those with points of similarity with COPAL, such as the research vessels. They will supply with technical and logistic solutions the research institutions which will develop a new organizational model for the COPAL infrastructure.

Expected results

Through a joint investment, COPAL will fill the main gap of the European fleet of research aircraft, namely the lack of heavy payload and long endurance plateforme and mitigate the very unbalanced distribution of expertise on airborne reesarch, mainly concentrated today in DE, UK and FR. In joint research programs with the community aircraft, stakeholder countries will develop knowledge and also gain access to the diverse fleet of smaller instrumented aircraft already operated in Europe.

With its heavy payload, the community aircraft will open opportunities to explore the complex Earth system by studying interactions and feedbacks between its physical processes, and ultimately improve the physics of the climate models.

Project partners	
Météo-France	FR
Instituto Nacional de Técnica Aeroespacial	ES
Finish Meteorological Institute	FI
Natural Environment Research Council	UK
Fundação para a Ciência e a Tecnologia	PT
Consiglio Nazionale delle Ricerche	IT
General Secretariat for Research and Technology	EL
University of Warsaw, Institute of Geophysics	PO
Enviscope GmbH	DE
The Meteorological Office	UK
Centre National de la Recherche	FR
SJ Berwin LLP	BE
Deutsches Zentrum Fuer Luft-und Raumfahrt E.V.	DE

DUSTTRAFFIC

At a glance
Title: Transatlantic fluxes of Saharan dust: changing climate through fertilising the ocean?
Funding scheme: ERC Starting Grant
ERC funding: 1 970 000 €
Duration: 60 months
Start date: 01/10/2012
Host institution: NIOZ – Royal Netherlands Institute for Sea Research, NL
Principal investigator: Jan-Berend W. Stuut
Project website: www.stuut.tv/html/dusttraffic.html
Key words: Climate, Atlantic Ocean, fertilisation

The challenge

From the geological record we know that desert dust, atmospheric CO2 contents and climate are strongly related; during glacial times atmospheric CO2 contents were low and atmospheric dust levels were high and vice versa. Marine phytoplankton sequesters CO2 from the atmosphere, and it can benefit from the nutrients and metals that are carried by mineral dust particles. The hypothesis we want to test is if mineral dust can be used to fertilise the ocean and thus to influence global climate change.

Project objectives

To record and quantify the downwind dust compositional changes in relation to horizontal (source-to-sink) and vertical transport changes (e.g., Saharan Air Layer at high altitude versus low-level Trades at given meteorological conditions (wind direction, speed, humidity).

To quantify compositional changes of aerosols after deposition in the ocean, the marine environmental effects of dust fertilisation in relation to the carbon pump, and the export of organic material from photic zone to sea floor by dust ballasting.

To reconstruct past changes in aerosol production, transport, and deposition in the Atlantic, as well as marine environmental effects of mineral aerosols in the geologic past.

Methodology

Five sediment trap moorings that will be deployed in a transatlantic array along 12°N directly downwind of the major dust sources in NW Africa to determine transient changes in Saharan dust flux, particle size and shape, mineralogy, chemistry, plant waxes, and microbiology.

In the central two moorings at 40°W, two atmospheric dust collectors will be placed on surface buoys. These buoys filter dust-laden air at the same temporal resolution (two-weekly) as the sediment traps in the ocean underneath.

Satellite observations and back-trajectory modelling will allow for exact provenancing of the dust outbreaks as well as quantification of the dust dispersal pathways and deposition.

The dust collected by the time-series mooring will be compared (size, shape, chemistry, mineralogy, plant waxes) with sediments from the source regions.

The proxies derived from the present-day observations will be applied through geologic history using sediment cores retrieved from several positions along the transatlantic transect.

Emerging results

It is expected that the proposed integration of land and marine studies and fully integrated source-to-sink approach will fill a number of the gaps in our present-day knowledge by providing answers to the questions about:

the seasonal variability of Saharan dust production and transport;

- its physical, chemical, mineralogical, nutrient, and (micro)biological composit-ion influenced by varying moisture condit-ions in the source areas;
- the compositional changes of the aerosols on their way through the atmosphere from source(s) to sink(s);
- the fertilising effect of aerosols on the marine environment;
- variability of aerosol production, dispersal and fertilising effects through the geologic past.

Especially the last point is of vital importance, as it offers the possibility to place ongoing global change into the context of dramatic and well-documented global changes throughout the geologic past.

EUCLIPSE

At a glance
Title: EU Cloud Intercomparison, Process Study & Ealuation Project
Instrument: Collaborative project
Total cost: 4 985 600 €
EC contribution: 3 500 000 €
Duration: 48 months
Start date: 01/02/2010
Consortium: 12 partners from 9 countries
Project coordinator: Koninklijk Nederlands Meteorologisch Instituut (KNMI), NL
Project website: www.euclipse.eu
Key words: clouds, climate change

The challenge

Cloud feedbacks in Earth System Models (ESMs) remain the largest source of uncertainty in projections of future climate. They are also a major contributor to uncertainty in other feedbacks (e.g., surface albedo, carbon cycle) in the Earth System. Through interactions with the large-scale circulation, cloud processes also contribute to synoptic circulations and regional climate. They are therefore critical to the prediction of future changes in precipitation patterns, climate variability and extreme events.

The central objective of EUCLIPSE is to reduce the uncertainty in the representation of cloud processes and feedbacks in the new generation of Earth System Models (ESMs), in support of the IPCC's fifth assessment report.

Project objectives

EUCLIPSE represents a focused multi-disciplinary effort to respond to this challenge by fostering coordinated research in the area of cloud feedbacks on climate change. The specific objectives of EUCLIPSE are:

- Evaluation of cloud processes in Earth System Models.
- Development of physical understanding of how cloud processes respond and feedback to climate change.
- Development of a metric to measure the relative credibility of the cloud feedbacks by different Earth System Models.
- Improvement the parameterization of cloud related processes in current Earth System Models

Methodology

EUCLIPSE will achieve these objectives by making use of revolutionary developments in both observational and numerical simulation techniques through

- Exploiting the full hierarchy of entirely new observations of clouds. These include active space-borne remote sensing, the use of advanced atmospheric profiling stations and the use of data from recent observational field experiments.

- Exploiting the full hierarchy of Modelling Tools. These include a set of proposed earth system model experiments along with targeted cloud-resolving simulations to answer specific questions identified in the analysis of the ESM experiments.
- Designing idealized simulations to help to isolate and diagnose the effect of key cloud-climate feedback processes.

Expected results

- Improvement of the representation of cloud related processes.
- A metrics to quantify the ability of Earth System Models to represent clouds, radiation and precipitation.
- Reduction of the uncertainty of model-based estimates of climate change due to cloud related processes
- Dissemination of new tools, analysis methods, simulations and observations that will provide a useful data base for the model development community at large.

Project partners	
Royal Netherlands Meteorological Institute	NL
Max Planck Institute for Meteorology	DE
Met Office	UK
Centre National de la Recherche Scientifique – Institute Pierre Simon Laplace	FR
Academy of Athens	EL
European Centre of Medium Range Weather Forecasts	UK
Delft University of Technology	NL
Météo-France – Centre National de Recherches Météorologiques	FR
University of Stockholm	SE
Eidgenössische Technische Hochschule Zürich	CH
University of Warsaw	PL
German High Performance Computing Centre for Climate- and Earth System Research	DE

EUROCHAMP-2

At a glance
Title: Integration of European Simulation Chambers for Investigating Atmospheric Processes – Part 2
Instrument: Collaborative project and coordination and support action
Total cost: 6 490 614 €
EC contribution: 4 999 999 €
Duration: 56 months
Start date: 01/05/2009
Consortium: 14 partners from 8 countries
Project coordinator: Peter Wiesen
Project website: www.eurochamp.org
Key words: climate change, atmospheric simulation chambers, atmospheric chemistry, air quality

The challenge

Understanding climate change is a priority nowa-days for science, policy formulation and industry. This can be achieved combining real-world obser-vations and experimental investigations to provide input for mathematical modelling. Controlled ex-periments on the behaviour of target substances under simulated atmospheric conditions – a box of air – are essential for a correct assessment and interpretation of the real-world observations and the validation of computer models. Simulation chambers situated at more than 20 locations in Europe represent such boxes. The chambers are equipped with state-of-the-art instrumentation operated by experts whose cumulative efforts are directed toward understanding chemistry-related climate changes in the atmosphere.

Project objectives

The project continues the development of an integrated, international infrastructure started 2004 by EUROCHAMP-1. Through these projects the most important atmospheric simulation cham-bers in Europe have been amalgamated to form a powerful and effective atmospheric chemistry research infrastructure with the aims:

- to make better use of these expensive facilities by breaking down boundaries between national research institutions;
- to improve the performance of the existing facilities, and create new ones if required
- to provide the world wide research community with a productive state-of-the-art tool for atmospheric chemistry investigations;
- to offer maximum support, training and funding for a broad community of researchers from different disciplines;
- to promote retention of Europe's international position of excellence in the area of atmospheric chemistry research.

Methodology

The project's work plan comprises three networking activities:

N1: Raw Data Analysis, Data Intercomparison And Quality Assurance,

N2: Central database of environmental chamber studies and central spectroscopic databases,

N3: Meetings and infrastructure-related workshops,

and two major joint research activities:

JRA1: Experimental techniques,

JRA2: Development of common techniques for use of chamber measurements in model development and evaluation,

and one Transnational Access activity.

This structure proved effective in promoting the interdisciplinary collaboration within the infra-structure, optimisation and further development of the infrastructures' performance and dissemination of the project outcomes.

The project is linked via involvement of partners with other on-going activities in the field such as to the projects EUFAR, ACTRIS, IAGOS, ICOS, PEGASOS and the ACCENT-Plus Network. This guarantees a continuous exchange of information with the aim to more effectively close the knowledge gaps in the field of atmospheric chemistry and physics.

Expected results

The projects have been a success story from the beginning of EUROCHAMP-1 in June 2004. The EUROCHAMP infrastructure is nowadays well recognised by colleagues worldwide.

Since 2004, more than 100 groups of scientist from all over the world and from many different disciplines related to atmospheric chemistry, such as indoor air quality, health and cultural heritage have made use of the infrastructure.

The project led to:

1. an improved knowledge in atmospheric chemistry and open access to this knowledge via the various EUROCHAMP data bases,
2. the development of updated and/or new models for the description of atmospheric chemical and physical processes,
3. the development of innovative and improved analytical instrumentation for atmospheric gaseous species and particles,
4. the restructuring of research performed in European environmental chambers which resulted in a departure from individual to more effective, productive and scientifically beneficial integrative research contributions,
5. high quality training for PhD students and early stage researchers.

The outcomes of these activities are documented in more than 150 publications in renowned, peer-reviewed scientific journals.

The EUROCHAMP infrastructure offers nowadays an excellent platform for the development, prototyping and testing of novel environmental analytical techniques in co-operation with SMEs. This complies with the innovation focus of the new HORIZON 2020 programme of the European Commission and could help to foster the leading role of European SMEs in this sector and to strengthen their competitiveness on the world market.

Project partners	
Bergische Universität Wuppertal (DE)	Karlsruher Institut für Technologie (DE)
Forschungszentrum Jülich, GmbH (DE)	University of Leeds (UK)
El Centro de Estudios Ambientales del Mediterráneo (ES)	SP Sveriges Tekniska Forskningsinstitut AB (SE)
Universität Bayreuth (DE)	Université Paris 12 (FR)
University College Cork (IE)	Leibniz-Institute for Tropospheric Research (DE)
The French National Center for Scientific Research (FR)	University of Copenhagen (DK)
Paul Scherrer Institut (CH)	University of Manchester (UK)

EXCATRO

At a glance
Title: In-situ experiments on the chemical composition of high altitude aerosols and clouds in the tropical upper troposphere and lower stratosphere
Funding scheme: ERC Advanced Grant
ERC funding: 2 780 000 €
Duration: 60 months
Start date: 01/03/2013
Host institution: Johannes Gutenberg University Mainz, DE
Principal investigator: Stephan Borrmann
Key words: atmospheric chemistry, aerosols, high clouds, chemical composition of particles, high altitude research aircraft, aerosol mass spectrometry

The challenge

The chemical composition of atmospheric aerosol and cloud particles is to be measured in-situ in the tropical upper troposphere and lower stratosphere. The corresponding altitudes of 16 to 20 km can be reached only by specialized high altitude research aircraft. The technological challenge is to devise fully automated measurement instrumentation which is capable of safely and reliably operating on a fast flying platform at ambient conditions with temperatures as low as –90 °C and only one twentieth of the ground pressure.

Project objectives

The physical and chemical properties of cloud forming aerosol particles are key elements for the mathematical representation of clouds within numerical models for climate and atmospheric chemistry. Of particular importance is the chemical composition of aerosol particles with sizes below 1 micrometer. Since clouds in the tropics can extend up to -almost unreachable- altitudes of 20 km such measurements need to be carried out on suitable aircraft platforms. The main project objectives thus are (1.) to design and construct fully automated instrumentation for in-situ chemical composition measurements and sampling, (2.) to implement these instruments on a high-altitude research aircraft, and (3.) to perform mission flights in the tropical upper troposphere and lower stratosphere as well as in the Tropical Transition Layer (TTL). The aim is to probe the air in the Asian monsoon region, if possible.

Methodology

New state-of-the-art instrumentation is being developed adopting aerosol mass spectrometry as main technique for in-situ, real time, direct-reading chemical analyses. This fully autonomous instrumentation is to be integrated on the Russian high-altitude research aircraft "M-55 Geophysica" and to be deployed at altitudes up to 20 km in the tropics and mid-latitudes. Additional instrumentation collects in-situ samples of the atmospheric particles for a-posteriori analyses in the laboratory by means of EDX electron microscopy and NanoSIMS in order to obtain more detailed information on particle sizes, morphological structure, and chemical composition. This way, for example, aerosol particles of meteoric origin can be identified and separated from anthropogenic, biogenic or mineral particles.

Emerging results

From EXCATRO we hope to gain essential insight into the processes underlying origin and the formation of tropical clouds and precipitation, as well as the formation of the global stratospheric aerosol. This is of relevance for climate and atmospheric chemistry e.g. in the context of stratospheric ozone production and destruction. Major emphasis is placed on the organic content of the aerosols and clouds, its sources and anthropogenic fraction, in particular from ground releases in the Asian Monsoon region and Southeast Asia. Due to the rapidly growing megacities and biomass-burning events we expect that the seemingly pristine tropical high altitude region already is affected by anthropogenic influence with "tele-connections" to the polar stratosphere and the ozone there.

The in-situ data will provide key input for the numerical simulation of clouds, and satellite product verification, which cannot be gained otherwise. EXCATRO will thus provide ground-breaking knowledge which is crucial to understand and mathematically describe of the role of tropical clouds and aerosols and their influence on the planet's atmospheric chemistry and climate.

IAGOS-ERI

At a glance

Title: In-service Aircraft for a Global Observing System – European Research Infrastructure

Instrument: Collaborative project and coordination and support action

Total cost: 4 389 127 €

EC contribution: 3 300 000 €

Duration: 60 Months

Start date: 01/09/2008

Consortium: 15 Partners from 3 countries

Project coordinator: Forschungszentrum Jülich GmbH, DE

Project website: www.iagos.org

Key words: Climate change, air quality, aviation, weather prediction

The challenge

Climate change represents arguably the most serious environmental issue mankind is facing today, with implications for global political stability and the global economy. Reliable predictions of future climate using climate models are a fundamental pre-requisite for determining future mitigation strategies.

The Intergovernmental Panel on Climate Change (IPCC) has emphasised the large uncertainties in the contributions of non-CO2 greenhouse gases, aerosol and clouds that prevent an accurate prediction of climate change and its causes. Particular uncertainties exist for the upper tropo-sphere and lower stratosphere, a very sensitive region for climate change, which is not adequately probed by satellites and ground-based systems.

Project objectives

IAGOS aims at establishing a cost efficient, world class Research Infrastructure for high-quality observations of atmospheric composition on a global scale. This will be achieved by merging scientific measurement technology with the global infrastructure of commercial aviation. The specific objectives are to:

- Collect global data sets of atmospheric chemical composition in the upper troposphere and lower stratosphere and vertical profiles of trace species by a set of autonomous instruments deployed aboard a fleet of passenger aircraft of internationally operating airlines.
- Provide long-term, frequent, regular, accurate, and spatially resolved in-situ data on atmospheric chemical composition, aerosol particles and clouds to the global scientific community.

Methodology

In IAGOS, two complementary approaches are combined:

1. AGOS-CORE: Implementation and operation of autonomous instruments installed in up to 20 long-range aircraft for continuous measurements of important reactive gases and greenhouse gases (ozone, carbon monoxide, nitrogen oxides, carbon dioxide, methane, water vapour), as well as aerosol (dust) and cloud particles. The installation consists of fully automated instruments that can operate aboard the aircraft in unattended mode for several weeks. The data are transmitted automatically via the global mobile phone network into the database and via SATCOM for real-time data users.
2. IAGOS-CARIBIC: Monthly deployment of a cargo container equipped with instrumentation for a much larger suite of components, including those above plus organic compounds, halocarbons, mercury, aerosol elemental composition, isotopes. The installation combines instrumentation for in-situ measurements and remote sensing, and the collection of samples for analysis in the laboratory.

This dual setup of IAGOS aims at providing global coverage of key atmospheric observables on a day-to-day basis with a more complex set of observations made less frequently and with reduced geographical coverage.

Expected results

IAGOS will eliminate major deficiencies in current atmospheric observation capabilities by filling the gap between satellite observations and ground based data.

IAGOS will provide long term, high-quality in-situ data for the upper troposphere and lower stratosphere where information is very sparse compared to the surface, although this region is paramount for understanding the causes of climate change. These data will serve as a basis for analyses of trends and budgets of atmospheric trace species as well as for investigating atmospheric transport processes

IAGOS will also provide vertical profile information at many locations over the globe from thousands of take-offs and landings. These profiles are essential for the validation of numerical models and satellite data products, including those used for IPCC and for the Copernicus Atmospheric Service.

Real-time transmission of IAGOS multi-component datasets will enable weather services and airlines to exploit the data for improving air quality forecasts and numerical weather prediction, and potentially for improved crisis management during volcanic eruptions.

Project partners	
Forschungszentrum Jülich GmbH	DE
Centre National de la Recherche Scientifique	FR
Meteo France	FR
University of Cambridge	UK
University of Manchester	UK
Deutsches Zentrum für Luft- und Raumfahrt e.V.	DE
British Airways plc	UK
Max Planck Gesellschaft e.V.	DE
Deutsche Lufthansa AG	DE
enviscope GmbH	DE
Leibniz Institut für Troposphärenforschung e.V.	DE
World Meteorological Organization	International Organisation
Natural Environmental Research Council	UK
Centre National D'Etudes Spatiales	FR
Airbus Operations SAS	FR

MEGAPOLI

At a glance

Title: Megacities: Emissions, urban, regional and Global Atmospheric POLlution and climate effects, and Integrated tools for assessment and mitigation

Instrument: Small or medium-scale focused research project

Total cost: 5 094 507 €

EC contribution: 3 398 989 €

Duration: 36 months

Start date: 01/10/2008

Consortium: 23 partners from 11 countries

Project coordinator: A. Baklanov

Project website: megapoli.info

Key words: Megacities, air pollution, climate change, atmospheric composition, urban meteorology and climate, urban effects, integrated modelling

The challenge

For the past few hundred years, human population has been clustering in increasingly large settlements, and in 2007 the world's urban population exceeded the rural. Megacities are highly populated urban areas with more than 5 Million inhabitants. At present, there are more than 30 megacities worldwide. In Europe there are several major centers that clearly qualify as megacities: London, Paris, the Rhine-Ruhr region, the Po Valley, Moscow, and Istanbul.

MEGAPOLI brings together leading European research groups, state-of-the-art scientific tools plus key players from non-European countries to investigate the atmospheric impacts of megacities. MEGAPOLI includes both basic and applied research, including feedbacks and mitigation, and bridges spatial and temporal scales connecting local emissions, air quality and weather with global atmospheric chemistry and climate. The project explores the hypothesis that megacities have an impact on air quality not only locally, but also regionally and potentially globally. MEGAPOLI addresses all major megacities, accounting for differences in developed and developing countries around the globe.

Project objectives

The main MEGAPOLI objectives are:

1. to assess impacts of megacities and large air-pollution hot-spots on local, regional and global air quality,
2. to quantify feedbacks among megacity air quality, local and regional climate, and global climate change,
3. to develop improved integrated tools for prediction of air pollution in megacities.

Methodology

The project includes modelling at all scales from urban to global, plus two month-long field campaigns examining the pollution plume of the Paris megacity. It is organized around 8 scientific workpackages, spanning from emissions through urban, regional and global impacts on air quality and climate. it includes development of tools for integrated air quality and climate assessment over multiple scales, as well as their application to assessing mitigation approaches.

Expected Results

The project is contributing to the strategic goal of promoting sustainable management of the environment and its resources. The expected main results of the project include:

1. Integration of the interactions and processes affecting air quality and climate change on different scales coupled with the capability of estimating the human, ecosystem and economic impact of air pollution resulting from megacities;
2. Development of an integrated European methodology and tools to assess the impacts within and from megacities on city to global scales;
3. Integration of ground-based, aircraft and satellite technologies with state-of-the-art modelling tools;
4. Integrated approaches for addressing the feedbacks and interlinkages between climate change and regional air quality related to megacities;
5. Integration of knowledge and practical implementation of improved tools according to the level of complexity to investigate a range of megacities and hotspots;
6. Improved current and future emission estimates for natural and anthropogenic sources of air pollutants;
7. Development of an integrated assessment methodology for supporting EU and global policy frameworks;
8. Examination of the key feedbacks among air quality and climate change;
9. Development of a robust, global information dissemination gateway on air quality, climate change and mitigation and policy options for European stakeholders strengthening the European Research Area.

Project partners	
Danish Meteorological Institute, DK	Paul Scherrer Institute, CH
Foundation for Research and Technology, Hellas, EL	TNO-Built Environment and Geosciences, NL
Max Planck Institute for Chemistry, DE	MetOffice, UK
ARIANET Consulting, IT	University of Hamburg, DE
Aristotle University Thessaloniki, EL	University of Helsinki, FI
Centre National de Recherche Scientifique, FR	University of Hertfordshire, UK
Finnish Meteorological Institute, FI	University of Stuttgart, DE
Joint Research Center, IT	World Meteorological Organization, CH
International Centre for Theoretical Physics, IT	Charles University Prague, CZ
King's College London, UK	Institute of Tropospheric Research, DE
Nansen Environmental and Remote Sensing Center, NO	University of Cambridge, UK
Norwegian Institute for Air Research, NO	

MOCAPAF

At a glance
Title: Role of Molecular Cluster in Atmospheric Particle Formation
Funding scheme: ERC Starting Grants
ERC funding: 1 476 418 €
Duration: 60 months
Start date: 01/02/2011
Principal investigator: Hanna Vehkamäki
Host institution: University of Helsinki, FI
Project website: wiki.helsinki.fi/display/SimuWiki
Key words: Atmopsheric aerosols, molecular clusters, particle formation

The challenge

Climate change is currently one of the central scientific issues in the world, and the ability to reliably forecast climate is crucial for making political decisions that affect the lives of billions of people. Aerosol particles remain the dominant uncertainty in predicting radiative forcing and future climate change, and they also have adverse effects on human health and visibility. One of the least-well understood aerosol-related processes is the formation of new particles from condensable vapours. While particle formation is related primarily to neutral clusters, state-of-the-art experimental methods measure only charged clusters.

Project objectives

The main scientific objectives of this project are 1) to understand the chemical composition of charged and especially neutral atmospheric clusters from molecular to multi-nanometre scale, and explain the mechanism by which they nucleate, and 2) to direct current intense instrument development and provide theoretical tools to maximize the information on neutral clusters that can be obtained from experimental results, which inevitably only yield direct data on charged clusters.

Methodology

Our scientific plan consists of a multilevel computational effort to provide formation rates and properties of atmospheric clusters and particles to aerosol dynamic and climate modellers. To capture the properties of the smallest clusters, we need to perform quantum chemical calculations, combined with simulations on cluster formation kinetics. Unfortunately, these methods are computationally far too demanding to describe the entire nucleation process. Thus, we will feed quantum chemical results to classical thermodynamic models, the results of which in turn must be parameterized for efficient use in larger-scale models.

Emerging results

The project will identify the molecular-level processes leading to climatically relevant atmospheric particle formation and parameterize these processes so that they can be effectively used in atmospheric and climate models. We will balso develop transfer functions, which allow data on neutral clusters to be extracted from experiments, which by necessity directly measure only charged clusters. Our group produces information on properties of nanoclusters both through purely computational studies, and by assisting in the design and interpretation of novel experiments. This information is of great interest not only in atmospheric sciences, but also in many other fields, from material science to the design of new pharmaceuticals and electronic devices.

PEGASOS

At a glance
Title: Pan-European Gas-Aerosol-Climate Interaction Study
Instrument: Large Scale Integrating Project
Total cost: 9 809 259 €
EC contribution: 6 999 992 €
Duration: 48 months
Start date: 01/01/2011
Consortium: 26 partners from 15 countries
Project coordinator: Spyros Pandis
Project website: pegasos.iceht.forth.gr
Key words: Climate change, air quality, mitigation strategies, air pollutant emissions, atmosphere-biosphere interactions.

The challenge

A rapidly emerging challenge for society is to tackle air pollution and climate change in a common policy framework. Many substances present in our atmosphere due to human activities play a dual role as climate change agents and as air pollutants. However, highly non-linear interactions of anthropogenic emissions with chemical reaction pathways, biosphere-atmosphere exchanges, climate, and pollutant transport make predictions of how this complex system will respond to changes in anthropogenic sources very difficult. A change of a single component can lead to significant and non-linear changes in others and the resulting feedbacks are critical to the behavior of the system as a whole.

Project objectives

The Pan-European Gas-AeroSOls-climate interaction Study (PEGASOS) European large scale integrating project brings together most of the leading European research groups, with state-of the-art observational and modeling facilities to:

1. Quantify the magnitude of regional to global feedbacks between atmospheric chemistry and a changing climate and to reduce the corresponding uncertainty of the major ones.
2. Identify mitigation strategies and policies to improve air quality while limiting their impact on climate change.

Methodology

The project is organized into four scientific themes designed to optimize the integration of methodologies, scales, and ultimately our understanding of air quality and climate change interactions:

1. Anthropogenic and biogenic emissions and their response to climate and socio-economy
2. Atmospheric interactions of chemical and physical processes
3. Regional and global links between atmospheric chemistry and climate change
4. Air quality in a changing climate: Integration with policy

PEGASOS will bridge the spatial and temporal scales that connect local surface-air pollutant exchanges, air quality and weather with global atmospheric chemistry and climate. Our major focus for air quality will be Europe including effects of changes in pollutant emissions elsewhere and the time horizon for the study will be the next 50 years.

The project will combine development of anthropogenic and biogenic emission inventories, laboratory studies in some of the premier European smog chamber facilities, field measurements over Europe using a Zeppelin combined with mobile and fixed ground platforms, air quality and climate models, and policy analysis to achieve its objectives.

Expected results

PEGASOS is providing:

1. Better estimates of air pollution in Europe and its impact on climate.
2. Support to the EC/Thematic Strategy on Air Pollution and Air Quality regulation.
3. Better quantification of regional and global links between air pollution and climate change to underpin mitigation options and other policy initiatives.

The philosophy of PEGASOS is to enhance our understanding of the interactions of climate and atmospheric chemistry in the past, present and future. This will allow us to assess the effectiveness of policies in-place and to better design future policy options. Policy making will be influenced by the PEGASOS outcomes; directly by public outreach, and providing relevant results to policy makers, and indirectly by delivering relevant scientific studies to international assessments and organisations that in turn are important in international and European policy making.

Through the long-standing involvement of most of its Partners in the IPCC process and other international assessments, PEGASOS ensures that results will have impact beyond Europe, which is important in the climate policy arena.

Project partners	
Foundation for Research and Technology, Hellas (EL)	University of Copenhagen (DK)
Research Centre Jülich (DE)	Weizmann Institute (IL)
University of Helsinki (FI)	Joint Research Center of the EU Commission
University of Leicester (UK)	Max Planck Institute (DE)
The French National Center for Scientific Research (FR)	Swiss Federal Institute of Technology (CH)
Institute of Atmospheric Sciences and Climate (IT)	Finnish Meteorological Institute (FI)
University of Lund (SE)	Paul Scherrer Institute (CH)
Wageningen University and Research Centre (NL)	Stockholm University (SE)
National University of Ireland, Galway (IE)	University of Leeds (UK)
Norwegian Meteorological Institute (NO)	Institute for Tropospheric Research (DE)
Natural Environment Research Council (UK)	Climate Service Center (DE)
AirEl (EE)	University Joseph Fourier ELenoble (FR)
International Institute for Applied Systems Analysis (AT)	Netherlands Environmental Assessment Agency (NL)

QUAERERE

At a glance
Title: Quantifying Aerosol-Cloud-Climate Effects by Regime
Funding scheme: ERC Starting Grant
ERC funding: 1 448 160 €
Duration: 60 months
Start date: 01/10/2012
Principal investigator: Johannes Quaas
Host institution: Universität Leipzig, DE
Project website: www.uni-leipzig.de/~climate/
Key words: climate, global climate change, aerosols, pollution, clouds, radiative forcing

The challenge

Climate change is one of the main concerns of humankind, yet it is poorly understood in quantiative terms. The largest uncertainty in the forcing of climate change is the effect of anthropogenic pollution (aerosols) on clouds. Aerosols serve as condensation and ice-forming nuclei for clouds and thus change their brightness as well as other properties such as their longevity. So far, no reliable, observations-based, global estimate exist beyond one study we did previously on the most basic effect on liquid-water clouds.

Project objectives

The aim is to quantify the best estimate and the uncertainty of the estimate for the so-called first indirect effect (the change in cloud brightness due to enhanced particle concentrations caused by the additional anthropogenic aerosols) and the second indirect effect (the effect of aerosols on cloud extent and water content) for both, liquid-water and ice clouds. This quantification shall be based as far as possible on observational data.

Methodology

The main method is to apply statistical analysis to satellite observations which are now available for more than a decade for most of the relevant quantities, and for more than five years including also vertical profile information. Reference ground-based measurements and modelling at global and regional scale will help to assess and improve the satellite statistics. The large internal variability of cloud systems will be accounted for by decomposing the global climate into individual aerosol-cloud regimes. Aerosol information will be used not directly from satellite data, but from a data-assimilation analysis which became available recently.

Emerging Results

QUAERERE will provide a best estimate and uncertainty range for the total aerosol cloud-climate effect. The uncertainty for second indirect effects and effects on ice clouds are expected to remain large in this first estimate, pathways to reduce the uncertainty will be proposed.

However, any observations-based quantification, even with a large error bar, will consitute a breaktrough in climate research, since it would allow also to interpret the observed global warming over the historical period and thus also allow to estimate climate sensitivity, or the warming expected for a given rise in greenhouse gas concentrations.

RECONCILE

At a glance

Title: Reconciliation of essential process parameters for an enhanced predictability of arctic stratospheric ozone loss and its climate interactions

Instrument: Collaborative project

Total cost: 4 656 564 €

EC contribution: 3 499 782 €

Duration: 48 months

Start date: 01/03/2009

Consortium: 16 partners from 8 countries

Project coordinator: Forschungszentrum Jülich, DE

Project website: www.fp7-reconcile.eu

Key words: Ozone layer, climate change, long term predictions

The challenge

The effects of the Montreal Protocol will very likely result in ozone recovery during the next few decades. In the long run, climate change and possible geo-engineering ventures to mitigate climate change may radically alter the temperature, circulation patterns and chemical composition in the stratosphere. To realistically predict the response of the ozone layer to these changes and the future evolution of Arctic ozone, a complete and correct representation of all relevant processes is necessary. RECONCILE sets out to reach full quantitative understanding of Arctic stratospheric ozone loss.

Project objectives

The issues where the lack of understanding is most palpable are (a) the catalytic ClOx/BrOx chemistry, (b) chlorine activation on cold stratospheric aerosol, (c) NAT nucleation mechanisms, and (d) mixing and transport of processed air to lower latitudes. A catalogue of open questions in all these areas has been defined including:

- Are there unknown additional mechanisms for O3 destruction in polar winter?
- Does the cold binary aerosol suffice to activate chlorine or are PSCs required?
- How does NAT nucleation leading to large denitrifying particles work?
- How intense is the transport through the vortex edge in both directions and how does it influence estimates of ozone depletion?

These and other important questions will be addressed in RECONCILE with the aim to develop parameterisations that can be used in computer models simulating stratospheric chemistry and transport.

Methodology

In the first project phase, a comprehensive approach of laboratory experiments, two field missions in the Arctic winter 2009/10 employing the high altitude aircraft M55-Geophysica and an extensive Match ozone sonde campaign, microphysical and chemical transport modelling as well as data assimilation is used to address the open questions defined in the objectives and produce reliable parameterisations of the key processes in Arctic stratospheric ozone depletion.

In the second phase, theseh are bridged to the large scale chemistry climate model (CCM) LMDZrepro. CCMs provide the prognostic tools to simulate the coupling between climate change and atmospheric chemistry. To assess the success of the CCM in simulating observed time series of total ozone, RECONCILE will adopt an innovative approach called detrended fluctuation analysis (DFA).

Expected results

Key results from laboratory experiments and the field activities in the Arctic winter 2009/10 include:

- Consistent quantification of the ClOOCl photolysis rate
- Unambiguous demonstration of heterogeneous NAT nucleation in the absence of ice and detection of various possible „nuclei", with implications for PSC formation and denitrification
- Strong evidence for significant chlorine activation not only on PSCs but also on cold binary aerosol
- Identification and quantification of discrepancies between observations and models with respect to transport and mixing (with ongoing work to refine the models)

Sophisticated process parameters and parameterisations have been implemented in the CCM LMDZrepro. Improved CCM simulations better reproduce observed past Antarctic ozone losses, while in the Arctic, external processes determining the stability of the polar vortex drive the interannual variability. In both hemispheres, the new and more robust CCM simulations confirm our current estimates of 21st century ozone depletion and recovery date.

Project partners	
Forschungszentrum Jülich	DE
University of Cambridge	UK
Deutsches Zentrum für Luft- und Raumfahrt	DE
Swiss Federal Institute of Technology	CH
Norwegian Institute for Air Research	NO
CNRS, Service d'Aeronomie	FR
University of Wuppertal	DE
Max-Planck-Institute Max Planck Society	DE
Centre Suisse d'Electronique et de Microtechnique	CH
Consiglio Nazionale Delle Ricerche	IT
Central Aerological Obervatory	RU
University of Heidelberg	DE
Karlsruhe Institute of Technology	DE
Eötvös University Budapest	HU
United Kingdom Meteorological Office	UK

SHIVA

AT A GLANCE
Title: Stratospheric ozone: Halogen Impacts in a Varying Atmosphere
Instrument: Small or medium-scale focused research project
Total cost: 4 748 000 €
EC contribution: 3 500 000 €
Duration: 48 months
Start date: 01/07/2009
Consortium: 13 partners from 6 countries
Project coordinator: University of Heidelberg, DE
Project website: shiva.iup.uni-heidelberg.de/
Key words: Stratospheric ozone, climate-change, halogens, very short-lived substances

The challenge

It is now well known that certain "ozone depleting substances" (ODSs) are broken down by the solar radiation in the stratosphere releasing the "halogen" elements: chlorine, bromine and iodine. The halogens are highly efficient at destroying ozone in the stratosphere, and rising concentrations from human activities has lead to depletion of global stratospheric ozone over the last three decades, and formation of the Antarctic "ozone hole". It is also known that ODSs enter the stratosphere principally in the topics, where ascending warm air carries them aloft. Climate feed-backs between the emissions and transport of ODSs exist, particularly in the tropics where even very short-lived (VSL) ODSs of natural origin (e.g. emitted by the oceans, and by marine and terrestrial organisms) can enter the stratosphere in powerful thundercloud systems.

Project objectives

SHIVA aims to reduce uncertainties in the amount of halogen-containing ODSs reaching the stratosphere, and the resulting ozone depletion, in a climate that is changing now, and which will change in the future.

Many short-lived ODSs are produced naturally in the world's oceans, the primary sources being coastal macro-algae (seaweeds), open ocean phytoplankton and aqueous photochemical reactions. There is strong evidence that the major VSL ODS emission regions are in the warmer waters found in the tropics, although very few measurements have been made to date. The Western Pacific region could be a highly significant location for two reasons: (i) it is an area where production rates of VSL ODS are likely to be high, and (ii) it is the most important region globally for efficient transport of low altitude (marine boundary layer) air to the stratosphere.

By combining measurements from land, ship, aircraft, and space-based platforms, with sophisticated numerical models, SHIVA aims to better predict the rate, timing and climate-sensitivity of ozone-layer recovery, and identify potential risks to that recovery.

Methodology

Long term measurements took place across the tropics. In late 2011 a core field campaign was performed in the South China Sea, and along the coastline of Peninsula Malaysia and Borneo using the Sonne Research Vessel, the DLR Falcon aircraft, satellites, and land-based investigation teams.

During this intense observation campaign the chemical transformation of ODSs during transport from the surface to the tropical tropopause layer (TTL), and in the stratosphere was studied using a combination of field observations together with process-oriented meso-scale modelling. These investigations were corroborated by space-based remote sensing of marine phytoplankton biomass as a possible proxy for the ocean-atmosphere flux of ODSs. From these investigations a systematic emission inventory of VSL ODSs could be established to allow construction of future-climate scenarios. The impact of climate-sensitive feedbacks between transport and the delivery of ODSs to the stratosphere, and their lifetime within it, has been studied using tracer observations and modelling.

Expected results

Global modelling is assessing the contribution of all ODSs to past, present and future ozone loss. The sensitivity of natural ODSs emissions to climate change parameters is used in combination with standard IPCC climate model scenarios in order to drive measurement-calibrated chemical transport model (CTM) simulations for present and future stratospheric ozone; to better predict the rate, timing and climate-sensitivity of ozone-layer recovery.

SHIVA brings together experts from different fields, ranging from marine biologists to atmospheric scientists. The improvement of the knowledge on how VSL ODSs are produced and emitted by the oceans and the factors influencing this (e.g. sea surface temperature, nutrient content and phytoplankton specification) is imperative in predicting how biospheric emissions of VSL ODSs will react to climate change and, further, which fraction of the emitted VSL ODSs will eventually reach the stratosphere.

SHIVA contributes to the scientific underpinning of the United Nations Montreal Protocol on Substances that Deplete the Ozone Layer, to the United Nations Framework Convention on Climate Change, and to global climate change research.

Project partners	
Ruprecht-Karls-Universität Heidelberg	DE
University of East Anglia	UK
Johann Wolfgang Goethe Universität Frankfurt	DE
Alfred-Wegner-Institute for Polar and Marine Research Potsdam and Bremerhaven	DE
Belgian Institute for Space Aeronomy	BE
University of Cambridge	UK
Leibniz-Institut für Meereswissenschaften an der Universität Kiel	DE
Centre National de la Recherche Scientifique	FR
University of Leeds	UK
The Norwegian Institute for Air Research	NO
Universität Bremen	DE
Deutsches Zentrum für Luft- und Raumfahrt	DE
University of Malaya	MY

SIDERI

At a glance

Title: Strengthening International Dimension of Euro-Argo Research Infrastructure

Instrument: Coordinating action

Total cost: 1 270 457 €

EC contribution: 900 000 €

Duration: 24 months

Start date: 01/12/2011

Consortium: 13 partners from 11 countries

Project coordinator: Emina Mamaca,

Project website: www.euro-argo.eu/

Key words: Argo, floats, climate change, ocean observatory, research infrastructure, GMES

The challenge

The main challenge of this project is an international extension of the Euro-Argo preparatory phase project, which addressed the legal and financial arrangements necessary to establish firmly a European Research Infrastructure consortium (ERIC). The project considered also strategic aspects of the infrastructure (its structure and operation, an analysis of float technology, strategy for deployment) and performed technical work on the data system and on float technology.

Project objectives

The objective of this project is to strengthen the links and integration of the Euro-Argo European research infrastructure (ERIC) into the Argo International strategy of global ocean observations, and to seek participation by, and to develop cooperation with, potential participants in the European neighbouring areas which have a maritime interest.

Methodology

The project is organized into six themes in order to optimize the integration of Euro-Argo into an international Argo context:

- first a work is planned on the evolution of the Argo core mission together with international partners (O2, bio-geochemical sensors, deep floats, extension to polar and marginal seas),
- a work on the evolution of the Argo data centers (Delayed Mode Quality Control of the North Atlantic ARC and Southern Ocean Argo Regional Center) and role of the European components is defined,
- we plan to refine the float deployment strategy in Europe and international seas and links with international partners,
- we make the interfaces with JCOMMOPS and Argo information center (AIC),
- a work is planned on legal aspects and policy issues (law of the sea) to identify possible difficulties in the operating plan,
- and finally we organize scientific and thematic (regional) workshops open to international partners to bring together different stakeholders.

Expected results

The expected result is to consolidate and broaden the present European participation in Argo and in ocean and climate research. By providing adequate networking and cooperation between member states, it will give an increased visibility to the large contribution made by Europe to Argo and will contribute to the development of Europe excellence in Argo-related research. The project plans to pursue further this cooperation with its international partners to reach agreement on the role of the ERIC in the long term operation of the Argo array, and on several key technical (float technology, data management and delivery system) and organizational (logistics for deployment, coordination of international contributions) issues.

Based on our recent activities in Europe, the project expects to have a major impact on the European contribution to the Argo array and its data management and delivery system, on enhancing European technical capabilities (instrumental performances, sensors, communication systems) and working towards extending Argo to study aspects of ocean biogeochemistry.

From the perspective of our European neighbourhood, beneficiaries expect to develop cooperative arrangements and to develop new partnerships between European Argo nations, new European countries and nations outside Europe.

Such arrangements could range from increased awareness of the wealth of high quality data, with easy access for scientific research, to different forms of collaboration in the implementation itself (e.g. the provision of ancillary data for completeness of the data sets, or logistical support for field operations), to full membership or observer status in the Euro-Argo ERIC.

A very significant increase in the number of floats to be deployed, the diversity of sensors to be added to the instruments, and the larger number of participants will have a positive impact on the research and development and commercial activities of the European companies manufacturing the instruments (in France and Germany). Our contacts with international colleagues should open up business opportunities and market shares for those companies.

This project is carried by the Euro-Argo preparatory phase project partners that form the future partners of the Euro-Argo ERIC.

Project partners	
INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER (FR)	MARINE INSTITUTE (IE)
BUNDESAMT FUR SEESCHIFFFAHRT UND HYDROELAPHIE (DE)	HAVFORSKNINGSINSTITUTTET (NO)
NATURAL ENVIRONMENT RESEARCH COUNCIL (UK)	HELLENIC CENTRE FOR MARINE RESEARCH (EL)
MET OFFICE (UK)	UNIVERSITE PIERRE ET MARIE CURIE - PARIS 6 (FR)
KONINKLIJK NEDERLANDS METEOROLOGISCH INSTITUUT-KNMI (NL)	SOFIISKI UNIVERSITET SVETI KLIMENT OHRIDSKI (BG)
INSTITUTO ESPANOL DE OCEANOELAFIA (ES)	INSTYTUT OCEANOLOGII POLSKIEJ AKADEMII NAUK (PL)
ISTITUTO NAZIONALE DI OCEANOELAFIA E DI GEOFISICA SPERIMENTALE - OGS (IT)	

SIP-VOL+

At a glance
Title: Stress-Induced Volatiles in Biosphere-Atmosphere System
Funding Schemes: ERC Advanced Grants
ERC funding: 2 259 366 €
Duration: 60 months
Start date: 01/05/2013
Host institution: Estonian University of Life Sciences, EE
Project website: cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=EN&PJ_RCN=13477944&pid=227&q=066797B6D3F374AB2E1221B33F072842&type=adv
Key words: plant volatiles, global change, stress, induced emissions, biogenic emissions

The challenge

Although it is accepted that plant trace gas (VOC) emissions play major roles in the formation of ozone, secondary organic aerosols (SOA) and cloud condensation nuclei (CNN) with potentially profound impacts on air quality and climate, the overall impact of VOC emissions in large-scale Earth processes is poorly understood. Research has focused only on constitutive emissions from certain "emitting" species. However, differently from constitutive emissions, all species can release induced VOCs under abiotic and biotic stress. As global change is resulting in higher level of stress in Earth ecosystems, relevance of induced emissions is expected to gain in importance.

Project objectives

So far, stress-induced high-reactivity plant-generated volatile organic compounds (VOCs) are not considered in global VOC budget, and thus, this proposal tests the key assumption that VOC emissions worldwide have been vastly underestimated. The current project has the overall objective to evaluate the effect of biogenic volatile emissions on air composition and environment under global change, with particular emphasis on the role of VOCs induced in response to environmental stress. In particular, the project intends to quantitatively test the possible feedback loops between plant stress resistance, VOC emissions and Earth System response. Plant VOC emission is expected to be an important factor reducing the speed of global climate change, and enhanced stress levels are expected to further dampen the rate of climate change. However, the effects depend on plant stress resistance in a complex manner, and quantitative assessments are needed to gain conclusive insight into the significance of the investigated phenomena.

Methodology

The study quantifies volatile production vs. stress severity relationships across species with differing stress tolerance under different atmospheric CO2 concentrations and advances and parameterizes the qualitative induced VOC model developed by PI's team. The novel quantitative model is further verified by flux measurements and scaled up to regional and global scales to assess the contribution of induced emissions to overall VOC budget, to study quantitatively stress-generated volatile production and formation of ozone, secondary organic aerosols and cloud condensation nuclei and to understand resulting effects on Earth climate using an hierarchy of models. The sensitivity of Earth climate to plant-generated volatile emissions is ultimately assessed by including the novel plant-driven feedbacks in Earth System Models.

Emerging results

This highly cross-disciplinary project is expected to result in key contributions in two research fields of major significance: plant stress tolerance from molecules to globe and the role of vegetation component in atmospheric reactivity and Earth climate. The first part of the study provides fundamental insight into the stress responsiveness of plants with differing tolerance to environmental limitations, extending "leaf economics spectrum", a hotspot of current plant ecology research. The second part provides quantitative information on large-scale importance of plant-generated volatiles in globally changing climates with major relevance for understanding the role of plants in the Earth System processes. The study particularly contributes to understanding of how vegetation adaptability and stress responses feedback to climate change, and what is the vegetation capacity to alter the rate of climate change.

4
Climate change impacts

ACCESS

At a glance

Title: Arctic Climate Change, Economy and Society

Instrument: Large-scale integrating project

Total cost: 14 861 574 €

EC contribution: 10 978 468 €

Duration: 48 months

Start date: 01/03/2011

Consortium: 27 partners from 10 countries

Project coordinator: Université Pierre et Marie Curie, FR

Project website: access-eu.org

Key words: Arctic climate change, sea ice, marine transportation, fisheries, offshore oil and gas, air pollution, marine pollution, governance, indigenous people

The challenge

The drastic retreat of Arctic sea-ice promises economic benefits but reminds us of the consequences of man-made climate change. A large population in the Arctic and abroad is concerned with climate change and economic development. Political decisions are in need of scientific information in all relevant fields of climate sciences. ACCESS aims at a better understanding of environmental changes in the Arctic and at quantifying the impact of climate change on key economic sector in order to assess the related risks and opportunities and to provide a foundation for sustainable development with a minimal impact on a sensitive environment.

Project objectives

ACCESS is composed of 5 working groups.

Climate change and the Arctic environment (WP1) is doing research on changing sea-ice properties and Arctic climate projections for the next 3 decades considering anthropogenic and natural sources of pollution.

Marine transportation in the Arctic (WP2), is evaluating the effects of climate change on increased Arctic shipping and tourism and considering rules and regulations, infrastructure needs, pollution and socio-economic costs and benefits.

(WP3) Fisheries is evaluating climate changes impact on Arctic fishers and aquaculture and the livelihood of communities and relevant economic actors.

(WP4) Resource extraction is assessing risks and opportunities related to the extraction of hydrocarbons from the Arctic Ocean in view of socio-economic impacts on European and World markets.

(WP5) Governance and Sustainable development is assessing shortfalls and lacunae in current regulations and is evaluating strategic options for integrated governance policy and sustainable development in the Arctic region.

Methodology

ACCESS aims at observing and modelling the Arctic environment, documenting, understanding and forecasting the atmosphere, ice and ocean as well as pollution. Regarding marine transportation and tourism, ACCESS will quantify the impact of climate change on routing, economy and environmental aspects. ACCESS will also evaluate and suggest improvements regarding safety and infrastructure needs. ACCESS will model and assess climate change impacts on Arctic fisheries and aquaculture. Specific aspects concern biological and regulatory constraints, socio-ecological feedbacks, input and output markets, exposure and social vulnerability of the sector. ACCESS will analyse the socio-economic impacts of resource extraction activity on economies and assess the risks of resource extraction and transportation in Arctic regions and provide recommendations. The development of Marine Spatial Planning (MSP) and of integrated Ecosystem Based Management (EBM) tools, and the effective participation of indigenous people in future Arctic governance will contribute to cross sectoral syntheses of economic, policy and governance options for sustainable development in the Arctic.

Expected results

ACCESS will provide tailored information about the Arctic climate system, for future developments during the next 3 decades with respect to key economic sectors. This will include information on changing ice conditions relevant to Arctic shipping operations, marine ecosystems mapping, offshore structure design and oil spill prevention. ACCESS will also provide recommendations for improving forecasting capabilities and observing systems. ACCESS will define necessary actions for implementation of marine transportation and tourism regarding economic opportunities and environmental protection, including noise effects on marine mammals. ACCESS will quantify climate change impacts on Arctic fisheries, aquaculture and related communities. Regarding oil and gas extraction modelling and assessing markets and economies, existing technology, rescue and evacuation crafts and vessels, risks related to oil spills and air pollution, sustainable development plans will be carefully evaluated. Specific attention will be given to governance, ecosystem conservation and socio-economic issues.

Project partners	
Université Pierre et Marie Curie (FR)	Shirshov Institute of Oceanology (RU)
O.A.Sys-Ocean Atmosphere Systems GmbH (DE)	IMPaC Offshore Engineering GmbH (DE)
Natural Environment Research Council NERC (UK)	Universitat Politècnica de Catalunya (ES)
Institut für Weltwirtschaft (DE)	Deutsches Zentrum für Luft & Raumfahrt (DE)
University of Cambridge UCAM/DAMTP (UK)	Arctic Antarctic Research Institute (RU)
Alfred-Wegener-Inst. für Polar&Meeresforschung (DE)	Economic & Social Research Institute ESRI (IE)
Schwarz Joachim Reinhold Franz (DE)	Lapin yliopisto (FI)
Nofima Marin AS (NO)	SINTEF Fiskeri og havbruk AS (NO)
Hamburgische Schiffbau-Versuchsanstalt GmbH (DE)	CICERO Senter for Klimaforskningstiftelse (NO)
Norsk Polarinstitutt (NO)	SINTEF Stiftelsen (NO)
Meteorologisk Institutt (NO)	GFEI Universität zu Köln GmbH- EWI (DE)
Fastopt GmbH (DE)	Association le Cercle Polaire (FR)
Scottish Association for Marine Sciences (UK)	Nordic Bulk Carriers AS (DK)
Kungl. Vetenskapsakademien (SE)	

ACQWA

At a glance

Title: Assessing climate impacts on the quantiy and quality of water
Instrument: Large-scale integrating project
Total cost: 8 563 566 €
EC contribution: 6 493 573 €
Duration: 60 months
Start date: 01/10/2008
Consortium: 30 partners from 10 countries
Project coordinator: Martin Beniston,
Project website: www.acqwa.ch/
Key words: Climate change, cryosphere, hydrology, socio-economic impacts, extreme events, governance, adaptation strategies

The challenge

Future shifts in temperature and precipitation patterns, and changes in the behaviour of snow and ice in many mountain regions will change the quantity, seasonality, and possibly also the quality of water originating in mountains and uplands. As a result, changing water availability will affect both upland and populated lowland areas. Economic sectors such as agriculture, tourism or hydropower may enter into rivalries if water is no longer available in sufficient quantities or at the right time of the year. The challenge is thus to estimate as accurately as possible future changes in order to prepare the way for appropriate adaptation strategies and improved water governance.

Project objectives

The project seeks to assess the vulnerability of water resources in mountain regions such as the European Alps or the Central Chilean Andes where declining snow and ice are likely to strongly affect hydrological regimes in a warmer climate. Model results are then used to quantify the environmental, economic and social impacts of changing water resources in order to assess how robust current water governance strategies are and what adaptations may be needed in order to alleviate the most negative impacts of climate change on water resources and water use.

Methodology

Current generations of state-of-the-art models are being applied to various interacting elements of the climate system, that include regional atmospheric processes in complex terrain, snow and ice, vegetation, and hydrology in order to project shifts in water regimes in a warmer climate in diverse mountain regions such as the Alps, the Central Andes of Chile, and the mountains of Central Asia (Kyrgyzstan). Observations, targeted models, and methodologies from the social sciences are applied to the impacts analyses on sectors such as tourism, agriculture and hydropower which could be strongly impacted upon by changing water regimes. The results from these different approaches then serve to suggest recommendations for adaptation and updated water governance strategies.

Expected results

- An integrated modelling approach to enable accurate projections of changes in the seasonality and quantity of runoff in the river basins under scrutiny in the ACQWA project
- The identification of key economic impacts on a number of sectors, including the possible compounded effect of changing frequencies and intensities of extreme events
- An assessment of the possible rivalries between economic actors that will be faced with changing water resources
- A portfolio of possible water governance strategies to alleviate future problems of water allocation and use, of relevance to future revisions of the EU Water Framework Directive

Project partners	
University of Geneva, CH	CNR-ISAC, Torino, IT,
Forschungsanstalt Reckenholz-Taenikon, CH	Fondazione Montagna Sicura, Valle d'Aosta, IT
ARPA Piemonte, IT	ICTP, Trieste, IT
ARPA Valle d'Aosta, IT	National Academy of Science, Bishkek, KG
Universität für Bodenkultur, Vienna, AT	CEA, Gif-sur-Yvette, FR
Universidad de la Serena, La Serena, CL	Monterosastar SRL, IT
Centro de Estudios Cientificos, Valdivia, CL	Max Planck Gesellschaft, Hamburg, DE
Instituto Torcuato di Tella, Buenos Aires, AR	Ente Parco Nazionale Gran Paradiso, IT,
Università degli Studi di l'Aquila, IT	Politecnico di Milano, IT,
CNRS, FR (3 entities: Grenoble (2) + Paris-Bellevue)	Universität Bern, CH
CSIC, Zaragoza, ES	The University of Birmingham, UK
Compagnia Valdostana delle Acque SPA, IT	Universität Graz, AT
ENEL Produzione SPA, Roma, IT	University of Dundee, UK
ETH-Zürich (3 entities), CH	Graduate Inst. Int'l Studies, Geneva, CH
Centre d'Etudes de la Neige, Grenoble, FR	Ricerca sul Sisema Energetico (RSE), Milan, IT

ANAEE

At a glance
Title: Infrastructure for Analysis and Experimentation on Ecosystems
Instrument: Collaborative project and coordination and support action
Total cost: 4 787 692 €
EC contribution: 3 400 000 €
Duration: 42 months
Start date: 01/11/2012
Consortium: 13 partners from 10 countries
Project coordinator: Abad Chabbi
Project website: www.anaee.com
Key words: Research infrastructure, ecosystem, experimental, distributed infrastructure, in natura platform, in vitro platform, ecotron, modelling platform, analytical platform, roadmap, governance, legal framework, business plan, innovation

The challenge

The effects of climate change and the increasing world population are challenging the capacity of ecosystems to provide goods and services long term. It is thus vital to understand how our ecosystems respond to these global changes and how managed ecosystem stewardship and resilience can ensure their sustainability. While the current set of monitoring and experimental sites distributed throughout Europe can provide some insight into ecosystem functioning, a fully integrated pan-European Research Infrastructure is needed to be able to fully understand the complexity of both managed (agricultural and forest) and natural ecosystems.

Project objectives

AnaEE will provide Europe with a distributed and coordinated set of in natura and in vitro experimental sites covering the full range of Europe's ecosystems and climate zones. These highly-equipped sites will be linked to centralised state-of-the-art analytical and modelling platforms that will analyse and predict in a precise manner the response of the main continental ecosystems to environmental and land use changes.

AnaEE is on the ESFRI (European Strategy Forum on Research Infrastructures) roadmap and will be rolled out in three phases:

- Preparatory Phase (2012 to 2016)
- Construction Phase (2014 to 2018)
- Implementation Phase (2018 onwards).

Methodology

In order to build the AnaEE infrastructure, the AnaEE Preparatory Phase will:

1. Develop a strategic plan and associated roadmap for AnaEE long-term sustainability, to ensure maximum impact and stakeholders satisfaction;
2. Elaborate a technical development plan for the construction and implementation phases in line with national roadmaps and in close consultation with the national research communities and stakeholders;
3. Agree on the set up of common central facilities and define the modality of access to the AnaEE infrastructures and tools to facilitate access to a large number of users;
4. Define and agree on a governance structure and legal framework for the construction and implementation phases;
5. Define a business model and associated business plan to ensure the sustainability of the financial, human and physical resources to maintain and upgrade the infrastructures in long term;
6. Establish links with private and public stakeholders through a specific Innovation program;
7. Implement a strong outreach programme to the science, environmental and political communities as well as the general public to promote the services and European added value of AnaEE.

Expected results

AnaEE will provide scientists with a unique platform to conduct experimental research into climate, land use and global changes. The integrated experimental, modelling and analytical facilities within AnaEE will allow scientists to manipulate drivers using state-of-the-art techniques in a highly interdisciplinary research environment and generate high quality data and projections on continental ecosystems responses to global changes.

AnaEE will provide industry actors with opportunities to develop new technologies as part of this state-of-art experimental platform enabling them to develop new products, expand markets and consequently create jobs and socio-economic benefits for society at wide.

AnaEE will provide policy makers with the capacity to acclimate and mitigate the effects of climate change by providing them with the quality data, analyses and forecasts needed to make informed decisions on environmental and land-use regulation and policies.

Project partners	Country
French National Institute for Agricultural Research-INRA	FR
Biotechnology and Biological Sciences Research Council	UK
Norwegian Institute for Agricultural and Environmental Research BIOFORSK	NO
French National Centre for Scientific Research CNRS	FR
Technical University of Denmark	DK
Istanbul Technical University	TR
Fondazione Edmund Mach	IT
CzechGlobe – Global Change Research Centre	CZ
University of Antwerp	BE
University of Helsinki	FI
Umeå University	SE
Rothamsted Research	UK
INRA Transfert	FR

ARCRISK

At a glance
Title: Arctic Health Risks: Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling
Instrument: Small or medium-scale focused research project
Total cost: 4 731 430 €
EC contribution: 3 499 052 €
Duration: 56 months
Start date: 01/06/2009
Consortium: 21 partners from 12 countries
Project coordinator: Arctic Monitoring and Assessment Programme (AMAP), NO
Project website: www.arcrisk.eu
Key words: climate change, persistent pollutants, mercury, long-range transport of contaminants, contaminant transfer and bioavailability, food web transfer of contaminants, human exposure, health effects, Arctic populations

The challenge

Global climate change has the potential to remobilize environmental contaminants and alter contaminant transport pathways, fate, and routes of exposure in human populations. The Arctic is particularly sensitive to climate change and already exhibits clear impacts. Research into contaminant exposure and its effects on human health in the Arctic, in comparison with other exposed populations in Europe, presents an opportunity to gain insight into changes that may later impact other areas. Projections of effects of climate change on contaminant exposure and health outcomes can be used to prepare strategies for adaptation and for prevention of adverse health outcomes.

Project objectives

To describe and quantify to the extent possible: 1) the transport routes of selected groups of contaminants to and within the Arctic and the potential influence of climate change; 2) uptake of these contaminants into food chains and their transfer to organisms consumed by humans, and possible influence of climate change on these processes; and 3) health outcomes related to exposure to contaminants in selected Arctic populations and exposed local populations in the EU. To develop projections for effects of climate change on contaminant exposure and health effects in the populations studied and develop scenarios of future health risks. To prepare strategies for adaptation and prevention of adverse health outcomes related to climate-mediated changes in contaminant exposure.

Expected results

A suite of abiotic modelling tools has been applied, including multimedia models and single media and coupled atmospheric and oceanic transport models, to model pollutant transport to the Arctic. Modelling simulations have been run under both current climate and projected future climate scenarios. A bioaccumulation model, which describes the food-web transfer of organic contaminants in an Arctic marine food web, has been developed and refined to determine the possible role of climate change on the food-web transfer of pollutants. Multi-media models have compared the influence of climate change on contaminant cycling in European regions as well as the Arctic and a modelling assessment to investigate climate-change induced effects on the environmental fate and transport of persistent organic pollutants in the Baltic Sea region has been conducted as a comparison region.

Fieldwork to examine contaminant deposition on the winter snowpack together with meltwater runoff has been conducted and laboratory simulations have been carried out to determine specific interactions of contaminants with snow/ice surfaces and the role of particles in contributing to the contaminant burden in snow. An assessment has been prepared of contemporary PCB loads to the coastal seas of the Arctic Ocean and the input of PCBs via the major Arctic-draining rivers. The occurrence and behaviour of organochlorine pesticides in a fjord in western Greenland has been examined. Contaminant fluxes from sea ice to marine surface waters have been assessed and samples have been taken around Svalbard to assess contaminant concentrations in seawater, sea ice and the sea-ice snowpack. Samples of marine and terrestrial biota, including several species of fish, reindeer and ptarmigan, as well as 'food-basket' samples from Greenland have been collected and analysed for organic contaminants to determine dietary sources and levels of contaminants affecting people in the Arctic.

A database on contaminant concentrations in tissues from people living in the Arctic and associated health outcomes has been created and reviews have been prepared concerning the association between exposure to PCBs and dioxins in relation to several types of health outcomes. An overall report has been prepared on the health effects of contaminants on people living in the Arctic based on the results of several human cohort studies, particularly mother-child cohorts, as well as a review of contemporary literature and a similar report has been prepared for health effects in the Mediterranean area. Dietary sources of contaminants in the Arctic have been reviewed, particularly for those cohort studies that included food frequency questionnaires, and some estimates will be made of the potential influence of climate change on dietary sources of contaminants for people in the Arctic.

Case studies reviewing PCBs and Hg from emissions through transport to the Arctic, transfer through environmental media and into food webs and ultimately to humans and health effects are being prepared. An overall synthesis report will also be prepared, in addition to the many scientific papers that have been or will be published. A web-based legacy 'database' containing an overview of the results of the project for policy makers, the public and scientists is being developed. The final conference will be held at Arctic Frontiers 2014 in Tromsø, Norway in January 2014.

Project partners	
Arctic Monitoring and Assessment Programme Secretariat, NO	Max Plank Institute for Chemistry (DE)
Department of Applied Environmental Science, Stockholm University (SE)	Department of Environmental Sciences, Jožef Stefan Institute (SI)
Department of Environmental Science, Aarhus University (DK)	O.A.Sys – Ocean Atmosphere Systems GmbH (DE)
Alfred Wegener Institute for Polar and Marine Research (DE)	Swiss Federal Institute of Technology, Zurich CH
Environmental Science Department, Lancaster University (UK)	Res. Centre for Environ.Chem. & Ecotoxic., Masaryk Univ. (DE)
University Centre in Svalbard NO	Dept. of Food Safety, Norwegian Institute of Public Health NO
Inst. Env. Assessment & Water Res., Spanish Council for Sci. Res. (ES)	Water Sci. & Tech. Directorate, Environment Canada, CA
IVL, Swedish Environmental Research Institute (SE)	Freshwater Institute, Department of Fisheries and Oceans , CA
Thule Institute, University of Oulu (FI)	Norwegian Institute for Air Research, NO
Safe Environments Programme, Health Canada CA	Institute of Community Medicine, University of Tromsø, NO

ATOPICA

At a glance

Title: Atopic diseases in changing climate, land use and air quality
Instrument: Small or medium-scale focused research project
Total cost: 4 426 870 €
EC contribution: 3 497 160 €
Duration: 36 months
Start date: 01/10/2011
Consortium: 11 partners from 7 countries
Project coordinator: Michelle Epstein
Project website: www.atopica.eu
Key words: Climate change, air quality, pollution scenarios, ambrosia pollen, allergic diseases, land use, experimental animal models of allergic disease

The challenge

Climate change foreseen for the next several decades of the 21st century over the European region is expected to increase the occurrence of extreme events, such as heatwaves, droughts and floods, to worsen air pollution through higher temperatures and more stagnant conditions, which may cause migration of new invasive plant species and disease vectors. The complex interplay across these multiple stressors might exacerbate the overall effect of environmental change on human health in synergistic ways that are difficult to assess from a disciplinary perspective. It is therefore necessary to develop integrated and cross-disciplinary approaches to assess health risks consequent to severe environmental change and to design suitable adaptation policies.

Project objectives

- explore the pan-European impact of changes in climate, land use and air pollution on pollen-induced allergic diseases through a novel chain of quantitative models
- study vulnerable groups of allergic patients and search for predictive biomarkers
- establish statistical models of disease response to pollen concentrations for assessing future trends and risk
- examine the effects of environmental change, including exposure of pollen to air pollution to determine effect on allergenicity in laboratory experiments
- communicate with relevant stakeholders and provide recommendations for potential response strategies to policy makers

Methodology

Atopica is establishing quantitative models of allergic disease due to different environmental stressors with the aim of making projections of future disease risk. The focus is on Ambrosia artemisiifolia L. (Asteraceae), commonly called ragweed, which is a highly invasive plant with pollen that causes allergic disease and has the potential to cause significant negative impacts on the European economy through its effect on health, agriculture, biodiversity and tourism. The Atopica conceptual framework shows allergic disease as a function of hazards, vulnerabilities and exposures. Climate conditions and land cover are key drivers of the development of pollen. Thus, new-targeted climate and air quality simulations are being undertaken focusing on the Atopica case-study areas in Croatia and Southern Germany. Clinical studies focusing on children and the elderly are being undertaken as part of these case studies. Children in Croatia, for example, are completing daily pollen diaries during pollen seasons. Synthesised outputs from these field studies will be combined with observed and simulated information on climate, air quality and pollen to build quantitative risk assessment models.

Expected results

- improved understanding of allergic disease response to multiple environmental stressors
- scenarios of allergic disease risk for near- and long-term future time horizons
- information useful for response options at national and European levels
- increased awareness of allergic diseases risk in response to multiple environmental change
- improved communication strategies between science and stakeholder communities

A better understanding and quantification of the effects of environmental changes on Ambrosia pollen-induced allergic disease in Europe, with early detection and awareness of invasive plants will support preventive management initiatives, along with sustainable strategies to control and reduce this invasive plant at national, local and European levels. To date one of the major achievements of Atopica is the creation of a conceptual framework. This is being used to facilitate a clear understanding of the Atopica project by all beneficiaries, partners and stakeholders. The conceptual framework presents allergic disease as a function of hazards, vulnerabilities, and exposures. In the Atopica conceptual framework, the outcome is allergic disease. In this framework, climate conditions and land cover are shown to be key drivers of the development of pollen, which presents the hazard to human health. Social and behavioural vulnerabilities can influence the degree to which individuals are exposed (with behavior also being affected by climate independently). Interventions such as pollen warning systems can also have impact on the level of exposure to pollen. Individual biological factors can alter the severity of the final outcome of allergic disease, and these can be influenced by both air quality (which itself can be influenced by climate) and interventions such as medication.

Project partners	
Medizinische Universitaet Wien	AT
Abdus Salam International Centre for Theoretical Physics	IT
Children's Hospital SREBRNJAK Croatia University	HR
Institut National de l'Environnement Industriel et des Risques	FR
Centre National de la Recherche Scientifique	FR
Moverim Consulting sprl	BE
Promoscience srl	IT
Rothamsted Research	UK
Universitaet Ulm	DE
University of East Anglia	UK
Università San Raffaele	IT

CIRCLE-2

At a glance

Title: Climate Impact Research & Response Coordination for a Larger Europe

Instrument: Coordination and support action

Total cost: 2 270 000 €

EC contribution: 2 000 000 €

Duration: 48 months

Start date: 01/05/2010

Consortium: 20 partners and 14 contributing partners from 23 countries

Project coordinator: Foundation of the Faculty of Sciences of Lisbon University, PT

Project website: www.circle-era.eu/

Key words: climate adaptation research, research coordination, science-policy interface, research agenda, research funding, joint initiatives, joint programming.

The challenge

Climate Change is one of the most important challenges facing the world in this century in all the four dimensions of sustainable development (ecological, economic, social and cultural).

Europe takes a leading role in the necessary response to these challenges. Severe impacts are unavoidable and European adaptation strategies must be supported by a coherent base of knowledge on its key vulnerabilities and response options. Such a base can only be generated by European, national and regional policy-relevant research.

Project Objectives

- Coordinate European transnational research funding on Climate Adaptation.
- Facilitate the transfer of research outcomes necessary to design effective yet economically efficient Adaptation initiatives and strategies.
- Share experiences and knowledge on Climate Adaptation and on national/sub-national Adaptation practices.
- Encourage international cooperation with non-European countries and the involvement of countries with less diverse research programme.

Methodology

The methodology is based in a flexible work plan that will LEAD the consortium to identify common policy-relevant CCIVA research needs. Those needs will serve to DESIGN a joint research agenda and deepen the networking and cooperation activities of the consortium. CIRCLE-2 will FUND transnational joint research initiatives including joint calls for projects on CCIVA. The outcomes of these initiatives and projects will provide the consortium with an updated knowledge base on European, National and Regional CCIVA research and CIRCLE-2 will SHARE this knowledge base with decision-makers at all relevant scales. CIRCLE-2 will thus contribute to the development of both European and national Climate Change response frameworks (e.g. Adaptation Strategies) by facilitating research outputs tailor-made to common needs. International cooperation with non-European countries (e.g. developing countries) as well as the involvement of new EU Member States and candidate countries will be particularly encouraged throughout CIRCLE-2 lifetime.

Expected results

CIRCLE-2's national and regional members have to take strategic decisions on their Climate Change Impacts, Vulnerability and Adaptation (CCIVA) programmes and manage them according to their knowledge of national and international research needs. Improving the transnational relevance of such decisions is a key feature of the ERA-Net as it is providing sound support to on-going European and national frameworks on Climate Change responses. This effort will result in an improvement of the common knowledge base which is needed for the coherent design of European climate Adaptation strategies.

Climate Adaptation will be a long and continuous process since it will operate at all levels and require close coordination with stakeholders. In order to succeed, European, national, regional and local authorities must cooperate closely and identify common needs and available options. Coordinated research efforts are needed to provide policy developers with a clear overview of research knowledge, to enable an evaluation of their various available options and to help national and regional programmes to align their activities within the European frameworks for Climate Change responses.

By developing open, long lasting and sustainable collaboration within and outside the consortium, CIRCLE-2 will reinforce the cooperation between CCIVA research programmes in Europe. Such efforts will contribute to the optimization of research spending and help maximize the research outcomes needed to address European climate policy needs.

Project partners	
Foundation of the Faculty of Sciences of Lisbon University	PT
Environment Agency Austria	AT
Foundation for Science and Technology	PT
Euro-Mediterranean Centre on Climate Change	IT
Ministry for Ecology, Sustainable Development and Energy	FR
Ministry of Economy and Competitiveness	ES
Swedish Meteorological and Hydrological Institute	SE
Knowledge for Climate Research Programme	NL
The Academy of Finland	FI
Irish Environmental Protection Agency	IE
German Aerospace Center- Project Management Agency	DE
Mariolopoulos-Kanaginis Foundation for the Environmental Sciences	EL
The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning	SE
Ministry of Rural Development	HU
Scientific and Technological Research Council of Turkey	TR
Estonian Research Council	EE
Israel Ministry of Environmental Protection	IL
Public Agency Flanders Hydraulics	BE
Department for Environment, Food and Rural Affairs	UK

CLAMER

At a glance

Title: Climate change and marine ecosystem research results
Instrument: Coordination and Support Action
Total cost: 1 158 936 €
EC contribution: 991 357 €
Duration: 18 months
Start date: 01/04/2010
Consortium: 22 partners from 12 countries
Project coordinator: Royal Netherlands Institute for Sea Research, NL
Project website: www.clamer.eu
Key words: climate change, marine ecosystems, public awareness, EU research results, dissemination

The Challenge

There is no certainty regarding the precise nature and rate of future climate change, but for the marine environment even the most moderate scenarios predict on-going alterations. The knock-on ecological and social impacts are potentially severe.

In preparing to mitigate and adapt to these changes, stimulating society's understanding of research findings, including the uncertainties, is key.

The first step towards realising this goal is to summarise what is already known about marine climate change and where the gaps in knowledge exist, both at national and global scales; translation and dissemination of this information to the various stakeholders should follow.

Project objectives

- To summarize EU research results regarding the impacts of climate change on the marine environment, including socio-economic aspects.
- To review the current gaps in EU research related to the impacts of climate change on the European marine environment.
- To assess the achievements of earlier EU 'outreach' programmes and their methodologies.
- To assess what the European public know and care about with regard to the effects of climate change on European seas.
- To disseminate the results of relevant EU research and the CLAMER project findings to the general public, European policy makers, scientific communities and other stakeholders by various innovative means.

Methodology

The project was organised into 4 work packages to cover: 1. Project coordination, 2. Scientific information, 3. Public perception, 4. Informing the general public, policy makers and other stakeholders of the project's main findings.

Initial project outputs were in report format, relying on desk-based research (primary literature and internet resources). Authors of the reports included the CLAMER Scientific Expert Panel, comprised of some of Europe's top scientists in the fields of marine climate change. Project outputs were reviewed both internally and externally.

Other research methods included the use of an internet-based questionnaire, polling 10 European countries to assess the EU public's perception and knowledge of climate change and its impacts on the marine environment.

Dissemination methods included various events at marine institutes and aquaria, a CLAMER film, a project book and a pan-European conference.

Results

- A state-of-the-art synthesis report to inform policy makers on the effects of climate change on Eu-

ropean marine ecosystems and socio-economic impacts.
- A peer-reviewed article for the scientific community.
- A policy briefing identifying the gaps in themes and regions of European marine climate change research, focused at policy makers and researchers.
- A public perception flyer summarising the CLAMER poll results on European public awareness of marine climate change issues, aimed at informing and supporting the social-science and education sectors.
- An evaluation report assessing previous EU 'outreach' programmes and their methodologies to provide the science and government sectors with 'good practice' guidelines in dissemination.
- A website, an illustrated book, a 52-minute documentary DVD, and various events at marine institutes and aquaria to stimulate broad public learning and interest in all CLAMER-related topics.
- A pan-European conference in Brussels to convey the CLAMER results and stimulate 'next step' discussions for policy-makers and the media.

Project partners	
Directorate and Dept. of Marine Ecology, Royal Netherlands Institute for Sea Research	NL
Marine Board-European Science Foundation	BE
Centre for Environment, Fisheries and Aquaculture Science	UK
Flanders Marine Institute	BE
Centre for Ocean and Ice, Danish Meteorological Institute	DK
Directorate, Plymouth Marine Laboratory	UK
European Institute for Marine Studies, Univ. of Western Brittany	FR
Dept. of Ocean Science, Marche Polytechnic Univ.	IT
Institute of Oceanography, Hellenic Centre for Marine Research	EL
Dept. of Earth and Ocean Sciences, National Univ. of Ireland, Galway	IE
Dept. of Ecosystem Studies, The Netherlands Institute of Ecology	NL
National Oceanography Centre, Univ. of Southampton and Natural Environment Research Council	UK
School of Environmental Sciences and Tyndall Centre, Univ. of East Anglia	UK
Océanopolis, SOPAB Brest	FR
Sir Alister Hardy Foundation for Ocean Science	UK
Dept. of Global Change Research, Mediterranean Institute for Advanced Studies	ES
Norwegian College of Fishery Science, Univ. of Tromsø	NO
Dept. of Atmospheric Composition and Surface Fluxes, Climate and Environment Sciences Laboratory	FR
Graduate School of Marine Sciences, Middle East Technical Univ.	TR
Department of Ecology, Pontifical Catholic Univ. of Chile	CL
School of Psychology, Cardiff Univ.	UK
The Scottish Association for Marine Science	UK

CLARIS LPB

At a glance
Title: A Europe South-America Network for Climate Change Assessment and Impact Studies in La Plata Basin
Instrument: Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 4 279 297 €
EC contribution: 3 358 995 €
Duration: 48 months
Start date: 01/10/2008
Consortium: 20 partners from 10 countries
Project coordinator: Institute de Recherche pour le Development (IRD), FR
Project website: www.claris-eu.org
Key words: climate change, impacts, adaptation strategies, La Plata Basin

The challenge

The CLARIS LPB Project aims at projecting the regional climate change impacts in La Plata Basin (LPB) in South Eastern South America, and at designing adaptation strategies for land-use, agriculture, rural development, hydropower production, river transportation, water resources and ecosystems in wetlands.

Project objectives

- Improve the description and understanding of decadal climate variability for short-term regional climate change projections (2010-2040).
- Improve the prediction capacity of climate change and its impacts in the region, through an ensemble of coordinated regional climate scenarios in order to quantify the amplitude and sources of uncertainties in LPB future climate at two time horizons: 2010-2040 for adaptation strategies and 2070-2100 for assessment of long-range impacts.
- Design adaptation strategies to regional scenarios of climate change impacts through a multi-disciplinary research.
- Involve and integrate stakeholders in the design of adaptation strategies through an interactive and communicative process, ensuring their dissemination to public, private and governmental policy-makers.
- Foster long-term collaborations between European and South American Partners (sustained beyond the project lifetime).
- Train young scientists in South American and European institutes.

Methodology

This multidisciplinary network is divided in four inter-related and fully complementary Subprojects (which are also divided in different work packages):

- *Subproject 1: Management, dissemination and coordination activities.*
- *Subproject 2: Past and future hydroclimate.* The objective is to improve our description and understanding of past and future climate variability in order to better represent possible future climate scenarios and quantify their possible uncertainties.
- *Subproject 3: Project interface.* The aim is to bridge climate and socio-economic issues to improve the multidisciplinary project activities and our communication.
- *Subproject 4: Socio-economic scenarios and adaptation/prevention strategies.* The objective is to build adaptation strategies to climate change on different issues associated to land-use, agriculture, deforestation, hydropower production, floods and ecosystems in wetlands.

CLARIS LPB uses methodology from natural and social sciences.

Expected results

In terms of climate research, CLARIS LPB gathered a unique daily meteorological database, analysed climate variability, trends and extreme events (drought, floods) in LPB, and performed an unprecedented coordinated ensemble of seven regional model simulations for present and future climate projections for 2010-2040 and 2070-2100 periods over the whole South American continent at 50km resolution.

The Government of Argentina will officially use these simulations in order to perform its Third National Communication on Climate Change.

Issues such as social and economic implications of land use changes due to different climate change scenarios, the design of adaptation strategies of land use based on crop modelling, the identification of drivers of fire occurrence, stakeholder involvement, and cattle production in situations of climate risk have been analyzed and discussed. The research was carried out in several study sites within LPB, and showed the importance of the involvement of local decision makers as well as affected farmers in the process of developing adaptation strategies.

In order to assess water resources impacts in La Plata Basin in the context of climate change, we analysed two distributed hydrological models, and focused on sectors such as energy, navigation, ecology and floods.

Project partners	
Institut de Recherche pour le Développement - IRD	FR
University of East Anglia - UEA	UK
Leibniz-Zentrums für Agrarlandschaftsforschung – ZALF	DE
Max-Planck Gesellschaft Institut – MPG	DE
Euro Mediterranean Center on Climate Change- CMCC	IT
Universidad de Bologna - UNIBO	IT
Universidad de Castilla La Mancha - UCLM	ES
Swedish Meteorological and Hydrological Institute - SMHI	SE
Instituto Nacional de Pesquisas Espacias - INPE	BR
Universidade de São Paulo - USP	BR
Universidade Federal de Santa Catarina - UFSC	BR
Universidade Federal do Paraná - UFPR	BR
Consejo Nacional de Investigaciones Cientificas y Técnicas - CONICET	AR
Universidad de Buenos Aires - UBA	AR
Instituto Nacional de Tecnología Agropecuaria - INTA	AR
Instituto Nacional del Agua - INA	AR
Universidad de la República - UR	UY
Centre National de la Recherche Scientifique - CNRS	FR
Ricerca sul Sistema Energetico - RSE SpA	IT
University of Geneve - UNIGE	CH

CLEAR

At a glance
Title: Climate change, environmental contaminants and reproductive health
Instrument: Small or medium-scale focused research project
Total cost: 3 181 079 €
EC contribution: 2 377 604 €
Duration: 54 months
Start date: 01/05/2009
Consortium: 8 partners from 8 countries
Project coordinator: Aarhus University Hospital, DK
Project website: www.inuendo.dk/clear
Key words: climate change, chemical exposure, human health effects

The challenge

This research project investigates the possible impact of global climate change on reproductive health in Arctic and three local European populations. The key questions to be addressed are, first, how may climate change impact on human exposure to widespread environmental contaminants and, second, how may contaminants impact on occurrence of reproductive disorders as sensitive indicators of health.

Project objectives

To provide affirmative answers to these questions the project will

(i) identify and describe mechanisms by which a changing climate may affect the exposure of arctic and other human populations to contaminants through change in chemical use and emissions, delivery to the arctic ecosystem as well as processing within the arctic physical environment and human food chain.

(ii) expand the existing knowledge database on human exposure to polybrominated diphenylethers, perfluorinated surfactants and phthalates by analyses of 1000 biobanked serum samples collected in the EU FP5 programme INUENDO.

(iii) increase the limited knowledge on links between human exposure to contaminants and reproductive health.

(iv) integrate data on relative climate induced changes in contaminant mobility and distribution and links between contaminant exposure and reproductive health into a risk evaluation providing insight into possible future risk scenarios related to global climate change.

Methodology

1. Modelling climate change and contaminant mobility and distribution.
2. Exposure assessment (analyses of up to 1500 biobanked serum samples for the content of perflourinated comounds, hexachlorbenzen, phthalate metabolites, heavy metals and polybrominated diphenyl ethers).
3. Epidemiological evaluations of male and female fertility in relation to exposure to the measured contaminants.
4. Collection of new data on childhood growth and development from a cohort of approximately 1500 mother child pairs.
5. Assessment of the impact of polymorphisms in genes related to androgen, estrogen and aryl hydrocarbon pathway and measurement of global methylation status in human semen samples.
6. Developing of models for evaluation of internal exposure based on predicted changes in exposure levels and measured level of exposure to be used for human risk assessment.
7. All results from the project will be used for risk assessment and risk evaluation providing insight into possible future risk scenarios related to global climate change.

Expected results

We expect that the CLEAR project will provide a quantitative evaluation of health risks in populations in the Arctic and selected areas in Europe due to the spreading of contaminants resulting from climate change. We use the largest existing mother-father-child cohort that include Arctic as well as several local European populations with average or high exposure levels. Hereby the project will, firstly, provide comprehensive and entirely new data on exposure profiles for several compounds that are of high concern because of possible reproductive effects. Secondly, it becomes possible cost-efficiently to add new original data to the limited knowledge on health outcomes in humans. In short, this project relies not only on existing data but will feed needed new original data into the assessment of risk related to environmental contaminants and future scenarios related to climate change.

Project partners	
Aarhus University Hospital, Department of occupational medicine	DK
Lund University, Department of Occupational and Environmental Medicine and Reproductive Medicine Center	SE
Ente per le Nuove tecnologie, l'Energia e l'Ambiente (ENEA)	IT
National Institute of Public Health – National institute of Hygiene (PZH)	PL
Kharkiv National Medical University	UA
Greenland Institute of Natural Resources	GL
Universitet Utrecht Institute for Risk Assessment Sciences	NL
University of Toronto, Department of Physical and Environmental Sciences	CA

CLICO

At a glance

Title: Climate Change. Hydro-conflicts and Human Security
Instrument: Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 3 766 269 €
EC contribution: 2 991 352 €
Duration: 36 months
Start date: 01/01/2010
Consortium: 14 partners from 11 countries
Project coordinator: Unversitat Autonoma de Barcelona, ES
Project website: www.clico.org/
Key words: water, droughts, floods, climate change, conflict, security, vulnerability, adaptation, transboundary management, institutions, Middle East, Sahel, socio-economic sciences and humanities.

The challenge

Climate change will have an enormous impact on environmental, social and economic conditions and may affect human security by exacerbating violent conflict. There are studies claiming that water and climate-related conflict may result from scarcity of water resources, a situation that may become more frequent or severe through climate change. However, climate change does not automatically lead to a worse human security situation or to conflict. Rather, there are complex relationships between political, social, economic, environmental and other factors that, in conjunction with climate change, can either undermine security or trigger/exacerbate conflicts.

Project objectives

CLICO explored the social dimensions of climate change and in particular the conditions under which hydro-climatic hazards, such as drought or floods, may infringe upon the security of human populations. The project focused on the geographical areas of the Mediterranean, Middle East and the Sahel, and on water-related stresses such as droughts, floods and sea-level rise, expected to intensify with climate change. More concretely, the project pursued the following objectives:

1. To understand relationships between hydro-climatic hazards, climate change vulnerability, human security and conflict, through theoretically-informed, comparative, empirical, quantitative and qualitative social science research.
2. To map international and national policies for security and adaptation in water resources and hazard management, and develop policy priorities as regards hydro-climatic hazards ("hydro-security") in the region, applicable to the UN, EU and national states.

Methodology

CLICO's scientific approach has been structured around one theoretical-conceptual and four empirical blocks of research, specifically:

- A conceptual framework developed at the initial stage of the project and updated at its end on the basis of empirical findings.
- In-depth case studies on the links between climate change and human security in 11 climate change hotspots.
- A statistical study of factors explaining domestic water related conflict and cooperation in 35 countries for the time period of 1997-2009, taking account more than 10 000 water-related events.
- An inventory of international and national policies dealing with water resource management, and responses to climate change, security, hydrological hazards and disasters.
- An appraisal of transboundary policies, including an evaluation of the adaptive capacity of institutions in the 42 shared, international basins of the study area, and an assessment of ways in which climatic uncertainties are tackled in international water treaties.

Expected results

Key findings:

- Climate change is one among many factors affecting human security
- Climate change is less influential than political, economic and social factors in causing or exacerbating water-related conflicts (for majority of CLICO studies)
- States are important actors in adaptation, but not the only ones; civil society and self-adaptation are also relevant
- Climate change adaptation can increase human insecurity and conflict, e.g. via divergent or mal-adaptations

Recommendations for policy-makers:

- Address root causes of vulnerability, such as poverty, lack of knowledge and institutions plagued by corruption
- Strengthening social security systems is an effective way for improving human security
- Affected groups should be empowered to influence adaptation decisions
- Integrate policies, e.g. link adaptation to policy agendas such as human development and poverty reduction
- Implementing some existing policies could improve human security
- Avoid simplistic explanations on the impact of climate change on conflict

Project partners	Country
ICTA, Universitat Autònoma de Barcelona	ES
Tyndrall Centre for Climate Change Research, University of East Anglia	UK
ECOLOGIC GmbH Institut für Internationale und Europäische Umweltpolitik	DE
Centre for the Study of Civil War (CSCW), International Peace Research Institute, Oslo (PRIO)	NO
Department of Geography, The Hebrew University of Jerusalem	IL
Suez Canal University	EG
Swiss Federal Institute of Technology, Zurich	CH
The Cyprus Institute	CY
School of Global Studies, University of Sussex	UK
United Nations University, Institute for Environment and Human Security	DE
Palestinian Hydrology Group For Water And Environmental Resources Development	PS
Centre de Recerca Ecològica i Aplicacions Forestals	ES
Israeli – Palestinian Science Organization	BE
Addis Ababa University	ET

CLIMATE FOR CULTURE

At a glance
Title: Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change
Instrument: Large-scale integrating project
Total cost: 6 566 393 €
EC contribution: 4 964 865 €
Duration: 60 months
Start date: 01/11/2009
Consortium: 27 partners from 14 countries
Project coordinator: Fraunhofer-Gesellschaft, DE
Project website: www.climateforculture.eu
Key words: climate change impacts, cultural heritage, damage risk assessment, climate models, climate change modelling, hygrothermal building simulation, socio-economic analysis, sustainability, preventive conservation, IPCC report, UNESCO World Heritage sites

The Challenge

The project investigates the impacts of climate change on historic buildings and their collections in Europe and the Mediterranean. It identifies the damage potential of cultural heritage most at risk and develops strategies to mitigate the effects of climate change by including policy makers and the IPCC reports. The main innovation is to use a combination of simulation and modelling tools to better predict the influence of the changing outdoor climate on the microclimate in historic buildings until 2100 and to assess the damage potential in various climate zones. Therefore, regional climate models with a high resolution of 10x10 km are developed and coupled with newly developed whole building simulation tools. Furthermore, the project provides data on the socio-economic impact of climate change.

Project objectives

- Climate evolution for damage assessment of movable and immovable cultural heritage objects in the near and far future,
- In situ non-destructive monitoring of cultural objects with digital holography speckle laser interferometry, 3D, microscopy, glass sensor measurements and free water sensor measurements,
- Retrospective investigation of climate induced damage processes,
- Development of adequate risk scenarios and new damage risk assessment methodologies for preventive conservation,
- Adaptation of software tools for hygrothermal building simulation of historic buildings,
- Development of new and energy saving approaches to microclimate control for mitigating climate change impacts,
- Economic assessment of climate change impacts on cultural heritage for decision makers and the interested public,
- Development of outdoor and indoor climate risk maps for decision makers in different European climate zones.

Methodology

To assess the effects of climate change and to identify the most urgent risks high resolution climate evolution scenarios (based on regional climate model simulations) are coupled with whole building simulation models. Together with close up surface monitoring this will build the basis for setting up new damage functions. Besides, climate data interpretations existing throughout Europe will be combined by integrating the latest expert knowledge, taking also into account the discussions held in the working group CEN TC 346. Collections in historic buildings from various European regions as well as UNESCO World Heritage Sites are included as case studies for in situ assessment of existing problems, retrospective investigations on the state of preservation and for the projection of future challenging issues. All results will be incorporated into the report on the assessment of the economic costs and impacts on cultural heritage under two different IPCC climate scenarios on regional scale.

Expected results

Results provide information on the possible impact of climate change on the built cultural heritage and its indoor environment. More reliable prediction models lead to insights on how the indoor climate will develop in historic buildings up to the year 2100 in various climate zones and to what extent damages to collections will occur. It will enable preventive measures to be taken, thus reducing the consumption of energy and resources. The project offers scientific results to be effectively transferred to both business and political communities. It integrates industrial and SMS partners as stakeholders to ensure the transfer into practice and market. The report on the macroeconomic impact on cultural heritage will be a contribution to future IPCC reports and suitable for integrating cultural heritage into the EU sustainable development strategy. Results will be a substantial prerequisite for persons involved in the wider range of decision making (e.g. members of the EU Parliament, national ministries and local authorities).

Project partners	
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (DE)	National Trust for England, Wales and Northern Ireland (UK)
Faculty of Mechanical Engineering, Czech Technical University in Prague (CZ)	Center for Documentation of Cultural & Natural Heritage (EG)
Institute of Atmospheric Sciences and Climate, Italian National Research Council (IT)	Consultant for Conservation Risk Assessment, Jonathan Ashley-Smith (UK)
Faculty of Civil Engineering, University of Zagreb (HR)	School of Built & Natural Environment, Glasgow Caledonian University (UK)
Holography Lab and Laser Applications Division, Institute Electronic Structure and Laser, Foundation for Research and Technology (EL)	Grantham Research Institute on Climate Change and the Environment, London School of Economics & Political Science (UK)
Department of Conservation, Technical University Munich (DE)	Environmental Research Center, Foundation Salvatore Maugeri (IT)
Max Planck Institute for Meteorology (DE)	The National Institute of Cultural Heritage (FR)
Eindhoven University of Technology, Unit Building Physics and Systems (NL)	Faculty of Civil and Geodetic Engineering, University of Ljubljana (SI)
Centre for Indoor Environment, Building Physics and Energy, Gradbeni Institute (SI)	Engineering Consulting & Software Development Jan Radon (PL)
Krah & Grote Measurement Solutions (DE)	TB Käferhaus GmbH (AT)
Building Conservation, Gotland University (SE)	Kybertec Ltd. (CZ)
Freelance conservator-restorer Andreas Weiß (DE)	Haftcourt Ltd. (SE)
Doerner Institut, Bavarian State Painting Collections (DE)	Restoration Centre, Bavarian Administration of State owned Palaces, Gardens and Lakes (DE)
ACCIONA Infrastructure (ES)	

CLIMB

At a glance

Title: Climate Induced Changes on the Hydrology of Mediterranean Basins: Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modeling System

Instrument: Small/medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries (SICA)

Total cost: 4 157 348 €

EC contribution: 3 148 945 €

Duration: 48 months

Start date: 01/01/2010

Consortium: 21 beneficiaries from 9 countries

Project coordinator: Ludwig-Maximilians-Universitaet Muenchen, Department of Geography, DE

Project website: www.climb-fp7.eu/

Key words: Mediterranean, climate change impacts, uncertainty, environmental monitoring, hydrological modelling, socio-economic factor as-sessment, risk assessment

The challenge

According to current climate projections for the 21st century, Mediterranean countries are at high risk for an even pronounced susceptibility to changes in the hydrological budget and extremes, increasing potential for tensions and conflict among the political and economic actors in this vulnerable region. In order to advance the capability to assess climate effects on water resources and uses, modelling capabilities must be largely improved and appropriate advanced methods must be developed to better quantify and deal with the inherent unce-tainties. Stakeholders and scientists must be provided with new tools of decision making in climate change impact assessment.

Project objectives

CLIMB improves modeling capabilities and develops appropriate tools to advance the capacity to assess climate effects on water resources and uses. The project consortium employs a combination of novel field monitoring concepts, remote sensing techniques, integrated hydrologic (and biophysical) modeling and socioeconomic factor analyses to reduce existing uncertainties in climate change impact analysis and to create an integrated quantitative risk and vulnerability assessment tool.

This tool will serve as a platform for the dissemination of scientific project results and the communication with and planning for local and regional stakeholders.

The analysis of climate change impacts on available water resources is targeted to selected mesoscale river or aquifer catchments, representing water management units for regional water authorities. Study sites are located in Sardinia, Northern Italy, Southern France, Turkey, Tunisia, Egypt and the Palestinian-administered area Gaza.

Methodology

New field monitoring and measurement strategies for hydrological processes are tested and adjusted to the specific requirements in the study sites. Synergistic radar and optical remote sensing techniques are extensively employed to provide steady state parameters (e.g. land use, land cover, soil hydraulic properties), to retrieve dynamic model parameters (e.g. soil moisture and roughness, vegetation structures), to monitor process variables (e.g. infiltration, water stress) and to validate model results. Data assimilation procedures are crucial to incorporate relevant data and process understanding into existing modeling concepts, thereby significantly reduce uncertainty in predicted hydrological quantities. Model concepts are optimized to adequately represent the current state hydrology in the study sites, they will be tested over a range of selected climate change scenarios to project future hydrological budgets and extremes. Hydrological model results and socio-economic factor analysis are integrated for the development and implementation of a GIS-based, modular Vulnerability and Risk Assessment Tool.

Expected results

In its effort to grant easy access to data and results from the project, CLIMB will develop a WebGIS-Server and Client architecture open to the public. It will disseminate the impacts of climate change on selected hydrological indicators, including a rigorous assessment of related uncertainties, as determined from the multi-model ensembles employed in the seven case studies. Further, it will comprise a risk modeling tool, assessing the risk of income loss and out-migration due to water shortages in agriculture, forestry and the tourism sector, based on the identification of key socio-economic indicators. Site-specific adaptive measures will be proposed and recommendations for future water resources management will be given, taking into account a thorough diagnosis of climate change impacts on water uses and rivalries. Further, it is expected that CLIMB results can be regionalized in general for water-stressed areas, in which climate and socioeconomic conditions render water-related problems compelling and urgent. This can happen in various ways to:

- foster and intensify the dialogue between scientists, managers, water experts and stakeholders in addressing local impacts of climate changes and identifying means for their assessments
- awareness among stakeholders about climate change impacts on water resources and land uses, which will lead to adequate approaches and adaptation strategies for water resources management and for food security
- empower stakeholders and scientists by providing new tools of decisions making in assessing climate change impacts

These science-management-policy links are indispensable to provide visibility of the research findings beyond the borders of the scientific community and will allow for an uptake of research results into policy and management practice. An important output of the research in the individual study sites will be the development of a set of recommendations for an improved monitoring and modeling strategy for climate change impact assessment, addressing in particular the minimum requirements towards data collection and model complexity to achieve sufficient predictive power for climate change impact assessment in the targeted regions and beyond.

Project partners	
Ludwig-Maximilians-Universitaet Muenchen (DE)	Institut National de la Recherche Scientifique (CA)
AGRIS Sardegna–Agenzia per la Ricerca de la Agricoltura (IT)	Joanneum Research Forschungsgesellschaft mbH (AT)
Christian-Albrechts-Universitaet Kiel (DE)	Université d'Angers (FR) (until March 2011)
Institut national de recherche en sciences et technologies pour l'environment at l'agriculture (FR)	Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere (IT)
Centre de Recherche et des Technologies des Eaux (TN)	Università degli Studi di Padova (IT)
Islamic University of Gaza PS - Palestinian-administered areas	Università degli Studi di Trento (IT)
Centro di Ricerca, Sviluppo e Studi Superiori Sardegna (IT)	Zagazig University (EG)
Deutsches Zentrum fuer Luft- und Raumfahrt e.V. (DE)	VISTA Geowissenschaftliche Fernerkundung GmbH (DE)
Forschungszentrum Juelich GmbH (DE)	Bayerische Forschungsallianz gemeinnuetzige GmbH (DE)
Gebze Yuksek Teknoloji Enstitusu (TR)	Université Francois-Rabelais du Tours (FR) (from February 2011)
	Yildiz Technical University (TR) (from July 2012)

DROPS

At a glance
Title: DROught-tolerant yielding PlantS
Instrument: Integrated project
Total Cost : 9 715 609 €
EC contribution: 5 999 866 €
Duration: 5 years
Start date: 06/2010
Consortium: 16 partners from 11 countries
Project coordinator: Francois Tardieu
Project website: www.drops-project.eu
Key words: Drought, tolerance, modelling, genetics, phenotyping, maize, wheat

The challenge

European agriculture is facing declining water availability. Breeding, based on the natural genetic diversity, has been efficient for increasing the yield of cereals under water deficit, but the pace of genetic progress must be accelerated by (i) developing methods for characterizing hundreds of plant types originating from different regions of the world, in diverse drought scenarios (ii) disentangling the complexity of yield under drought via heritable traits (iii) identifying new alleles in the natural diversity, which allow yield improvement in drought scenarios (iv) predicting the yield of plants with diverse alleles in the most frequent drought scenarios in Europe.

Project objectives

1. Develop new methods for identifying drought-tolerant genotypes, and the alleles that determine this behavior. This is based on novel phenotyping platforms (including precision phenotyping and omics), and novel methods for data analysis in platforms and in the field
2. Explore the natural variation of target traits by identifying genomic regions that control them in diverse drought scenarios. We aim at (i) linking these traits to physiological pathways, genes or genomic regions, (ii) assessing the effects of allelic diversity on the target traits and on yield.
3. Estimate the comparative advantages of relevant alleles under contrasting drought scenarios. This is performed by (i) developing a generic crop model incorporating novel understanding of the physiology and genetics of target traits, (ii) simulating yields of genotypes that differ by traits or alleles at specific loci, over the variability of drought scenarios occurring across Europe

Methodology

The project deals with maize, durum wheat and bread wheat, and with four traits: leaf growth /plant architecture, root growth, grain abortion and Water Use Efficiency.

Panels of plants (150 to 250 accessions) are analysed in (i) 10-20 field experiments per species, with or without irrigation in different climatic regions of Europe, (ii) phenotyping platforms that allow estimating novel traits (roots, growth, transpiration), (iii) omic platforms for metabolites and expression of key genes for growth under drought.

A thorough environmental characterisation is performed in each field and platform. We establish sensitivity indices for traits and for yield, for each studied genotype.

The panels are densely genotyped (50 000 to 500 000 markers), thereby allowing to establish associations between gene alleles, studied traits in platform and sensitivity traits in the field.

The APSIM model, with improved modules for drought response of target traits, is used to simulate yield over 50 years in 50 sites, with different allelic combinations.

Expected results

The identification of genes involved in tolerance to water deficit will result in the identification of markers and in the assessment of the allelic variants. These markers will be used in breeding.

DROPS will release tools that allow predicting the comparative advantages of alleles according to European regions.

The presence of breeding companies in the consortium will ensure "real life" tests of the validity of results in a breeding strategy.

Project partners	
Institut national de la recherche agronomique	FR
Australian Centre for Plant Functional Genomics	AU
Biogemma	FR
Inra Transfert	FR
KWS SAAT AG	DE
Lancaster University	UK
Agricultural Research Institute of the Hungarian Academy of Sciences	HU
Max-Planck-Institut für Molekulare Pflanzenphysiologie	DE
Pioneer Hi-Bred International	US
Sabanci Üniversitesi	TR
Syngenta Seeds SAS	FR
Università di Bologna	IT
Université catholique de Louvain	BE
University of Queensland	AU
Wageningen Universiteit	NL
RWTH Aachen University	DE

ECCONET

At a glance
Title: Effects of climate change on the inland waterway
Instrument: Coordination action
Total cost: 2 250 345 €
EC contribution: 1 633 087 €
Duration: 36 months
Start date: 01/01/2010
Project coordinator: Transport and mobility Leuven, BE
Project website: www.ecconet.eu
Key words: transport, climate change, adaptation, inland waterways

The challenge

ECCONET specifically addresses the topic of adaptation to climate change, taking Inland Waterway Transport (IWT) as a case-study. The project addresses both the impact of climate change on inland waterways as well as the study of adaptation measures.

The innovative character of ECCONET rests in its integrative approach, combining the existing knowledge on the effects of climate change, transport infrastructure, ship technology, economy and relevant policy to support the inland waterway transport mode.

Project objectives

To provide a coherent overview of the impacts of climate change on the inland waterway transport on the Rhine and Danube basin

To deal with the identification, analysis and assessment of adaptation strategies for improved operation of inland waterway vessels

Methodology

ECCONET uses many different models to assess the current state of knowledge on climate change, including its uncertainty band. This approach resulted in a balanced view on the future navigability of the Rhine-Main-Danube waterway area.

The impact on the modal shift of inland waterway transport was assessed combining the strong points of the TRANSTOOLS and NODUS transport network models.

A cost-effectiveness analysis was performed on the basis of the model results, to complement and review the assessment of adaptation measures.

Results

Performing a transport economic analysis we demonstrated that the possible climate changes from 2005 to 2050 and their impact on the inland waterway transport market are not likely to be strong enough to trigger any significant shift in modal shares away from inland waterway transportation.

In parallel, ECCONET aimed to identify a number of adaptation measures. These fell broadly in 4 classes: technology and operational measures, infrastructure and maintenance, improved water level forecasting and production and logistics processes. These adaptation measures were verified by a combination of literature review, transport economic modelling, cost-effectiveness analysis and stakeholder consultation.

In the class of **ship and operation related measures**, the most promising measures involve weight reducing technologies and the use of coupling convoys (especially on the Rhine river). Flexible 24 hour operation of ships that are currently operating only 12 hours was negative due to high labour costs.

In terms of **infrastructure measures** we can conclude that large infrastructural works are currently not justified with respect to climate change. There is however, even under current conditions, a strong need for improved maintenance of the waterways, especially on the Danube.

Improved forecasting, for example in the form of a seasonal forecast of water levels are a responsibility of the governmental agencies. While a reliable forecast of this type is very hard to make, any improvement in this type of forecasting is considered very valuable to the sector.

As for the change of **production processes and stock keeping,** we show that the forwarder/shipper will usually wait or use already available storage capacity. Only when problems continue, the shipper will consider using another transport mode, in general railway freight, which is a more costly and inflexible solution. Investments in stock keeping and relocation are only taken as a final option.

While the expected climate change impact until mid of the century does not justify large investments in costly adaptation measures under the present prevised navigability conditions, we do stress the importance of good waterway maintenance for a smooth continuation of waterway transport on the Rhine and Danube rivers. Also we place a cautious question mark while observing the trend towards increasingly large vessels on the Rhine, as the benefit of increased carrying capacity may disappear under drier conditions.

The results from ECCONET were presented on numerous international conferences all over the world, among others TRA in Athens (April 2012), TRB in Washington (January 2012), WTC in Berlin (2012), PIANC Smart Rivers conference (2011, 2012, 2013).

Moreover, ECCONET involved close cooperation with the related EWENT and the WEATHER projects, which both treat the effect of extreme weather conditions on the entire transport network.

Project partners	
Transport and Mobility Leuven (TML)	BE
via donau–Österreichische Wasserstraßen GmbH	AT
VU, Amsterdam (VU-FEWEB)	NL
Transport Research and Training (NEA)	NL
Facultés Universitaires Catholiques de Mons (FUCaM)	BE
Bundesanstalt für Gewässerkunde (BfG)	DE
VITUKI Environmental Protection and Water Management Research Institute Non-profit Company (VITUKI)	HU
Országos Meteorológiai Szolgálat (OMSZ)	HU
Entwicklungszentrum für Schiffstechnik und Transportsysteme e.V (DST)	DE
Koninklijk Nederlands Meteorologisch Instituut (KNMI)	NL

ECLAIRE

At a glance
Title: Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems
Instrument: Large-scale integrating project
Total cost: 10 731 964 €
EC contribution: 6 997 001 €
Duration: 48 months
Start date: 01/10/2011
Consortium: 39 partners from 18 counries
Project coordinator: Mark A. Sutton–Natural Environment Research Council–Centre for Ecology & Hydrology (CEH)
Project website: www.eclaire-fp7.eu
Key words: Air pollution, Climate change, Ozone, Nitrogen, NOx, impact on ecosystems, agriculture, economic implications, EU Air quality policy

The challenge

Air pollution has costly impacts on semi-natural and managed ecosystems, through Ozone, Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs) and Ammonia (NH3), also compromising our food security. However, not only are these components of air pollution also important climate forcing agents – their atmospheric burden is also strongly affected by climate change. The complex interactions of air pollution and climate differ in time and spatial scale and can be both positive and negative influences on climate change. In order to inform both air pollution and climate policy, these systems need to be better understood.

Project objectives

ÉCLAIRE seeks to quantify the effects of climate change on air pollution impacts and use this to develop response strategies for European ecosystems. Focusing especially on the role of ozone and nitrogen, and where relevant their interactions with volatile organic compounds, aerosols and sulphur, the Overall Objectives of ÉCLAIRE are therefore:

1. to provide robust understanding of air pollution impacts on European land ecosystems including soils under changing climate conditions, and
2. to provide reliable and innovative risk assessment methodologies for these ecosystem impacts of air pollution, including the economic implications, to support EU policy.

ÉCLAIRE is targetting climate-ecosystem-atmosphere interactions and their implications for ecosystem effects at the European scale, combining observations and experiments in the field and laboratory with modelling experiments from plot to European scales, while accounting for changes in global background.

Methodology

The project objectives are being met through work in five science components:

Component 1: Derives the process understanding to link biogenic/agricultural emissions and deposition to vegetation and soils, to meteorological conditions and to pollutant inputs.

Component 2: Develops improved more mechanistic, modelling frameworks that simulate the effect of the interactions of the climate-atmosphere-biosphere system on biogenic emission and bi-directional exchange.

Component 3: Improves dose/response relationships under changing climate, develops new thresholds and improved models to simulate the effect of pollutants on above- and below-ground carbon stocks.

Component 4: Upscales ecological responses, thresholds and exceedances to the regional and European scale and its spatial variability.

Component 5: Assesses the implications for the economy and ecosystem services, and implications for mitigation and adaptation strategies.

These are supported by a smaller number of strategic and management actions, including data management, measurement and modeling protocols, harmonization of scenarios and also training and dissemination.

Expected results

The results of the ÉCLAIRE project are relevant to a wide range of stakeholders and scientists. New flux measurements, meta-analyses, updated parameterisations and modelling frameworks will contribute to core knowledge and its integration will inform stakeholders. More specifically the project will deliver:

- New empirical evidence quantifying the effects of climate change on air pollution ecosystem impacts of empirical relationships
- New process-based descriptions of effects of climate on air pollution ecosystems impacts
- Quantification of potential feedback mechanisms of climate change on trace gas and pollutant emissions affecting climate
- Correction in European estimate and quantification of uncertainties, especially those of key policy significance;
- Cost-benefit analysis of air pollution control options in relation to future climate scenarios, of direct use for EU policy analysis (e.g. in CLRTAP Gothenburg Protocol and NEC Directive revision, with messages to IPCC).
- Next generation European air pollution mitigation and adaptation strategies under climate change

Project partners	
Natural Environment Research Council, UK	University of York, UK
Lunds Universitet, SE	Goeteborgs Universitet, SE
Danmarks Tekniske Universitet, DK	Erdészeti Tudományos Intézet, HU
Stichting Dienst Landbouwkundig Onderzoek, NL	Ilmatieteen Laitos, FI
Internationales Institut Fuer Angewandte Systemanalyse, AT	Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, DE
Meteorologisk Institutt, NO	Helsigin Yliopisto, FI
Forschungszentrum Juelich GmbH, DE	Universita Cattolica Del Sacro Cuore, IT
Stichting Energieonderzoek Centrum Nederland, NL	Universitaet Fuer Bodenkultur Wien, AT
Consiglio Nazionale Delle Ricerche, IT	Universidad Politecnica de Madrid, ES
JRC–Joint Research Centre–European Commission, IT	Institut National de la Recherche Agronomique, FR
National Institute for Public Health and the Environment, NL	Eidgenoessisches Volkswirtschaftsdepartment, CH
Odessa National I.I. Mechnikov University, UA	Centro de Investigactiones Energeticas, Medioambientales y Tecnologicas – CIEMAT, ES
Centre National de la Recherche Scientifique, FR	The University of Edinburgh, UK
Svergies Meteorologiska Och Hydrologiska Institut, SE	IVL Svenska Miljoeinstitutet AB, SE
Drzavni Hidrometeoroloski Zavod, HR	Holland Michael, UK
Rheinische Friedrich-Wilhems -Universitaet Bonn, DE	Aarhus Universitet, DK
Eidgenoessische Forschungsanstalt WSL, CH	Max Planck Gesellschaft zur Foerderung der Wissenschaften E.V, DE
Institute of Physico-chemical and Biological Problems in Soil Science, RU	Institute of Plant Physiology and Genetics of Bulgarian Academy of Sciences, BG
Wageningen Universiteit, NL	Universite Libre de Bruxelles, BE
Nederlandse Organisatie Voor Toegepast Natuurwetenschappelijk Onderzoek, NL	

ECLIPSE

At a glance
Title: Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants
Instrument: Small/medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 3 810 033 €
EC contribution: 2 706 051 €
Duration: 36 months
Start date: 01/11/2011
Consortium: 11 partners from 8 countries
Project coordinator: Norwegian Institute for Air Research, NO
Project website: eclipse.nilu.no
Key words: Air pollution, Long-range transport, climate, air quality, radiative forcing, climate model

The challenge

Current climate policy does not consider a range of short-lived gases and aerosols, and their precursors (including nitrogen oxides, volatile organic compounds, sulphate, and black carbon). These nevertheless make a significant contribution to climate change and directly influence air quality. There are fundamental scientific uncertainties in characterizing both the climate and air quality impacts of short-lived species and many aspects (for example, the regional dependence) are quite distinct to those for the longer-lived climate gases already included in the Kyoto Protocol.

Project objectives

We will be improving the knowledge about emissions of SLCFs and their precursors and validate the models used to determine the climate and air quality impacts of SLCFs Further perform case studies involving two major SLCF source regions as well as the Arctic as a receptor region and characterizing the uncertainties associated with impacts of SLCFs on air quality and climate and quantify the climate impacts of SLCFs beyond global-mean radiative forcing.

In the project we will refine the calculation of existing metrics and developing novel metrics for policy making, to analyse the cost-effectiveness of emission control strategies. We will clarify the win-win and trade-off situations between climate policy and air quality policy, explore the role of co-emissions of other depended species and identifying a set of concrete cost-effective abatement measures with large co-benefits.

Methodology

The specific strategy employed in ECLIPSE consists of using existing modelling tools, applying them immediately to construct a straw man SLCF mitigation scenario and allowing a knowledge loop within the project to improve those aspects and areas that are most relevant for the design of emission control strategies. This loop will allow the further scientific investigation of the roles of the various model uncertainties and climate responses on top of the initial underlying model assumptions on emissions and SLCF atmospheric chemistry and radiative forcing, and thereby provide fresh and relevant information to policy making processes in Europe and China

Expected results

ECLIPSE aims to develop and assess effective emission abatement strategies for short-lived climate agents in order to provide sound scientific advice on how to mitigate climate change while improving the quality of air. It will (i) improve understanding of key atmospheric processes (including the impact of short-lived species on cloud properties) and characterize existing uncertainties; (ii) evaluate model simulations of short-lived species and their long-range transport using ground-based and satellite observations; (iii) perform case studies on key source and receptor regions (iv) quantify the radiative forcing and climate response due to short-lived species, incorporating the dependence on where the species are emitted; (v) refine the calculation of climate metrics, and develop novel metrics which, go beyond using global-mean quantities; (vi) clarify possible win-win and trade-off situations between climate policy and air quality policy; (vii) identify a set of concrete cost-effective abatement measures of short-lived species with large co-benefits.

Project partners	
Norwegian Institute for Air Research	NO
Center for International Climate and Environmental Research	NO
Norwegian Meteorological Institute	NO
Meteorological Office, Hadley Center	UK
Univ. Pierre et Marie Curie	FR
Univ. Leipzig	DE
International Institute for Applied Systems Analysis	AT
Univ. of Reading	UK
Univ. Crete	EL
Univ. Tsinghua	CN
Univ Peking	CN

ESCAPE

At a glance

Title: European Study of Cohorts for Air Pollution Effects
Instrument: Integrated Project
Total cost: 8 218 266 €
EC contribution: 5 858 973 €
Duration: 54 months
Start date: 01/06/2008
Consortium: 26 partners from 17 countries
Project coordinator: Utrecht University, NL
Project website: www.escapeproject.eu
Key words: Health, Environment, Transport

The challenge

Long-term effects of air pollution have not been studied widely in Europe. Yet, air pollution abatement policies, and cost benefit analyses heavily depend on an objective quantification of these long-term effects.

Project objectives

1. to develop a flexible methodology for assessment of long-term population exposure to air pollution focused primarily on fine particles, particle composition, and nitrogen oxides.
2. to apply the exposure assessment methodology on existing cohort studies of mortality and chronic disease in Europe that have been selected based on their potential to quantify relationships between long-term exposure and health response.
3. specifically, to investigate exposure-response relationships and thresholds for (a) adverse perinatal health outcomes, and development of diseases such as asthma in children; (b) respiratory disease endpoints in adults; (c) cardiovascular disease endpoints in adults; (d) all-cause and cause-specific mortality, and cancer incidence.
4. to develop a database for quantitative estimates of the health impacts of long-term exposure to air pollution for all of these health endpoints for the European population.

Methodology

A monitoring program was set up in multiple European regions to establish the spatial distribution of particulate matter and nitrogen oxides. Geographic variables that may explain this spatial distribution were collected from European (Eurostreets, CORINE) as well as local databases. Land User Regression models were generated for all regions to obtain quantitative equations for predicting air pollution concentrations at the home addresses of study participants. The relationships between air pollution and health effects were then analysed in four main categories of studies:

1. Studies on pregnancy outcomes and disease development in children
2. Studies on respiratory disease in adults
3. Studies on cardiovascular disease in adults
4. Studies on cancer and mortality in adults.

The results provide a basis for further quantification and valuation of health effects of long-term exposure to air pollutants in Europe.

Expected results

The expected result include quantification of the relationships between long-term exposure to air pollution and a series of morbidity and mortality effects in European populations.

This will provide the European commission with a more solid basis for quantification and valuation of health effects of long-term exposure to air pollutants in Europe.

Benefits will also arise for stakeholders interested in the health effects of air pollution. These include industries potentially affected by air pollution control measures, patient organisations as well as environmental NGOs and national and local governments.

Project partners	
Institute for Risk Assessment Sciences, University of Utrecht	NL
Department of Hygiene, University of Athens	EL
Department of Social Medicine, University of Crete	EL
Dipartimento di Epidemiologia, Azienda Sanitaria Locale Roma	IT
Swiss Tropical Health Institute, University of Basel	CH
Centre for Research in Environmental Epidemiology (CREAL), Barcelona	ES
Imperial ColleDE London	UK
University of Manchester School of Medicine	UK
Helmholtz Zentrum München–DErman Research Center for Environmental Health	DE
IUF University of Duesseldorf	DE
IMIBE, University of Duisburg-Essen	DE
Institute of Epidemiology of the University of Ulm	DE
Institute of Cancer Epidemiology CopenhaDEn	DK
National Institute of Public Health Oslo	NO
Institute for Environmental Medicine, Karolinska Institutet Stockholm	SE
Umeå University, Department of Public Health and Clinical Medicine	SE
Département santé environnement Institut de veille sanitaire St Maurice	FR
INSERM, Villejuif	FR
National Institute for Health and Welfare, Kuopio	SU
Vytautas Magnus University (VMU) Kaunas	LT
National Institute for Environmental Health, Budapest	HU
Institute of Occupational Medicine, Edinburgh	UK
National Institute of Public Health and the Environment RIVM Bilthoven	NL
Medical Research Council	UK
OMIH at National Taiwan University	TW
Hellenic Health Foundation	EL

EUROPOLAR

At a glance
Titel: European Polar Consortium: Strategic Coordination and Networking of European Polar RTD Programmes
Funding instrument: Coordination Action
Contract starting date: 01/03/2005
Duration: 48 months
Total project cost: 2 484 992 €
EC contribution: 2 484 992 €
Coordinator: Institut Polaire, FR
Project website: www.europolar.org/

Abstract

EUROPOLAR ERA-NET is a consortium of 25 Ministries, Funding Agencies and National Polar RTD Authorities from 19 European countries with a combined critical mass of Polar Programmes and Infrastructures of over 500 Million Euros per annum. It is the most significant initiative to coordinate and network European Polar RTD programmes ever attempted.

EUROPOLAR ERA-NET will exert a massive and positive impact on this domain and lead to long-term durable partnerships within Europe and Internationally. EUROPOLAR ERA-NET will encourage and support the closer relationship of National Polar RTD programme managers from Europe and the Russian Federation, fostering cooperation and leading to joint programme activities. EUROPOLAR ERA-NET will also deepen and strengthen the interactions between countries with large Polar RTD Programmes and nations with evolving Polar Programmes in central and south-eastern Europe, encouraging exchange of experiences and best practise on management and financing of programmes and infrastructures. The presence of key European and international organizations within EUROPOLAR ERA-NET will open up a vast network of human and material capital.

The structuring and coordination of European Trans-national elements will enable the construction of mechanisms to mobilise joint funding flows and the reciprocal access to Polar Research Infrastructures. The long-term goal of the European Polar Consortium is the development of a 'European Polar Entity' which will be established following the EUROPOLAR ERA-NET through dialogue and agreement at a political level and will enable Europe to maximise and direct its critical mass at the Global level.'

Objectives

Research and technology in the Polar Regions is fundamental to our understanding of the functioning of the earth system especially in relation to climate change, climate variability and its wide economic and societal impact on European and global populations. European nations have played a central role in scientific research in the Polar Regions throughout the last century. The Polar Regions are central to answering questions of global relevance and importance in modern climate research and its effects. Europe has a high capacity in both research and infrastructure terms in the Polar Regions, the combined critical mass of national polar programmes and assets across Europe exceeds 500 Million Euros per annum.

There is a clearly identifiable need for Europe to optimize this high-investment and provide an enhanced utilization of research infrastructures, harmonizing scientific, human and technology capacity. Polar research from its very beginning has been a cooperative activity in large part due to the extreme nature of the environments it requires agreements on a national and more often-international scale to implement very large projects with complex logistics.

"….Europe is at the forefront of international efforts in polar research," said Research Commissioner Philippe Busquin at the launch, in Bremerhaven (DE) last February, of several Polar research projects being supported by the European Union. "The poles are unique indicators of climate change processes [making] polar research a key element in our overall research effort on global climate change...."

Former European Research Commissioner Philippe Busquin 2004

"The Northern Dimension concept covers a broad and diverse geographic area, stretching from the Arctic and sub-Arctic to the southern shores of the Baltic, and from North-West Russia in the East to Iceland and Greenland in the west. The Northern Dimension also pays special attention to regions with specific needs, such as Kaliningrad and the Arctic region."

Former External Relations Commissioner Chris Pattern 2004

The management of national programmes in the Polar Regions is subject to a great deal of variability across Europe, with a complex funding and evaluation architecture, there is a need to simplify and harmonize these systems to produce a coherent set of interlinked and fully networked agencies. The common access to a suite of world class Polar Infrastructures that are dedicated to supporting at a national level a wide range of Scientific programme disciplines. To avoid duplication of research efforts and to better understand the differences in scale of operation for Arctic and Antarctic science campaigns, EUROPOLAR ERA-NET will analyze and compare the structural and management approaches from its partner countries resulting in strategies to harmonize these systems on a trans-national basis. The Landscape of Research in Europe has been dramatically changed during the 6th framework programme with emphasis placed on the Lisbon Agenda and the development of A 'European Research Area' leading to the Europe's aspirations as becoming the most competitive knowledge based Economy in the world by 2010. EUROPOLAR ERA-NET will establish the unique conditions for a durable cooperation between European research programmes in the Polar Regions. EUROPOLAR ERA-NET will strive to enhance and maintain Europe's premier capacity for research in the Polar Regions by building a framework of sufficient scale and critical mass to facilitate, promote and sustain intellectual interchange in the international research arena. Agreements between National Polar RTD funding agencies and ministries have historically been at a bilateral level and the structures and mechanisms for internal agreement amongst European nations on multinational agreements are still lacking or need testing. This requirement for an enhanced coordination and management at a Pan-European scale in Polar Research, driven by success of programmes such as EPICA (European Project Ice Coring in Antarctica) which has acted as a model for the way in which a group of 10 nations can implement with pooled funding a major scientific research programme which addresses global concerns. This model needs to be applied in a wider context to Polar RTD programmes on the new and exciting frontiers.

The Consortium that forms EUROPOLAR ERA-NET comprises 25 funding agencies, national ministries and Polar Authorities from 19 countries in Europe including key new accession states, candidate states to the EU and external states such as Russia Federation. The composition of the consortium represents every significant actor and European nation with Arctic and Antarctic research programme activities. EUROPOLAR therefore represents the most significant initiative to network European Polar RTD Programmes ever attempted.

General Objectives for the EUROPOLAR ERA-NET comprise:

- Creating the conditions for a gradual deepening of the interaction between National Polar RTD Programmes in order to mobilize and coordinate the existing critical mass of infrastructures, human capital to maximize the impact of European Polar activities.
- Contributing to the establishment of leading edge collaborative Polar Research Centres and supporting the intellectual development of the next generation of Polar Research specialists especially in new and candidate nations of the Union.
- Supporting the EC Northern Dimension Action Plan by creating research opportunities (RTD programmes, researcher mobility and support mechanisms) relevant for the Arctic issues.
- Generating a prototype advisory and policy support mechanism for European Governments in the Polar Regions.
- Enabling the integration of new accession and candidate states to the European Union by the stepwise and agreed mutual opening of Europe's Polar RTD Programmes and strengthening the relationship between Europe and the Russian Federation through cooperation between consortium partners.
- Optimizing the management and utilization of European Polar facilities and assets.
- Providing the focus of European strategic activities in the Polar Regions through the development of a common European planning and research implementation framework.

The principle benefits arising from EUROPOLAR ERA-NET will be:

- Structuring the environment and landscape of Europe's Polar RTD programmes to allow fully trans-national research programmes and enhanced access to Polar Research infrastructures.

- Enabling National Polar RTD Agencies to build strong multilateral partnerships within and outside Europe.
- Enabling the effective integration of new accession and candidate countries of the European Union through involvement in extensive Polar RTD activities.
- Delivering high quality science policy advice in support of European Union Policies.
- Consideration of Polar RTD issues, which are beyond the capacities of individual member states and generate sufficient critical mass Increased awareness of policy issues of relevance to the Polar Regions.
- Contributing to the strengthening of the European Research and innovation area.
- The development of common management best practice and European research strategies in the Polar Regions.

Partners		
N°	Organisation	Country
1.	Institut Polaire Français Paul Emile Victor IPE	FR
2.	Foundation Européenne de la Science/European Polar Board EPB-ESF	FR
3.	Fonds –zur Förderung der Wissenschaftlichen Forschung FWF	AT
4.	Fonds National de la Recherche Scientifique FNRS	BE
5.	Fonds Voor Wetenschappelijk onderzoek Vlannderen FWO	BE
6.	Belgian Federal Planning Service Science Policy BELSPO	BE
7.	Ministry of Foreign Affairs Republic of Bulgaria MFA	BG
8.	Ministry of Education, Youth and Sports MSMT	CZ
9.	Dansk Polarcenter (Danish Polar Center) DPC	DK
10.	Forskningsstyrelsen (Danish Research Agency) FORSK	DK
11.	Eesti Teadusfond Sihtasutus (Estonian Science Foundation) EstSF	EE
12.	Liikenne-Ja Viestintaministerio (Ministry of Transport and Communication) MiTOC	FI
13.	Alfred Wegener Institut Fur Polar und Meeresforschung AWI	DE
14.	Bundesministerium für Bildung und Forschung BMBF	DE
15.	Kultureqarmut, Ilinniartitaanermut, Ilisimatusarnermut, Ilageeqarnermullu Greenland Pisortaqarfik (Department for Culture Research and Church) KIIP	
16.	Ministero dell'istruzione dell' Università della Ricerca MIUR	IT
17.	Nederlandse Organisatitie Voor Wetenschappelijk onderzoek (Netherlands organisation for Scientific Research) N W O	NL
18.	The Research Council of Norway RCN	NO
19.	Norsk Polarinstitut (Norwegian Polar Institute) NPI	NO
20.	Ministerstwo Nauki I Informatyzacji (Ministry of Scientific Research and Information Technology) MSRIT	PL
21.	Arctic and Antarctic Research Institute of Roshydromet, Russian Federation Service for Hydrometeorology & Environmental Monitoring AARI	RU
22.	Ministerul Educatiei Si Cercetarii (Ministry of Education and Research) MedC	RO
23.	Ministero de Educacion y Ciencia MEC	ES
24.	Ventenskapsradet (Swedish Research Council) VR	SE
25.	Natural Environment Research Council NERC	UK

FORCE

At a glance
Title: Future of Reefs in a Changing Environment (FORCE): an ecosystem approach to managing Caribbean coral reefs in the face of climate change
Instrument: Collaborative project
Total cost: 8 581 205 €
EC contribution: 6 474 632 €
Duration: 53 months
Start date: 01/01/2010
Consortium: 18 partners from 10 countries including 6 International Cooperation partners, 1 Associated country + 1 Third country
Project coordinator: University of Exeter, United Kingdom (science & administration)
Project website: www.force-project.eu
Key words: Collaborative project, caribbean sustainable management, coral reefs, climate change, livelihood, governance, fisheries, marine science

The challenge

Each year, coral reefs contribute billions of dollars to Caribbean countries in terms of tourism, fisheries and the provision of coastal defense from hurricanes. Millions of people depend on these reefs yet they are already being impacted by climate change, overfishing and pollution. FORCE brings together researchers from the natural and social science disciplines to understand the causes of change in reef health and improve the management of Caribbean reefs. FORCE Principal Investigators (PIs) represent 18 Member Organisations, located in 10 countries within Europe, the Caribbean and Australia. By combining natural and social sciences from the outset, the consortium has a rare opportunity to identify the management strategies and governance structures needed to help ensure the delivery of ecosystem services on which so many people depend.

Project objectives

The overall scientific objective of FORCE is to identify the most appropriate management interventions for coral reefs and the governance structures needed for their implementation. This will be achieved in four steps. First, FORCE will determine the effects of climate change, overfishing, pollution and poor governance on the health of Caribbean reefs. The team will then assemble and refine a toolbox of management measures that can be used to improve the health and wise use of coral reefs. However, not all management measures are equally effective so the project will use ecological models and novel social science methods to assess the efficacy of each tool and the governance constraints to its implementation. Finally, the team will assure longevity of their conclusions beyond 2014 through the production of a region-wide management toolkit.

Methodology

FORCE Programme of Activities comprises integrating activities on physical, ecological and social science aspects of coral reef health and management. A series of ecological surveys were conducted in eleven countries whilst a series of social science studies were conducted in four countries, three of which provided the opportunity for joint studies. Detailed governance, livelihood and social studies have been conducted in three to four priority areas in each case study with some adjacent to the coral reef ecological survey sites. New field investigations have quantified the effects of changing reef health on biodiversity, seek ways of improving fisheries management, and allow the effects of ocean acidification and coral bleaching to be modelled more accurately. These empirical studies will be integrated with global climate models using ecosystem models.

Expected results

The FORCE consortium is in the process of producing tools and advice for government, managers and stakeholders to utilise in the sustainable management of coral reefs. It will not only provide management tools but also provide a clearer understanding of the causes of reef degradation, and therefore opportunities to mitigate such problems. A 'Marine Reserves for Climate Change' toolkit coupled with the 'Managing Caribbean Coral Reefs for Climate Change' handbook and workshop is being developed for reef managers. FORCE is advancing the science of marine reserve design with the inclusion of coral bleaching. Caribbean-wide maps of thermal regime and guidelines on using the maps with existing reserve design tools to stratify the location of marine reserves have been developed. The project has developed coral friendly fisheries regulations to help maintain the resilience of reefs to climate change by determining the appropriate levels of herbivore extraction. Taken together, these products should help improve the management of Caribbean reefs with a view to improving the economic and social well-being of coastal communities.

Project partners	
University of Exeter, (UNEXE) UK	Verein zur Foerderung der Wissenschaftlichen forschung in der Freien Hansestadt Breman, (VFWF) DE
Integrated Marine Management, (IMM) UK	Bar Ilan University, (BIU) IL
University of Newcastle upon Tyne, (UNEW) UK	University of Costa Rica, (UCR) CR
University of Amsterdam, (UVA), NL	University of the West Indies, (UWI) BB
Stichting Koninklijk Nederlands Instituut voor Onderzoek der Zee, (NIOZ), NL	University of Mexico, (UNAM) MX
Stichting Dienst Landbouwkundig Onderzoek (DLO)), NL	El Colegio de la Frontera Sur, (ECOSUR) MX
Wageningen University, (WU) NL	Centro de Ecologia Marina de Utila, (UCME) HN
Stichting Koninklijke Rotterdamse Diergaarde, (RZOO), NL	University of Queensland, (UQ) AU
Caribbean Research and Management of Biodiversity, (CARMABI), CW	

FUME

At a glance

Title: Forest fires under climate, social and economic changes in Europe, the Mediterranean and other fire affected areas of the world

Instrument: Integrated Project

Total cost: 8 230 786 €

EC contribution: 6 178 152 €

Duration: 48 months

Start date: 01/01/2010

Consortium: 33 partners from 17 countries

Project coordinator: Universidad de Castilla-La Mancha (UCLM)

Project website: www-fumeproject.eu

Key words: forest fires, climate change, socioeconomic change, climate change impact, climate change adaptation, climate change vulnerability, fire risk, extreme events

The challenge

In the EU, 60,000 fires burn 0.5 Mha annually. In the last decades, rural exodus, changes in land-use/land cover (LULC) and socioeconomics increased fire risk. Climate warming may have added to it. Extreme weather/climate events are critical for fires, prompting megafire episodes. Changes in socioeconomics, LULC and climate, including extremes, are projected to continue. Assessing past interactions between changing drivers and fire is important for managing risk. Additionally, evaluating future changes in drivers and their impact on fires, the ecosystem, and the capacity to adapt current protocols to them is utmost important to deal with projected increases in fire risk.

Project objectives

Fires result from interactions between climate, land-use and land-cover (LULC), and socioeconomic factors. These have been changing and are expected to change in the future. FUME assesses how their interplay affected in the recent past, and will affect during this century, forest fires, and their impacts on some ecosystems and society by:

- Reconstructing past LULC changes, mapping fires, and determining the relationships between fire, LULC, and climate, including extreme events
- Producing/adjusting scenarios of drivers of fire, included future climate, LULC and vegetation.
- Evaluating the sensitivity of the vegetation, including restoration capacity, under future climate conditions
- Analyse options to cope with future changes in fire risk, including costs of certain forest services, and policy needs.
- Increase knowledge transfer to end-users through specific training activities

Research will focus on old and new fire areas, the wildland-urban interface, Europe and the Mediterranean, including all Mediterranean-type areas of the world.

Methodology

Reconstruct past changes in socioeconomics and LULC, map fires, and determine factors driving LULC change and fire risk (including the WUI); calculate past relationships between weather/climate and fires, including extremes; detect changes in fire trends and drivers and disentangle the relative influence of these on fire; e) develop/update LULC, climate and vegetation scenarios for assessing future changes in fire; f) project impacts of changes in drivers on fire danger and regime by modelling; g) test the impact of changes in temperature and water on plant responses, including experimental manipulations of drought in burned ecosystems; h) select plants and update protocols for restoring under more stressful climate; i) appraise fire protocols in EU countries to face more extreme fire; j) calculate economic costs of some forest services and policy implications of future fire changes; j) train and meet with stake-holders to facilitate knowledge-transfer.

Expected results

FUME has produced knowledge and tools for quantifying the role of various drivers (socio-economics, land-use/land cover, climate) on fire across the Mediterranean. These, aided with scenarios of future change, are being used to produce models to assess future changes in fire. Maps of past fire perimeters across the Mediterranean and Europe have been produced, as well as maps and models of future LULC, vegetation and fire danger and risk. The capacity of plants and some ecosystems to cope with drought and the potential use of certain species in restoration is being determined. An evaluation of current protocols to deal with extreme fire conditions, models to assess economic costs of some forest services, and a list of policies that may need to be revised in light of the new fire conditions is being made. Forest managers, planners and experts involved in fire and climate change policies are the main beneficiaries.

Project partners	
Universidad de Castilla-La ManchaToledo, ES	Universidad de Cantabria, ES
Centro de Estudios Ambientales del Mediterráneo, ES	Institut de Recherche pour le Développement, FR
Università degli Studi della Tuscia, IT	Ilmatieteen Laitos, IT
Centre National de la Recherche Scientifique, FR	Tecnologías y Servicios Agrarios, S.A., ES
Potsdam-Institut für Klimafolgenforschung, DE	Instituto Superior de Agronomia, PT
Fundaçao da Faculdade de Ciencias da Universidade de Lisboa, PT	Commission of the European Communities- Directorate General Joint Research Centre-JRC
Centro Euro-Mediterraneo per i Cambiamenti Climatici, IT	Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture (IRSTEA), FR
Università degli Studi di Sassari, IT	Centre for European Policy Studies, BE
National and Kapodistrian University of Athens, GR	University of Ioannina, EL
University of Wollongong, AU	Lunds Universitet, SW
Universidad Austral de Chile, CL	The University of Arizona, US
Mediterranean Agronomic Institute of Zaragoza/International Centre for Advanced Mediterranean Agronomic Studies, ES	Agencia Estatal Consejo Superior de Investigaciones Científicas, ES
Université F. Abbas de Sétif–Laboratoire d'Optique Appliquée, AL	Institute National de Recherches en Gènie rural, Eaux et Forêts, TU
National Meteorological Service Morocco, MO	
Southwest Anatolia Forestry Research Institute, TR	South African National Biodiversity Institute, ZA
US Forest Service- Pacific Southwets Research Station US	US Geological Service, Western Ecological Research Center, US
Northern Arizona University, US	

GENESIS

At a glance

Title: Groundwater and Dependent Ecosystems: New Scientific and Technological Basis for Assessing Climate Change and Land-use Impacts on Groundwater (GENESIS)

Instrument: Large-scale integrating project

Total cost: 9 170 600 €

EC contribution: 6 997 200 €

Duration: 60 months

Start date: 01/04/2009

Consortium: 25 partners from 17 countries

Project coordinator: Norwegian Institute for Agricultural and Environmental Research (Bioforsk), NO

Project website: http://www.bioforsk.no/ikbViewer/page/prosjekt/forside?p_dimension_id=16858&p_menu_id=16904&p_sub_id=16859&p_dim2=16859

Key words: Ground Water Directive, ground water systems, water resources, land use, water management, agriculture, pollution, leaching, nitrate, pesticides, groundwater dependent ecosystems, modelling, climate change, management, socio-economy and legal aspects.

The challenge

Groundwater resources are facing increasing quantitative and qualitative pressure from land-use. In some areas, groundwater levels have been reduced, resulting in negative impacts on water quantity and important ecosystems relying on groundwater. In many areas, groundwater has been contaminated by diffuse loading resulting from land-use activities (e.g. agriculture) or point sources (e.g. industry, sewage). There is a strong need to reduce input of pollutants to prevent groundwater pollution. Additional threats from climate change include direct changes in recharge and groundwater renewal and indirect changes that can affect water consumption.

Project objectives

The objective of GENESIS is to integrate pre-existing and new scientific knowledge into new methods, concepts and tools for the revision of the Ground Water Directive and better management of groundwater resources.

The research will: i) use tracers to characterize groundwater flowpaths, ii) improve the understanding of pollutant leaching from different land-uses both in time and space considering also uncertainty, iii) develop a better understanding of how ecosystems depend on groundwater, iv) increase the knowledge on how these systems should be modelled to better understand how changes in land-use and climate affect the groundwater and dependent ecosystems, and v) develop better cost-efficient management and monitoring tools. The research results will be transferred to research community, stakeholders and end-users for better management.

Methodology

The project is multidisciplinary with focus in hydrology, water resources, hydrogeology, ecology, agronomy, soil science, modelling, economy, sociology and legal aspects. The work in GENESIS is organised in eight Work Packages (WPs). The first WP1 harmonizes monitoring practices between partners.

The main scientific research work on groundwater and ecosystems processes will be carried out in the WPs 2-6. This comprises studies on water flow paths with isotopes, pollutant transport and leaching processes, groundwater ecosystems, modelling, management and engineering. Case study aquifers and ecosystems will be carried out in different climatic regions with various land use pressures.

Expected results

GENESIS will provide various tools to assess land-use and climate impacts on ground water and related ecosystems. A better scientific basis will be developed for i) groundwater flowpaths characterization, ii) pollutant leaching and biogeochemical processes, iii) groundwater interaction with ecosystems, and iv) integrated modelling and management.

GENESIS will provide a range of methods to better identify, manage and protect future groundwater systems for pressures of land use and climate change. Better conceptual models will be developed for aquifers and connected ecosystems. These models will include hydrology, ecology and main pressures and responses. Numerical models will be developed for several aquifers and experience gained from modelling of aquifer and connected ecosystems. Models will simulate future impacts of land use and climate change.

Critical process and models that govern leaching of agricultural derived nitrate and pesticides will be evaluated. Models will be benchmarked using data from well monitored pilot sites.

The role of groundwater in ecosystems has yet received little attention. Considerable results have been gained on understanding I) individual ecosystems and II) providing a multidisciplinary approach to protection and management where hydrology and ecology interactions are better included. Important results have been gained on the characterization of hydraulic contacts between ecosystems and groundwater using environmental tracers.

New information on socio-economic and legal aspects will result. Several methods will be tested at case studies. This will allow a better inclusion of cost efficiency and stakeholder participation as well as other principles of integrated resources management.

Project partners	
Norwegian Institute for Agricultural and Environmental Research (Bioforsk), NO	Swiss Federal Institute of Technology Zurich (ETH), CH
Joanneum Research Forschungsgesellschaft mbH (JR), AT	Integrated Global Ecosystem Management Research and Consulting Co. (IGEM), TR
Luleå University of Technology (LTU), SE	Democritus University of Thrace (DUTh), EL
GIS-Geoindustry s.r.o. (GIS), CZ	University of Oulu (UOULU), FI
Wageningen University and Research Center (Alterra), NL	Swedish Meteorological and Hydrological Institute (SMHI), SE
Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (EAWAG), CH	University of Zagreb- Faculty of Mining, Geology and Petroleum Engineering (UNIZG-RGNF), HR
Università Cattolica del Sacro Cuore (UCSC), IT	University of Neuchâtel (UNINE), CH
Universidad Politecnica de Valencia (UPVLC), ES	Universitatea din Bucuresti (UNIBUC), RO
University of Science and Technology (AGH), PL	München Gesundheit Umwelt (HMGU), DE
Institute National de la Recherche Agronomique (INRA), FR	Athens University of Economics and Business-Research Centre (AUEB-RC), EL
University of Kiel (UKiel), DE	Cracow University of Technology (CUT), PL
University of Bologna (UNIBO), IT	University of Dundee (UNIDUN), UK
Helmholtz Zentrum für Umweltforschung GmgH (UFZ), DE	

HERMIONE

At a glance
Title: Hotspot Ecosystem Research and Man's Impact on European Seas
Instrument: Small or medium-scale focused research project
Total cost: 10 884 787 €
EC contribution: 7 998 955 €
Duration: 36 months
Start date: 01/04/2009
Consortium: 38 partners from 14 countries
Project coordinator: National Oceanography Centre, Southampton, UK
Project website: www.eu-hermione.net
Key words: Deep-sea ecosystems, marine biodiversity, ecosystem functioning, sustainable management, ocean governance

The challenge

The HERMIONE project sets out to investigate ecosystems at critical sites on Europe's deep-ocean margin. Even these remote areas are being affected by man, either through the indirect affects of climate change or directly through exploitation of deep-sea resources. Urgent questions need to be addressed such as what will be the impact of climate change on deep-sea ecosystems? What changes are expected in deep-sea ecosystem functioning? How do species interconnect between isolated communities? What are the direct effects of man's impact and how can we adapt or mitigate these so as to use the oceans in a sustainable manner? Answering these questions will require complex experiments combined with long-term monitoring of sensitive environments.

Project objectives

HERMIONE will investigate the distribution of ecosystems of varying size on the deep-sea floor and look at interconnections between them. It will try to define the environmental tolerances that maintain ecosystems e.g. temperature, and predict what will happen as climate changes or as man impacts them in other ways. HERMIONE will look at the functioning of these ecosystems, which is dependent on biodiversity, and estimate the possible consequences of biodiversity loss. Finally, the project will engage with stakeholders and policy-makers and provide them with the scientific knowledge to support deep-sea governance aimed at the sustainable management of resources and the conservation of ecosystems.

Methodology

The HERMIONE project will study a range of hotspot ecosystems – open slopes, cold and hot seeps (where fluids and methane escape at the seabed), canyons, cold-water corals and seamounts. Strong connections to policy makers will ensure that the science is focused on the most relevant issues and that the results are used in plans for the sustainable use of the oceans.

The HERMIONE workplan includes a significant field and sampling programme based around more than 1000 days of shiptime aboard Europe's research vessel fleet and with extensive use of remotely operated vehicles. Study sites (see map) encompass the key ecosystem hotspots and include; the Arctic because of its importance in monitoring climate change; Nordic margin with abundant cold-water corals, extensive hydrocarbon exploration and the Håkon Mosby mud volcano natural laboratory; Celtic margin with a mid latitude canyon, cold water corals and the long term Porcupine Abyssal Plain monitoring site; Portuguese margin with the highly diverse Nazaré and Setúbal Canyons: seamounts in the Atlantic and W. Mediterranean as important biodiversity hotspots potentially under threat; mid Atlantic Ridge site to link cold seep to hot seep chemosynthetic studies; Mediterranean cold water cascading sites in the Gulf of Lions and outflows of the Adriatic and Aegean Seas.

The HERMIONE sampling programme will start in spring 2009, ensuring maximum time for data collection through the project, and will continue through to Year 3. The focus will shift mid-way through the project towards more laboratory work, but the continuing field programme will allow additional or complementary data to be collected as the project evolves.

Expected results

The multidisciplinary research under HERMIONE is designed to fill the knowledge gap about threatened deep-sea marine ecosystems and their environments. It will reveal the impact of man on these ecosystems, both directly e.g. via bottom trawling and indirectly via climate change. The results will feed national, regional (EU) and global policy and decision makers with the information needed to establish policies to ensure sustainable use of the deep ocean.

Project partners	
Natural Environment Research Council, UK	Cardiff University, UK
Ifremer, FR	Institute of Marine Research, NO
Royal NIOZ, NL	University of Goteborg, SE
University of Barcelona, ES	University of Southampton, UK
Hellenic Centre of Marine Research, GR	Netherlands Institute for Ecology, NL
IFM-GEOMAR, DE	University of Aberdeen, UK
University of Tromsø, NO	University of Liverpool, UK
National University of Ireland, Galway, IE	Scottish Association of Marine Science, UK
Friedrich-Alexander University of Erlangen-Nuremberg, DE	University of Aveiro, PT
University of Gent, BE	Université de Marie et Pierre Curie, FR
Consejo Superior de Investigaciones Scientificas, ES	P.P. Shirshov Institute of Oceanology, RU
Consorzio Nazionale Interuniversitario per le Scienze del Mare, IT	United Nations Environment Programme WCMC
Max Planck Institute for Marine Microbiology, DE	University of the Azores, PT
Centre National de la Recherche Scientifique, FR	Median SCP, ES
Instituto Hidrografico, PT	ArchimediX, DE
Jacobs University Bremen, DE	University of Thessaly, GR
MARUM University of Bremen, DE	University College Cork, IE
Consiglio Nazionale delle Richerche, IT	National Marine Aquarium, UK
Alfred Wegener Institute, DE	Acquario di Genova, IT

ICE2SEA

At a glance

Title: Ice2sea – estimating the future contribution of continental ice to sea-level rise
Instrument: Collaborative project
Total cost: 13 632 213 €
EC contribution: 9 994 842 €
Duration: 51 months
Start date: 01/03/2009
Consortium: 24 partners from 13 countries
Project coordinator: British Antarctic Survey, Natural Environment Research Council (United Kingdom)
Project website: www.ice2sea.eu
Key words: sea-level rise, glaciers, IPCC, climate change

The challenge

Fifteen EU countries have substantial coastlines that will be affected by global sea-level rise. Within these coastal regions

- economic assets within 500 metres of the sea have an estimated value between €500 and €1,000 billion;
- 47,500 km2 of sites within 500m of the coastline are identified as having high ecological value;
- population has more than doubled to 70 million people – currently 14% of the entire EU population.

Project Objectives

Ice2sea is a collaborative research programme involving 24 institutional partners. Ice2sea is specifically focussed on the contribution to sea-level rise that will arise from loss of continental glaciers and ice sheets and which give rise to the largest part of the uncertainty in the projections.

The programme will run for four years, (2009-2013) with a schedule designed to provide input to the next Intergovernmental Panel on Climate Change (IPCC) assessment of climate change and its impacts.

Methodology

The various aspects of science research, management and delivery are undertaken through five interrelated work packages, each led by an expert in the field.

- WP1 – Programme management
- WP2 – Key glacial processes
- WP3 – Model foundation and validation
- WP4 – Projection of climate forcing
- WP5 – Projection of glacial change
- WP6 – Synthesis and dissemination

Expected results

From its outset, ice2sea had twin goals of improving the science that underpins sea-level prediction, and of providing new sea-level projections based on the most up-to-date climate projections. These goals have been realised through:

- targeted studies of key processes in mountain glaciers, ice caps, and in the polar ice sheets (Greenland and Antarctica);
- improved satellite determinations of current changes in continental ice mass;
- development of more reliable techniques for predicting the response of ice-sheets and glaciers to environmental change;
- delivery of comprehensive projections of the contribution of continental ice to sea-level rise over the next 200 years.

The ice2sea projections based on simulations of physical processes suggest lower overall contributions from melting ice to sea-level rise than many studies published since IPCC AR4 (2007).

For the “business as usual” mid-range emissions scenario (A1B), the ice2sea projections based on simulations of physical process suggest a range of contributions to sea-level rise slightly higher than the 'incomplete' projections presented in the IPCC AR4 (2007). However, they are considerably lower than several high-end projections published since AR4. To obtain a projection of total global sea-level rise, other contributions, not explicitly addressed by ice2sea, must be added (e.g. thermal expansion of the oceans, and changes in terrestrial water storage).

For the period after 2100, sea levels will continue to rise, initially at an accelerating rate, for many centuries.

Project partners	
Natural Environment Research Council–British Antarctic Survey, UK	Alfred Wegener Institut Helmholtz Zentrum für Polar und Meeresforschung, DE
CSC–IT Center for Science Ltd, FI	Danmarks Meterologiske Institut, DK
Danmarks Tekniske Universitet, DK	Haskoli Islands, University of Iceland, IS
The Geological Survey of Denmark and Greenland, GL	Universiteit Utrecht, NL
Centre National de la Recherche Scientifique, FR	Met Office Hadley Centre, UK
Universitetet Oslo, NO	Université Libré de Bruxelles, BE
Universita degli Studi di Urbino, IT	University of Bristol, UK
University of Leeds, UK	Vrije Universiteit Brussel, BE
Kebenhavns Universitet, DK	Universite de Liege, BE
Universitaet Zuerich CH	Uniwersytet Slaski/ University of Silesia, PL
Centro de Estudios Cientificos, CL	Norsk Polarinstitutt, NO
Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile, IT	Instytut Geofizyki Polskiej Akademii Nauk, PL

ICEPURE

At a glance
Title: Impact of Climatic and Environmental Factors on Personal Ultraviolet Radiation Exposure and Human Health
Instrument: Small and Medium Collaborative project, 7th Framework Programme
Total cost: 4 589 795 €
EC contribution: 3 497 616 €
Duration: 48 Months
Start date: 01/02/2009
Consortium: 8 partners from 6 countries
Project coordinator: King's College London, UK
Project website: www.icepure.eu
Key words: UVR, exposure behaviour, UV, personal dosimetry, vitamin D, DNA damage, immunosuppression, modelling, climate model

The challenge

To obtain field data for personal UVR exposure in work and leisure situations in Europe and to correlate these with biological outcomes that are indicative of the beneficial and adverse effects of solar UVR.

To use the UVR exposure data obtained from field studies in combination with ambient UVR and relevant meteorological modifying factors to develop models that can be incorporated into climate models to predict UVR exposure in the future.

To assess the validity of measurements of UVR exposure in the epidemiological literature and devise means of improving these.

Project Objectives

Measure personal UVR exposure in different work and leisure environments in Europe

- In relation to important leisure (skiing, beach) and working activities in Europe
- To validate existing UVR estimates in epidemiological studies
- To correlate personal UVR exposure with satellite and ground station data
    - UVR
    - Albedo
    - Aerosol
    - Cloud cover
- Use combined personal, satellite and ground station UVR data to develop new radiative transfer models that can be used in climate models to predict future UVR levels
- Determine the beneficial and harmful biological effects of UVR, and critical dose levels, in relation to personal UVR exposure including
    - Vitamin D synthesis
    - DNA damage
    - Immunosuppression
- Review the current health risks of UVR exposure and assess the impact of using personal UVR data on existing exposure relationships, and where possible, determine critical levels of exposure.

Methodology

Different approaches were used in different parts of the project. A major aspect of the project was field studies of work and leisure activities in Europe. Participants in these studies wore SunSavers that recorded personal UVR exposure, and ground stations recorded ambient exposure. Blood and urine samples were taken to make assessments of vitamin D and DNA damage status prior and post study. These data were supported by diary and clinical data. In one study, we assessed the effect of solar exposure on skin immunity.

Human laboratory studies were also done to study the relationship between erythema, vitamin D synthesis and immunosuppression.

The other aspects of the projects were based on modelling using data generated from the field studies that were incorporated into radiative transfer/climate models to predict UVR exposure in the future. Modelling was also done to validate UVR measures in epidemiology and deriving methods of improving such measures.

Expected results

The project has been completed and we much have a better understanding of the relationship between UVB exposure (including body surface area), increase in vitamin D and DNA damage. It seems that one does not occur without the other, and this has been demonstrated in children and adults. We have shown that a week in the sun is very immunosuppressive and that such immunosuppression can be predicted by erythema, irrespective UVR spectrum.

A combination of SunSaver and diary data show that holidaymakers, especially Danes, seek almost as much sun as possible and obtain high levels of sunburn, which means that public education of sun behaviour has a long way to go.

Our UVR exposure models correlated well with observed exposure so we believe they are valid as a basis to predict future UVR exposure. Furthermore, we have devised means to make better assessments of UVR exposure in epidemiology studies.

Project partners	
King’s College London	UK
Bispebjerg Hospital	DK
Medical University of Lodz	PL
Karolinska Institute	SE
Centre for Research on Environmental Epidemiology	ES
University of Veterinary Medicine Vienna	AT
Health Protection Agency	UK
Danish Meteorological Institute	DK

IMPACT2C

At a glance

Title: Quantifying projected impacts under 2°C warming

Instrument: Collaborative project

Total cost: 8 447 372 €

EC contribution: 6 499 999 €

Duration: 48 months

Start date: 01/10/2011

Consortium: 29 partners from 17 countries

Project coordinator: Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung

Project website: www.impact2c.eu

Key words: Climate change, 2°C warming, impacts, vulnerability, risks, adaptation, decision making, floods, droughts, water availability, water management, agriculture, forestry, health, air pollution

The challenge

A so called "2°C reduction target" is a trigger for the research addressing climate sensitivity, e.g., the actual relationship between a magnitude and timing of a "maximum allowable" atmospheric greenhouse gases concentration, and the resulting (global) average warming of a maximum of 2°C. However, only very little work has been done on consequences of such warming so far. Estimating the key impacts of a 2°C climate change signal for different regions and sectors, both in Europe and outside, is therefore the primary objective of the IMPACT2C project.

Project objectives

The project:

- provides detailed information based on an ensemble of climate change scenarios, plus statistics and derived indices, tailored to the needs of various sectors, for the time slice in which the global temperature is simulated to be 2°C above pre industrial levels;
- provides a detailed assessment of risks, vulnerabilities, impacts and associated costs for a broad range of sectors against the background of socio-economic scenarios consistent with the development paths aimed at global warming being limited to 2°C;
- develops an optimal mix of response strategies (technological, governance, capacity building) accounting for the regional differences in adaptive capacities, which are distinguished between those that can be accommodated autonomously and those that require additional policy interventions.

Methodology

IMPACT2C enhances knowledge, quantifies climate change impacts, and adopts a clear and logical structure, with climate and impacts modelling, vulnerabilities, risks and economic costs, as well as potential responses, within a pan-European sector based analysis. The project utilises a range of models and assesses effects on water, energy, infrastructure, tourism, forestry, agriculture, ecosystem services, and health.

Harmonised socio-economic assumptions/scenarios have been used, to ensure that both individual and cross-sector assessments are aligned to the 2°C scenario for both impacts and adaptation. IMPACT2C has a core theme of uncertainty and develops a methodological framework integrating the uncertainties within and across the different sectors in a consistent way. A cross-sectoral perspective is adopted to complement the sector analysis on the pan-European level. The project assesses climate change impacts in Bangladesh, Africa (Nile and Niger basins) and the Maldives.

Expected Results

- estimating the key impacts of a 2°C (1.5°C) climate change signal for different regions and sectors, both in Europe and outside, and suggesting appropriate response strategies;
- tailoring the scenarios to the needs of the sectoral impact modellers by providing bias corrections, downscaled products and derived statistics and associated uncertainties;
- developing integrated (climate – impact – cost) assessments of uncertainty in support of the (cross) sectoral climate change impact and adaptation projections; developing policy guidelines to deal with these uncertainties.

IMPACT2C draws this information together in a synthesis report that highlights the risks, trade-offs, synergies and costs. This will be particularly useful for European authorities who participate in international negotiations on climate change.

The project also includes an ambitious awareness-raising programme that will disseminate the findings effectively and provide easily accessible climate-related information to policy-makers, the media, and users in general.

Project partners	
Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH, Climate Service Center, DE	Wageningen Universiteit, NL
Potsdam Institut fuer Klimafolgenforschung, DE	Technical University of Crete, EL
UniResearch, Bjerknes Centre for Climate Research, Norway (NO)	Norway (NO)
Meteorologisk Institutt, Norway (NO)	Norway (NO)
Sveriges Meteorologiska och Hydrologiska Institut, Rossby Centre, SE	Paul Watkiss Associates Ltd, UK
JRC -Joint Research Centre- European Commission, BE	Universite de Lausanne, Switzerland (CH)
Agenzia Nazionale per le Nuove Tecnologie,L'energia e lo Sviluppo Economico Sostenibile, IT	University of Southampton, UK
Centre National de la Recherche Scientifique Institut Pierre Simon Laplace, FR	Ministry of Housing and Environment, Maldives (MV)
Centre National de Recherches Meteorologiques, FR	Bangladesh Center for Advanced Studies, Bangladesh (BD)
Universität Graz, Wegener Zentrum für Klima und Globalen Wandel, AT	International Water Management Institute, Sri Lanka (LK)
Joanneum Research Forschungsgesellschaft MbH, AT	Stichting Wetlands International, NL
Internationales Institut fuer Angewandte Systemanalyse, AT	World Health Organization, Regional Office for Europe, Kopenhagen-Rome, Switzerland (CH)
Danmarks Meteorologiske Institut, DK	Institute of Water Modelling, Bangladesh (BD)
Koninklijk Nederlands Meteorologisch Instituut, NL	Global Climate Forum E.V., DE
African Centre of Meteorological Application for Development, Niger (NE)	

INCREASE

At a glance

Title: An Integrated Network on Climate REsearch Activities on Shrubland Ecosystems

Instrument: Large scale integrated project

Total cost: 7 780 186 €

EC contribution: 5 999 764 €

Duration: 57 months

Start date: 01/03/2009

Consortium: 9 partners from 5 countries

Project coordinator: Inger Kappel Schmidt

Project website: www.increase-infrastructure.eu

Key words: Climate change, manipulation experiments, non-intrusive sampling methodology, ecosystems, soil carbon dynamis, carbon balance, predictive models

The challenge

The climate is changing and ecosystems will face changes in atmospheric CO2, temperature and precipitation. All are key factors in the regulation of biological processes and will affect natural ecosystems. Climate change poses a serious challenge for the scientific communities to develop new concepts for research and modelling to provide better and more realistic answers and predictions of what the impacts will be.

Project objectives

INCREASE is an EU-funded network of large-scale climate change experiments across Europe, which will meet the climate challenges by further development of non-intrusive technologies for realistic climate manipulations and for non-destructive sampling methodologies and by synthesis of long data records obtained from the same infrastructures.

The objectives are:

1. To improve technologies for large-scale climate change experiments with realistic manipulation of climate
2. To improve methodologies for studies of climate change effects on ecosystems
3. To gather and disseminate a compre-hensive data base of experimental data
4. To develop and disseminate an ecosystem model for shrubland ecosystems
5. To provide access to large-scale field-based climate change experiments to a wider scientific community.

Methodology

INCREASE is a network of six large-scale field experiments and one phytotron for studies of climate effects on vulnerable shrubland ecosystems in Europe.

The field-based component of INCREASE is unique in combining experimental manipulations of climate factors with natural gradients of temperature and precipitation in Europe, thus allowing comparison of shrublands and their response to climate change using both the gradient and experimental approach. In summary, we superimpose manipulations with water and temperature on existing gradients with respect to the same factors. The experimental approach has been developed by the partners and provides a significant improvement of past approaches due to the reduction in experimental artefacts. It provides three levels of information:

- Between year data
- Treatment data from climate manipulations
- Across gradient data

The temperature rise observed so far has been due to increased minimum night-time temperatures. In the field-scale experiments, the night-time warming is mimicked by covering the ecosystem during the night by IR-reflective materials – i.e. passive night-time warming. Further, extended drought periods during the growing season mimic changes in precipitation patterns. Automated transparent covers activated by rain sensors are used to extend drought periods.

The non-intrusive character of the experimental design and non-destructive sampling methods within the infrastructures are unique and contribute to the long term sustainability of the infrastructures.

Expected results

INCREASE has provided a number of services to the scientific community within the first four years including:

1. access to a unique set of large scale climate change experiment for European scientists. In total, we have had about 70 visiting scientists representing 12 EU and 2 non-EU countries and 40 projects. In total, we have provided more than 1200 user days
2. a comprehensive data base of experimental data covering the period 1998-2012. The data base will support cross site synthesis improving our understanding of ecosystem feed-back to climate change and interaction with other drivers of change
3. development and documentation of the climate change manipulation technologies with special focus on warming and irrigation methodologies
4. development of non-destructive methodology and best practice for measurement of a range of key ecosystem processes including Net Ecosystem Exchange (NEE), below ground biomass. Further, we have developed an automated chamber system for NEE measurements and ecosystem respiration
5. development of ecosystem model for assessment of ecosystem carbon balance for future predictions and upscaling.

Partners in INCREASE are involved in other climate change networks world-wide, which ensures that the results will have impact beyond the network.

Project partners	
University of Copenhagen	DK
Technical University of Denmark	DK
University of Amsterdam	NL
Natural Environment Research Council	UK
University of Tuscia	IT
National Research Council of Italy	IT
Università degli Studi di Sassari	IT
Centre for Ecological Research Hungarian Academy of Sciences	HU
Bangor University	UK

ISEFOR

At a glance
Title: Increasing Sustainability of European Forests
Instrument: Collaborative project
Total cost: 3 995 536 €
EC contribution: 2 973 181 €
Duration: 36 months
Start date: 01/09/2010
Consortium: 16 partners from 11 countries
Project coordinator: University of Aberdeen, Scotland, UK
Project website: www.isefor.com/
Key words: Forest health; climate change; security; agriculture

The challenge

Rapid climate change, increased global trade in plants for planting and increased pathogen fitness threaten the vitality of European forests.

Project objectives

To identify the alien pests and pathogens and quantify the plant trade pathways that most threaten European forests. To provide the plant health surveillance community with diagnostic and predictive tools that will assist in mitigating threats from alien invasive forest pathogens and pests.

Methodology

Current information on pests and pathogens known as potentially invasive and the host taxa of these organisms will be collated and analysed to define the types of threats and update a database of invasive forest pathogens (IFPs).

State-of-the-art techniques, in particular using next generation sequencing, will be developed and evaluated for the rapid detection and diagnosis of invasive alien pests and pathogens. Participating laboratories will focus on pests in their area of expertise e.g. Phytophthora spp., Hymenoscyphus pseudoalbidus, Coleoptera and Lepidoptera, Ceratocystis platani, and Fusarium circinatum.

Data on plant nursery trade in Europe will be analysed as a pathway for the dispersal of alien pests. Plants traded and sentinel plants in nurseries in China will be sampled to identify and assess emerging pest and pathogen risks from the plants-for-planting pathway.

Cellular automaton (CA) modelling software will be developed to accurately predict spread and impacts of the alien pests and pathogens that have been identified as threats with climate change through the fundamental research of ISEFOR.

Expected results

Over 40 papers in peer-reviewed journals have been published detailing research and results from ISEFOR. This note gives only a sample of the vast amount of new knowledge generated.

There has been an exponential increase in invasive forest pathogens (IFPs) over the last 40-years. Countries with a higher human impact, wider range of environments, or international trade host more IFPs. The new European Database of 123 IFPs is available on the ISEFOR website and lists species, host range, disease, impact and other factors. The DAISIE inventory of alien invasive species for Europe was reviewed and updated for arthropods.

Various sampling and DNA isolation methods were developed and tested to address the technical challenges of identifying alien invasive species that are in environments in low abundance. This included characterisation of Phytophthora communities in forest soils in Poland and Italy, airborne trapping in Swedish forests, Italian urban streets and detecting species associated with insects in France and migratory birds in the UK. Isolations from ten birds yielded 3 345 distinct eukaryotic species of which 135 were identified as plant pathogens, implicating migratory birds as a pathway.

Traditional morphological methods of species diagnosis combined with DNA barcoding indentified 31 potential pest invaders (mostly coleopterans, lepidopterans and a few heteropterans) from sampling sentinel European trees planted in China and surveys in Siberia and the Russian Far East. Sampling from Acer palmatum, Buxus microphylla Fraxinus chinensis, Ilex cornuta and Zelkova schneideriana trees commonly imported from China into Europe continues.

Netherlands and Italy are the main importers of live plants into Europe comprising 98% of over four billion plants imported each year. Most of the imported live plants come from Africa 81.3%, followed by Asia 11.5% and North America 4.6%. Woody plants form about a quarter of the live plants imported. There is considerable trade of imported plants between countries within Europe.

CA models are developed for nine species causing serious damage with documented environmental requirements that are sensitive to climate change, these are: Bursaphelenchus xylophilus, Hymenoscyphus pseudoalbidus (Chalara fraxinea), Dendroctonus ponderosae, Leptoglossus occidentalis, Agrilus planipennis, Dendrolimus sibiricus, Phytophthora alni, Fusarium circinatum and Dothistroma septosporum. Initial runs predicted well for the spread of Ash Dieback and Pinewood nematode. Model parameters are refined through an iterative process with forest health experts.

Project partners	
Institute of Biological & Environmental Science, University of Aberdeen	UK
Dept of Forest Entomology, Swedish University of Agricultural Sciences	SE
Laboratory of Soil Biology, University of Neuchatel	CH
Facolta di Agraria, Università degli Studi della Tuscia	IT
Istituto per la Protezione delle Piante	IT
Dept of Silviculture and Genetics, Forest Research Institute	PL
Biological Control and Spatial Ecology Lab, Université Libre de Bruxelles	BE
Forest Management and Planning, University of Eastern Finland	FI
Institut National de la Recherche Agronomique	FR
Forestry Pest Research, Centre for Agricultural Bioscience International	CH
St. Petersburg Forest Technical Academy	RU
University of Natural Resources and Life Sciences Vienna	AT
European State Forest Association	BE
Confederation of European Forest Owners	BE
Programme for the Endorsement of Forest Certification schemes	CH
Institute of Zoology, Chinese Academy of Sciences	CN

MACROCLIMATE

At a glance
Title: Quantitative dynamic macroeconomic analysis of global climate change and inequality
Funding Scheme: ERC Advanced Grant
ERC funding: 2 100 000 €
Duration: 60 months
Start date: 01/01/2009
Principal investigator: Per Krusell
Host institution: Stockholm University
Key words: integrated assessment, optimal carbon tax, simulation model, policy heterogeneity, impact heterogeneity

The challenge

There is a need for a framework allowing analysis of how different kinds of policies aimed at dealing with climate change influence different regions of the world. One important challenge is to make the framework fully "integrated": projections for climate change and its effects on economic activity must be consistent with the same model's assumptions about fossil fuel use over time; there are few integrated assessment models (IAMs) that are fully integrated. The challenge here is to solve a DSGE model (see below) with many regions: it is technically very demanding, but recent advances in computational macroeconomics now allowed it.

Project objectives

The goal is to deliver a set of models with different regional resolution (from one region to 5000 regions) that can be used for analysing and communicating the effects of different policies, both on climate outcomes and economic outcomes. The high-resolution model is in focus but models with fewer regions can be effective too in research and policy discussions. High-resolution models can be used to discuss differential impacts of policy and climate change and to analyse policy heterogeneity across different regions of the world. With clear, internally consistent projections and a welfare evaluation based on solid economic underpinnings, it will be possible to communicate, in concrete terms, the impact of different policies and, hopefully, thereby improve the chances for agreement across nations on global policy to combat climate change.

Methodology

The model builds on so-called dynamic, stochastic, general-equilibrium (DSGE) methods: it explicitly describes how the climate and the economies evolve over time (D), it explicitly incorporates uncertainty and how economies respond to it (S), and it is based on economic theory with microeconomic foundations and explicit description of market interactions between consumers and firms and across countries (GE). Its one-region version is closely related to Nordhaus's DICE model, but more solidly based on microeconomic fundaments. Its multiregion model is comparable to Nordhaus's RICE but much more disaggregated (5000 regions in the world, compared to around 10 in RICE).

Emerging results

A first pilot project delivered a one-region model with an optimal-tax formula for carbon that is surprisingly general.

This generality, in itself, implies an argument for using taxes rather than quotas, since the robustness of optimal quota prescriptions are far more sensitive to model details. These results have been communicated in a number of arenas, ranging from purely academic ones to policy circles and the general public, and received very favourable feedback. The multi-region model is under way and will be made available online.

It can be likened to a product (its working name is Sim-Globe), though playing out over time. Users will be able to pull policy levers themselves and follow the results on colourful screens depicting outcomes over time and across regions. A prototype of Sim-Globe will be available by the end of the year and a full model before the completion of the ERC project.

MEECE

At a glance

Title: Marine Environmental Evolution in a Changing Environment
Instrument: Integrated project
Total cost: 9 750 000 €
EC contribution: 6 500 000 €
Duration: 48 months
Start date: 01/09/2008
Consortium: 21 partners from 12 countries
Project coordinator: Plymouth Marine Laboratory, UK
Project website: www.meece.eu
Key words: Marine ecosystems, models, climate change, fishing, pollution, alien invasive species, decision support tools.

The challenge

Marine ecosystems are increasingly under pressure from the activities of man and are consequently changing. Climate change may lead to large scale changes in climate patterns, ocean circulation and climatic variables such as temperature and light and simultaneously, combinations of direct anthropogenic drivers such as fishing, eutrophication and pollution impact on marine ecosystems.

Project objectives

The primary goal of MEECE was to improve the knowledge base on marine ecosystems and input to the development of innovative tools for understanding and assessing Good Environmental Status (GES) in marine waters in European regional seas to inform the implementation of the MSFD. The implementation of the Marine Strategy Framework Directive (MSFD) requires member states to develop strategies to achieve a healthy marine environment and make ecosystems more resilient to climate change in all European marine waters by 2020 at the latest.

Methodology

MEECE explored multiple driver impacts on complex environments through numerical simulation models which include dynamic feedbacks, unlike statistical approaches. The project followed a logical process starting with targeted data synthesis, experimentation, model parameterisation and development, followed by model exploration through a range of scenarios addressing the full set of drivers. This innovative approach was designed to help scientists and decision makers to respond to the multiple driver impacts with appropriate, knowledge-based, management applications.

Results

MEECE has improved the knowledge base on marine ecosystems and how they are impacted by drivers by undertaking meta-analysis of existing data and targeted experimentation to investigate the response of key species and ecosystem to climate and direct anthropogenic drivers. By developing a library of modelling tools and a generic model coupler (FABM), MEECE has made an important step towards integrated end-to-end modelling tools which include a range of feedbacks between drivers and ecosystems from both physiological and population scale processes.

These modelling tools have been used to investigate the response of European regional seas ecosystems to climate change, direct anthropogenic perturbations and to combinations. The response of marine ecosystems to combinations of climate change and anthropogenic drivers was made using regional coupled hydrodynamic-ecosystem models. The results are complex and variable from region to region. For example the ecosystems of enclosed basins such as the Adriatic, Black and Baltic Sea are highly responsive to wind stress and eutrophication. In contrast the ecosystems of shelf seas with connection to open ocean (e.g. NE Atlantic, Biscay, Benguela) are responsive to changes in the nutrient supply from the open ocean. In contrast the impacts of fishing are generally a function of the local fish stock and which species are targeted.

To contribute to the development of innovative tools and strategies for rebuilding degraded marine ecosystems MEECE has undertaken an integrated assessment of marine resources which linked human activities to the MSFD descriptors. Outputs from the experiments and model simulations were used to devise decision support tools and develop management strategies which address combinations of climate, pollution, eutrophication, invasive species and fishing. Furthermore MEECE developed concepts and strategies for implementing management strategy evaluation procedures capable of integrating fisheries management in the context of interactions between climate, fishing, pollution, NIS and eutrophication. Tools have been developed which can be used to evaluate management strategies including both data demanding quantitative models and a semi-quantitative indicator-based framework. In addition a Working Group called indiSeas has worked jointly to evaluate the status of world marine ecosystems by providing a generic set of synthetic ecological indicators to accurately reflect the effects of fisheries on marine ecosystems, to facilitate effective dissemination of these effects to the general public, stakeholders at large and fisheries managers, and to promote sound fisheries management practices.

MEECE Model Atlas www.meeceatlas.eu covers the main European regional seas and provides simulations and projections for how ecosystems will respond to different scenarios for environmental change, in a form that's readily accessible to policy-makers, fisheries officials and other users of marine science.

Project partners	
Plymouth Marine Laboratory (Coordinator), UK	Institute of Marine Sciences, Middle East Technical University, , TR
Universitetet i Bergen, NO	Hellenic Centre for Marine Research, EL
University Hamburg, DE	Centre National de la Recherche Scientifique, FR
Fundación AZTI–AZTI Fundazioa, ES	Sir Alister Hardy Foundation for Ocean Science, UK
Alma Mater Studiorum Università di Bologna, IT	Università del Piemonte orientale "Amedeo Avogado", IT
Wageningen IMARES B.V., NL	Klaipeda University, Coastal Research and Planning Institute, LT
Centre for Environment, Fisheries & Aquaculture Science, UK	Bolding & Burchard ApS, DK
Natural Environment Research Council, UK	Instituto Español de Oceanografía, ES
Institut de Recherche pour le Développement, FR	Commissariat à l'énergie atomique, FR
Technical University of Denmark, Danish Institute for Fisheries Research, DK	Syddansk Universitet, DK
Institute of Marine Research, NO	

MESMA

At a glance
Title: Monitoring and Evaluation of Spatially Managed Areas
Instrument: Collaborative project
Total cost: 8 517 749 €
EC contribution: 6 568 842 €
Duration: 48 months
Start date: 01/11/2009
Consortium: 18 partners from 12 countries
Project coordinator: IMARES, NL
Project website: www.mesma.org
Key words: Marine Spatial Management, Spatially Managed Areas, SMA, ecosystem-based approach, planning strategies, sustainable development

The challenge

The seas around Europe are home to an exceptionally wide range of marine habitats which must also support a variety of marine industries. 'Multiple use' can cause problems between various user groups, between economic interests and conservation requirements, and there is also a greater potential for degradation of the marine ecosystems themselves. This all increases future challenges for marine environmental managers

The increasing pressures upon the European seas and coastal areas call for a well planned approach for their continued spatial development. The challenge for marine spatial management is to find an optimal balance between the competing demands of economic use, ecological development, and nature conservation while at the same time maintaining a sensitivity towards traditional practices.

Marine spatial management is place- or area-based and can provide a practical approach to long-term ecosystem-based management. The planning efforts should be comprehensive, adaptive, and participatory, and resolve conflicts among the relevant multiple users and the ecosystem. This can only be done via a sound scientific knowledge base pertaining to the ecology and resilience of species and marine habitats, the impacts of human activity and the variability in time and space of ecological, natural and historical values.

The major challenge is to combine an optimized economic use of the European seas and coastal areas, with a sustained marine ecosystem of high quality.

Project objectives

The MESMA project focuses on marine spatial planning and aims to produce integrated management tools (concepts, models and guidelines) for monitoring, evaluation and implementation of Spatially Managed Areas (SMAs). The project results will support integrated management plans for designated or proposed sites with assessment methods based on European collaboration.

Methodology

The main tasks in the project are information analysis, the development of a generic framework, the testing and evaluation of this framework through case-studies and the development of a toolbox. A significant proportion of the effort will be centred on the case studies within five geographical regions: the North Sea, Baltic, Mediterranean, Atlantic, and Black Sea. This approach makes it possible to compare pressures on an inter-regional level (e.g. Offshore wind farms in the North Sea, Black Sea and Baltic), or a multi-pressure level for a specific region (e.g. SMA in Fishing, Wind-energy, Geo-hazards and Tourism in the Black Sea).

Expected results

MESMA will supply innovative methods and integrated strategies for governments, local authorities, stakeholders, and other managerial bodies for planning and decision making at different local, national, and European scales, for sustainable development of European seas and coastal areas. This will comprise an easy accessible data system, containing information on the distribution of marine habitats and species, economic values, and human uses, in order to support dialogue between politicians, stakeholders and the public in general.

The project contributes to the design and implementation of the Common Fisheries Policy, the Thematic Strategy for Marine Protection and the recently endorsed Marine Strategy Framework Directive. The Directive aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend.

MESMA will provide a firm basis for the implementation of the Marine Strategy Directive and related policies.

Project partners	
IMARES (Institute for Marine Resources & Ecosystem Studies), NL	Fundacion AZTI/AZTI Fundazioa (Tecnalia AZTI), ES
University College London (ULC), UK	Ministry for Resources and Rural affairs–Malta Centre for Fisheries Sciences (MRRA-MCFS), MT
Senckenbergische Naturforschende Gesellschaft (Senckenberg) , DE	Danmarks Tekniske Universitet–National Institute of Aquatic Resources (DTU AQUA), DK
Universiteit Gent (UGent), BE	Heriot-Watt University (HWU), UK
Hellenic Centre for Marine Research (HCMR), GR	Stichting Deltares (Deltares), NL
Institute of Oceanology – Bulgarian Academy of Sciences (IO-BAS), BG	The Secretary of State for Environment, Food and Rural Affairs–Centre for Environment, Fisheries & Aquaculture Science (CEFAS), UK
Havforskninginstituttet (IMR), NO	Norsk Institutt for Vannforskning (NIVA), NO
University College Cork, National University of Ireland (UCC Cork), IE	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek–Building and Construction (TNO-BenO), NL
Consiglio Nazionale delle Ricerche (CRN-IAMC), IT	Vlaams Gewest (VlaGew), BE

OFFICAIR

At a glance

Title: On the reduction of health effects from combined exposure to indoor air pollutants in modern offices

Instrument: Small or medium-scale focused research project

Total cost: 4 068 399 €

EC contribution: 2 867 121 €

Duration: 36 months

Start date: 01/11/2010

Consortium: 14 partners from 10 countries

Project coordinator: University of Western Macedonia, EL

Project website: www.officair-project.eu

Key words: indoor air quality, modern office buildings, air pollutants, health effects, environment, health

The challenge

Modern offices have several sorts of electronic equipment and other dominant heat sources indoors, making them almost unaffected by local climatic conditions. Air conditioning and mechanical ventilation, coupled with the often excessive levels of artificial lighting, require high levels of energy. An important issue to consider regards Indoor Air Quality (IAQ). It is anticipated that developments in the field of energy use in offices will lead to its reduction through various strategies, including comfort/health standards and ventilation levels. In such a context and given the technological evolution of the functions and services accomplished in offices, the issue of IAQ in offices is addressed.

Project objectives

- Develop a European database with relevant information on indoor air pollution and its impact, in terms of concentrations, sources, emissions, exposures, health effects;
- Identify new, health relevant pollutants originating from indoor sources present in typical modern office environments;
- Inventory and identify associations identified as possible sources of IAQ problems in European modern offices, via field investigation;
- Assess possible synergies of ozone-initiated pollutants in office air emitted from office equipment;
- Set up an integrated modelling system to link emissions of key pollutants and major secondary indoor pollutants to their concentrations and to the assessment of the exposure of office workers;
- Evaluate the health effects of indoor air pollution under different conditions in modern office buildings in Europe;
- Make recommendations for IAQ policies in modern office buildings across Europe, propose adjustments to current practices and techniques.

Methodology

Field and health campaigns have been undertaken and provide input to the IAQ and exposure modelling studies and to policies, risk assessment and new policies/recommendations. Data obtained from the campaigns will lead to the development of a new database for office buildings, which derives from pre-existing databases.

Laboratory studies on chemical reaction mechanisms are performed where some results may influence the methods used in the field campaigns and the IAQ chemistry modeling and exposure assessment. The same applies to the toxicological studies. Regarding the dissemination, the consortium has devised a number of strategies which allow it to act as a network for capturing, formalising, sharing and promoting knowledge accumulated during the project, with emphasis on the scientific community, stakeholders and policy makers, end users and the public at large.

Expected results

i. Improve knowledge about the current situation in modern office buildings (improving databases, tools that estimate indoor air pollution, total exposure, related health impacts);
ii. Provide improved risk assessment data usable in regulation via the studies of validated biomarkers, the survey of the indoor office environments and toxicological studies;
iii. Support policies such as the Thematic Strategy on Air Pollution and the European Environment and Health Action Plan, after a close co-operation with all relevant stakeholders (e.g. building industry, health professionals, policy makers).

The OFFICAIR outputs, in association with other European initiatives, will have a great impact on:

- The assessment of the IAQ actual conditions with a reliable, economically acceptable and meaningful way, in terms of health effects and correlated guarantees;
- The setting of good practices and target indicators for the design, construction, maintenance and management of office buildings, bearing in mind the overall "sustainability" assessment, the IAQ conditions for comfort and health and the energy use conditions.

Project partners	
PANEPISTIMIO DYTIKIS MAKEDONIAS (UNIVERSITY OF WESTERN MACEDONIA)	EL
JRC -JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	IT
VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.	BE
DET NATIONALE FORSKNINGSCENTER FORARBEJDSMILJO	DK
UNIVERSITY OF YORK	UK
UNIVERSITA DEGLI STUDI DI MILANO	IT
INSTITUTO DE ENGENHARIA MECANICA	PT
KING'S COLLEGE LONDON	UK
NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK–TNO	NL
CENTRE SCIENTIFIQUE ET TECHNIQUE DU BATIMENT	FR
CONSIGLIO NAZIONALE DELLE RICERCHE	IT
EÖTVÖS LORÁND TUDOMÁNYEGYETEM	HU
PANEPISTIMIO IOANNINON	EL
UNIVERSITA DEGLI STUDI DELL'INSUBRIA	IT

QWECI

At a glance
Title: Quantifying Weather and Climate Impacts on Health in Developing Countries
Instrument: Small or medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 4.598.073 €
EC contribution: 3.499.401 €
Duration: 42 months
Start date: 1/02/2010
Consortium: 13 partners from 9 countries
Project coordinator: University of Liverpool, GB
Project website: www.liv.ac.uk/qweci/
Key words: environment, health, climate, weather, forecasting, disease, seamless, ensemble, seasonal, Africa, impacts

The challenge

One of the most dramatic and immediate impacts of climate variation is that on disease, especially the vector-borne diseases that disproportionally affect the poorest people in Africa. We remain poor at understanding why particular areas are vulnerable and how this will change in coming decades, with climate change likely to cause entirely new global disease distributions for most vector borne disease. At the same time we do not know the limit of predictability of the specific climate drivers for vector-borne disease using state-of-the-art seasonal forecast models, and how best to use these to produce skilful infection-rate predictions on seasonal timescales.

Project objectives

Key objectives of the project included:

- Evaluate predictions and projections of atmospheric variability at time scales of weeks/months/seasons/decades
- Develop methods to utilise weather and climate ensemble forecasts and scenario driven future climate projections from regional and global climate models
- Evaluate and implement user driven post-processing, e.g. downscaling of ensemble prediction and climate ensembles projection systems output to improve skill
- Diagnose climate-disease relationships for each targeted disease-location, assessing the potential drivers of selected diseases and enhancing the existing vector-pathogen-host database for climate related diseases impacting on human and animal health in Africa
- Assess the potential of long-range WiFi technology to monitor disease incidence and epidemic outbreaks, for both epidemic response and forecast verification purposes
- Define and/or refine climate-driven disease models of increasing complexity, assessing skill through hindcast validation
- Develop seamless approaches that give transparently produced climate information and disease risk maps for health impacts communities.

Methodology

The QWeCI project is aimed to understand at a more fundamental level the climate drivers of the vector-borne diseases of malaria, Rift Valley Fever, and certain tick-borne diseases, which all have major human and livestock health and economic implications in Africa, in order to assist with their short-term management and make projections of their likely future impacts.

With a focus on vector-borne diseases, and implementing a “bottom up” approach, QWeCI assessed and improved our present understanding of climate-driver disease inter-relationships in three target regions of Africa.

QWeCI developed and tested the methods and technology required for an integrated decision support framework to allow health stakeholders and planners to react in a timely and cost-effective manner to reduce the severity of epidemic outbreaks and make long-term decisions regarding health infrastructure investment.

Expected results

QWeCl brought together world-leading integrated weather/climate forecasting systems with health impacts modelling and climate change research groups, building an end-to-end seamless integration of climate and weather information for the quantification and prediction of climate health impacts in Africa.

Significant advances in our understanding of decadal climate forecasting were made.

Climate models run in decadal prediction mode have been proven useful for temperature predictions but do not yet have sufficient skill to drive health impact models (which also require rainfall estimates) over decadal timescales.

Significant progress has also been achieved in modelling vector-borne diseases and producing disease forecasts. New disease models have been developed within QWeCI, such as VECTRI–a dynamical malaria model that accounts for population density, climate and surface hydrology. VECTRI and the Liverpool Malaria Model have been implemented at the European Centre for Medium-Range Weather Forecasts, producing Europe's first operational prototype seasonal malaria forecasts for Africa.

Project partners	
University of Liverpool	UK
Centre de Suivi Ecologique	SN
Consejo Superior de Investigaciones Cientificas	ES
European Centre for Medium-Range Weather Forecasts	UK
Fundació Privada Institut Català de Ciències del Clima	ES
The Abdus Salam International Centre for Theoretical Physics	IT
International Livestock Research Institute	KE
Institut Pasteur de Dakar	SN
Kwame Nkrumah University of Science and Technology	GH
University Cheikh Anta Diop de Dakar	SN
University of Malawi (Polytechnic & College of Medicine)	MW
Universitaet zu Koeln	DE
University of Pretoria	ZA

RUMINOMICS

At a glance

Title: Connecting the animal genome, gastrointestinal microbiomes and nutrition to improve digestion efficiency and the environmental impacts of ruminant livestock production

Instrument: Collaborative project

Total cost: 7 710 829 €

EC contribution: 5 974 674, €

Duration: 48 months

Start date: 01/01/2012

Consortium: 11 partners from 7 countries

Project coordinator: University of Aberdeen, UK

Project website: www.ruminomics.eu

Key words: Genetics, genomics, metagenomics, methane, nutrition, rumen

The challenge

Methane emissions and low N retention are environmental problems long associated with ruminant livestock production. Recent developments in –omics technologies and bioinformatics mean this can now be investigated in greater detail than before. Using these new technologies RuminOmics will investigate whether the animal genome controls the microbiome or if the gut microbiota is regulated independently. Diet is known to affect greenhouse gas emissions and nutrient efficiency but how this affects the composition and function of the rumen microbiome remains unclear. This will be investigated by varying the three most abundant macronutrients in the diet (carbohydrate, protein and lipid) and assessing methane and N emissions.

Project objectives

The project aims to relate the animal genome to the microbiome, feed efficiency and methane emissions in order to improve digestion efficiency and the environmental impacts of ruminant livestock production. It will do so by investigating the relationship between the host genome and methane production via the microbiome. Host-microbe interactions in genetically identical and genetically diverse animals will determine who controls the microbiome. Changes in the nutrient supply of the cow with the composition and function of the ruminal microbiome will relate emissions, the microbiome, nutrition and health. Tools and bioinformatic systems will to developed to enable rapid analysis of phenotypes and microbiomes and a public metagenomic database will be produced to store all the metagenomics data produced both by RuminOmics and the scientific community. Finally the results and technologies generated within the project will be disseminated to the wider community.

Methodology

Methane emissions will be measured on-farm, and samples of blood, milk, ruminal digesta, and faeces will be collected from up to 1000 dairy cows. Animal genome and metagenome analysis will enable the association of marker genotypes to be compared with production efficiency, methane emissions and the microbiome. Digesta exchange will take place between identical twins and non-identical twin cows on the same diets to determine if the microbiome reverts to its original composition. Cows and reindeer will be sampled and their digesta analysed by metagenomic sequencing and methane and digestibility measurements. Different carbohydrate, protein and lipid diets will be used to investigate lowering methanogenesis, altering milk fatty acids and on the rumen microbiome. New models and tools will be developed to translate the genetics/metagenomics/emissions observations into a simpler form that is useful to scientists and livestock breeders.

Expected results

A series of public databases will be generated on the genetics of dairy cows and their corresponding microbiomes and emissions, on metagenomic sequences from high and low methane emitters, and on methodology for efficient microbiome analysis. Tools will be generated for researchers that will facilitate the estimation of methane emissions without costly respiration chambers or related techniques. Nutritional consultants and company nutritionists will be able to predict low- and high-methane diets, and breeders will be able to select for animals with heritable low-emission status. Most of all, the results will address the long-standing conundrum about whether the animal controls its emissions via the rumen microbiota, or vice-versa.

Project partners	Country
Rowett Institute of Nutrition & Health, Univ. ABDN	UK
Parco Tecnologico Padano (PTP)	IT
Agrifood Research Finland (MTT)	FI
Dept. Agriculture, Swedish Univ. of Agricultural Sciences	SE
Faculty of Science, Univ. Nottingham	UK
Lab of Anaerobic Microbiology, Inst. of Animal Physiology and Genetics	CZ
Nutrigenomics Research Centre, Univ. Cattolica	IT
Lab d'Ecologie Alpine, Centre National de la Recherche Scientifique	FR
European Association of Animal Science (EAAP)	IT
The European Forum of Farm Animal Breeders (EFFAB)	NL
Quality Meat Scotland (QMS)	UK

TRANSPHORM

At a glance
Title: Transport related Air Pollution and Health impacts- Integrated Methodologies for Assessing Particulate Matter
Instrument: Integrating project
Total cost: 9 200 000 €
EC contribution: 6 900 000 €
Duration: 48 months
Start date: 01/01/2010
Consortium: 21 partners from 14 countries
Project coordinator: Ranjeet Sokhi
Project website: www.transphorm.eu/
Key words: Air pollution, climate change, transport, particulate matter, PM10, PM2.5, health impacts

The challenge

Although, the importance of climate change and air quality interactions has been widely recognised, large uncertainties exist, for example, in our understanding of the role of aerosols on radiative forcing. As a result of such interactions, air quality is affected on multiple scales. In the last decade, advances in high resolution modelling have led to improvements in air quality-climate predictions especially on regional scales. TRANSPHORM addresses the key challenge of improving the quantification of regional variations in air quality and related health impacts associated with changes in emissions and climate on higher resolution than has been achieved previously with global models.

Project objectives

Transport emissions, in particular from road transport, can have significant impacts on both air quality and climate. TRANSPHORM brings together international air quality and health researchers and users to improve our knowledge of transport related airborne particulate matter (PM) and its impact on human health on city to European scales. Key objectives of TRANSPHORM include:

1. To provide new and improved data on PM emission factors and inventories;
2. To undertake new measurements for source apportionment of PM;
3. To derive improved concentration response functions for different health end points;
4. To develop more robust integrated approaches (e.g. full chain assessment) for quantifying PM related exposure and health impacts based on urban, regional and global scale air quality models; and
5. To examine the influence of changes in climate and emissions on spatial and temporal variations of future air quality across Europe and to quantify the resulting health impacts.

Methodology

TRANSPHORM has developed improved European emission inventories for base year 2005 and future years 2020 and 2030. For regional scale analysis, five models have been employed (EMEP, Enviro-HIRLAM, LOTOS-EUROS, SILAM and WRF-CMAQ) allowing inter-model variabilities to be examined along with the model ensembles. Global boundary conditions are derived from EMAC/MATCH model. For climate-air quality modelling, high resolution models such as WRF-CMAQ are interfaced with the global climate model HadGEM2-ES (based on RCP 8.5 scenario). Analysis is being conducted for periods representing 2000 and future year 2030 over Europe at 54km horizontal resolution. The influence of separate and combined changes in emissions and climate on concentrations of ozone, PM10 and PM2.5 has been calculated for Europe including at a country level to provide policy relevant information. Through the use of concentration response functions and other population datasets, health impacts are being estimated for cities and Europe.

Expected results

Initial model simulations have been completed for the WRF-CMAQ-HadGEM2-ES system. Results indicate that climate change effects on ozone are significant relative to those due to changes in emissions and will lead to an increase in mean ozone concentrations by about 3ppbv by 2030 over Europe. Spatial variations are observed for different parts of Europe, especially between northern and southern Europe regions. For the 2030 emission scenario considered within TRANSPHORM, mean concentrations of PM2.5 and PM10 are expected to reduce by up to 30% over Europe. While the climate change effects on PM are weaker compared with emission change effects, substantial spatial heterogeneity is predicted by the models, implying different variations in health impacts for different parts of Europe. Multiple decadal studies are underway to further examine the initial results and to arrive at more robust signals of climate change impacts on air quality and on the resulting health impacts.

Project partners	Country
University of Hertfordshire (UH-CAIR)	UK
The Netherlands Applied Research Org (TNO)	NL
Utrecht University (UU)	NL
Norwegian Institute for Air Research (NILU)	NO
Finnish Meteorological Institute (FMI)	FI
German Aerospace Center (DLR)	DE
Transport & Mobility Leuven (TML)	BE
Aristotle University of Thessaloniki (AUTH)	EL
European Commission – Joint Research Centre (JRC)	International
Institute Of Occupational Medicine (IOM)	UK
Swedish Environmental Institute (IVL)	SE
National Institute for Health and Welfare (THL)	FI
The Norwegian Meteorological Institute (Met.no)	NO
German Research Center for Env. Health (HMGU)	DE
Institute of Environmental Medicine (KI)	SE
The Danish Meteorological Institute (DMI)	DK
Imperial College London (IC)	UK
Swiss Tropical Institute (STI)	CH
Center for Physical Sciences and Tech. (CPST)	LT
University of Stuttgart (USTUTT)	DE
City Development Authority of Prague (URM)	CZ

VIROCLIME

At a glance
Title: Impact of Climate Change on The Transport, Fate, and Risk Management of Viral Pathogens in Water
Instrument: Collaborative project
Total cost: 2 881 593 €
EC contribution: 2 491 513 €
Duration: 36 months
Start date: 01/12/2009
Consortium: 8 partners from 5 countries
Project coordinator: David Kay
Project website: www.viroclime.org
Key words: Pathogens, virus, climate change, modelling, catchment microbial dynamics, water framework directive, bathing water, shellfish water, management of extreme weather events, health impact assessment, quantitative microbial risk assessment

The challenge

Climate change will cause modifications to the aquatic environment which will affect exposure to all pathogenic micro-organisms transmitted by the water route. The VIROCLIME proposal was initiated because:

1. in any climate change scenario viruses will retain the pre-eminent role in water-related disease because of the almost ubiquitous presence of human-derived viruses in sewage and waste water and because of their environmental robustness;
2. there are currently few tools for routine and quantitative virological monitoring of the environment to provide credible health risk quantification; and
3. before Viroclime, no models have been developed to describe and predict catchment virus dynamics.

Project objectives

This project aimed to deploy new molecular tools for measurement of pathogenic viruses in EU waters, thence using the results to calibrate catchment models of viral delivery and then to use climate change projections to suggest how the risk from pathogenic viruses would change under climate change scenarios.

Methodology

The project involved: guidance development for extreme events management; integrated laboratory methods development; long terms surveillance data acquisition; modelling catchment hydrology and microbial dynamics; and finally climate change projection.

Results

This project has delivered: (i) the largest current surveillance data set (world-wide) describing virus pathogen concentration in sentinel waters; (ii) it has provided an EU-wide analysis of inter-laboratory comparability to determine the reproducibility of virus measurements in environmental waters; (iii) it has assessed the seasonal and flow impacts on virus presence and conducted targeted mesocosm experiments to provide the first catchment-scale insight into viral dynamics in surface waters; (iv) at the sentinel sites chosen, climate change scenarios have been used to predict changes in river flow regimes during the present century; and finally (v) the climate change impacts on virus pathogen presence have been modelled to produce a quantitative microbial risk assessment of the projected effects on climate change on health risk to users of EU surface waters.

Key findings

Viruses, measured using molecular analysis of genetic material, do not correlate well with the traditional microbial parameters used to regulate health risk in EU waters which are faecal indicator bacteria commonly measured by culture methods. This is of regulatory significance because the viruses provide the most direct risk index; whilst the faecal indicator bacteria provide proof of 'connectivity' between the surface water and some source of faecal contamination.

A key findings are that, riverine viral dynamics are markedly different to those commonly observed for the better characterised faecal indicator bacteria (principally Escherichia coli and intestinal enterococci). The bacterial dynamics are characterised by several log10 orders increase in concentration in response to normal elevations in flow following rainfall. This produces short term flushes of high bacterial concentration which dominate the delivery pattern. Understanding this episodic flush process vital to characterise the pollutant loading pattern into (and hence regulatory compliance of) WFD (2000) Annex 4 'protected areas' such as bathing and shellfish harvesting areas.

Importantly, many EU waters exhibit long periods of 'zero' values for the viral pathogens. This is pleasing and probably indicates the highly intermittent 'supply' of virus which depends on the infection and, disease, patterns in the upstream human populations.

Challenges remain in delivering inter-laboratory reproducibility of viral pathogen enumeration from environmental waters which would be acceptable for regulatory purposes.

As part of this investigation, new viral source tracking tools have been investigated to quantify the faecal loading contribution from different animal species: e.g. animal or human. This has produced some very promising data which suggest a considerable advance is possible over existing systems in operational use by EU regulators.

VIROCLIME has resulted in new guidance on the management of extreme weather events designed to mitigate potential adverse health outcomes.

Present climate change scenarios, affecting the chosen European rivers and near-shore waters, offer a wide range of outcomes but relatively small changes in the major drivers such as river flow over the next century. Some of the projected effects of these on viral pathogen flux are relatively small. We do not consider, therefore that viral enteric pathogen risk will significantly increase as a response to climate change effects on catchment hydrology and microbial dynamics in the next century. This is in broad agreement with recent work reported by Kay et al. (2011).

Project partners	
University of Aberystwyth	UK
University of Barcelon	ES
National Public Health Service of Wales	UK
University of Patras	EL
University of Umeå	SE
Oswaldo Cruz Institute	BR
National Institute for Environmental Health	HU
Laboratori de Reserca del Clima	ES

WASSERMED

At a glance
Title: Water Availability and Security in Southern EuRope and the Mediterranean
Instrument: Collaborative project
Total cost: 3 669 943 €
EC contribution: 2 933 973 €
Duration: 39 months
Start date: 01/01/2010
Consortium: 12 partners from 9 countries
Project coordinator: Roberto Roson (CMCC, IT)
Project website: www.wassermed.eu
Key words: water scarcity, water security, climate change, Mediterranean region

The challenge

The conditions of increasing water stress faced in the Mediterranean regions of Southern Europe, North Africa and the Middle East already have adverse effects on two significant strategic sectors of the area, agriculture and tourism, as well as wider environmental and social implications at both the local and national scale. Such issues are expected to exacerbate as a result of climate change: the anticipated rise in temperatures, the potential decrease in rainfall and the increase in the frequency and magnitude of extreme events are bound to significantly affect human livelihoods and local economies. However, and despite concerns over climate change impacts, policy development is often hampered by the ambiguity and uncertainty of future projections at local scale, and the (often) high costs of adaptation measures.

Project objectives

WASSERMed is an interdisciplinary project, which overall aims at the integration of climate change scenarios, holistic water system modelling and interdisciplinary impact assessment.

The WASSERMed project analyses, in a multi-disciplinary way, ongoing and future climate induced changes in hydrological budgets and extremes in southern Europe, North Africa and the Middle East under the frame of threats to national and human security. This includes the assessment of changes in mean flows, frequency and magnitude of extreme precipitation (intensity and duration), surface run-off, stream flows ground water balance, as well as social and economic factors.

Five case studies have been considered: (1) Syros Island (Cyclades Complex, Greece), a region which is characterised by multiple water uses and experiences significant tourism development in recent years, (2) Sardinia Island (Italy), with huge water demand and conflicting water uses between agricultural and tourism sectors, (3) Merguellil watershed (Tunisia), a river basin which concentrates multiple and conflicting water uses, (4) Jordan river basin, where the Case Study will focus mainly on trans-boundary water management and conflicting water demands, and (5) the Nile River system, focusing mainly on Egypt and issues related to inter-regional water supply-demand balances and allocation.

Methodology

Research starts from the assessment of changes in mean flows, frequency and magnitude of extreme events, stream-flows and groundwater balance, to provide a coherent assessment of future to water security and the economy. Technological solutions and integrated management practices are assessed in terms of risk reduction and trade-offs, and formulated into coherent strategies to address climate variability and change. Research works on two distinct and interrelated geographical scales. A Mediterranean-wide analysis focuses on strategic sectors (agriculture and tourism) to better understand climate change impacts on the specific characteristics of water demand and explore the applicable range of technical solutions. Furthermore, the impacts of water availability changes on national economies, trade flows and implicit water trade (virtual water) are assessed through the development of a Global Computable General Equilibrium Model. This global assessment is used to identify the main mechanisms of propagation of water-related shocks throughout the economic system and potential changes in economic structure, as response to climate change.Case Study level analyses are employed to explore potential security threats, infrastructure requirements and integrated adaptation strategies in 5 areas of the Mediterranean, also considering exogenous drivers of change and potential environmental and socio-economic implications.

Results

The impact of climate change on the Mediterranean agricultural sector will likely be affected by water availability and could be prevalently: (i) positive for the Northern Mediterranean countries and areas characterized by relatively cold and humid climate, and (ii) negative for the Southern Mediterranean countries and the areas already characterized by arid and semi-arid conditions.

The extension of the areas suitable for cultivation toward the Northern latitudes and higher altitudes and the overall expansion of the cultivation season could bring benefits especially to the Northern Mediterranean countries.

Results of the macroeconomic analysis of the consequences of climate change on agricultural productivity and tourism attractiveness indicate that several Mediterranean countries will likely face water shortages with significant implications in terms of agricultural productivity, income and welfare.

The analysis of climate change impacts on tourism indicates that conditions will remain favorable for outdoor activities in the Mediterranean basin; however a change in seasonality is foreseen. Particularly, negative impacts for summer tourism are foreseen in Southern Mediterranean countries, whereas the situation is different for northern countries.

Different policy and adaptation options have emerged in the five case studies. However, similarities and recurrent issues have also been noticed: solutions for increased water productivity, recycling, desalination, water harvesting.

Project partners	
Centro Euro-Mediterraneo per i Cambiamenti Climatici, IT	University of Jordan, JO
Centro Internazionale di Alti Studi Agronomici Mediterranei, IT	CLU srl, IT
National Technical University of Athens, EL	University of Exeter, UK
Istitut National Agronomique de Tunisie, (Tunisia) TN	Universidad Politecnica de Madrid, ES
Institut de Recherche pour le Developpement, FR	
Environment and Climate Change Research Institute, EG	
National Center for Agricultural Research and Extension, JO	
Potsdam Institute for Climate Impact Research, DE	

WRECKPROTECT

At a glance

Title: Strategies for the protection of shipwrecks in the Baltic Sea against forthcoming attack by wood degrading marine borers. A synthesis and information project based on the effects of climatic changes.

Instrument: Coordination and support action

Total cost: 1.104.362 €

EC contribution: 754.812 €

Duration: 24 months

Start date: 01-05-2009

Consortium: 6 partners from 3 countries

Project coordinator: SP Technical Research institute of Sweden, SE

Project website: www.wreckprotect.eu

Key words: cultural heritage, wood, shipwreck, Baltic Sea, spread of shipworm, microbial, degradation, in situ protection, environment including climatic change, GIS-modelling

The challenge

The Baltic Sea is a brackish marine environment, enclosing a unique well preserved historical collection of shipwrecks and settlements due to the absence of marine borers. There are however strong indications that the shipworm are spreading into the Baltic Sea, possibly an effect of climatic changes. A strategy to handling this alarming scenario is to provide museum and conservators responsible for long term preservation with tools for prediction of risk areas and methods for physical protection of the wrecks. It is essential that the protection is given in time.

Project objectives

The main aim of WreckProtect is to secure the preservation of two important objects of cultural heritage in marine environments: Shipwreck and submerged archaeological settlements.

The objectives are:

- To provide cultural resource managers, archaeologists, and conservators responsible for the long term preservation of cultural heritage with tools for assessing and predicting the future spread of wood degrading organisms especially Teredo navalis which can rapidly attack underwater wooden objects and constructions.
- To evaluate and recommend practical methods for protection of the wreck and historical settlements in situ, in order to prevent decay.
- To develop two user-friendly practical guidelines for the prediction and protection of cultural heritage.
- To organise work shops and training courses for the dissemination of guidelines.
- To produce monograph and scientific publications

Methodology

The overall working plan is divided into 5 work packages:

- Coordination of present biological and environmental data. With help of a comprehensive literature study on biodegradation of wood in marine environments with special emphasis on the aggressive marine borer Teredo navalis, the environmental condition for their activity and spread will be clarified and generated into a GIS model, where marine environmental parameters for the Baltic Sea are mapped. All data will be synthesised into a tool for assessing the potential spread and decay of underwater cultural heritage.
- Review of methods for protection of historical wreck and settlements in marine environments
- Strategy and tools for protection of cultural heritage, where two user-friendly guidelines aimed at stakeholders will be developed

- Dissemination of knowledge to stakeholder, managers and conservators with help of workshop, practical training course, monograph and scientific papers.

Expected results

The Baltic region as well as other parts of Europe will benefit from this increased knowledge. The main outcomes will be:

- Guidelines for physical protection of shipwreck that can be used for managing underwater cultural heritage world-wide
- Methods for identification of sites under imminent threat from shipworm
- A recommendation of methods which support the UNESCO Convention on the protection of the underwater cultural heritage

Project partners	
SP technical research Institute of Sweden, Coordinator	SE
Cultural Heritage Agency	NL
University of Gothenburg	SE
National Museum of Denmark	DK
The Geological Survey of Denmark and Greenland	DK
The Viking Ship Museum, Roskilde	DK

5
Climate relevant projects on natural hazards and extreme events

3ENCULT

At a glance
Title: Efficient ENergy for EU Cultural Heritage
Instrument: Collaborative project
Total cost: 6 643 959 €
EC contribuion: 4 990 475 €
Duration: 42 months
Start date: 01/10/2010
Consortium: 21 partners from 10 countries
Project coordinator: EURAC, IT
Project website: www.3encult.eu
Key words: historic building, energy efficiency, urban development, factor 10, active & passive heating and cooling, RES, lighting, integrated monitoring and control, IEQ, simulation, EPBD, energy, environment

The challenge

Historic buildings are the trademark of numerous European cities, towns and villages: historic quarters give uniqueness to our cities, they are a living symbol of Europe's rich cultural heritage and reflect society's identity.

However, it is clear that these buildings are not energy efficient and are substantial contributors to greenhouse gas (GHG) emissions and rising energy bills. At a time when climate change poses a real and urgent threat to humanity and its infrastructure, it is vital to initiate an improved approach to the refurbishment of historic buildings, which in many cases are in danger themselves.

Project objectives

The project 3ENCULT bridges the gap between conservation of historic buildings and climate protection, which is not an antagonism at all: historic buildings will only survive if maintained as living space. Energy efficient retrofit is useful for structural protection as well as for comfort reasons – comfort for users and "comfort" for heritage collections.

3ENCULT demonstrates the feasibility of "Factor 4" to "Factor 10" reduction in energy demand, depending on the case and the heritage value.

Such reduction of energy demand of the 26% of EU building stock dating before 1945 would result in more than 180 Mt CO2 saved and improve living conditions and quality management in historic urban areas.

Methodology

The joint task of conservation and energy efficient retrofit is highly interdisciplinary. The 3ENCULT partnership thus includes conservation, technical & urban development experts, industry partners, implementation experts and stakeholders.

Starting in with an analysis of the challenge and the needs for comprehensive diagnosis, we will investigate technical solutions for the energy enhancement as well as smart monitoring and control. Part of the project will be dedicated to the demonstration of the developed solutions, while case studies in WP6 give (i) stimulus for solution development and (ii) successively feedback. Tools of design and quality assurance will also be developed.

Expected results

To date the following – newly developed or speci-fically adapted – solutions have been implemented at case studies:

- a highly **energy-efficient conservation-compatible window** prototype has been installed at the Public Weigh House in Bolzano (IT);
- **capillary active internal insulation** is under investigation at the four case study buildings around Dresden (DE);

- a **low impact ventilation system based on active overflow principle** is being tested at the Höttinger School (AT);
- **wireless sensor networks** are demonstrated at the Palazzina della Viola in Bologna (IT) and the first version of a dedicated **BMS system** is tested at the Engineering School in Bejar (ES);
- **Comprehensive diagnosis** has been documented for Palazzo d'Accursio in Bologna (IT) for which also **LED based wall washer for conservation compatible, high quality and low impact lighting** was developed.

Furthermore

- starting from the in conservation established "**Roombook**" an ICT tool integrating also energy related aspects has been developed;
- technical solutions are going to be disseminated via a **virtual library**;
- a handbook with design guidelines for planners is in realization;
- **study tours and workshops** for local governments and other target groups are organised (www.3encult.eu/en/newsevents)
- to support policy, the relation between historic buildings, **EPBD & CEN** is analysed, and CEN TC 346 on Cultural Heritage is supported in the development of a relative standard.

Project partners	
Accademia Europea Bolzano EURAC	IT
The Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation–KA	DK
Institut für Diagnostik und Konservierung an Denkmalen–IDK	DE
Universität Innsbruck–UIBK	AT
Ove Arup & Partners International Limited–ARUP	UK
Fundación CARTIF–CARTIF	ES
Bartenbach LichtLabor–BLL	AT
Technische Universität Dresden–TUD	DE
Comune di Bologna–COBO	IT
Passivhaus Institut–PHI	DE
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek–TNO	NL
Università di Bologna–UNIBO	IT
Artemis Diagnostica Edilizia–ARTEMIS	IT
Soliker – G1S	ES
Menuiserie Andre–ANDRE	FR
Remmers Baustofftechnik AG–REMMERS	DE
ATREA s.r.o.–ATREA	CZ
Youris.com–YOURIS	BE
ICLEI Europe–ICLEI	DE
Federation of European Heating, Ventilation and Air-conditioning Associations–REHVA	BE
Universität Stuttgart–USTUTT	DE

ABSTRESS

At a glance

Title: Improving the resistance of legume crops to combined abiotic and biotic stress

Instrument: Integrated Project

Total cost: 4 017 212 €

EC contribution: 2 999 074 €

Duration: 60 months

Start date: 01/01/2012

Consortium: 13 partners from 7 countries

Project coordinator: The Food and Environment Research Agency, UK

Project website: www.abstress.eu

Key words: Climate change, food, crops, water, disease, systems biology, plant breeding, legumes.

The challenge

ABSTRESS will improve the breeding of sustainable crop varieties that are better able to tolerate the diverse effects of climate change. Modern phenotyping tools and more diverse genetic resources are required to ensure efficient crop breeding. Crops with direct resistance to combined environmental and biological stress are required, also considering symbiotic relationships with the soil microbiome.

Legumes will be used as an exemplar of how state-of-the-art technologies can be used to significantly reduce the time taken to introduce novel breeding materials into commercial breeding programmes.

Legumes don't require nitrogen fertilisers, a major source of greenhouse gases and farm energy consumption.

Project objectives

- To develop crops that have increased resistance to drought (abiotic) and Fusarium oxysporum (biotic) stress and still produce a good yield. This is important in ensuring future food security, whilst mitigating the effects of climate change.
- Significantly reduce the time taken to breed new crop varieties that are more able to withstand the challenges commonly associated with climate change, such as extreme weather and changing incidence of pests and diseases.
- Improve the accessibility of modern breeding techniques within the European Union and in association with partners across the world.
- To further understand the role of the soil microbiome in relation to plant health and how this can be considered more thoroughly in breeding programmes.
- To generate novel plant material to be fed into the breeding programmes of our SME partners for future commercialisation.

Methodology

ABSTRESS applies combined, integrated systems biology and comparative genomics approaches to conduct a comprehensive study of the gene networks implicated in the interaction between drought stress and Fusarium infection in legumes and symbiotic organisms. It uses Medicago truncatula as a model to rapidly identify characteristics for development in pea.

Plant material subjected to combined stress is generated using a high throughput phenotyping platform equipped with molecular imaging technologies. Bayesian models are applied to metabolomics and transcriptomics data derived from M. truncatula to identify genes implicated in combined drought and disease response. Gene expression and molecular phenotype are determined in pea under similar experimental conditions. Pea mutants are produced and promising phenotypes are selected from this material during field trials. Orthologous genes in other crops such as tomato are identified.

Expected results

ABSTRESS will achieve a step change in "sustainability in agriculture" by undertaking breeding research that seeks to develop varieties having improved resistance to a combination of biotic and abiotic stress. The outputs of the project are expected to be:

- The generation of diverse genetic materials and an associated knowledge base to improve resistance to drought and disease in a range of crops.
- The use of SME expertise to address commercial requirements for the development of new crop varieties, tested in a range of growing conditions.
- The demonstration of the benefits of integrating cutting edge technologies within active commercial breeding programmes.
- The development of high throughput molecular phenotyping, to gain a step change in the speed of the breeding cycle.

These will help to ameliorate climate change and develop the tools to mitigate its effects on a sustainable food/feed supply chain.

Project partners	Country
The Food And Environment Research Agency (Fera)	UK
University Of Essex	UK
Aberystwyth University	UK
Centre National De La Recherche Scientifique (Cnrs)	FR
Institut National De La Recherche Agronomique (Inra)	FR
Mezogazdasagi Biotechnologiai Kutatokozpont	HU
Agencia Estatal Consejo Superior De Investigaciones Cientificas	ES
Genxpro Gmbh	DE
Arterra Bioscience Srl	IT
Processors & Growers Research Organisation Lbg	UK
Agrovegetal S.A	ES
Agritec	CZ
Biotecgen Srl	IT

CAPHAZ-NET

At a glance

Title: Social Capacity Building for Natural Hazards: Towards more resilient Societies

Instrument: Coordination Action

Total cost: 1 131 189 €

EC contribution: 910 000 €

Duration: 36 months

Start date: 01/06/2009

Consortium: 8 partners from 6 countries

Project coordinator: Helmholtz-Zentrum für Umweltforschung UFZ, Leipzig, DE

Project website: www.caphaz-net.org

Key words: risk perception, social vulnerability, risk communication, education preparedness, risk governance

The challenge

Despite long-lasting attempts to mitigate and reduce the damages due to natural hazards and a constant accumulation of knowledge, the losses caused by disasters are not decreasing. On the contrary, they have increased significantly in Europe. Why is this occurring – and what can research and societies do about it? To find explanations for this paradoxical development CapHaz-Net is concerned with people's, organisations' and communities' capacities. By using the term social capacity building we want to emphasise that capacity building is a social process which involves different actors, includes different stages and is concerned with different forms of capacities.

Project objectives

The central question CapHaz-Net is dealing with is:

How can we enhance the capacities of European societies to prepare for, cope with and recover from the impacts of a natural hazard? Obviously one should not expect a simple answer to this question (otherwise it would have been provided in the past). To understand and evaluate the necessity as well as the success of enhancing the capacities of individuals, organisations and communities for natural hazards, we distinguish in three overarching objectives: CapHaz-Net examines and evaluates the current situation and asks with regard to social vulnerability and risk perception "Who is possibly affected by natural hazards and how are they perceived?" It furthermore, examines and evaluates the processes of risk communication and education involved in changing this situation by asking "Does the current situation need improvement and, if yes, what can be done?" Finally, it examines and evaluates the outcomes of this process: "What should the outcome of social capacity building processes look like?"

Methodology

CapHaz-Net does not conduct 'first hand' empirical research. As a Coordination Action it rather builds upon existing knowledge. We review and synthesise previous and ongoing research from across Europe as well as related practices. We permanently reflect upon transparent criteria for these evaluations. CapHaz-Net's methodology focuses on the interaction of different stakeholders. We give researchers, practitioners and policy-makers the opportunity to contribute with their expertise and therefore organise interactive and thematic oriented workshops. The aim of these workshops is to document the state-of-the art of social scientific research on natural hazards. We furthermore organise workshops that take place in selected regions across Europe by focusing on specific hazards (i.e. heat-related hazards in Southern Europe, Alpine hazards in the Alpine region and flooding in Central Europe). The aim of these workshops is to contextualise the theoretical knowledge by confronting it more thoroughly with actual experiences and regional practices related social capacity building efforts.

Expected results

The overall goal is to develop deeper insights and recommendations on how to enhance the social capacities of European societies to prepare for, cope with and recover from the impact of a natural hazard. One major outcome will be a state-of-the-art overview of natural hazards research in the social sciences as well as recommendations for and prioritisation of future research needs by identifying gaps of knowledge and open questions. This outcome may be particularly relevant for scholars. Recommendations and practice examples on how to enhance social capacities for natural hazards and increase social resilience from across Europe aim at providing information for policy-makers and practitioners working in the field of natural hazards and/or climate adaptation. Throughout the project we provide interested people and institutions with information via policy briefs. We make our results accessible on the public parts of our website and are open for feedback and further inputs.

Project partners	
Helmholtz Centre for Environmental Research	DE
Institute for International Sociology	FR
Middlesex University Higher Education Corporation	UK
Autonomous University Barcelona	ES
Scientific Research Centre of the Slovenian Academy of Sciences and Arts	SI
Swiss Federal Institute for Forest, Snow and Landscape Research	CH
DIALOGIK Non-Profit Institute for Communication and Cooperative Research Stuttgart	DE
University Lancaster	UK

CATALYST

At a glance

Title: Capacity Development for Natural Hazards Risk Reduction and Adaptation

Instrument: Coordinating Action

Total cost: 992 800 €

EC contribution: 843 931 €

Duration: 24 months

Start date: 01/10/2011

Consortium: 7 partners from 4 countries

Project coordinator: seeconsult GmbH, DE

Project website: www.catalyst-project.eu

Key words: natural hazards, disaster risk reduction, climate change adaptation, capacity development, knowledge exchange

The Challange

Each year, disasters wreak havoc across the globe, upending the lives of people in rich and poor countries. In 2010, floods, droughts, tornados, tsunamis and earthquakes caused an estimated 295,000 deaths and over USD100 billion in damages.

Disasters are on the rise, in part, due to growing global populations and increasing urbanization, and, in part, as a result of such fundamental environmental challenges as climate change.

Thanks to dedicated research and enlightened policies, a growing number of countries and localities have strengthened their capacities for natural hazard and disaster risk reduction (NH/DRR). Yet, only limited steps have been taken to integrate such knowledge into overall development, planning and environmental policies.

A critical challenge is to narrow the gap between the research community's increased understanding of how, when and where disasters take place and the long-standing forces that have driven economic development, which have generally made NH/DRR a low priority.

Project objectives

The CATALYST project is designed to create a wide range of opportunities for researchers, stakeholders (and the networks to which they belong) to identify and share knowledge about best practices related to natural hazard and disaster risk reduction. The ultimate goal is to bring risk management knowledge to bear on economic development issues and to make NH/DRR a critical component of the sustainability agenda.

Methodolgy

Strengthening of capacity will be achieved by:

- facilitating knowledge exchange and improving the science-application interface;
- adding value to the body of integrated knowledge on NH/DRR;
- identifying key gaps in current NH/DRR knowledge and research;
- reinforcing existing European and international networking capacity;
- strengthening the capacity of nongovernmental organizations (NGOs) and small-and medium-sized enterprises (SMEs) to mainstream NH/DRR into their activities;
- disseminating project findings in an effective way, including developing a NH/DRR reference website and online discussion forum.

A core activity of CATALYST is to convene stakeholders, including researchers, practitioners and policy makers, in a web-based "think-tank" to facilitate 'virtual' face-to-face exchanges on best practices and, more generally, discussions on such issues as information and data gaps, methodological limitations and the disconnect that often exists between the research and policy communities.

Expected results

The think-tank has been designed as an interactive interface between the scientific, practitioner and policy communities, offering a means to share information and experiences. A best practise Policy Notebook and different Best Practices Papers are going to be released at the end of the project.

CATALYST project has also organized four Regional Workshops, in the four world regions that the project examines, held in Bari (Italy), Addis Ababa (Ethiopia), Montego Bay (Jamaica) and Bangkok (Thailand) between September 2012 and January 2013. An average of 25 participants attended each workshop, where regional issues, such as capacity development in the assessment of the biophysical and social vulnerability aspects; good practices for integrating DRR and CCA in a sustainable urban development; ecosystem services for disaster risk reduction; and governance of risk and climate change adaptation, mainstreaming uncertainty in capacity development in DRR and CCA were discussed.

A web archive helps ensure that data and information assembled and produced during the project is available to as large an audience as possible. The archive includes a broad range of material related to NH/DRR resources and research. Upon the conclusion of the project, the web-site and archive will be transferred to either a public sector organization or a small/medium-sized enterprise involved in natural hazard and disaster risk reduction to ensure that it is maintained and enhanced beyond the project's two-year duration.

Project partners	
Seeconsult GmbH	DE
Fondazione Eni Enrico Mattei	IT
Helmholtz Centre for Environmental Research	DE
Academy of Sciences for the Developing World	IT
Alterra – Wageningen University	NL
National Geologic Survey of Denmark and Greenland	DK
United Nations University–Institute for Environment and Human Security	DE

CLIM-RUN

At a glance
Title: Climate Local Information in the Mediterranean region Responding to User Needs
Instrument: Collaborative project
Total cost: 4 680 340 €
EC contribution: 3 489 333 €
Duration: 36 months
Start date: 01/03/2011
Consortium: 16 partners from 10 countries
Project coordinator: ENEA, IT
Project website: www.climrun.eu
Key words: Climate Services, Stakeholders, energy, tourism, wild fires, integrated case studies, Mediterranean region, global warming

The challenge

Lack of methodologies, modelling and downscaling tools for the provision of adequate climate information at regional scale

Project objectives

CLIM-RUN aims at developing a protocol for applying new methodologies and improved modeling and downscaling tools for the provision of adequate climate information at regional to local scale that is relevant to and usable by different sectors of society (policymakers, industry, cities, etc.).

Methodology

Differently from current approaches, CLIM-RUN will develop a bottom-up protocol directly involving stakeholders early in the process with the aim of identifying well defined needs at the regional to local scale. The improved modeling and downscaling tools will then be used to optimally respond to these specific needs. The protocol is assessed by application to relevant case studies involving interdependent sectors, primarily tourism and energy, and natural hazards (wild fires) for representative target areas (mountainous regions, coastal areas and islands

Expected results

CLIM-RUN is also intended to provide the seed for the formation of a Mediterranean basin-side climate service network which would eventually converge into a pan-European network. The general time horizon of interest for the project is the future period 2010-2050, a time horizon that encompasses the contributions of both inter-decadal variability and greenhouse-forced climate change.

Project partners	
ENEA, Technical Unit on Energy and Environmental Modelling	IT
EEWRC, Energy, Environment and Water Research Center	CY
CNRM, Division des Affaires Générales	FR
UNESCO-ICTP, Earth System Physics	IT
IC3, R&d	ES
NOA–Institute for Environmental Research and Sustainable Development	EL
CMCC–Numerical Applications and Scenarios	IT
TEC	FR
PLAN BLEU, Strategic Unit	FR
PIK, Transdisciplinary Concept and Methods	DE
UEA, Research, Enterprise & Engagement Office	UK
GREVACHOT, Université de Tunis, FSHS	TN
JRC, Management Support Unit, Institute for Prospective Technological Studies	ES
DHMZ	HR
USMD, University of Maryland, Earth System Science Interdisciplinary Center	US
UC–Matemática Aplicada y Ciencias de la Computación	ES

CLUVA

At a glance
Title: CLimate Change and Urban Vulnerability in Africa
Instrument: Collaborative project
Total cost: 4 397 825 €
EC contribution: 3 494 580 €
Duration: 36 months
Start date: 01/12/2010
Consortium: 13 partners from 11 countries
Project coordinator: AMRA S.c.a.r.l.–ANALISI E MONITORAGGIO DEL RISCHIO AMBIENTALE
Project website: www.cluva.eu
Key words: Climate change, multi-hazard, urban areas, Africa, vulnerability

The challenge

The drought and the famine risk that are affecting the Horn of Africa represent only the last of the increasing humanitarian emergencies in Africa.

Although it is not clearly understood to what extent the current situation is due to climate changes, it is clear that Africa is a continent particularly vulnerable to them. Indeed, many African countries have fragile economies unable to absorb the shocks caused by natural disasters enhanced by the increasing vulnerability of rapidly expanding urban areas and climate change is likely to rapidly exacerbate this situation.

The main challenge of CLUVA is to join and harmonize different approaches to vulnerability (physical, systemic, outcome, contextual) and to develop methods to account for the different facets of risk converging them in an effective and applicable multi risk model. Innovative climate change risk adaptation strategies for African urban areas affected by climate change induced hazards will be developed on the base of these models.

Project objectives

The overall objective of CLUVA is to develop methods and knowledge to be applied to selected African test cities (Addis Ababa–Ethiopia, Dar Es Salaam–Tanzania, Douala–Cameroun, Ouagadougou – Burkina Faso, St. Louis–Senegal), to manage climate risks, to reduce vulnerabilities and to improve coping capacity and resilience towards climate changes. CLUVA will assess the environmental, social and economic impacts and the risks related to climate change induced hazards (floods, sea-level rise, droughts, heat waves, desertification), at various time frames.

Methodology

Starting from an ensemble of six global projections of climate changes produced by CMCC and CSIR considering the new IPCC scenarios, climate change related hazards will be defined for each test city. In addition, for each case study, vulnerability of urban structures and lifelines will be assessed, as well as vulnerability of in-town ecosystems and urban-rural interfaces and social vulnerability. The estimation of vulnerability of urban settlement will be particularly focused on very common African buildings, i.e. adobe houses and other poorly built houses, which represent a social criticality in Africa.

Hazard and vulnerability analysis will be integrated in a multi-risk framework, taking into account mutual interactions among hazards and considering critical scenarios induced by cascade effects.

CLUVA will also develop and propose innovative land use and governance strategies, based on multi-risk analysis, in order to reduce vulnerability to climate change.

Expected results

The principal outputs of CLUVA project are: the definition of probabilistic scenarios of natural hazards based on climate change projections produced for the five test cities; the assessment of multiple vulnerabilities to dominant climate change enhanced hazards of the five test cities (including informal settlements, critical infrastructure such as sewer and road networks, the urban and urban-rural ecosystems, the exposed population according their socio-economic characteristics); the development of multi-risk models to define risk indexes accounting for different types of vulnerability.

In addition, innovative strategies will be developed for urban development to reduce the vulnerability of the African test cities to climate change. Improvement of African R&D capacity in the projects fields and dissemination of results to practice are also expected results for improving the capacity of scientific institutions, local councils and civil society to cope with climate change.

Project partners	
Analisi E Monitoraggio Del Rischio Ambientale	IT
Kobenhavns Universitet	DK
The University Of Manchester	UK
Technische Universitaet Muenchen	DE
Council For Scientific And Industrial Research	ZA
Centro Euro-Mediterraneo Per I Cambiamenti Climatici Scarl	IT
Helmholtz-Zentrum Fuer Umweltforschung Gmbh	DE
Norsk Institutt For ByOg Regionforskning	NO
Universite Gaston Berger De Saint Louis	SN
Universite De Yaounde I	CM
Universite De Ouagadougou	BF
Ardhi University	TZ
Addis Ababa University	ET

CONHAZ

At a glance
Title: Costs of Natural Hazards
Instrument: Coordination Action Project
Total cost: 382 192 €
EC contribution: 245 560 €
Duration: 24 months
Start date: 01/02/2010
Consortium: 8 partners from 7 countries
Project coordinator: Helmholtz-Centre for Environmental ResearchUFZ, DE
Project website: www.conhaz.org
Key words: natural hazards, climate change, damage cost assessments, mitigation, adaptation, risk management

The challenge

Cost assessments of damages, prevention and responses to natural hazards provide crucial information to decision support and policy development in the fields of natural hazard management and climate change adaptation planning. Efficiently reducing natural hazard risks therefore requires a thorough understanding of the costs of natural hazards. However, the current methods assessing the costs of different natural hazards employ a diversity of approaches for different hazards and impacted sectors.

Project objectives

In order to strengthen the role of cost assessments in the development of integrated natural hazard management and to identify cross-hazard opportunities for learning, a review of existing cost assessment approaches was undertaken. CONHAZ aimed at compiling and synthesising current knowledge on cost assessment methods considering natural hazards ranging from droughts, floods and coastal hazards to Alpine hazards, as well as different impacted sectors and cost types (i.e. direct tangible damages, losses due to business interruption, indirect damages, intangible effects, and costs of risk mitigation).

The project objectives in specific comprehend, first, a compilation of the state-of-the-art methods for cost assessment as used in European case studies. Second, the project aimed at analysing and assessing these compiled methods in terms of methods' aspects, as well as terminology, data quality and availability, and research gaps. The third objective was to synthesise resulting knowledge gaps and provide recommendations for practice and research.

Methodology

CONHAZ was structured in ten different work packages (WPs). WPs 1-4 provided in-depth knowledge on methodological issues concerning direct, indirect, intangible and risk mitigation costs to WPs 5-8, which integrated these inputs into their respective hazard contexts (droughts, floods, coastal and Alpine hazards). Within these four different hazard communities, workshops with stakeholders from academia and policy were held in order to ensure the incorporation of their knowledge and the end-user needs.

The combination of hazard related work packages and cost type related work packages in a matrix structure successfully contributed to an extensive exchange of knowledge and to harmonize results across the work packages. WP9, concerned with the synthesis of the results, summarized all cost and hazard types findings and identified overall knowledge gaps.

These were subsequently discussed and prioritized by researchers and practitioners at a synthesis conference bringing together around 60 experts and practitioners from all four hazard communities.

Results

CONHAZ provides support to practitioners and policy makers, as well as other relevant decision makers regarding cost assessments of natural hazards in order to support an integrated natural hazard management and adaptation planning.

CONHAZ presents an overview of the state-of-the-art of cost assessment approaches, discusses knowledge gaps and outlines respective recommendations in eight reports and summarizes these findings in a synthesis report and a review article (Meyer et al., 2013).

The findings show that the application of cost assessments in practice is often incomplete and biased, as direct costs receive a relatively large amount of attention while intangible and indirect effects are rarely considered. Furthermore, all parts of cost assessment entail considerable uncertainties due to insufficient or highly aggregated data sources along with a lack of knowledge about the processes leading to damage and thus the appropriate models required. Recommendations are provided on how to reduce or handle these uncertainties by improving data sources and cost assessment methods. Further recommendations address how risk dynamics due to climate and socio-economic change can be better considered, how costs are distributed and risks transferred, and in what ways cost assessment can function as part of decision support.

Project partners	
Dept. of Economics, HelmholtzCentre for Environmental Research (UFZ)	DE
Institute of Geography, University of Innsbruck (UIBK)	AT
Société de Mathématique Appliquée aux Sciences Sociales (SMASH-CIRED)	FR
Middlesex University, Flood Hazard Research Centre (MU)	UK
Helmholtz Centre Potsdam, German Research Centre for Geosciences (GFZ)	DE
Dept. of Physics and Earth Sciences, University of Ferrara (UniFe)	IT
Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona (UAB)	ES
Institute for Environmental Studies, VU University, Amsterdam (IVM)	NL

CORFU

At a glance

Title: Collaborative research on flood resilience in urban areas
Instrument: Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 4 711 598 €
EC contribution: 3 490 000 €
Duration: 48 months
Start date: 01/04/2010
Consortium: 17 partners from 10 countries
Project coordinator: University of Exeter, UK
Project website: www.corfu7.eu
Key words: Flood resilience, urban flooding, rainfall patterns, climate change, hazard assessment, risk management, resilience measures

The challenge

In Europe alone, hundreds of severe floods in the first decade of 21st century led to more than one thousand deaths, displacement of half a million people and damage and economic losses amounting to tens of billions of Euros. Projections of climate change and urban growth indicate that flood risk will be exacerbated in many regions.

Consequently, governments, policy makers and communities worldwide are forced to review flood management strategies and invest more in portfolios of measures. The EU Floods Directive and the wider EU Flood Action Programme call for improved flood forecasting and early warning systems as well as for flood risk mapping.

Project objectives

Collaborative research on flood resilience in urban areas (CORFU) is an interdisciplinary international project that looks at advanced strategies and measures for improved flood management in cities. Through a four-year collaborative research programme, the latest technological advances will be cross-fertilised with traditional and emerging approaches to living with floods.

Project objectives include determination of the interactions between economic and urban growth, societal trends and the urban structure; real time urban flood forecast systems development; assessment of health impacts of flooding by combining hydraulic modelling with QMRA; enhancement of existing flood risk management strategies, all through a series of case studies.

The overall aim of CORFU is to enable European and Asian institutions to learn from each other through joint investigation, development, implementation and dissemination of strategies that will enable more scientifically sound management of the consequences of urban flooding in the future.

Methodology

First, drivers that impact on urban flooding will be looked at and the DPSIR (drivers-pressures-state-impact-response) framework will be developed. The analysis will be based on IPCC projections of climate change, economic, health and social development, aiming at identifying the future policy areas where the responses to the drivers and pressures can be most effective.

Methodologies and tools for off-line and real-time flood hazard assessment based on urban flood modelling will be enhanced. Missing elements in existing models for system analysis will be developed in order to identify procedures for calibration of urban flood models at different scales, having in mind technological advances such as wider availability of weather radars and on-line rain gauges, increase in computer speed and possibilities for coupling of hydraulic models.

Modern methods for flood impact assessment will be improved, extended and integrated within a comprehensive and flexible framework that will merge different methodologies for evaluation of all types of damage. Interrelationships between risk perception, level of preparedness and actual responses will be studied, distinguishing between impacts on individuals and on communities.

New flood risk assessment strategies will be developed. Flood resilience will be defined and implemented according to the situation of any city. Research, application and dissemination at local, national and international levels will engage policy makers. They will be encouraged to engender a 'flood resilience' culture through awareness rising of proposed strategies and comprehensive adoption of CORFU tools.

Expected results

Flood impacts in urban areas – potential deaths, damage to infrastructure and health problems and consequent effects on individuals and on communities – and possible responses will be assessed by envisaging different scenarios of relevant drivers: urban development, socio-economic trends and climate changes.The cost-effectiveness of resilience measures and integrative and adaptable flood management plans for these scenarios will be quantified.

Project results will include better understanding and representing the key factors leading to increased flood risk; updated city flood models; developed means to better quantify potential flood impacts; improved national standards for design of drainage systems; inculcated flood resilience mentality in key stakeholders.

Project outputs will be collated in about forty deliverables of different nature: reports, papers, guidelines, analysed questionnaires, web sites, simulation models, GIS tools and real-time systems. Three years into the project, most of the envisaged outputs have been produced.

The results will be disseminated on workshops in case study cities and by various other means. The main CORFU dissemination event will be the International Conference on Flood Resilience: Experiences in Asia and Europe, which will be held in Exeter in September 2013, www.icfr2013.org.

A number of young people will be trained in various areas of urban flood modelling and analysis. Knowledge exchange and future collaboration between European and Asian experts in the domain of flood management will be raised to a new level.

Project partners	
University of Exeter, UK	Beijing Municipal Institute of City Planning and Design, CN
Hamburg University of Technology, DE	China Academy of Urban Planning and Design, CN
DHI Water & Environment, DK	Centro Technológico del Agua, ES
University of Nice–Sophia Antipolis, FR	Hydrometeorological Innovative Solutions, ES
Indian Institute of Technology Bombay, IN	Cranfield University, UK
AREP Ville, FR	Dura Vermeer Groep NV, NL
Institute of Water Modelling, BD	Hamburg Institute of International Economics, DE
Beijing University of Technology, CN	National Taiwan University, TW
International Center for Urban Water Hydrodynamics, KR	

DEWFORA

At a glance

Title: Improved Drought Early Warning and FORecasting to strengthen preparedness and adaptation to droughts in Africa.

Instrument: Collaborative Research Project

Total cost: 4 403 104 €

EC contribution: 3 490 000 €

Duration: 36 months

Start date: 01/01/2011

Consortium: 19 partners from 12 countries and 2 from EU

Project coordinator: Deltares, NL

Project website: www.dewfora.net

Key words: Drought, forecasting, Early warning, indicators, mitigation, adaptation, hazard, climate change, Africa, preparedness, water resources

The challenge

Drought is one of the major natural hazards in many parts of the world, including Africa and some regions in Europe, and drought events have resulted in extensive damage to livelihoods, environment and economy. Recent predictions on climate change suggest this situation may worsen, projecting an increased frequency and severity of drought in many areas. Effective drought risk management, including the provision of advance warning and the implementation of effective mitigation in response to drought, however, offers the potential to reduce the adverse impacts. Preparedness and education can increase resilience of affected societies, allowing them to cope better with drought and its impacts, and help break the disaster-response cycle.

Project objectives

The principal aim is to develop a framework for the provision of early warning and response through drought impact mitigation for Africa. This framework will cover the whole chain from monitoring and vulnerability assessment, to forecasting, warning, response and knowledge dissemination.

The project has been designed to achieve four key targets:

- Assessing existing capacities in Africa in terms of drought monitoring, forecasting and warning, enhancing drought monitoring methods through improved indicators, and understanding the relationship between drought hazard and vulnerability in the current climate and how this will change as a result of climate change.
- Improving performance of methods used for forecasting droughts in Africa by implementing stateof-the-art in (seasonal) meteorological, hydrological and agricultural forecasting.
- Improving early warning of droughts through appropriate thresholds for initiation of mitigation activities, and establishing strategies to increase resilience to drought at seasonal and longer time scales.
- Transferring knowledge to practitioners and building capacity in Africa to ensure that knowledge developed continues to be exploited beyond the project

Methodology

The DEWFORA project is structured in eight work packages. WP1 includes all activities related to the management of the consortium and communication with the European Commission. WP2 reviews existing capacities in Africa for monitoring, forecasting and early warning of drought on local, regional and continental scales, as well as mitigation practices and adaptation strategies. A gap analysis is included to help identify constraints and opportunities for improvement.

WP3 assesses and maps vulnerability to drought through newly developed indicators. It assesses the expected impacts of climate change on the frequency of occurrence and persistence of droughts in Africa and the impact on drought vulnerability. WP4 concentrates on drought forecasting from the meteorological, hydrological and agricultural perspectives. Appropriate methods for forecasting drought at medium to seasonal time scales are developed and made operational within a pilot drought forecasting system. WP5 addresses early warning of drought and the response to such warnings. Response is assessed at the community, national and trans-boundary scales. Advances made in the previous work packages, as well as experience gained in the case studies will be consolidated to establish a framework and guidelines for effective drought early warning and response in Africa. WP6 integrates the advances made in drought monitoring, forecasting and warning by applying them in the case studies. The methods developed are tested and refined in order to ensure an efficient contribution to early warning and response. In addition, a prototype pan-African drought monitoring and forecasting system is developed, and a comparative review of European and African initiatives performed. WP7 focuses on disseminating the knowledge gained, and ensures sustainable embedding of that knowledge with stakeholders and water resources capacity building programmes. WP8 is dedicated at establishing scientific synergies and exchange with related research projects in Europe and Africa, and outreach to policy networks in Africa and Europe.

Expected results

DEWFORA expects to contribute to an increase in the effectiveness with which drought forecasting, warning and response can be provided. It will provide guidance on how and where drought preparedness and adaptation should be targeted to contribute to an increase in resilience and improve effectiveness of drought mitigation measures.

Project partners	
Deltares (NL)	Wetlands International – Sahelian Sub Regional Office (ML)
UNESCO-IHE Institute for Water Education (NL)	Dinder Center for Environmental Research (SD)
European Centre for Medium-range Weather Forecasts (EU)	IGAD Climate Prediction and Applications Centre (KE)
Joint Research Centre (EU)	Faculty of Engineering, University Eduardo Mondlane (MZ)
Potsdam Institute for Climate Impact Research (DE)	Council for Scientific and Industrial Research (ZA)
German Research Centre for Geosciences (DE)	WR Nyabeze & Associates (ZA)
Universidad Politecnica de Madrid (ES)	Institut Agronomique et Vétérinaire Hassan II (MA)
Mediterranean Agronomic Institute of Zaragoza (ES)	WaterNet Trust (BW)
Faculty of Engineering, University of Porto (PO)	Hydraulic Research Institute – Nile Basin Capacity Building Network for River Engineering (EG)
Nile Forecast Center (EG)	

DOFOCO

At a glance
Title: Do forests cool the Earth? Reconciling sustained productivity and minimum climate response with ensembles of contrasting forest management strategies
Funding scheme: ERC Starting Grants
ERC funding: 1 300 000 €
Duration: 60 months
Start date: 01/02/2010
Host institution: Commissariat à l'Energie Atomique et des Energies Alternatives (CEA), FR
Principal investigator: Sebastiaan Luyssaert
Key words: Forest management, climate impact

The challenge

Forests play a particularly important role in the global carbon cycle. Globally, 70% of the forest is managed and the importance of management is still increasing both in relative and absolute terms. Recently, forest management has become a top priority on the agenda of the political negotiations to mitigate climate change because it has great potential for mitigating climate change, which was recognized in the United Nations Framework Convention on Climate Change and the Kyoto Protocol. However, this political imperative is at present running well ahead of the science required to deliver it.

Project objectives

The overall goal of DOFOCO is to quantify and understand the role of forest management in mitigating climate change. Specifically, I want to challenge the current focus on the carbon cycle and replace it with a total climate impact approach. Hence, the whole forest management spectrum ranging from short rotation coppice to old-growth forests will be analysed for its effects on the water, energy and carbon cycles. Climate response of forest will be quantified by means of albedo, evapotranspiration, greenhouse gas sources and sinks and their resulting climate feedback mechanisms.

The anticipated new quantitative results will be used to lay the foundations for a port-folio of management strategies which will sustain wood production while minimizing climate change impacts.

Methodology

Earth system models are the most advanced tools to predict future climate. These models represent the interactions between the atmosphere and the surface beneath. The most advanced land-surface models account for changes in vegetation cover but consider forests to be mature and ageless. At present, none of the predictions of future climate thus account for the essential interactions between forest management and climate. DOFOCO will further develop the IPSL Earth system model to overcome this gap in modelling capability. The enhanced Earth system model will be used to quantify and understand radiative forcing, non-radiative forcing and feedback mechanisms of contrasting forest management strategies integrated over their life cycle and to create a spatially optimized regional portfolio of management strategies that minimizes climate response while meeting the demand for biomass and wood, as well as the socio-economic functions of forests.

Emerging results

At the time of writing (May 2013), three out of the four key developments have been implemented and are numerically stable (i.e. the forest management module, the vertical and horizontal representation of canopy structure and the two way canopy radiative transfer scheme). A fourth development (i.e. multi-layer energy budget scheme for the canopy) is near completion and the team is now shifting its attention from development to parametrization, validation and application. In order for our science to better address the concerns of mitigation stakeholders, we are moving away from the PFT approach (which simulates groups of species) towards a parametrization at the tree species level.

Given that the developments have not been fully integrated yet, it is too early to assess their use and impact. Nevertheless, if successful, these developments have the potential to address the next generation of scientific questions in support of decision making.

DROUGHT-R&SPI

At a glance
Title: Fostering European Drought Research and Science-Policy Interfacing
Instrument: Collaborative project
Total cost: 4 191 890 €
EC contribution: 3 439 950 €
Duration: 36 months
Start date: 01/10/2011
Consortium: 12 partners from 9 countries
Project coordinator: Henny van Lanen
Project website: www.eu-drought.org
Key words: Vulnerability, risk, natural hazard, impact, drought research, drought management plans, drought-sensitive regions, Science-Policy interfacing

The challenge

Drought is natural hazard that has hit Europe hard over the last decades. Likely it will become more frequent and severe and the scale will increase due to the increased likelihood of warmer Northern winters and hotter Mediterranean summers. There is an urgent need to improve drought preparedness through increased knowledge on the past and future hazard, impacts, and possible management and policy options. Drought management plans and an improved science-policy interfacing. This will reduce vulnerability to future drought and the risks they pose for Europe.

Project objectives

DROUGHT-R&SPI will enhance the understanding of:

1. drought as a natural hazard, incl. climate drivers, drought processes and occurrences;
2. environmental and socio-economic impacts, and
3. vulnerabilities, risks and policy responses, incl. the further development of drought management plans in support of EU and other international policies, e.g. UN/ISDR-HFA.

The project will address the past and future climate, link science and science policy dialogue across scales and across a range of affected sectors.

Methodology

DROUGHT-R&SPI uses a transdisciplinary approach that includes innovative in-depth studies that combine drought analyses for selected case studies in water-stressed regions across Europe with drought analyses at the pan-European scale both for past and future climate.

DROUGHT-R&SPI is organized into three scientific themes:

1. drought as a natural hazard;
2. drought (socio-economic and environmental);
3. drought vulnerability risk reduction and policy responses

The case studies represent different scales (local, river basin and national) and cover different geo-climatic regions (Greece, Italy, Netherlands, Portugal, Spain and Switzerland) that are vulnerable to different drought impacts. Drought research will be well integrated into the policy-making process across scales by the establishment of Case Study Dialogue Fora at a detailed scale and a pan-Europe Dialogue Forum at the large scale from the start of the project onwards.

Expected results

DROUGHT-R&SPI will deliver the following:

1. enhanced knowledge of past droughts (underlying processes, frequencies, severities), driving atmos-

pheric factors and characteristics of the most extreme historic events at the pan-European scale;
2. in-depth understanding of environmental and socio-economic impacts at a small scale in water-stressed regions (case studies) and considering the large-scale drivers;
3. past responses to drought events at the case study scale, and identify best practice examples and lessons learnt for the development of drought management planning;
4. drought indicators that integrate physical, impact and vulnerability indices, addressing different scales and water sectors;
5. innovative methodology for early warning (monitoring and forecasting) at the pan-European scale;
6. Dialogue Fora at different scales for Science-Policy Interfacing;
7. drought hazard and potential vulnerabilities at the case study and pan-European scale in the 21st Century to identify drought sensitive sectors and regions;
8. web-based information and knowledge sharing facilitated by the European Drought Centre (EDC).

Project partners	
Wageningen Universiteit (NL)	Eidgenössische Technische Hochschule Zürich (CH)
National Technical University of Athens (EL)	Universidad Complutense de Madrid (ES)
Universitetet I Oslo (NO)	Universita Commerciale 'Luigi Bocconi' (IT)
Albert-Ludwigs-Universitaet Freiburg (DE)	Universite de Caen Basse Normandie (FR)
Universidad Politecnica de Valencia (ES)	Stichting Dienst Landbouwkundig Onderzoek (NL)
Instituto Superior de Agronomia (PT)	Eidgenössische Forschungsanstalt, (CH)

ENHANCE

At a glance
Title: Enhancing risk management partnerships for catastrophic natural disasters in Europe
Instrument: Collaborative project
Total cost: 7 687 123 €
EC contribution: 5 992 084 €
Duration: 48 months
Start date: 01/12/2012
Consortium: 24 partners from 11 countries
Project coordinator: Prof. Jeroen. Aerts, VU University Amsterdam, NL
Project website: www.enhanceproject.eu
Key words: partnership, resilience, economic instrument, insurance, drought, flood, forest fire, storm surge, volcanic eruption, heat wave

The challenge

Risk from natural disasters are increasing through climate change and socio-economic developments. However, these trends are highly dynamic, with varying impacts at different times and places. Especially extreme –low probabilityevents are difficult to predict. The ENHANCE project will develop new risk scenarios with a focus on extremes. These will be evaluated in close collaboration with partners in the public and private sectors, and will contribute to the development of new multi-sector partnerships (MSPs) throughout Europe to reduce or redistribute risk. The role of the financial sector is critical in this process.

Project objectives

- Describe indicators for successful (and unsuccessful) partnerships in improving resilience, and identify processes for fostering novel MSPs;
- Provide methods and guidelines for a harmonised scheme for risk assessment and scenarios through an inventory of existing risk information, and by developing new methods and scenarios for (low) probability risk assessment in collaboration with MSPs;
- Describe and test through case studies, which concepts of economic instruments, including insurance and risk management policies, work for MSPs;
- Provide guidelines and policy recommendations for the horizontal integration of risk management and climate-proofing in policies.

Methodology

The promotion of participatory processes for designing new MSPs is at the heart of the ENHANCE methodology. Hence, the project is designed around a work package of 10 selected participatory case studies on risk reduction of catastrophic events taking place at different geographical and spatial scales in Europe. The potential for new MSPs will be explored and resilience measures and policies will be tested and disseminated

Expected results

- Harmonised dynamic scenarios of vulnerability, exposure, and hazard at the pan-European scale, using existing information and new probabilistic approaches for multi-hazards, heat-waves, forest fires, floods, droughts, storm surges, and volcanic eruptions;
- Guidelines and key features for enhancing MSP interaction in successful resilience enhancement and risk reduction. These will be pre-tested via participatory workshops on risk-based scenarios;
- Methods for linking MSPs to novel scientific risk scenarios and assessments;
- A toolbox of economic instruments and non-structural mitigation measures for assessing risk and increasing societal resilience. Developed in a participatory manner, these will be applicable at national, regional, and local levels; and
- Policy recommendations to the EU and the Hyogo Framework for Action (HFA) signatories delivered through a dissemination platform for enhancing resilience that encompasses all levels from governments to local communities.

Project partners	Country
Institute for Environmental Studies, VU University Amsterdam	NL
Fondazione Eni Enrico Mattei	IT
HelmholtzZentrum Geesthacht, Zentrum fur Material-und Kustenforschung	DE
International Institute for Applied Systems Analysis	AT
London School of Economics and Political Science	UK
The United Nations Office for Disaster Risk Reduction	CH
Université Catholique de Louvain	BE
European Business and Innovation Centre Network / ARCTIK	BE
Instituto de Ingeniería del Agua y Medio Ambiente, Universitat Politècnica de València	ES
Environmental Change Institute, University of Oxford	UK
HKV Consultants	NL
Joint Research Centre, European Commission	BE
Instituto Superior de Agronomia, Universidade Técnica de Lisboa	PT
Academia de Studii Economice din Bucaresti	RO
University of Iceland	IS
Institute for Earth and Environmental Science, Universitaet Potsdam	DE
ClimateWise	UK
Willis Research Network	UK
Empresa Mixta Valenciana de Aguas S.A.	ES
OpenTrack Railway Technology Gmbh	AT
Perspectives GmbH	DE
Agenzia Regionale Prevenzione e Ambiente dell' Emilia-Romagna	IT
Wadden Sea Forum e.V.	DE
Metacortex S.A.	PT

ENSURE

At a glance

Title: Enhancing resilience of communities and territories facing natural and na-tech hazards

Instrument: Collaborative project

Total cost: 1 805 738 €

EC contribution: 1 388 634 €

Duration: 32 months

Start date: 01/06/2008

Consortium: 10 partners from 7 countries

Project coordinator: Bureau de Recherches Géologiques et Minières–BRGM

Project website: ensureproject.eu

Key words: physical vulnerability, systemic vulnerability, social vulnerability, economic vulnerability, natural hazards, resilience, coping capacity, climate change

The challenge

Vulnerability has long been a key concept in disaster literature. However, the majority of studies have focused on research related to the hazard, therefore neglecting the influence of the vulnerability of exposed systems to the consequences of such hazards, such as the death toll and losses from natural or man made disasters. There is also a need to better identify and measure the ability of 'at risk' and affected communities and territorial systems to respond to such disasters. This is the starting point of the ENSURE project.

Project objectives

More precisely, ENSURE aims at achieving the following objectives:

- to improve the understanding of the articulated nature of the concept of vulnerability at different spatial scales;
- to analyze the relationship between the concept of vulnerability and other concepts such as "risk", "damage", "exposure", "resilience" and "adaptation";
- to develop the integration and connection of different types of vulnerability;
- to investigate the temporal and spatial variability of the relations between different types of vulnerability and different types of damage;
- to propose new, and improve existing vulnerability assessment models and parameters;

to develop an on-line course for students, young researchers and public administration staff in the field of vulnerability assessment

Methodology

The project is developed as follow:

- State of the art on vulnerability types,
- Analysis of the interactions and connections of different vulnerabilities,
- Analysis of different vulnerabilities through time and space dimensions
- Development of a new methodological framework for an Integrated multi-scale Vulnerability assessment,
- Application of an Integrated conceptual model to three case studies (Western Peloponese, Greece; Northern Negev, Israel; Vulcano Island, Italy)

The framework is based on a comprehensive, integrated and inter-disciplinary understanding of how mitigation strategies can be improved in the future. Such a framework will contribute to the reduction of human losses, economic damage and social disruption due to extreme events striking communities exposed to a variety of natural hazards, as well as to the potential consequences of Climate Change.

Expected results

ENSURE contributed to an improved analysis of vulnerability for increasing the resilience of communities. Specific expected impacts are to:

- **provide support for policy decisions with key stakeholders** at various scales, relating to prevention measures and plans;
- present, through the Integrated Multi-Scale Vulnerability Assessment, a **feasible tool to improve communication with local communities** in the process of raising risk awareness;
- **understand adaptation and resilience factors, and system responses,** which help to minimize risks from natural and human-triggered technological disasters;
- improve our understanding of **environmental vulnerability to some natural disasters.**

Results of relevance for users, practitioners and managers are:

- **Scientific Colloquium on the Integrated Vulnerability Approach,** organized with relevant policy makers, end-users and stakeholders on the issue of vulnerability types vs. natural hazards, coping capacity and resilience of communities;
- **E-learning on-line course** (in English, French, German, Greek, Italian, Spanish), which will provide students, young researchers and professionals with the opportunity to learn on new approaches for vulnerability assessment;
- **Multimedia CD** to present project results in a user-friendly and interactive way.

Project partners	
BRGM–Bureau de Recherches Géologiques et Minières	FR
POLIMI–Politecnico di Milano	IT
UNINA–Università degli studi di Napoli Federico II	IT
HUA–Harokopio University of Athens	EL
UT – Universiteit Twente	NL
PIK–Postdam Institut fuer Klimafolgenforschung	DE
UNIGE–Universite de Genève	CH
TAU–Tel Aviv University	IL
MDX–Middlesex University Higher Education Corporation	UK
T6 Ecosystems srl	IT

EUPORIAS

At a glance
Title: European Provision Of Regional Impacts Assessment on a Seasonal to decadal timescale
Instrument: Colaborative Project
Total cost: 13 049 000 Euro
EC contribution: 8 977 000 Euro
Duration: 51 months
Start date: 01/11/2012
Consortium: 24 partners from 11 countries, including two UN bodies
Project coordinator: Met Office (Dr Chris Hewitt)
Project website: www.euporias.eu
Key words: climate, services, risk management, variability change, tools, seasonal to decadal, user-focussed, environment

The Challenge

There is a growing need to make European society more resilient to climate-related hazards and better manage the risks and opportunities arising from climate variability and climate change. Skilful predictions are beginning to be made routinely on seasonal to decadal timescales. However, the challenge is ensuring that these forecasts are of use to a wide range of decision making where outcomes are strongly influenced by variations in the climate. EUPORIAS aims to address this challenge, by engaging closely with potential users of such predictions and developing tools to provide useful and useable information tailored to their specific needs.

Project objectives

EUPORIAS has the following key objectives:

- To develop and deliver a reliable and trusted climate impact prediction system for a number of carefully selected semi-operational prototypes. These will provide working examples of 'end-to-end' climate-to-impacts-to-decision-making services operating on the seasonal to decadal timescale;
- To assess and document key knowledge gaps, vulnerabilities and needs of key sectors (to include water, energy, health, transport, agriculture and food security, infrastructure, forestry and tourism);
- To develop a set of standard tools and techniques for calibrating, downscaling and modelling sector-specific impacts on seasonal to decadal timescales;
- To develop techniques to map the meteorological variables from seasonal to decadal prediction systems into variables that are directly relevant to the needs of specific stakeholders;
- To develop a knowledge-sharing protocol necessary to promote the use of these technologies;
- To assess and document the current marketability of climate services in Europe.

Methodology

EUPORIAS will maximise the usefulness of seasonal to decadal forecasts by focussing right from the start on the needs of the users and project stakeholders. Firstly an assessment of sector-specific vulnerability and an assessment of users' needs will be carried out. Then research will be conducted to make seasonal to decadal information relevant to decision makers, including downscaling and calibrating the forecasts to spatial scales of use, producing impact-relevant climate information (such as agricultural productivity, river runoff and hydropower for the coming seasons), and using models to predict the impacts of climate variability.

In parallel, research will be undertaken to quantify uncertainty in the impact models, develop a framework for managing the inherent uncertainty in the predictions, and explore ways of communicating levels of confidence.

Finally, building on all the above, the project will develop some prototype climate services and conduct research into the use of climate information in decision-making processes, possible delivery tools, and an assessment of the viability of climate services as business opportunities.

Expected results

The main outcome of EUPORIAS will be the development and the delivery of robust and useable probabilistic predictions of the impact of high-risk events. The tools developed will allow users to better understand high-risk climate patterns relevant to their sector (such as flooding, winter storms, heat waves, droughts).This will lead to enhanced business continuity through appropriate action being taken, thus making society more prepared and resilient to the impacts of climate variability and change; for example through modifying investment plans and reviewing contingency plans. In turn, this will hopefully help reduce the associated costs of emergency interventions. Users will ultimately be able to use climate information in their decision making more easily and more effectively.

If used effectively these tools will encourage realistic expectations to be set about the level of confidence available through seasonal to decadal climate services.

Project partners	
Met Office, UK	Universidade de Lisboa, PT
Tourisme Transports Territoires Environnement Conseil, FR	University of Leeds, UK
Agenzia nazionale per le nuove tecnologie, L'energia e lo sviluppo economico sostenibile, IT	Sveriges Meteorologiska och Hydrologiska Institut, SE
Federal Office of Meteorology and Climatology MeteoSwiss , CH	Lunds Universitet, SE
Universidad de Cantabria, ES	Météo-France, FR
Predictia Intelligent Data Solutions SL, ES	Cetaqua Centro Tecnológico del Agua Fundación Privada, ES
Agencia Estatal de Meteorología, ES	Instituto Português do Mar e da Atmosfera, I.P., PT
DHI, DK	World Food Programme, IT
Wageningen Universiteit, NL	World Health Organisation, Regional Office for Europe, CH
Deutscher Wetterdienst, DE	FutureEverything CIC, UK
Institut Català de Ciències del Clima, ES#	Electricité De France, FR
Koninklijk Nederlands Meteorologisch Instituut, NL	Administratia Nationala de Meteorologie R.A., RO

EUROOT

At a glance

Title: Enhancing resource Uptake from Roots under stress in cereal crops
Instrument: Integrated project
Total cost: 4 803 070 €
EC contribution: 2 999 996 €
Duration: 48 months
Start date: 01/01/2012
Consortium:20 partners from 12 countries
Project coordinator: CIRAD, FR
Project website: www.euroot.eu
Key words: protecting the environment and promoting resource efficiency, promoting climate change adaptation, risk prevention and management, strengthening research, technological development and innovation

The challenge

European agriculture is facing climate instability and has to respond to the economical and social demands for reducing both irrigation water and chemical fertilizers. 314 million tons of grain cereals are produced yearly in the EU27 over more than 60 million ha -i.e. 60% of the total arable landand consumes half of the EU fertilizer use. Water and nutrients ensuring plant growth maintenance are heterogeneously distributed in the soil both spatially and temporally over the crop cycle and a drying topsoil further reduces access to these resources, notably phosphorus. Plants have therefore to adjust the placement of their new roots to capture the resources in response to variable soil water and soil strength constraints This soil exploration is largely determined by root system architecture, root intrinsic uptake efficiency and root:soil biogeochemical interactions.

Project objectives

The EURoot consortium which gathers 20 partners including SMEs with complementary expertises has the objective to enhance the cereal plant capability to acquire water and nutrients through its roots and maintain growth and performance under stress conditions. More precisely, EURoot research aims at delineating a cereal root system ideotype in terms of architecture, uptake and signalling processes (including beneficial interactions with micro-organisms) that allows soil exploration and resource acquisition under limited soil water and nutrients. EURoot knowledge, tools and methodologies will contribute to the further development of novel cereal cultivars with higher resilience, tolerating erratic rainfalls and reduced fertilizer application, while achieving their yield potential

Methodology

EURoot will conduct a suite of experiments integrated into 3 work packages (WPs) designed to better understand and model: i. The genetic and functional bases of root traits involved in soil exploration and resource uptake (WP1), ii.The bio-geochemical properties of the soil, including beneficial association with mycorhizal fungi, influencing extraction of nutrient and water by the root system (WP2) and iii.The plant signalling processes involved in soil environment sensing and responsible for adaptive root system response enhancing soil exploration and resource acquisition (WP3). In addition, two platform WPs allow the sharing of innovative phenotyping methods relevant to field conditions and linked to crop performance (WP4) and integration of root architecture, resource dynamics in the soil and root uptake, and inner plant signalling processes through multi scale modelling, to design root ideotypes allowing enhanced resource acquisition under stress (WP5)

Expected results

The 4 year research program of the EURoot consortium will produce:

Genes and alleles that can be used in marker-assisted breeding to manipulate root architecture and soil resource uptake, Root-sourced biochemical and molecular signatures that can be used as diagnostic tools of intensity of perception of resource scarcity and success of translation into adaptive morphological and functional changes aiding in resource capture in relation to whole plant performance. A bridge between root QTL and functional information across sequenced cereals, through integrative and comparative bioinformatics Innovative root phenotyping and imaging methods allowing a screen of materials for response behaviour under heterogeneous and reduced water, N and P and with relevance to field conditions,

Predictive models of root architecture integrating soil resource dynamics to construct virtual root ideotypes with appropriate response to nutrient and water distribution and availability, that can be used as a blueprint for genetic and physiological analyses and breeding.

Results will be readily translated into screening methods, models and tools to guide the challenging breeding for improved root traits allowing enhanced water and nutrient capture in cereals. Plant breeding companies and specialized SMEs will harness them into innovations with more stable yield under stress that will benefit to cereal farmers and through a reduction of costs and of water and fertilizer use to the European consumer.

Project partners	
Centre de coopération internationale en recherche agronomique pour le développement, Montpellier	FR
Centre de Recerca en Agrigenòmica Barcelona	ES
Eidgenössische Technische Hochschule Zürich,Zürich	CH
Forschungszentrum Jülich , Jülich	DE
Institut national de la recherche agronomique, Montpellier and Avignon	FR
Radboud Universiteit Nijmegen, Nijmegen	NL
Rheinische Friedrich-Wilhelms-Universität Bonn , Bonn	DE
James Hutton Institute, Dundee	UK
Università di Bologna, Bologna	IT
Université catholique de Louvain, Louvain-la-Neuve	BE
University of Aberdeen, Aberdeen	UK
University of Lancaster, Lancaster	UK
University of Nottingham, Nottingham	UK
Uniwersytet Śląski w Katowicach , Katowice	PL
Società Produttori Sementi – Bologna	IT
Delley Samen und Pflanzen AG, Delley	CH
PreSens, Regensburg	DE
Australian Centre for Plant Functional Genomics, Adelaide	AU
Japanese International Research Centre for Agricultural Sciences, Tsukuba	JP
Pennsylvania State University,	US

EWENT

At a glance
Title: Assessing disruptive effects of extreme weather events on operation and performance of EU transport system
Instrument: Collaborative project
Total cost: 1 915 793 €
EC contribution: 1 478 981 €
Duration: 30 months
Start date: 01/09/2009
Consortium: 9 partners from 7 countries
Project coordinator: VTT Technical Research Centre of Finland, FI
Project website: ewent.vtt.fi
Key words: European transport system, extreme weather, natural disasters, cost estimates

The challenge

EWENT will start by identifying the hazardous phenomena, their probability and consequences and proceed to assessing the expected economic losses caused by extreme weather when it impacts the European transport system, taking also into account the present and expected future quality of weather forecasting and warning services within Europe.

Project objectives

The goal of EWENT project is to assess the impacts of extreme weather events on EU transport system. These impacts are monetised. EWENT will also evaluate the efficiency, applicability and finance needs for adoption and mitigation measures which will dampen and reduce the costs of weather impacts.

Methodology

The methodological approach is based on generic risk management framework that follows a standardised process from identification of hazardous phenomena (extreme weather), followed by impact assessment and closed by mitigation and risk control measures.

Results

EWENT produced a quantified cost estimate of extreme weather at European level. This alone is a significant piece of decision-making information. Furthermore, EWENT took a holistic view to transport system, including infrastructure and operations and further still, the customers of transport services. The results are useful in argumentation of investment and maintenance funding in regions affected by extreme weather.

Project partners	
VTT Technical Research Centre of Finland	FI
Deutsches Zentrum für Luftund Raumfahrt	DE
Institute of Transport Economics (TÖI)	NO
Foreca Consulting Ltd.	FI
Finnish Meteorological Institute	FI
Cyprus Meteorological Institute	CY
Österreichische Wasserstraßen-Gesellschaft mbH	AT
European Severe Storms Laboratory	DE
Wold Meteorological Organization	UN

FACCE-JPI

At a glance
Title: Joint Programming Initiative for Agriculture, Food Security and Climate Change
Instrument: Coordination action in support of the implementation by participating States of a Joint Programming Initiative
Total Cost (of the CSA): 2 315 850 €
EC contribution: 1 998 873 €
Duration: **JPI:** long term **CSA:** 36 months
Start date: **JPI:** January 2010 **CSA:** April 2011
Consortium (of the JPI) : AT, DE, DK, ES, FR, IE, NL, RO, UK; BE, CH, CY, CZ, EE, FI, IT, IL, NO, PO, SE, TR
Project Coordinator (of the CSA): INRA (FRANCE) & BBSRC (UK)
Project website: www.faccejpi.com
Key words: Agriculture, Food Security, Climate Change, Joint Programming, Societal Challenges, Alignment, European Research Area, Research, ERA-NET, Bioeconomy, international calls

The challenge

Agriculture, food security and climate change pose key challenges for the world.

- The 2007-2008 world food crisis was a stark reminder of the need to build more resilient food systems in the light of changes ahead.
- Agriculture (including forestry and aquaculture) is highly exposed to climate change (crop yield variability, etc.). However these sectors also offer the potential for mitigation, while reducing greenhouse gas emissions.
- Agriculture has to meet a demand for food which is estimated to double by 2050 due to population growth, urbanisation and increased affluence in societies.

European Research needs to enhance sustainable growth in the agriculture sector to:

- Meet growing world food demand
- Enhance rural livelihoods
- Address competing demands on land use for biomass production
- Stimulate sustainable economic growth
- Maintain and restore ecosystem function / services
- Make the transition to a bio-based economy.

Project objectives

The FACCE-JPI brings together 21 countries committed to building an integrated European Research Area addressing the challenges of agriculture, food security and climate change. The JPI will provide research to support sustainable growth in agricultural production to meet increasing world food demand and to contribute to a European bio-based economy while maintaining and restoring ecosystem services under current and future climate change.

To do so, a strong transdisciplinary research base, encompassing economic and social aspects in addition to scientific ones, is required. This implies the need for a creative approach towards aligning national programmes. The interrelated challenges addressed are European and global and require the effort of multiple actors and stakeholders.

FACCE-JPI commits to climate change issues by organising large events, for instance the last interactive wide audience debate: “The Great Debate between Food Security and Climate Change”, with speakers iincluding IPCC Chair Nobel R. Pachauri, in Dublin (July 2012).

Methodology

To respond to the interconnected challenges of sustainable agriculture, food security and impacts of climate change, an integrated

Strategic Research Agenda (SRA) has been designed, including five evidence-base interdisciplinary core research themes:

1. **Sustainable food security under climate change,** based on an integrated food systems perspective: modeling, benchmarking and policy research perspective
2. Environmentally **sustainable growth and intensification of agricultural systems** under current and future climate and resource availability
3. Assessing and reducing **trade-offs between food production, biodiversity and ecosystem services**
4. **Adaptation to climate change** throughout the whole food chain, including market repercussions
5. **Greenhouse gas mitigation:** nitrous oxide and methane mitigation in the agriculture and forestry sector, carbon sequestration, fossil fuel substitution and mitigating GHG emissions induced by indirect land use change
6. **Short-, medium and long-term priority actions** have been defined within each of these **core themes.**

An **Implementation** is addressing short-term priority actions for the years 2014 to 2015.

Expected results

This JPI aims to align national research to deliver key outputs through its Strategic Research Agenda (SRA):

1. to raise the biological efficiency of European agriculture,
2. to respond to a globally increased food demand,
3. to operate agriculture within greenhouse gas, energy, biodiversity and contaminant limits and
4. to build resilience in agricultural and food systems.

These outputs are designed to provide benefits for end users (farmers), consumers, and the policy making and scientific community.

So far, 3 actions have been launched:

1. Knowledge Hub instrument on the modelling of the impacts of climate change on European agriculture (FACCE-MACSUR)
2. A multi-partner call on agricultural greenhouse gas research
3. An ERA-NET + on "Climate-Smart Agriculture: Adaptation of European Agricultural Systems" that will launch a call in September 2013

Another one is in preparation:

4. Collaborative Research Action on "Food Security and Land Use Change"

CSA Project partners	Country
Federal Ministry of Agriculture, Forestry, Environment and Water Management	AT
Ministry of Science, Technology and Innovation	DK
INRA	FR
BMELV	DE
Jülich	DE
Teagasc	IE
Ministry of Economic Affairs, Agriculture and Innovation	NL
WUR	NL
National Authority for Scientific Research	RO
INIA	ES
BBSRC	UK

FLOODCHANGE

At a glance
Title: Deciphering River Flood Change
Funding scheme: ERC Advanced Grant
ERC funding: 2 260 000 €
Duration: 60 months
Start date: 01/04/2012
Host institution: Vienna University of Technololgy, AT
Principal investigator: Günter Blöschl
Project website: erc.hydro.tuwien.ac.at
Key words: Floods, Climate Change, Land use change, Historic floods

The Challenge

Many major and devastating floods have occurred around the world recently. Their number and magnitude seems to have increased but such changes are not clear. More surprisingly, the exact causes of changes remain a mystery. Are these related to changed weather patterns, larger number of convective storms, change in antecedent soil moisture or changes in land use and management? Although drivers such as climate and land use change are known to play a critical role, their complex interactions in flood generation have not been disentangled.

Project objectives

The key objectives of this project are to understand how changes in land use and climate translate into changes in river floods, what factors are controlling this relationship and what uncertainties are involved. The purpose is not to predict future river flood changes in a particular catchment but to understand the more fundamental processes relating floods to their drivers. The research in this project is hence complementary to the traditional scenario approach and will provide a significant step towards a unified treatment of river flood changes. Specifically, the following key questions are addressed:

- When, where, how have floods changed?
- Why do floods change?
- How sensitive are floods to changes in land use and climate?
- How confident can we be about predicting future changes in floods?

Methodology

We use the concept of process types, such as flash floods, rain-on-snow floods and large scale synoptic floods, as a common currency to systematise floods. We then decipher the relationship between changes in floods and their drivers, such as climate and land use, based on this classification. We proceed in four steps:

1. We develop new indicators of flood processes to detect changes in long, high-quality flood data series along transects across Europe.
2. We separately analyse floods in catchments where climate variability is large and land use changes are small and where the opposite is the case, and will build a probabilistic flood-change model that explicitly accounts for the dominant mechanisms of change.
3. We quantify the sensitivity of floods to climate and land use change by three independent methods based on temporal data variability, spatial data variability and the flood-change model.
4. We assess the predictability of river flood changes by combining the three methods.

Emerging results

Understanding the causes of flood changes, their sensitivities to the drivers, and the uncertainties in a unified way will provide a vital step towards predicting how floods will change in the future. The main advantage of the proposed approach is that it gives an understanding of the differences in the uncertainty ranges for the different mechanisms of flood change. With the results it will be possible, for the first time, to quantify the magnitudes and sources of uncertainty of estimated flood changes in a systematic way. The results are particularly relevant for the reports from the Intergovernmental Panel on Climate Change (IPCC, 2007), for possible future EU directives related to climate change adaptation end extreme events and, more generally, for better understanding extremes in the Earth System.

FORMIT

At a glance
Title: Forest management strategies to enhance the MITigation potential of European forests (FORMIT)
Instrument: Integrated project
Total cost: 3 852 034 €
EC contribution: 2 978 197 €
Duration: 48 months
Start date: 10/10/2012
Consortium: 12 partners from 12 countries
Project coordinator: Wageningen University, NL
Project website: www.eu-formit-eu
Key words: forestry, forest management, carbon storage, climate change, mitigation, adaptative management strategies

The challenge

Forests store large amounts of carbon, and forest management influences carbon storage capacity. Identification of forest management strategies to enhance the mitigation potential of European forests will allow informed decision making about future forest management strategies that are adapted to climate change, provide ecosystem goods and services to society, and contribute to climate change mitigation by optimizing carbon storage, while maintaining other forest functions.

Project objectives

To develop realistic adaptive forest management strategies for climate change mitigation in forests in Europe to assess the mitigation potential of European forests.

Methodology

- Assessing the potential for carbon sequestration in different regions of Europe, taking into account historical development in forest use and forest management;
- Assessing the mitigation potential of forest management strategies, including carbon storage in forest products and forest soils, substitution of fossil fuels, and substitution of high-emission building material in these regions;
- Assessing the trade-offs between (i) forest carbon sequestration and mitigation through forest management, (ii) the production of forest products, including wood and bio-energy production, and (iii) the production of other goods and services, such as berries or cork, biodiversity conservation, soil protection, water quality, flood prevention, and recreation;
- Developing scenarios and pathways for carbon sequestration in forests in Europe, including measures and management strategies for climate change mitigation, taking into account regional differences in Europe, potential climate change impacts, and changes in species composition.

Expected results

The FORMIT project will develop criteria, know-how and methodologies for assessing forest management strategies for enhancing the mitigation potential of European forests, taking into account regional differences and other forest functions. Impacts on carbon storage of past, present, and possible future forest management practices will be assessed with respect to all forest functions, including ecosystem carbon storage and mitigation. Carbon storage in forest products and the mitigating effect of substituting fossil fuels with forest biomass (wood) in energy production, and the secondary effect of replacing CO2-intensive building materials, such as cement and steel with the renewable forest resources will be quantified. The potentially conflicting effects from carbon mitigation for other forest goods and ecosystem services (e.g. biodiversity, wildlife management, recreation and tourism) will be analysed, to quantify management strategies in terms of carbon storage and other criteria and indicators of forest functions, to assess the mitigation potential of European forests in different bio-geographical regions.

Project partners	
Wageningen University	NL
Universität für Bodenkultur Wien	AT
Hamburg University	DE
University of Molise	IT
University of Helsinki	FI
Catholic University of Leuven	BE
Czech University of Life Science	CZ
Norwegian University of Life Sciences	NO
Institut technologique FCBA	FR
University Stefan cel Mare Suceava	RO
Tartu Observatory	ES
Warsaw University of Life Sciences	PL

HEALTHY FUTURES

At a glance
Title: Health, environmental change and adaptive capacity: mapping, examining and anticipating future risks of water-related vector-borne diseases in eastern Africa
Instrument: Small/medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries (SICA)
Total cost: 4 194 963 €
EC contribution: 3 377 998 €
Duration: 48 months
Start date: 01/2011
Consortium: 16 partners of which 8 based in Africa, 7 in Europe, 1 in South-east Asia
Project coordinator: Trinity College Dublin, IR
Project website: healthyfutures.eu
Key words: Decision Support tools; eastern Africa; hydrology; malaria; Rift Valley fever; regional climate and vector borne disease modelling; risk mapping; schistosomiasis; vulnera-bility

The challenge

Environmental change, such as climate change, will impact human health. The health effects of climate change will not be shared equally, however. Instead the effects will be felt most acutely among the poorest members of society, raising inter alia an important issue of justice for the global community to confront. Much concern has focused on the future distribution and spread of infectious diseases, and in particular the negative health impacts of changes in transmission and outbreaks of vector-borne diseases (or VBDs) as a result of climate change. The impacts may be direct, in terms of outbreaks of disease among human populations, or indirect, in the form of outbreaks of diseases that affect domesticated animals or plants, and therefore jeopardise food security, agriculture-based economic activities and trade.

Project objectives

The project focuses on three water-related, high-impact VBDs (malaria, Rift Valley fever and schistosomiasis) in eastern Africa (comprising the countries of Burundi, Kenya, Rwanda, Uganda and United Republic of Tanzania). It takes into account environmental/climatic trends and changes in socio-economic conditions to predict future disease risk. HEALTHY FUTURES aims to;

1. Build partnerships between African and European researchers and organisations in the fields of environmental change, and animal and public health;
2. Gain a comprehensive overview and knowledge of the historical, socio-economic and environmental factors of the tree target VBD's;
3. Devise and construct a future disease and risk vulnerability mapping system, and accompanying Decision Support tools to anticipate and respond to risks, and;
4. Connect and transfer knowledge to key stakeholders, and the wider scientific and policy-related communities.

Methodology

Concentrating on eastern Africa as a study area, HEALTHY FUTURES comprises a comprehensive, inter-disciplinary consortium of health, environment, socio-economic, disease modelling and climate experts in addition to governmental health departments.

To achieve its aims, HEALTHY FUTURES deploys a bottom-up, end user/stakeholder-focused approach combining field-, laboratory- (including computer modelling) and library-based research. HEALTHY FUTURES is also contributing to the training of young African scientists in the trans-disciplinary fields of environmental change and animal and human health by funding PhD and MSc (research) scholarships, and by helping to develop the research networks of the funded graduate research students. An External Review Panel provides scientific oversight, review project methodology and comment on draft outputs.

Expected results

HEALTHY FUTURES has the expected results of:

- An evaluation of and development of statistical & dynamical disease models.
- High resolution regional climate projections for the eastern African study region and future disease risk and vulnerability maps.
- Publically accessible, online information and data resources,
- Workshops, international conferences and symposia.
- Peer-reviewed publications in high impact journals.
- Two-way dialogue between researchers and key stakeholders within the consortium.

These will ensure that the findings of the research are widely disseminated among stakeholders, policy-makers and the global scientific community and that the results, including the Decision Support tools, are made available to interested parties in areas of disease outbreaks in other parts of Africa (i.e. beyond the boundaries of the study area) and, if relevant, Europe.

Project partners	
Trinity College, University of Dublin, IE	Stockholm Environment Institute, TZ
The Abdus Salam International Centre for Theoretical Physics, IT	Ministry of Health, UG
Paris Lodron University of Salzburg, AT	Kenya Medical Research Institute, KE
Swedish Meteorological and Hydrological Institute, SE	Ministry of Health, RW
University of Nairobi, KE	University of Cape Town, ZA
AquaTT, IE	University of Durham, UK
International Livestock Research Institute, KE	University of Liverpool, UK
National University of Rwanda, RW	National University of Singapore, SG

HURRICANE

At a glance
Title: Past hurricane activity reconstructed using cave deposits: Have humans increased storm risk?
Funding scheme: ERC Starting Grant
ERC funding: 1 387 813 €
Duration: 60 months
Start date: 01/01/2010
Host institution: University of Durham, UK
Principal investigator: James Baldini
Project website: www.dur.ac.uk/hurricane.project
Key words: tropical cyclones, stalagmites, caves, climate, palaeoclimate, hurricanes, ITCZ, archaeology

The challenge

The principal objective is to overcome the limitations imposed by the brevity of existing tropical cyclone datasets to permit statistically robust comparisons of hurricane activity between the pre- and post-anthropogenic greenhouse climate states. The project endeavours to address the question: Is anthropogenic climate change leading to increased hurricane activity?

Project objectives

1. To reconstruct Atlantic hurricane activity through at least the last 500 years using stalagmite geochemical proxy records
2. To evaluate future hurricane risk
3. To reconstruct rainfall in Central America as far back as possible, thereby potentially linking climate and past cultural change
4. To determine the link between ENSO variability and stalagmite chemistry

Methodology

Very high resolution stable isotope and trace element sampling, combined with high-precision U-series dating, is producing climate proxy records from a transect across the main Atlantic tropical storm corridor. Field sites include Belize, Turks and Caicos Islands, and Bermuda. The environment at all the field locations is being monitored to improve the accuracy of our interpretations.

Emerging results

We have constructed one of the highest resolution climate proxy records for the America's, which will be used to create the tropical cyclone record. Two more records are in the process of development, and taken together the three tropical cyclone records will be able to help determine if storm frequency changed basin-wide or if storm trajectory shifted. Another record we contributed to has provided the most definitive link yet between the collapse of the Classic Maya Civilisation and drought, giving tangible evidence that the populations of this region have suffered from the consequences of climate change in the past. All these results will help the Caribbean countries mitigate future risks arising from climate change.

IMPRINTS

At a glance

Title: Improving Preparedness and Risk Management for Flash Floods and Debris Flow Events

Instrument: Collaborative project

Total cost: 4 460 191 €

EC contribution: 3 280 000 €

Duration: 46 months

Start date: 15/01/2009

Consortium: 19 partners from 8 countries (18 legal entities and an associated partner)

Project coordinator: Daniel Sempere-Torres, Centre de Recerca Aplicada en Hidrometeorologia. Universitat Politècnica de Catalunya, Barcelona, ES

Project website: www.imprints-.eu

Key words: Flash Floods, Flood Forecasting, Debris Flows, Rainfall Forecasting, Hydrological Forecasting, Probabilistic Forecasting, Early Warning System, Operational Tools, Flash Flood Risk, Climate Change Impacts, Flood Directive.

The challenge

Floods are the major natural hazard in Europe. In six years from 1998, Europe suffered more than 100 floods, causing 700 deaths, displacing nearly 500,000 people, and resulted in damages of €25 billion. And this is seen again regularly. Flash Floods are floods with short response times, between 15 minutes and 3 hours. They can occur in any point of a basin and usually they are related to heavy rainfalls that can accumulate over 25% of the annual rainfall in few hours. Due to their torrential characteristics, Flash Floods are the most devastating floods at global scale, and the number of casualties and damages increase worldwide at a higher speed than riverine floods.

The implementation of active risk management strategies and Flash Flood and Debris Flow forecasting and early warning systems are the most effective way to increase preparedness and mitigate its associated risks. Many previous projects have gone deep into the understanding of the nature and dynamics of Flash Flood and Debris Flow (FF/DF) from the phenomenological point of view, but the application of the results had not conveniently reached the operational world.

Project objectives

IMPRINTS represents an integrated effort to establish a coherent, common methodology in Europe oriented to develop and test advanced forecasting operational tools specifically designed to be used for the practitioners responsible for flood risk management and associated effects and damages.

Methodology

IMPRINTS has been organized in 9 sub-projects aiming at achieving 5 main objectives:

1. The **improvement of short-term rainfall forecasts** as the best way to **increase anticipation** in front of these FF/DF events
2. The development of **three methodologies of different complexities to provide FF/DF forecasting and early warnings.**
3. The study of **risk management and mitigation strategies** by assessing the **impact of potential plausible future changes** (climate, land use and forest fires) in the test-bed areas and **their effects**

on the hydrological response and their vulnerability in front of FF/DF generating events.

4. The development of **a prototype of the operational platform including the** IMPRINTS **tools and methodologies** developed under the project.

Emerging Results

The Project has been able to integrate in an Early Warning operational platform the developments produced by the 19 partners, including hydrological warnings based on the rainfall forecasted by meteorological models (few days in advance) and by weather radar networks (few hours in advance). The platform is able to transform the anticipation provided by the rainfall forecasts into hydrological forecasts, and also to combine these hydrometeorological forecasts with the available information about vulnerability and flooding risks, providing a full Early Warning System for Flash Flood and Debris Flow risk management. The IMPRINTS platform is a major development to support the EU Flood Directive implementation, and specifically an advanced tool to support the development of the flood risk management plans required by the Directive.

It has been designed to be easily adapted to any basin in Europe over the coverage of meteorological models and radar networks, and it has been tested on 6 river basins in Europe under the close collaboration between researchers and decision-makers.

Finally, the IMPRINTS Project have made a huge effort to disseminate the results and produce audio-visual support for policy makers, risk managers, water enterprises and for the local authorities confronted to the risk of floods. This material is accessible in the dissemination webpage of the Project at http://www.imprints-fp7.eu/en/dissemination

Project partners	
Universitat Politècnica de Catalunya, Centre de Recerca Aplicada en Hidrometeorologia (ES)	Servei Meteorològic de Catalunya (ES)
Universitat Politècnica de Catalunya, Grupo de Investigación en Transporte de Sedimentos (ES)	Service Central d'Hydrométéorologie et d'Appui à la Prévision des Inondations (FR)
Bundesamt für Meteorologie und Klimatologie MeteoSchweiz (CH)	Hydrometeorological Innovative Solutions, S.L. (ES)
Commission of the European Communities, Directorate General Joint Research Centre (IT)	Agència Catalana de l'Aigua (ES)
Lancaster University (UK)	Departement Bau und Umwelt, Kanton Glarus (CH)
Eidgenoessische Forschungsanstalt WSL (CH)	Verzasca SA (CH)
Wageningen Universiteit (NL)	Azienda Elettrica Ticinese (CH)
Centro Tecnológico del Agua, Fundación Privada (ES)	Autorità di Bacino destra Sele (IT)
Consorzio inter-universitario per la previsione e prevenzione dei Grandi Rischi (IT)	Agencia de Medio Ambiente y Agua de Andalucía, formerly EGMASA (ES)
University of Kwazulu-Natal (ZA)	Associated partner (no EC funding): McGill University (CA)

IPCCAR5

At a glance
Title: Support in Preparation of the IPCC 5th Assesment Report
Instrument: Coordination and Support Action
Total cost: 3 373 000 €
EC contribution: 600 000 €
Duration: 42 months
Start date: 15/08/2011
Project coordinator: Organisation Météorologique Mondiale (WMO), CH
Project website: www.ipcc.ch
Key words: AR5, Fifth Assessment Report

The challenge

To contribute to the production of more accurate and comprehensive scientific information to support global climate change policies.

Project objectives

To ensure increased involvement of experts from developing countries and economies-in-transition to provide appropriate funding, consistent with IPCC practices, in the preparation of the IPCC 5th Assessment Report by ensuring adequate participation of experts from the above-mentioned countries in Working Groups meetings, Task Group meetings, expert meetings, seminars and conferences.

Methodology

The grant will be used for the preparation of the Working Groups contributions to the IPCC 5th Assessment Report by ensuring appropriate reflection of expertise and knowledge from the experts being funded. Experts from developing countries and economies-in-transition will attend IPCC meetings preparing the AR5 thereby enhancing the credibility of the outcome through balanced representation and interpretation of the scientific results on climate change.

Some experts from developing countries will serve as Review Editors thus contributing to a transparent review process and balanced interpretation of scientific results on climate change from their regions. Some of the IPCC AR5 preparation meetings will be organized in Europe to encourage local experts' participation to promote the regional focus of the AR5 and to assist in awareness-raising and capacity building in those countries, in relation to the chapter dedicated to the European geographical region.

Expected results

The IPCC 5th Assessment Report will provide an updated assessment of scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. It will address, amongst, others, some specific cross-cutting issues such as scientific and technical aspects of Article 2 of the UNFCCC, regional aspects, costing and economic analysis, consistent evaluation of uncertainties and risks. The beneficiaries of the AR5 report include policymakers, United Nations Programmes, Funds and Specialised Agencies, scientific community, tertiary institutions, NGOs, students, business groups, research organizations/researchers and SMEs/SMIs.

KNOW-4-DRR

At a glance
Title: Enabling Knowledge for disaster risk reduction in integration to climate change adaptation
Instrument: Coordination and Support actions
Total cost: 1 144 215 €
EC contribution: 992 951 €
Duration: 24 months
Start date: 03/06/2013
Consortium: 11 partners from 7 countries
Project coordinator: Politecnico di Milano, IT
Key words: Disaster Risk Reduction Knowledge, Knowledge Management System, Knowledge in Risk Mitigation and Management

The challenge

Despite significant improvement in hazard analysis, monitoring technologies, and construction science, gaps between what is known and what is done in disaster risk reduction (DRR) are still very large. In addition to the challenges inherited from the past, new ones have emerged: apart from the already visible effects of climate change, recent large disasters have clearly shown that a more interconnected world is both more vulnerable and with more potential of resilience to natural extremes. Stakeholders interpret risk situations differently, as they weight differently the blend of "facts" and "values" inherent to any decision where uncertainties and stakes are both high. Enabling knowledge for DRR requires a strong joint effort of scientists, practitioners, decisions makers, educational actors, to develop appropriate skill sets and solutions whilst keeping lessons learnt from the past.

Project objectives

The project aims to explore and coordinate the complex interaction of knowledge, decision making and implementation. It is aimed at understanding what has hampered the use of knowledge that has been developed so far by various stakeholders, in conjunction or disjunction from each other, to make appropriate decisions for risk mitigation and further on to transform the decisions into practice. Secondly, the project aims at framing a knowledge management framework, to be considered as the structure of a coherent set of tools to facilitate the co-production of knowledge, its sharing as well as its maintenance overtime. Such a framework will not just list possible tools to use, but will also provide some guidance with respect to their appropriateness given contextual conditions.

Methodology

Having as a methodological reference the objective and the on-going development of a knowledge management framework, KNOW-4-DRR will organise a coherent set of activities that will constitute on the one hand exemplification of effective and/or innovative tools and on the other will provide feedbacks on how enhanced knowledge management should take place, considering in particular the development of EU policies in the DRR and climate change adaptation. The following activities are foreseen: living labs, seminars on key issues, workshops among stakeholders from different sectors, monitoring of EU relevant policies, networking activities among existing networks in the field of DRR. Dissemination activities will be carried out to reach a wider audience. Among them a number of radio and web-tv casts will be performed.

Expected results

Setting the base of a knowledge management system is actually the ultimate goal of KNOW-4-DRR. The definition of criteria and a guideline for such a system to be developed in the future are considered as an important expected result of the project. To achieve this result, an ensemble of coordinated activities has been carefully designed. The living labs are the most evident example, in which innovative ways of sharing knowledge among stakeholders will be tested, thanks to the implication of relevant actors, such as the Po Riverbasin Authority in Italy, the Lorca Municipality in Spain and the presence of an NGO with a long tradition of field work in Vietnam as a partner in the project.

A knowledge management system in this field must be a blend of approaches and tools to be carefully combined adopting a systemic perspective. KNOW-4-DRR will provide decision makers and policy makers with a sound methodological approach to achieve not only better decision making processes, but also decisions, strategies and policies that are implementable.

Project partners	Country
Politecnico di Milano	IT
Horokopio University	EL
Agencia Estatal Consejo Superior de Investigaciones Cientificas	ES
Development Workshop France	FR
Universit of Salzburg – Department of Geoinformartics – Z_GIS	AT
United Nations University–Institute for Environment and Human Security	DE
Universitè de Savoie	FR
EURAC	IT
ADELPHI	DE
Centro de Investigaciones y Estudios Superiores en Antropologia Social	MX
TiConUno Srl.	IT

KULTURISK

At A Glance
Title: Knowledge-Based Approach To Develop A Culture Of Risk Prevention
Instrument: Collaborative project
Total cost: 4 451 097 €
EC contribution: 3 225 616 €
Duration: 36 months
Start date: 01/01/2011
Consortium: 11 Partners From 6 Countries
Project coordinator: Giuliano Di Baldassarre, Unesco-Ihe
Project website: www.Kulturisk.Eu
Key words: Risk Prevention, Early Warning, Mapping, Land-Use Planning, Risk Communication

The challenge

The extreme consequences of recent water-related disasters have highlighted that risk prevention still needs to be improved to reduce human losses and economic damages. The KULTURisk project aims at developing a culture of risk prevention by means of a comprehensive demonstration of the benefits of prevention measures. The development of a culture of risk prevention requires the improvement of our: a) memory and knowledge of past disasters; b) communication and understanding capacity of current and future hazards; c) awareness of risk and d) preparedness for future events.

Project objectives

KULTURisk aims to:

1. Review static and dynamic measures to prevent water-related hazards with focus on risk communication techniques.
2. Develop a risk-based methodology for evaluating diverse risk prevention measures in different case studies.
3. Demonstrate that prevention measures are more effective from a social and economic point of view than post-disaster recovery for different types of water-related risks (e.g. floods, landslides).
4. Promote a culture of risk prevention by using the KULTURisk outcomes as examples to: a) increase the risk awareness of the public via improved communication; b) shape risk perception of inhabitants in an appropriate and responsible way; and c) train professionals to better evaluate the socio-economic benefit of risk prevention techniques for water-related risks.

Methodology

KULTURisk is organised into 8 inter-dependent work packages (WPs). WP1 develops a risk-based methodology for evaluating costs and benefits of different risk prevention options. The methodology is then tested and applied to a variety of case studies. Three work packages deal with different types of prevention measures: WP2 (early warning systems and risk preparedness), WP3 (non-structural options) and WP4 (structural measures). Besides, WP5 evaluates and revises risk communication techniques, in the form of a stakeholder forum, by promoting stakeholder participation. WP6 aims to validate the methodology and generalise it for other types of hazards, such as forest fires and earthquakes. WP7 disseminates and exploits the results of the KULTURisk project, educates the public and train professionals in risk awareness and prevention.

Expected results

The KULTURisk project has developed a methodology to demonstrate the benefits of risk prevention techniques, which are being applied to a variety of case studies characterised by different socio-economic contexts and types of water-related hazards. The method can evaluate to which extent prevention actions are more efficient than post-event recovery and help stakeholders to better consider the benefits of risk prevention. Two transboundary catchments (the Soca-Isonzo and the Danube) enable the investigation of cross border aspects. The case studies (6 in total), are used to demonstrate not only the benefits of risk prevention, but also the need for a European approach to disaster risk reduction. The KULTURisk research is based on up-to-date techniques and the methodology includes driving factors such as land-use changes, spatial planning and climate change impacts.

Project partners	
Unesco-IHE Institute For Water Education	NL
Universita Degli Studi Di Brescia	IT
European Centre For Medium-Range Weather Forecasts	UK
Univerza V Ljubljani	SI
Eidgenoessische Forschungsanstalt	CH
Corila	IT
King's College London	UK
Joint Research Centre- European Commission	BE
Autorita Di Bacino Dei Fiumi Isonzo Tagliamento Livenza Piave Brenta Bacchiglione	IT
University Of Bristol	UK
Willis Limited	UK

MICORE

At a glance
Title: Morphological Impacts and Coastal Risks by extreme storm events
Instrument: Collaborative project
Total cost: 4 597 071 €
EC contribution: 3 499 954 €
Duration: 40 months
Start date: 01/06/2008
Consortium: 16 partners from 9 countries
Project coordinator: Paolo Ciavola, Dipartimento di Scienze della Terra Università degli Studi di Ferrara, IT
Project website: www.micore.eu
Key words: Coastal storms, coastal erosion, coastal flooding, storm surges, numerical models, warning systems

The challenge

Recent extreme hydrometeorological events in coastal areas have highlighted the devastating effects that can occur from hazards of marine origin. The experiences of Hurricane Katrina that struck the City of New Orleans as well as the two massive tsunamis in the Indian Ocean and Japan tragically demonstrate what can go wrong when engineering design is subjected to forcing beyond its design limits and civil evacuation and management plans fail.

In this context, the ability to predict the imminent arrival of coastal threats is a valuable tool for civil protection agencies in order to prepare themselves and, if need be, to execute the appropriate hazard-reduction measures.

Project objectives

The overall aims of the project were to set-up and demonstrate an on-line Early Warning System (EWS) for the reliable prediction of morphological impacts due to marine storm events in support of civil protection mitigation strategies.

Another important objective was to undertake an analysis of changes in storm occurrence and to consider possible future variability in the context of climate change. This analysis included the study of trends in meteorological data (e.g. changes in storminess proxies) and intended to provide guidance for the understanding of the response of coastlines to potential changes in the forcing agents.

Methodology

The project focused on nine case-study sites (corresponding to the nine European countries involved). At all sites a number of individual work phases were conducted in order to reach the end goal of setting up a prototype EWS for coastal storm risk. These phases included: a review of historical coastal storm events; field monitoring of storm impacts that occurred throughout the project; validating and testing a new as well as existing coastal storm models using the field data results; the development of a prototype EWS; and linking early warnings to civil protection protocols. The use of these nine unique and morphologically diverse sites made the approach developed as generic as possible and demonstrated the robustness of the methodology.

Given that coastal storm predictions are typically provided up to a three-day prediction window, the MICORE project specifically related to short-term emergency response rather than on longer-term strategic objective.

Expected results

To gain an understanding of past coastal storm trends across Europe, a total of 58 long-term (i.e. the past 30+ years) time-series of various storminess indicators were assembled and analysed. These indicators included elevated water levels, large waves and strong wind speeds, with their selection depending on data availability as well as the specific exposure conditions of each site.

Significantly, while some localised trends were observed, no European-wide trend of past coastal storminess was evident.

A generic structure for an Early Warning System of coastal risk was developed and found to be adaptable to each of the nine prototype systems. Each prototype EWS was operated in on-line mode. Running the EWS in daily mode, instead of only during extreme offshore conditions, was found to be crucial in testing the system's robustness and gaining additional confidence by end-users in its overall performance. It also expanded the applicability of the EWS to more day-to-day functions such as beach safety.

Project partners	
Dipartimento di Scienze della Terra, Università degli Studi di Ferrara	IT
Hydro-Meteorological and Climatological Service of the Emilia Romagna Region (ARPA-SIM)	IT
Geological, Seismic and Soil Survey of the Emilia-Romagna Region	IT
University of the Algarve, CIACOMAR-CIMA	PT
University of Lisbon–Fundação da Faculdade de Ciências da Universidade de Lisboa	PT
University of Cadiz, Department of Earth Sciences	ES
BRGM-French Geological Survey–Regional Geological Survey of Languedoc-Roussillon Montpellier	FR
International Marine Dredging Consultants	BE
University of Plymouth, School of Geography	UK
University of Szczecin INoM Laboratory of Remote Sensing and Marine Cartography	PL
Institute of Oceanology, Bulgarian Academy of Sciences	BG
Stichting Deltares	NL
Technical University of Delft Civil Engineering	NL
Natural Environment Research Council Proudman Oceanographic Laboratory	UK
University Pablo de Olavide Department of Physical, Chemical and Natural Systems	ES
Consorzio Ferrara Ricerche	IT

MOVE

At a glance
Title: Methods for the Improvement Vulnerability Assessment in Europe
Instrument: Collaborative project
Total cost: 2 650 841 €
EC contribution: 2 078 067 €
Duration: 38 months
Start date: 01/10/2008
Consortium: 13 partners from 9 countries
Project coordinator: University of Florence, IT
Project website: www.move-.eu
Key words: Natural hazards, Climate change, Vulnerability, Resilience, Stakeholder involvement

The challenge

Vulnerability to natural hazards and climate change is a complex and increasing problem in Europe. Whereas hazards have been studied in detail, there is less expertise and information on how to study human, cultural, institutional and socio-economic vulnerabilities, and their interaction. Profound challenges will occur in Europe as a result of climate change and its effect on meteorological hazards. It is vital that vulnerability be understood in its fully interdisciplinary, multi-dimensional form. This will enable improvements to be made in resilience to natural disasters.

Project objectives

MOVE considers the vulnerability of social, economic, institutional, cultural and physical systems to climate change and eight types of natural hazards: earthquakes, floods, wildfires, landslides, avalanches, heat waves, cold snaps and storms. It will produce a manual of different methodologies, validated with case studies, for the integrated assessment of vulnerability to these hazards. MOVE aims to involve key stakeholders in the process of deciding how to assess vulnerability. These include representatives of communities, industries and appropriate professions and public administrators at different levels of government. Stakeholder feedback and validation of the results of MOVE is vital to the process of creating usable theory and methodology.

Methodology

MOVE analyses vulnerability at different scales from the national to the local and in a wide variety of European environments (coasts, floodplains, mountains, metropolitan areas, urban areas and rural zones). The project summarises current knowledge of vulnerability to hazards and offers a glossary of agreed definitions of key terms. MOVE studies susceptibility to hazards and the resilience of human systems, communities and institutions. It uses indicators and other quantitative and qualitative data to produce measures of vulnerability in physical, social, economic, cultural and institutional contexts, and across the boundaries between these categories. Stakeholders are invited to validate the results and contribute to the process of implementing them in improved hazard and disaster management policy. Geographic information systems, social survey, remote sensing, mapping and risk assessment are among the methods involved.

Emerging results

One of the MOVE highlights has been a new integrative and holistic framework to systematize and assess vulnerability, risk and adaptation. As a thinking tool it represents an important step forward in providing clarity on concepts and terminologies.

This framework outlines key factors and different dimensions that need to be addressed when assessing vulnerability in the context of natural hazards and climate change. It has been applied and tested in several case studies across Europe in a variety of hazard settings. Based on this experience and as an additional major outcome, the MOVE project developed a 'Manual of Vulnerability Assessment in Europe', which can be used by stakeholders for developing their own vulnerability assessment. It outlines existing methodologies for estimating, studying and analysing multi-faceted vulnerabilities to natural hazards. It also provides an evaluation of their utility under particular circumstances. The findings of the project can serve as clear guidelines for policy development within different contexts, complemented by the manual, which provides a comprehensive, user-friendly sourcebook for the practitioner acting at a variety of scales.

Project partners	
CESPRO, University of Florence (UNIFI)	IT
French Geological Survey (BRGM)	FR
Centre for Geoinformatics, University of Salzburg (Z_GIS)	AT
European Academy, Institute for Applied Remote Sensing (EURAC)	IT
Atlas Innoglobe Tervezö és Szolgáltató (ATLAS)	HU
King's College, University of London (KCL-AC)	UK
Norwegian Geotechnical Institute (NGI)	NO
Rupprecht Consult Forschung und Beratung GmbH (RC)	DE
International Centre for Numerical Mathods in Engineering, Technical Univ. of Catalonia (CIMNE)	ES
United Nations University, Institute for Environment and Human Security (UNU-EHS)	UN
Faculty of Spatial Planning, University of Dortmund (UNIDO)	DE
Faculty of Arts, University of Oporto (FLUP)	PT
Department of Geography and Regional Planning, University of Vienna (UNIVIE)	AT

MOWE-IT

At a glance

Title: Management of weather events in transport system

Instrument: Support action

Total cost: 2 085 622 €

EC contribution: 1 641 564 €

Duration: 24 months

Start date: 01/10/2012

Project coordinator: VTT Technical Research Centre of Finland, FI

Project website: www.mowe-it.eu

Key words: European transport system, cross-modality, policy guidance, decision support, extreme weather, natural disasters

The challenge

Different weather phenomena and natural disasters impact transport system in different ways. There is no holistic view as to how European transport system should respond to different sources of interruption. Previous research has given several tools how to address the challenges but no conclusive presentation has been made prior to this project

Project objectives

The goal of the MOWE-IT project is to identify existing best practices and to develop methodologies to assist transport operators, authorities and transport system users to mitigate the impact of natural disasters and extreme weather phenomena on transport system performance.

Methodology

The project collects best practices from different EU Member States and elsewhere and produces mode-specific guidebooks that assist the different stakeholder groups in building resilience against the disruptions to transport of goods and people. Experiences will be drawn from recent EU FP7 projects “EWENT” and “WEATHER” which have also addressed the topic.

Expected results

The project will provide tools to plan transport system operations, investments and maintenance in a more efficient way now and in future conditions. This will cover all transport modes and all regions in Europe against the main challenges encountered.

Project partners	
VTT Technical Research Centre of Finland	FI
Istituto di Studi per l'Integrazione dei Sistemi	IT
Deutsches Zentrum für Luft- und Raumfahrt	DE
Finnish Meteorological Institute	FI
Karlsruhe Institute of Technology	DE
Centre for Research and Technology Hellas – Hellenic Institute of Transport CERTH – HIT	EL
Fraunhofer-Institute for Systems and Innovation Research ISI	DE
Cyprus Meteorological Institute	CY
Österreichische Wasserstraßen-Gesellschaft mbH	AT
Vaisala	FI
University of Birmingham	UK
Odessa National Maritime Academy	UA

ROOTOPOWER

At a glance
Title: Empowering root-targeted strategies to minimize abiotic stress impacts on horticultural crops
Instrument: Collaborative project
Total cost: 3 890 540 €
EC contribution: 2 997 449 €
Duration: 48 months
Start date: 01/01/2012
Consortium: 13 partners from 6 countries
Project coordinator: Agencia Estatal Consejo Superior de Investigaciones Científicas, ES
Project website: www.rootopower.eu
Key words: combined abiotic stresses; Food, Agriculture and Fisheries, Biotechnology; genetic markers; vegetable grafting; hormonal signalling; mycorrhiza; recombinant imbred lines; resource use efficiency; rhizobacteria; rootstock; yield stability

The challenge

After more than fifty years of crop improvement principally selecting for above ground traits, scientists now perceive root system engineering as an opportunity to maintain sustainable crop production under changing environmental conditions while minimizing the demand for new resources. Root-specific traits such as root system architecture, sensing of edaphic stress and root-to-shoot communication can be exploited to improve resource capture and plant development under adverse conditions. In this regard, Rootopower seeks to improve crop stress resistance and develop more resource efficient crops, allowing more efficient use of dwindling water and phosphorus resources, and to reduce excessive use of nitrogen fertilizers.

Project objectives

Under the premise of understanding the power of root traits, Rootopower aims to develop a multidisciplinary suite of new tools targeted to the root system to enhance agronomical stability and sustainability of dicotyledonous crops under multiple and combined stress conditions. Central to our approach is the use of tomato as a model species, since it can be very easily grafted.

This project will analyze and exploit the natural genetic variability existing in wild-relative tomato species (used as rootstocks) and their beneficial interactions with natural soil microorganisms (mycorrhiza and rhizobacteria). Genetic information and physiological understanding of mechanisms vital for high-performing root systems will be obtained. Therefore, the main objectives are: identifying stress-resistant root systems and rhizosphere microorganisms (and their synergisms) for enhanced resistance to individual and combined abiotic stresses and understanding the underlying genetic and physiological mechanisms, which are potentially fundamental to all crops and readily exploited in dicotyledonous crops.

Methodology

Rootopower will analyse the relationships between root genotype and shoot performance. QTL and candidate genes (fine mapping, transcriptomics and RT-PCR) for rootstock-mediated abiotic stress resistances and interactions with beneficial rhizosphere fungi and bacteria will be identified.

High throughput comprehensive hormonal and ionome analyses will be performed in root and leaf xylem sap to identify and quantify the signals involved in root perception and response to individual and multiple stresses and selected biological interactions. Regulatory effects of root genotype and rhizosphere microbiology on shoot photosynthesis, organ growth and development, carbon, nitrogen, phosphorous, potassium accumulation and water fluxes will be identified. Data from analyses of the genome, transcriptome, hormonome, ionome and phenome will be processed through advanced statistical and modelling approaches to define the mechanistic links between genes and trait responses to stress. Such understanding will enable delivery of specific combinations of root and biota-traits for use in root-targeted breeding strategies.

Expected results

The expected tangible results will include the delivery of tomato lines, physiological processes, genetic markers and integrative modelling for rootstock-mediated abiotic stress resistances and interactions with beneficial rhizosphere microorganisms that will be directly suitable for the scientific community and breeding programs.

The results obtained in Rootopower will help the scientific community, crop producers, breeders and society at large to deal with the predicted impacts of climate change and to overcome the consequences of unsustainable agricultural practices that are causing soil degradation and depleting natural resources. Thus, the project will have a major quantitative impact in terms of intermediate inputs use and consequently, a qualitative impact on food safety and environment preservation, increasing the sustainability of agriculture in Europe, a highly SME-intensive sector.

Project partners	
Organisation	**Country**
Agencia Estatal Consejo Superior de Investigaciones Científicas	ES
Université Catholique de Louvain	BE
The University of Warwick	UK
Lancaster University	UK
Instituto Valenciano de Investigaciones Agrarias	ES
Çucurova University Wageni	TR
Wageningen University	NL
Agrícola Perichán	ES
Unigenia Bioscience	ES
Agrocare AC	NL
INOQ GmbH	DE
Universidad Miguel Hernández	ES
Cranfield University	UK

SAFELAND

At a glance
Title: Living with Landslide Risks in Europe
Instrument: Collaborative project
Total cost: 9 529 867 €
EC contribution: 6 610 000 €
Duration: 36 months
Start date: 01/05/2009
Consortium: 27 partners from 12 countries
Project coordinator: Norwegian Geotechnical Institute, NO
Project website: www.safeland-.eu
Key words: Landslide, triggers, run-out, monitoring, climate change, risk management

The challenge

Landslides represent a major threat to human life, property and constructed facilities, infrastructure and natural environment in most mountainous and hilly regions of the world. As a consequence of climate change and increase in exposure in many parts of the world, the risk associated with landslides is growing. The growing hazard and risk, the need to protect people and property, the expected climate change and the reality for society in Europe to live with hazard and risk and the need to manage risk are the reasons for the SafeLand project.

Project objectives

(1) Provide policy-makers, public administrators, researchers, scientists, educators and other stakeholders with improved harmonised framework and methodology for the assessment and quantification of landslide risk in Europe's regions; (2) evaluate the changes in risk pattern caused by climate change, human activity and policy changes; and (3) provide guidelines for choosing the most appropriate risk management strategies, including risk mitigation and prevention measures. SafeLand developed and implemented an integrated and comprehensive approach to help guide decision-making. The harmonised methodologies and technical developments, combined with the social, economic and environmental dimensions will play a significant role in the detection, prediction and forecasting of landslides and landslide risk posed to individuals, society and the environment. SafeLand improved and adapted existing knowledge on landslide hazard and risk to link the slope-scale results to methodologies required for the assessment of landslide hazard and risk at regional and European scales.

Methodology

In order to fulfil the project objectives, SafeLand was divided into five different research areas. The scientific content in these research areas varied from strictly geological/engineering type of analyses such as the ones in Area 1 which focused on improving the knowledge on triggering mechanisms, processes and thresholds, through evaluation of climate- and demographic changes addressed in Area 3 to risk management issues including socio-economic variables as studied in Area 5. SafeLand therefore not only required an integrated approach involving different specialists in geo-sciences (engineers, geologists, geophysicists, meteorologists) to assess and quantify the risk, but also a close collaboration between the geo-scientists and social scientists to identify the most appropriate risk mitigation measures. Even though the methodological framework may differ between these disciplines, a basic methodological concept for all research areas is to test and document the analyses with help of case studies. A common database for case studies and results is therefore established.

Expected results

SafeLand will have impact on the protection and safety of population and material property at several levels: technology was improved, new more reliable maps were made available and public awareness was put on the agenda in a systematic manner, dialogue and understanding among scientists and experts was made more natural, early warning systems guidelines were prepared and procedures for stakeholder involvement were established. The project deliverables will provide the basis for future European directives in relation to natural hazards.

Examples of specific impacts are (1) the inventory (synthesis) of landslide "hotspots" in Europe, (2) the guidelines for landslide susceptibility, hazard and risk assessment, and (3) a methodology for landslide risk assessment due to global change at the European level that will help policy-setters and decision-makers to optimise the urban development and infrastructure planning.

Project partners	
Norges Geotekniske Institutt, NO	Studio Geotecnico Italiano SRL, IT
Universitat Politecnica de Catalunya, ES	Universiteit Twente, NL
Amra SCARL, IT, FR	Universite de Lausanne, CH
BRGM, FR	C.S.G. Centro Servizi di Geoingegneria, IT
Universita Degli Studi di Firenze, IT	King's College London, UK
International Institut for Applied System Analysis, AT	Universita Degli Studi di Salerno Via Ponte Don Melillo 1 Fisciano (sa), IT
Commission of the European Communities – Directorate General Joint Research Centre – JRC, IT	Eidgenössische Technische Hochschule Zürich, CH
Fundacion Agustin de Betancourt, ES	Geologische Bundesanstalt, AT
Aristotelio Panepistimio Thessalonikis, EL	TRL Limited, UK
Universita' degli Studi di Milano-Bicocca, IT	Institutul Geologic al Romaniei, RO
Max Planck Gesellschaft zur Foerderung der Wissenschaften, DE	Centre National de la Recherche Scientifique (CNRS), FR
Centro Euro-Mediterraneo per i Cambiamenti Climatici SCARL, IT	Ecole Polytechnique Federale de Lausanne, CH
Geoloski Zavod Slovenije, ZS	Risques et développement, FR
Centrale Recherche SA, FR	

SEFIRA

At a glance
Title: Socio Economic implications For Individual Responses to Air pollution policies in EU+27
Instrument: Coordination Action
Total cost: 1 178 600 €
EC contribution: 998 000 €
Duration: 36 months
Start date: 01/06/2013
Consortium: 8 partners from 6 countries
Project coordinator: University of Urbino Carlo Bo, IT
Project website: www.sefira-project.eu/
Key words: Environment, Air Quality, Noise, Climate Change, Socio-Economic Sciences

The challenge

The European Commission DG Environment began in 2011 a review of EU air quality legislation. To assist in this review, the Commission has funded a wide range of projects, mainly based on physical, chemical and medical sciences, and economic analysis. In practice to date, the preferred method of assessing the acceptability of policies has been through cost-benefit analysis. Although this is a valuable tool, it is of limited value in assessing the wider acceptability of policies, particularly in relation to the impact on individual behaviour. A wider and deeper comprehension of the socio-economic implications of air policies is needed. Such a challenge needs an innovative and cooperative approach between disciplines, which in the past have had a low degree of integration.

Project objectives

The main objectives of SEFIRA are: i) To integrate the scientific and technical knowledge on air quality with the socio-economic aspects of national, regional and EU wide implications of air and noise pollution policies; ii) To explore ways to better integrate the socio-economic dimension in those policies, especially with respect to preferences, behaviours and responses of individuals, stakeholder groups and civil society, in order to obtain a better understanding of the feasibility and acceptability of the implementation of the policies; iii) To develop a specific analytical method based on discrete choice models and ecosystem services that integrate quantitative and qualitative data on European population attitudes and actions toward air quality regulations; iv) To provide specific reports in support to the on-going revision and implementation of the EU air policy; v) To produce integrated transdisciplinary syntheses and peer-reviewed papers.

Methodology

SEFIRA will work through four main disciplinary areas: atmospheric sciences, political, social and economic sciences.

SEFIRA will start with a transdisciplinary review of air and noise pollution policies, in order to form a basis for the assessment of the socio-economic implications of those policies.

SEFIRA will then carry out an explorative study to identify the relevant dimensions to be investigated through a computer-assisted telephone interviewing (CATI) survey in five European countries. The data provided by the pilot survey and the CATI will be processed applying Discrete Choice Models (DCM).

Outcomes aim at providing advice on policy implementation tools and testing, considering alternative socio-economic implications of air quality and noise policy. DCM will enter in a dialog with GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) scenarios aiming at integrating important behavioural information in order to select and test – in its forecast scenarios – the most appropriate air quality policies.

The consortium will organize both thematic seminars in the disciplinary fields of the project and cross-disciplinary integration seminars and documents. All the outputs and outcomes will contribute to build spaces and communication tools in order to establish a direct feedback with European, national and local stakeholders.

Expected results

SEFIRA will for the first time bring socio-economic methods and thinking into the area of air quality policy-making at the EU level.

This emerged as a much needed approach by several stakeholders, including the EU. In particular the need was not only to complement current knowledge with a different approach, but to integrate it in view of more adequate policy assessments based on natural and economic sciences to date.

These results of the SEFIRA project are expected to have a very significant impact. Indeed, through its complex methodological design, the project will enhance the interdisciplinary dialogue and knowledge production processes supporting policy making through new approaches in policy analysis in the field of air quality and noise.

The novel coordination between various scientific and socio-economic disciplines will enrich each approach and ultimately result in more effective and robust policy making.

Project partners	
Università degli Studi di Urbino Carlo Bo (coordinator)	IT
Internationales Institut für Angewandte System Analyse	AT
Katholieke Universiteit Leuven	BE
Consiglio Nationale delle Ricerche	IT
PRAGMA SRL	IT
Szkola Glowna Handlowa W Warszawie	PL
Lunds Universitet	SE
King's College London	UK

STAR-FLOOD

At a glance
Title: Strengthening And Redesigning European FLOOD risk practices: Towards appropriate and resilient flood risk governance arrangements
Instrument: Integrated Project
Total cost: 6 769 661 €
EC contribution: 5 284 529€
Duration: 42 months
Start date: 01/10/2012
Consortium: 9 partners from 6 countries
Project coordinator: Peter Driessen, Utrecht University, NL
Project website: www.starflood.eu
Key words: Flood-Risk Management Strategies, Governance Arrangements, Resilience, Appropriateness, Legal and Policy Issues, Vulnerable Urban Agglomerations, Design-oriented framework, Practitioners' guide.

The challenge

Flood risks are increasing due to climate change, soil subsidence and increasing urbanization of river areas. To deal with these risks, many European countries focus on building, reinforcing and maintaining flood defense works. STAR-FLOOD takes as its starting point that such a focus is necessary, but not sufficient in order to ensure sustained flood protection. From a resilience point of view, the strategy should be broadened with pro-active spatial planning, building prescriptions, warning systems, evacuation- and recovery plans. To study how this broadening of strategies can be brought about, the project will combine and integrate public administration and legal expertise.

Project objectives

1. Uncover the opportunities and barriers of broadening the Flood Risk Management Strategies (FRSs) in different countries;
2. Support authorities and other stakeholders in vulnerable urban agglomerations in Europe by designing appropriate and resilient Flood Risk Governance Arrangements (FRGAs);
3. Develop policy design principles for Flood Risk Governance Arrangements (FRGAs) and their implications for policies and law at the level of the EU, its member states, regional authorities, and public-private partnerships;
4. Disseminate these design principles to high-level policy makers at the national, EU and regional level through workshops, conferences, policy briefs and a practitioners' guide.

Methodology

Design principles for Flood Risk Governance will be derived after analysing, explaining and evaluating current arrangements in six European countries (The Netherlands, United Kingdom, Belgium, Sweden, Poland, France). The countries vary in their attempts to broaden Flood Risk Management Strategies; the significance of flooding as well as their administrative structure and culture. Three vulnerable urban agglomerations in each of the six consortium countries have been selected as case study areas. In each case study area, public administration and legal scholars will analyse, evaluate and explain Flood Risk Governance Arrangements.

Expected results

The project will result in design principles for improving flood risk governance. Examples include, but are not limited to recommendations for:

1. New public-private partnerships & the improvement of existing ones.
2. Policy programmes.
3. Measures for policy implementation.
4. Methods for dealing with uncertainties.
5. Legal instruments.
6. Public and private modes of financing Flood Risk Management Strategies.
7. Competence development of practitioners.
8. Ways of minimizing distributional effects of Flood Risk Governance Arrangements (FRGAs).

The programme's results will be of relevance for high-level policymakers at national and EU level, but also for stakeholders at the regional level (inside the eighteen case study areas and beyond).

Project partners	
1 Utrecht University – NL	Environmental Governance
	Centre for Environmental Law and Policy
2 Radboud University Nijmegen – NL	Group Political Sciences of the Environment
3 Grontmij Nederland BV – NL	Including affiliated identities in other countries
4 Middlesex University – UK	Flood Hazard Research Centre
5 University of Antwerp – BE	Research Group Society and the Environment
6 KU Leuven – BE	Institute for Environmental and Energy Law
7 Lulea University of Technology – SE	Division of Social Sciences
8 IAFE Polish Academy of Sciences – PL	
9 Université François Rabelais de Tours – FR	

TRACE

At a glance
Title: Tephra Constraints on Rapid Climate Events (TRACE)
Funding scheme: ERC Starting Grant
ERC funding: 1 470 000 €
Duration: 60 months
Start date: 01/09/2011
Host institution: Swansea University, Wales, UK
Principal investigator: Siwan Davies
Project website:
Key words: rapid climate change, volcanic events, ice-cores, marine records

The challenge

Why does climate change abruptly? Rapid climatic jumps occurred within decades between 110 000 and 25 000 years ago. These sudden climate shifts are thought to have involved a strong interplay between the ocean circulation and atmospheric dynamics, yet the mechanisms that drove these processes are poorly understood. Understanding the cause and effect of these abrupt climate jumps is critical for predicting the likelihood of future events.

Project objectives

TRACE uses microscopic volcanic ash layers to determine why climate has changed abruptly in the past. A detailed record of past volcanic events will be constructed and these ash layers will be used to assess the atmospheric versus oceanic response during rapid climatic events. This insight permits an assessment of the cause and effect and, as such, the mechanisms driving these climatic instabilities.

Methodology

Microscopic traces of tephra or volcanic ash allow precise linkages or tie-lines to be drawn between the North Atlantic marine records and Greenland ice-cores. Recent work has uncovered the fact that these invisible layers of volcanic ash have a wide geographical reach, just as we saw with the 2010 Icelandic ash cloud distribution. Each tephra has a distinct geochemical fingerprint, allowing us to trace the layers between records. These tie-lines act as isochrons permitting an assessment of the comparative behaviour of the oceanic and atmospheric systems during a rapid climatic event.

Emerging results

Over 80 previously unknown volcanic deposits have been identified in the Greenland ice-cores, providing an exceptional insight into the frequency and history of Icelandic volcanic events in the past. So far, at least 5 of these can be traced into North Atlantic marine records under investigation allowing an unprecedented insight into the oceanic and atmospheric dynamics during rapid climatic events. This work will help climate scientists to understand the trigger of abrupt climate shifts.

XEROCHORE

At a glance

Title: An Exercise to Assess Research Needs and Policy Choices in Areas of Drought

Instrument: Support action

Total cost: 1 831 002 €

EC contribution: 1 500 889 €

Duration: 24 monts

Start date: 01/05/2008

Consortium: 12 partners from 9 countries

Project coordinator: Fondazione Eni Enrico Mattei – FEEM, IT

Project website: www.feem-project.net/xerochore/

Key words: Drought, impacts, water resources, climate change, policy, drought network, european drought centre

The challenge

As a part of natural variability, the precipitation and availability of water resources throughout time and space vary within bounds determined by given climate conditions. Droughts are extreme events at the lower bound of climate variability. They are natural and recurring phenomena of prolonged absence or marked deficiency of precipitation. Climate change induced alteration of rainfall pattern will have significant effects on frequency of extreme events such as droughts. The knock-on effects of these changes will affect almost all communities throughout Europe. The European Water Framework Directive (WFD) recognised droughts as potential threats which may undo the efforts to achieve good ecological status.

Project objectives

The Xerochore project set to:

- review and synthesize knowledge on past, current and future drought events;
- develop guidance that provides a short to long term vision on research needs and steps forward towards supporting the implementation of drought management plans within the context of River Basin District management Plans compelled by the WFD;
- sets up a network of experts with various backgrounds and extends the European Drought Centre (EDC, http://www.geo.uio.no/edc/);

Methodology

The consortium conducted review and compiled state-of-the-art reports on natural and human-made causes of drought, social-economic and environmental impacts; and management and policy options, to mitigate the negative impacts of droughts and increase community and ecosystem resilience.

The first review report analysed 1) climatic aspects of drought and hydrological responses and the land-atmosphere feedbacks through soil moisture, shallow groundwater, snow/glaciers, irrigation and dams; 2) integrated drought assessment framework (atmosphere and land), and 3) drought monitoring and seasonal forecasting.

The second review report synthesized knowledge on economic, social and environmental impacts of droughts. In doing so it reviewed a number of recent drought cases, methodologies used for the impact estimation; practical issues making the assessment difficult; and research gaps to which future research should be directed. A wide range of water demandand supply management (WDM and WSD) instruments have been reviewed and experiences from their application synthesised.

The third review report provides an overview about the European and international policies and management efforts addressing droughts.

Expected results

Besides the review reports and guidance documents, the project organised expert workshops (Venice October 5-7th, 2009) and science-policy conference (23-24 February, 2010, Brussels), providing opportunity for extensive discussion and exchange among the drought research and policy communities. In addition, a Science-Policy event (22 February 2010) was organised to brief some key experts and policy makers about the results of the project.

As a final result and integrating the above reviews, the XEROCHORE project has produced a comprehensive guidance document with a concise overview of the existing knowledge, research gaps, policy recommendations and where possible, practical advices for water managers and authorities responsible for drought management and relief/reconstruction planning.

The project has set up a network of experts with various backgrounds (e.g. scientists, water resources engineers, stakeholders, planners, policy analysts, decision makers) and invited them to join the European Drought Centre (EDC, http://www.geo.uio.no/edc/), established in 2004.

Finally, a set of five multilingual science policy briefs (PB) was developed to inform the implementation of the Water Framework Directive (WFD, Directive 2000/60). The PBs were circulated among the intended readership and presented during the Conference on Integrated River Basin Management under the Water Framework Directive (26-28 April 2010, Lille/France).

Project partners	Country
Fondazione Eni Enrico Mattei – FEEM	IT
Wageningen Universiteit (WU)	NL
Ministero dell'Ambiente, della Tutela del Territorio e del Mare	IT
Ministerio de Medio Ambiente	ES
Natural Environment Research Council	UK
National Technical University of Athens	EL
DG Joint Research Centre, European Commission	EU
Centre National du Machinisme Agricole, du Genie Rural, des eauxet des Forets	FR
The International Union for Conservation of Nature and Natural Resources	NGO
Stichting Dienst Landbouwkundig Onderzoek – ALTERRA	NL

6
Climate change adaptation, mitigation and policies

ACCENT

At a glance

Title: Action on Climate Change through Engagement, Networks and Tools

Instrument: Coordination and Support Action

Total cost: 1 348 964 €

EC contribution: 1 017 881 €

Duration: 24 months

Start date: 01/04/2009

Consortium: 12 partners from 9 countries

Project coordinator: Fondazione IDIS – Città della Scienza

Project website: www-i-do-climate.eu

Key words: Climate change, Mitigation strategies

The challenge

Climate change issues are clearly a growing concern for the public today. People have received a great deal of information from the media on causes and consequences of climate change. On the Internet, citizens and young people have free access to a wide variety of in-depth information concerning many aspects of climate change, while they are not often prepared to evaluate such information and to elaborate their own opinions. Fifteen relevant organizations, among science centres and aquaria, were engaged by the ACCENT project in a coordinated action aimed at rationalizing their two-way communication practices and at strengthening their collaborations with the scientific community on climate change issues.

Project objectives

The ACCENT consortium contributed to generate interests and to increase public awareness on global and local aspects of climate change. In this context, four main objectives were identified for the ACCENT project:

- The first one was exchanging practices and integrating synergies among the science centres, museums and aquaria engaged in the communication of climate change.
- The second one was to implement a global communication action based on the two-way science communication of climate change issues in Europe.
- The third one was to disseminate the latest results of research and its contribution to the advancement of climate change comprehension.
- The fourth one was the engagement of citizens in debates, and the collection of data concerning their perception in Europe on climate change issues, its risks and impact, both for the general public and for policymakers and other stakeholders.

These objectives were achieved through a coordinated work plan of activities during the two years of the project.

Methodology

ACCENT's proposal contributes to a global effort, in order to move the campaign for climate change from the "informative" to the "active" phase, through the exchange and dissemination of the best practices, with specific actions aimed at encouraging the involvement of citizens in actions and in dialogues. Through ACCENT, the science centre's community itself has strengthened the efforts together with the local institutions in a one-year European Communication Action on climate change issues, the "I Do Campaign", for the dissemination of research results, and has established a dialogue among scientists, stakeholders and the public through participatory practices. They capitalized on their skills in a European sustainable web platform that has worked as a "collector", as well as a "disseminator", for any organization dealing with public engagement in science. ACCENT delivered reliable data on European citizens' opinions and perceptions on climate change issues through Local Citizens Debates.

Results

The main results achieved during the Local Citizens Debate were:

- People need a clarification on the effects of climate change, as they expressly ask for. They would need to know how much part of the global warming is caused by human activities and how much is a natural phenomenon.
- The panellists, and the citizens in general, ask for more (scientific) information very often; citizens seem to believe that the more they know, the more they are likely to act.

Considering the number of science centres, museums and aquaria involved in the project, ACCENT certainly had a significant impact on the high number of the implemented informal educational practices. Thanks to the involvement of ECSITE, the European Network, many science centres and science museums will benefit from the best practices disseminated through ACCENT for the development of public programs in their institutions.

From the number of the participants involved, it is possible to deduce that there is a big interest in the topics of climate change and of global warming, concentrating both on the information to reducing climate problems than on scientific topics.

Project partners	
Fondazione IDIS-Città della Scienza, Naples, IT	Teknikens Hus, Lulea, SE
Ecsite, BE	Experimentarium, Copenhagen, DK
Observa, Vicenza IT	AHHAA, Tartu, EE
University of Lapland – Arctic Centre, FI	The Israel National Museum of Science, Technology & Space, Haifa, IL
Aquarium of Genoa, IT	Bloomfield Science Museum, Jerusalem, IL
Nausicaa, Boulogne, FR	
Heureka, Vantaa, FI	
Techniquest, Cardiff, UK	
Technopolis, Mechelen, BE	
Universeum, Gothenburg, SE	

ADAPTAWHEAT

At a glance

Title: Genetics and physiology of wheat development to flowering: tools to breed for improved adaptation and yield potential

Instrument: Collaborative project

Total cost: 4 620 282 €

EC contribution: 3 000 000 €

Duration: 48 months

Start date: 01/01/2012

Consortium: 20 partners from 13 countries

Project coordinator: Simon Griffiths (John Innes Centre, UK)

Project website: www.jic.ac.uk/ADAPTAWHEAT

Key words: Adaptation, yield, wheat, physiology, genetics, breeding

The challenge

Bread wheat is the major cereal crop for Europe but our understanding of how to use genetics and breeding to fine tune adaptation, and maximise grain yield, in breeding this for new environments is still limited to just two or three genes.

Project objectives

This project is quantifying the potential impact of known genetic variation (photoperiod and vernalization response) on adaptation and yield and discovering new variation to benefit future breeding programmes.

Methodology

Gene action and environmental interaction is quantified using precise genetic stocks, most importantly, Near Isogenic Lines (NILs) for photoperiod response, vernalization, and earliness per se genes. New genes are discovered in segregating populations. The agronomic impact and physiological mechanism of gene action is dissected. At the molecular level the action of flowering time network genes is better understood. Deployment of genetic markers, physiological trait selection, and exploitation of novel germplasm is channelled into application by three SMEs and five larger breeding companies.

Expected results

New knowledge of genes that can be deployed for breeding. Trait and marker packages for breeders to deploy this knowledge. Better understanding of the flowering time pathways that underlie these phenotypes. Knowledge of trade offs between adadptation and performance traits.

Project partners	
John Innes Centre	UK
University of Lleida	ES
Institut National de Recherche Agronomique	FR
Leibniz-Institute of Plant Genetics and Crop Plant Research	DE
Agricultural Research Institute of the Hungarian Academy of Sciences	HU
University of Copenhagen	DK
Crop Research Institute	CZ
The Institute of Plant Biology and Biotechnology	KZ
National Council of Scientific Research of Argentina	AR
International Wheat and Maize Improvement Center	MX
Commonwealth Scientific and Industrial Research Organisation	AU
RAGT 2n	FR
Semillas Batlle	ES
Institute of Field and Vegetable Crops	RS
Trait Genetics	DE
KWS LOCHOW GMBH	DE
Limagrain	UK
Arvalis	FR
Selgen	CZ
Rothamsted	UK

ADVANCE

At a glance
Title: Advance Model Development and Validation for Improved Analysis of Costs and Impacts of Mitigation Policies
Instrument: Collaborative project
Total cost: 7 425 559 €
EC contribution: 6 699 168 €
Duration: 48 months
Start date: 01/01/2013
Consortium: 14 partners from 8 countries
Project coordinator: PIK, DE
Project website: www.fp7-advance.eu
Key words: environment (including climate change), climate policy, model development, mitigation pathways, validation, mitigation costs, integrated assessment, energy demand, energy-economy model, model transparency, uncertainty, technological change

The challenge

Climate policy needs to be informed by assessments of climate mitigation targets and their long-term implications for the coupled global energy-economy-landuse-climate system. So-called Integrated Assessment Models (IAMs) are central tools for these assessments.

With the increasing use of such models, the demand for improved representation of relevant meso- and macro-scale dynamics, for a broadened sustainability perspective, for better linkages to complementary energy-economic frameworks, and for a better understanding of model input and structure as well as differences across model results has grown significantly. A new generation of IAMs is needed for improved climate and energy policy assessments in the decade to come.

Project objectives

- Building trust and confidence of politicians in the results of energy-economy and integrated assessment models (IAM) by increasing transparency of models, underlying structures, and model-specific input data assumptions
- Developing a new generation of advanced energy-economy and integrated assessment modeling tools for the analysis of the costs and impacts of climate change mitigation policies
- Validation and diagnostics of models with the aim of evaluating their strengths and limitations
- Considerably improving the representation of energy demand in IAMs through better modeling of energy services, technologies, and consumer behavior
- Enhanced understanding and representation of technological innovation, uncertainty, system integration and resource constraints
- Evaluation of impacts of mitigation policies on economic sectors in the EU and beyond
- Creation of a platform for the coordinated development and sharing of methodologies and input data sets for the general modeling community

Methodology

To achieve the overall objective of the project, the work plan is designed in a highly integrated way. For all research tasks related to methodological improvements, ADVANCE has a first phase in which a core group of 1-3 “pioneer” modeling teams develops, implements and tests innovative modelling approaches. Based on the results of the pioneer group, suitable reduced-form representations for use in other models are developed. In a second phase, the other teams participating in the task adopt and implement the modelling approaches in their models. Eventually, the resulting model algorithms and relevant raw input data sets are made available to the entire modelling community as an open access resource.

The IAM modeling work draws upon empirical work and/or detailed sector modeling of experts in the relevant areas. In addition, ADVANCE holds three expert and stakeholder workshops to involve outside expertise in the project.

Expected results

ADVANCE aims at developing a new generation of integrated assessment models. This is achieved by substantial research and development work in the key areas mentioned above.

In the past, methodological innovations and improvements were hindered by the unavailability of suitable input data. The ADVANCE project makes a large and coordinated effort to generate relevant datasets. These datasets, along with newly developed methodologies, will be made available to the broader scientific community as open-access resources at the end of the project.

ADVANCE also puts a focus on improved model transparency, model validation, and data handling. A central objective of ADVANCE is to evaluate and to improve the suitability of models for climate policy impact assessments. The improved models will be applied to an assessment of long-term EU climate policy in a global context, and the results disseminated to the wider community.

Project partners	
PIK – Potsdam Institute for Climate Impact Research	DE
IIASA – International Institute for Applied Systems Analysis	AU
PBL – Netherlands Environmental Assessment Agency	NL
FEEM – Fondazione Eni Enrico Mattei	IT
IPTS – Joint Research Centre European Commission	BE
UCL – University College London	UK
SMASH – Societe de Mathematiques Appliquees et de Sciences Humaines	FR
UEA, Univ. of East Anglia	UK
ICCS – Institute of Communication and Computer Systems	EL
UPMF-EDDEN, Univ. Pierre Mendes	FR
NTNU – Norwegian Univ. of Science and Technology	NO
DLR – German Aerospace Center	DE
UU – Univ. Utrecht	NL
Enerdata SA	FR

AFRICAN CLIMATE

At a glance
Title: The Web Platform for Uptake of Climate Related Research Results for Africa
Instrument: Coordination and Support Action
Total cost: 1 270 903 €
EC contribution: 999 884 €
Duration: 36 months
Start date: 01/10/2011
Consortium: 10 partners from 8 countries
Project coordinator: WIP Renewable Energies
Project website: www.africanclimate.net
Key words: Climate change, adaptation, mitigation, policy, impact, Africa, uptake of research results knowledge sharing, interactive web platform, good practice dissemination, networking, good practice

The challenge

Extreme weather events and increasingly unpredictable climate patterns are having a dramatic effect across Africa, especially for the people who rely on its land, lakes and seas to feed themselves and earn a living. Africa's response to climate change has so far been hampered by a fundamental lack of knowledge transfer.

The European Union has been funding research into climate change and related technologies since the 1980s. This has been of great value in formulating realistic policy objectives – now it is time to translate these results into action.

Project objectives

There is a clear need for research findings to be widely communicated, especially to stakeholders who can put them into practice on the ground. Public awareness campaigns are rare, particularly outside Africa's major urban centres.

The AfriCAN Climate project aims to help Africa adapt to climate change by bridging the gap between research and action. A dynamic web platform brings together an active network of European and African researchers. In addition to disseminating information on climate change research and policy, the project facilitates the widespread sharing of indigenous knowledge and examples of good practice.

AfriCAN Climate engages stakeholders – mainly politicians and project developers – from the initial planning of climate change initiatives to the subsequent sharing of results and experiences.

The anticipated effect is an increased uptake of research results and their translation into practical projects that will have a direct impact on people's lives.

Methodology

To achieve its aims, the AfriCAN Climate project addresses nine specific objectives:

1. Elaborate an editorial policy and editorial team structure to facilitate the integration of knowledge/content and web design.
2. Develop the necessary technical infrastructure to create an attractive web presence and support effective editorial work flows for the online knowledge sharing platform.
3. Disseminate the results of climate change research through identifying and processing knowledge on mitigation, adaptation, climate policy and financing.
4. Identify and assess the impact on the ground of projects aimed at mitigating or adapting to climate change in Africa.
5. Operate and maintain the web platform and implement internal quality control mechanisms.

6. Perform technical maintenance and web hosting tasks to ensure the accessibility and flawless functioning of the platform.
7. Engage networks and other information multipliers in promotional activities, both online and offline.
8. Promote good practice amongst the targeted stakeholders, including researchers, local authorities, NGOs, SMEs, artists and educational partners.
9. Increase the visibility and recognition of the AfriCAN Climate portal among the target audience.

Results

The most relevant results of the AfriCAN Climate project are:

- A multilingual, dynamic and interactive web platform with Web 2.0 functionalities for knowledge sharing.
- A knowledge base structured in five main portal sections, with wide thematic and geographic coverage.
- Fact sheets detailing the current and projected impact of climate change on each of Africa's 54 countries.
- More than 25 good practice cases that highlight eight principles of good practice.
- Regularly updated web content featuring news, events, links, and practical tools.
- A section of the website dedicated to projects supported by the European Commission.
- A multimedia gallery with video and images showing the faces behind good practice in climate change adaptation and mitigation in Africa.
- A bi-monthly newsletter.
- More than 200 registered members and five online communities.
- Three rounds of promotional events comprising workshops and technical tours to good practice sites.
- AfriCAN Climate Awards in three categories: Awareness Raising, Good Practice, and Science.

Project partners	
WIP – Renewable Energies	DE
Imperial College	UK
P.A.U. Education	ES
UNEP Risø Centre, Technical University Denmark	DK
Practical Action	UK
ENDA	SN
The Food, Agriculture and Natural Resources Policy Analysis Network of Southern Africa	ZA
The University of the Witwatersrand	ZA
International Centre for Research in Agroforestry	KE
IGAD Climate Prediction and Application Centre	KE

AMAZALERT

At a glance
Title: AMAZALERT – Raising the alert about critical feedbacks between climate and long-tern land use change in the Amazon
Instrument: Collaborative project
Total cost: 4 757 920 €
EC contribution: 3 494 420 €
Duration: 36 months
Start date: 01/09/2011
Consortium: 14 partners from 9 countries
Project coordinator: Stichting Dienst Landbouwkundig Onderzoek – ALTERRA, NL
Project website: www. eu-amazalert.org
Key words: Amazonia, deforestation, climate change, REDD, tipping points, early warning system, climate feedbacks, CO2, policy earth model, DGVM

The challenge

AMAZALERT responds to predictions of climate-induced changes in the Amazon Basin's vegetation. The extent and distribution of changes in these changes will, however, be determined by interactions between global temperature and precipitation, Amazon land-cover and use patterns - including those resulting from fire - and socio-economic forces, including impacts of policies and programs. AMAZALERT is designed to provide better understanding of these multiple, Inter-linked processes, to reduce uncertainties in predictions and lay the groundwork for an early warning system. The need for an early warning system to assist society in taking action before critical ecosystem services are lost has been identified by both Amazonian and international stakeholders.

Project objectives

AMAZALERT will:

- Identify the most important ecosystem services represented by Amazonia.
- Analyse and improve coupled models of global climate and Amazon land use, vegetation and socio-economic drivers to quantify anthropogenic and climate induced land-use and land cover change and non-linear, irreversible feedbacks among these components.
- Assess the potential role of regional and global policies and societal responses in the Amazon region for altering the trajectory of land-use change in the face of climate change and other anthropogenic factors.
- Propose an Early Warning System (EWS) for detecting any imminent irreversible loss of Amazon ecosystem services.
- Propose policy response strategies to avoid such loss.

Methodology

AMAZALERT is structured in 7 work packages. WP1 aims to identify the priority if the Amazon ecosystem functions and services and their drivers of change. WP2 determines the response of land use change, vegetation and water to anthropogenic drivers and climate change. In WP3 the role of vegetation-climate non-linear feedbacks in the impacts of land-use and climate change will be identified and quantified. WP4 evaluates the implications of climate and land-use scenarios for national and international policies. In WP5 the understanding from previous work packages will be integrated in an Early Warning System. WP6 disseminates the results of the project and offers training sessions on project methods. WP7 deals with the management and coordination of the project.

First Results

Halfway the project, first important results have been achieved:

- We identified the most important ecosystem services of the Amazon: maintaining water cycling and climate, carbon storage, regional production and biodiversity.
- Multi-model projections for the Amazon basin from the state-of-the-art in climate and earth system modelling were presented. The simulations were carried out according to different IPCC scenarios of greenhouse gas concentrations including land use change consistent with development pathway and policy decisions.
- First simulations with vegetation and climate models show a challenge to correctly represent biomass, temperature and CO2 sensitivity of forest growth.
- Field work has addressed temperature and drought sensitivities.
- A set of detailed land use change scenarios have been simulated.
- The boundary conditions for an early warning system have been defined.
- Policy research identified both national and international policies and initiatives affecting land use in the Amazon – directly and indirectly.

Expected results

In 3 years' time, the project should provide a set of greatly improved tools to evaluate, and assist in political decisions on, the future management of the Amazon region, including ways to monitor the functioning of the Amazon to avoid immanent, irreversible changes to its environment. This means:

- Sets of scenarios that include both the response of the natural system to climate and land-use change, as well as the likely effects of policies and the possible response of the agriculture and society to Amazon degradation. These scenarios will aid in evaluating possible courses of action.
- A blueprint for an early warning system of irreversible change, based upon a monitoring network, including land surface cover, climate, rivers, and socio-economic indicators.

Project partners	
STICHTING DIENST LANDBOUWKUNDIG ONDERZOEK (ALTERRA)	NL
INSTITUTO NACIONAL DE PERSQUISAS ESPACIAIS (INPE)	BR
MET OFFICE	UK
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS/IPSL)	FR
VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS, WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG (VU)	NL
EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA (EMBRAPA)	BR
UNIVERSITEIT GENT (UGENT)	BE
JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH (JR)	AT
THE UNIVERSITY OF EDINBURGH (UEDIN)	UK
FUNDACION AMIGOS DE LA NATURALEZA (FAN)	BO
POTSDAM INSTITUT FUER KLIMAFOLGENFORSCHUNG (PIK)	DE
UNIVERSITY OF LEEDS (UNIVLEEDS)	UK
UNIVERSIDADE DE SAO PAULO (USP)	BR
UNIVERSIDAD NACIONAL DECOLOMBIA (UNAL)	CO

AMPERE

At a glance

Title: Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates

Instrument: Collaborative project

Total cost: 4 259 720 EUR

EC contribution: 3 149 489 EUR

Duration: 36 months

Start date: 01/02/2011

Consortium: 21 partners from 13 countries

Project coordinator: Potsdam Institute for Climte Impact Research, DE

Project website: ampere-project.eu

Key words: climate policy, mitigation costs, integrated assessment, model intercomparison, validation, climate system representation, decarbonisation for EU27

The challenge

Climate stabilisation requires ambitious policies for initiating and managing a transition to low-carbon economies within this century. It is indispensable for policy makers to have insightful information on viable pathways for such a transition and on the associated mitigation costs. Yet the complexity of technological developments and economic interactions relevant to climate policy pose a challenge for even the most advanced energy-economy models. This challenge is particularly great when taking into account that international climate policy has largely been fragmented and focussed on the short term, whereas climate stabilisation ultimately requires dedicated long-term efforts. In light of these complexities, more robust assessments of mitigation pathways and cost estimates are needed.

Project objectives

The AMPERE project analyses possible long-term mitigation pathways and associated mitigation costs at the global and European level. For improved policy relevance, these analyses account for real-world limitations such as imperfect international cooperation and technology lock-ins. The goal is to generate insights into the relevance of short-term policy targets for long-term mitigation, the implications of fragmented policy coverage and the potential impacts of an early mover status for the European Union.

AMPERE aims to strengthen the robustness of climate change mitigation assessments and mitigation cost estimates. This task requires inter-comparisons among a variety of integrated assessment models with different strengths and representations of the energy-economy-climate system. A key objective of AMPERE is to generate a better understanding of the differences across models and the relation to historical trends. This also includes pointing out the uncertainties associated with relevant political and technical developments and climate system responses.

Methodology

AMPERE analyses mitigation pathways and associated mitigation costs through a series of multi-model intercomparisons. To ensure robust insights, AMPERE combines an ensemble of 19 internationally recognised energy economy and integrated assessment models – all with their own unique strengths and limitations. While model results may diverge due to different representations of economic and technological dynamics, model intercomparisons help to explain the underlying causes of model differences and their implications for policy assessments. The AMPERE study frameworks are designed to systematically explore these implications.

To enhance the robustness of the analyses, the AMPERE teams are developing and testing methodologies for model diagnostics and validation. These approaches discover new ground for the integrated assessment community and are inspired by best practices from other modelling communities.

The AMPERE work is based on close collaboration between teams from Europe, Asia and North America and is guided by a scientific advisory board of outside experts.

Expected results

The AMPERE project findings are expected to be useful for the preparation of post-2015 climate policy roadmaps with a long-term path toward climate stabilisation.

To put these findings on a solid basis, the project aims to provide improved explanations of model differences and robust insights taking into account:

1. the impact of the climate response to anthropogenic forcing on the remaining carbon budget;
2. the role of technology availability, innovation and myopia in the energy sector;
3. the role of regional fragmentation in international climate policy efforts;
4. the implications of decarbonisation scenarios and policies for Europe.

This information is intended for use by policy makers and stakeholders as well as by other scientific efforts evaluating climate policy scenarios through model intercomparisons.

A first round of AMPERE studies was completed in January 2013 and submitted for publication. Further studies will follow and the insights will be disseminated through publications and workshops.

Project partners	
Potsdam Institute for Climate Impact Research, DE	University of Stuttgart, DE
Int. Institute for Applied Systems Analysis, AT	Vienna University of Technology, AT
Utrecht University, NL	CPB Bureau for Economic Policy Analysis, NL
Fondazione Eni Enrico Mattei, IT	Université Paris I Pantheon-Sorbonne, FR
Institute of Communication & Computer Systems, EL	MetOffice Hadley Centre, UK
Centre for European Policy Studies, BE	Climate Analytics, DE
SMASH-CIRED, FR	Nat. Inst. for Environmental Studies, JP
Paul Scherrer Institute, CH	RITE, JP
Centre National de la Recherche Scientifique, FR	NDRC Energy Research Institute, CN
Enerdata, FR	Indian Institute of Management, IN
EU-JRC-IPTS, ES	External Partner: PNNL, US

ARANGE

At a glance
Title: Advanced multifunctional forest management in European mountain ranges
Instrument: Collaborative project
Total cost: 3 818 788 €
EC contribution: 2 991 077 €
Duration: 36 months
Start date: 01/02/2012
Consortium: 16 partners from 12 countries
Project coordinator: Universitaet fuer Bodenkultur Wien, AT
Project website: www.arange-project.eu
Key words: mountain forests, climate change, adaptation, mitigation, ecosystem services

The challenge

The sustainable provision of ecosystem services in and from mountain regions is of crucial importance to an array of stakeholders and society in general, going much beyond the interests of particular landowners in the mountain regions themselves.

Increasing pressure from biomass utilization as well as decreasing interest of new landowners jeopardize the provisioning of such ecosystem services. Mountain ecosystems can only continue to provide all these services in a rapidly changing world if a wide array of ecosystem services is considered in forest management from local to regional scales.

Project objectives

The overall aims of ARANGE are (1) to investigate the potentials and limitations of current and alternative approaches to mountain forest management for providing portfolios of ecosystem services under changing climatic and socio-economic conditions; (2) to identify related risks and uncertainties; and (3) to translate the scientific knowledge about the efficient provision of multiple ecosystem services from mountain forests into information supporting policy makers and forest practitioners.

ARANGE addresses four main ecosystem services: (1) timber production, (2) protection against gravitational natural hazards, (3) the role of forests in climate change mitigation via carbon sequestration as well as bioenergy production, and (4) nature conservation and the maintenance of biodiversity. Non-timber forest products, landscape aesthetics for recreation and the use of forested landscapes by game and livestock species will be addressed by the project in subsidiary.

Methodology

ARANGE research is carried out in seven mountain regions across Europe covering the most important mountain forest types within the main biomes and representing distinct biophysical and governance settings. Generic themes across all case study regions are (a) the identification of the relationships among ecosystem services along environmental gradients; (b) the analysis of policy and governance frameworks, (c) the identification of economically efficient management strategies for generic ecosystem service portfolios from landowner and public perspectives; and (c) the exploration of the sensitivity of current management concepts to climatic and socio-economic uncertainties. Major parts of the analysis will rely on state-of-the-art models and planning techniques. In each case study, specific multifunctional planning problems will be analyzed in close cooperation with regional stakeholders. To support interested stakeholders beyond the lifetime of ARANGE, a web-based decision support toolbox for multifunctional mountain forest management will also be developed by the project.

Expected results

ARANGE will achieve impact in several ways: (1) extending the scientific state of knowledge in the field of multi-functional mountain forest management under changing climatic and socio-economic conditions. This will include methodological progress in modeling and planning techniques as well as by specific applications of ARANGE methodology to case study specific problems;

(2) raising awareness in the case study regions via the stakeholder interaction process and via the demo applications;(3) specifically targeting forest resource managers, as they are key user group of ARANGE project results. In the case study areas guidelines synthesized from ARANGE analyses will be disseminated in forest management workshops with practitioners. Guidelines and related training materials will be disseminated via the Internet together with a set of software planning tools for mountain forest management in the ARANGE Decision Support Tool Box.

Project partners	
Universitaet fuer Bodenkultur Wien	AT
Eidgenössische Technische Hochschule Zürich	CH
Institute National de Recherche en Sc. et Techn. p. l'Environnement et l'Agriculture	FR
Technische Universitaet Muenchen	DE
Sveriges Lantbruksuniversitet	SE
Univerza v Ljubljani	SI
Narodne Lesnicke Centrum	SK
Institut za Gorata - BAN	BG
Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria	ES
European Forest Institute	FI
Universitaet Graz	AT
IFER - Ustav pro vyzkum lesnich ekosystemu, s.r.o.	CZ
Geoexpert Research and Planning GmbH	AT
Stichting Birdlife Europe	NL
Aranzada Gestion Forestal SLP	ES
Dr. Stephen Matthew Webb	AT

BASE

At a glance

Title: Bottom-up Climate Adaptation Strategies towards a Sustainable Europe

Instrument: Collaborative project

Total cost: 7 555 674 €

EC contribution: 5 899 442 €

Duration: 48 months

Start date: 01/10/2012

Consortium: 14 partners from 9 countries

Project coordinator: Aarhus University, DK

Project website: www.BASE-adapt.eu

Key words: Climate change, adaptation, cost-benefit, participation, case studies, health, water, cities, rural, ecosystem services, coastal

The challenge

The impacts of a changing climate are likely to disrupt ecological, social and economic systems, with some regions and sectors in Europe and globally likely to suffer greater adverse effects. New opportunities will also emerge. The EU is already impacted with an average increase in temperature of 1.3°C above the preindustrial level. With the recent measurement of a global atmospheric CO2 concentration greater than 400 ppm emphasizes the importance of adaptation as the challenge to stay within the 2°C scenario increases. A growing number of EU member states have developed National Adaptation Strategies and have completed vulnerability assessments, and in the spring of 2013 the EU launched its adaptation strategy amongst other to further stimulate this development. An important resource in implementing the strategy is the European one-stop-shop for climate change adaptation information, the Climate-ADAPT portal, to which BASE will provide research results and a series of replicate case studies of key sectors adaptation across Europe. BASE will thus support strategy development and to reduce the uncertainty in the cost-benefit analyses of adaptation by bridging the gap between top-down models and policies and bottom-up empirical data and implementation efficiency of the strategies and cost-benefit results.

Project objectives

The Bottom-up Climate Adaptation Strategies towards a Sustainable Europe project brings together some of the leading European research groups, with state-of-the-art climate change adaptation knowledge – together they will in BASE:

- Compile and analyse data and information on adaptation measures and their effectiveness. This includes analysis of social and economic benefits, the costs of adaptation for sectors. This knowledge and data will be made publicly available through dissemination tools such as Climate-ADAPT
- Improve current, develop new, and integrate methods and tools to assess climate impacts, vulnerability, risks and adaptation.
- Identify conflicts and synergies of adaptation policies at different levels of policy making with other policies (e.g. mitigation)
- Assess the effectiveness and full costs and benefits of adaptation strategies to be undertaken at local, regional, and national
- Bridge the gap between specific assessments of adaptation measures and top-down implementation of comprehensive and integrated strategies.
- Use and develop novel participatory and deliberative tools to enhance the effective use of local contextualised knowledge and the co-design by stakeholders
- Disseminate findings by sharing the results of the project with policy-makers, practitioners and other stakeholders

BASE is a truly interdisciplinary project, with representation from natural and social sciences. There is an emphasis on quantitative and more qualitative results and on how these can be translated to more quantitative models. By combining diverse expertise BASE will provide sustainable research and policy support in the area of adaptation to climate change. The structure enables BASE to both focus on the more top-down driven policy and economic analyses, but also on the ground-truthing of these in the case studies and thus provide valuable real world feed-back to the modelers and policy process. BASE is keenly aware of the urgent and more practical nature of the climate change adaptation.

Methodology

BASE will use replicate case studies which will be clustered and made comparable across countries in order to provide new empirical cost-benefit (e.g. via the PRIMATE model), policy integration, and participation data. The directly quantitative data will be used in modeling larger scale modeling (e.g. AD-WITCH), whereas more qualitative data will be analysed and presented e.g. by using adaptation pathways and storylines in integrated assessment modeling. The aim is to test and analyse ways of bridging the gap between top-down and bottom-up approaches in evaluating adaptation policies and measures. Promoting bottom-up processes is essential to ensure sustainable adaptation. BASE will also analyse the conditions for facilitating the adoption of comprehensive top-down strategies by citizens and stakeholders. These findings can guide the design of strategies and actions that have a greater chance of being effectively implemented.

Expected results

BASE will improve the knowledge base regarding the cost-benefit of adaptation, as well as provide replicated adaptation case-study insights. The comparative nature of the case studies will allow for a series of investigations determining adaptation success – e.g. contextual differences. This will allow for hypothesis testing e.g. regarding adaptation differences North/South, and East/West of EU. The replicated cases will also allow for better generalization of the cost-benefit assessments and outcomes, which can be used to refine larger scale integrated models. Many of the researchers in BASE are also members of the European Environment Agency (EEA) topic centre on adaptation. This group supports the EEA in implementing the portal Climate-ADAPT, and BASE will hence be in a beneficial position to support Climate-ADAPT and policy development. Lastly, the many case studies will be of direct benefit of the participants and stakeholders.

Project partners	
Aarhus University (DK)	CzechGlobe (CZ)
Ecologic Institute (DE)	University of Leeds (UK)
Lisbon University (PT)	Polytechnic University of Madrid (ES)
Centro Euro-Mediterraneo sui Cambiamenti Climatici (IT)	Danish Board of Technology (DK)
Helmholtz Zentrum fur Umweltforshung (DE)	
University of Exeter (UK)	
Stichting Deltares (NL)	
Basque Centre for Climate Change (ES)	
Finnish Environment Institute (FI)	
Institute for Environmental Protection and Research (IT)	

CC-TAME

At a glance
Title: Climate Change – Terrestrial Adaptation and Mitigation in Europe
Instrument: Collaborative project
Total cost: 4 487 340 €
EC contribution: 3 226 793 €
Duration: 36 months
Start date: 01/06/2008
Consortium: 14 partners from 8 countries
Project coordinator: International Institute for Applied System Analysis, AT
Project website: www.cctame.eu/
Key words: European Climate Change Programme, CAP, Rural Development Strategy, EU Forestry Strategy and Forest Action Plan, Land use efficiency, adaptation, mitigation, climate change, carbon sink, biomass/-fuel production, cross-benefit analysis, policy impact, biophysical and economic land-use modelling

The challenge

The CC-TAME project assessed the impacts of agricultural, climate, energy, forestry and other associated land-use policies, considering the resulting feed-backs on the climate system in the European Union. Geographically explicit biophysical models together with an integrated cluster of economic land-use models were coupled with a regional climate model to assess and identify mitigation and adaptation strategies for European land use systems.

Project objectives

CC-TAME's aim was to build a strong Science-Policy interface by delivering timely, relevant and understandable information from state-of-the-art policy impact assessments to the policy community. The scientific-technical objective was to carry out an assessment of the efficiency of current and future land use adaptation and mitigation processes.

The concept of CC-TAME was to model explicit land use on farm/forest management practice level taking into account the emerging technological changes in the land-use sector and its associated industries. A regional climate model was coupled with biophysical ecosystem models, which generated a vast variety of production possibility sets for each geographic unit. State of the art economic models, which are embedded in the theory of modern welfare economics, used the rich sets of geographic explicit biophysical production possibilities to generate globally consistent local mitigation and adaptation land use strategies.

Methodology

CC-TAME has built an operational cluster of models to carry out policy impact studies in the land-use sector under climate change. All biophysical CC-TAME models covering the forest and agricultural domain have been made consistent at global, European, and regional levels generating detailed model representation of a wide variety of management practices. Consistency has been established by building a large-scale model input data infrastructure and harmonized scenario generation protocols.

Cross-scale validation of GHG responses to management change for biophysical models has been performed. Model linkages have been tested and implemented to calculate reference scenarios, which are consistent across geographic scales, time and multiple sectors. An operational and consistent methodology to carry out policy assessments for the LULUCF sector has been prepared. Analysis of the economics of mitigation in the LULUCF sector has been tested the tools have been provided to interested parties in EU member states.

Emerging results

CC-TAME has implemented regional climate scenarios and has carried out a fully fledged mitigation and adaptation analysis with the focus on the co-benefits of mitigation and adaptation. The CC-TAME model cluster was employed to assess a wide range of environmental, agricultural, forest, and energy policy scenarios. We found that policies that aimed at enhancing or preserving carbon stocks as well as policies aimed at reducing non-CO2

GHG emissions from agriculture also scored high with respect to ecosystem adaptation to climate change.

CC-TAME has contributed tools, data and analysis to European policy making in the land use and land use change and forestry (LULUCF) sector. These tools were used to provide reference level information for reporting under the UNFCCC. Furthermore, CC-TAME tools were used to generate information entering the policy process on burden sharing for post-Kyoto climate policies in Europe and elsewhere.

Project partners	
INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE	AT
VYSKUMNY USTAV PODOZNALECTVA A OCHRANY PODY	SK
EUROPEAN CENTER FOR AGRICULTURAL, REGIONAL AND ENVIRONMENTAL POLICY RESEARCH, EUROCARE	DE
CENTRO DE INVESTIGACION ECOLOGICA YAPLICACIONES FORESTALES	ES
UNIVERZITA KOMENSKEHO V BRATISLAVE	SK
UNIVERSITAET HAMBURG	DE
THE UNIVERSITY COURT OF THE UNIVERSITY OF ABERDEEN	UK
JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH	AT
UNIVERSITAET FUER BODENKULTUR WIEN	AT
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	DE
DANMARKS TEKNISKE UNIVERSITET	DK
COMMISSION OF THE EUROPEAN COMMUNITIES – DIRECTORATE GENERAL JOINT RESEARCH CENTRE- EUROPEAN COMMISSION	BE
INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	FR
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE	UK

CECILIA2050

At a glance

Title: Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets

Instrument: Collaborative project

Total cost: 3 470 770 €

EC contribution: 2 797 381 €

Duration: 36 months

Start date: 01/09/2012

Consortium: 10 partners from 8 countries

Project coordinator: Ecologic institute, DE

Project website: www.cecilia2050.eu

Key words: Policy evaluation, effi-ciency, effectiveness, low-carbon economy, economic instruments, poli-cy mix

The challenge

Europe has embarked on a major endeavour: to transform itself into a low-carbon economy by mid-century. However, the mix of climate policy instruments already in existence will need to be scaled up drastically in order to initiate the neces-sary changes and meet the collective economic goals.

The existing EU climate policy framework, with the EU Emissions Trading System (EU ETS) as its cornerstone and a range of other EU-level and Member State-level policies, places the EU on track for achieving its "20-20-20" targets. However, there is as yet no policy framework to place the EU on the Commission's own suggested emissions trajectory for the longer term – that is, reaching 40% and 60% below 1990 levels by 2030 and 2040 respectively (EC 2011, "Roadmap for moving to a low-carbon economy in 2050", Roadmap for moving to a low-carbon economy in 2050, COM/2011/0112 final). There is an urgent need for an understanding of how the existing policy mix can be further developed and improved so as to ensure that these milestones can be met in the most efficient and feasible manner, on the way to the 2050 target of establishing a low-carbon economy with emission reductions of 80-95%.

The CECILIA2050 project investigates the perfor-mance and implementation of existing climate policy instruments and their interaction, and maps the development of further coordination among these instruments in Europe.

Project objectives

1. Connecting academic methods with real-life conditions: The team members work regu-larly on the border between policy and sci-ence, and understand both worlds.
2. Working across disciplines for relevant re-sults: By combining the fields of economics, law, political science and others, the project identifies solutions, as well as ways to im-plement them.
3. Radical realism: The project focuses on the radical change needed to meet the EU's long-term climate goals, but also maps pathways that depart from the current poli-cy mix.
4. Analysing combinations of policy instruments and their interaction: The project employs different disciplines to understand the constraints that limit the performance of policies, and derive options to tackle these.
5. Policy-relevant research results produced in a readable format: In addition to scientific publications, a series of CECILIA2050 Policy Briefs summarises key results for a wider audience.
6. Involvement of stakeholders in research: Political stakeholders, industry players, and civil society are involved through different channels.

Methodology

The project combines state of the art modelling tools with qualitative and participatory methods. To complement the EU-level analysis, the effects of EU climate policies are quantified at the global level.

The CECILIA2050 project combines backward-looking (ex-post) and forward-looking (ex-ante) analysis. The backward-looking part of the project takes stock of the existing instrument mix in the EU and its Member States, and assesses their coherence and past performance. The forward-looking part maps pathways toward a more ambi-tious policy mix for 2030 and 2050. CECILIA2050 describes and models how the instrumentation could evolve and how constraints and bottlenecks – such as infrastructure, access to finance, or dis-tributional impacts – can be addressed. To ensure policy relevance and mobilise practitioners' knowledge, the project engages with stakeholders in different ways: with workshops, online surveys, and through the guidance of a Science and Policy Advisory Board composed of specifically selected experts

Expected results

CECILIA2050 is expected to develop policy sce-narios for meeting the 2050 emission reduction objectives of the European Union.

These should suggest ways to improve the eco-nomic efficiency and environmental effectiveness of the instrument mix. The results will address constraints that limit the performance or feasibility of economic instruments. These include public acceptance, availability of finance, the physical infrastructure, and also the administrative and legal framework.

The outcome should be realistic, feasible and yet ambitious policy pathways for the evolution of the current instrument mix towards an "optimal" policy instrument mix. These should inform the political debate at the EU and the Member State level regarding the post-2020 EU climate policy framework, for targets and policies for the time horizon 2030. A formal consultation process on the issue was started by the European Commission in March 2013, with a view to tabling a proposal for discus-sion on the future framework to Heads of State and Government in 2014, and possible legislation to be discussed in 2014/5. The CECILIA 2050 out-puts should thus provide relevant and timely in-sights for use by decision-makers involved in this process.

Project partners	Country
Ecologic Institute	DE
Energy Institute, University College London	UK
LU-CML, Leiden University	NL
Charles University Environment Centre (CUNI)	CZ
Institute for Economic Structures Research (GWS)	DE
Institute for Environmental Studies, VU University Amsterdam	NL
Centre International de Recherche sur l'Environnement et le Développement	FR
Warsaw Ecological Economics Centre, University of Warsaw	PL
Basque Center for Climate Change (BC3)	ES
Università di ferrara	IT

CLIMAFRICA

At a glance
Title: Climate change predictions in Sub-Saharan Africa: impacts and adaptations
Instrument: Collaborative project
Total cost: 4 662 502 €
EC contribution: 3 496 231 €
Duration: 48 months
Start date: 01/10/10
Consortium: 18 partners from 17 countries
Project coordinator: Euro-Mediterranean Centre on Climate Change (CMCC), IT
Project website: www. climafrica.net
Key words: Sub-Saharan Africa, Climate Predictions, Climate Impacts, Adaptation, Agriculture and Water Resources, Socio-economic Analysis

The challenge

Africa is probably the most vulnerable continent to climate change and variability, because of the combination of its low adaptive capacity with particular eco-climatic and socio-economic conditions. Nevertheless it remains one of the regions less covered by climate change studies.

African population mostly depends on the rural sector, which relies in turn on rainfall patterns: any negative effect of climate on the water cycle and agriculture production significantly threatens its livelihood and economy.

The challenge is to deliver improved predictions of climate change and impacts in Sub-Saharan Africa on a temporal scale and spatial resolution effective for timely adaptation actions.

Project objectives

ClimAfrica aims at producing the most appropriate and up-to-date tools to better understand and predict climate change in Sub-Saharan Africa (SSA) for the next 10-20 years, analysing the expected impacts on water and agriculture and proposing adaptation strategies tailored to the African context. Specific objectives are: 1- Develop improved climate predictions for SSA on seasonal to decadal scale; 2- Assess climate impacts in key sectors of SSA livelihood and economy, like water resources and agriculture; 3- Evaluate the vulnerability of ecosystems and civil population to inter-annual variations and decadal trends in climate; 4- Suggest and analyse new adaptation strategies suited to SSA; 5- Develop a new concept of medium term monitoring and forecasting warning system for food security, risk management and civil protection; 6- Analyse the economic impacts of climate change on agriculture and water resources in SSA and the cost-effectiveness of potential adaptation measures.

Methodology

The activities are carried out through an integrated approach organized in eight complementary work-packages:

WP1: Effects of past climate variability on ecosystem productivity and water cycle

WP2: Modelling seasonal to decadal climate predictions

WP3: Analysing the climate impacts on water resources and agriculture production

WP4: Medium-term warning system, vulnerability, adaptation

WP5: Socio-economic implications of climate change impacts and adaptation measures in SSA

WP6: Field case studies in Africa

WP7 & WP8: Project Management & Dissemination.

Expected results

State of the art data streams of remotely sensed land surface properties, harmonized meteorological reanalysis, and synergistic land use products are already available; among them a 30+ year (1979-2010) record of global daily soil moisture database, with 0.25 degree spatial resolution.

ClimAfrica is already delivering improved climate predictions, ranging from 50 to 25km resolution, from the dynamical downscaling, and to point resolution, from statistical downscaling, for the specific field studies carried out in Burkina Faso, Congo, Ethiopia, Ghana, Kenya, Malawi, Sudan, Tanzania, and Togo. The resolution will be even higher for the impact models on water balance and main crop types, i.e. Sorghum, Maize, Millet, Rice, and Cassava. Other expected results are: new adaptation strategies suited to local needs; the assessment of economic implications of climate change impacts and adaptation options; a prototype of a medium term monitoring and forecasting warning system for food security, risk management and civil protection.

Project partners	
1 Euro-Mediterranean Center on Climate Change, CMCC	IT
2 Lunds Universitet	SE
3 Commissariat à l'Énergie Atomique, CEA	FR
4 Max Planck Gesellschaft zur Foerderung der Wissenschaften, MPG	DE
5 Vrije Universiteit Amsterdam, VUA	NL
6 Centre Tecnològic Forestal de Catalunya, CTFC	ES
7 Potsdam Institut für Klimafolgenforschung, PIK	DE
8 Centre de Coopération Internationale en Recherche Agronomique pour le Développement, CIRAD	FR
9 Food and Agriculture Organisation of the United Nations, FAO	IT
10 Stichting Onderzoek Wereldvoedselvoorziening van de Vrije Universiteit, SOW	NL
11 Centre de recherches sur la durabilité et la productivité des plantations industrielles, CRDPI	CG
12 University of Cape Town, UCT	ZA
13 University of Malawi	MW
14 Université de Lomé	TG
15 Agricultural Research Corporation, ARC	SD
16 IGAD Centre for Climate Prediction and Application, ICPAC	KE
17 Council for Scientific and Industrial Research, Crops Research Institute, CSIR-CRI	GH
18 Centre d'Étude de Recherche et de Production en Information pour l'Environnement et le Développement Durable, CERPINEDD	BF

CLIMATECOST

At a glance
Title: ClimateCost The Full Costs of Climate Change
Instrument: Collaborative project
Total cost: 4 607 408 €
EC contribution: 3 499 994 €
Duration: 32 months
Start date: 01/12/2008
Consortium: 22 partners from 14 countries
Project coordinator: Stockholm Environment Institute Oxford, UK
Project website: www.climatecost.cc
Key words: climate change economics, cost of inaction, mitigation costs, social cost of carbon

The challenge

There is increasing interest in the economics of climate change to:

- provide important information on the costs of inaction (the economic effects of climate change);
- assess the costs and benefits of adaptation;
- inform the policy debate on long-term targets and mitigation policies.

Although relatively detailed and comprehensive research has been carried out in these areas, there are many gaps in the assessment of the full costs of climate change.

Using detailed disaggregated, bottom-up approaches, and top-down aggregated analysis, this project advanced the knowledge across all of the three areas above.

Project objectives

The objectives were to advance knowledge across the areas outlined above, by:

- identifying and developing consistent climate and socio-economic scenarios, including for mitigation.
- quantifying the effects of climate change in Europe, in physical terms and economic costs (for coastal zones, health, energy, agriculture and infrastructure), and identifying the costs and benefits of adaptation.
- assessing the impacts and economic costs of major catastrophic and socially contingent events.
- updating the costs of mitigation, including (induced) technological change, non-CO2 GHG and sinks, and recent abatement technologies.
- quantifying and monetising the ancillary air-quality co-benefits of mitigation in Europe, China and India.
- developing a number of existing global level economic Integrated Assessment Models (IAMs).
- providing policy relevant output, including analysis of policy scenarios.

The project advanced multi-disciplinary research, developing integrated bottom-up and top-down analysis, and directly engaging policy makers to provide policy relevant outputs.

Methodology

The ClimateCost study used a consistent and harmonised set of climate and socio-economic scenarios and climate model outputs for Europe, and employed these in sectoral impact assessment models, to assess the impacts and economic costs of climate change and the costs and benefits of adaptation, at a sector level across the EU and at Member State level.

The study has also reviewed major climate discontinuities (tipping elements) and undertaken analysis of the impact and economic costs of major sea level rise.

It has updated and run a suite of mitigation models (POLES, GEM-E3, PACE), and quantified the ancillary air quality benefits (including monetary benefits) of mitigation in Europe. It has also updated and run a number of models that assess the costs and benefits of climate change policy, including computerised general equilibrium models and integrated assessment models (including PAGE, FUND, WITCH).

Finished results

The project provided a more complete, updated assessment of cost of mitigation, impacts and economic costs of climate change, and the costs and benefits of adaptation. The potential impact of the project has been primarily through the outputs and results (including a set of policy briefs), which are highly relevant for European Commission climate policy, as well as for Member States. Indeed, the results have already been included in policy discussion and deliberations.

The project has provided results on the future potential economic costs of climate change that are of high relevance to Commission Services and have been cited in the 2013 EU Strategy on adaptation to climate change (COM(2013) 216 final). This information, and analysis of the costs and benefits of adaptation, has been included in the European Climate Adaptation Platform (CLIMATE-ADAPT).

In addition, in relation to long-term targets and justification for mitigation, the study has provided final results and available models that are of high relevance for the Commission and others, in relation to the short and long-term GHG emission reduction targets and stabilisation. This includes information on the cost of inaction for Europe under future scenarios – and the economic co-benefits of mitigation for Europe – which were both included in the EC impact assessment for the Roadmap for moving to a competitive low carbon economy in 2050.

An updated suite of models that are used in European Commission mitigation cost and economic analyses (POLES, GEM-E3) has been produced, with new runs with these models. An updated suite of CGM and IAM models has been produced, for potential use in policy analysis, including the new PAGE09 model.

The results of the project also has provided valuable research inputs, as measured through the publication of many academic papers.

The project has produced a set of policy briefing notes that summarise sector results.

Project partners	
Stockholm Environment Institute, Oxford, UK	Universidad Politecnica de Madrid, ES
European Commission – JRC, ES	Paul Watkiss Associates, UK
Danish Meteorological Institute, DK	Economic and Social Research Institute, EI
Potsdam Institute for Climate Impact Research DE	London School of Hygiene & Tropical Medicine, UK
University of Southampton, UK	Zentrum für Europäische Wirtschaftsforschung, DE
Fondazione Eni Enrico Mattei, IT	University of the Aegean, EL
International Institute for Applied Systems Analysis, AT	University of East Anglia, UK
Metroeconomica, UK	Charles University Environment Center, CZ
Institute of Communication and Computer Systems, EL	Université de Grenoble-2, FR
Katholieke Universiteit Leuven- Center of Economic Studies, BE	The Energy and Resources Institute, IN
AEA Technology plc, UK	Energy Research Institute (ERI), CN

CLIMATEWATER

At a glance
Title: Bridging the gap between adaptation strategies of climate change impacts and European water policies
Instrument: Coordination and support action
Total cost: 1 171 003 €
EC contribution: 956 932 €
Duration: 36 months
Start date: 01/11/2008
Consortium: 11 partners from 8 countries
Project coordinator: VITUKI, HU
Project website: www.climatewater.org
Key words: impacts on water resources, adaptation strategies, EU water policies

The challenge

Scarcity and abundance of water are two of the major problems of Mankind. New scientific approaches are needed to handle the water-related climate change impacts and adaptation strategies. ClimateWater reviewed these new fields of the water-related sciences and attempted to bridge the existing gaps, the 'missing links' between scientific approaches and the tools offered by policy makers. The Project aimed at the development of new scenarios for adaptation measures to climate change, identifying their potential to alleviate climate change impacts and to build them into implementation of water policies.

Project objectives

ClimateWater's main objectives were to analyse and synthesise data and information on the likely (known, assumed, expected, modelled, forecasted, predicted, estimated) water-related impacts of changes in climate with special regard to their risk and to the urgency of preparation to combat these changes and their impacts. The Project identified adaptation strategies that are, and could be, developed in Europe (and also globally) for handling (preventing, eliminating, combating, mitigating) the impacts of global climate changes on water resources and aquatic ecosystems, including all other water-related issues of Society and Nature. Research needs in the field of climate impact on the water cycle and water users were identified. The most important output of the project was the identification of gaps that would hinder the implementation of the EU water policy in combating climate impacts on water.

Methodology

The Project has reviewed the water-related climate change impacts as they were identifiable by other relevant projects and international literature, both net-based and traditional. The Project also reviewed the needs of adaptation and damage mitigation strategies and measures over the entire range of water-related human activities. The strategies identified also consider how these demands can be satisfied by the water-related policies. International conventions, regulations and policies were also considered. Strong emphasis was laid on the research needs to identify science-policy gaps and also on that of water-sciences in general. The Project reviewed all European water-related policies, breaking down to tasks and topics according to main policy fields, with strong emphasis on identifying their ability and capacity of adaptation to climate change impacts and how these can be taken into account in the (re)formulation of current and future policies, thereby proposing recommendations and solutions to identified shortcomings.

Finished results

Climate change impacts on the hydrological cycle, water resources and the ecosystems are much larger than they were assumed when starting the project. Floods, drought and flash-flood induced non-point source pollution were the most dangerous impact categories. It was found that identified adaptation strategies and measures need to be upgraded and their implementation accelerated. A major gap identified is that water policies recommend only generalities to fight climate change and are much lagging behind the real water problems. The urgency of action is not realised. Among the identified research needs, 11 very important new or novel fields were considered and an Index of Impact Magnitude and Action Urgency (IMAU) was developed in two versions.

Ecohydrology was identified among research targets of high importance, as a general adaptation strategy. The final output is a list of recommendations to upgrade water-impact related EU policies; it includes a novel approach to WFD/RBMP, new strategies for flood control and for eliminating urban sewer outflow onto streets. Advice to improve model and planning tool oriented field measurements is given along with that for the improvement of legal tools to enable enforcement of strategies and measures in international river basins. The small letter amendments of existing conventions and agreements that allow escaping from obligations must be rectified. The upgrading of accidental pollution warning and forecasting systems with field measurements is also suggested as the hazard for accidents is dramatically increased. For bridging policy gaps in fighting climate-change induced water problems, the major general advice is to include actual measures and strategies and to give strict deadlines. To do so, appropriate financial resources should be allocated, nationally and Europe-wide. Available resources should be spent on urgent and known measures immediately. It is recommended to include the ecohydrological approach in the WFD to upgrade resilience and resistance of ecosystems and to control floods, drought and non-point source pollution. Most of the other policies could also benefit from this approach, especially those related to forestry, agriculture through the enhancement of land-use planning. There are policies, like the Drinking Water Directive, where certain basic modifications were recommended. It is also suggested to alter some concepts of the planning tools and models for River Basin Management Planning and Integrated Water Resources Management.

Project partners	
VITUKI Environmental and Water Research Institute	HU
University of Debrecen, Faculty of Engineering	HU
Water Research Institute of the National Research Council	IT
Institute of Environmental Systems Research, University of Osnabrück	DE
National Institute of Marine Geology and Geoecology	RO
Geonardo Environmental Technologies Ltd.	HU
University of Vienna, Faculty of Life Sciences	AT
University of Leicester, Department of Biology	UK
Slovak Hydrometeorological Institute	SK
SOGREAH Consultants	FR
Malta Resources Authority	MT

CLIMSAVE

At a glance

Title: Climate change integrated assessment methodology for cross-sectoral adaptation and vulnerability in Europe

Instrument: Collaborative project

Total cost: 4 157 841 €

EC contribution: 3 149 644 €

Duration: 46 months

Start date: 01/01/2010

Consortium: 18 partners from 13 countries

Project coordinator: Chancellor, Master and Scholars of the University of Oxford, UK

Project website: www.climsave.eu

Key words: climate change, impacts, adaptation, vulnerability, cross-sectoral

The challenge

There is widespread acceptance that the climate is changing due to human emissions of greenhouse gases. Such changes in climate will affect all sectors of society and the environment at all scales, ranging from the continental to the national and local. Decision-makers and other interested citizens need to be able to access reliable science-based information to help them respond to the risks of climate change impacts and assess opportunities for adaptation.

Project objectives

The overall aim of the CLIMSAVE project is to deliver an integrated methodology to assess cross-sectoral climate change impacts, adaptation and vulnerability. It will put science in the service of stakeholders and policy-makers by providing a common platform for an improved integrated assessment of climate change impacts, vulnerability and related cost-effective adaptation measures covering key sectors in Europe. There are six specific objectives:

- to analyse the policy and governance context for adaptation;
- to develop an Integrated Assessment Platform which includes linkages and feedbacks between key landscape sectors;
- to apply the Integrated Assessment Platform to assess climate change impacts on, and adaptation options for, ecosystem services;
- to integrate stakeholder input into climate change impacts and adaptation research through the development of participatory scenarios;
- to identify vulnerability hotspots through metrics of impacts and adaptive capacity; and
- to analyse the cost-effectiveness of adaptation strategies and investigate sources of uncertainty to inform appropriate policy options.

Methodology

CLIMSAVE is developing a user-friendly, interactive web-based tool that allows stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources and urban development. The linking of models for the different sectors enables stakeholders to see how their interactions could affect European landscape change. Outputs from the linked models are translated into ecosystem services (the benefits that people obtain from ecosystems) in order to link climate change impacts directly to human well-being. The tool also enables stakeholders to explore adaptation strategies for reducing climate change vulnerability, discovering where, when and under what circumstances such actions may help. It highlights the cost-effectiveness and cross-sectoral benefits and conflicts of different adaptation options and enables uncertainties to be investigated to better inform the development of robust policy responses.

Expected results

CLIMSAVE's integrated assessment approach will enable stakeholders to explore and understand the interactions between different sectors, rather than viewing their own area in isolation.

This contributes to the development of a well adapted Europe by building the capacity of decision-makers to understand cross-sectoral vulnerability to climate change and how it might be reduced by various adaptation options.

A number of CLIMSAVE outputs are already available from the project website (www.climsave.eu). These include reports on the stakeholder workshops, scenario development, adaptive capacity, vulnerability, adaptation policy and governance, and the specification of the Integrated Assessment Platform and the sectoral meta-models within it. The final output from CLIMSAVE will be the Integrated Assessment Platform which will allow stakeholders or interested citizens to analyse climate change impacts, vulnerability and adaptation options themselves. The Platform will be available from October 2013 from the CLIMSAVE website (www.climsave.eu) and the Climate-Adapt website (www.climate-adapt.eea.europa.eu).

Project partners	
Environmental Change Institute, University of Oxford	UK
TIAMASG Foundation	RO
Prospex bvba	BE
ESSRG Kft	HU
Department of Natural Resources , Cranfield University	UK
Centre for Ecological Research and Forestry Applications	ES
Center for Environmental Systems Research , University of Kassel	DE
Institute of Agrosystems and Bioclimatology, Mendel University in Brno	CZ
Department of Environmental Studies, University of the Aegean	EL
Rob Tinch (Independent researcher)	BE
Sustainable Environment Research Institute	AT
School of Geosciences, University of Edinburgh	UK
Department of Earth & Ecosystem Sciences, University of Lund	SE
Land Dynamics Group, Wageningen University	NL
School of Civil Engineering and the Environment, University of Southampton	UK
Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences	CN
Faculty of Science, Health & Education, University of the Sunshine Coast	AU
Centre for Strategic Economic Studies, Victoria University	AU

COMPLEX

At a glance

Title: Knowledge Based Climate Mitigation Systems for a Low Carbon Economy

Instrument: Collaborative project

Total cost: 6 982 677 €

EC contribution: 5 428 606 €

Duration: 48 months

Start date: 01/10/2012

Consortium: 17 partners from 11countries

Project coordinator: International Centre for Cultural and Historical Studies, Newcastle University, UK

Project website: www.complex2050.eu/home/

Key words: Energy, agriculture, forestry, environment

The challenge

The transition to a low carbon economy by 2050 will involve irreversible step-changes in the cultural, economic and natural domains, with qualitatively different socio-economic configurations before and after. By the time the low carbon economy has emerged, many vested interests and culture-clashes will have been resolved and socio-natural systems will have changed irreversibly. It is imperative that these transformations be managed in a way that maintains social cohesion, prosperity and good governance.

Project objectives

COMPLEX will develop new modeling techniques for exploring non-linear, i.e. step-change dynamics of socio-natural systems. This work will require an integration of the 'soft' (human) and the 'hard' (natural) approaches.

A suite of modelling tools and decision-support systems will be developed to inform national and supra-national policy and support communities across Europe working to make the transition to a low-carbon economy.

We will deal with real-world complexity, with stakeholder engagement and upscaling and downscaling problems. These differences in perspective become manifest as links with different stakeholder communities. Their task will be to fine-tune problem specifications to facilitate system flips and innovation cascades consistent with the shift to a low carbon economy.

Our vision is to create an interlinked modelling system, which operates at different geographical scales (supra-national, national and regional) and allows us to take full account of regional and national specificities related to technology, behaviour and ecosystem.

Methodology

Our approach is to mount two parallel types of research; one will be focussed on the realities of regional life, the impacts of mitigation policies and issues of receptivity and will pay particular attention to climate related technologies and carbon emission. The other will be focussed on economic and systems modelling. The level of integration between these two themes will develop as the project proceeds and each set of studies works to meet the other.

We will design a flexible system of integrated models and components that can be further modified and expanded to facilitate case studies. Each regional case-study will undertake an initial stakeholder engagement exercise and produce a case-study scoping statement. These scoping statements will feed into a process of 'model-stakeholder fusion.'

The integration platform will help stakeholders communicate their knowledge, conceptual and mental models towards a synchronized and shared vision of a climate mitigation policy.

Expected results

Improved accessibility and better integration of existing databases and approaches to produce important cost savings. Besides the representation of Economic, Energy, Climate and Ecological systems the modelling suite will allow policy measures to be prioritized according to the probability of critical climatic events and the likelihood of their acceptance to be evaluated.

Reduction of the costs that could result from the penetration of various low carbon technologies as well as from behavioural change in energy markets.

Development of knowledge-based mitigation policy options designed to de-couple economic growth from resource consumption and environmental degradation.

Build confidence in mitigation strategies by a better representation of economic, energy, climate and biota in modelling systems.

Project partners	
BC3 Basque Centre for Climate Change	ES
CNRS National Centre for Scientific Research	FR
EDF Energy	FR
IRSTEA National Research Institute of Science and Technology for Environment and Agriculture	FR
IIASA International Institute for Applied Systems	AT
MPG Max Planck Institute for Meteorology	DE
TNO Dutch Organisation for Applied Scientific Research	NL
OCT Observatory for a Culture of the Territory	ES
NIERSC Scientific Foundation Nansen International Environmental and Remote Sensing Centre	RU
SIGTUNA Foundation	SE
SINTEF Energy Research	NO
Stockholm University	SE
SLU Swedish Agricultural University	SE
University of Padova	IT
University of Newcastle	UK
University of Sussex	UK
University of TWENTE	NL

ECLISE

At a glance

Title: Enabling Climate Information Services for Europe
Instrument: Collaborative project
Total cost: 4 477 194 €
EC contribution: 3 408 670 €
Duration: 36 months
Start date: 01/02/2011
Consortium: 13 partners from 8 countries
Project coordinator: KNMI, NL
Project website: www.eclise-project.org
Key words: European climate services, climate change, climate impact, energy, climate adaptation, coasts, users, cities, water, data, rain, wind, drought, solar power, hydropower, climate models, environment, flooding

The challenge

Climate and climate change has high impact on society. Better understanding and improved prediction skills of future weather and climate is vital to protect lives, goods and infrastructures. Different sectors of society and infrastructure are more or less designed to accommodate the current level of climate variability. The prospect of a changing climate necessitates adapting these designs. To prevent high costs, it is of paramount importance that the most reliable and accurate climate information is used to underpin the development of new adaptation strategies.

Project objectives

To provide a European perspective to the functionality of climate services and the entrainment of national services into a broader European approach.

To take a first step towards the realisation of a European Climate Service, addressing climate information needs of the EU and its Member States.

To capitalize on previous research projects and bring together European climate research expertise and the needs of public and private organizations on future climate information.

To further develop local climate services in four areas, Coasts, Cities, Water and Energy, and to make concrete demonstrations of the utility of these services in support of local climate adaptation policies.

To provide an outline and proof of concept for future European-wide Climate Services.

Methodology

To meet the objectives of ECLISE at the local and European scale, the project is divided into four thematic work packages (coasts, cities, water and energy) including various local user cases, and three cross-cutting work packages covering project-wide and European-wide tasks.

The many (26) use cases defined in ECLISE serve the 'learning-by-doing' approach of the project. The project aims to learn from the different use cases in the project whether there are similarities in the needs of local users for climate services within Europe and whether generic solutions can be found that address these needs. This is done by involving the users, study their needs and develop the services. Policy makers and stakeholders will be engaged with the findings of ECLISE by collaboration with the project team and the users during a synthesis workshop, which is aimed at communication and discussing of the findings of ECLISE to stakeholders and policy makers on climate adaptation.

Expected results

ECLISE will result in a wide overview of the development of a range of climate services across sectors and regions in Europe. The use cases will reveal a variety of usage of climate model runs, of multi-model ensembles, of different statistical downscaling techniques, of model calibration, and processing of model results to usable information for the users. The use cases will show the results of various ways to interact with local users and with advanced and experienced users.

The use cases will have generated valuable data sets such as maps of sea-state and sea-level, precipitation and temperature for Italy, Crete, Romania, the Baltic sea, the cities of Rotterdam, Oslo, Bergen and Stockholm.

The socio-economic impact of these results will be an increased ability to reduce vulnerabilities to climate change for the regions, cities and sectors involved.

The climate service will support decisions on flood defence, on water management, on urban and coastal planning, on energy generation and energy usage. These climate adaptation measures generally involve large costs, thus weighting the economic importance of high-quality climate services. On the other hand, no or erroneous climate information may lead to inadequate planning and avoidable damages that are often very costly in terms of property or human lives lost.

The final result of ECLISE is the outline of a pan-European climate service. This would alleviate current problems in cross-border jumps in data due to different approached or base data used by different countries. Also, countries with less-developed climate services may profit from more advanced services, thus increasing the overall ability of the European services.

Project partners	
Royal Netherlands Meteorological Institute	NL
Swedish Meteorological and Hydrological Institute	SE
Helmholtz-Zentrum Geesthacht – Centre for Materials and Coastal research	DE
Wageningen University & Research Centre	NL
Institute of Atmospheric Sciences and Climate – Italian National Research Council	IT
Uni Research AS	NO
Norwegian Meteorological Institute	NO
Institute of Geography – Romanian Academy	RO
Technical University of Crete	EL
University of Newcastle Upon Tyne	UK
National Institute of Hydrology and Water Management	RO

ECOADAPT

At a glance

Title: Ecosystem-based strategies and innovations in water governance networks for adaptation to climate change in Latin American Landscapes

Instrument:

Total cost: 2 411 021 €

EC contribution: 1 899 000 €

Duration: 48 months

Start date: 15/01/2015

Consortium: 4 CSOs and 1 RTD in Latin America and 1 CSO and 3 RTDs in Europe.

Project coordinator: CIRAD, FR

Project website: www.ecoadapt.eu

Key words: ecosystem-based adaptation; climate change; network governance; watershed and landscape planning for water resources.

The challenge

International debates on climate change have been arguing the need to foster adaptation planning in Latin America where impacts are expected to be significant given the vulnerable socio-economic context. However, evidence shows that little progress has been made so far both at national and at community level due to the complexity of adaptation planning in these countries. These difficulties are due to factors such as poor integration of local knowledge, the complexity of multi-actors contexts, little experience in interdisciplinary approaches, little experience in managing environmental dynamics characterized by deep uncertainties, potential tensions in cross-scale interactions among scientists, policy makers and local communities among others.

Project objectives

The main goal of EcoAdapt is to improve, through action-research, adaptive capacity to climate change of at least 3 territorial platforms ("model forests") that are dependent on ecosystems' hydrological services. The science and technology objectives are twofold: 1) to understand the key factors for sustainable adaptation and develop solutions that address the main challenges that communities face in developing their adaptation strategy, i.e. the capacity of stakeholders to network and "scale" their practice, and the capacity to collectively define adaptation strategies; 2) develop socially relevant "discussion-support" participatory processes, models and tools for developing adaptation strategies. The operational objective will be to improve the capacity of CSOs and scientists to unfold participatory scenario-analysis processes with communities. A specific objective is thus to produce locally-owned innovations and strategies that will be implemented in participating communities and will eventually spread to other communities with similar issues.

Methodology

The main of hypothesis of EcoAdapt is that adaptation to climate change goes way beyond coping and is not something that can be done in isolation by any player at any organization level (i.e. focus on collective action). In addition we consider that ecosystem-based management provides a robust basis for successful adaptation to climate change especially in Latin America which is strongly-dependent on its natural resources. Knowledge-sharing forms the backbone of the project by the valorization and integration of different sources of knowledge to promote a common understanding of the problem context as well as its solutions. We rely on a hybrid form of participatory scenario analysis that combines Story and Simulation, structured decision making and social validation via socio-technical forums. This deliberative approach helps us in supporting the elaboration of socially and technically robust adaptation strategies and socio-technical innovations that will help improve environmental governance and prevent water-related conflicts.

Expected results

Project partners and allies are engaged in a knowledge sharing culture based on critical thinking and self-evaluation. This allows them to address the research and development questions in a way that puts equal weight in local and scientific knowledge. Moreover, the project's RTDs, CSOs and their partners, local universities and RIOCC have a shared understanding of the context of the intervention in each project site. They have the necessary data and information to support this understanding. Along with a shared understanding of problems there will also be a co-creation of jointly-produced and socially and technically robust exploratory scenarios where also RTDs learn how to adapt their methods and tools to local issues and contexts and test their hypotheses.

CSOs and their partners improve their capacity to adapt to the impacts of climate change to ecosystem's hydrological services by developing strategies and innovations involving actors of different governance levels working at different geographical scales.

Finally, stakeholders and policymakers in the countries of intervention are aware of the main project results, CSOs and RTDs fully understand key project lessons, national and regional policy-makers have a much better grasp of local issues and solutions and integrate this knowledge in renewed policies.

Project partners	
French Agricultural Research Centre for International Development, FR	Fundación Internacional para la Promoción del Desarrollo Sustentable Futuro Latinoamericano, EC
Tropical Agriculture Higher Education and research Centre, CR	Asociación Civil Bosque Modelo Jujuy, AR
Stockholm Environment Institute, Oxford-UK	Fundación para la Conservación del Bosque Seco Chiquitano, BO
International Union of Forestry Research Organization, Wien, AT	Servicio Evangélico para el Desarrollo, CL

ENCI-LOWCARB

At a glance

Title: European Network engaging Civil society in Low Carbon scenarios
Instrument: Coordination and support action
Total cost: 790 819 €
EC contribution: 717 979 €
Duration: 36 months
Start date: 01/04/2009
Consortium: 5 partners from 3 countries
Project coordinator: Meike Fink – Climate&Energy Campaigner-Réseau Action Climat, FR
Project website: www.lowcarbon-societies.eu
Key words: European network, Low carbon scenarios, Civil society, Research, reports, Policies and measures, social acceptability, seminars

The challenge

Due to the upcoming impacts of climate change there is a great need for energy transition. In recent years an increasing number of energy scenarios have been published. These scenarios are influential tools in political decision-making processes particularly because they focus on the long-term impacts of today's investment decisions, especially regarding infrastructures. Many of them are based on public or stakeholders' consultations. However, most of them don't emphasize the importance of the scenario design process, nor are they carried out in a transparent way showing how contributions are integrated into modelling tools.

Project objectives

ENCI LowCARB addressed this lack of transparency by developing and applying a methodology that can be easily reproduced for a more transparent integration of stakeholders' contributions into the collaborative scenario creation process. Engaging stakeholders in the process encourages the transition of today's highly carbonised society to a climate friendly one. The aim of the project was to engage civil society in research on low carbon scenarios in order to create a European network composed of Civil Society Organisations (CSOs) and research institutes. This network was set up to encourage a lively exchange of opinions and views on existing energy scenarios, and to raise awareness about the importance of collaborative scenario creation processes. Another objective of ENCI LowCARB was the development and the fine tuning of hybrid modelling-tools that can represent technical sector details and simultaneously the interplay with an economic system. The final objective of ENCI LowCARB was the elaboration of reliable mitigation scenarios for France and Germany.

Methodology

The core idea of this project was to develop a methodology for the transparent integration of stakeholders contributions in the scenario creation process in order to enhance the stakeholder acceptance of the resulting low carbon pathways. By adding this element an important step was made from showing what is technically and economically possible to what is socially accepted.

Many energy scenarios are based on public or stakeholders consultations. However, few attribute importance to the scenario design process and explain in a transparent way how contributions are taken into account and integrated in a modelling tool. The project ENCI-LowCarb aimed at exploring this scientific gap.

The innovation of the project resides in the scenario creation process itself. The stakeholder's involvement in the modelling process was essential in elaborating the ENCI-LowCARB scenarios. This approach allowed the integration in scenario modelling of social acceptance of mitigation options as an additional element for effective policy making The methodology for collaborative scenario creation processes that was developed and applied during this project is replicable and could serve as a possible blueprint for the development of scenarios that are open to stakeholder participation (such as official multi-stakeholder scenario creation processes coordinated by the government, regional scenario development processes led by local authorities, or even EU-wide scenario developments like the EU energy roadmap).

Finished results

The main outcomes of ENCI-LowCARB are the following:

- Developing and refining innovative hybrid modeling tools Remind-D and Imaclim-R that represent explicitly monetary values and physical quantities so as to capture the specific role of the different energy sectors and their interaction with the rest of the economy.
- Establishing a cooperative relationship between CSOs and researchers to build energy scenarios together despite diverging cultural approaches. A reproducible methodology for collaborative scenario creation processes was developed.
- Collaboratively creating energy mitigation scenarios for Germany and France and ensuring a sense of ownership for these scenarios among the participating stakeholders.

In addition, the project established a cooperative relationship between CSOs and researchers by creating the "Low Carbon Societies Network", a European network on low carbon scenarios which continues also after the Project's end.

The ENCI-LowCARB greenhouse gas emission reduction scenarios for Germany and France allowed evaluating different panels of policies and their economic impacts on sectoral activity, on employment and on prices of goods. The assumptions (technical and economic) of the scenarios were defined exclusively by national stakeholders (trade unions, consumer associations, private companies etc.) who were invited to thematic workshops (residential, transport, electricity).

The results of these models provide interesting insights for policy making. For instance, the French model reveals that if only those measures that are judged acceptable by the consulted stakeholders are implemented a 68% CO2 emission reduction compared to 1990 can be achieved, which is less than the French climate objective (75% of greenhouse gas emissions in 2050).

The results of ENCI-LowCARB provide a new vision for supporting the transition to a climate friendly economy by putting the society at the centre of the analysis.

Project partners	
Réseau Action Climat (RAC)	FR
Germanwatch	DE
INFORSE-Europe	DK
Centre International de Recherche sur l'Environnement et le Développement (CIRED)	FR
Postdam Institute for Climate Impact Research	DE

ENTRACTE

At a glance
Title: Assessment and further development of the European climate policy
Instrument: Collaborative project
Total cost: 3 742 706 €
EC contribution: 2 935 276 €
Duration: 36 months
Start date: 01/09/2012
Consortium: 9 partners from 6 countries
Project coordinator: Centre for European Economic Research (ZEW)
Project website: www.entracte-project.eu
Key words: Environment, Energy, Economics, climate Policy, Policy Interactions.

The challenge

Climate policy-making in today's world is complex. Transaction and enforcement costs affect the effectiveness and efficiency of policy instruments. Related policy fields, such as energy policy, may influence the performance of climate policy instruments, while path dependency could lead to a lock-in on carbon intensive technological paths and hinder the penetration of low carbon technologies.

All these considerations highlight the need for carefully considered policy design that has to take into account existing market failures, suboptimal outcomes of international agreements, the necessity to secure competitiveness and reduce carbon leakage as well as its interaction with other political goals.

Project objectives

The overarching objective of the ENTRACTE research project is to assess, understand, and model the EUs current, as well as future, climate policy portfolios in light of the key interdependencies between policy instruments and thereby identify the optimal mix of policies needed to achieve legislated (i.e. 2020) and aspirational (i.e. 2050) targets of GHG emission reductions.

More specifically, the ENTRACTE project has four goals:

- to coherently assess the most important climate policy instruments with the full range of economic research methods.
- to gain a deeper understanding of the interactions between multiple climate policy instruments.
- to provide an analysis that takes into account the barriers to the implementation of climate policy instruments.
- to identify mixes of climate policy instruments that provide an effective, efficient, and feasible overall climate policy.

Methodology

ENTRACTE integrates empirical findings from ex-post assessments using broad sets of empirical data as well as ex-ante analyses with simulation models and experimental approaches with theoretical findings in order to optimize the policy mix. ENTRACTE draws on large set of economic methods and exploits their respective strengths.

The strength of econometrics lies in the analysis of impacts of current policies in real world markets and their imperfections. Conversely, experimental analysis is particularly helpful to establish the comparability of policy choices. Moreover, economic theory highlights the incentives that policy instruments create, and numerical simulations allow assessing in a comprehensive manner the economic impacts of policy instruments not yet implemented.

By adopting a project-wide harmonization of assumptions and scenarios about the current and future policy environment, ENTRACTE allows to pursue an integrated approach and to arrive at a synthesis of research results which identifies strengths and weaknesses of different instrument mixes.

Expected results

ENTRACTE analyses the EU ETS and other policy instruments such as energy efficiency standards, renewable policies, carbon taxes, innovation policies, and trade measures and as well as their interactions and takes existing barriers to implementation of policies into account. The analysis is based on an integrative approach and targeted towards policy recommendations on an effective, efficient and feasible climate policy mix.

ENTRACTE makes a major step in providing practically applicable recommendations for policy makers on how to design the environmentally effective, economically efficient and politically and legally feasible climate policy mix needed to achieve medium-term and long-term GHG reduction targets in Europe.

Project partners	Country Code
Centre for European Economic Research (ZEW)	DE
Potsdam Institute for Climate Impact Research (PIK)	DE
Fondazione eni Enrico Mattei (FEEM)	IT
London School of Economics and Political Science (LSE)	UK
Imperial College of Science, Technology and Medicine (Imperial)	UK
Tilburg University (TSC)	NL
CREE, Frisch Centre (FCO)	NO
AP EnvEcon Limited	IR
European Research and Project Office GmbH	DE

EUTRACE

At a glance
Title: EuTRACE – A European Transdisciplinary Assessment of Climate Engineering
Instrument: Coordination and support action
Total cost: 1 360 000 €
EC contribution: 999 960 €
Duration: 28 months
Start date: 01/06/2012
Consortium: 14 partners from 5 countries
Project coordinator: IASS – Institute for Advanced Sustainability Studies e.V., Potsdam, DE
Project website: www.eutrace.org
Key words: Climate Engineering, Risk & Uncertainties, Governance and Regulation of Climate Engineering

The challenge

Climate Engineering (CE) is rapidly gaining scientific, political, commercial, and public attention as a possible counterpart in climate change mitigation. A distinct European perspective, particularly with regard to the EU and how CE relates to its ambitious climate targets, is still missing. The project "European Trans-disciplinary Assessment of Climate Engineering" (EuTRACE) has been formed to fill this gap.

Project objectives

- A transdisciplinary assessment of CE
- to engage in dialogue with the public, policy makers and other civil society stakeholders to adequately address concerns and perspectives and to incorporate them in the assessment;
- to outline policy options and pathways for the EU and the challenges CE poses;
- to identify the most important gaps in current understanding of climate engineering.

Methodology

Literature review, argument maps, public debates, case studies, workshops

Expected Results:

A final assessment with an Executive Summary and Policy Recommendations in 22 European languages.

Project partners	Country
IASS–Institute for Advanced Sustainability Studies e.V., Potsdam	DE
Adelphi	DE
Center for International Climate and Environmental Research (CICERO),	NO
Karlsruher Institut für Technologie	DE
Kiel Earth Institute	DE
Klima Campus Hamburg	DE
Laboratoire de Météorologie Dynamique, IPSL / CNRS (CNRS-LMD)	FR
Norwegian Meteorological Institute (MetNo)	NO
Univ. Bristol	UK
Univ. East Anglia	UK
Univ. Edinburgh	UK
Univ. Exeter	UK
Univ. Graz	AT
Univ. Oslo	NO

FUTURESOC

At a glance
Title: Forecasting Societies'Adaptive Capacities to Climate Change
Funding scheme: ERC Advanced Grant
ERC funding: 2 438 405 €
Duration: 60 months
Start date: 01/03/2009
Host institution: International Institute for Applied Systems Analysis (IIASA), AT
Principal investigator: Wolfgang Lutz
Project website: www.iiasa.ac.at/web/home/research/researchProjects/FutureSoc/FutureSoc.en.html
Key words: Future population, human capital, multi-dimensional demographic methods, differential vulnerability to climate change, investments in education

The challenge

When trying to understand how dangerous climate change will be to human well-being in the future then frequently the mistake is made to relate the forecasted climate conditions for e.g. 2060 to the societal conditions and adaptive capabilities of today. This makes little sense since we know that societies will be different in the future. When looking back in most societies such capabilities were very different in the 1960s as compared to today and we have reason to assume that they will be also very different in 2060. The challenge thus is to find a meaningful scientific model that can help build scenarios of long term changes in societal capabilities to deal with changing climatic conditions.

Project objectives

The project has essentially two key objectives:

- To empirically study to what extent educational attainment of individuals as well as the average education in a society are protecting factors in vulnerability to natural disasters and other climate change related risk. It focuses primarily on the risks of premature death and serious health impairments.
- To produce the first comprehensive science-based global population projections by age, sex and level of educational attainment for all countries in the world up to 2100 in the form of alternative scenarios. Assuming a strong link between human capital and adaptive capacity, these scenarios could help to get an analytical handle for matching future climate conditions and future societal capabilities for countries at comparable points in time.

Methodology

For assessing the relative importance of education in reducing vulnerability as compared to income/wealth and other possible factors, multi-variate statistical analyses are being carried out at the level of global time series data as well as national level data sets on disaster victims. This is being complemented by in-depth case studies in different parts of the world.

For forecasting future human capital trends for all countries multi-dimensional demographic projection methods offer a powerful analytical tool for producing forecasts for several decades into the future due to the great inertia of population changes which is a consequence of human life expectancy being 65-85 years in most countries. In short: if we know how many uneducated 15-year olds there are today, we have a basis for projecting how many uneducated 65-year olds there will be in 2060, adjusting for differential mortality and migration. Assumptions on future fertility, mortality and migration are being defined on the basis of a global expert inquiry with over 500 participants.

Expected results

From all the empirical studies at local, national and global level we found convincing empirical evidence that indeed the level of educational attainment of women (even more than men) is a key factor in reducing vulnerability to natural disasters even after controlling for many other factors. Actually, in most cases education turns out to be clearly more important than income/wealth, which conventionally has been considered the key determinant because education had not yet been included in the models. This finding has important policy implications in giving priority to programs of universal basic education for women as a strategy to enhance adaptive capacity in the least developed countries.

The new population scenarios by age, sex and level of education have recently been chosen as the "human core" of the new set of SSPs (Shared Socioeconomic Pathways) that will be a common point of reference for modeling groups in the field of Integrated Assessment (IA) as well as Vulnerability, Risk and Adaptation (VRA) around the world.

GHG-TRANSPORD

At a glance
Title: Reducing greenhouse-gas emissions of transport beyond 2020: linking R&D, transport policies and reduction targets
Instrument:: Coordination and support action
Total cost: 1 416 464 €
EC contribution: 940 675 €
Duration: 27 months
Start date: 01/10/2009
Consortium: 5 partners from 5 countries
Project coordinator: Fraunhofer Institute for Systems and Innovation Research (ISI), DE
Project website: www.ghg-transpord.eu/
Key words: Greenhouse gas mitigation, transport, GHG reduction targets, R&D strategy, policy strategy, all modes, time horizons 2020 and 2050

The challenge

Transport currently contributes about 27% of the total EU greenhouse gas (GHG) emissions. In a trend scenario this share is expected to grow due to continued strong growth of transport demand, in particular of freight transport and air passenger transport, and slower efficiency improvements than for other GHG emitting sectors.

Given the overall EU GHG reduction targets of 20% until 2020 compared with the emission levels of 1990 and of -80% until 2050 (even -95% is debated), it is obvious that in the future (1) the transport sector will have to contribute to GHG emission reductions such that (2) reduction targets for the different transport modes have to be anticipated and (3) aligned research strategies and transport policies have to be developed to efficiently and effectively meet these reduction targets for the medium to long-term.

Project objectives

The GHG-TransPoRD project aimed at developing an integrated European transport sector strategy that links R&D efforts with other transport policies and technological measures to achieve substantial greenhouse gas emission reductions in the transport sector. The achieved reductions should be in line with the overall greenhouse gas reduction targets of the EU. As part of this strategy, the project proposed GHG reduction targets for transport as a whole as well as for each transport mode for 2020 and 2050.

Methodology

GHG-TransPoRD has undertaken six steps to develop the R&D strategy and the reduction targets:

- analysis of R&D efforts of all transport modes.
- analysis of innovation system and diffusion of innovations in transport sector.
- scoping of measures for GHG reductions generating a long list of measures.
- estimating potentials of GHG reductions of measures and creating a short list of promising measures.
- assessing the cost development of each single GHG reduction measure by a stand-alone approach.
- integrating measures into policy packages for which an integrated assessment of R&D strategies and policy strategies was performed by the four models: ASTRA, POLES, TREMOVE, MARS.

The results were quantified scenarios that integrate transport-energy-economy variables enabling to estimate GHG reductions of transport.

Finished results

Our innovation system analysis found that EU-based transport-related companies are the largest R&D investors of the European society. In 2008 their research effort amounted to 40 bn €. Significant parts of their R&D investments are already dedicated to the reduction of GHG emissions throughout all modes.

The most important conclusion to draw from the model-based analysis is that the transport sector target of at least 60% GHG emission reduction by 2050 compared with 1990 can be achieved.

Of course, this target is ambitious such that most of the scenarios and policy packages tested by GHG-TransPoRD failed to deliver the required reductions.However, the scenario analysis concluded that scenarios combining, fast development of efficiency technology, alternative engine technologies able to build their energy supply on renewable electricity, ambitious policy-making to counterbalance rebound effects and maintain financial stability of government transport revenues, ambitious regulation phasing out fossil fuel cars around 2035 together with a moderate modal-shift from road towards more energy efficient modes and adaptation of the electricity system to become largely renewable based will enable to achieve the GHG targets.

The following table shows the reductions that can be achieved until 2020, 2030 and 2050. The upper part displays the reductions against 2010 for each mode. The lower part puts these reductions in relation to 1990, the base year of climate policy-making.

		2020	2030	2050
Road	Passenger	-20% to -30%	-40% to -55%	-70% to -85%
	Freight	-10% to -20%	-30% to -45%	-40% to -60%
Air		0% to -5%	-10% to -20%	-40% to -55%
Ship		(+15% to 0%)	(+30% to 0%)	(+50% to -20%)
Rail		+10% to -10%	0% to -20%	-10% to -35%
Transport	(excl. ship)	-10% to -20%	-40% to -50%	-70% to -90%
		EU27 target against 1990		
Transport	**vs. 1990**	**+10% to +5%**	**-20% to -30%**	**-60% to -70%**

Source: GHG-TransPoRD

Project partners	Country
Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe Research (ISI),	DE
Trasporti e Territorio SRL (TRT), Milan	IT
Institute for Prospective Technological Studies, European Commission – DG-JRC, Seville European Commission – DG-JRC, Seville,	ES
Transport & Mobility Leuven (TML)	BE
Institute for Transport Studies (ITS), University of Leeds	UK

At a glance
Title: COMBATING CLIMATE CHANGE: Political economy of Green Paradoxes
Funding scheme: ERC Advanced Grant
ERC funding: 3 000 000 €
Duration: 60 months
Start date: 01/05/2011
Host institution: VU University Amsterdam, The Netherlands
Principal investigator: Cees Withagen
Project website: personal.vu.nl/c.a.a.m.withagen/default.html
Key words: green paradox, backstops, fossil fuel, climate change

The challenge

Reducing the use of fossil fuels in order to reduce greenhouse gas emissions is one important option to mitigate climate change. Imposing a global carbon tax reflecting the marginal damage of emissions is difficult to implement in practice. The question is whether other policy measures directed at the demand side of energy, such as subsidies on renewables, might present a viable alternative.

Project objectives

The danger of concentrating on demand side oriented policies is that the supply side of fossil fuels is neglected. Theory of non-renewable resource use tells us that such resources should be considered as capital goods, earning a rate of return. An implication of this insight is that backstop subsidies might lead to faster instead of slower extraction of these resources. This phenomenon is coined Green Paradox. The project's objective is to gain insight in the conditions under which this phenomenon occurs and how it can be tackled.

Methodology

We use dynamic economic models a different levels of aggregation. In first instance, we study models of the global economy in order to determine the optimal global carbon tax, and to see how, in the absence of such a tax, a second-best policy can be developed. In the next stage we consider models of trading economies and see how the behavior of individual countries/regions affect to design of climate policy. In a third stage we allow the countries to interact in a strategic way. For example, oil exporting countries might act as monopolists, and oil importing countries might tax oil use, for strategic reasons. We are also interested in the effect of political economy motives that might play a role in decision making. Last but not least, we try to calibrate the models used, in order to come up with policy recommendations.

Expected results

Results obtained so far indicate that a crucial element in the debate on Green Paradoxes is whether extraction costs of fossil fuel are stock dependent. We have also found that backstop subsidies might be effective in reducing the use of abundant resources such as coal. Moreover, the stage of development of economies determines to a large degree whether Green Paradoxes are detrimental to welfare or not. In the general equilibrium models of open economies, the rate of return on capital, a crucial variable in resource economics, is endogenous. This has a mitigating effect on the Green Paradoxes. Simulations based on real world data have led to insights into the optimal world-wide carbon tax, depending on the modelling of climate change damages.

HIGHNOON

At a glance
Title: Adaptation to Changing Water Resources Availability in Northern India with respect to Himalayan Glacier Retreat and Changing Monsoon Pattern
Instrument: Collaborative project
Total cost: € 4 292 841
EC contribution: € 3 311 751
Duration: 36 months
Start date: 01/05/2009
Consortium: 9 partners from 6 countries
Project coordinator: Dr. Eddy Moors, Alterra, Wageningen UR, NL
Project website: www.eu-highnoon.org
Key words: Himalaya, glaciers retreat, India, summer monsoon, Ganges, rainfall distribution, water resources, extreme events, adaptation strategies, agricultural economy, socio-economic development, science-policy interface

The challenge

Millions of people in Northern-India depend on water resources derived both from melting snow and ice in Himalayan headwaters and from monsoon rainfall over most of the basin area. Retreating glaciers, changing monsoon patterns, and declining groundwater levels coupled with increasing population, enhanced demand for irrigation water, developing industrialization, and demand for hydropower are likely to place water resources under considerable stress as the 21st century unfolds. The urgency of these threats was recognized in 2007, when impact of climate change on water resources was identified as one of the important areas for EU–India research collaboration.

Project objectives

The HighNoon project aims to assess the impact of Himalayan glaciers retreat and possible changes of the Indian summer monsoon on the spatial and temporal distribution of water resources in Northern India. The project further aims to provide recommendations for appropriate and efficient adaptation strategies, by:

- Developing scenarios for snow melt and monsoon patterns based on improved regional climate projections;
- Developing realistic regional socio-economic scenarios and assess the changing water resources using regional models;
- Providing new methods for the prioritization of adaptation measures to be used for the selection of adaptation options;
- Participative development of specific multi-sector adaptation measures in consultation with stakeholders.

Methodology

HighNoon applies a trans-disciplinary research approach to climate change adaptation. Knowledge on climate change and climate variability of stakeholders at different levels is integrated with scientific knowledge derived from improved regional climate modelling and socio-economic scenario development.

The HighNoon approach integrates biophysical and socio-economic data to develop knowledge on water availability and demand and iteratively involves stakeholders to develop acceptable and robust adaptation options.

Besides data and tools developed within the HighNoon project, it makes use of available existing data and a suite of modelling tools at different spatial scales; from Global Climate Models (GCMs) to basin scale hydrological models to dam-burst models.

Finished results

- Gradual wide-spread warming over northern India is projected by Regional Climate Models (RCM). Temperatures in the Ganges basin are expected to increase by an average of about 2 °C by 2050 and 4 °C by 2100, being more pronounced over mountainous areas.
- Annual total precipitation changes across Northern India are less certain. Against a backdrop of considerable decadal variability, the slight increase in precipitation to 2050 indicated by the RCMs is unlikely to be significant.
- The expected continuation of glacier shrinkage in most parts of the Himalayan mountain ranges is confirmed, but with some increase in the western Himalaya and Karakoram.
- It is unlikely that the next decades will see dramatic changes in total runoff, but continued glacier recession will lead to changes in the seasonal pattern of runoff in upstream basins, with changes in both timing and amount of snow melt likely to affect flow in spring months, at times when other sources of runoff are scarce.
- In upstream regions of the Ganges basin adaptation measures to prevent flood damage are highly prioritized by stakeholders. In mid and downstream regions, measures to maintain groundwater levels, and to develop water harvesting and increase water use efficiency are favoured.

Project partners	
Alterra–Wageningen University and Research Centre (NL) – Eddy Moors	University of Geneva (CH) – Markus Stoffel
The Energy and Resources Institute (IN) – Suruchi Bhadwal	Max Plank Institute for Meteorology (DE) – Daniela Jacob
UK Met Office (UK) – Andy Wiltshire	Indian Institute of Technology, Kharagpur (IN) – Ashok Mishra
University of Salford (UK)–David Collins	Nagoya University (JP) – Tetsuzo Yasunari
Indian Institute of Technology, Delhi (IN) – Ashvin Gosain	

ICAD

At a glance
Title: Advancing Knowledge Systems to Inform Climate Adaptation Decisions
Funding scheme: ERC Starting Grant
ERC funding: 1 045 000 €
Duration: 48 months
Start date: 01/04/12
Host institution: University of Leeds, UK
Principal investigator: Suraje Dessai
Project website: www.icad.leeds.ac.uk
Key words: climate change adaptation, decision-making, knowledge systems, techno-scientific, co-production

The challenge

Adaptation to climate variability and change represents an important challenge for the sustainable development of society. Informing climate-related decisions will require new kinds of information and new ways of thinking and learning to function effectively in a changing climate. Adaptation research requires integration across disciplines and across research methodologies.

Currently, we lack the critical understanding of which kinds of knowledge systems can most effectively harness science and technology for long-term sustainable adaptation. This interdisciplinary research programme aims to significantly advance knowledge systems to enable society to adapt effectively to an uncertain climate.

Project objectives

ICAD will examine climate knowledge systems (based on climate projections and impacts models for example) and its utility for long term adaptation planning (i.e., timescales beyond 30years) to understand climate information needs across society. Split into two research domains we have identified the following objectives:

- understand different adaptation contexts and capacities
- understand how observed or projected climate information has been used in organisations and decision-making
- understand the importance of non-climatic information for decision-making
- understand what level of uncertainty users are able to tolerate for different kinds of scientific knowledge used in decision-making
- understand what users expect science to deliver
- gain an understanding of how techno-scientific knowledge is constructed in the domain of adaptation to climate change.
- analyse experts' perception of users' needs
- assess experts' views of the use of the knowledge they produce by others
- evaluate the degree of co-production of knowledge
- assess how climate knowledge travels across different social worlds

Methodology

Using the UK's Climate Change Act 'Adaptation Reporting Power' to map the key actors involved in long-term adaptation to climate change we will conduct a users' survey and carry out face-to-face interviews in order to assess current knowledge systems, and assess whether users find existing climate (and climate impacts) information credible, legitimate, actionable and salient. We will also establish the importance of climate information versus non-climatic information. Ultimately we will construct a theory of climate-related decision-making using grounded theory and elements of information/decision sciences literature.

At the same time we will use the UK's recent Climate Change Risk Assessment (CCRA) and the UK's Climate Change Projections (UKCP09) as a starting point to focus on the key role played by climate scientists, modellers, statisticians and specialist consultancies in the construction, evaluation and interpretation of climate information. Combining in-depth interviews with ethnographic-based observations we will understand what effect, if any, these actors have on the kind of climate knowledge that is produced, and by extension, its later use.

Expected results

This ambitious research programme will inform the development of robust knowledge systems for climate decision support under an uncertain and changing climate. Using the UK as a context of application, the research programme will provide both depth and breadth. Depth is achieved through the ethnographic research methods applied to both users and producers of climate knowledge (which is richer in detail than questionnaire surveys for example). Breadth is accomplished by conducting a comprehensive survey that captures UK 'society'.

The scale (a whole nation) and the focus (knowledge systems for adaptation to climate change) of this research programme are unparalleled and don't current exist in the state of the art literature. By advancing knowledge systems to inform climate adaptation decisions, this research programme is expected to 1) increase the usefulness of climate information; 2) improve the relationship between knowledge producers and users; and 3) lead to better, more informed, robust (adaptation) decisions.

In 2014 we will hold an international workshop on "Reconciling the supply and demand of climate knowledge for adaptation decision-making" to present our initial findings and bring together other international scholars working in this field.

ICARUS

At a glance
Title: Innovation for Climate chAnge mitigation: a study of energy R&d, its Uncertain effectiveness and Spillovers
Funding scheme: ERC Starting Grants
ERC funding:v: 920 000 €
Duration: 48 months
Start date: 01/01/2010
Host institution: FEEM, IT
Principal investigator: Valentina Bosetti
Project website: icarus-project.org
Key words: Climate Change, Innovation

The challenge

In order to stabilize atmospheric concentrations of greenhouse gases to a safe level, net anthropogenic emissions must fall to zero within a few decades.

To achieve this goal in a manner acceptable to the larger part of the world's population, there is the need of some kind of technological revolution.

As witnessed in the past, this calls for adequate levels of R&D investments, particularly in the energy sector. As the demand is bound to increase, alongside with the growing concern for environmental issues and global warming, the energy sector is indeed essential for the development and the deployment of more efficient generation technologies.

Project objectives

ICARUS aimed to a better understanding of the dynamics of innovation in the energy sector, including the technological breakthroughs and technological transfers to developing countries. In order to investigate how R&D stimulates innovation in the energy sector, the ICARUS project had three main objectives:

- understanding the past to clarify the linkages between R&D investments, policy, patenting and innovation;
- learning from the experts to better characterize the uncertainty concerning the innovation process in selected technologies, such as: batteries, solar, biofuels, nuclear, and carbon capture and storage;
- projecting into the future using the empirical analyses and the expert elicitations' results as building blocks to improve WITCH, an Integrated Assessment Model with detailed information of R&D dynamics.

Methodology

To increase the understanding of the linkages between R&D investments, policy, patenting and innovation, the research team built a comprehensive database on public and private energy R&D and compliance expenditures, carrying out novel empirical analyses on a set of core issues such as technological innovation, diffusion and transfer.

In order to better characterise the uncertainty concerning the innovation process and in particular the role of R&D in selected technologies, the research team systematically collected and elaborated qualitative and quantitative estimates from more than a hundred experts.

Using both the empirical analyses and the expert elicitations' results as building blocks, the research team was able to shed light on a number of areas relevant for the modelling community. On the one hand, the team provided a better description of the mechanisms that lead to the construction of an energy knowledge stock, while on the other, the results of the expert elicitation process were integrated into WITCH to represent uncertainty.

Expected results

The extensive elicitations of European experts indicate that none of the carbon-free energy technologies considered will ever be competitive with their fossil fuel alternatives, unless a carbon price is set in place. Even under scenarios where public R&D expenditures increase substantially with respect to today's levels, the cost decrease will not be sufficient to bridge the competitive gap with fossil fuels. In particular, in the next twenty years, the cost of nuclear power will very likely increase rather than decrease.

In addition to their crucial impact on domestic innovation, environmental policies–such as carbon taxes and limits on emissions–stand out as a key driver also for international technology transfers as a complement of innovation policies.

These and the other upcoming insights from the ICARUS project will have crucial importance for policy makers, private investors as well as citizens who are concerned with the sustainability of the energy sector.

IMPLICC

At a glance
Title: Implications and risks of engineering solar radiation to limit climate change
Instrument: Collaborative project
Total cost: 1 320 537 €
EC contribution: 999 152 €
Duration: 39 months
Start date: 01/06/2009
Consortium: 4 partners from 3 countries
Project coordinator: Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., Max-Planck-Institut für Meteorologie
Project website: implicc.zmaw.de
Key words: climate change, geoengineering, solar radiation management

The challenge

Anthropogenic emissions of greenhouse gases (GHG) are widely considered to have a significant impact on Earth's climate. The projected temperature increase until 2100 lies in the range of 1.8 to 4.0 K. In order to prepare for possible failure of emission reduction attempts, recently, the public and scientific communities have intensified the discussion of "geoengineering", meaning the deliberate, large scale manipulation of climate. "Solar radiation management", i.e. methods to limit the solar radiation that reaches the surface may allow a counterbalancing of the effects of GHG emissions on global temperature, but may also result in undesirable side effects for crucial parts of the Earth system.

Project objectives

Among the so-called solar radiation management methods, two have received particular attention, so far: a) the injection of large amounts of sulphur dioxide in the Earth's stratosphere that would build sulphate aerosols that are expected to reflect solar radiation analogous to effects observed after large volcanic eruptions, and b) the brightening of low level marine clouds via the injection of additional condensation nuclei. So far it is unclear, if the methods have the desired cooling potential and which side effects would have to be expected. The overall goal of this project is to significantly increase the level of knowledge about the feasibility and implications of these suggested geoengineering options. This concerns in particular the climatic consequences – even if a global temperature reduction could be reached, local climate may change significantly under geoengineering -, but also economical implications.

Methodology

Three complex climate models are used to quantify the effectiveness and side effects of such geoengineering concepts aiming at a reduction of the incoming solar radiation. Simulations of a climate modified through geoengineering have been performed based on IPCC type future emission scenarios. The performance of the same type of numerical experiments with several different complex climate models is necessary to assess uncertainties of the simulated geoengineered climate. Besides these transient simulations of the 21st century, sensitivity studies have been performed to study effects of different implementation strategies of geoengineering on specific, vulnerable parts of the Earth system like the ozone layer. Economic modelling has been used to link benefits and side effects of the studied geoengineering concepts.

Finished results

An eventual application of any geoengineering technique will have to be decided by some political body. But a decision to apply or not to apply geoengineering should not be taken before considering as carefully as possible its potential benefits and side effects. Our project is a part of the international scientific efforts to provide to policy makers in general and to the European Commission in particular the necessary information for future decisions. Because of the project's limited scope we obviously can't provide final conclusion on the issue of geoengineering. However, one of the main deliverables of IMPLICC is a summary for policymakers of the results obtained from the numerical modelling performed in the project.

One important result was obtained assuming to balance a large greenhouse gas forcing fully by the reduction of solar irradiance. In this case it would be possible to compensate the increase of global mean temperature, but at the same time, the increase of precipitation under enhanced greenhouse gas concentrations would be overcompensated. A geoengineered climate would have less precipitation than a natural climate of the same global mean temperature. The model intercomparison showed that precipitation decreases – under the chosen scenarios– would affect in particular large land masses in the mid-latitudes of the Northern hemisphere, i.e. Canada and the US, central and northern Europe and Asia.

IMPLICC has also provided progress concerning microphysical processes involved in the aerosol-based radiation management methods and hence concerning their effectiveness. It has become clear that the effectiveness of the methods depends strongly on the implementation, e.g. on the size of emitted sea salt particles. However, uncertainties concerning the amount of aerosol necessary to reach a certain climate effect remain.

The estimation of economic implications of climate change and climate engineering on long time-scales has obvious limitations. However, our simulations suggest that additional climate engineering under a moderate mitigation scenario may not be advantageous. This could be different under high-emission scenarios but in such a case also the economic importance of side-effects may become significant.

Project partners	
Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V., Max-Planck-Institut für Meteorologie	DE
Commissariat à l'Energie Atomique, Laboratoire des Sciences du Climat et l'Environnement	FR
Universitetet I Oslo	NO
Center for International and Environmental Research–Oslo	NO

I-REDD+

At a glance

Title: Impacts of Reducing Emissions from Deforestation and Forest Degradation and Enhancing Carbon Stocks (I-REDD+)

Instrument: Collaborative project

Total cost: 4 287 085 €

EC contribution: 3 149 968 €

Duration: 48 months

Start date: 01/01/2011

Consortium: 14 partners from 9 countries

Project coordinator: University of Copenhagen, DK

Project website: www.i-redd.eu

Key words: Carbon, Climate change, Environment, Governance, Land use change, Monitoring, REDD, Southeast Asia

The challenge

The negotiations under the United Nations Framework Convention on Climate Change have since 2005 included considerations of a mechanism that could ensure reduced greenhouse gas emissions (GHG) by avoiding deforestation and forest degradation and by enhancing forest carbon stocks (REDD+) in developing countries. So far, no international agreement has been reached both because of political difficulties but also because there is an insufficient research base to fully operationalize REDD+. Research on REDD+ has therefore increased rapidly in the past few years, and the EU-FP7 funded I-REDD+ project is contributing with an interdisciplinary approach to resolving a number of issues that are necessary for REDD+ to move forward and be successful.

Project objectives

With a specific focus on forest degradation and mosaic landscapes, the objectives of I-REDD+ are to enhance the understanding of how the implementation of a REDD+ mechanisms:

- may reduce emissions of greenhouse gases and maintain or enhance existing stocks of carbon in vegetation and soil of various land cover types;
- will impact livelihoods, welfare and equity in local communities with forest-based economies;
- can ensure equitable benefit distribution in different governance settings; and
- can be monitored efficiently by both remote sensing and community based approaches.

Methodology

I-REDD+ is an interdisciplinary project using both natural and social science methodologies. Methods include destructive sampling and carbon stock measurement of above- and belowground biomass; remote sensing based approaches combining multiple satellite products such as LandSat, MODIS and Radar; comparing community based and scientist based carbon stock measurement through in situ measurement of plots; assessing potential livelihood impacts of REDD+ through questionnaires and participatory land use planning workshops; interview based assessments of benefit distribution mechanisms and governance systems; and interviews at local, provincial and national level as well as integration of results to guide development of monitoring programs. Field sites are in Indonesia (East Kalimantan), Vietnam (Nghe An), Laos (Huaphan and Luang Prabang) and Yunnan, China (Xishuangbanna).

Expected results

Results are so far are limited to analysis of governance systems, livelihoods and community based monitoring. Important conclusions relating to monitoring systems are:

- drivers of forest degradation lead to local and fine-grained changes in forest quality and carbon density rather than large scale changes in forest cover and these local changes require local measurement approaches;
- participatory forest carbon measurement provides measurements that are just as accurate and less costly compared to those performed by professional foresters;
- a participatory approach to monitoring would contribute to effective and just REDD+ governance;

Other expected results still in progress are:

- improved allometric equations of secondary forest vegetation (degraded forests) to more accurately account for emission reductions
- remote sensing based approaches to monitor carbon stocks in degraded forests that balance costs and benefits in terms of accuracy in carbon accounting;
- guidance for monitoring systems to establish credible reference emission scenarios and ensure long term emission reductions.

Project partners	
University of Copenhagen	DK
Leibniz Institut für Agrarentwicklung in Mittel- und Osteuropa	DE
Humboldt-Universität zu Berlin	DE
University of East Anglia	UK
The University of Edinburgh	UK
Institut de Recherche pour le Développement	FR
Universität Bern	CH
Kunming Institute of Botany of Chinese Academy of Sciences	CN
Center for Agricultural Research and Ecological Studies	VN
National University of Laos	LA
Yayasan WWF Indonesia	ID
Center for International Forestry Research	International
International Centre for Research in Agroforestry (World Agroforestry Centre)	International
Nordisk Fond for Miljø og Udvikling (Nordic Agency for Development and Ecology)	DK

LAGOONS

At a glance
Title: Integrated water resources and coastal zone management in European lagoons in the context of climate change
Instrument: Collaborative project
Total cost: 3 338 591 €
EC contribution: 2 545 659 €
Duration: 36 months
Start date: -01/10/2011
Consortium: 9 partners from 8 countries
Project coordinator: Ana Isabel Lillebø (Univ. of Aveiro) & Per Stålnacke (Bioforsk)
Project website: lagoons.web.ua.pt/
Key words: Lagoons, Climate change, Modelling, Ecosystem Services, WFD, Science-policy-Stakeholders interface, River basins

The challenge

In the context of climate change, there is growing evidence that many ecosystems could reach the "tipping point", at which sudden and irreversible changes have important implications for human well-being (www.maweb.org). In this context, the environmental issue of concern of the LAGOONS project is the anthropogenic deterioration and climate change impacts – especially the effects of extreme weather events – on surface water and on the ecological services provided by lagoons ecosystems. Knowledge produced by different scientific disciplines will be combined and integrated with local knowledge and the views of stakeholders in order to produce integrated, participatory scenarios (by means of a qualitative-quantitative-qualitative scenario approach supplemented with the science modelling inputs) of future possible trends and conditions in coastal lagoons in the context of climate change.

Project objectives

The main and overall objective of the LAGOONS project is to develop science-based strategies and decision support frameworks for the integrated management of lagoons, based on an increased understanding of land-sea linkages processes and the science-policy-stakeholder interface. To this end, the project will seek to contribute to interface between the EU Water Framework Directive, the Habitat Directive, the EU's integrated coastal zone management (ICZM) Recommendation, and the EU Marine Strategy Directive.

Methodology

Four case study lagoons have selected to represent a set of "hotspot" coastal lagoons with a wide and balanced geographical distribution and different characteristics. The lagoons included are: Vistula Lagoon in the Baltic Sea (Poland/Russia); Tylygulskyi Lagoon in the Black Sea (Ukraine); Ria de Aveiro Lagoon in the Atlantic Ocean (Portugal), and Mar Menor in the Mediterranean Sea (Spain). These case studies will be the support for Pan-European integration through a bottom-up approach, showing that I is possible to enhance connectivity between research and policy-making in a lagoons context using a proactive approach to water issues, which assures more efficient use of existing research results.

Expected results

The integrated and participatory scenarios will be formulated to develop strategies and methodologies for integrated decision support for stakeholders, as well as with special focus on recommendations of suitable use of ecosystems services, foreseen eco-efficiency of the services and eco-innovation in solutions to overcome or mitigate the services losses due to the changing environment. In management terms, LAGOONS will contribute to the decision-support methodologies for a coordinated approach to the Water Framework Directive and the Marine Strategy Directive. In addition, LAGOONS will propose actions to tackle bottlenecks in the context of climate change, i.e., LAGOONS will propose actions foreseen in the goals of the Europe 2020 strategy – A strategy for smart, sustainable and inclusive growth.

Project partners	
University of Aveiro	PT
Bioforsk – Norwegian Institute for Agricultural and Environmental Research	NO
Institute of Hydro-Engineering of the Polish Academy of Sciences	PL
Atlantic Branch of P.P. Shirshov Institute of Oceanology of Russian Academy of Sciences	RU
Sea Fisheries Institute if Gdynia,(National Marine Fisheries Research Institute since 24 June, 2011)	PL
University of Dundee	UK
Odessa State Environmental University	UA
Potsdam Institute for Climate Impact Research	DE
Universidad de Murcia	ES

LIMITS

At a glance

Title: Low climate IMpact scenarios and the Implications of required Tight emission control Strategies

Instrument: Collaborative project

Total cost: 4 462 878 €

EC contribution: 3 462 863 €

Duration: 36 months

Start date: 01/11/2011

Consortium: 10 partners from 9 countries and collaborators from the US and Japan

Project coordinator: Fondazione Eni Enrico Mattei – FEEM, IT

Project website: www.feem-project.net/limits/

Key words: Climate mitigation and adaptation policy, Integrated assessment models, Energy infrastructure, Energy Security, Land Use, Air pollution, Climate finance, Sustainable Development

The challenge

LIMITS' challenge is to highlight questions especially relevant for climate policy making:

- What is the economic, technical and political feasibility of attaining stringent climate policies?
- How can we jump start investments and innovation into clean energy technologies?
- What is the role of policies in promoting mitigation and adaptation, recognizing the diversity of regional and national interests?
- What is the role of technologies and their advancements to meet the change in energy infrastructure?

By using state-of-the-art methodological instruments, LIMITS aims at carrying out a rigorous assessment of what a stringent climate policy entails and what is needed to overcome major impediments

Project objectives

LIMITS intends to provide an assessment of the emissions reductions strategies at the level of the world and the major global economies, assessing their implementation in terms of:

- Defining the feasibility of low carbon scenarios and the associated emission reduction pathways according to different assumptions about technology availability, policy regimes, implementation obstacles, and regional level of commitment
- Assessing the investment requirements to implement these transformation pathways and the financing mechanisms such that these resources can be best raised and allocated. Evaluating the national and international policies needed to ensure that the transition to a low carbon energy infrastructure is attained efficiently
- Quantifying the changes in the energy infrastructure and land use which major economies would need to implement to attain stringent climate policies, and assessing the feasibility and risks of such changes
- Evaluating the linkages of climate policies with other pressing social and environmental issues (i.e. energy security, air pollution, economic development)

Methodology

LIMITS takes advantage of the best methodological instruments to assess climate policies, whose analysis will interact with policy evaluation.

Key global integrated assessment models will run climate mitigation and adaptation scenarios under new conditions and constraints, and the policy implications will be thoroughly evaluated. 13 models will be used throughout the project covering a wide range of different aspects. Using these models, LIMITS will explore the implications and uncertainties in reaching a 2°C target under different assumptions regarding the remaining leeway for greenhouse gas emissions, technology availability, the participation of different regions in international climate policy, and implementation obstacles.

The input on local knowledge on the major economies is provided by local partners in China and India, but also in the USA (PNNL) and Japan (NIES) through external collaborations, and thanks to the interaction with key local experts and stakeholders.

In addition, a strong dissemination and communication component aims to disseminate the policy implications of the project results.

Expected results

The LIMITS project aims at generating original insight into how 2°C compatible targets can be really made implementable:

- the technological challenge of achieving a low carbon world. The outcome of the scenario work and the regional infrastructural change will provide a novel view of the physical challenge of transitioning to a low carbon world
- climate finance. The project is meant to advance the status of knowledge on the issue of how to finance the low carbon transition
- local versus global policy instruments: the project will advance our understanding of the interplay of climate and energy policies at different geographical scales
- multidimensional analysis of climate change with specific assessments on the relation between climate and other (health, security, development) policies
- will provide original research on the potential role of negative emissions technologies (such as biomass burning with CCS) on the timing and actions involved in meeting stringent climate policies

Project partners	
Fondazione Eni Enrico Mattei (FEEM)	IT
Internationales Institut für Angewandte Systemanalyse (IIASA)	AT
Potsdam-Institut für Klimafolgenforschung (PIK)	DE
Universiteit Utrecht (UU)	NL
London School of Economics and Political Science (LSE)	UK
Energy Research Centre of the Netherlands (ECN)	NL
Joint Research Centre, Institute for Environment and Sustainability, EC (JRC-IES)	IT
Central European University (CEU)	HU
Energy Research Institute of the National Development and Reform Commission (NDRC-ERI)	RC
Indian Institute of Management (IIM)	IN

LONG-TERM RISKS

At a glance
Title: Evaluation and Management of Collective long-term risks
Funding Scheme: ERC Advanced Grant
ERC funding: 1 400 000 €
Duration: 60 months
Start date: 01/01/2009
Principal investigator: Christian Gollier
Host institution: Toulouse School of Economics
Project website: www.tse-fr.eu/
Key words: Social cost of carbon, discounting, risk evaluation, responsibilities towards future generations

The challenge

In order to determine the optimal strategy to fight climate change, one needs to compare immediate costs of mitigation and the benefits of these green investments. These benefits which take the form of reduced climate damages, are usually very distant in the future, and very uncertain. This raises a particularly challenging evaluation problem for these investments. Because financial markets are inefficient and potentially short-termist, one needs to establish new valuation rules.

Project objectives

Today, the judge, the citizen, the politician, the entrepreneur and markets are concerned by the sustainability of our development, but they don't have a strong scientific basis for the evaluation of their actions and their decision-making. The objective of this project is to provide a simple framework to organize the debate on what should we do for the future? We want to address the difficult question of whether the allocation and the intensity of these sacrifices in favour of the distant future are socially efficient or not. A central aspect of this problem is the deep uncertainties affecting our long-term destiny.

Methodology

We re-examine the modern theory of asset pricing by extending its domain of validity to asset durations expressed in centuries (rather than months or years), and to degrees of uncertainty that are so large than they could put humankind on the verge of collapsing. The evaluation of green investments is based on the measure of their (environmental, social, sanitary, financial,...) contributions to the intergenerational social welfare, which is the sum of each generation's wellbeing. The typical outcome of this set of research efforts is a "discount rate", which is the socially desirable minimum rate of return of these green investments.

Expected results

The standard argument for considering that one gallon of milk and honey in 100 years has a smaller social value than one gallon of milk and honey today (positive discount rate) is that one usually believe that future generations will live "in a ocean of milk and honey". Therefore investing is equivalent to reduce the consumption of the poor current generation for the benefit of the very wealthy future generations. We show that the accumulation of uncertainties affecting the distant future reduces the strength of this argument. For very safe projects, a discount rate going down to 1% for maturities larger than 50 years may be socially desirable. However, for a project whose flow of social benefits is strongly correlated (as measured by the "beta" of the project) to the growth of the economy, a much larger discount rate of 6-7% may be desirable. This raises the unsolved question of the beta of investment projects aimed at reducing emissions of greenhouse gases.

MEDIATION

At a glance

Title: Methodology for Effective Decision-making on Impacts and AdaptaTION

Instrument: Collaborative project

Total cost: 4 050 579 €

EC contribution: 3 142 744 €

Duration: 42 months

Start date: 01/01/2010

Consortium: 11 partners from 8 countries

Project coordinator: Alterra, NL

Project website: mediation-project.eu/

Key words: climate change, adaptation strategies, methods and tools, decision-support

The challenge

The EU and its member states, cities and local communities acknowledge the importance of climate change for safety and wellbeing and started to develop strategies to increase their resilience or protect their territory. Development of useable knowledge on how to adapt, however, has been lagging. The emphasis of scientific inquiry has been on deriving potential regional impacts from downscaled global climate projections, not on providing practical tools for designing response actions. The knowledge base supporting adaptation is still fragmented and incomplete. Easily accessible and policy-relevant information, including methods and tools, to support the dynamic adaptation policy development, is largely missing.

Project objectives

MEDIATION aims to provide a coherent framework for systematically identifying available methods and tools that can be meaningfully applied to address specific adaptation and vulnerability questions and support adaptation action. This is required to address the currently fragmented knowledge base supporting climate change adaptation decision-making in Europe, in particular in the area of methods and tools. To achieve this, firstly the knowledge requirements associated with the ongoing impact assessment and adaptation policy developments in Europe had to be mapped for various decision domains, in consultation with the appropriate decision- makers and stakeholders. Secondly, existing methods, tools and metrics had to be reviewed, linked and–where needed and feasible–improved or developed. A final objective was to make the framework and associated toolbox available and disseminate the project results.

Methodology

To do justice to the diverse and dynamic nature of adaptation challenges in Europe, the MEDIATION framework was developed mainly on the basis of a varied set of case studies reflecting different regions, climatic risks, and institutional contexts. The case studies were complemented by input from other projects such as CLIMSAVE, and the literature. “Method teams” analysed the policy context and methods used in the case studies at a meta level and in a number of consecutive steps with the “case study teams”, developed the targeted overarching methodology in an iterative manner. Stakeholder interactions played an important though variable role in all case studies, attempting to align the scientific work as much as possible with real-world policy processes. The resulting interlinked framework encompasses generic methodologies, natural-science based models, socio-economic evaluation methods, and social and institutional analytical frameworks. The framework was tested both within the project team and with external users.

Finished results

Rather than suggesting a one-size-fits-all solution, MEDIATION acknowledges that adaptation questions are diverse as they are determined by their regional and sectoral context. A diagnostic framework for problem-oriented adaptation research was developed that organizes adaptation questions into a logical structure, linking them to suitable methods and tools. The framework was used for UNEP PROVIA's Guidance for the Assessment of Impacts, Vulnerability and Adaptation and is made available via an interactive platform, which includes: (a) the Adaptation Pathfinder that enables users to find the most appropriate methods and tools for their adaptation questions; (b) the MEDIATION Toolbox that provides detailed information about some 40 methods and tools with conditions for their applicability; and (c) the Case study search tool. The platform is intended to be used by experts with basic technical or scientific knowledge and skills, who engage in policy advice, policy analysis, or other research aiming at supporting climate change adaptation decision making.

Project partners	
Stichting DLO/ALTERRA	NL
IIASA	AT
Global Climate Forum	DE
EC-Joint Research Centre	EU/IT
Potsdam Institut für Klimafolgenforschung	DE
Regional Environment Center	HU
Stockholm Environment Institute, Oxford	UK
Suomen Ymparistokeskus SYKE	FI
Universita degli Studi Firenze	IT
Universidad Politécnica de Madrid	ES
Wageningen Universiteit	NL

MOTIVE

At a glance
Title: MOdels for AdapTIVE forest Management (MOTIVE)
Instrument: Large -scale integrating project
Total cost: 9 000 000 €
EC contribution: 7 000 000 €
Duration: 48 months
Start date: 01/05/2009
Consortium: 20 partners from 14 countries
Project coordinator: Prof. Dr. Marc Hanewinkel
Project website: www.motive-project.net
Key words: Adaptive forest management, decision support, climate change

The challenge

Climate change is posing a major challenge to forestry across Europe. In the Boreal zone, forest productivity is generally expected to increase, but less severe winters with shorter intervals of frost-hardened ground could make forests more vulnerable to wind damage. In the Atlantic (Temperate Oceanic) region, an increase in frequency or severity of Atlantic storms would cause augmented forest losses. In the Temperate Continental bioclimatic zone, the health of spruce forests may be negatively affected by an increase in aridity and become more vulnerable to damage from bark beetles, with other forest species becoming more prevalent as a result. In the Mediterranean zone, an increase in aridity and in the variability of precipitation could stress even the most drought-tolerant tree species and increase the risk from forest fires. The development of forest management strategies under climate change is a key challenge for sustainable resource management in Europe, and also worldwide.

Project objectives

The ultimate objective was to provide insights, data and tools to improve policy-making and adaptive forest resource management. Past experiences about the local and site-specific suitability of species are no longer valid and this calls for an adaptation of present forest management strategies. An integrated assessment of these strategies is needed simultaneously considering multiple ecosystem goods and services.

Methodology

MOTIVE developed and evaluated strategies that can adapt forest management practices to balance multiple objectives under changing environmental conditions. The evaluation of different adaptive management systems took place within a scenario analysis and a regional landscape framework. The most important bioclimatic regions were covered within ten regional cases-studies. This allowed the project to capture major differences in forest conditions. Forests across Europe are not only growing under different climatic conditions; management history as well as past and present socio-economic circumstances are also diverse and lead to variable objectives in forest management.

Key Results

The MOTIVE consortium developed a common understanding of the behaviour of standard decision makers and formalized the decision-making process using a Bayesian update approach. Such an approach is crucial to depict how decision makers may deal with the increasing uncertainty when managing forests under changing climatic conditions. Furthermore it is important to show the consequences of not adapting to climate change by simply continuing a "business-as-usual" strategy compared to an adaptive management approach. Based on the Bayesian update approach we were able to show that, while forest managers may be inclined to rely on observed forest variables to infer climate change and impacts; observation of climate state, e.g. temperature or precipitation is superior for updating beliefs and supporting decision-making.

Models were improved, for example regarding the simulation of disturbances under a changing climate, and further developed to model adaptive forest management regimes. Within a European knowledge transfer, models were adapted to the regional conditions in the case studies in countries where no model-base was available so far.

Besides the regional studies the MOTIVE consortium also worked on the European level. It developed insights into major trends for important climate parameters, growth, productivity and political developments. Based on a European species distribution model, a group of MOTIVE researchers was able to show that Climate Change may have severe economic impacts. Increasing temperatures and a change of the precipitation regime may lead to a decrease of the area of species like Norway spruce that are assumed to move northwards and lose large fractions of their growing space. These productive species that nowadays are the backbone of the timber industry in many European countries may be replaced by more drought-adapted but far less productive species like Mediterranean oaks that – under an extreme climate scenario – may take up to 60% of the total forest area in Europe. Such a drastic change in species distribution may lead to a decrease of the value of forest land in the range of a couple of hundred billions of Euros.

The results of a questionnaire showed that there is a clear decrease in the belief of forest owners in adverse effects of Climate Change to forests from Portugal over Germany to Sweden. So far it has not been much recognized that there are distinct differences in the perception of Climate Change and that the application of adaptation measures essentially depends on having personally observed Climate Change. This is an important insight, because it underlines how important knowledge and information is in determining the adaptive capacity of the forest sector to respond to climate change.

The scientific work in MOTIVE was firmly based on participatory involvement of local and regional stakeholders and decision makers. The project also invested a lot of efforts into outreach to decision makers and politicians. Further information: www.motive-project.net.

Project partners	
Alterra Wagening UR, NL	French National Institute for Agriculture Research, FR
Albert Ludwigs Universität Freiburg, DE	Technical University of Lisboa, PT
University of Natural Resources and Applied Life Sciences, AT	Pensoft Publishers Ltd., BG
Center for Ecological Research and Forestry Application, ES	Potsdam Institute for Climate Impact Research, DE
European Forest Institute incl. EFIMED (Med. Regional office)	Swedish University of Agricultural Research, SE
Swiss Federal Institute of Technology, CH	University of Copenhagen, DK
FORECO Technologies, ES	University of Forestry, Sofia, BG
Forest Research, UK	University of Eastern Finland, FI
Forest Research Institute Baden-Württemberg, DE	University Stefan Cel Mare, Suceava, RO
Institute of Forest Ecosystem Research, CZ	Swiss Federal Research Institute, CH

PLANETS

At a glance
Title: Probabilistic Long-Term Assessment of New Technology Scenarios
Funding instrument: Collaborative project
Contract starting date: 01/01/2008
Duration: 30 Months
Project Total cost: 1 927 050 €
EC contribution: 1 541 674 €
Project coordinator: Fondazione Eni Enrico Mattei (F.E.E.M.) Milano, Massimo TAVONI, IT
EC Office: Energy Directorate
Project website: www.feem-project.net/planets

The challenge

The goal of PLANETS is to devise robust scenarios for the evolution of energy technologies in the next 50 years. This is achieved by means of an ensemble of quantitative and analytical tools that are designed to foresee the best technological hedging policy in response to future environmental and energy policies. Focused technological assessments will provide the necessary guidance for technology availability and competitiveness. Given the long term nature of the analysis, not to mention the many uncertainties surrounding the natural, technological and socio-economic determinants, the scenarios development will be accompanied by probabilistic and stochastic modelling analysis to quantify the most determinant sensitivities. To this purpose, a suite of state-of-the-art energy-economy-climate models will be brought together. The model portfolio spans varieties of regional coverage, technological detail and economic interrelations. Dedicated integrated assessments will explore the technological options that are most likely to play a role over the time horizon under investigation, and the critical issues that are needed for their competitive deployment. PLANETS will research the future of energy systems by examining environmental and energy policies at the European and global level in their capacity to influence the deployment of new technologies with respect to a mutually agreed Business-As-Usual scenario. This project will also analyse the linkage between European and world perspectives of energy technology futures and forecasts, in particular in terms of issues like economic competitiveness and the capacity to export clean technology adoption. Finally, PLANETS will aim to broadly disseminate EU energy technology futures, by setting up an informative scenarios website and acquainting a large number of stakeholders – from science, industry, government and so forth – with peer-reviewed publications and a final general-audience conference.

Project objectives

The objective of PLANETS is to contribute to the energy FP7 goal to adapt the current energy system into a more sustainable, competitive and secure one. To this purpose, the project will focus on how a series of currently foreseen and future energy and environmental policies will shape the outlook for energy technology development.

This research objective is particularly relevant for the European Union for a successful compliance to its policies. Among such policies there are the EU commitment under the Kyoto Protocol and the future agreement that will emerge from post-Kyoto negotiations, and –equally importantly- the recent proposal by the European Council to adopt binding targets for carbon emission reductions and clean technology development.

These regulations require a substantial deviation from what would happen in a Business as Usual scenario; besides demand side management and energy efficiency measures, large scale deployment of innovative technologies that are clean but currently not enough competitive will be key to achieving these sustainable targets. As such, a comprehensive indication of the energy technology penetration potential will provide valuable support to specific policies, by for example indicating the implications in terms of energy investments, R&D budget and test programmes.

In addition to this, the project will focus on the bearing of a sustainable energy development on the competitiveness of EU economy and the ability to become an energy technology leader. The EU is currently well positioned with respect to other developed countries, with a large renewables share, the first ongoing CCS projects and a proven experience with nuclear energy. Nonetheless, it will need to move ahead to ensure a position as an energy technological forerunner. For example, Europe land constraints and restrained coal availability pose an upper bound to the development of new technologies such as renewables, bio-energy and CCS. The capacity to export such technologies in other parts of the world, especially to the fast growing developing countries, would ensure adequate economic returns to the significant up-front investments needed to make advanced technologies competitive. This will provide the EU with highly qualified jobs and a competitive economy, as originally envisaged by the Lisbon Summit in 2000.

PLANETS research objective is to design the evolution of energy technologies in Europe and at the world level for the next 50/60 years. It envisages the construction of a number of scenarios to assess the potential technological deployment in response to different energy and environmental policies, at various levels of geographical, technological and economic detail.

A pool of various numerical models and targeted technology assessments is used to build results on a solid quantitative and qualitative methodology. The key features of the proposed research activity are:

- Definition of Business as Usual scenarios, as produced by the various models once a set of driving assumptions is agreed upon. This is a crucial step in that it ultimately entails the effort of achieving given energy and environmental targets, and its achievement is envisioned in the second milestone of the project.
- Specific assessments of the main technologies needed for a sustainable energy development, such as Renewables, Carbon Capture and Storage, New Nuclear, Syn-Biofuels. The assessments will both evaluate technical aspects as well as the impact on sustainability and competitiveness.
- Policy scenarios: for a specified set of energy and environmental policies at the EU and global level, the resulting energy technologies development are derived, accounting for both capacity and research and development investments needs. The economic policy implications, in terms of costs, carbon prices, sectoral readjustments of the economy, are evaluated.
- Probabilistic analysis, to assess the impact of the many uncertain dimensions at stake and the critical input assumptions of models. This will be done accounting for technical and economic uncertainties, with state of the art techniques such as Monte Carlo simulations and stochastic programming. Policy recommendations and EU competitiveness: given the relevance of the issues analysed in this project outside the EU borders, the project will analyse the potential outcome of EU policies on the European industry capability to spread clean technology adoption and thus reinforce EU economic competitiveness.

Partners		
N°	Organisation	Country
1.	Fondazione Eni Enrico Mattei	IT
2.	Energy Research Center of the Netherlands	NL
3.	Universitaet Stuttgart	DE
4.	SARL KANLO Consultants	FR
5.	Operations Research Decisions and Systems Consultants	CH
6.	Chalmers Tekniska Hoegskola	SE
7.	Lithuanian Energy Institute	LT
8.	University of Manchester	UK

POEM

At a glance

Title: Policy Options to engage Emerging Asian economies in a post-Kyoto regime

Instrument: Coordination and support action

Total cost: 1 089 576 €

EC contribution: 971 518 €

Duration: 36 months

Start date: 01/10/2009

Consortium: 7 partners from 5 countries

Project coordinator: Chalmers University of Technology, SE

Project website: www.chalmers.se/ee/poem-en

Key words: integrated energy-climate-development modelling, burden sharing regimes, India, China, national development policy perspective

The challenge

In order to restrict global warming to 2 oC, major greenhouse gas (GHG) emission reductions are needed by 2050. While most of the accumulated anthropogenic atmospheric carbon dioxide can be attributed to industrialized countries, the greater share of future emissions will come from the developing world, and India and China will contribute to a substantial part of this. Thus, participation by India and China in climate change abatement is essential. However, the countries are reluctant to enter into any binding commitment due to development objectives. Are there policy options being able to combine both the development and climate perspectives?

Project objectives

Any climate policy has spill-over effects across several social sectors and, thus, carefully chosen national policies coupled with international cooperation may offset some of the possibly negative effects. The primary objective of the study is to develop a portfolio of policy options including both

- international and national policies as well as institutional frameworks for international
- cooperation for India and China in order to facilitate their engagement in post-2012 climate change abatement regime. By applying an integrated modeling framework, the project will explore possible multiple pathways which may exist for India and China to contribute into international climate initiatives while not compromising national development priorities.

Methodology

The project applies a modelling framework soft-linking seven national and global models being either economy wide (CGE models) or energy system models.

A harmonized baseline development is used for the modelling analysis.

The analysis is based on a global greenhouse gas emission pathway that aims at a radiative forcing of 2.9 W/m2 in 2100 and with a policy regime based on the so-called common-but-differentiated convergence (CDC) effort-sharing approach, a simple allocation scheme that takes into account common but differentiated responsibilities and convergence of per capita CO2 emissions with emissions trading.

A sensitivity analysis is carried out with respect to economic growth, timing in global emission reductions and the effort-sharing approach.

Finished results

The multi-model analysis concludes that significant reductions are required in both

China and India, implying huge changes in their energy systems. Today, there are large differences in the size of the energy system and the related CO2 emissions between China and India. The current situation and the assumed future developments imply that there are differences as well as similarities in how India and China may be affected by climate policies.

In the climate policy case, Indian emissions are allowed to grow more than the Chinese emissions and still stay below their assigned amount, due to the per capita convergence rule and the higher population growth in India. Clear differences and similarities with respect to the actual consequences for the energy system due to the climate policy can be observed, not only among the two countries, but also among the two model types–CGE vs. energy system model. Energy efficiency improvements are important in the CGE models, while improvements in the carbon intensity are more important for the energy system models. With respect to the carbon intensity improvements, renewable energy (including biomass) together with nuclear power are important in both countries while the role of CCS is larger in China.

The economic impacts of international climate policy – measured as direct mitigation costs in the energy system models or as welfare losses relative to baseline GDP in the CGE models–are generally larger in China than in India, while India can even gain primarily due to benefits from international emissions trading. In general, China is a seller on the short term, but becomes a buyer on the long-term, while India is a seller over the whole 2010-2050 period. Dependent on the model, costs are also affected by decreasing global fossil fuel prices, currency depreciation resulting from a net capital inflow from international carbon trading and timing of emission reductions.

Project partners	
Chalmers University of Technology	SE
Netherlands Environmental Assessment Agency	NL
Indian Institute of Management – Ahmedabad	IN
Tsinghua University	CN
Kiel Institute for the World Economy	DE
Institute of Economic Growth	IN
Beijing Institute of Technology	CN

POLIMP

At a glance

Title: Mobilizing and transferring knowledge on post-2012 climate policy implications

Instrument: Coordination and support action

Total cost: 1 233 885 €

EC contribution: 998 147 €

Duration: 36 months

Start date: 01/05/2013

Consortium: 7 partners from 7 countries

Project coordinator: Stichting Joint Implementation Network (Netherlands)

Project website: www.polimp.eu

Key words: climate change, negotiations, low emission economy, implications for business, knowledge gaps

The Challenge

It is acknowledged that much information is already available for climate policy stakeholders but the way the information is presented is often difficult to access, not in the right format or otherwise of limited use for stakeholders. POLIMP aims at identifying, where knowledge gaps exist, of what future international climate policy directions may look like and what these imply for policy and decision makers internationally and within the EU. The overarching motivation of POLIMP is to facilitate exchange and transfer of information about climate policy and its implications among the policymakers, market actors and general society within the EU. This will be done by identifying where knowledge gaps exist and how these gaps can be filled.

Project objectives

POLIMP objective is to facilitate a process to identify, for different policy and decision making levels, knowledge gaps about implications of possible directions of international climate policies. Subsequently, it will cover these gaps with knowledge packages derived from a broad range of existing reports, research and climate policy decisions at, e.g., EU and UNFCCC levels. The aim is to provide stakeholders with better insights on implications of possible international climate policy directions; so that they can take more informed decisions with reduced uncertainties and mitigated risks. Through that, POLIMP can enhance the implementation of the EU climate targets, strengthen the EU climate policy information and its effects and increase stakeholders' understanding of the consequences of current and future international climate regimes.

Methodology

POLIMP approach is based on an extensive two-way stakeholder consultation process. POLIMP will collect and process information on future climate policy trends and impacts in an integrated manner for exchange with decision makers at different levels. Instead of exchanging information about climate change mitigation, adaptation, technology transfer, etc., through separate channels, POLIMP will integrate these information flows into balanced information packages to support decision makers. POLIMP will first identify what information about climate policy making and its implications is needed, then collect this information from various different sources and offer it to stakeholders in desired packages, in intuitively easy formats and clear language. With these information packages, which will be communicated through series of workshops, climate policy associated stakeholders will be better able to extract key policy conclusions. These activities will be facilitated by an online platform for information exchange of a wider list of contemporary and future policy incentives.

Expected results

POLIMP will create a thematic knowledge base on, among other topics, climate change mitigation, adaptation, technology transfer, finance and market mechanisms. The knowledge collection and processing network thus under POLIMP will enhance the insights of policy and decision makers on possible courses of international climate policy making, which reduces the uncertainty of policy makers and sector and company level decision makers and helps these stakeholders to better understand the consequences of different policies and climate regimes on economic sectors and the European society as a whole. This will help to build trust among them so that they can strengthen their efforts for implementation of the 'Climate and Energy package (20/20/20 targets)'. These insights will increase stakeholders' understanding of the consequences and opportunities of international climate regime and EU climate policies for European citizens, as well as enhance awareness and public acceptance.

Project partners	
Stichting Joint Implementation Network	NL
Centre For European Policy Studies	BE
University Of Piraeus Research Center	GR
Universitaet Graz	AT
Ecologic Institut Gemeinnützige Gmbh	DE
Climate Strategies Lbg	UK
Fundacja Naukowa Instytut Badan Strukturalnych	PL

PROMITHEAS-4

At a glance

Title: Knowledge transfer and research needs for preparing mitigation/ adaptation policy portfolios

Instrument: Coordination and support action

Total cost: 1 057 208 €

EC contribution: 961 455 €

Duration: 36 months

Start date: 01/01/2011

Consortium: 16 partners from 14 countries

Project coordinator: NKUA – KEPA (HELLAS), Prof. Dimitrios Mavrakis

Project website: www.promitheasnet.kepa.uoa.gr/ Promitheas4

Key words: climate change, mitigation, adaptation, research needs and gaps, policy portfolios

The challenge

The EU and the international community are striving to set under the UNFCCC a global post-2012 agreement whose implementation should be ensured on a sound scientific knowledge base with the participation of emerging economies. PROMITHEAS-4 aims to develop and transfer the necessary knowledge to academic institutions in countries with emerging economies (Albania, Armenia, Azerbaijan, Bulgaria, Estonia, Kazakhstan, Moldova, Romania, Russian Federation, Serbia, Turkey and Ukraine) in order to develop, assess and disseminate effective Mitigation/ Adaptation (M/A) policy portfolios, in close cooperation with their governments at both national and regional level.

Project Objectives

1. Evaluation of available data and information: Overview of international procedures and standards in collecting and reporting data and information. Data collection and development of national databases for the beneficiaries.
2. Choice and implementation of appropriate model(s) for emerging economies: Selection of the most appropriate model for the development of the necessary scenarios based on the existing conditions and the reliability of input data.
3. Development of scenarios – M/A policy portfolios: Implementation of scenarios (BAU, Optimistic, Pessimistic) for the development effective M/A policy portfolios under a post Kyoto agreement for the twelve beneficiary countries.
4. Evaluation of policy portfolios: Evaluation of the developed M/A policy portfolios against a set of criteria incorporating social, economical and environmental requirements by using a specially developed multi-criteria method (AMS).
5. Prioritization of research needs and gaps: Identification of existing research needs and gaps preventing the development of effective M/A policy scenarios in beneficiary countries with parallel presentation of existing EU and other international funding mechanisms.
6. Training: A two-stage seminar (long distance learning and one week case study in Athens) for post graduates and decision makers was developed. Those that passed successfully the training stages were invited in their national workshops – conferences. Further to that an intensive contingency plan was developed to meet unscheduled knowledge gaps.
7. Dissemination: Conventional dissemination procedures (see below) are foreseen. In addition all reports were submitted to the 12 governments of BSEC countries for comments before their finalization. Participation to ministerial and working groups is foreseen. Final outcomes are presented to UN, international Conferences and twelve national workshops – conferences, while scientific editions are also foreseen.

Methodology

The project is implemented through successive steps that aim to develop, transfer and implement the necessary high quality knowledge for the development and assessment of Mitigation / Adaptation policy portfolios for each beneficiary country and identify existing gaps and needs. In parallel it is encouraged the interaction and cooperation between academic, governmental and market communities at national and international – regional level.

Expected results

There are three primary results in support of the implementation of a post-2012 climate change agreement in emerging economies:

- identification and assessment of policy portfolios for effective M/A actions;
- prioritization of research needs and gaps;
- knowledge transfer to local societies and governments.

It is expected that at the end of the project in twelve (12) countries, characterized as emerging economies, there will be a scientific potential ready to contribute in developing policy portfolios for effective M/A measures and this potential will be in contact with governmental authorities. Finally an additional impact will be produced by the knowledge transfer to intergovernmental bodies of the region (BSEC).

Additional secondary results are:

- strengthening of the EU role in climate change policy research;
- integration of global climate policy needs into the EU's external relations;
- building of a new alliance with partners around the world;
- development of means through which climate change can be confronted;
- cooperation among scientists from different countries;
- promotion of the green economy perspective.

Project partners	
National and Kapodistrian University of Athens	GR
National Observatory of Athens	GR
Institut fuer Hoehere Studien und Wissenschaftliche Forschung	AT
TUBITAK Marmara Research Center	TR
Scientific Research Institute of Energy	AM
Faculty of Mining and Geology, University of Belgrade	RS
Institutul de Energetica al Academiei de Stiinte a Moldovei	MD
Aristotelio Panepistimio Thessalonikis	EL
Finansoviy Universitet pri Pravitelstve Rossiykoy Federacii	RU
Institutul de Studii si Protectari Energetice SA	RO
Universiteti Politeknik I Tiranes	AL
Ministry of Education of the Azerbaijan Republic	AZ
Black Sea Regional Energy Centre	BG
Nacionalniy Tehnichniy Universitet Ukranini Kiivskiy Politehnichniy Institut	UA
Research and Production Firm Kazchiminvest LLC* Kazhiminvest	KZ
Tallinna Tehnikau likool	EE

RAMSES

At a glance

Title: Reconciling Adaptation, Mitigation and Sustainable Development for Cities

Instrument: Collaborative project

Total cost: 6 524 259 €

EC contribution: 5 200 000 €

Duration: 60 months

Start date: 01/10/2012

Consortium: 13 partners from 7 countries or international organisations

Project coordinator: Potdam Institute for Climate Impact Research, DE

Project website: www.ramses-cities.eu/

Key words: Climate change, Adaptation, Systematic cost assessment, Impact function, City, Response function, Systematic stakeholder involvement

The challenge

Research on adaptation to climate change is crucial to better inform and support the development and implementation of adaptation policies and related action programmes at international, European and Member State level. It is well known that the local effects of climate change and the costs and benefits of adaptation vary greatly. Cities are both drivers of climate change and foci of climate impacts – yet this provides the opportunity to reduce climate risks and emissions as well as to address sustainability challenges in general. The majority of people in Europe, and now globally, live and work in urban areas. Therefore for a transition towards a risk resilient and sustainable future, cities must be at the forefront of this endeavour.

Project objectives

The main aim of RAMSES is to deliver much needed quantified evidence of the impacts of climate change and the costs and benefits of a wide range of adaptation measures. The project will focus on climate impacts and adaptation strategies pertinent to urban areas due to their high social and economic importance.

Specific objectives are:

- development and application of methods and tools to assess climate impacts, vulnerability and risks in cities;
- methods to quantify the full economic costs and benefits of climate change adaptation (integrated top-down/bottom-up approach);
- assessment of the environmental, social and economic effects, at sector level with particular attention to cities which are concentrations of high economic and social importance;
- consideration of human responses to adaptation and other drivers of change such as mitigation, demographic change and sustainable development issues–including the investigation of conflicts and synergies between mitigation and adaptation actions;
- integration of this knowledge base into decision making, in adaptation policy as well as in all other policy and business areas potentially affected by climate change; and,
- provision of outputs that enlarge databases of socio-economic data related to climate change impacts, vulnerability and adaptation, e.g. European Climate Adaptation Platform (CLIMATE-ADAPT).

Methodology

The RAMSES project develops an advanced methodology for presenting urban impacts and estimates of adaptation costs and benefits using a ‘common currency’. In this way, stakeholders will be able to make direct comparisons across cities and sectors with a specific focus on the financial costs of adaptation. RAMSES will follow complementary lines: a generalized approach will identify key urban infrastructure and characteristics and their relation to efficiency regarding adaptation and mitigation in agglomerations which will be complemented by a detailed, high resolution, approach to simulating the effects of climate change for selected case studies. Both will form the basis of a new analysis of the institutional and political context to promote changes and finally the development of city specific transition strategies. This process will be closely connected to stakeholders within the selected case studies (Antwerp, Bilbao, Bogotá, Hyderabad, London, New York, Rio de Janeiro and Skopje) throughout the project duration. Comprehensive and innovative dissemination and communication tools and formats ensure a broad diffusion of the project results.

Expected Results

RAMSES will improve our understanding of urban systems and deliver much needed quantitative evidence of the impacts of climate change and the costs and benefits of adaptation in cities.

By combining analyses at an intermediate level of complexity with detailed case studies, RAMSES will provide transferable and applicable knowledge on climate impacts and adequate responses, detailing the costs and benefits of adaptation options for specific settings.

Research and methodologies will be based on an appropriate assessment of needs of policy makers and stakeholders. This will be achieved by stakeholder dialogues and training exercises for selected cities. Further, using innovative climate media and educational concepts, we seek for a broader distribution of our results to stimulate adaptation actions beyond the case studies.

Project partners	
Potsdam Institute for Climate Impact Research , DE	World Health Organisation, Regional Office for Europe
London School of Economics and Political Science, UK	ICLEI Local Governments for Sustainability, European Secretariat, DE
University of Newcastle upon Tyne, UK	T6 Ecosystems, IT
Flemish Institute for Technological Research, BE	The Climate Centre, BE
Institut du développement durable et des relations internationals, FR	Climate Media Factory, DE
Fundación Tecnalia Research & Innovation, ES	Institut Veolia Environnement, FR
Norwegian University of Science and Technology, NO	

REDD-ALERT

At a glance

Title: Reducing Emissions from Deforestation and Degradation through Alternative Landuses in Rainforests of the Tropics (REDD-ALERT)

Instrument: Collaborative project

Total cost: 4 520 466 €

EC contribution: 3 488 760 €

Duration: 42 months

Start date: 01/05/2009

Consortium: 12 partners from 11 countries

Project coordinator: Robin Matthews

Project website: www.redd-alert.eu

Key words: Climate change, REDD+, land use change, deforestation, carbon

The challenge

Discussions in global fora are underway on how Kyoto Protocol non-Annex 1 countries can use reductions in deforestation to gain carbon credits which could be sold on international carbon trading markets or to other governments, thus earning income for the country. Known as REDD (Reducing Emissions from Deforestation and Degradation), much of the debate has been on the global architecture of such schemes, but there is an urgent need to understand how emission reduction targets agreed at the national scale are to be translated into changes of behaviour relating to land use at the local scale, while not affecting the rights of minority and vulnerable social groups, or the provision of ecosystem services in general.

Project objectives

1. Documenting the diversity in social, cultural, economic and ecological drivers of forest transition and conservation in selected case study areas in Indonesia, Vietnam, Cameroon, and Peru.
2. Quantifying rates of forest conversion and change in forest carbon stocks using improved methods.
3. Improving accounting of the consequences of land use change for GHG emissions in tropical forest margins including peatlands.
4. Identifying and assessing viable policy options addressing the drivers of deforestation and their consistency with other policy approaches.
5. Analysing scenarios of the local impacts of potential international REDD+ policies on GHG emission reductions, land use and livelihoods.
6. Developing new negotiation support tools for stakeholders at international, national and local scales to explore options for incorporating REDD+ into post-2012 climate agreements.

Methodology

The project focused on four study areas in different stages of deforestation, namely Indonesia, Cameroon, Peru and Vietnam. Field data was collected and collated on deforestation rates, deforestation drivers, socio-economic variables, soil and biomass carbon contents, and GHG emission rates from selected land use transitions. A particular focus for the latter were peatlands in Indonesia. An analysis of forestry-related policies at the international level was made to investigate conflicts and synergies, and potential REDD mechanisms were identified for influencing deforestation behaviour at the local level. Modelling of the key social, economic and biophysical processes evaluated these mechanisms in terms of their effectiveness, efficiency and fairness. Finally, the results of the project were used to develop tools that could be used by negotiators at various levels in the REDD process.

Results

Results showed that some developing tropical countries have recently been through a forest transition, thus shifting from declining to expanding forests at a national scale. However, in many of these (e.g. Vietnam), a significant part of the recent increase in national forest cover is associated with an increase in importation of food and timber products from aboard, representing leakage of carbon stocks across international borders. Avoiding deforestation and restoring forests will require a mixture of state-level command-and-control (regulatory) approaches, emerging market-based instruments (e.g. eco-certification of products, corporate environmental responsibility, stewardship agreements, and other demand-driven interventions), suasive options, and management measures. Most of the available policy instruments tend to focus on local and proximate drivers with very few instruments that address global underlying (e.g. world demand) and national underlying drivers (e.g. population growth, the perceived need for economic growth).

Significant progress was made in the quantification of carbon and GHG fluxes following land use change in the tropics, contributing to narrower confidence intervals on peat-based emissions and their reporting standards. Specifically, it was found that net CO2 emissions and removals contributed more than 90% to the soil net balance of all GHGs across all land-use categories on peat soils, that the overall decrease in CH4 emissions from conversion of peat swamp forests does not offset the simultaneous increase in soil CO2 emissions due to accelerated peat decomposition, and that forest conversion to agriculture and agroforestry significantly and highly increased soil N2O emissions.

For mineral soils, it was found that there was a strong geographic bias in the published literature, with most studies being skewed toward regions with higher precipitation and allophanic clay mineralogy, while areas with low precipitation and high activity clays were clearly underrepresented. It was also found that measurement of soil carbon stocks down to one metre was sufficient to capture changes following land use change.

Policy analysis and modelling work showed the high degree of complexity at local levels and highlighted the need to take this heterogeneity into account – it is unlikely that there will be a 'one size fits all' approach to make REDD+ work. It is important to see REDD+ as part of larger systems which also include arable agriculture, grasslands, wetlands, and human settlements, as these can often be a driver of deforestation (e.g. agriculture) or may represent leakage (alternative income opportunities. Dealing with any one land use component (such as forests) in isolation is likely to result in partial solutions at best as the Law of Unintended Consequences starts to operate.

There are indications that there is only a short and relatively small window of opportunity of making REDD+ work – these included the fact that forest-related emissions as a fraction of total global greenhouse gas emissions have been decreasing over time due to the increase in fossil fuel emissions, and that the cost efficiency of REDD+ may be much less than originally thought due to the need to factor in safeguard costs, transaction costs and monitoring costs.

Project partners	
The James Hutton Institute (JHI), UK	International Institute of Tropical Agriculture, IITA), NG
Université Catholique de Louvain (UCL), BE	Centro Internacional de Agricultura Tropical (CIAT), CO
Vrije Universiteit Amsterdam (VUE), NL	Indonesian Soils Research Institute (ISRI), ID
Georg August University of Göttingen (UGOE), DE	Research Centre for Forest Ecology and Environment (RCFEE), VN
World Agroforestry Centre (ICRAF), KE	Institut de Recherche Agricole pour le Développement (IRAD), CM
Centre for International Forestry Research (CIFOR), ID	Instituto Nacional de Investigacion y Extension Agraria (INRA), PE

RESPONSES

At a glance

Title: European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation (RESPONSES)

Instrument: Small or medium-scale focused research project

Total cost: 4 117 787 €

EC contribution: 3 149 659 €

Duration: 40 months

Start date: 01/01/2010

Consortium: 10 partners from 9 countries

Project coordinator: Institute for Environmental Studies, VU University, Amsterdam, NL

Project website: www.responsesproject.eu

Key words: climate change, adaptation, EU sectoral policy, mainstreaming, low emissions scenarios

The challenge

EU action on climate change is focused on accelerating emission reductions, while seeking to put adaptation at the heart of all sectoral policies. As policy attention to climate change intensifies, mitigation and adaptation need increasingly to be pursued in parallel, and where feasible integrated. Climate change risks need to be taken into account, or mainstreamed, throughout the private and public sectors. European action also needs to take into account the broader international context, in order to ensure that EU mitigation and adaptation efforts are effective, efficient, proportionate and affordable, and coordinated with action in other countries and regions.

Project objectives

The RESPONSES project addressed these policy challenges. Its overall objective was to assess integrated EU climate-change policy responses to achieve ambitious mitigation and environmental targets while at the same time reducing the Union's vulnerability to inevitable climate-change impacts. The empirical focus of the project was on five EU policy sectors: water and agriculture, biodiversity, regional and cohesion policy, health, and energy. Specifically, the project:

- developed a new set of low emission scenarios;
- developed and assessed strategies for integrating mitigation and adaptation to climate impacts into existing EU policies; and
- identified synergies, trade-offs and conflicts between mitigation and adaptation, and identify opportunities for future EU strategies and policy measures.

Methodology

The RESPONSES project had three analytical elements:

1. scenario modelling;
2. sector case studies; and
3. integrative activities.

These elements were integrated by an initial Scoping activity, which set out a common research protocol for the five EU policy sector case studies. Each case study carried out a baseline assessment, vulnerability and mitigation potential assessments, and generated and assessed mitigation and adaptation policy options by sector. The low emissions scenarios were developed using the TIMER Energy Model of the IMAGE Integrated Assessment Modelling framework, coupled with the European Power Model ACE. A Synthesis work package brought together the results of the scenarios and case study research.

Interaction and communication with European Commission and other stakeholders was continuous throughout the project, in the initial framing of the research, in conducting research, and in debating and communicating results at the ECCA2013 conference.

Key Results

1. Synergies can be achieved between greenhouse gas emissions reductions (mitigation) and increasing climate resilience (adaptation) in some areas of EU policy, such as land use management in agriculture. But for much EU policy mitigation and adaptation are likely to remain separate.
2. The electricity sector is critical to achieving deep emissions reductions in the EU. Under a new RESPONSES low emissions scenario for the EU, we find that a reduction of 34-43% in total EU emissions by 2050 could be achieved in the power generation sector alone, with wind generation playing a major role.
3. A key governance dilemma for climate adaptation mainstreaming exists between the need for central direction and the benefits of local discretion. The European Commission can play an important role in providing guidance, information and supporting capabilities on the ground. Especially for long-term investments, there will be growing benefits in opting for robust solutions that are resilient under different scenarios.
4. Mainstreaming adaptation often involves linkages between different sectoral policies (for instance, between water and agriculture, or between cohesion and health policies). The RESPONSES project developed a way of mapping these interactions and linking them to climate vulnerabilities and adaptation strategies. There are many opportunities for cross-sectoral support for adaptation.
5. EU nature and biodiversity policy is implemented by providing protected areas for valuable and endangered species and ecosystem types. With changing climates, the suitability of localities for species and ecosystems will shift over time. The current policy of protecting particular species and habitats at particular places is untenable given climate change. Key adaptive responses, such as habitat restoration and ensuring coherence of reserve networks, are left to the discretion of EU Member States.
6. The distribution of climate vulnerabilities across the EU varies greatly by impact category (RESPONSES looked at fire, heat stress and river flooding). A new analysis, combining climate impacts with adaptive capacity, shows that climate risks, which currently exist mainly in southern Europe, will grow significantly in many parts of continental Europe by the 2040s. In contrast, for Ireland, Scandinavia, much of Poland, the Baltic countries, and most UK regions, overall impacts will remain relatively lower.
7. Many new and emerging vector-borne diseases could potentially become endemic in Europe over the coming decades under climate change. However, based on modelling dengue fever risk in Europe, the scale of disease burden appears to be modest, even when looking at projections to the end of the century. Effective public health interventions exist for some diseases, as well as for reducing heat stress risk among vulnerable groups.
8. Appraising the eventual effect of policy interventions made today on mitigation and adaptation goals is fraught with problems. For adaptation, it often makes sense to focus efforts on correcting existing mal-adaptations, rather than trying to prepare for highly uncertain conditions in the far-future.

Project partners	
VU University Amsterdam (NL)	IIASA (AT)
Fraunhofer ISI (DE)	University of East Anglia (UK)
Joint Research Centre of the European Commission	CSIC, Biochange Lab, Madrid (ES)
Netherlands Environmental Assessment Agency (NL)	University of Helsinki (FI)
The Energy and Resources Institute (IN)	Chinese Academy of Sciences (CH)

ROBIN

At a glance
Title: The Role of Biodiversity in Climate Change Mitigation in Latin America (ROBIN)
Instrument: Collaborative project
Total cost: 9 000 000 €
EC contribution: 7 000 000 €
Duration: 48 months
Start date: 01/11/2011
Consortium: 12 partners from 9 countries
Project coordinator: NERC, Centre for Ecology & Hydrology, GB
Project website: www.robinproject.info
Key words: Environment (including climate change), indicators, mitigation, carbon stores, land-use change, tropical rainforests, biodiversity, ecosystems, ecosystem services, multifunctional landscapes, remote sensing, participatory approaches, REDD+.

The Challenge

Tropical forest ecosystems are hotspots for biodiversity and play a key role in carbon storage and climate change mitigation programmes such as "Reducing Emissions from Deforestation and Forest Degradation" (REDD+) and similar "Payment for Ecosystem Service" (PES) schemes. REDD+ aims to enhance the role of forests as carbon pools by supporting the conservation and sustainable management of forests and the restoration of degraded forest areas. It also contains social and environmental safeguards for people, communities and biodiversity.

Currently we do not know what biodiversity is needed to sustain the ecosystem processes and ecosystem services needed for climate change mitigation or the delivery of social and environmental co-benefits. ROBIN's research will help fill this knowledge gap and provide policy makers and natural resource managers with simple decision support tools for assessing the likely outcomes of land management and policy options on carbon storage, biodiversity and ecosystem services such as water supply, disease regulation and non-timber forest products.

Project objectives

ROBIN's research covers the tropical rainforest areas of Mesoamerica and South America. Its main objectives are to: (i) evaluate the socio-ecological consequences of changes in biodiversity and ecosystem services under climate change; (ii) quantify the role of biodiversity in tropical forest ecosystems in mitigating climate change; (iii) analyse the impacts of alternative land-use scenarios (and other mitigation options) on carbon stores and

other ecosystem services; and (iv) provide guidance on land-use planning and other climate change mitigation options with the aim of increasing carbon stores and avoiding undesirable ecological and socio-economic effects.

Methodology

An inter-disciplinary team from Europe and Latin America will use field data and remote sensing to understand the relationships between carbon stocks, biodiversity and ecosystem services. Linked models will be used to examine how different climate, socio-economic and land-use scenarios could affect carbon storage, biodiversity and ecosystem services in the longer term. The models will be used in a socio-ecological assessment framework using key indicators to evaluate synergies and trade-offs.

Local case studies will be done in sites covering multi-functional landscapes across a climatic gradient of tropical forest areas. These sites will provide data for investigating the complex trade-offs between biodiversity, climate change mitigation options and other ecosystem services. Some sites will be used for stakeholder participatory approaches to gain a better understanding of the main drivers of land-use change and biodiversity loss and to test the model outputs, maps and decision support tools that are being developed.

Expected Results

ROBIN will provide:

- decision support tools for local and national implementation of REDD+ to help decision makers compare options for using biodiversity and ecosystems for climate change mitigation;
- assessments of the risks and uncertainties associated with these options; and
- improved methods for monitoring carbon and biodiversity indicators for REDD+ reporting.

The main outcomes of the work should be increased storage of carbon in forest landscapes and the delivery of social and environmental co-benefits through REDD+ and similar PES schemes. The work will inform national and local stakeholders in forestry, agriculture and nature conservation sectors. Advice will be provided on how to increase carbon stocks and biodiversity while simultaneously delivering a range of other ecosystem services to communities, particularly those operating in multi-functional landscapes.

The work will also inform the implementation of UN Convention on Biological Diversity (CBD) in relation to some of the CBD (Aichi) 2020 targets.

Progress has already been made towards developing a REDD+ monitoring system for Mesoamerica using satellite data and a biodiversity/degradation gradient system based on work done in ROBIN.

Project partners	
NERC Centre for Ecology & Hydrology,, CEH	UK
Alterra,	NL
Ministerio del Medio Ambiente y Recursos Naturales, CONABIO	MX
Empresa Brasileira de Pesquisa Agropecuaria, EMBRAPA	BR
Instituto Boliviano de Investigación Forestal Asociacion, IBIF	BO
Universitaet Klagenfurt, UNI-KLU	AU
Instituto de Ecología, INECOL	MX
Potsdam Institut fuer Klimafolgenforschun, PIK	DE
Universidad Nacional Autonoma de Mexico, UNAM	MX
Wageningen Universiteit, WU	NL
Universidad Politécnica de Madrid, UPM	ES
Guyana Forestry Commission, GFC	GY

SAFEWIND

At a glance
Title: Multi-scale data assimilation, advanced wind modelling and forecasting with an emphasis on extreme weather situations for safe large-scale wind power integration.
Instrument: Collaborative project
Total cost: 5 617 761 €
EC contribution: 3 992 400 €
Duration: 48 months
Start date: 01/09/2008
Consortium: 22 partners from 9 countries
Project coordinator: ARMINES – MINES ParisTech
Project website: www.safewind.eu
Key words: Energy, Environment, ICT

The challenge

The integration of wind generation into power systems is challenging because of the dependence on weather conditions. Forecasting the power output of wind farms, and the related uncertainties, facilitates large-scale integration of wind generation, in line with the EU goals for 20% of renewables by 2020.

Prior to SafeWind, the focus was on forecasting "usual" operating conditions. However, challenging or extreme situations can result in severe forecasting errors that can be costly for both infrastructures (i.e. damage of wind turbines) and the electricity grid (i.e. black-out).

Project objectives

SafeWind was successful in satisfying the end-user's need for specific approaches that substantially improve wind power predictability by reducing large errors, or by predicting extremes:

- at various temporal scales ranging from very short-term (few minutes) to medium term (few days ahead);
- at various spatial scales: local, regional, European.

In addition, wind predictability was considered as a system design parameter linked to spatial planning and the investment phase, where the aim is to take optimal decisions when installing new wind farms.

Obtaining improvements of wind predictability is not trivial. It necessitates bringing together excellence from different disciplines including meteorology, statistics, power engineering, ICT technologies. SafeWind developed this synergy, through research objectives inspired by the needs of the industry for solutions of an operational nature to address the problem of extremes. Finally, the project studied the challenges of predictability at different climates (i.e. India).

Methodology

The methodology addressed scientific & technical objectives including:

- Definition and identification of extreme events reflecting the perception of the different communities (forecasters, end-users, meteorologists...).
- Development of an information system integrating data from a large number of wind farms and more than 2000 meteo stations over Europe.
- Strong synergy with research in meteorology which favoured the emergence of new products dedicated to wind energy as well as an optimized ensemble forecast system.
- Development of new forecasting approaches to adequately monitor and assess the weather situation over Europe in order to detect severe deviations in the wind power forecast due to extreme events and issue alerts to end-users.
- Development of dedicated novel probabilistic methods for wind power forecasting with focus on extremes.
- Evaluation of the role of wind predictability in spa-

tial planning and in the investment phase of wind farms.

- Assessment of benefits from new measuring technologies for better estimation of external conditions, resource assessment and forecasting.
- Demonstration of operational benefits through validation at the end-users.

Results

SafeWind has developed leading-edge research in short-term forecasting of wind power by:

- Delivering state-of-the-art solutions to facilitate large-scale integration of wind energy into electricity networks. The innovative solutions improve forecast skill up to 20%.
- Integrating solutions within the business processes of the European power systems industry.
- Developing academic excellence and European leadership in the field with more than 145 scientific publications (40+ journal papers).
- Creating worldwide business opportunities for high-end European technology. SMEs in the project already use the new knowledge acquired to provide forecasting services.
- A successful public workshop presented the project results to a broad public from academia and industry.

Project partners			
ARMINES – Association pour la Recherche et le Développement des Méthodes et Processus Industriels–MINES ParisTech	FR	Universidad Compultense de Madrid	ES
CENER–Centro Nacional de Energías Renovables	ES	Universidad Carlos III de Madrid	ES
DTU Technical University of Denmark	DE	PPC- Public Power Corporation SA	GR
University of Oldenburg–ForWind	DE	METEO FRANCE	FR
Energy & Meteo Systems GmbH	DE	TERI–The Energy and Resources Institute	IN
OVERSPEED GmbH & Co. KG	DE	SONI–System Operator of Northern Ireland	UK
ENERGINET.dk	DK	RTE–Gestionnaire du Réseau de Transport de l'Electricité	FR
ECMWF–European Centre for Medium-Range Weather Forecasts	INT	ICCS/NTUA – Institute of Communication & Computer Systems	EL
EDF–Electricité de France	FR	ACCIONA ENERGIA S.A.	ES
EirGrid p.l.c.	IE	ENFOR A/S	DK
The Chancellor, Masters & Scholars of the University of Oxford	UK		

SPECS

At a glance

Title: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

Instrument: Collaborative project

Total cost: 11 785 694 € €

EC contribution: 8 224 862 €

Duration: 51 months

Start date: 01/11/2012

Consortium: 20 partners, 9 countries

Project coordinator: Fundació Institut Català de Ciències del Clima (IC3), ES

Project website: www.specs-fp7.eu

Key words: climate prediction, climate services, climate modelling, forecast reliability, forecast quality, initialisation, calibration, downscaling, impact assessment, operational prediction.

The challenge:

Deliver a new generation of European climate forecast systems with improved forecast quality and efficient regionalisation tools to produce reliable, local climate information over land at seasonal-to-decadal (s2d) time scales, while providing an enhanced communication to address the needs of a wide range of both public and private stakeholders.

Project objectives:

- Evaluation of the forecast quality of current climate forecast systems.
- Test specific hypotheses for the improvement of s2d predictions.
- Integrate the best observational data of the climate system as initial conditions.
- Improve forecast quality by better initialization and by increasing the spatial resolution of the forecast systems.
- Achieve a best assessment of the uncertainties in climate prediction.
- Perform reliable and accurate local-to-regional predictions via the combination and calibration of the information from different sources and a range of state-of-the-art regionalisation tools.
- Illustrate the usefulness of the improvements for climate services and better communicate actionable climate information.
- Support the European contributions to WMO research initiatives on s2d climate prediction.

Methodology

Six European dynamical climate forecast systems will be used to advance climate prediction on s2d time scales. A climate forecast system takes existing models used in either weather forecasting or climate modelling and adapts them to the climate forecasting problem. This requires adding an initialization module to give initial conditions to the forecasts. A forecast system also includes a) an adequate system to generate an ensemble of forecasts, b) a statistical model to create reliable probabilistic predictions by combining the data from different forecast systems and other sources like statistical predictions, and c) a downscaling solution that can deal with the multi-forecast system ensemble source of forecasts to offer climate information at a local scale. All the steps used in current operational systems, when they exist, need updating and merging in with the knowledge generated in the weather forecasting and climate-change projection communities. In addition, these updates will be motivated by an increased knowledge about the sources of climate predictability in a climate-change context. As a project like SPECS aims at contributing to the development of climate services, the new forecast systems require appropriate documentation at all knowledge levels and a data dissemination strategy that offers a seamless access to climate information. SPECS brings together, for the first time, several of these elements in a systematic way and with the aim of applying the results in an operational context where climate information based on climate predictions is produced and released at regular time intervals.

Expected results

SPECS will be the origin of a new generation of European climate forecast systems, with improved forecast quality including better reliability, higher resolution, a simpler access to their data and an exhaustive documentation. This will result in more actionable operational seasonal forecasts and the advancement towards a better understanding of the usefulness of decadal predictions.

The processes responsible for s2d climate predictability will be better understood, including those linked to the changes in both natural and anthropogenic forcings. This knowledge will be used to interpret an ambitious set of coordinated global forecast experiments that aim to assess the role of the appropriate initialization of different components of the climate system (sea ice, continental surfaces, atmospheric composition) and of the necessary model improvement (increased resolution, atmospheric chemistry, vegetation, ocean-atmosphere coupling).

A set of functions in the R language with standardized input-output will be created to perform statistical downscaling in a climate-prediction context. They will be merged with existing and new forecast verification functions to be publicly released as the first tool of its kind. This will provide a long-lasting response to the demand of local climate predictions for specific services.

SPECS will also provide a coordinated European response to and leadership in the different international initiatives in climate prediction, as well as a set of case studies illustrating the socio-economic benefits of climate prediction.

At the end of the SPECS project, climate predictions and climate-change projections will be brought closer together for the benefit of both climate services and the advancement of climate adaptation.

Project partners	
Fundació Institut Català de Ciències del Clima (ES)	University of Leeds (UK)
Instituto Nacional de Pesquisas Espaciais (BR)	University of Exeter (UK)
Max-Planck-Institut für Meteorologie (DE)	Meteorologisk Institutt (NO)
Het Koninklijk Nederlands Meteorologisch Instituut (NL)	Vortex Factoria de Calculs S.L. (ES)
Atmospheric, Oceanic and Planetary Physics, University of Oxford (UK)	Met Office (UK)
Météo-France (FR)	Sveriges Meteorologiska Och Hydrologiska Institut (SE)
Centre Européen de Recherche et Formation Avancée en Calcul Scientifique (FR)	Institut Pierre et Simon Laplace, Centre National de la Recherche Scientifique (FR)
Norsk Institutt for Luftforskning (NO)	University of Reading (UK)
Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (IT)	Agencia Estatal Consejo Superior de Investigaciones Científicas (ES)
Universität Hamburg (DE)	European Centre for Medium-Range Weather Forecasts (DE)

TOPDAD

At a glance
Title: ToPDAd Tool-Supported Policy-Development for Regional Adaptation
Instrument: Collaborative project
Total cost: 5 900 000 €
EC contribution: 4 500 000 €
Duration: 36 months
Start date: 01/10/2012
Consortium: Ten partners from nine countries
Project coordinator: Tony Rosquist
Project website: www.topdad.eu
Key words: Climate change, adaptation, policy-making, decision-making, cost-benefit assessment, impact assessment

The challenge

Climate change impacts are already being felt across Europe. Floods in central and northern Europe are extreme events that in particular will affect road transport. Infrastructures for transport and energy will be affected with specific threats to densely populated urban areas. While the drop in revenues from shorter skiing seasons in the Alps has been offset by increased summer tourism, the tourism industry in the Mediterranean is likely to suffer from increasing temperatures. A more strategic approach is needed to ensure that effective adaptation will take place across different sectors and levels of governance.

Project objectives

ToPDAD's objective is to develop methods and tools for businesses and governments to address technical and socioeconomic developments within the fields of energy, transport and tourism in order to assess the aggregated impacts of climate change hazards on health, environment and the economy.

The fundamental driver for regional adaptation, are regional climate scenarios. ToPDAd will deliver state-of-the-art socioeconomic methods and tools for an integrated assessment, helping adaptation decision-makers in evaluate regional, national and EU-level climate change adaptation strategies and policies more comprehensively than before. The focus of the project is on tourism and the infrastructure sectors energy and transport. Important outputs are full cost estimates of inaction versus selected adaptation measures.

Methodology

ToPDAd methodology can be divided into four phases:

1. Scenarios
   ToPDAd works with the scenarios RCP2.6, RCP4.5 (optionally RCP8.5) and sector related EU roadmaps for Energy and Transport. Risk themes will be selected as representative to the scenarios chosen.
2. System/sector impacts
   Sector level impacts are modelled by dedicated models and tools for the Energy, Transport and Tourism sectors. These tools are tuned by ToPDAd partners to fit selected case studies on sector strategies for adaptation.
3. Macro-level/integrated assessment
   Tools developed for macro-level and integrated assessment are tuned and used to aggregate bottom-up information to a broader societal level, supporting national and EU policy development. Impact assessment will focus on economics, but also study implications to health and environment.
4. Value judgements and decisions
   Adaptation decisions at regional and sector levels entail valuing of trade-offs within sector and between various stakeholders at the regional level. Participatory methods to express preferences will be utilized.

Expected results

ToPDAd will provide updated methods and tools for adaptation assessment in the ToPDAd application areas:

- well founded estimates of direct cost of climate change effects;
- the macro-economic implications of these direct costs and possible benefits;
- the overall socioeconomic net benefits of timely adaptation;
- feedback to current adaptation policies at sector and EU levels.

The messages from ToPDAd will be conveyed outside the project community through the stakeholder network and the CLIMATE-ADAPT portal where the demonstration cases will be run.

Project partners	
VTT Technical Research Centre of Finland	FI
Center for International Climate and Environmental Research	NO
Cambridge Centre for Climate Change Mitigation Research	UK
Joanneum Research	AT
Transport & Mobility Leuven	BE
University of East Anglia	UK
Institute for Transport Planning and Systems	CH
Finnish Meteorological institute	FI
Stichting Dienst Landbouwkundig Onderzoek	NL
Institute of Economic Structures Research	DE

TREES4FUTURE

At a glance
Title: Designing Trees for the Future
Instrument: Research Infra-structures Integrating Activity
Total cost: 9 059 348 €
EC contribution: 7 000 000 €
Duration: 48 months
Start date: 01/11/2011
Consortium: 28 partners from 13 countries
Project coordinator: Dr. Luc E. Pâques, INRA, FR
Project website: trees4future.eu
Key words: Forest, Infrastructure, Breeding, Wood Quality, Climate Change, Adaptation, Innovation, Genetics, Biological Resources, Wood Technology, GIS, Modelling, Databases, Economy, Environment

The challenge

Forestry research is a continuum of disciplines ranging from biological and ecological sciences to wood technology and social-economics operating on a wide range of objects: from cells (even genes) and tissues up to ecosystems and wood resource basins. Exchanges and flow of information between scientific communities have been made complicated because on one side each discipline has evolved on its own and has developed its own language and scientific environment and on the other side, because forestry research communities are fragmented and dispersed all over Europe. However, none of these disciplines (or scales) alone is able to tackle current challenges facing European forest and forestry (adaptation, multi-use, bio-economics, etc). Cross-fertilisation between disciplines and integration of scientific outputs are urgently needed and will only be possible if researchers are well-aware of resources existing in other communities, share a regulatory framework for exchange of biological material, share a language comprehensive to all and rely on common experimental and laboratory standards, get educated and trained and debate in key-thematic networks.

Project Objectives

The project partners of Trees4Future represent a wide range of expertise from the tree/population scale to the forestry landscape scale. Trees4Future will develop new integrated facilities and research tools, in addition to providing trans-national access (TNA) to their research infrastructures. The results of their joint research effort will help the European forestry sector respond in a sustainable manner to increasing demands for wood products and services (including the preservation of forest biodiversity) in the context of changing climatic conditions.

Methodology

Trees4Future will integrate for the first time major, yet rarely interacting forestry communities (and their resources) from geneticists to environmentalists and from communities working at the tree/population scale to those working at forestry landscape/wood basin levels as well as industry concerns. These scientific communities will combine their complementary infrastructures, tools and knowledge and thus fill in the current gaps between:

1. Physical environment vs. genetic studies
2. Basic wood properties vs. end-products quality
3. Scales of study: from individual trees to forests

This collaboration will result in a holistic approach to integrating abiotic and biotic environmental aspects through biological responses (eco-physiological and pest/disease risk studies), biomass production (breeding and silviculture) and industrial technology (wood quality and technology).

Expected results

Trees4Future will develop:

- A user-friendly analytical platform for statistical and genetic data analysis. This will be a novel and unique platform in Europe that will enable forest researchers to have free access to a wider, better performing and integrated way of analysing their datasets, coupled with a data-mining tool.
- A platform for molecular analysis. The platform will collect and provide a set of genetic markers and standardised laboratory protocols for genetic identification and fingerprinting of forest resources from several species. It will support the development of a pan-European traceability system for example for forest reproductive material.
- A GIS-based decision making tool for better matching forest tree species and varieties to environmental conditions across Europe, in particular in the context of climate change. This tool will also enable breeders to delineate pan-European breeding zones and deployment zones in the frame of collaborative tree improvement programmes.
- A clearinghouse with GIS functionality. The research data from national and EU environmental and genetic databases, plots and resources will help improve existing data sources and provide a common reference point to access the data via geo-enabled web services.
- Integrated compatible modelling tools for prediction of forest wood resources and services. These tools will be interconnected and enriched by integrating genetic information as well as wood quality models in order to better assess forest goods and services and their sustainability in relation to management practices and changes in environment. They will help with evaluating adaptation and mitigation strategies for European forests.
- High-throughput phenotyping metho-dologies. For some key-traits linked to tree adaptation and wood properties, improved or innovative assessment methods or tools will be developed to increase phenotyping capacity, compatible with new needs in genetic studies and genomic selection for example.

Several of these outcomes together with TNA infrastructures should further support the creation of a European Tree Breeding Centre envisioned in the preceding project TREEBREEDEX.

Project partners	
INRA National Institute for Agricultural Research (FR)	Instytut Badawczy Leśnictwa (PL)
Austrian Institute of Technology (AT)	Institutul de Cercetări şi Amenajări Silvice (RO)
Alterra (NL)	Instytut Dendrologii PAN (PL)
Bavarian Office for Forest Seeding and Planting (DE)	IICT (PT)
BFW (AT)	Vlaams Gewest (BE)
BOKU – Universität für Bodenkultur Wien (AT)	INIA (ES)
CEA – LSCE (FR)	Innventia AB (SE)
CIDTG – CIS-Madera (ES)	INRA Transfert (FR)
CNR – Consiglio Nazionale delle Ricerche (IT)	Metla – Metsäntutkimuslaitos (FI)
CRA – Forestry Research Centre (IT)	University of Ghent (BE)
EFI – European Forest Institute (FI)	vTI – Thünen-Institut (DE)
FCBA Technological Institute (FR)	Joint Research Centre of the EU Commission
Fondazione Edmund Mach (IT)	Statsbetrieb Sachsenforst (DE)
Forestry Commission Research Agency (UK)	InnovaWood (BE)

UNDERSERT

At a glance
Title: Understanding and combating desertification to mitigate its impact on ecosystem services
Instrument: Collaborative project
Total cost: 4 922 397 €
EC contribution: 3 499 378 €
Duration: 60 months
Start date: 01/06/2010
Consortium: 9 partners from 7 countries
Project coordinator: Aarhus University, DK
Project website: www.undesert.neri.dk
Key words: biodiversity, CO2 sequestration, decision support, desertification prevention, local knowledge, restoration, participatory approach

The challenge

The West African region is central for understanding desertification and degradation processes, which are already severe and widespread as a consequence of climate change and human impact. An improved understanding of the effects of desertification and degradation processes on a local to regional scale is important in order to combat desertification and degradation directly and in order to contribute to the implementation of relevant international strategies, initiatives and commitments of the EU and African countries.

Project objectives

UNDESERT aims at combating desertification and land degradation in order to mitigate their impacts on ecosystem services and, consequently, on human livelihoods. By integrating regional information with sound field data on biodiversity and soil as well as socioeconomic and climate data, we aim to create improved understanding of the effects of desertification and degradation processes in West Africa on a local and regional scale. On this basis, decision support models and tools will be developed and introduced to natural resource managers. UNDESERT also includes two very practical aspects, 1) restoration through tree planting, which will be certified for CO2 marketing as the first restoration site in West Africa and 2) ecosystem management based on scientific data and best practices developed in close collaboration between scientists and local communities. UNDESERT activities will be imple-mented by employing 17 young PhD students, who will receive training to enhance future capacities to manage risks and uncertainties in the frame of future demographic and climatic changes. The scientific results will be used to combat desertification and degradation directly and will be transferred to international pro-grams in order to contribute to the implementation of relevant international strategies.

Methodology

Even the most advanced and modern remote sensing and analytical techniques cannot provide solutions to the realities of desertification and degradation problems unless the realities on the ground are understood. A key stone in UNDESERT, is to relate the newest techniques of modelling with hard core data on soil and biodiversity as well as socioeconomic and climate data in order to understand how desertification and degradation processes affect ecosystem services. Practical measures to combat desertification and land degradation will be based on research results.

The geographic focus is Africa, the continent which is most severely menaced by desertification, and, more specifically, West Africa with a very regular ecological zonation from north to south, which makes deserti-fication and degradation processes easier to investigate by means of satellite data. The focus will be on the Sahelian and Sudanian zones where desertification affects many people's lives.

Practical measures to combat desertification and degradation include development of computer-based models aimed at decision support and establishment of tree plantations and nature management plans in close collaboration with local communities.

Expected results

Expected results include a better scientific under-standing of degradation and desertification processes, online databases with available biodiversity and socioeconomic data and decision support systems that can be used as a tool by natural resource managers.

Practical measures will include management plans and establishment of tree planting projects, where CO_2 sequestration will be monitored and certified for carbon trade as the first project in West Africa.

Project partners	
Aarhus University	DK
University Abdou Moumouni	NE
Université Cheikh Anta Diop de Dakar	SN
Johann Wolfgang Goethe-University Frankfurt am Main	DE
Senckenberg Gesellschaft für Naturforschung	DE
University of Ouagadougou	BF
University of Bobo Dioulasso	BF
University of Abomey-Calavi	BJ
BioClimate Research & Development	UK

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Over two-hundred fifty multidisciplinary pan-European research projects dealing with climate change have been funded by the Seventh Framework Programme of the European Union for Research, Technological Development and Demonstration Activities (2007-2013).

The projects presented address a multitude of scientific issues ranging from climate processes, observation and projections to climate change adaptation, mitigation and policies. This overview should be useful to many stakeholders including the scientific community and regulatory authorities.

Project information

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