COMBINE

At a Glance

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

Instrument: FP7, Collaborative and large-scale Integrating Project

Total Cost: 11,423,157.54 €

EC Contribution: 7,922,679.90 €

Duration: 48 months

Start Date: 1.5.2009

Consortium: 22 partners from 14 countries

Project Coordinator: Max Planck Institute for Meteorology, Max-Planck-Gesellschaft (Germany)

Project Web Site: www.combine-project.eu

Key Words: Earth system model, processes, initialization, decadal climate prediction, 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 CO_2 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 for the incorporation of the new components: The carbon and nitrogen cycles (WP1), the coupling of aerosols, cloud microphysics and chemistry (WP2), stratospheric dynamics (WP3), and the dynamics of ice sheets, sea-ice and permafrost (WP4). Ocean and sea-ice initialization techniques are tackled in WP5. Validation against analyses and observational data of the ESMs including the single new components is included in the respective WPs. The effects of combined new components are investigated systematically by means of dedicated numerical experiments (simulations) in WP6 and 7. To evaluate improvements, these simulations are carried out with the ESMs existing at the beginning of the project and with the newly developed ESMs. WP6 analyses the effect of the new components on the predictability of the climate system and 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 the feedbacks. WP8 explores the outputs of decadal climate predictions and centennial climate projections of WP6 and WP7 for impact analyses, at the global and regional scale, and for studying feedbacks in 3 different regions. WP8 combines the ESM outputs and integrated assessment modelling to find revised CO_2 emission scenarios.

Expected Results

The COMBINE project will deliver new process model components, new ESMs and simulations meeting specific user needs. From the development of the new ESMs, deeper and more quantitative understanding of the basic processes, couplings and feedbacks governing the Earth System will emerge. The COMBINE simulations will cover both the near-term (2030) and long-term (2100) future time periods, envisaged by the the World Climate Research Programme 's Working Group on Coupled Modelling. COMBINE simulations will demonstrate the improvements in Earth System modelling and their usefulness for adaptation to and mitigation of climate change. The combined results of the new ESMs and integrated assessment models will provide new information to the policy makers on the necessary reduction in CO_2 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 climate model data will contribute to further strengthen the European climate modelling community and the European voice in international climate negotiations.

Project Partners	Countries
Max-Planck-Gesellschaft	DE
Met Office	UK
Centre National de la Recherche Scientifique	FR
Centro Euro-Mediterraneo per i Cambiamenti Climatici	IT
Météo-France - Centre National de Recherches Météorologiques	FR
Het Koninklijk Nederlands Meteorologisch Instituut	NL
University of Bergen	NO
Danish Meteorological Institute	DK
European Centre for Medium-Range Weather Forecast	UK
Eidgenössische Technische Hochschule Zürich	CH
Finnish Meteorological Institute	FI
Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Millieubheer (Planbureau voor de leefomgeving)	NL
Swedish Meteorological and Hydrological Institute	SE
Wageningen University & Research Centre	NL
University of Helsinki	FI
European Centre for Research and Advanced Training in Scientific Computation	FR
Université Catholique de Louvain	BE
University of Bristol	UK
University of Kassel - Centre for Environmental Systems Research (CESR)	DE
Technical University of Crete	GR
Cyprus Research and Educational Foundation	CY
Instituto Nacional de Pesquisas Espaciais	BR

Climate change