ASTER

Assessment of modelling uncertainties in long-term climate and sea-level change projections

DURATION OF THE PROJECT
Phase 1 : 15/12/2005 – 14/12/2007
Phase 2 : 15/12/2007 – 31/01/2010

BUDGET
1.149.995 €

KEYWORDS
Future climate, sea level, carbon cycle, modelling, uncertainties, Holocene

CONTEXT

Policymakers are facing a wide range of possible scenarios for long-term climate and sea level evolutions without knowing precisely why they differ and how reliable they are. Two factors explain this wide estimated range: uncertainties in the future anthropogenic emissions of greenhouse gases and aerosols, and uncertainties in the understanding and modelling of the processes that influence climate. Under these circumstances, it is difficult to know which decision should be taken to avoid the most dramatic effects of climate change. However, decisions should be taken in a very near future because we could possibly pass some threshold that would lead to irreversible changes.

PROJECT DESCRIPTION

Objectives

The overall objective of ASTER is to identify a range of possible climate and sea level change scenarios over the next three millennia that are coherent with the past evolution of the Earth system in order to get some insight on uncertainties in the modelling process and to understand the causes of this range of projections.

Methodology

We will vary some key physical parameters of LOVECLIM, a global three-dimensional Earth system model of intermediate complexity, within their range of uncertainty in order to construct about 30 different model versions resulting in contrasted climate, sea level and CO_2 atmospheric concentration responses to changes in forcing. This approach has been chosen because it is cheap in term of computer time and because, using a restricted number of model versions will allow a better knowledge of the characteristics of each version. For each set of parameter values, three types of experiments will be conducted, i.e. a long control experiment under pre-industrial conditions, a freshwater hosing experiment to assess the stability of the North Atlantic meridional overturning circulation and an experiment in which the CO_2 concentration will be quadrupled to have a clear and strong climate signal.
The selected model versions, which should all yield a reasonable control climate, will then be utilized to carry out transient experiments over the Holocene, with a particular focus on the period around 8200 year before present, i.e. at a time of an abrupt climate change event, and the last millennium. In a last step, we will select the model versions that show the best agreement with the available reconstructions of past climates and tracer distributions, and we will employ them to perform climate and sea level change projections over the next three millennia under various CO_2 emission scenarios.

INTERACTIONS BETWEEN THE DIFFERENT PARTNERS

Each partner (UCL, VUB and ULg) carries out model improvements in his/her field of expertise in order to build a basic 'ASTER' model. UCL will develop an automatic procedure for set-up of the simulation and post-processing of the results and will design a test of the ability of the models to simulate specific climate situations.
The partners choose together the parameters of the model that will be at the base of the various versions, on the basis of result of three types of experiments (long pre-industrial equilibrium, quadrupling of the CO_2 concentration, water hosing in the North Atlantic). VUB, ULg and UCL conduct the simulations specific to the project, i.e. 8200 year event, the Holocene and the last millennium, respectively. This work is distributed amongst the partners, but each partner performs the analyses related to his/her field of expertise for all the experiments. Regular meetings allow a thorough discussion of the results.

Link with international programmes

The objectives of ASTER perfectly meet those of the Global Change and Ecosystem Programme of the European Union's Framework Programmes, the World Climate Research Programme (WCRP), in particular its core projects Climate

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and Cryosphere (CliC), Climate Variability and Predictability (CLIVAR), and Coordinated Observation and Prediction of the Earth System (COPES), the International Geosphere-Biosphere Programme (IGBP), especially its core projects Past Global Changes (PAGES) and Surface-Ocean-Lower Atmosphere Study (SOLAS), and the core project Antarctic Climate Evolution (ACE) of the Scientific Committee on Antarctic Research (SCAR). It is worth mentioning that ASTER partners actively participate in those research programmes. ASTER is complementary to the European projects MOTIF (Models and observations to test climate feedbacks) and ENSEMBLES (Ensemble-based predictions of climate changes and their impacts) The former version of the model was employed in the previous assessment reports of the Intergovernmental Panel on Climate Change (IPCC). ASTER results will undoubtedly be part of the IPCC Fifth Assessment Report.

showing a large range of responses to prescribed forcings; it finally will present a detailed study on the model response to increased CO_2 concentration and freshwater perturbation.

Apart from the scientific benefits, the project will provide policymakers with long-term projections of climate and sea level changes with increased confidence. This should help the decision-making process regarding reduction in future CO_2 emissions and adaptation to climate and sea level changes. Additionally, the model outputs will be useful for a number of follow-up projects in the climate impact research community, for example, for studies dealing with agricultural productivity, human health and socio-economical aspects of climate change.

EXPECTED RESULTS AND/ OR PRODUCTS

On the scientific point of view, the main deliverables of ASTER will consist of an improved version of LOVECLIM; it will also identify a selection of set of parameters leading to an ensemble of model versions

PARTNERS - ACTIVITIES

Thierry Fichefet
has a long experience in global climate modelling, with focus on ice-climate interactions. He is deeply involved in national and international research programmes and organisations.

Hugues Goosse's
research interest is focused on decadal-to-centennial climate variability in mid- and high latitudes and on the evolution of climate over the last few millennia. He is also one of the main developers of the ECBILT-CLIO model.

Philippe Huybrechts
is well known for his expertise in the numerical modelling of ice sheets and glaciers.

Anne Mouchet's
research interests presently focus on the modelling of global biogeochemical cycles in the ocean and on the use of tracer in understanding the ocean circulation and model behaviour. She developed the three-dimensional oceanic carbon cycle model LOCH at ULg-LPAP.

CONTACT INFORMATION

Project website:
www.climate.be/ASTER/

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Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra or http://www.belspo.be/ssd

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