



The ENSEMBLES project of the EC – integrating climate change impacts studies into an ensemble prediction system



The information on this handout is to complement the ENSEMBLES side event being held in the EU Pavilion (Brussels Room) on the 4th December at 1.00 pm.

What is the ENSEMBLES project?

The ENSEMBLES project is developing an ensemble climate forecast system for use across a range of timescales (seasonal, decadal and longer) and spatial scales (global, regional and local). The modelling system is being used to produce probabilistic scenarios of future climate for a quantitative assessment of impacts in a range of applications, to provide policy-relevant information.

Why is the ENSEMBLES project relevant to the UNFCCC process?

The ENSEMBLES project helps to fulfil some objectives of the Kyoto Protocol, and also addresses recommendations in the IPCC Third Assessment Report.

Activities and results from the ENSEMBLES project

The ENSEMBLES project is now three years into its five year programme and policy-relevant scientific results are now being delivered. Specifically, the following results have been achieved, and are grouped under topical headings:

Development of global ensemble climate prediction system, based on European earth system climate models

- New stochastic physics and perturbed parameter ensemble systems developed to sample modelling uncertainties in seasonal to decadal climate prediction.
- The performance of multi-model, stochastic physics and perturbed parameter systems have been assessed in a set of seasonal to decadal ensemble hindcasts.
- The initialisation of seasonal to decadal hindcasts has been improved through the development of improved datasets of ocean observations, and improved methods for the assimilation of these data into climate models.
- A new set of Earth System models has been constructed, tested and provided for use in simulations of future climate change.
- Methods to quantify uncertainties in decadal to centennial climate change have been developed, based on perturbed parameter ensembles sampling uncertainties in atmosphere, ocean, sulphur cycle and carbon cycle processes.

Development of a high resolution regional climate model (RCM) ensemble system for Europe

- A regional climate model system, of 10 different models, for use in multidecadal simulation experiment ensembles at 25 km.
- Co-ordinated regional climate model evaluation runs (~1960-2000, ERA40 boundaries).
- Provision of the co-ordinated regional climate model simulation data for the international climate and climate impact research community, available through an on-line database.
- Performance-based weighting of the ENSEMBLES regional climate models, focusing on temperature and precipitation, as a means to advance probabilistic climate change projections on regional scale.

Production of sets of simulations at seasonal-decadal and centennial timescales using the global ensemble prediction system

- A first set of multi-model seasonal, annual and multi-annual hindcast simulations has been produced over a 10 year period (1991-2001), from 7 coupled GCMs with each 9 ensemble members, in order to sample uncertainties.
- A public data server based on NetCDF files and OPenDAP technology has been developed at ECMWF for dissemination of the results of the seasonal-to-decadal integrations, including daily and monthly data.
- For the second phase of the project the seasonal-to-decadal hindcast simulations are currently being extended over the period 1960-2001 with 5 coupled models
- Coupled multi-decadal simulations using existing coupled atmosphere-ocean-sea ice models from the European modeling groups (CNRM, DMI, IPSL, METO-HC, MPIMET, NERSC) have been coordinated so as to produce a consistent set of state-of-the-art benchmark multi-model simulations usable for the Fourth Assessment Report of IPCC (AR-4).
- Starting from long control coupled simulations for preindustrial conditions, a set of multi-model simulations have been produced over the period 1860-2000 to simulate the longer-term climate anomalies observed during the 20th century in response to a prescribed set anthropogenic forcings only and with the addition of natural forcings
- A multi-model set of coupled simulations over the 21st century has been produced with the 3 scenarios of aerosol and GHG forcings recommended by IPCC (scenarios A2, A1B and B1) in order to produce a projection of the future climate with a better estimate of the uncertainties due to model formulation, initial state of the climate system, and scenario choice.
- Some simulations have been extended beyond year 2100 with constant forcings from the B1 and A1B scenarios, and additional simulations have been performed with 1% increase of CO₂ per year with stabilisation at 2xCO₂ and 4xCO₂
- Results of the RT2A climate scenarios have been stored in the WCRP CMIP3 multi-model dataset archive at PCMDI, from where they have been used in numerous diagnostic subprojects and publications contributing to the IPCC AR-4 assessment.

- High temporal resolution (daily and 6-hourly) results from the RT2A multi-decadal simulations have been made available, first on local servers at the participating institutions, and are now being centralised, with the required metadata, on the CERA database, run by the Model&Data group at the Max-Planck Institute for Meteorology.
- Improved versions of the coupled climate models, some including new components for the carbon cycle and aerosols, have been prepared for running a new set of simulations taking into account land-use changes, as observed or computed by a recent version of IMAGE integrated assessment model. In addition to an A1B scenario, a new stabilisation scenario to 450-ppm of CO₂ equivalent, developed in collaboration with RT7, will be used for a second stream of simulations in 2008.

Production of regional climate scenarios for impacts assessments with high resolution RCM ensemble system

- Construction of a web portal for data downscaling system covering Europe and operating at seasonal to decadal timescales: <http://grupos.unican.es/ai/meteo/ensembles/>
- Online provision of ENSEMBLES regional climate model data.
- Production of transient climate change projections (1950-2050/2100) for Europe. Development of modelling methodologies, ensemble averaging techniques and pattern scaling methods.

Climate variability, predictability and the probability of extreme events

- Demonstrated that the magnitude of the climate-carbon cycle feedback depends on non-CO₂ GHGs and aerosols forcings.
- Advanced understanding the decrease of the concentration of sea ice in the Barents Sea under global warming and freshening of the Arctic Ocean over the 21st century.
- Demonstrated that the MJO, ENSO, ENSO-monsoon interaction, and tropical storm variability are significantly improved in a high resolution model.
- Studied the impacts of external forcings on the characteristics of the active-break cycle of monsoon. The results indicate that events will become more intense at 2xCO₂ relative to the seasonal cycle.
- Assessed the main features of climate and variability over the Euro-Mediterranean region and how they might be affected by climate change. Developed a new statistical method to optimally link local weather extremes to large-scale atmospheric circulation structures and investigated the occurrence of summer heat waves over Euro-Mediterranean and its connection with the large scale circulation.
- Investigated and elucidated the decadal predictability associated with Atlantic THC by using model simulation.

Evaluation of the prediction system against observations

- Development of a gridded data set of daily observed data for Europe, with online availability: <http://eca.knmi.nl/download/ensembles/ensembles.php>
- Assessment of the simulation of the Asian summer monsoon, climate predictability in Europe, and land surface physics in Boreal summer climate. Evaluation of precipitation extremes in the Alpine region.
- Comprehensive assessment of actual and potential seasonal to decadal forecast quality of the Earth system model and the multi-model system.
- Development of validation systems for the range of models used in ENSEMBLES.

Assessment of the impacts of climate change

- The integration of impacts models into ensemble prediction systems, which predict impacts on timescale from seasonal to centuries and at regional (and local) scales to global scales.
- Development of benchmarking marking tests (for climate change impacts on the biosphere) using global ecosystem models.
- Development of the use of regional climate impact response surfaces (allowing the prediction of changes in temperature and rainfall to be used to predict impacts for a range of systems).
- Maximising impact model skill at seasonal times scales through the development of probabilistic approaches
- Developing impacts methods that can be used across a range of prediction timescales i.e. climate model products - s2d, ACC RCM and ACC GCM
- Incorporation of realistic fire, forestry and grazing system within the biosphere of global climate models
- Development of integrated forecasting systems with benefit to NGOs, governments and private companies for seasonal lead times.
- Climate change is estimated to increase the temperature-attributable proportion of diarrhoeal disease, but this is in the context of an overall decline in diarrhoeal disease mortality.
- Climate change will increase heat-related mortality and decrease cold-related mortality. The estimates of changes in attributable cardiovascular mortality are large due to population ageing and the large burden of cardiovascular projected in low and middle income countries.
- Climate change (as projected under the A2 and B2 emissions scenarios) may decrease labour productivity, particularly in Africa and South-East Asia region unless adaptation measures are implemented -impacts or adaptation will be incur costs to businesses, depending on their capacity to protect the health of their workers.

Emissions scenarios, with land-use change and adaptive capacity, with and without international climate policy

- Conducted critical review of the economic assumptions of SRES scenarios, reaching the conclusion that more realistic and theoretically sound scenarios could be adopted, but this would not significantly modify the order of magnitude of global GHG emissions;
- Produced stabilization scenarios, which are used as inputs in climate models;
- Carried out economic impact studies, and developed two dynamic economic models to this purpose;
- Assessed feedback of climate change impacts on global GHG emissions (carbon dioxide and sulphurs).

Funded by the European Commission and coordinated by the Met Office Hadley Centre, the ENSEMBLES project aims to quantify the uncertainty in long-term predictions of climate change. ENSEMBLES is a collaborative venture involving 67 institutes to provide a reliable quantitative risk assessment of long term climate change and its impacts. Particular emphasis is given to probable future climate changes in extremes, including storms, intense rainfall, drought and climate 'shocks'. To focus on the needs of policymakers, ENSEMBLES considers impacts on timeframes ranging from seasonal to decadal to centennial, and at local, regional and global spatial scales.
<http://www.ensembles-eu.org>