COMBINE

Quarterly Newsletter 1 – July 2010

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

COMBINE is a collaborative and large-scale integrating project of the European Commission's 7th Framework Programme. The project started 1 May 2009, and is planned to run for four years. The focus of the project is to advance the prediction capabilities of Earth System models (ESMs), by including key physical and biogeochemical processes into the models, to represent more accurately the forcing mechanisms and the feedbacks determining the magnitude of climate change in the 21st century.

Within the project, development work of Earth System models covers the incorporation of the carbon and nitrogen cycles, aerosols coupled to cloud microphysics and chemistry, proper stratospheric dynamics and increased resolution, ice sheets and permafrost for the cryosphere. To benefit from the predictability of the climate system in predictions of the climate of the next few decades, a part of the project work is dedicated to the improvement and development of ocean and sea-ice initialization techniques.

A further important aim of the project is to use Earth system models for decadal climate prediction and climate projection experiments following the protocols of the Coupled Model Inter-comparison Project 5 (CMIP5) for the Inter-governmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) simulations.

At the regional level, the project work focuses on analyzing climate change in: The Arctic, the Eastern Mediterranean and the Amazon basin, where different feedbacks are important. Globally and for the selected regions, climate change impacts are quantified for two sectors: water availability and agriculture.

The COMBINE Earth system models are also used, in combination with an integrated assessment model, to estimate CO_2 emissions that are compatible with representative concentrations scenarios specified for the IPCC AR5 climate projections, and to revise the scenarios accordingly.

Since the starting of the project, work on the development of new components for Earth system models is well underway. The COMBINE partners have so far assembled twice: At the Kick-off meeting in September 2009, hosted by MPI-M, Hamburg, Germany, and at the 1st General Assembly (GA) in June 2010, hosted by ETHZ, Zurich, Switzerland. To report on the 1st COMBINE GA is the subject of this newsletter.

It is anticipated, that the 2nd COMBINE GA will take place in late spring 2011, in Exeter, UK, kindly hosted by the Met Office.

1st COMBINE GA 2010

The 1st COMBINE GA was held in Zurich, Switzerland, 9-11 June 2010. The GA 2010 has brought together 57 participants from 13 countries. Most partners have been represented by 2 or 3 participants. The first day of the GA has been dedicated to breakout sessions by Work Package (WP) and additionally by the Data Protocol Panel (DPP) meeting. The breakout sessions have been well attended (5 to 15 participants at each session) and lively. A post-GA survey has indicated that they have been found to be an effective way for discussing questions that are specific to each WP and for the intra-WP coordination.

The plenary meeting (1 and ½ days) included presentations by WP (hereafter summarized) the Poster Session, and General Discussion Sessions. The WP presentations reported both on scientific results of the project first year and on the status of deliverables and milestones and the work ahead. The well-attended Poster Session consisted of 20 contributed scientific presentations, with at least a poster for each WP.

Carbon and Nitrogen (WP1)

P Friedlingstein and C Jones reported on the progress in incorporating land-use, permafrost, wetlands and fire parameterizations in the land & vegetation surface schemes of the ESMs. All the six ESMs participating in WP1 already include an interactive representation of transient land-use changes (Hurt/RCP dataset), however only four models (HadGEM, IPSL-ESM, COSMOS and NorCLIM) do so within the framework of a land carbon model. Development work for the EC-EARTH model in WP1 focuses only on permafrost and wetland representations, while the CNRM-CM model development has been completed with the inclusion of land-use changes. While now each group is working independently, coordinated analysis of CMIP5 runs for land use will follow. Work on the inclusion of the nitrogen cycle is underway. It is also planned that a subset of WP1 participants will perform a set of simple CMIP5 experiments for further testing of new component: "+1%CO2/yr" or "instantaneous 4xCO2" runs with carbon and nitrogen interactions, or methane emissions from wetlands and permafrost.

Aerosols, Clouds, and Chemistry (WP2)

U Lohmann reported ongoing work at ETHZ on the consideration of vertical velocities associated with orographic gravity waves in the representation of cirrus clouds, on the impact of including subgrid variability in stratiform clouds and on implementing a new shallow convection scheme in the ECHAM5 model. Further activities in WP2 include (1) the introduction of a multi-layer canopy exchange model into the EMAC model (an atmospheric chemistry model) for estimating the impact of land-cover and land-use changes on the exchanges between the atmosphere and the biosphere (Wageningen); (2) an intercomparison of coupled aerosol climate simulations (Y Balkanski and collaborators) and (3) the implementation of stochastic treatment of clouds and radiative transfer in the COSMOS ESM (reported by H Järvinen).

Stratosphere (WP3)

C Cagnazzo reported on the incorporation of the stratosphere within the five ESMs (CMCC, COSMOS, EC-EARTH, HadGEM2 and IPSL) active in WP3. High top atmospheric components of the ESMs have been coupled to the respective ocean&sea-ice models during the first year of the project. Test and/or longer runs have been carried out, demonstrating the stability of the newly coupled atmosphere-ocean&sea-ice models. Generally, high top atmospheric model components are usually considered to have a top at pressure lower than 1 hPa (approximate location of the stratopause) and a minimum of 35 vertical levels. Although the standard atmospheric component of the EC-EARTH model is just at 1 hPa, it already has a high vertical resolution (L63). Therefore, the comparison of this EC-EARTH model version with the rest of the WP3 models will enable the evaluation of the relative role of high vertical resolution and model tops in the simulation of the stratospheric climate, and its connection to surface climate.

Cryosphere (WP4)

M Kageyama reported that the main challenges in coupling Ice sheet Models (ISMs) are related to a satisfactory representation of snow processes on the ice sheet, in order to compute the mass balance of the ice sheet; to implement mass and energy conserving coupling and down/up-scaling schemes; and to achieve consistency in topography and sea level at the model interface. Additional challenges are limited observations of the ice sheets, for validation and initialization. Progress during the first project-year covered the validation of the atmospheric model component output over Greenland (CNRS, MF-CNRM, MPI and DMI), in order to assess the driving of the ISMs, the development of a new energy balance model by MPI, the development and/or improvement of snow ice schemes by CNRS and DMI, and off-line runs of the ISMs with different input fields from atmospheric components of climate models (CNRS, MF-CNRM, MPI and DMI). The incorporation of melt ponds has been tested with off-line runs of the GELATO sea-ice model (MF-CNRM) and with sensitivity runs (EC-EARTH model). In WP4, there are currently 3 ISMs (PISM, GISM, and GRISLI), 2 sea-ice models (LIM2/3 and GELATO) and 3 permafrost models. The ESMs under development in WP4 are COSMOS, HadCM, IPSL-ESM, CNRM-CM, and EC-Earth.

Initialization (WP5)

M Balmaseda reported on the progress in initializing the ocean and sea-ice components in models for the application to decadal climate prediction runs, namely the stream-1 and stream-2 runs (see WP6). Two initialization techniques are currently used for the stream-1 runs: (1) Anomaly initialization using existing ocean re-analysis (MPI and METO); (2) Direct use of ocean re-analysis as initial conditions (CMCC and ECMWF). To date, the ocean re-analysis needed to initialize the stream-1 runs are accomplished. Evaluation of these ocean re-analyses is concerned with the representation of trends, the penetration of heat into the ocean interior, and the large uncertainty in the Atlantic meridional overturning circulation. Work on progressing beyond the state of the art include further development of assimilation methods, such as the inclusion of altimeter data, and the inter-comparison of initialization strategies.

Climate Prediction (WP6)

R Haarsma reported on the ongoing work of the partners involved in the production of the stream-1 climate predictability and prediction runs. Most of the work so far has focused on the adaptation of the forcing fields to the ESMs, as well as the final preparation of the ESMs for the production runs. Decadal predictability runs are expected to be finished by October 2010, while the decadal prediction runs are scheduled for January 2011.

Climate Projection and Feedbacks (WP7)

J Quaas reported on the ongoing work of the partners involved in the production of the stream-1 climate centennial scenario runs for CMIP5, with deadline January 2011. Of the 7 models participating to WP7, 5 models (CMCC, COSMOS, HadGEM2, IPSL-ESM, and NorCLIM) include the carbon cycle and 6 (CMCC, COSMOS, EC-Earth, HadGEM2, IPSL-ESM and CNRM-CM) the dynamical stratosphere. Interactive aerosols and chemistry as well as the cryosphere are only very limitedly included in the model versions for stream-1.

Impacts and Scenarios (WP8)

D Van Vuuren reviewed the construction of the RCPs (Representative Concentration Pathways) with the focus on their extension from 2100 to 2300. Otherwise, WP8 will start once the stream-1 runs of WP6 and WP7 are completed.

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CYI, CY	**INPE, BR**	

EVENTS of interest:

16-20 August 2010 ***Conference on Decadal Predictability***, Trieste, Italy

20-23 September 2010 ***WGOMD-GSOP Workshop on Decadal Variability, Predictability, and Prediction: Understanding the Role of the Ocean***, Boulder, CO, USA

27-28 September 2010 ***Wallace Symposium***, Seattle, WA, USA

27-29 September 2010 ***Workshop on metrics and methodologies of estimation of extreme climate events,*** Paris, France

12-14 October 2010 ***International Workshop on ENSO, Decadal Variability and Climate Change in South America,*** Guayaquil, Ecuador

3-5 November 2010 ***SPARC DynVar Workshop 2***, Boulder, CO, USA

6 - 8 December, 2010 ***The Global Dimension of Change in River Basins – Threats, Linkages and Adaptation,*** Bonn, Germany

13–17 December 2010 ***AGU Fall Meeting***, San Francisco, CA, USA