

**WMO/ICSU/IOC
WORLD CLIMATE RESEARCH PROGRAMME**

**JSC-31/Doc. 4.7
(28.1.2010)**

JOINT SCIENTIFIC COMMITTEE

Item number

**THIRTY-FIRST SESSION
ANTALYA, TURKEY
15-19 FEBRUARY 2010**

**Report from the 13th Session of the Working Group
on Coupled Modelling (WGCM)
28-30 September 2009**

(Submitted by Drs A. Pirani, S. Bony and G. Meehl)

**Report from the 13th Session of the Working Group on Coupled Modelling (WGCM)
28-30 September, 2009**

A. Pirani, S. Bony and G. Meehl

The 13th Session of the CLIVAR/WCRP Working Group on Coupled Modelling (WGCM) was hosted by the Program for Climate Model Diagnosis and Intercomparison (PCMDI) in Sausalito, San Francisco, USA. PCMDI celebrated its 20th anniversary in 2009, having been established in 1989 at the Lawrence Livermore National Laboratory (LLNL) in Livermore, California. WGCM was extremely grateful for the welcome and organization provided by K. Taylor, P. Gleckler and P. Drumtra of PCMDI that made this meeting so successful.

The two main topics of this meeting were the progress of the Coupled Model Intercomparison Project: Phase 5 (CMIP5) and the theme of model evaluation and improvement. WGCM's partners (including CLIVAR, GEWEX, SPARC, CliC, WGNE, WOAP, IDAG) and the global modelling centres reported on their activities of relevance to CMIP5, including associated coordinated experiments, and progress in model development. Additional WGCM discussion topics included air quality and climate and a proposal for a coordinated geoengineering experiment. The third day of the meeting was held jointly with the Scientific Steering Committee of the IGBP Earth System modelling project, Analysis, Integration and Modelling of the Earth System (AIMES). The mini-workshop addressed the current status of Earth System Model (ESM) development and future directions.

CMIP5 and Coordinated Modelling Activities

Over 20 global modelling groups are in the process of starting to generate their contributions to the Climate Modelling Intercomparison Project, Phase 5 (CMIP5). The PCMDI CMIP5 website (<http://cmip-pcmdi.llnl.gov/cmip5/>) is in place and includes the full set of forcings for CMIP5 (emissions and concentrations) and the list of fields to save from the simulations.

The Representative Concentration Pathways (RCP) database currently includes harmonized and consolidated data for three of the four RCPs (RCP2.6, RCP4.5 and RCP8.5). The database will include historic and harmonized future land use/land cover data as well as further spatial detail for historical emissions. The data for RCP 6.0 is undergoing internal review within the Integrated Assessment Modelling (IAM) community and will be made available as soon as possible. Registered users of the database will receive information about further developments and updates of the database.

The AC&C/SPARC Ozone Database is available from the CMIP5 website and has the goal of providing a merged tropospheric/stratospheric ozone time series from 1850 to 2100 for use in CMIP5 simulations by models without interactive chemistry.

The inclusion of the Cloud Feedback Model Inter-comparison Project, Phase 2 (CFMIP2) experiments in CMIP5 has created a direct link between the process and climate communities. The CFMIP component of CMIP5, both experiments and outputs, has been finalized. CFMIP has developed the CFMIP Observations Simulator Package (COSP), a community tool for facilitating the comparison of model with satellite data (www.cfmip.net). Observations consistent with COSP diagnostics are available on <http://climserv.ipsl.polytechnique.fr/cfmip-obs.html>. COSP V1.2 will be compliant with CMIP5 data format requirements.

The Paleoclimate Modelling Intercomparison Project, Phase 3 (PMIP3) is contributing to the CMIP5 list of simulations on the last glacial maximum (LGM), the Mid-Holocene and the last millennium. The experimental design of the experiments has been finalized (<http://pmip3.lsce.ipsl.fr/>). The last millennium simulations will assess the relative role of external forcing and internal variability in shaping the climate on interdecadal to multi-centennial time scales, ensuring continuity with the CMIP5 control integrations. The PaleoCarbon Modelling Intercomparison Project (PCMIP) focuses on the coupling between climate and the carbon cycle on Quaternary time scales and is a Tier 2 experiment for CMIP5. PMIP recommends that groups

use the same model version as is being used for simulations of the current and future climate, though recognizing that the stress on resources may mean that different resolutions are used.

The Task Force on Regional Climate Downscaling (TF-RCD) was formed in 2008 and its main outcome has been to organize the Coordinated Regional Climate Downscaling Experiment (CORDEX) that is aimed at fostering coordination between regional downscaling efforts around the world, and at assessing and understanding the sources of uncertainty in RCD-based projections. CORDEX has a model evaluation framework consisting in a set of simulations at 50 km resolution using ERA-Interim reanalyses as boundary conditions over the period 1989-2007, and a climate projection framework related to the RCP 4.5 and 8.5 CMIP5 simulations, contributing to the near term, decadal runs. CORDEX will evaluate what is the added value of downscaling and address issues of uncertainty at small scales. The aim is to look at the regional changes in climate and air quality associated with the evolution of GHGs, aerosols, land use changes, etc, and to assess their possible impacts. The initial focus will be on Africa. A CORDEX website is being developed, there is commitment from global modelling groups to provide the necessary output, hosted by PCMDI, and results will be held in CORDEX databanks.

A framework to facilitate the use of observations alongside CMIP5 model data has been proposed, initially for NASA, but hopefully for expansion to other agencies and data centres (a discussion about this is underway within WOAP). The proposal aims to identify observational datasets that are pertinent for CMIP5 analysis, something never done before, engaging the observational community directly. A strategy is being developed to provide the community of researchers that will access and analyze CMIP5 model results access to analogous sets of observational data in a common and convenient format. The need to inform modellers about observations, uncertainties and differences across algorithms has been raised.

Model Development and Evaluation

Now that CMIP5 is underway, WGCM and the wider modelling community has the opportunity to start the process necessary to achieve major improvements to develop the next generation of models, with an eye on a future CMIP6. WGCM will be strengthening its partnership with the WCRP Working Group on Numerical Experimentation (WGNE) that is also aiming to drive this process, working on parameterization development, metrics, organizing focused workshops, etc. As part of this partnership, a joint WGNE-WGCM initiative (named Transpose-AMIP) aiming at evaluating climate models in a numerical weather prediction mode has been endorsed.

Model errors and biases are key limitations of the skill of model predictions over a wide range of time and space scales. This is not a new story and the increases in resolution and in model complexity have not solved the problem. In an effort to reinvigorate the discussion of how to improve and evaluate models, a bottom-up community-wide consultation has been initiated within WCRP and its core project working groups and panels, WWRP and THORPEX, and IGBP. The groups surveyed range from the process study, theoretical and observational communities to the NWP and climate modelling communities. The fact that WCRP is undergoing a period of evolution in its structure is an opportunity to put the recommendations from the survey into action.

More than 100 responses have been received so far, many of which are group, lab or project-wide responses. The survey recommendations and outcomes will be available on a dedicated website and the results will be synthesized for the WCRP, WWRP and THORPEX steering committees. The survey outcomes will help to provide advice regarding where international coordination and efforts need to be strengthened. The results will also be published in the peer-reviewed literature.

Joint WGCM-AIMES SSC Meeting on Earth System Modelling

The final day of the WGCM meeting that was held jointly with the AIMES SSC included updates on the state of the art of ESMs in Japan, Europe and the USA as well as a discussion on what the increasing complexity of ESMs means for evaluating uncertainties, feedbacks and climate sensitivities. There will be new issues emerging with CMIP5 now that some modelling groups are running ESMs, with new questions arising on how to evaluate them. The need to coordinate efforts

on the process-oriented analysis and evaluation of ESMs across the different MIPs (C4MIP, CFMIP, CCMVal, etc) has been recognized.

The meeting addressed the future directions for Integrated Assessment Models (IAMs), including the prospects for coupling IAMs to ESMs, and adding human dimensions. There have been three major transformations in the human population over time, the last being since the industrial revolution. From an IAM perspective, there will be a new change over the next century. This will be in part intentional, due to policies and choices in development paths, and in part depending on natural processes and climate. This gives the motivation for coupling the IAM and ESM disciplines. Integrated 'Anthropocene' (human and Earth) System Models (IASMs) could couple human well being and earth systems in an internally consistent way by coupling emissions, land-use and land-cover, carbon and nitrogen cycles, energy, industry, transport, settlement patterns, agriculture, forestry.

The model and data needs of predicting biogeochemistry and biology in the Earth System were discussed together with a presentation of the National Ecological Observatory Network (NEON), an observing system in the USA with 20 eco-climatic zones. NEON data is being integrated to produce analyses and forecasts, for example, of the suitability of habitats for invasive species. Long-term observations of relevant quantities are necessary to assess and develop models.

The closing discussion of the joint meeting focused on the common interests between the WCRP and IGBP in pursuing a coordinated strategy to Earth System Modelling, looking at what are the key questions that should be addressed by a suite of ESMs and how to best develop the models needed to address these questions, including what are the climate related questions and what additional dimensions could be included into ESMs. The idea is to think ambitiously on where ESMs are going in the future and whether other collaborations are necessary that are outside the traditional WCRP-IGBP partnership. Future plans should also include a 'deliverables' dimension on how observations and model improvements lead to capabilities for those investing in the fundamental research as well as users of the output information.