Introduction to CMIP5

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This special issue of CLIVAR Exchanges provides updates and details regarding the latest phase of the Coupled Model Intercomparison Project, CMIP5. About 20 modeling groups from around the world are currently running the CMIP5 experiments that represent the most ambitious multi-model intercomparison and analysis project ever attempted. The WCRP Working Group on Coupled Models (WGCM), in consultation with the IGBP Analysis Integration and Modeling of the Earth System (AIMES) and a number of other elements of WCRP and the climate research community, is coordinating the running and analysis of these model simulations. More details on CMIP5 can be found at Taylor et al. (2009; 2011). This article provides a brief background and introduction, as well as the latest updates on CMIP5 activities, including two workshops where CMIP5 results can be presented.

The motivation for CMIP5 emerged in the latter stages of the IPCC 4th Assessment report (AR4) process where a number of gaps became evident in the information CMIP3 could provide. At an Aspen Global Change Institute session in mid-2006, representatives from a number of interested communities (e.g. physical climate science, biogeochemistry, impacts/adaptation, integrated assessment modeling) formulated the basic concept for CMIP5, dividing the simulations into the near-term and long term time scales, with additional experiments to better address biogeochemical feedbacks in the climate system. The outlines of this process were published in Meehl and Hibbard (2007) and Hibbard et al. (2007). In parallel, the community interested in physical climate feedbacks, in particular those associated with clouds and moist processes, have elaborated a strategy to better assess these processes in models and better understand their role in climate change (Bony et al., 2008; Quaas et al., 2009). It led to the recommendation of using satellite simulators in some CMIP5 experiments to facilitate the evaluation of model-simulated clouds in comparison to observations, and to the proposition of adding very idealized model experiments (e.g. aquaplanet) to CMIP5 to better unravel the physical mechanisms that control robust climate responses. These new aspects of CMIP5 are designed to help in the interpretation of inter-model differences in climate change projections.

Thus, the scope of CMIP5 is much broader than CMIP3, with not only long term concentration-driven AOGCM experiments with the four new representative concentration pathway (RCP) mitigation scenarios (Moss et al., 2010), but also emission-driven Earth System Model (ESM) experiments, some of those with partial coupling to explore sensitivity of the carbon cycle feedback. The new field of climate research called decadal climate prediction (Meehl et al., 2009) will be represented by a number of hindcasts and near term prediction experiments. There will be many more experiments to explore the impact on climate of various natural and anthropogenic forcings, the reasons for model spread in terms of size and nature of feedbacks, and paleo-climatic experiments to assess the ability of CMIP5 models to reproduce past climate changes to better inform the credibility of the models' future climate change projections. Even more versions of models will involve aerosols-chemistry-climate models, higher resolution AOGCMs (about 50 km resolution) and higher resolution yet (about 25 km) atmosphere-only time slice experiments. CMIP5, together with model intercomparison projects run in parallel to CMIP5 (e.g. Transpose-AMIP, which will evaluate CMIP5 climate models in weather forecast mode), will make it possible to assess and to analyze models participating in CMIP5 over a wide range of time-scales (from the process to the paleo-climatic scale) and configurations. The articles in this CLIVAR Exchanges Special Issue provide further descriptions of the elements of CMIP5, including the long term experiments; carbon cycle feedbacks; the cloud feedback experiments recommended by the Cloud Forcing Model Intercomparison Project (CFMIP); the paleo-climate experiments put forward by the Paleo-climate Modelling Intercomparison Project (PMIP); global coupled climate models that extend the vertical domain to include more detail in the stratosphere, called high top models; the protocol to provide better descriptions of the models and experiments in CMIP5 called Metafor; the decadal climate prediction experiments; satellite observations for CMIP5 analyses; and aspects relevant to ocean modeling in CMIP5.

Some model data are already available for analysis through the PCMDI web page, with more steadily coming on line http://cmip-pcmdi.llnl.gov/cmip5/. The multi-model dataset will mature through the course of 2011 as more and more model data become available. We advise analysts to be flexible in their analyses, starting with a few models, but allowing the capability to include additional model data as more becomes available. Experience with CMIP3 indicates that general conclusions can be reached with a few models, and uncertainties can be better quantified with the addition of more models to reach final publishable results. We also suggest to analysts that they try to evaluate and analyze model simulations over a wide range of experiments, time-scales and configurations (coupled/atmosphere-only, with/without ocean initialization, etc), as it may provide hints about the origin of inter-model differences or model errors, and thus benefit the model development process.

With regards to opportunities to present results from CMIP5 model data analyses, the first is a CMIP5 poster session at the upcoming WCRP Open Science Conference (OSC) to be held in Denver, Colorado USA 24-28 October, 2011. For more information on the OSC, please check: www.wcrp-climate.org/conference2011

The CMIP5 session at OSC is Session C34: **Global Model Evaluation and Projections: CMIP5 and Other Model Intercomparisons**, with conveners G. Meehl, D. Waugh, J. Fasullo, K. Williams. Though the emphasis is on new CMIP5 analyses, results from CMIP3 and other model intercomparisons such as CCMVal are also welcome. The session could also include results pertaining to, for example, reanalyses, transpose AMIP, and quantitative performance metrics. The deadline for submitting abstracts is 30 April 2011. Abstract submission is available now on the OSC web page noted above.

A few other key dates for the OSC:

- Early bird registration deadline for OSC: 30 June 2011
- General registration deadline for OSC: 24 October 2011

The second opportunity to present CMIP5 model analysis results will be a CMIP5 Workshop to be hosted by the International Pacific Research Center at the University of Hawaii, March 5-9, 2012. This will be comparable to the CMIP3 Workshop held there in 2005. The CMIP5 Workshop will be a similar "short presentation/poster" format. This workshop is currently being formulated, and further details will be made available on the WCRP, CLIVAR and PCMDI web pages.

To access the CMIP5 data, please register on the PCMDI CMIP5 web page: http://cmip-pcmdi.llnl.gov/cmip5

Due to the widespread interest in CMIP5, we encourage you to pass along the information in this Special Issue to your colleagues and associates.

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CMIP5 Long-term experimental Design

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1. Introduction

CMIP5 (Coupled Model Intercomparison Project phase 5) follows the highly successful phase 3 of CMIP (Meehl et al. 2007), which made available a coordinated set of global coupled climate model experiments, which were analyzed by the international climate science community and subsequently assessed in the 2007 IPCC Fourth Assessment Report. It is expected that CMIP5 will have an even greater impact on climate science research, which will be assessed in the IPCC Fifth Assessment Report due out in 2013.

The experiment design for CMIP5 was first described by Hibbard et al. (2007) and Meehl and Hibbard (2007), and the complete specifications are given in Taylor et al. (2009). CMIP5 includes two new parts when compared with CMIP3. The first is the formulation of experiments that are designed for assessing the skill of decadal climate predictions that have been initialized with observed information. These experiments are the so-called near term experiments and are discussed in more detail by Doblas-Reyes et al. in this issue of the Exchanges Newsletter.

The formulation of the long-term simulations is the second new part of the CMIP5 experiment design and is the focus here. The long-term experiment design now includes not only experiments for conventional climate models (i.e., Atmosphere Ocean General Circulation Models – AOGCMs -- and Earth-System Models of Intermediate Complexity – EMICS), but now also experiments for the newer earth system models (ESMs, see Friedlinstein et al., this issue).