WGCM Report

1. **Panel or Working Group**: WCRP Group on Coupled Models and Anthropogenic Climate Change (WGCM), submitted by Gerald Meehl, co-chair, WGCM

2. Contributions to WCRP cross cutting topics as appropriate: Anthropogenic Climate Change; Atmospheric Chemistry and Climate; Monsoons; Decadal Predictability; Extreme Events and Climate

Modeling groups are now making decisions on what form their next generation climate models will take with an eye to running new climate change experiments that may be evaluated in a next IPCC assessment. However, the experiments proposed here regarding stabilization scenarios warrant community experiments to address this issue even if there is not another IPCC assessment. Additionally, new emission scenarios developed by the integrated assessment community reflect recommendations of the 25th IPCC Session. These advances in both the climate modeling and scenarios communities provide an opportunity for increased communication and collaboration that recommends plausible action towards assessing human mitigation of changing climate.

This confluence of activities in model and scenario development must be communicated and coordinated across various groups and scientific communities. To this end, a strategy for the next generation climate simulations is discussed that: (1) identifies new components in preparation for inclusion in AOGCMs (e.g. chemistry, aerosols, carbon cycle, dynamic vegetation), (2) establishes communication for coordination through the World Climate Research Programme (WCRP: WGCM and WGSIP in particular, along with at least SPARC), Integrated Geosphere-Biosphere Programme (IGBP: AIMES) and the Integrated Assessment (IA) modeling teams (the recently formed "scenarios consortium"), (3) proposes an experimental design for 21st century climate change experiments involving short term (decadal prediction) experiments out to about 2030, and long term mitigation/adaptation experiments out to 2300, and (4) specifies the requirements for new stabilization scenarios (particularly with regard to impacts, mitigation, and adaptation).

3. Highlights of wider contributions to CLIVAR science

1. Near term Experimental Design (2005-2030)

A major goal for 25-year model projections is to provide better guidance as to the likelihood of changes in climate extremes at regional scales. Meeting this challenge will depend on scientific questions involving understanding the processes that produce such extremes related to the hydrological cycle, and relevant atmospheric and oceanic processes operative on appropriate timescales. Regional scale predictions will require finer resolution models (at least 0.5^{o} -1^{o} atmospheric, with increased vertical resolution) that incorporate simple chemistry, aerosols, and dynamic vegetation, but on this short timescale a carbon cycle component would not be included. Both improved process

representation and higher resolution are important and compromises will be required to make the simulations computationally feasible.

To determine the significance of regional changes, and especially those of extremes, will require numerous simulations in an ensemble approach. Given that scenarios of long-lived greenhouse gases do not differ substantially prior to 2030, a single, mid-range scenario will be used for model predictions. Near-term experiments will produce relatively small magnitude climate change, however, the signal to noise discrimination will be more difficult. An exact number of ensemble simulations required is somewhat uncertain, but a minimum of 10 ensemble members for each case should be performed and discriminating changes in hydrologic extremes may require even more.

These near-term simulations could use a coupled initialized state close to the present-day state of the climate system, though the utility of this approach is still being explored as a research problem. This would require accurate representation of, for example, ocean salinity data and soil moisture, which are currently problematic due to sparse observations, and improved initialization datasets of sea ice may be required. Simulations would commence during the latter half of the 20th century in order to incorporate past climate forcings to account for radiative imbalances that produce short-term committed climate change, facilitate model verification and the logistics involved with the coupled assimilation/initialization process.

This will involve coordination with WGSIP with regards to issues involving coupled initialization. This is actually a decadal prediction problem, with model versions also used for longer term climate change.

2. Long-term (2005-2100 and beyond)

Longer-term projections quantify feedbacks in the Earth system related to climate outcomes that could be affected by various socio-economic and policy considerations (e.g., stabilization). These types of experiments would utilize a lower resolution AOGCM (roughly 2^{o}) with a conventional pre-industrial spin-up, followed by a 20th century experiment with natural and anthropogenic forcings providing a reference to earlier experiments and a multi-model ensemble of a mid-range scenario (e.g. SRES A1B) for analysis to compare to the previous generation of models run with that scenario. Carbon cycle feedbacks are important on this timescale and would be included for these long term experiments, though atmospheric chemistry and aerosols would be calculated simply or prescribed. Three experiments are proposed, two to quantify carbon cycle feedback in terms of emissions, and one to quantify this feedback in terms of climate change.

4. Cooperation with IGBP projects

See essential connection to AIMES above

5. New activities being planned, including timeline

Benchmark scenarios chosen at Amsterdam meeting, September, 2007; finalized benchmark scenarios supplied to modelling groups via WGCM: July, 2008; modelling

groups perform simulations: end of 2008-2010; model data collected and archived at PCMDI for analysis: 2010; analyses performed: 2010-2012

6. Description of your expected "legacy" at the end of CLIVAR (2013)

Coordinated experiments for short term decadal prediction and long term mitigation/adaptation to inform policy, and a resulting multi-model dataset for analysis by the community, likely to be called "CMIP4"