Papers Proposed for the *J. Climate* Special Issue

**Themes:**
1. Overview of CCSM
2. Description of components and their simulations
3. Climate sensitivity
4. Response of major to paleo, pre-industrial, climate change scenarios
5. Major modes of variability

**Scientific Steering Committee**

1. **The Community Climate System Model, Version 3**
   - General overview of system components
   - Differences in formulation relative to CSM1, CCSM2
   - Description of coupled system mean climate
     - Energy balance at TOA, surface
     - Sea-surface temperature and salinity
     - Atmosphere and ocean heat transport
     - Atmospheric wind patterns, ocean currents
     - Sea-ice thickness and concentration
     - Land-surface temperature
     - Precipitation (double ITCZ)
   - Stability and long-term behavior
     - Radiative fluxes
     - Sea-ice interdecadal variability
     - Surface temperatures
     - Deep ocean drifts
   - Variability: Characterization of ENSO, NAO, etc.
   - Ocean Science: developments from CCSM2. Brief description of the mean ocean climate with reference to surface biases in OWG #1. Analysis of deep-ocean drifts in maintaining the long-term drift in the CCSM3 heat budget.
   - Key Topic 1
   - The SSC, Collins (Lead), and R. Smith (OMWG author) + others

2. **The Impact of Changing Moist Physical Processes on the General Circulation of CAM; Sensitivity Studies.**
   - describes the changes to the representation of cloud physics in CCSM3 and the impact on the simulated climate through sensitivity studies; examines the cloud physics issues in the context of remaining biases.
   - Key Topic 1 and 2
   - B. Boville et al.

3. **The Hydrological Cycle: Mean State**
   - The climatology and year-to-year variations in the global and large-scale movements of water in the CCSM3, such as terrestrial precipitation, water storage and runoff, continental freshwater discharge, oceanic evaporation, oceanic freshwater transport, atmospheric water vapor transport, etc. We will focus on the aspects where observations are available for comparison.
   - Ocean Science: The ocean freshwater forcing (precipitation, evaporation, and runoff), storage, and Eulerian and eddy-induced transports within the global context of freshwater in the land, ice, and atmosphere, too. Positive feedback in the western tropical Pacific as a “rain gauge.” The role of the ocean model in the overall conservation of freshwater in CCSM3.
   - Key Topics 1 and 2
   - J. Hack or A. Dai (Lead); S. Yeager (OWG author) + others

4. **The Hydrological Cycle: Transients**
   - describes the variability of the components of the water cycle including the diurnal cycle, the pdf’s of rain intensity, and the relationship of water processes transients to modes of variability and the H2O greenhouse effect.
   - Key Topics 2 and 5
   - P. Rasch et al.

5. **Characteristics of Transport Using Three Formulations of Atmospheric Dynamics in a Single GCM Framework.**
- describes influence of differing numerics on a suite of constituents relevant for numerous climate studies to be carried out using CCSM in the future
- Key Topic N/A
- P. Rasch

- what are the differences in the atmospheric general circulation under different numerical formulations? why are they different? does it matter?
- Key Topic N/A
- B. Boville, P. Rasch et al.

7. A Slab Ocean Model
- describes and documents the slab ocean model, describes the variability and touches on the issue of climate sensitivity
- about 1/3 of the equilibrium climate sensitivity in CCSM is due to sea ice feedbacks, and yet the equilibrium climate sensitivity is estimated with a SOM embedded in CAM (without the coupler) that lacks major pieces of physics in the sea ice model. The PCWG has developed a SOM embedded in CSIM that is run through the coupler and thus uses precisely the same ice, atmosphere, and land components as in CCSM3. The “qflux” is taken directly from POP model output of the CCSM3 control, so the climatology of the control run with the SOM is virtually indistinguishable from the fully coupled CCSM3. The climate mean and sensitivity in both types of SOM runs will be compared.
- Key Topic 3
- J. Hack, C. Bitz et al.

8. Impacts of horizontal resolution
- how is the general circulation influenced by changes in horizontal resolution; why?
- documents the impact of horizontal resolution on climate simulations for model configurations frequently used in the CCSM/CAM community.
- Key Topic 2
- J. Hack et al.

Climate Change Working Group

1. 20th and 21st Century Climate, Climate Change, and Climate Change Commitment in the CCSM3 Simulations for the IPCC AR4.

- How well does the CCSM3 simulate the time evolution of 20th century climate in comparison to previous model versions (e.g., PCM), and how does this related to new measures of equilibrium sensitivity and TCR in the CCSM3? What are the mid-21st and late-21st century climate changes projected by the CCSM3 for the three scenarios (A1B, B1, and A2), how do these relate to previous model versions (e.g., PCM) and if they are different, why? What climate changes are we committed to in the 21st century if concentrations of atmospheric constituents are frozen at values for the end of the 20th century? What climate changes are we committed to in the 22nd and 23rd centuries if concentrations of atmospheric constituents are frozen at values for the end of the 21st century for the A1B and B1 scenarios?
- Key Topics 3 and 4

2. The Climate Sensitivity of CCSM/CAM: Fully Coupled and SOM Simulations.
- documents model climate sensitivity; provides insight into processes controlling climate change in the atmosphere and climate system; exposes strengths and weaknesses of CAM and the SOM.
- Key Topic 3
- J. Kiehl et al.

3. Impact of Pre-industrial vs Present Day Forcing on the Atmosphere
- identifies the major differences in the forcing regimes and the impact on the atmosphere.
- Key Topic 4
- W. Collins et al.

Climate Variability Working Group

1. Tropical Variability of the Coupled Ocean-Atmosphere System
- Description of ENSO in the T42 and T85 coupled control runs, including ENSO teleconnections to higher latitudes and to the Tropical Indian-Atlantic Oceans, thermocline variability, and an evaluation of the recharge/delayed oscillator paradigms.
- Comparison of ENSO atmospheric variability in coupled control runs and CAM3 AMIP runs at both resolutions.
- Comparison of ENSO ocean variability in coupled control runs and ocean-only runs.
- non-ENSO variability in the Tropical Atlantic and Indian Oceans.
- Key Topic 5
- C. Deser (Lead), A. Capotondi, Saravanan, E. Schneider, J. Norris

2. Extra-tropical Coupled Ocean-Atmosphere Variability
- ENSO teleconnections; annular modes and regional teleconnection patterns; weather regimes; tropospheric wave guide and storm tracks; cloud patterns; relationship of atmospheric variability to SST and mixed-layer depth including the re-emergence mechanism; thermocline variability and its relation to atmospheric variability.
- Ocean: Subtropical-tropical cells (to be merged by Wainer and Capotondi in concert with Alexander and Deser)
- Key Topic 5
- M. Alexander (Lead), I. Wainer and A. Capotondi

3. Monsoons around the Globe
- examine the different monsoon regimes around the globe as simulated by CCSM3; relate the monsoon circulations to particular modes of variability such as the Tropical Biennial Oscillation, ENSO, and the Indian Ocean Dipole.
- Key Topics 2 and 5
- J. Meehl et al.

4. Dynamic Circulation and Variability
- explores atmospheric variability in CAM stand-alone model
- Key Topic 5
- J. Hurrell et al.

Land Model Working Group

1. CLM surface climate
- description of the CLM surface climate
- Key Topic 2
- Robert Dickinson

2. Dynamic Vegetation in CCSM3
- document the dynamic vegetation physics in the model.
- Key Topic 2
- G. Bonan

Ocean Working Group

1. Attribution and Implications of Upper Ocean Biases in CCSM3
- A description of the climate state of the upper ocean, from the point of view of documenting the biases, attributing a source, and exploring the implications to the atmosphere model, ice model, and coupled behavior. Biases will include not only SST and SSS, but also the mean and seasonal cycle of equatorial T and S and Velocity.
- Key Topic 2
- W. Large (Lead), G. Danabasoglu, and I. Wainer (pending positive result from current analysis)

2. Diurnal Coupling in CCSM3
- The response of the climate system to diurnal coupling, in particular ENSO variability, in both the ocean and the atmosphere, since we know that this is the primary response to the changed SST pattern. The paper is to demonstrate the ability of CCSM3’s simple ocean diurnal cycle (SW heating) and daily ocean-atmosphere coupling to capture the daily SST rectification.
- Key Topic 5
- G. Danabasoglu (Lead), W. Large, J. Tribbia, P. Gent, J. McWilliams

3. Ventilation of the Thermocline and Deep Ocean during the 20th Century
- How does the ocean distribute unbalanced fluxes (active heat and freshwater, as well as passive transient tracers like CFCs) in the vertical and horizontal? The CFCs are the critical validation, because of the relatively abundant ocean observations, and they have been included in the 20th century ensembles. Assessment of biases and drift in the T-S structure of the thermocline, intermediate and deep waters, with attribution where possible. Projection of changes in heat content into sea level change and comparison of global mean and regional sea level change with tide gauge and altimetric observations.
- Key Topics 3 and 4
- Peter Gent (Lead), F. Bryan, D. Tsumune, K. Lindsay, G. Danabasoglu, M. Hecht, and S. Doney

4. Transient Response of the Thermohaline Circulation and Ocean Ventilation
- How does the thermohaline circulation respond to transient climate forcing? What
are the dominant physical processes affecting the change in meridional mass transport? Why does the strength of the overturning differ between T42 and T85 controls? Does the response of the THC also depend on atmosphere model resolution? How do changes in the thermohaline circulation relate to changes in ventilation as indicated by ideal age? What do the changes in ocean ventilation rate imply for CO2 uptake in a changing climate?

- Key Topics 4 and 5
- F. Bryan (Lead), G. Danabasoglu, D. Tsumune, N. Nakashiki

**Paleoclimate Working Group**

1. **Sensitivity of the Climate System to Glacial-Interglacial Forcing in CCSM3**
   - The sensitivity/response of CCSM3 to glacial (21 ka) and interglacial (6 ka) forcing.
   - Key Topics 3 and 4
   - B. Otto-Bliesner, E. Brady, S. Levis, Kothavala et al.

2. **Range of Natural Climate Variability over the Past Millennium in CCSM**
   - Longer-term evaluation of CCSM response to natural forcing components in 20th century is adequately included. Determine range of natural variability in global, hemispheric, and regional perspective. Provide model support for proxy-based climate reconstructions of recent climate changes at transition from natural to anthropogenic dominated forcing.
   - Key Topics 3 and 4
   - C. Amman et al.

**3a. The Low Resolution CCSM3**
   - Description of new developments and control simulations both coupled and uncoupled of the low-resolution ocean component of CCSM3. Assessment of the degree of degradation, compared to higher resolution, exchanged for the reduction in computational cost. Foci will reflect the needs for Paleoclimate, Biogeochemistry, and Climate Change. These will include the overturning circulation of the North Atlantic, SST biases, equatorial circulation including upwelling, ENSO simulations, polar sea-ice distributions in time and space, transports of the major current systems, and mixed layer depths.
   - Key Topic 1

- S. Yeager (Lead), C. Shields, J. Hack, and W. Large

**3b. Pre-industrial Climate Change in CCSM3**
   - A description of the climate of the T42x1 and T31x3 coupled 1780 CCSM3 simulations and their comparisons to present. The 1780 simulations (T31x3 and T42x1) provide the control for many of the paleoclimate and biogeochemistry experiments. Particular attention of the paper will be to the statistics of interest to these communities. The comparisons to present will allow a clearer evaluation compared to proxies, which typically vary between pre-industrial and present in terms of their calibration and thus their definition of “modern.”
   - Key Topics 3 and 4
   - Bette Otto-Bliesner, E. Brady, C. Ammann, Z. Kothavala, B. Tomas

**Polar Climate Working Group**

1. **Influence of the ITD on CCSM3 Simulations**
   - A description of the mean ice state in T42 control integration; show influence of ITD on mean state; examine influence of ITD on climate sensitivity
   - Key Topics 2 and 3
   - Holland, Bitz, Schramm, Lipscomb, Hunke et al.

2. **Resolution influence on the polar climate of CCSM3**
   - Examination of the changes in the spatial distribution of sea ice in the Arctic Ocean as simulated by the higher resolution T85 CCSM3; examination of the polar and subpolar atmospheric circulation and heat budget as it influences the surface climate of the Arctic.
   - Key Topic 2
   - DeWeaver, Bitz, and others

3. **Influence of sea ice albedo feedback on CCSM3 climate sensitivity**
   - Evaluation of both transient and equilibrium climate sensitivity with and without sea ice-albedo feedback. The feedback is turned off by specifying the albedo over polar oceans based on a climatology from the CCSM3 control run. The preliminary experiments have shown that sea ice accounts for about 40% of the equilibrium climate sensitivity but only 20% of the transient climate sensitivity, which
suggests sea ice has a substantial influence on ocean heat uptake. In addition, the non-local influences that result from turning off sea ice albedo feedback are profoundly different in transient and equilibrium experiments. There will be work carried out with colleagues in the OMWG to evaluate ocean heat uptake in the whole of the world's oceans in 20th century simulations to better understand the role of sea ice in ocean heat uptake.

- Key Topic 3
- Bitz, Holland, Hall et al.

4. Polar atmosphere and ocean heat budgets in CCSM3
- comprehensive evaluation of the atmospheric and oceanic heat budgets in the polar regions of CCSM; the mean annual cycle, interannual variability, and the sensitivity to radiative forcing (transient versus equilibrium change). A comparison of CCSM3 and GFDL models from these points of view will be undertaken.
- Key Topics 2 and 3
- Hall, Bitz et al.