CCSM Chemistry-Climate Working Group Meeting Report
22-24 March 2006
NCAR, Boulder, CO

The first Chemistry-Climate Working Group (ChemWG) spring meeting was held March 22–March 24, 2006 at NCAR. The immediate goal of the ChemWG is to give implementation options for processes linked with chemistry, the simulation costs for each option, the benefits of each option, and a recommendation as to the best option. The recommendation needs to be justified in terms of climate impact, science, computation cost, and needs of the community. The time horizon for this is late 2008. The specific goals of the 2006 spring meeting were:

1) For each identified process give a range of possible implementations.
2) Identify who is working on what.
3) Identify holes and priorities.
4) Endorsement of approach in White Papers.

The meeting was divided into 7 sessions, each of which covered a process linked with chemistry. The first 3 of these sessions were jointly held with the Atmosphere Model Working Group (AMWG):

- Microphysics
- Scavenging
- Aerosols
- Simplified chemical mechanisms
- Interactions with the biosphere
- Air quality
- The stratosphere

These sessions included the themes identified as those most important in the ChemWG planning meeting held in June 2005. Two additional themes were included in this meeting: simplified chemical mechanisms and the stratosphere. Not included, but discussed, was an additional theme: emissions.

- *Microphysics*. Talks by Morrison, Gettleman, and Heymsfield were given in the microphysics session. Substantial progress has been made in the initial implementation of a moment scheme into CAM microphysics. The plan is to make a go/no go decision with respect to this microphysics by fall 2006. Otherwise a fall-back position will be the modification of the current microphysics.

- *Scavenging*. A talk by Hongyu Liu was given in the scavenging session, discussing the Harvard/GMI wet-deposition scheme in the GFDL Global Atmosphere Model AM2. The following decisions were made with respect to scavenging:

  - Aerosol Scavenging: Steve Ghan agreed to implement nucleation scavenging and impact scavenging as part of his proposed aerosol scheme. A fall-back position is to use the current aerosol scavenging scheme.
  - Convective Scavenging: This depends on the convective parameterization to be implemented. The Donner scheme has convective scavenging incorporated into it. A request has been made to the AMWG that implementation of any new convective scheme be required to include scavenging. A fall-back position is use the current convective scavenging scheme.
  - Scavenging of soluble chemical species: The possibilities include the Harvard/GMI scheme, a new conceptual scheme designed and partially implemented by Hess, or the current scheme as implemented into CAM-CHEM.

- *Aerosols*. Talks on aerosols were given by Rasch, Lamarque, Ghan, Heald, Wang, and Toon. The White Paper entitled "Aerosol Effects on Clouds, Energy and the Hydrologic Cycle" was presented by Ghan. The ChemWG identified a number of candidate aerosol schemes for the next generation model. All of these schemes can be used to represent the indirect effect of aerosols in CAM. The schemes under consideration are:

  - A 7-mode scheme where the number distribution is a prognostic variable and internal aerosol mixtures are allowed. Ghan is currently implementing this scheme into CAM with chemistry.
  - A scheme similar to the above, but with 4 modes.
  - A similar scheme to that currently implemented where the aerosol number distribution is diagnosed from the aerosol mass and only external aerosol mixtures are allowed. This is the fall-back position.
  - A more complex scheme (e.g., CARMA) to be used for testing purposes where the aerosol size distribution is explicitly resolved.

- *Simplified Chemical Mechanisms*. Talks on simplified chemical mechanisms were presented by Cameron-Smith and Lamarque.

  - Both Lamarque and Cameron-Smith have proposed a reduced mechanism for tropospheric chemistry. These mechanisms can be easily extended to include stratospheric chemistry.
  - The fall-back position is a running CAM without interactive chemistry where the necessary chemical fields are read from tape for SO_2 oxidation, nitrogen deposition, and possibly surface ozone.
  - The full mechanism needs to be available for testing purposes

- *Interactions with the Biosphere*. Talks on interactions with the biosphere were given by Guenther (presented by Hess), Hess, Yoshioka, and Mahowald. Mahowald presented the White Paper entitled "Atmospheric Chemistry Impacts on the Land Biosphere." Immediate goals are to incorporate the physics to allow

the land model to respond to surface ozone stress and an understanding of the high bias in simulated surface ozone. A longer term goal is to incorporate a parameterization of methane emissions from wetlands into CAM.

- *Air Quality*. A talk on air quality was given by Hess who also presented the White Paper entitled "Hemispheric Pollution to Regional Air Quality: An Issue of Resolution." A need for air quality simulations is to couple the CCSM with WRF-chem so as to simulate chemistry at very high resolution.

- *The Stratosphere*. This session included talks by Andronova, Kinnison, and Collins. Collins identified a number of reasons for including a stratosphere in a future model to be used for the next IPCC: inclusion of solar forcing and volcanoes in historical simulations; inclusion of ozone forcing; inclusion of fingerprints of climate change in a coupled model; inclusion of dynamical coupling between the stratosphere and troposphere; inclusion of changes in the mean coupled state; and sensitivity of the mean coupled state to climate change. It was decided that over the next year a concerted effort is needed to ascertain the importance of the stratosphere to climate simulations.

Some discussion centered on how many versions of the model the ChemWG should maintain. The consensus was that two versions should be maintained: 1) a default version for IPCC studies focusing on the chemistry impact on climate; and 2) a chemistry version focusing on the climate impact on chemistry and air quality. The latter version might not need to be documented as extensively as the default version.

A strategy was also outlined with respect to the White Papers. These will be reviewed through email. After a set period for comments, and following the response of the authors to these comments, the White Papers will be considered endorsed by the working group. Comments to date on the existing White Papers include the addition of metrics in the White Paper on "Aerosol Effects on Clouds, Energy and the Hydrologic Cycle" and the combination of the White Papers on "Atmospheric Chemistry Impacts and Feedbacks on the Global Carbon Cycle" and "Atmospheric Chemistry Impacts on the Land Biosphere." Cameron-Smith and Lamarque agreed to write a White Paper on "Simplified Chemical Mechanisms," and Granier and Lamarque agreed to write a White Paper on "Emissions." A summary document will be written and given to the SSC.

Attendees:

Andronova, Natalia	Ghan, Steven J	Lamarque, Jean-Francois
Arellano, Avelino	Granier, Claire	Larson, Vince
Bardeen, Charles	Heald, Colette L.	Lauritzen, Peter Hjort
Barth, Mary	Hess, Peter	Liu, Hongyu
Cameron-Smith, Philip	Heymsfield, Andrew	Liu, Xiaohong
Collins, William	Hoffman, Forrest	Mahowald, Natalie
Eaton, Brian	Karlsson, Johannes	Marsh, Dan
Garcia, Rolando	Kinnison, Doug	Mauritsen, Thorsten
Gettelman, Andrew	Lamptey, Benjamin	Mitchell, David

Morrison, Hugh
Neale, Richard
Neu, Jessica
Perlwitz, Judith
Pincus, Robert
Raeder, Kevin
Richter, Jadwiga (Yaga)
Rodriguez, Jose M.
Sassi, Fabrizio
Svensson, Gunilla
Thornton, Peter
Vitt, Francis
Wang, Chien
Wuebbles, Don
Youn, Daeok
Yudin, Valery
Zhang, Guang J.