WCRP Community-wide Consultation on Model Evaluation and Improvement

Please complete the following template by writing your answers into the boxes below the questions, sending any supplementary material such as clearly labeled figures in a separate file. Please submit your response electronically by ***15 September 2009*** to Anna Pirani at apirani@princeton.edu.

Q1: Please state your particular area of interest, e.g. global or regional climate or NWP modeling, seasonal prediction, sea-ice feedbacks, monsoons, troposphere-stratosphere exchanges, etc.

Global climate modelling including climate-chemistry interaction; impact of climate change on stratospheric processes and feedback on surface climate; feedbacks and climate sensitivity related to non-CO2 climate forcings (particularly from aviation and other sectors of transport); UTLS processes and feedbacks like cirrus formation and aerosol-cirrus interaction, dehydration, troposphere-stratosphere coupling and air mass exchange.

Q2: Given your interest, what would you consider/identify as the KEY uncertainties/deficiencies/problems of current models? What do you think should be evaluated/improved as a priority in models in terms of parameterization and/or interactions among processes? (Give references and/or one key figure where possible)

Uncertainties of cloud feedbacks to non-CO2 forcings (semi-direct effect, indirect effects via microphysical processes) prevent a reliable assessment of climate sensitivity, efficacy parameters (Hansen et al., 2005), and the potential climate impact in a future climate. In particular, aerosols and aerosol-cloud interactions have remained highly uncertain. Cloud feedbacks should be studied in comprehensive model simulations (and not only in CO2 driven simulations), a strategy should be developed for comparison with both global and regional observed cloud variability, and components to the net cloud feedback by individual forcings should be indentified, quantified, and attributed.
Another key uncertainty is the role of the stratosphere in a changing climate. Changes of stratospheric dynamics in a future climate with enhanced greenhouse gas concentrations are uncertain. For example, it is not clear if the Brewer-Dobson circulation will be accelerated or not; therefore assessments of consequences for the transport of chemical substances, in particular radiatively active gases, are highly uncertain. Moreover, the impact of a changing stratosphere on surface climate and weather is unclear.

Q3: Do you see a particular gap (in knowledge, in observations or in practice) that would need to be filled, or a particular connection between different modeling communities or between modeling, process studies and observations that should be made a priority?

Cloud parameterisation schemes in current global models are largely independent from resolution while cloud resolving models are still too resource-demanding to be operationally run on global and climatological time scales. Intercomparison on regional scales may fill this gap and help to prepare improved cloud parameterisations with the goal to get them implemented and tested on the global scale as soon as possible.
The community of climate modellers (i.e. those who are working with coupled atmosphere-ocean models (AOGCMs) but mostly neglecting the stratosphere) and climate-chemistry modellers (i.e. those who are using climate-chemistry models (CCMs) which include the stratosphere but with prescribed sea surface temperatures without an interactive ocean model) should open a more intensive dialogue in order to get more comprehensive estimates of future atmospheric changes.
High quality satellite-based observations (dynamics and chemistry) of the upper troposphere/ lower

stratosphere (UTLS) region are needed, as the UTLS is a key region for the understanding of the climate system.

Q4: Do you see any particular resource or opportunity within the modeling/process study/observational/theoretical community (e.g. new results, new observations) that would be particularly useful and should be exploited to tackle this problem?

Exploit the output of models with different cloud parameterisations and systematically run a limited number of models with on and the same cloud parameterisation in various resolution for a respective comparison. Prepare regional models with advanced parameterisations (or cloud resolving framework) to be included for regional comparisons. Preferrably for special measurement periods where 3-D cloud developments are also available from observations.
Concerning joint activities of modelling groups running AOGCMs and CCMs, a concerted action of the SPARC-group and climate researchers to combine AOGCMs and CCMs, i.e. CCMs with an interactively coupled ocean model, would be very helpful.

Q5 What would best accelerate progress on the topics raised in questions 1-4? Do you have suggestions for new initiatives (new process studies, field campaigns, or new collaborative approaches, eg international Working Groups, Climate Process Teams)?

Extend the CFMIP project concept to non-CO2 forcing mechanisms; collaboration with AEROCOM project recommended; see Q4: joint action of SPARC and climate researchers.

Q6: Any other suggestions/issues to be raised?