



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 and regional climate modelling, parametrization of non-orographic gravity wave drag

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)

1) Nested regional climate models have insufficient resolution (~50-100km) to properly capture processes such as precipitation and clouds (Giorgi et al., 1994; Duffy et al., 2006). Such processes require a resolution of ~2-4 km (Webster et al., 2008).

Giorgi, Shields Brodeur, and Bates, 1994: Regional climate change scenarios over the United States produced with a nested regional climate model, *J. Climate*, 7, 375-399.

Duffy et al., 2006: Simulations of present and future climates in the western United States with four nested regional climate models, *J. Climate*, 19, 873-895.

Webster, Uddstrom, Oliver, Vosper, 2008: A high-resolution modelling case study of a severe weather event over New Zealand, *Atmos. Sci. Lett.*, 9, 119-128.

2) Stronger observational constraints of gravity wave launch spectrums (required in non-orographic gravity wave schemes, and typically launched from the upper troposphere) are required. Such observations are still limited, and not adequately cover temporal, seasonal, and spatial variations. See Alexander and Rosenlof (2003).

Alexander and Rosenlof, 2003: Gravity wave forcing in the stratosphere: Observational constraints from the Upper Atmosphere Research Satellite and implications for parametrization in global models, *J. Geophys. Res.*, 108, doi:10.1029/2003JD003373.

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?

1) I think there is a gap in reliable regional climate simulations of the present and future climate, for the reasons detailed above that the simulations are not run at high enough resolution to resolve fine scale forcing such as the local topography and vegetation. This is particularly vital over the Himalayas and California, which are both areas which depend strongly on winter rainfall and spring-summer time melting of the snow pack to provide year round water for over a billion people. However, it is still not know how precipitation will change over these regions in the future.

2) Also, as stated above, there is a lack of observations of gravity waves.

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?

Some modelling groups are developing/using double nested regional climate models, which have a horizontal resolution of 10-20 km -- I think this should be encouraged.

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)?

1) Increased awareness of the difficulties of regional climate modelling over areas of complex terrain.

Increased funding to develop these models and have sufficient computer resources with which to run them.

2) A suggestion for a new initiative would be a international field campaign / working group composed of scientists from countries with a vested interests in Himalayan water resources (e.g. Nepal, India, China, etc) to understand the processes driving water availability as well as how water availability might change in the future (i.e. changes to the Indian Summer Monsoon).

Q6: Any other suggestions/issues to be raised?