WEDNESDAY 21 APRIL 2004: CLIMATE SENSITIVITY AND FEEDBACKS

Dr Susan Solomon NOAA USA **Climate Sensitivity: IPCC Perspective**
The Intergovernmental Panel on Climate Change (IPCC) was jointly established by the World Meteorological Organization and the United Nations Environment Programme (UNEP) in 1988. The purpose of Working Group 1 (WG1) of the IPCC is to assess available information on the science of climate change and to provide policy-relevant but not policy-prescriptive assessments of interest to policymakers, scientists, and the public. IPCC is currently beginning preparation of its fourth comprehensive assessment report (AR4) of the state of understanding of climate change, to be completed in 2007. One of the most important parameters in all of climate science is the 'climate sensitivity', broadly defined as the global mean temperature change (°C) for a given forcing, generally that of a doubling of atmospheric carbon dioxide relative to its pre-industrial levels. Climate sensitivity plays a central role in interpretation of model outputs, evaluation of climate changes expected from various scenarios, interpretation of some aspects of past climate change, and in describing related scientific uncertainties. Throughout the last three IPCC assessments this basic parameter of the Earth's climate system has been estimated as being in the range 1.5 to 4.5C (i.e., uncertain by a factor of three). The primary reason for this broad range in model-based estimates of climate sensitivity is widely believed to be differences in the treatment of feedbacks, particularly cloud feedbacks. In this talk, I will briefly discuss the role of climate sensitivity in past IPCC assessments and will consider how improved information may sharpen scientific understanding for the IPCC fourth assessment.

Dr Myles Allen, University of Oxford **Observational constraints on climate sensitivity**
This talk will review studies attempting to constrain climate sensitivity with observations of recent transient climate change, focusing on the problems that arise due to uncertainties in forcing and the non-linear relationship between sensitivity and transient response. I will argue that recent warming attributable to greenhouse gas increase continues to provide the strongest single objective observational constraint on climate sensitivity. The role of prior assumptions regarding uncertainty in climate sensitivity or net atmospheric feedbacks will be discussed in more depth, because this turns out to have a very significant impact on conclusions. A general approach to using a combination of observations and hind-casting to constrain uncertain quantities in a climate forecast, explicitly designed to accelerate convergence of results and minimize the impact of prior assumptions, will be proposed and discussed in the context of the CFMIP.

Dr James Murphy ,Met Office, Hadley Centre, **Quantifying uncertainty in the response to doubled CO_2 from a large ensemble of GCM integrations**
For a given emissions scenario, GCM projections of climate change are subject to uncertainties arising from their representations of Earth system processes and the effects of natural variability. In principle the range of possible outcomes can be estimated from

large ensembles of projections designed to sample the relevant uncertainties. In practice, the lack of such ensembles have forced the impacts community to rely on uncertainty estimates based on a handful of models run at different centres. Further stumbling blocks have been a lack of objective methods of assessing the reliability of predictions from different models, and of identifying plausible model versions in the first place. Results will be presented from a new "perturbed physics" ensemble approach designed to address these issues. As a first step, ensemble predictions of the response to doubled CO2 have been produced using alternative versions of the Hadley Centre's coupled atmosphere/mixed layer ocean model distinguished by changes to its uncertain parameters. These have been run both on the Hadley Centre's supercomputers and on PCs owned by businesses and the general public via the climateprediction.net project. Uncertainty ranges for regional and global changes produced by these ensembles will be shown. The production of probabilistic predictions from the ensemble results will be discussed, illustrating two key issues of achieving a comprehensive sampling of parameter space and attaching reliability-based weights to the projections of alternative model versions. Finally, plans to extend the work to consider the time-dependent response to anthropogenic forcing will be outlined.

Dr Bryant McAveney Bureau of Meteorology Research Centre, Australia **The cloud feedback intercomparison project: What we hope to achieve**

The Cloud Feedback Model Intercomparison Project (CFMIP) has been set up by the WCRP Working Group on Coupled Modelling in order to provide a systematic modelling framework for studying and intercomparing feedback due to clouds. Initial experiments have concentrated on recalibrating the cloud feedback in existing models using fixed SST's and using slab ocean models. A number of diagnostic projects have been set up and an emphasis has been given to diagnosing aspects of clouds in simulations of the present climate through the use of the ISCCP cloud simulator.

Dr Rob Coleman t Bureau of Meteorology Research Centre, Australia **Analysing contributions to model climate feedbacks**

This presentation will look at an 'offline' approach to diagnosing the radiative changes important for climate feedbacks in models. In particular, it will consider the vertical and meridional structure of radiative contributions to the global water vapour, lapse rate and cloud feedbacks in the BMRC climate model from 2xCO2 experiments. The relative importance of differing regions (e.g. upper versus lower troposphere, tropics versus extra tropics), and different processes (e.g.lapse rate change, relative humidity changes) on the water vapour feedback will be considered. Total cloud feedback will also be examined. It is found that the net cloud feedback can be understood in terms of separate changes to cloud faction and optical properties, in turn associated with changes to water content and phase. The vertical and meridional structure of radiative changes from these processes will also be discussed, and its implications for climate sensitivity.

Dr William Rossow NASA, GISS **Diagnosing feedbacks in a multi-variate, non-linear dynamical system like climatel**

The general question of defining and diagnosing feedbacks in a more complex dynamical system like the climate is considered using Lorenz' simple dynamical model as a very simple example. Even in this simple model, it is easy to show that the classical feedbacks cannot be diagnosed in any practical way. However, this analysis does suggest some other approaches that might advance understanding of the climate.