19 JANUARY 2005: PERFECTING IMPERFECT MODELS

Dr Anton Beljaars, ECMWF Evaluating model processes using short range forecasts

Climate models and numerical weather prediction models represent the same atmospheric processes and there is no fundamental reason why they should be different. So the evaluation of parametrized processes can in principle be done in the NWP context. This is an interesting option because it allows comparison in a deterministic mode with analyses and verification with observations becoming much simpler because the synoptic patterns in the model atmosphere are close to reality. A number of examples of short range forecast errors will be discussed in relation to possible parametrization deficiencies. The examples range from the diurnal cycle of temperature over land linked to boundary layer and land surface processes to wind errors in relation to subgrid orography effects. Also some examples of research type observations are discussed e.g. from ground based cloud and precipitation radar, buoy observations and lidar from space. Also fine scale models are becoming increasingly important to provide a reference to parametrized models e.g. for convection and orography.

Dr Mike Davey, **UCL/Met Office**. Do you get my drift? Model deficiencies in the context of long range forecasting –s

Coupled ocean-atmosphere models are important systems for long range forecasting, offering the opportunity to predict a comprehensive and consistent range of products. However, raw forecasts from such systems contain a drift toward the intrinsic climatology of the coupled system that may differ substantially from observed climatology. In this talk examples of this effect will be described. Fortunately various simple adjustments can be made to reduce the influence of drift and thus produce skilful forecasts

Steve Woolnough, **CGAM, University of Reading** -Evaluating processes and phenomena for building better climate models

Individual weather systems and events make up the building blocks of the climate. If we are to have confidence in our simulations of climate variability and change, climate models must be able to properly represent these short timescale processes. This talk will describe how short timescale processes such as the diurnal cycle and individual weather systems influence the climate. The Madden-Julian Oscillation will be used to demonstrate how a combination of observations and modelling can identify important processes in the climate system which are absent from or poorly represented in climate models and the approach for improving our models.

Dr David Sexton, **Met Office** - Predicting climate change with imperfect models

A probabilistic climate prediction measures how uncertainty about the future arises from uncertainty in the evidence (observations and climate modelling). To explore one aspect of the modelling uncertainty, a 'physics ensemble' of models is produced where each member differs from a standard model by a perturbation to one of 29 ill-constrained physics parameters. The ensemble is used to predict the global mean of temperature response to double CO_2 levels where the relative contribution of each ensemble member varies according to its ability to simulate the mean observed climate (Murphy et al 2004). Another modelling uncertainty, omitted from the above analysis, arises because all ensemble members are an imperfect representation of the real world. The implications of this for probabilistic climate prediction are discussed.

Dr Tim Palmer, **ECMWF** - Reducing errors in earth system models by stochastic-dynamic parametrisation of unresolved scales

It will be argued that a component of the systematic error of climate models may arise from the underlying methodology used to represent sub-grid processes in terms of bulk-formula parametrisations. Such methodology assumes that, within a grid box, there exists a statistical ensemble of sub-grid processes in secular equilibrium with the resolved flow. In many circumstances this assumption cannot be justified. The notion of stochastic-dynamic parametrisation is raised as an alternative; here a potential realisation of the sub-grid scale (rather than a statistical ensemble) is represented at any time step. Examples of reduction in systematic error using a cellular automaton stochastic backscatter parametrisation scheme, recently implemented in the ECMWF model, will be shown.

Prof Alan Thorpe, NCAS, Univeristy of Reading -Weather and climate forecasting: what about the known unknowns?

In the era of ensemble prediction, appropriate ensemble-based terminology is needed. Modelling systems and initial conditions have uncertainties (known-unknowns) - not errors. Forecasts have errors. There is no such thing as a perfect model. A "deterministic" prediction is a single member ensembles with no estimation made of uncertainty/probability/risk/errors ("undressed"). No physicist would conduct an experiment without estimating the errors. Therefore quantifying uncertainty is not an option - it's what has to be done for all scientific predictions. We have to both reduce and quantify uncertainties. Sometimes dealing with model uncertainty is improperly viewed as non-scientific either because it's not to do with the "real" world or it's a mindless "twiddling" of parameters. Ensemble forecasting systems need to cover what actually happens or they are of poor quality. We require an ensemble forecasting system that has what actually happens as a high probability rather than a low probability outcome of the ensemble forecasting system. Increasingly the value of a multi-analysis multi-model ("grand") ensemble unified for weather and climate forecasting is recognised.