Diagnosing climate model parameterization errors via numerical weather forecasts

D. Williamson
(wmson@ncar.ucar.edu)

Climate models are traditionally evaluated globally by comparing statistics of the atmospheric evolution simulated by a model with estimates of those statistics determined from atmospheric observations and analyses. Such comparisons indicate if the statistics are correct, but not if the processes creating the simulated evolution are modelled correctly. To have confidence in the ultimate application of climate models, namely climate projection, we must have confidence that the processes creating the climate are modelled correctly. One difficulty with relying only on statistics of the climate is that even if the simulated statistics are correct, there may be errors in several processes which compensate. Another is that given just knowledge of the errors in the statistics it is difficult to gain insight into the cause of the errors.

Combining weather forecasts with field campaign observations allows the processes in the model to be evaluated locally. In particular, the detailed evolution of parameterized variables in a forecast can be compared with direct observations of those variables. We will describe an approach which allows the application a climate model to weather forecasts without developing a complete weather forecast and analysis system. We will illustrate this approach by examining the capability of the Community Atmosphere Model (CAM) to simulate the moisture and energy budgets at the Atmospheric Radiation Program (ARM) Southern Great Plains site. The CAM forecasts are compared to data collected during ARM intensive observing periods. We will argue that the analysis indicates which processes are producing the wrong state, but does not imply that those processes are formulated incorrectly since they might be responding to other errors. It does, however, indicate where to look first to determine why the processes act incorrectly. This approach should help parameterization developers gain insight into the errors and lead to hypotheses for further experiments and development. The success of these early investigations has led to a proposal from the CAS/WCRP

Working Group on Numerical Experimentation (WGNE) for an intercomparison of climate models applied in a weather forecast mode - Transpose AMIP - which will also be described.