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Transpose AMIP: a process oriented climate model evaluation and intercomparison using model weather forecasts and field campaign observations

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Transpose AMIP is a WGNE intercomparison of weather forecasts made by climate models, with the goal of exposing parameterization errors. The approach allows direct comparison of parameterized variables such as clouds, precipitation, and radiative flues with observations from field programs. During the early period of the forecasts, the parameterization calculations are based on a resolved model state which is close to the observed atmosphere instead of one which is in a model balance. Thus the parameterization errors can be identified.

We compare global models from the the Numerical Prediction Division, Japan Meteorological Agency; the National Center for Atmospheric Research; the Geophysical Fluid Dynamics Laboratory; the Experimental Climate Prediction Center, Scripps Institute of Oceanography; and the Climate Model Development and Evaluation group of the Met Office Hadley Centre. We consider the parameterization behaviors in the atmospheric column at the ARM Southern Great Plains site during summer 1997 and spring 2000 IOPs for five-day forecasts initialized from ERA-40 data. ARM observations and the ARM variational analysis are used for verification.

We will show that the models exhibit a wide range of behaviors in the parameterization tendencies, which lead to different dynamical responses, balances, and errors. In summer, some models dry the lower troposphere compared to ARM data while others moisten it, and still others produce only modest changes. However, those modest changes arise from a balance between parameterization and dynamical tendency errors as calculated against the ARM estimates. One model shows large 0-24 hour parameterization errors which produce an erroneous state after 1 day. However, for days 2-5 the parameterization errors are relatively small, and the state errors remain relatively unchanged from the day 1 values. The parameterizations produce the correct forcing after day 1 but they calculate it from the wrong state. We speculate that this is a result of tuning for the climate. In contrast, other models show relatively constant state errors from day 1 to day 3, with the parameterization and dynamics errors balancing after day 1 to yield relatively constant state errors. The 0-24 hr rainfall varies greatly between models, one rains heavily almost every day, another rains very little, and still another is in between and captures the episodic nature of the rain fairly well. However, for each model the 24-48 hr rainfall is very different from the 0-24 hour values. This arises because after day one the model states no longer match the atmosphere. Other aspects of the development of the errors will be discussed, in particular the diurnal phasing of the errors, and the response of the dynamics to the parameterizations.