

Final report for Klein portion of DE-AI02-02ER63334, "Parameterization of mesoscale circulations and frontal cloudiness in GCMs based on ARM observations". Grant period: 11/01/2001-10/30/2004

NOTE THAT THIS REPORT DESCRIBES THE ACCOMPLISHMENTS FROM THE KLEIN PORTION OF THIS GRANT. THIS GRANT IS JOINT WITH DR. JOEL NORRIS OF THE UNIVERSITY OF CALIFORNIA AT SAN DIEGO AND DR. CHRISTOPHER WEAVER OF RUTGERS UNIVERSITY. THERE SHOULD BE SEPARATE REPORTS FROM THEIR PORTIONS OF THE GRANT.

Accomplishments

The aim of this research was to explore the causes for the incorrect simulations of frontal cloudiness by global climate models. The tools to do this included careful diagnosis of the observations and comparison to single-column model output from the climate model as well as careful diagnosis of selected simulations of frontal clouds by high-resolution regional models (with resolutions up to 3 kilometers).

The Klein portion of this work included supplying single column model output from the GFDL model. The single column model simulated the years 1999 and 2000 at the ARM Southern Great Plains site using the continuous forcing developed by the Lawrence Livermore National Laboratory ARM Infrastructure team. An additional contribution to this work was through many fruitful discussions and review of the products produced by this work.

As a result of this work, several things were learned:

- The sub-grid scale variability in column cloud optical thickness and cloud top pressure were underestimated by the GFDL single column model (SCM)
- The GFDL SCM showed a general bias to overestimating the optical thickness of the clouds when they occur. In addition, the cloud fractions associated with shallow cumulus or thin cirrus were significantly underestimated
- Parameterization of variations in frontal cloudiness requires careful consideration the sub-grid scale variations in vertical velocity. In addition, clouds appear to be more variable when vertical advection moistens the column but horizontal advection dries the column. Parameterizations should be more sensitive to the differing effects of horizontal and vertical advection.

Postdoctoral Fellows

None

Publications

Two journal articles for this work exist:

- Gordon, N. D., J. R. Norris, C. P. Weaver, and S. A. Klein: Cluster analysis of cloud regimes and characteristic dynamics of midlatitude synoptic systems in observations and a model. *J. Geophys. Res.*, **110**, D15S17, doi:10.1029/2004JD005027.
- Weaver, C. P., J. R. Norris, N. D. Gordon, and S. A. Klein, 2005: Dynamical controls on sub-GCM-grid-scale cloud variability for ARM case 4. *J. Geophys. Res.*, **110**, D15S05, doi:10.1029/2004JD005022.

Talks Given and Meetings Attended

None