Project Title: Collaborative Project: A Flexible Atmospheric Modeling Framework for the Community Earth System Model (CESM)
PI: Andrew Gettelman
Awardee: University Corporation For Atmospheric Res
Award Number: ER65357 (DE-SC0006746)
Program Officer Name: Dorothy Koch

Project Final Report, October 2015.

In this project we have been upgrading the Multiscale Modeling Framework (MMF) in the Community Atmosphere Model (CAM), also known as Super-Parameterized CAM (SP-CAM). This has included a major effort to update the coding standards and interface with CAM so that it can be placed on the main development trunk. It has also included development of a new software structure for CAM to be able to handle sub-grid column information. These efforts have formed the major thrust of the work.

We are nearly finished with SPCAM integration into CESM. We expect to release a reference version of SPCAM inside of CESM with CESM2. This represents a significant effort, and a significant achievement in our development efforts. It will enable future science to continue with SPCAM and the coupled version SPCESM, and allow benchmarks against CESM2, the next generation of the Community Earth System Model. This project provided most of the resources to perform this task, and it is being completed under existing NCAR resources.

We have also continued development of standard CAM physical parameterizations to meet the need for the new high-resolution non-hydrostatic cores that have been developed under this project by collaborators at CSU. This led to the development of a new sub-column layer to handle new cloud models. The sub-column layer enables the CAM physics to be 'scale-aware' and meet the challenge of high-resolution. Essentially sub-grid information on the state is to be used to generate uniform 'sub-columns' on which cloud microphysics and radiation can be run. This allows the large-scale variance to control microphysics independent of scale. At larger horizontal scales, the variance is high, and different sub-columns capture that. At smaller horizontal scales, variance decreases, and sub-columns converge: but the clouds and radiation are representing the same scale regardless of the large-scale model resolution. This implementation was successfully completed, and will be used with the new dynamical cores and new physics. A paper describing the implementation is in Geoscientific Model Development Discussions, and we expect will be final soon (Thayer-Calder et al 2015). This represents another significant achievement in meeting the challenge of high resolution and scale aware modeling. This project has been very successful in accomplishing these goals.

Thayer-Calder, K., Gettelman, A., Craig, C., Goldhaber, S., Bogenschutz, P. A., Chen, C.-C., Morrison, H., Höft, J., Raut, E., Griffin, B. M., Weber, J. K., Larson, V. E., Wyant, M. C., Wang, M., Guo, Z., and Ghan, S. J.: A unified parameterization of clouds and turbulence using CLUBB and subcolumns in the Community Atmosphere Model, Geosci. Model Dev. Discuss., 8, 5041-5088, doi:10.5194/gmdd-8-5041-2015, 2015.