Continuous Dynamic Grid Adaptation in A Global Atmospheric Model: Application and Refinement

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We have been developing and applying a fully operational atmospheric GCM that employs static or dynamic grid stretching for targeted phenomena. We focus on continuous grid deformation methods that offer local enhancements of resolution where most needed in climate simulation. For this effort, we have developed general coordinate transformation techniques for continuous dynamic grid adaptation (CDGA) in the non-hydrostatic, non-oscillatory, forward-in-time, massively parallel global model EULAG, while concurrently producing a global, adaptive-grid atmospheric climate model. Specifically, we have implemented EULAG as a dynamical core for the NCAR Community Atmospheric Model. Our efforts started with CAM3 physics, which we have retained so far in order to concentrate on advancing the dynamical methods and performing test cases (we plan to evolve to CAM5 physics in further development). We now have a working atmospheric global climate model (AGCM) with static and dynamic grid adaptation capability that can greatly enhance its efficacy of computation.

This presentation is an overview of model capabilities. Much of our simulation has focused on West African climate. Our fully functional atmospheric GCM produces simulations of West African climate that are improvements over corresponding simulation using a standard CAM formulation, both at uniform resolution and, especially, when we invoke static grid adaptation for finer, 50-km horizontal resolution over West Africa. In addition, CAM-EULAG can produce extreme daily precipitation for West Africa for physical reasons similar to observed behavior. Finally, further study has focused on CAM-EULAG simulations of gravity waves by South African topography and remote sea-surface temperature influences on southern African climate.