An Update on Our Comparison of Alternative Dynamical Frameworks for Global Cloud-Resolving Models

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Abstract

Various approaches are being explored in the rapidly evolving world of dynamical cores for global cloud-resolving models. Issues include alternative equation sets (fully compressible versus sound-proof), alternative choices of prognostic variables (momentum versus vorticity), alternative methods to discretize the sphere itself (icosahedral versus cubic), and alternative vertical staggerings (Lorenz versus Charney-Phillips). In this talk we will show comparisons of cloud-resolving simulations with different dynamical cores but identical physics for both idealized (e.g., bubble) and realistic (e.g., TWP-ICE) cases.

We are comparing the merits of several prognostic variables to represent the wind field. These include:

- the momentum vector,
- the vertical component of the vorticity and the horizontal divergence as in the Z-grid model of Randall (1994),
- the horizontal vorticity vector as in the "vector vorticity model" (VVM) of Jung and Arakawa (2008), and finally
- the curl of the horizontal vorticity vector combined with the vertical component of the vorticity.

The momentum equation is being tested with the fully compressible system of equations, and also the anelastic system and the "Unified System" of Arakawa and Konor (2009).

The other three choices are tested only with the anelastic and Unified systems.

All of the dynamical cores currently use the Lorenz grid, although we plan to test the Charney-Phillips grid in the future.

All of the dynamical cores have been coupled with the physical parameterizations of the System for Atmospheric Modeling (SAM; Khairoutdinov and Randall, 2003). We are also comparing our results with comparable simulations using SAM.

The cores are being tested with Cartesian grids on a plane, hexagonal grids on a plane, and geodesic grids. Test cases include dry bubbles, radiative-convective equilibrium, cases based on field data, e.g., TWP-ICE (Fridlind et al., 2012), and idealized baroclinic waves on the sphere.

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