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Global modeling with GEOS-5 from 50-km to 1-km with a single unified GCM

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The Goddard Earth Observing System model (GEOS-5) of the Global Modeling and Assimilation Office (GMAO) at NASA Goddard Space Flight Center is uniquely designed to adapt to increasing resolution. This supports application of GEOS-5 for decadal scale climate simulation and reanalysis with a horizontal resolution of 50-kilometers (km), high-resolution numerical weather prediction at 25- to 14-km, and global mesoscale modeling at resolutions of 7- to 1.5-km. Resolution-aware parameterizations and dynamics support this diverse portfolio of applications within a single unified GEOS-5 GCM code-base.

We will discuss the adaptation of physics parameterizations with increasing resolution. This includes the role of deep convective parameterization, the move to an improved two-moment microphysics scheme, the need for shallow convective parameterization, and the role of non-hydrostatic dynamics and implicit/explicit damping. Parameterization and dynamics evaluation are explored not only in global integrations with GEOS-5 but with radiative convective equilibrium tests that permit the rapid exploration of high-resolution simulations in a smaller doubly periodic Cartesian domain.

Simulation results will highlight intercomparisons of model biases in cloud forcing and precipitation from the 30-year 50-km MERRA-2 reanalysis, 50- to 25-km free-running AMIP simulations, a 2-year 7-km global mesoscale simulation, and monthly global simulations at 3.5-km. A global 1.5-km simulation with GEOS-5 highlights our pursuit of truly convection permitting global simulations with GEOS-5. The tuning evaluation for this simulation using doubly periodic radiative convective equilibrium experiments will be discussed.