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Applications of KIAPS nonhydrostatic dynamical core on cubed sphere for refinement

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Growing computational capabilities are hopefully expected to be able to permit global atmospheric model applications explicitly resolved nonhydrostatic motions within a few kilometers resolution. However, running a global model for numerical weather prediction over specific area with uniform grid spacing at scales needed to fully resolve these features is still impractical using today's computers. A solution would be to use a global model with a stretched grid or to use a nested model. In this context, this presentation covers an introduction and preliminary results of developments of a dynamical core for refining global KIAPS integrated model (KIM) of which the solver is a compressible Euler equation with horizontal spectral element method (SEM) over cubed sphere (Choi and Hong, 2016).
One approach is to use a stretched cubed sphere grid by the transformation method of Schmidt (1977). It is used to transform any grid system on the sphere to a stretched version of the same grid with preserving isotropy so there are more gird points over the region of interest. In the opposite side of the globe there are fewer grid cells and thereby lower resolution. Currently several idealized tests are passed successfully with a moderate magnification factor up to 3. Through an idealized baroclinic instability test in which the perturbations are injected over northern and southern hemisphere symmetrically, it is shown that the resulting simulations are globally consistent and clearly demonstrate an added value over the higher resolution area as we would expect, but an improper degradation of the whole global simulation for fine-to coarse scale feedbacks of system is given as simulation time passed.
The other approach is using a one- or two-way nested model. Prior to nesting, it is struggled for constructing a limited-area dynamical core which inherits the global dynamical core. In this presentation, lateral boundary condition options which are constructed for idealized benchmark tests are shown and the results are compared to WRF model's simulation.
Reference
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[2] Schmidt, F., 1977: Variable fine mesh in spectral global model. Beitr, Phys. Atmos., 50, 211-217.