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Dynamic Grid Adaptations in Moist 2D Shallow Water and 3D Nonhydrostatic Dynamical Cores

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In previous work (McCorquodale at al., 2015; Ferguson et al., 2016) we have developed and tested a high-order, finite-volume, multi-block Adaptive Mesh Refinement (AMR) framework for solving the shallow water equations on the sphere. The framework is built upon the AMR library Chombo which has been developed at the Lawrence Berkeley National Laboratory (LBNL). Chombo supports the ‘cubed-sphere’ grid geometry which serves as the base computational grid for atmospheric AMR applications.

The paper provides insight into the latest Chombo-AMR model developments. In particular, moisture processes have been added to the 2D shallow water framework which mimics the addition of a simplified physical parameterization package to the atmospheric dynamical core. The moisture interactions provide nonlinear forcing effects which challenge the AMR technique snd the scale dependencies in the moist model. In addition, the Chombo-AMR framework supports the 3D nonhydrostatic, shallow-atmosphere equation set with 2D (horizontal) mesh adaptations. Idealized dynamical core test cases, like the colliding modons test by Lin et al. (2017) and selected examples from the Dynamical Core Model Intercomparison Project (DCMIP) test case suite, are used to illustrate the characteristics of the dynamically adaptive atmospheric model. It is suggested that AMR dynamical cores can serve as the basis for future-generation weather and climate models. They allow selected high-resolution areas while limiting the overall computational burden.

References:

Dynamical Core Model Intercomparison Project (DCMIP). Online resources and test case descriptions available at
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