Assessments of the Chombo adaptive mesh refinement model in shallow water mode

Authors: Jared Ferguson, Christiane Jablonowski, Hans Johansen, Elliot English, Paul Ulrich, Peter McCorquodale, and Phillip Colella

Many high impact atmospheric phenomena such as tropical cyclones are multiscale hydrometeorlogical extremes that challenge tradition climate models with coarse uniform grids. Adaptive mesh refinement allows for sufficiently high local resolution to better simulate these phenomena without being computational prohibitive. One approach being developed by the Applied Numerics Algorithms Group at Lawerence Berkeley National Laboratory and collaborators is an adaptive, conservative finite volume global circulation model on a cubed-sphere grid, which implements the non-hydrostatic shallow atmosphere equations. Its adaptive mesh refinement approach utilizes the Chombo library. The 2D shallow water equations exhibit many of dynamics and complexities of atmospheric modeling. Thus they serve as an effective method for testing the dynamical core and the refinement strategies of adaptive atmospheric models. We discuss the efficiency and accuracy of the shallow water version of the model and its refinement approach using a suite of shallow water test cases. In addition, we test the sensitivity of the model results to the choice of the refinement criteria using addition a new test case designed to simulate cyclone like vortices.