Geophysical Research Abstracts
Vol. 20, EGU2018-3090, 2018
EGU General Assembly 2018

A wavelet-based adaptive hydrostatic dynamical core: results and performance

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In previous work (Kevlahan, Dubos, Aechtner 2015; Aechtner, Kevlahan; Dubos 2015, Dubos and Kevlahan 2013) we have developed a general framework for a wavelet-based multiscale dynamically adaptive dynamical core. This method is based on iterative dyadic refinement of the icosahedron, which generates a sequence of approximation subspaces (i.e. different grid levels) with arbitrarily fine local resolution controlled by a single parameter controlling the errors in the tendencies at each time step. Biorthogonal wavelets are used to measure local error and to restrict or prolongate fluxes between different grid levels. The adaptivity is designed to preserve the mimetic properties (such as mass conservation) of the underlying discretization (e.g.TRiSK).

In this update we present results for a hydrostatic implementation based on the DYNAMICO model, but with a consistent discretization of the kinetic energy (Peixoto 2016). The grid is adapted horizontally using the strictest condition over all vertical layers and the Lagrangian vertical coordinates are conservatively remapped periodically onto the initial grid (Chen 2013). We will discuss the results of a number of test cases from the DCMIP series as well as parallel performance. The goal of this project is to help assess the potential of dynamical adaptivity to improve the computational performance and numerical accuracy of climate models.