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Towards a wavelet-based dynamically adaptive climate model

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Abstract

We propose a general framework for a wavelet-based multiscale dynamically adaptive climate model. 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 limiting 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.We present results for a hydrostatic implementation based on the DYNAMICO discretization. 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. We will describe the results of a number of test cases, as well as assess 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.