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# High-order mimetic finite elements for the hydrostatic primitive equations on a cubed-sphere grid using Hamiltonian methods

Christopher Eldred (1), Thomas Dubos (2), and Evaggelos Kritsikis (3)

(1) LAGA, University of Paris 13, Paris, France (chris.eldred@gmail.com), (2) LMD, Ecole Polytechnique, Paris, France (dubos@lmd.polytechnique.fr), (3) LAGA, University of Paris 13, Paris, France (wkrits@gmail.com)

There has been a great deal of work in the past decade on the development of mimetic and conservative numerical schemes for atmospheric dynamical cores using Hamiltonian methods, such as Dynamico (Dubos et. al 2015). This model conserves mass, potential vorticity and total energy; and posses properties such as a curl-free pressure gradient that does not produce spurious vorticity. Unfortunately, the underlying finite-difference discretization scheme used in Dynamico has been shown to be inconsistent on general grids. An alternative scheme based on mimetic finite elements has been developed for the rotating shallow water equations that solves these accuracy issues but retains the desirable mimetic and conservation properties. Preliminary results on the extension of this scheme to the hydrostatic primitive equations are shown. The compatible 2D finite elements spaces are extended to compatible 3D spaces using tensor products, in a way that preserves their properties. It is shown that use of the same prognostic variables as Dynamico combined with a Lorenz staggering leads to a relatively simple formulation that allows conservation of total energy along with high-order accuracy.