

# Towards an Efficient and Scalable Discontinuous Galerkin Atmospheric Model

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## Abstract

An efficient and scalable Discontinuous Galerkin shallow water model on the cubed sphere is developed by extending the transport scheme of Nair et al. The continuous flux form nonlinear shallow water equations in curvilinear coordinates are developed. Spatial discretization is a nodal basis set of Legendre polynomials. Fluxes along internal element interfaces are approximated by a Lax-Friedrichs scheme. A third-order total variation diminishing Runge-Kutta scheme is applied for time integration, without any filter or limiter. The standard shallow-water test suite of Williamson et al. is used to validate the model. It is observed that the numerical solutions are accurate, the model conserves mass to machine precision, and there are no spurious oscillations in a test case where zonal flow impinges a mountain. Development time was substantially reduced by building the model in the High Order Method Modeling Environment (HOMME) developed at the National Center for Atmospheric Research (NCAR). Performance and scaling data for the steady state geostrophic flow problem is presented. Sustained performance in excess of 10% of peak is observed out to 64 processors on a Linux cluster.

**keywords:** discontinuous Galerkin method, climate and atmospheric modeling, parallel computing.

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