About the spherical and ellipsoidal geopotential approximation and first results with a Discontinuous Galerkin dynamical core

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Abstract

Since a couple of years, attempts are made to develop an alternative dynamical core for the weather and climate prediction model ICON, based on the Discontinuous Galerkin (DG) method (the BRIDGE code). Essentially, the DG method allows a higher order approximation of the Euler equations and local conservation (or better say, no artificial sources or sinks of the flux divergence) of all the prognostic variables. Beyond this, a better scalability on massively parallel conmputers can be achieved compared to several other numerical methods. Efficiency is enlarged by a horizontally explicit-vertically implicit (HEVI) scheme based on IMEX-Runge Kutta time integrators, tensor product representation and use of collocation. The DG approach further allows a quite clear separation between the numerical discretization, the formulation of the (Euler- or other transport) equations and the metrics of the the underlying manifold (flat plane, sphere, ellipsoid, ...) and the terrain-following description.

The latter property together with the above mentioned positive numerical properties of the DG method is tempting to investigate a question that might arrise with incresingly accurate dynamical cores: is the spherical geopotential approximation still valid for todays global atmospheric simulation models? In the talk, currently available alternative ellipsoidal formulations are discussed and simulation results with BRIDGE are presented.

Keywords: Discontinuous Galerkin, Euler equations

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