

Horizontally Explicit and Vertically Implicit (HEVI) Time Discretization Scheme for a Discontinuous Galerkin Non-Hydrostatic Model

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Discontinuous Galerkin (DG) method is becoming increasingly popular in atmospheric modeling due to its conservation properties, accuracy and excellent parallel efficiency on current massively parallel supercomputers. However, a major drawback for DG method is the stringent CFL stability associated with explicit time stepping. For non-hydrostatic (NH) models, the vertical fast-moving acoustic waves together with high aspect ratio between horizontal and vertical spacial discretization impose a stringent restriction on time step size for the resulting ODE system. For the development of NH models based on compressible Euler equations DG discretization can be efficiently utilized, if the time stepping mechanism relies on implicit or semi-implicit method. We propose a NH model based on DG method, in 2D (x - z), with a semi-implicit time stepping procedure; which employs so-called ‘horizontally explicit and vertically implicit (HEVI)’ approach through an operator-split procedure. Vertical part of the discretization is treated implicitly and the horizontal part in an explicit manner. The DG spatial discretization uses lower-order polynomial which is amenable to relatively larger CFL limit for the explicit Runge-Kutta (RK) part of time integration. The DG-NH model is free from time step restriction resulting from small grid-spacing (dz) in the vertical. The validation and performance of the proposed DG-NH model will be presented at the seminar.