The ICON dynamical core project: modelling strategies and preliminary results

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The ICON project is a joint development effort of MPI-M and DWD to achieve a unified climate and NWP model using geodesic grids with local grid refinement. The model under development in the ICON project will use the fully elastic, nonhydrostatic Navier-Stokes equations, which provide a framework that is sufficiently general for meteorological applications on most scales relevant to numerical weather prediction and climate simulation.

As an intermediate step, a semi-implicit discretization for the hydrostatic primitive equations is being developed. The proposed horizontal discretization uses the triangular Delaunay cells of the icosahedral grid as control volumes. It achieves mass and potential enstrophy conservation, thus replicating the results of [4] for standard rectangular C grids. Vector radial basis function interpolation is used to reconstruct a uniquely defined velocity field from the velocity components normal to the cell sides, which are the discrete model variables along with the cell averaged values of the mass variables like pressure, temperature or geopotential height. A full description of the horizontal discretization can be found in [1], [2]. One result obtained with a preliminary shallow water implementation on an idealized test case (see [5]) is shown in figure 1(a). The difference in the geopotential height field after 15 days of simulation between the model using 327680 triangles (approximately 40 km horizontal resolution) and a reference field obtained with resolution T426 of a slightly modified NCAR spectral shallow water model [3] are presented. Application of the same technique to a hydrostatic model with local grid refinement option is currently being investigated. Figure 1(b) and (c) show two possible computational grids, with different local refinement strategies.

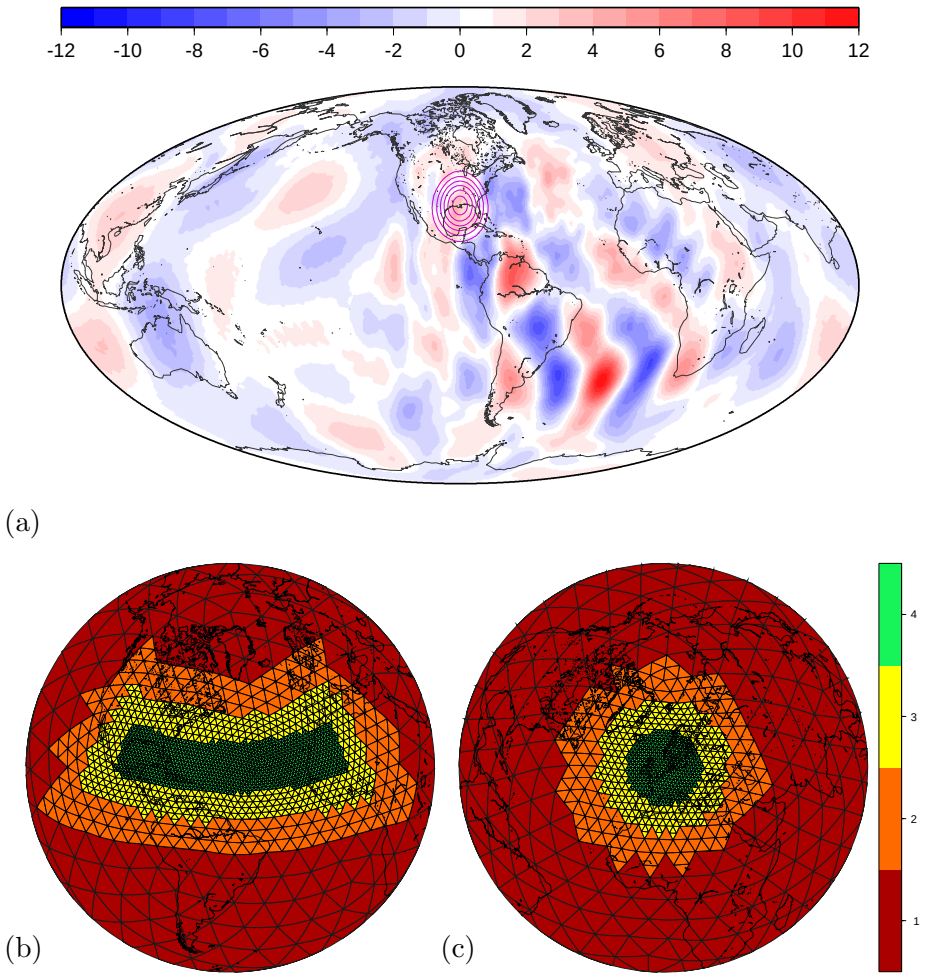

Figure 1: (a) Difference to reference of geopotential height field after 15 days for test case 5 of [5]. Reference is modified NCAR spectral shallow water model with resolution T426 [3]. (b) and (c) Two configurations of the computational grid with local refinement option using 4 refinement steps.

References

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