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The ICON model: actual state and first steps towards a new dynamical core based on the Discontinuous Galerkin method

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The ICON model is in operational use at DWD since 2015 for global forecasts and since 2016 for a nest over Europe.

Actually, it runs additionally in a convection-permitting setup (called ICON-D2) in a parallel routine to replace COSMO-D2 probably in Q4/2020. ICON uses horizontally a triangle grid, extracted by multiple subdivisions of icosahedral triangles. The spatial discretization is a mixed finite-volume, finite-difference approach. Newer developments in the dynamical core are a deep atmosphere variant.

During the next years, it is planned to develop an alternative dynamical core based on the Discontinuous Galerkin (DG) approach. The DG method allows the conservation of each prognostic variable and to achieve a higher order approximation. Beyond this, it promises to run faster on massively parallel architectures due to a more compact data transfer and due to a higher computational intensity. On the other hand, relatively small time steps might be a potential obstacle for its operational use.

The current work towards this goal consists in the development of a 2D toy model. The solution of the shallow-water equations on the sphere is done via local coordinates on each triangle and a transformation of fluxes between their edges. To get rid of too small time-steps for flat grid cells, a horizontally explicit-vertically implicit (HEVI) approach for the solution of the Euler equations in a 2D slice model is chosen.

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