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An adaptive Lagrange-Galerkin Method for a barotropic Model of the Atmosphere

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Atmospheric multi-scale interactions generating planetary waves play an important role for atmospheric climate variability on timescales from seasons to decades. As well external forcings, e.g. by mountains, as internal forcings, e.g. by synoptic flow patterns, on spatial scales of about 1000 km generate planetary waves. Conversely, the planetary wave structure effects synoptic flow patterns by large-scale momentum and energy fluxes.

To simulate these atmospheric multi-scale interactions we present an adaptive barotropic model based on the spherical shallow water equations. We use an adaptive Lagrange-Galerkin method consisting of the finite element method and the semi-Lagrange method for the spatial and temporal discretization.Thereby the triangular unstructured grid is temporally variable und spatially adaptive.

First experiments with the model PLASMA show the applicability of the adaptive method to atmospheric processes for idealized atmospheric flows.Beside the successful reproduction of analytical solutions the modeling of the orographic forcing of planetary waves is shown. In sensitivity experiments the influence of different zonal wind velocities and different mountain heights on the planetary wave structure is analyzed.