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Anelastic approach for mesoscale numerical weather prediction - a validation of the EULAG model

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Numerical weather prediction (NWP) is a basic tool supporting operational weather forecasting. Among the issues related to modeling of complex atmospheric flows, one of the most important is a conservation of dynamical variables such as mass, momentum and energy. Other problem regards numerical stability of the flow over steep orography. As the spatial resolution of NWP models increases, approaching $\sim$1km, the presence of steep slopes might result in an emergence of numerical problems.

The above issues were successfully solved in the frame of the EULAG model, making it a prospective candidate for the future dynamical core of a new generation regional NWP models. EULAG is a non-hydrostatic anelastic code employing the finite-volume non-oscillatory positive definite transport algorithm MPDATA, able to solve the flow equations both in Eulerian and Lagrangian framework.

In order to verify an applicability of anelastic approximation for representation of mesoscale flows and examine the robustness of the EULAG solver, a series of benchmark tests was conducted. Here, we present the results of the idealized tests, including: cold density current along with complimentary orographics experiments, inertia-gravity waves and mountain waves. The results of the experiments confirm the applicability of anelastic approximation for mesoscale NWP since all characteristic features of the solutions obtained with fully-compressible reference models were accurately reconstructed using EULAG.