Recent progress on developing the new anelastic dynamical core for the future operational NWP model - COSMO

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ABSTRACT

Institute of Meteorology and Water Management – National Research Institute participates in the development of the new dynamical core for future operational weather forecasting model – COSMO (www.cosmo-model.org). The main effort of the project is focused on development of the next-generation numerical weather prediction model that would be capable of simulating atmospheric flows at convection-permitting scales *O*(1km). Conducting realistic simulations at such high resolution is numerically expensive and involves necessity of employing specially designed algorithms. The algorithms have to be highly robust, since along with increasing grid resolution more turbulent scales are resolved.

Within the frames of the COSMO priority project a new prototype model is being developed. In this pioneering implementation the original compressible dynamical core has been replaced by anelastic one, adopted from the well-established EULAG research model. This innovative approach seams to be promising as EULAG has desirable conservative properties and robustness.

In order to test the suitability of the hybrid EULAG-COSMO implementation for NWP applications, a set of experiments with representative atmospheric problems have been designed. Here, we present results of three idealized test cases, which are typically employed for validation of the NWP models. The first test involves modeling of propagation of the inertia-gravity waves in a periodic channel (Skamarock and Klemp 1994). The experiment was performed for a short (300km) and long (6000km) channels. The second experiment concerns the evolution of two-dimensional density current induced by a large elliptical blob of cold air descending to the ground (Straka et al. 1993). This test demands higher level of synchronization between the both models in order to properly represent the subgrid scale processes. As there is no analytical solution for the problem the results obtained from the hybrid model are compared with the published benchmark results of numerical simulations. Finally, the gravity waves generated in a stable air passing over a single Agnesi mountain (Bonaventura 2000) have been simulated. Several different regimes of the flow, depending on the air velocity and the characteristics of the hill, have been tested. The results were validated against the published results of compressible models by Pinty et al. (1995) and Bonaventura (2000), as well as the results of the EULAG standalone version.

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