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Toward Very High Horizontal Resolution NWP over the Alps: Influence of Increasing Model Resolution on the Flow Pattern

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Abstract

The increasing resolution of contemporary regional numerical weather prediction (NWP) models, reaching horizontal grid sizes of $\mathcal{O}(1\text{ km})$, requires robust and reliable dynamical cores, working well beyond the approximation of quasi-horizontal flows. That stimulates an interest in an application for NWP purposes of dynamical cores based on the anelastic, or – more generally – sound-proof flow equations, and characterized by appropriate robustness and reliability. The paper presents results from testing the dynamical core of EULAG, the anelastic research model for multi-scale flows, as a prospective NWP dynamical core. The model simulates the semi-realistic frictionless and adiabatic flow over realistic steep Alpine topographies, employing horizontal grid sizes of 2.2, 1.1, and 0.55 km. The paper demonstrates not only the numerical robustness of EULAG, but also studies the influence of the varying horizontal resolution on the simulated flow. Results show that the increased horizontal resolution increases orographic drag on the flow. While the general flow pattern remains the same, increased resolution influences the flow on scales from hundreds of kilometers to meso-gamma scales. The differences are especially apparent in the near-surface layer of 1.5 to 3 km deep, and in the distribution and amplitudes of the orographically-induced gravity waves.

Key words: numerical weather prediction, anelastic equations, EULAG, Alpine flow, mountain drag.