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Using the Froude number to evaluate flow-above and blocked-flow situations in the European Alpine region as simulated by convection permitting models

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We use the Froude number of continuum mechanics to study the flow behaviour in the Alpine region, especially to identify flow-above and blocked-flow situations for model evaluation purposes. Using the wind speed of an air parcel U, the Brunt-Väisälä frequency N (describing buoyancy and taking moisture and condensation into account) as well as the barrier height h of a mountain the Froude number F can be easily calculated using F=U/Nh. F therefore represents the ratio of kinetic energy of an air parcel to the potential energy required to surmount a barrier. High values of F then indicate flow-above, while F<1 represent blocked-flow situations.

In the framework of the project NHCM-2 (www.nhcm-2.eu), funded by the Austrian Science Fund (FWF, project ID P24758-N29), we use this method to analyse the differences between the regional climate models COSMO-CLM and WRF, operated on convection permitting scale (3 km grid spacing), and the analysis fields from the operational Swiss forecast system COSMO-7 (7 km grid spacing). Calculating a two-dimensional field of F values for a layer of interest (e.g. constant geometric height of 1500 meters), we introduce different flow categories (such as flow-above and blocked-flow and taking local stability into account) and study their frequency of occurrence based on hourly data.

First results from a test period (November 2002) show that differences between COSMO-CLM and COSMO-7 in areas close to the Alps are usually larger than in areas further away. However, there are some subregions (especially the Po Valley as well as the regions from Burgundy to Southern Germany) that show a clear over- or underestimation of these categories. Detailed results for an extended period (including WRF) will be presented.