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A novel front detection algorithm tested in complex terrain

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Atmospheric fronts play a major role in day-to-day weather and are well known for sharp changes in local weather conditions. Especially in regions of high mountains, such as the European Alps, fronts are typically deformed and retarded when they interact with the orography. As a result of retardation, fronts can become nearly stationary which then often lead to heavy precipitation.
Fronts are located within the transition zone between two airmasses and their localization makes them very useful for the readability of weather maps. In general such frontal lines are still generated subjectively by meteorologists.

Automated detection of fronts based on atmospheric conditions is an objective method to identify frontal lines. In the framework of the project "Non-hydrostatic Climate Modeling (NHCM-2)" (www.nhcm-2.eu), funded by the Austrian Science Fund (FWF), different algorithms are tested to identify frontal line location, motion and type. First, a known algorithm based on gradients in equivalent potential temperature is adopted. Subsequently, a spectral filter is introduced to avoid noise in the output. The benefit of the spectral filter is also that it allows a user to define a desired scale for the frontal detection. Additionally, the spectral filter is independent of grid spacing and therefore allows a comparison of datasets based on different model resolutions.
For testing purposes, a ERA-Interim driven hindcast with 0.11° (∼12.5 km) grid spacing from the COSMO model in climate mode (CCLM) covering the European continent and conducted by Brandenburg University of Technology (BTU-Cottbus; www.clm-community.eu), is used. Additionally, a CCLM hindcast simulation on convective permitting scale 0.0275° (3 km) is investigated. It covers the Alpine region and is driven by the 0.11° simulation. The aim is to reveal differences in the representation of fronts in these two simulations and on different types of vertical levels (pressure levels, terrain following coordinates, and geopotential height). First results, which demonstrate the deformation and retardation of fronts in the presence of mountains as seen by models at different resolutions, are presented.