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Assessment of water cycle parameters in high-resolution reanalysis

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In recent years, there has been a tendency towards regional reanalyses with increased spatial resolutions. One important question is whether these reanalyses are able to better represent small-scale features. Especially the atmospheric parameters, which are part of the hydrological cycle, such as water vapor and precipitation, exhibit strong variability on small scales.

A regional reanalysis is produced in the framework of the Hans-Ertel-Centre for Weather Research using the COSMO model of Deutscher Wetterdienst (DWD). The current data set comprises the period from 2007 to 2012 for two nested domains covering Europe (6 km horizontal resolution) and Germany (2 km). The model output has not only a high spatial resolution but also a high temporal resolution of 15 minutes. For the European domain, two more experiments have been conducted. The first includes Latent Heat Nudging (LHN) for assimilating radar data and the second one is a dynamical downscaling of ERA-Interim and therefore does not assimilate any measurements.

Water vapor variations are assessed using GPS observations provided by the German Research Centre for Geosciences (GFZ). These constitute independent measurements with a good spatial coverage for the model domain and the same temporal resolution as the model output. The comparison focuses on the dependence of errors on the diurnal and annual cycle, weather conditions, and geographic location.

Further, the representation of convective cells and frontal systems in the data sets is compared using microwave satellite data and the Passive and Active Microwave TRAnsfer operator (PAMTRA), which simulates brightness temperature fields from the 3-dimensional reanalysis output. The evaluation is based on objects identified using a gradient-based feature identification algorithm. Case studies show that some convective cells, which are well captured in the 2 km product, are missing in the 6 km product. The experiments show that, besides the increased spatial resolution, LHN seems to play a role in this better representation since the 6 km product including LHN is superior to the one without LHN. For frontal systems, the difference between the reanalysis products is less pronounced.