Integrated water vapor variability – exploiting unique field campaign data and high-resolution reanalysis

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Since water vapor is part of various atmospheric processes, it is very variable in both space and time. Quantifying this variability in terms of the integrated water vapor (IWV) is difficult as the different measurement techniques available can exhibit significant differences due to sampling. To overcome this issue a combination of high-resolution field campaign and model data is exploited.

During the High Definition Clouds and Precipitation for advancing Climate Prediction ($HD(CP)^2$) Observational Prototype Experiment (HOPE) in Jülich, Germany (April/May 2013) IWV is available from a GPS antenna, 5 microwave radiometers, a sunphotometer, >200 radiosoundings, several lidar systems, and 3 Moderate Resolution Imaging Spectroradiometer (MODIS) retrievals. With this data a multi-instrument comparison of IWV focusing on its small-scale variability is performed. We investigate the temporal variability within time intervals of a few minutes up to 1 day. To expand the quantification of variability into the spatial domain a high resolved (156 m) simulation with the novel ICOsahedral Non-hydrostatic modeling framework (ICON) is used.

While the analysis of HOPE data focuses on small scales, IWV variations for central Europe are assessed using 2 regional reanalyses with resolutions of 2 and 6 km which are produced in the Hans Ertel Centre for several years with the COSMO model of Deutscher Wetterdienst (DWD). To evaluate the IWV, measurements at 157 GPS stations are provided by Geoforschungszentrum Potsdam. These are independent measurements with a good spatial coverage of the model domain and the same temporal resolution (15 minutes) as the model output. The comparison focuses on the dependence of errors on the diurnal and annual cycle, weather conditions, and geographic location.