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Influence of model resolution on spatial and temporal variability of clouds and precipitation over Germany

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To improve our understanding of cloud and precipitation processes and their implication for climate prediction, the research initiative High Definition Clouds and Precipitation (HDCP2) has been started. Besides the development of a new model system capable of very high-resolution simulations over domains of 1000 km, a fundamental part of the project was a large measurement campaign near Jülich in western Germany which was conducted in spring 2013. These measurements enable a critical model evaluation at the scale of the model simulations and provide information on sub grid variability and microphysical properties that are subject to parameterizations.

In order to explore the resolution dependence of clouds and precipitation in that area, numerical simulations with the Consortium for small-scale modeling (COSMO) model were conducted with horizontal grid spacings of 2.8 km, 1 km, 500 m, and 250 m. To analyze different synoptic conditions, simulations were performed for six intensive observation periods of the measurement campaign. It is found that although the representation of a number of processes is enhanced with resolution (e.g. boundary-layer thermals, convergence zones, gravity waves), their influence on the daily precipitation amount is rather weak. Probability density functions of convection- and cloud-relevant parameters are analyzed to investigate their dependence on model resolution and their impact on cloud formation and subsequent precipitation. Furthermore, first comparisons with radar-derived precipitation are shown.