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Evaluation of Humidity, Clouds and Precipitation in COSMO-CLM and MM5

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The knowledge of uncertainties resulting from simulations of the hydrological cycle in meteorological models is crucial for the interpretation of model results. This study focuses on the evaluation of the atmospheric part of the hydrological cycle in two mesoscale meteorological models, MM5 (the fifth-generation Pennsylvania State University-National Center for Atmospheric Research Mesoscale Model) and COSMO-CLM (CCLM). Through using high resolution observations from the General Observation Period (GOP) performed within the German Priority Program on Quantitative Precipitation Forecasting (PQF) the representation of integrated water vapor (IWV), total cloud cover and precipitation are evaluated. Model runs were performed for the integration period of 2007 and 2008 within the model domain covering Germany with a spatial resolution of $\sim$18 km. Both models are forced by reanalysis data of the National Centers for Environmental Prediction (NCEP). The performance of the models is evaluated concerning the domain mean as well as the spatial structure. It becomes apparent that the performance of the simulations by the CCLM and MM5 vary by orography, season and model physics. For MM5 systematic overestimations of yearly- and daily-mean for IWV occur. CCLM captures IWV with little deviations. Spatial error structures of both models in representing IWV are related. Total cloud cover is well represented by both models. While underestimations above the Alps occur, the remaining model domain is dominated by overestimations. Pronounced overestimations in MM5 seem to be connected to maritime climate. Both models are not able to represent the diurnal cycle of the total cloud cover. The diurnal cycle of total precipitation in MM5 is overestimated due to too high convective precipitation amounts. In contrast CCLM shows nearly no diurnal cycle in total precipitation. In both models the occurrence of precipitation is overestimated in winter. In summer CCLM underestimates and MM5 still overestimates the occurrence of precipitation. Analysis of error-correlations show that parts of the precipitation error can be defined more precisely by a synthesis of the three evaluated components.