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Microphysical processes observed by X band polarimetric radars during the evolution of storm systems

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Polarimetric radars are now widely used for characterizing storm systems since they offer significant information for the improvement for atmospheric models and numerical weather prediction. Their observations allow a detailed insight into macro- and micro-physical processes during the spatial and temporal evolution of storm systems.

In the frame of the initiative for High Definition Clouds and Precipitation for advancing Climate Prediction (HD(CP)2), which focuses on improving the accuracy of climate models in relation to cloud and precipitation processes, the HD(CP)2 Observational Prototype Experiment (HOPE) was designed to provide a critical model evaluation at scales covered by Large Eddy Simulation (LES) models, which in turn will be used to better understand sub-grid variability and microphysical properties and processes parameterized by larger scale models. Three X-band polarimetric radars deployed in Bonn (BoXPol) and in the vicinity of Juelich (JuXPol and KiXPol), Germany, were operated together with other instruments during the HOPE campaign, in order to obtain a holistic view of precipitation systems covering both macro- and microscopic processes.

Given the variability of polarimetric moments observed by polarimetric radars, the corresponding microphysical processes occurring during the development of storm cells thus can be inferred accordingly. This study focuses on the microscopic processes of storm systems which were observed by RHI (range-height indicator) scans of the three X band radars. The two frequently observed microphysical processes during the HOPE campaign, coalescence and differential sedimentation, will be shown, and the evolution of droplet size distributions (DSDs) will be also analyzed. The associated DSDs which are retrieved using radar measured polarimetric moments are further verified by the polarimetric forward operator where the assumptions of non-spherical hydrometeors have been embedded. The results indicate that the estimated DSDs from the tested retrieval algorithms are in consistency with the identified microphysical processes although discrepancies still exist. Together with the analysis from the macroscopic perspective which quantifies macroscopic structures of storm cells like height, intensity and temporal change of brightband, a holistic view of the development of storm systems will be provided.