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Towards the retrieval of ice crystals properties within mixed-phase clouds using dual polarization spectral radar measurements

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Nowadays clouds radiative effects are being considered as ones of the greatest uncertainty on the future climate prediction (IPCC 2007). It is mostly driven by the microphysical state as well as the cloud phase since the water content tends to dominate the radiative impact compared to ice. Cloud observation strategies based on the synergy of devices and measurements at different time and space scales are then required to assess and further improve global circulation models used to forecast the climate. In a saturated atmosphere, the possible presence of a liquid phase in a wide range of negative temperature leads to regions inside clouds where small supercooled water droplets coexist with a large panel of different ice crystal habits and sizes. Such ice clouds with mixed-phase layers embedded are present about 40% of the time which makes it relevant in the radiative balance. In remote sensing the emitted signal backscattered or absorbed by most of this mix of particles is difficult to interpret. A new technique is under development at Delft University to remotely determine the size distribution of different ice particles within mixed-phase regions. This work aims to create long time series of microphysical measurements which can be used for satellite retrievals validation. The retrieval is based on an iterative comparison of expected scattering properties from ice crystals (obtained with a microphysical model) and spectral dual-polarization measurements from radar observations (the Transportable Atmospheric RAdar TARA, Cabauw - The Netherlands). This radar has the advantage to get a direct measurement of the ice phase of the clouds since supercooled water droplets are small enough to be not detectable at the working frequency (3.3 GHz). A model has been built in parallel in order to characterize the microphysical state of a bulk of atmosphere. For compar-

ison purposes both the radar and the model can provide the polarimetric parameter spectral differential reflectivity (sZDR) which gives the axial ratio (from dual polarization) versus the size (from Doppler velocities) of the ice particles, assuming they can be modeled as spheroids. Besides presenting a general overview of the method specific attention will be made to explain and show some results on the improvement of the model using ground-based and in-situ measurements taken during the COPS campaign in Germany (Convective and Orographically-induced Precipitation Study) last summer.