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Advantages and limitations on combining radar dual - wavelength and polarimetric observations for ice microphysics retrievals

Eleni Tetoni[1], Florian Ewald[1], Gregor Möller[2], Martin Hagen[1], Tobias Zinner[2], Bernhard Mayer[2], Christoph Knote[2,3], and Silke Gross[1]

[1]Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Germany (eleni.tetoni@dlr.de)

[2]Meteorologisches Institut, Ludwig-Maximilians-Universität, Munich, Germany

[3]Medizinische Fakultät, Universität Augsburg, Augsburg, Germany

The challenge of the ice microphysical processes representation in numerical weather models is a well-known phenomenon as it can lead to high uncertainty due to the variety of ice microphysics. As ice microphysical properties can strongly affect the initiation of precipitation as well as the type and amount of it, we need to better understand the complexity of ice processes. To accomplish this, better microphysics information through ice retrievals from measurements is needed. The multi-wavelength radar method is nowadays becoming more and more popular in such microphysics retrievals. Taking advantage of different scattering regimes (Rayleigh or Mie), information about the size of atmospheric hydrometeors can be inferred using different radar bands. For this study, dual-wavelength reflectivity ratio measurements were combined with polarimetric measurements to estimate the size of ice hydrometeors. The measurements were obtained by using the synergy of the C-band POLDIRAD weather radar from the German Aerospace Center, located in Oberpfaffenhofen, and the Ka-band MIRA-35 cloud radar from the Ludwig Maximilian University of Munich. Along with the dual-wavelength dataset, the Differential Reflectivity (Z_{DR}) from POLDIRAD was used as a polarimetric contribution for the shape estimation of the detected ice particles. The radar observations were compared with T-matrix scattering simulations for the development of a retrieval scheme of ice microphysics. In the course of these studies, different assumptions were considered in the simulations. To capture the size variability, a Gamma particle size distribution (PSD) with different values of median volume diameter (MVD) was used. The soft spheroid approximation was used to approximate the ice particle shapes and to simplify the calculation and variation of their aspect ratios and effective densities. The selection of the most representative mass-size relation was the most crucial for the scattering simulations. In this study, we explored the modified Brown and Francis as well as the aggregates mass-size relation. After comparing the simulations to radar observations, we selected the better fitting one, i.e. aggregates, excluding the Brown and Francis as the simulated particles appeared to be too fluffy. Using the aggregates formulas, Look-Up tables (LUTs) for MVD, aspect ratio, and IWC were developed and used in the ice microphysics retrieval scheme. Here, we present preliminary microphysics retrievals of the median size, shape, and IWC of the detected hydrometeors combining the simulations in LUTs with the radar observations from different precipitation events

over the Munich area.