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Developement of a microphyscial retrieval based on beam-aware columnar vertical profiles: Combining side-looking polarimetry with vertical radar measurements

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The understanding of microphysical processes and properties in clouds plays a substantial role in the improvement of existing numerical weather models and forecasting. To gain access to these quantities deep within clouds, microphysical retrievals based on radar measurements are indispensable tools. Single-wavelength radar measurements, however, are not enough to properly constrain the microphysical properties of hydrometeors like size and shape alone and therefore need to be paired with additional observations like multi-wavelength or polarimetric quantities. While polarimetric quantities are mainly useful from an oblique perspective, multi-wavelength or doppler fall-speed observations are best made vertically and from close distance.

To tackle this observational dilemma we employ the previously developed method of beam-aware columnar vertical profiles (BA-CVPs) to combine a vertically pointing cloud radar in the Ka-band with operational measurements of two side-looking polarization Doppler weather radars in the C-band which are part of the national German radar network operated by the Deutscher Wetterdienst. In the next step a microphysical retrieval is developed incorporating existing approaches based on dual-wavelength ratio and differential reflectivity measurements to study the size and shape of hydrometeors. The measurement geometry grants the opportunity to explore the inclusion of linear depolarisation ratio and Doppler fallspeed velocity measurements in the retrieval to further constrain existing ambiguities. Retrieval results based on simple T-matrix scattering simulations are compared to results using more sophisticated discrete dipole approximation simulations weighing computational cost against accurate scattering properties of simulated hydrometeors.

The findings of this study in form of more accurate information about ice hydrometeors based on multi-frequency radar measurements can ultimately be used to improve existing numerical weather models with regards to ice growth processes and their representation within the models. Naturally, the retrieval can be applied to any other measurement geometry that combines side- and vertically-pointing radar measurements, e.g. BA-CVPs of operational weather radars along the flightpaths of airborne or satellite radar measurements.

VAT

Session

From Classical to Integrated Remote Sensing: New observation strategies for clouds and precipitation (multi-frequency, spectral polarimetry, multi-sensor)

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Presenting Author

Christian Heske

Email Address of Presenting Author

christian.heske@dlr.de

Affiliation of Presenting Author

Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR e.V.), Oberpfaffenhofen, Germany

Address of Presenting Author

Münchener Straße 20, 82234 Weßling, Germany

Author: HESKE, Christian (Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR e.V.) Oberpfaffenhofen, Germany)

Co-authors: EWALD, Florian (Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Germany); KÖCHER, Gregor (Ludwig-Maximilians-Universität); GROSS, Silke (Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR e.V.), Oberpfaffenhofen, Germany); ZINNER, Tobias (Meteorologisches Institut, Ludwig-Maximilians-Universität München, Germany)

Presenter: HESKE, Christian (Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR e.V.) Oberpfaffenhofen, Germany)