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Investigating the Origin of W-Band Radar KDP Signatures Inside and Below the Dendritic Growth Layer

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In snow, the specific differential phase (KDP) measured by dual-polarimetric cloud radars is often considered an indicator of high concentrations of small, nonspherical particles. However, KDP also depends on other hydrometeor characteristics such as density, orientation, phase, and size. Determining the contributions of various hydrometeors to observed KDP values is challenging and typically addressed through modeling approaches.
During the winter of 2022-2023, we deployed an innovative simultaneous-transmission-simultaneous-reception (STSR) Doppler W-band cloud radar (LIMRAD94) operated at 40deg elevation angle alongside a novel video in situ snowfall sensor (VISSS) in the Colorado Rocky Mountains. These observations supplemented the extensive measurements of the Atmospheric Radiation Measurement (ARM) Surface Atmosphere Integrated Field Laboratory (SAIL) campaign, which also featured Ka-band and X-band radars. The VISSS provided valuable particle data, including size, number, shape, and complexity.
Our analysis of high-KDP fall streaks, combined with in situ data from the VISSS, revealed that similar KDP magnitudes were produced by particle populations with significantly different number concentrations and mean mass-weighted particle diameters. By analyzing additional radar variables such as spectral differential reflectivity, reflectivity, spectral width, and correlation coefficient, we aim to understand when and how small and large particles contribute to the observed KDP magnitude. Moreover, we explore the influence of external factors, such as turbulence layers and synoptic fronts on polarimetric radar measurements.

VAT

Session

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

Preferred Contribution Type

Oral Presentation

Presenting Author

Anton Kötsche

Email Address of Presenting Author

anton.koetsche@uni-leipzig.de

Affiliation of Presenting Author

Leipzig Institute for Meteorology, Leipzig University, Germany

Address of Presenting Author

Stefanstr. 3, 04103 Leipzig

Author: KÖTSCHE, Anton (Leipzig University)

Co-authors: Dr MYAGKOV, Alexander (RPG Radiometer Physics GmbH, Germany); Dr RYZHKOV, Alexander (NSSL, Norman, OK, USA); Dr ORI, Davide (Institute of Geophysics and Meteorology, University of Cologne, Cologne, Germany); KALESSE-LOS, Heike (Leipzig University); Dr TERZI, Leonie von (Meteorological Institute, Ludwig-Maximilians-Universität in Munich, Munich, Germany); Dr MAAHN, Maximilian (Leipzig University); BUKOVCIC, Petar (NSSL, Norman, OK, USA); Dr KNEIFEL, Stefan (Meteorological Institute, Ludwig-Maximilians-Universität in Munich, Munich, Germany); Dr ETTRICHRÄTZ, Veronika (Leipzig University)

Presenter: KÖTSCHE, Anton (Leipzig University)