12.2 USING TRIPLE-FREQUENCY RADAR DOPPLER SPECTRA TO CONSTRAIN SNOW PARTICLE SCATTERING MODELS

S. KNEIFEL[1], PAVLOS KOLLIAS[2], ALESSANDRO BATTAGLIA[3]

[1] Institute for Geophysics and Meteorology, University of Cologne, Cologne, Germany
[2] Stony Brook University, USA
[3] University of Leicester, Leicester, UK
skneifel@meteo.uni-koeln.de

During the last years, an increasing number of scattering databases for single particles, complex aggregates and even rimed and melting aggregates became available. While these developments are in general a great step forward, their evaluation with observations is a very necessary but also challenging task. Recently available multi-frequency radar observations which cover the Rayleigh up to the Mie scattering regime revealed characteristic signatures of rimed and unrimed aggregated particles. However, the observed signatures are still affected by both, the particle size distribution (PSD) and the single scattering properties of the particles which makes a clear evaluation of one or the other challenging.

In this contribution, we present a new approach which uses the radar Doppler spectra at three frequencies (X, Ka, and W-band) collected during a recent winter field campaign in Finland. We analysed a snowfall event which includes rimed and unrimed snow aggregates. A large selection of spectra obtained from low-turbulence regions within the cloud reveals distinctly different signatures of the derived Doppler spectral ratios. Due to the third frequency, a characteristic curve can be derived which is almost independent of the underlying particle size distribution and velocity-size relation. The characteristics of the curves obtained for rimed and unrimed are distinctly different. The observed signatures were compared with scattering calculations obtained with discrete dipole approximation (DDA), self-similar Rayleigh-Gans approximation (SSRG), and with the classical soft spheroid (T-Matrix) method. While the DDA calculations of unrimed and rimed aggregates fit the observed signatures well, the T-Matrix results lie far outside the observed range. The SSRG approximations was found to be principally able to recover the main features after an adjustment of the previously published coefficients.