First experimental evidence for the potential of triple-frequency radar observations to derive key snowfall microphysical properties

Stefan Kneifel, Annakaisa von Lerber, Dmitri Moisseev, Pavlos Kollias, Jussi Leinonen, Jussi Tiira

Recent theoretical and observational studies indicated that triple-frequency measurements (e.g. combining Ku, Ka, W-band) bear the potential to derive important snowfall microphysical parameters like median mass diameter, fractal dimension, or particle habit. However, direct comparisons with in-situ observations to validate these predictions were missing.

In this presentation we will show results from a campaign in Hyytiälä (Finland) in 2014 where ground-based triple-frequency (X-, Ka-, and W-band) radar observations are for the first time analyzed in combination with a comprehensive set of collocated in-situ observations. The three analyzed case studies cover a wide range of snowflake habits and densities (degrees of riming). The observed triple-frequency signatures are in general agreement with former studies but also reveal new features and additional snowfall categories: Besides open low-density aggregates, rimed particles populate in a distinctly different regions; the signatures show high sensitivity on the change in bulk particle density. Therefore, we conclude that triple-frequency radar observations bear the potential to constrain some key parameters of snowfall microphysics like median mass diameter or bulk snowfall density. In combination with collocated in-situ observations they can also be used to test the consistency of snowfall scattering models.