Triple-frequency cloud radar approach: A novel way to investigate aggregation and riming processes in clouds

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Recent theoretical and observational studies indicated that triple-frequency radar measurements (e.g. combining 10, 35, and 95 GHz) bear the potential to derive important snow and ice microphysical parameters like median mass diameter, fractal dimension, or particle habit. However, direct comparisons with in-situ observations to validate these predictions were still missing.

In this presentation we will show results from a recent field campaign in Finland where ground-based triple-frequency radar observations are for the first time analyzed in combination with a comprehensive set of collocated in-situ observations. The comparisons revealed a close link between the unique signatures in the triple-frequency space to key hydrometeor properties like particle density and characteristic size of the particle size distribution – quantities which cannot be disentangled with conventional single-frequency cloud radars. We will also present recent analysis of the full triple-frequency Doppler spectra and demonstrate how their information can be used to validate ice and snow particle scattering models and to constrain velocity-size relations of the underlying particle population.

Finally, initial results of analyzing triple-frequency observations together with the polarimetric fingerprints of two nearby scanning polarimetric radars will be shown. These observations have been obtained during the first German triple-frequency experiment at the Research Centre Jülich (FZJ) during 2015 which was a collaborative effort of the U. Cologne, U. Bonn, FZJ and Karlsruhe institute of technology (KIT) to further explore the potential of combining triple-frequency, Doppler spectra, and polarimetric radar techniques to obtain detailed observational information about complex ice microphysical processes.