13.19 CLOUD RADAR SPECTRAL POLARIMETRY FOR QUANTITATIVE PRECIPITATION ESTIMATION

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Since decades polarimetric weather radars have been widely used by national weather services for monitoring clouds and precipitation. Beside the detection and ranging of atmospheric scatterers, modern weather radars provide a detailed classification of precipitation and estimate its intensity. Such retrievals are based on a set of polarimetric variables including backscattering parameters (e.g. differential reflectivity and correlation coefficient) and propagation parameters (e.g. specific differential phase shift). In general, rain rate retrievals that include propagation properties have superior accuracy due to their proportionality to the amount of liquid water in a volume. Nevertheless, the estimation of propagation parameters from the radar signal is often problematic, especially at low signal-to-noise ratios. Relatively low accuracy of the quantitative retrievals based only on backscattering parameters is mostly related to an assumed particle size distribution. Operational weather radars usually perform fast azimuthal scans at low elevation in order to cover large areas and achieve high temporal resolution. Such regimes often limit an application of advanced techniques based on the Doppler processing.

Polarimetric cloud radars, which become more and more available nowadays, have a great potential to overcome the problems of weather radars in improving the accuracy of precipitation intensity estimations. Having Doppler capabilities, polarimetric cloud radars can measure spectra of polarimetric variables with the resolution down to a few cm/s. At millimeter wavelengths, scattering of the radar signal by raindrops larger than 1 mm in size is in the Mie regime. Detection of Mie effects in a power spectrum is a challenging task. In contrast, Mie effects are clearly seen in the spectral differential reflectivity and the spectral differential phase as consecutive peaks and lows. A deep analysis of the Mie effects in the polarimetric spectra can be a base for a development of advanced retrieval algorithms.

In this talk we present first spectral polarimetric observations in rain at W-band. The measurements are obtained with a newly developed scanning FMCW cloud radar with the hybrid polarimetric configuration. We show that (1) polarimetric spectra can be used for a relatively simple separation of backscattering and propagation effects and (2) polarimetric spectra can be used for particle size distribution retrievals.