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Particle Size Distribution Retrieval Using Vertically Pointing Polarimetric Radar

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The particle size distribution (PSD) characterizes the precipitation and its knowledge allows a precise estimation of bulk quantities such as (equivalent) liquid water content (e)LWC or (equivalent) rainfall rate (e)RR. This paper presents the methodology used to retrieve PSD from vertically pointing radar.

The technique has two steps. In the first step the melting layer position is identified examining regions where the co-polar correlation coefficient ρ_{hv} drops and there is a significant vertical gradient of Doppler velocity and Doppler spectrum width. The radar range bins are consequently divided according to their position with respect to the melting layer. Above the melting layer precipitation is considered to be in a solid phase while below it is considered to be in a liquid phase. In the second step, PSD for each precipitation phase is retrieved by considering the relation between particle equivalent diameter D and its terminal velocity V_t and backscatter cross section σ_b. From the PSD, bulk quantities such as eLWC, eRR, volume equivalent diameter D0, etc. can be computed.

The retrieval has several sources of uncertainty, among them: the influence of the vertical wind and turbulence in the terminal velocity of the particles, the uncertainty in the modelling of such terminal velocity and the backscatter cross section (particularly for solid hydrometeors) and the influence of miss-calibration and attenuation on the spectral reflectivity.

The retrieval has been performed on data from two X-band radars during the PARADISO campaign in Payerne, Switzerland. In the paper, the results will be compared against co-located disdrometers as well as columns of eLWC obtained from the COSMO numerical weather prediction model analysis.