Convective Versus Stratiform Rain Microphysics Characterized by 2D-Video Disdrometer and Polarimetric Radar Observations – The Fuzzy Logic Approach

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Accurate rain estimation and model parameterization demand better understanding of rain microphysical properties. Polarimetric radars measure reflectivity at horizontal and vertical polarization $Z_{H,V}$, differential reflectivity Z_{DR}, differential phase Φ_{DP}, and co-polar correlation coefficient ρ_{hv}. Also, polarimetric radar measurements contain cloud/precipitation microphysics information such as hydrometeor size, shape, orientation, phase, useful for retrieval of drop size distributions (DSDs). Two dimensional video disdrometer (2DVD) directly measures the shape, size and falling velocity of precipitation particles, which is essential for interpreting polarization radar data. A joint radar-disdrometer observation allows to further understand precipitation microphysics and to reveal the cause for discrepancy. This methodology is applied herein.

Comparisons between polarimetric KOUN radar drop size distribution (DSD) retrievals and the two dimensional video disdrometer (2DVD) measurements indicate that some of the retrieved microphysical parameters differ depending on the type of precipitation. The biggest discrepancy between observations and radar measurements is in the median volume diameter D_0, whereby the radar-retrieved value is slightly higher in the convective part and somewhat lower in the stratiform portion of the storms compared to the observed one. Herein a multi variable fuzzy logic algorithm is used to separate the rain events into convective and stratiform periods, and derive the corresponding shape-slope (μ-Λ) relations of gamma distribution for the two types of rain, respectively. The constrained gamma (CG) relations are then used for DSD retrieval from polarimetric radar data. The retrieval results are compared with those obtained from the unified μ-Λ relation previously used in CG DSD retrievals. It is evident that the new relations better represent precipitation microphysics and yield more accurate retrieval results.