Utilization of differential phase for rainfall measurements, attenuation correction, and mitigation of radar miscalibration and partial beam blockage at X band. Promises and challenges.

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Using specific differential phase K_{DP} for rainfall estimation at X band proves to be efficient if a spatial / temporal scale of the rainfall product is sufficiently large. Instantaneous rain rates retrieved from K_{DP} often look noisy and erratic, especially in the areas of lighter rain or in the presence of the nonuniform beam filling. Separating contributions from the forward and backscattering components of differential phase is also a problem at X band. This dictates the need to combine the $R(K_{DP})$ estimates with the rain rate estimates based on radar reflectivity factor Z which can be biased by attenuation, radar miscalibration, and partial beam blockage.

Alternate approach implies utilization of specific attenuation A retrieved from radial profile of Z and total differential phase using ZPHI method. The R(A) estimate is less susceptible to DSD variations than the R(Z) and $R(K_{DP})$ estimates and is completely immune to radar miscalibration and partial beam blockage. Moreover, as opposed to $R(K_{DP})$, the fields of R(A) adequately reproduce realistic spatial structure of precipitation without distorting the shapes of rain cells. On the negative side, however, accurate quantification of A is a problem because of inherent limitations of the ZPHI technique, namely, the uncertainty in the ratio A/K_{DP} and variability of the A(Z) relation along the radar beam. Hence, it is suggested that the R(A) estimates should complement the R(Z) and $R(K_{DP})$ if the latter are seriously

compromised. It is also recommended that radar reflectivity factor Z_V and specific attenuation A_v at vertical polarization are utilized (instead of the ones at horizontal polarization) in order to improve radar sensitivity in the areas of heavy differential attenuation.

The benefits and deficiencies of all mentioned rainfall estimators examined via theoretical simulations and observations from the two X-band polarimetic weather radars in the Bonn area, Germany, will be discussed in the presentation. The comparison of the strategies for measuring precipitation with polarimetric radars at X, C, and S bands will be also addressed.