Implementation of variable relationships of radar reflectivity and rainfall rate in a network of X-band radars

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The relationship between radar reflectivity factor Z and rain rate R depicts the only possibility of rain rate estimation when using simple backscatter radars without dual polarized moments. In general, fixed climatological power-law relations are applied for operational use. In order to reduce the bias and large variability between radar rainfall and ground measurements, local adjustment with precipitation measurements from a ground-based network of rain gauges is required.

Within the project PATTERN (Precipitation and Attenuation Estimates from a High Resolution Weather Radar Network) the University of Hamburg and the Max-Planck-Institute for Meteorology set up a network consisting of four low-cost X-band radars. The network is completed by seven vertically pointing micro rain radars (MRR), providing drop size spectra as well as reflectivity and rain rate for 31 height levels. The MRRs are used for calibration purposes as well as for estimation of instantaneous local Z-R relationship in the common intersecting volume of X-band radar and MRR.

Recent studies based on measurements with MRRs with high temporal resolution, show that Z-R relationships are remaining constant from several minutes up to hours until they suddenly change their state within seconds. In the PATTERN network a correlation analysis technique is used to detect these time-dependent Z-R relationships using MRRs. The relations are then applied to the X-band radar network leading to more accurate quantitative radar rainfall rates in comparison to rainfall estimates based on common climatological relations.

The presentation will give an overview of the technique used to derive present Z-R relationships at the MRR sites as well as the implementation in the X-band radar network.