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Time series analysis of Z-R relationships for urban drainage

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Rainfall estimates for urban drainage applications can be made in real time over regional and local scales by accurately calibrating reflectivity returns from ground-based radars through the use of radar variable equations. Analysis of the variability of drop size distributions (DSD) output by ground-based disdrometers can form these necessary relations which can be adapted to different climate types, seasons and synoptic conditions. There will still be uncertainty in the estimation of rainfall and forecasts for hydrological modelling due to various factors, including clutter, radome attenuation, and anomalous propagation.

In this study, rainfall (R) to radar reflectivity (Z) relationships are produced based on DSD measurements from disdrometers located in Essen, Hamburg and Hannover, in Germany. After filtering unrealistically large rain rates, mostly caused by hail and snow, the results were in line with co-located rain gauges. Exponents and coefficients of the Z-R relations also compared well with those found by studies in similar climates.

Yearly time series are broken down into multiple events from which separate Z-R relationships are found and tested with radar reflectivity data. Rainfall is estimated using the small temporal scale event based relationships, which are then compared with the climatological relations. The results are tested against local networks of rain gauges to determine any enhancement in quality of radar rainfall estimation.