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Estimation of rainfall area-intensity-duration-frequency curves from weather radar data

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Intensity-duration-frequency (IDF) curves are frequently used for practical derivation of design storms. These curves are valid for extreme rainfall at local points. For the estimation of design flows in larger catchments, the point rainfall leads to overestimation. Hence, an adjustment is often carried out based on areal reduction factors (ARF). Radar data are available with a high resolution in space and could be used for a direct derivation of areal design storms.

This study deals with the estimation of area-intensity-duration-frequency curves (AIDF) directly from weather radar data. Addressed are the following research questions: a) What is the best sampling strategy for collecting areal design storms from radar data using a fixed origin or a variable pattern detection approach? b) What is the spatial variability of AIDF curves and ARFs with and without normalization by an index storm? and c) Which influence has the temporal sample size on the spatial variability of the extremes?

First, radar data are adjusted with rainfall observations from the daily station network. Thereafter, areal intensity duration frequency curves and areal reduction factors are calculated for different sampling strategies and temporal sample sizes. The AIDF and ARFs are compared regarding their spatial variability. The data used for this study cover about 20 years of observations from the radar device located near Hannover in Northern Germany as well as about 40 recording rain gauges and 500 non-recording rain gauges. AIDF curves and ARFS are analyzed for rainfall durations from 5 minutes to 24 hours and return periods from 1 year to 30 years. It is hypothesized, that the spatial variability decreases with sample size and when normalization is applied. In addition, the variable pattern detection approach should detect larger extremes than the fixed origin sampling approach.