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Influence of Different Areal Precipitation Estimation Methods Using Rain Gauges and Radar on the Simulation of Floods

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Precipitation data with a high resolution in space and time are the most important driving forces for hydrological modelling of floods. While there are terrestrial stations, which record precipitation with a sufficient temporal resolution, the network density is often too sparse for a reliable estimation of mean areal rainfall. Meanwhile radar data have been used more frequently as input for hydrological modelling due to its advantage of the high spatial resolution. A number of studies have shown though, that uncorrected radar data can have a large space-time variable bias. Considering these circumstances the best strategy is obviously to make use of all available information about rainfall and applying sophisticated interpolation and merging methods.

In this study precipitation is spatially interpolated with the multivariate geostatistical method external drift kriging (EDK) using additional information from topography, rainfall data from the denser daily networks and weather radar data. The focus is on the evaluation of the benefit of improved precipitation estimation for hydrological modelling of floods. The main problem for an objective assessment is to avoid a biased model calibration in favour of one precipitation data set. In the first strategy re-calibration of the hydrological model for each input with cross-validation on an event basis is applied. The second strategy uses a Monte-Carlo approach, where a large number of model parameter sets is randomly generated. For each parameter set the model is run with all precipitation inputs. The smallest average error indicates the best precipitation estimate. This procedure is more objective compared to the conventional calibration procedure.

Investigations are carried out for several flood events in the time period between 2000 and 2005 caused by different meteorological conditions. The 125 km radius around the radar station Ummendorf in northern Germany covers the overall study area including 21 recording stations. Hydrological modelling is carried out for three catchments located at the foothills of the Harz Mountains with a drainage area ranging from 50 to 180 km^2.

Weather radar data have turned out to be the most valuable additional information for EDK. The results from hydrological simulations using the model HEC-HMS show however, that the advantages of EDK with radar data over other interpolation methods seen in precipitation cross-validations are not fully transformed into improvements regarding the simulation of floods.