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An Enhanced Approach to Generate Synthetic Hydrographs with Low Probability of Occurrence

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Extreme flood hydrographs are required for many different issues in hydraulic engineering applications. As an alternative to rainfall runoff models, the Flood Characteristic Simulation, based on the German guideline "Generation of Design Hydrographs following the DIN 19700 in North Rhine-Westphalia", published by the Ministry of Environment of North Rhine-Westphalia (MUNLV) provides the opportunity to generate synthetic hydrographs solely based on recorded discharge time series. The shapes of recorded flood hydrographs can be described mathematically by the combination of two analytic functions: The Kozeny Function for the rising part of the flood event and a parabolic function for the recession part. Overall, four parameters are used to describe the hydrograph: the time period of increasing discharge (t_A), the peak run-off (Q_S), the dimensionless shape parameters for the rising period (m_{an}) and the recession period (m_{ab}). Fitting distribution functions to all samples will allow generation of any number (e.g. 10,000) of synthetic flood events by the random walk method. The model produces reasonable results for simple-shaped hydrographs, i.e. single peak hydrographs. However, application of this method shows the deficiency of not being able to simulate flood events with almost constant peak flows over a specific time period. Thus, considering the peak flow duration t_P in the simulation seems to be desirable. By extending the existing simulation method with the time duration t_P as a fifth parameter the overall results are expected to be improved.

In this study, results of the enhanced hydrograph generator, considering t_P, will be presented. In Bender & Jensen (2012, accepted) the classical as well as the enhanced method have been applied to a case study in Germany. Using the enhanced method the results show that in particular the upper part of the hydrographs can be simulated substantially better. In order to quantify the improvements all recorded hydrographs of a 38-year time series have been parameterized and re-simulated using both methods. Correlating the simulated flood volumes with the recorded flood volumes then provides a classification of the improvement. The results show that the enhanced method leads up to a 20 % higher correlation coefficient compared to the classical method with only little additional effort for the user.