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Estimation of flood peak distributions from maximum daily flow statistics

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Derived flood frequency analysis based on continuous daily streamflow simulations is much less demanding than continuous simulations with hourly or shorter time steps. Reasons for that are the better availability of daily precipitation data and possible simplifications in hydrological modelling regarding reduced process dynamics. However, maximum daily flows underestimate the real flood peaks. This effect is usually as stronger as smaller the catchment and as shorter and more intense the rainfall forcing. An estimation of the real flood peak distribution from maximum daily flow statistics would enable simplified hydrological modelling on a daily time steps with posterior adjustment of derived flood frequencies and thus benefit the planning of flood protection measures for poorly gauged basins.

Objective of this case study is the investigation of simple approaches for the assessment of flood peak quantiles from observed or simulated maximum daily flow statistics. The following different estimation methods are applied and compared: empirical relationships between estimated quantiles using peak flows and maximum daily flows, empirical relationships between moments of distributions of peak flows and of maximum daily flows and scaling relationships derived from temporal upscaling of hourly flow series.

The study area used here is the 3200 km2 Bode river basin located in the Harz Mountains in Northern Germany. Long term data about peak flows and daily flows are analysed from about 25 stream flow gauges. In addition about 10 years of continuous hourly flow data available for most of the gauges are utilised for establishing the scaling relationships. The results indicate if such a simple estimation of peak flow distributions is possible and which approach is to be preferred under which circumstances.