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Consistent IDF Curves with R

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Intensity-Duration-Frequency (IDF) Curves are a popular tool in Hydrology for estimating the properties of extreme precipitation events. They describe the relationship between the exceedance probability (or frequency) of a given rainfall intensity for different durations. A frequently used method to obtain these curves is based on a hierarchy of two separate statistical models: First the exeedance probabilities for fixed durations are described with extreme value statistics. Afterwards the dependency of fixed exceedance probabilities on duration is described with a regression model. This two step approach can lead to physically inconsistent results, such as higher intensities occuring with higher probability (‘crossing of quantiles’) particularly for longer durations,.
A consistent estimation of the IDF relationship can be obtained by simultaneously modelling the probability distributions for all durations. To this end a duration dependent generalized extreme value distribution (GEV, after Koutsoyannis et al., 1998) is used. This method is implemented in the R-package ‘IDF’ for the statistical programming environment R which is available on CRAN. To ensure simple handling, a function is provided to calculate events of different durations from an existing regularly sampled time series of precipitation amounts. Hence, block maxima (e.g. annual maxima or maxima for selected months) can be calculated for the different durations. The probability distribution of the block maxima for different durations is then modeled with the duration dependent GEV.
Based on this model, physically consistent IDF curves for arbitrary return periods can be displayed. Additionally, this approach allows the integration of covariates to describe the variability of the duration dependent GEV parameters, e.g. in time, space or with atmospheric variables. We present a case study as well as the usage of the R-package ’IDF’.