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Flood frequency analysis – assessment of uncertainties in flood data, plotting positions and fitted distributions

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The operational aim of flood frequency analysis is to estimate design floods that are used for areal planning and the design of important infrastructure. In most operational guidelines, annual maximum data are fitted to one or several distributions. Typical distribution that are used include the Generalized extreme value-, Gumbel-, Log_pearson-III- , and Generalized logistic distributions. Typical estimation methods include Bayesian, ordinary moments, l-moment and maximum likelihood approaches.
In an operational setting, the assessment of how well the model fit to data, is based on visualizing the fitted distribution together with the empirical distribution of the data. If no specific requirements are given, this visualization is used to select the distributions providing the best fit to data.
Several elements of a return level plot are influenced by uncertainties. Firstly, the fitted distribution is uncertain since a limited dataset is used in the estimation. Secondly the observed flood data are uncertain since they are derived from a rating curve. Thirdly, the plotting position used for estimating the empirical distribution is based on order statistics and is also uncertain due to the limited sample size.
The aim of this presentation is to investigate the combined uncertainties in a return level plot and discuss how the visualization might influence the interpretation of distribution fits. To achieve this aim, we used a Bayesian approach for estimated the parameters of the selected distributions. This approach provided us with a posterior sample of return levels from which we can assess credibility intervals. The uncertainties in observed streamflow was assessed by assessing the uncertainty of the rating curve, providing us with a posterior sample of flood sizes from which credibility intervals can be assessed. The uncertainty of the plotting position was assessed using a numerical approach.
The results shows that uncertainties in plotting positions, in particular for the highest values is large. The uncertainty of the observed data depends in particular on far the rating curve is extrapolated and might be large, in particular for the highest floods. Visual assessments of distribution fit, might therefore be based of over-confident assessment of the information in the observed data. We therefore argue that including uncertainties in return levels plot will be a useful tool and avoid us to be overconfident when choosing distribution.