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Process-informed extreme value statistics- Why and how?

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In many parts of the world, annual maximum series (AMS) of runoff consist of flood peaks, which differ in their genesis. There are several aspects why these differences should be considered: Often multivariate flood characteristics (volumes, shapes) are of interest. These characteristics depend on the flood types. For regionalization, the main impacts on the flood regime has to be specified. If this regime depends on different flood types, type-specific hydro-meteorological and/or watershed characteristics are relevant. The ratios between event types often change over the range of observations. If a majority of events, which belongs to certain flood type, dominates the extrapolation of a probability distribution function (pdf), it is a problem if this more frequent type would not be typical for extraordinary large extremes, determining the right tail of the pdf. To consider differences in flood origin, several problems has to be solved. The events have to be separated into different groups according to their genesis. This can be a problem for long past events where e.g. precipitation data are not available. Another problem consists in the flood type-specific statistics. If block maxima are used, the sample of floods belong to a certain type is often incomplete as other events are overlaying smaller events. Some practical useable statistical tools to solve this and other problems are presented in a case study. Seasonal models were developed which differ between winter and summer floods but also between events with long and short timescales. The pdfs of the two groups of summer floods are combined via a new mixing model. The application to German watersheds demonstrates the advantages of the new model, giving specific influence to flood types.