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Frequency analysis on water stages - opportunities and challenges

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Frequency analysis of annual peak flows is a common task in numerous hydrological applications, such as the planning and design of risk reduction measures. The traditional approach is to use a probability distribution function to fit time series of annual peak flows, which are typically derived from a (uncertain) rating curve describing the relationship between flows and water stages. The parameterized distribution function is then used to derive flood quantiles corresponding to the desired return periods. These design floods are often used as input of a (uncertain) hydraulic model to derive the corresponding flood water stage, which is then used for design purposes (e.g. levee height). In this study, we investigate the idea of conducting the frequency analysis directly on the water stages. Our rationale is that a flood stage is what is actually desired for many hydrological applications, thus it is not always necessary to derive the corresponding river flow, which implies the introduction of additional sources of uncertainty (rating curve and hydraulic model). Here we discuss the potentials and limitations of using water stages directly and show example applications to real world cases.