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# A Bayesian Approach to Multifractal Extremes

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Drivers such as climate change and rapid urbanisation will result in increasing flood problems in urban environments through this century. Problems encountered in existing flood defence strategies are often related to the data non-stationary, long range dependencies and the clustering of extremes often resulting in fat tailed (i.e. a power-law tail) probability distributions.

We discuss how to better predict the floods by using a physically based approach established on systems that respect a scale symmetry over a wide range of space-time scales to determine the relationship between flood magnitude and return period for a wide range of aggregation periods. The classical quantile distributions unfortunately rely on two hypotheses that are questionable: stationarity and independency of the components of the time series. We pointed out that beyond the classical sampling of the extremes and its limitations, there is the possibility to eliminate long-range dependency by uncovering a white-noise process whose fractional integration generates the observed long-range dependent process.

The results were obtained during the CEATI Project "Multifractals and physically based estimates of extreme floods". The ambition of this project was to investigate very large data sets of reasonable quality (e.g., daily stream flow data recorded for at least 20 years for several thousands of gages distributed all over Canada and the USA). The multifractal parameters such as the mean intermittency parameter and the multifractality index were estimated on 8332 time series.

The results confirm the dependence of multifractal parameter estimates on the length of available data. Then developing a metric for parameter estimation error became a principal step in uncertainty evaluation with respect to the multifractal estimates. A technique for estimating confidence intervals with the help of a Bayesian approach was developed. A detailed comparison of multifractal quantile plots and paleoflood data validates the forthcoming use of a Bayesian approach to multifractal extremes