Bayesian inference for functional extreme events defined via partially unobserved processes

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In order to describe the extremal behaviour of some stochastic process X approaches from univariate extreme value theory are typically generalized to the spacial domain.

Besides max-stable processes, that can be used in analogy to the block maxima approach, a generalized peaks-over-threshold approach can be used, allowing us to consider single extreme events. These can be flexibly defined as exceedances of a risk functional ℓ, such as a spatial average, applied to X. Inference for the resulting limit process, the so called ℓ-Pareto process [1], requires the evaluation of $\ell(X)$ and thus the knowledge of the whole process X.

In practical application we face the challenge that observations of X are only available at single sites. To overcome this issue, we propose a two-step MCMC-algorithm in a Bayesian framework. In a first step, we sample from X conditionally on the observations in order to evaluate which observations lead to ℓ-exceedances. In a second step, we use these exceedances to sample from the posterior distribution of the parameters of the limiting ℓ-Pareto process. Alternating these steps results in a full Bayesian model for the extremes of X.

References

[1] De Fondeville, R. and Davison, A. C. 2018. High-dimensional peaks-over-threshold inference. In: *Biometrika* 105.3:575–592.