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A Bayesian assessment of non-stationary daily precipitation extremes

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Extreme value analysis are often carried out under the assumption that Climate is stationary, even though there is evidence pointing out that this hypothesis is not accurate for all timescales. Seasonal variability, as well as inter-annual variability (e.g. ENSO), are examples of non-stationary behaviors that may affect the characterization of extremes and that are not often included in the analysis. On top of this natural variability, Climate Change seems to be going to contribute to increase non-stationary effects, thus reducing the validity of the stationarity hypothesis. Non-stationary extreme value analysis can deal with most of these effects in the characterization of extreme events, leading to a more accurate quantification of extremes.

Non-stationary extreme value analysis often relies on assuming a functional form for the time dependence of the model parameters (e.g. the parameters of the Generalized Extreme Value distribution or the Pareto-Poisson one). This functional form often presents a parametric representation whose parameters are assumed to be stationary. Maximum likelihood methods are then used to fit the model parameters, which are ultimately the parameters of the functional form for time dependence, determining the weight of every factor in the non-stationarity, as well as the time dependence of the parameters of the original distribution (e.g. GEV).

In this work, different functional forms for the time dependence are tested to capture the non-stationarity of daily precipitation extremes. The quality of the different functional forms fitting the observations is assessed. A Bayesian analysis is carried out to obtain the distributions of the parameters of interest, which allows an in-depth evaluation of model uncertainties. The performance of hierarchical models is also assessed. Return levels are computed and compared with the ones obtained through a classical stationary extreme value analysis.

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