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Spatio-Temporal Regression Based Clustering of Precipitation Extremes in a Presence of Systematically Missing Covariates

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Regression based Generalized Pareto Distribution (GPD) models are often used to describe the dynamics of hydrological threshold excesses relying on the explicit availability of all of the relevant covariates. But, in real application the complete set of relevant covariates might be not available. In this context, it was shown that under weak assumptions the influence coming from systematically missing covariates can be reflected by a nonstationary and nonhomogenous dynamics.
We present a data-driven, semiparametric and an adaptive approach for spatio-temporal regression based clustering of threshold excesses in a presence of systematically missing covariates. The nonstationary and nonhomogenous behavior of threshold excesses is describes by a set of local stationary GPD models, where the parameters are expressed as regression models, and a non-parametric spatio-temporal hidden switching process. Exploiting nonparametric Finite Element time-series analysis Methodology (FEM) with Bounded Variation of the model parameters (BV) for resolving the spatio-temporal switching process, the approach goes beyond strong a priori assumptions made is standard latent class models like Mixture Models and Hidden Markov Models. Additionally, the presented FEM-BV-GPD provides a pragmatic description of the corresponding spatial dependence structure by grouping together all locations that exhibit similar behavior of the switching process. The performance of the framework is demonstrated on daily accumulated precipitation series over 17 different locations in Switzerland from 1981 till 2013 - showing that the introduced approach allows for a better description of the historical data.