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Robustness of precipitation and river discharge extremes in the surrogate world of seasonal forecasts

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Robust information of hydrometeorological extremes is important for effective risk management, mitigation and adaptation measures by public authorities, civil and engineers dealing for example with water management. Typically, return values of certain variables, such as extreme precipitation and river discharge, are of particular interest and are modelled statistically using Extreme Value Theory (EVT). However, the estimation of these rare events based on extreme value analysis are affected by short observational data records leading to large uncertainties.

In order to overcome this limitation, we propose to use the latest seasonal meteorological prediction system of the European Centre for Medium-Range Weather Forecasts (ECMWF SEAS5) and seasonal hydrological forecasts generated with the pan-European E-HYPE model of the original period 1993-2015 and to extend the dataset to longer synthetic time series by pooling single forecast months to surrogate years. To ensure an independent dataset, the seasonal forecast skill is assessed in advance and months (and lead months) with positive skill are excluded. In this study, we simplify the method and work with samples of 6- and 4-month forecasts (instead of the full 7-month forecasts) depending on the statistical independency of the variables. It enables the record to be extended from the original 23 years to 3450 and 2300 surrogate years for the 6- and 4-month forecasts respectively.

Furthermore, we investigate the robustness of estimated 50- and 100-year return values for extreme precipitation and river discharge using 1-year block maxima that are fitted to the Generalized Extreme Value distribution. Surrogate sets of pooled years are randomly constructed using the Monte-Carlo approach and different sample sizes are chosen. This analysis reveals a considerable reduction in the uncertainty of all return period estimations for both variables for selected locations across Europe using a sample size of 500 years. This highlights the potential in using the ensembles of meteorological and hydrological seasonal forecasts to obtain timeseries of sufficient length and minimize the uncertainty in the extreme value analysis.