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Exploring the uncertainty of Weather Generators' extreme estimates associated with the length of the input data series

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Stochastic Weather Generators (WG) have been extensively used in recent years for hydrologic modeling, among others. Compared to traditional approaches, the main advantage of using WGs is that they can produce synthetic continuous time series of weather data of unlimited length preserving their spatiotemporal distribution. Synthetic simulations are based on the statistical characteristics of the observed weather, thus, relying upon the length and spatial distribution of the input data series. In most cases, and especially in arid/semiarid regions, these are scarce, which makes it difficult for WGs to obtain reliable quantile estimates, particularly those associated with low-frequency events. The present study aims to explore the importance of the input weather data length in the performance of WGs, focusing on the adequate estimation of the higher quantiles, and quantifying their uncertainty.

An experimental case study consisting of nine rain gauges from the Spain02-v5 network in a 0.11º resolution covering an approximate area of 180 km^2 was implemented. The WG used for the experiment was GWEX, which includes a three-parameter (σ, κ, and ξ) cumulative distribution function (E-GPD) to model de precipitation amounts, being the shape parameter ξ the one directly governing the upper tail of the distribution function. A fictitious climate scenario of 15,000 was simulated fixing the ξ value to 0.11. From this scenario, 50 realizations of 5,000 years with a different sample length (i.e. 30, 60, 90, 120, 150, 200, 300 years) were simulated for four different particular cases: (1) leaving the ξ value as default (i.e. 0.05); (2) estimating the ξ value from the observations; (3) calibrating the ξ value with the T = 100 years quantile from the 15,000 years; and (4) fixing the ξ value to the fictitious scenario value. Relative root mean square error (RRMSE) and coefficient of variation (CV) were calculated for each set of realizations and compared with the obtained from the fictitious climate scenario.

Preliminary results showed a clear reduction in the value of both the CV and the RRMSE with the increase of the sample length for the four particular cases, being this reduction more evident for the higher order quantiles and as we move from particular case (1) to (4). Furthermore, it was observed that there was not any significant improvement in the higher quantile estimates between the 200-yrs and the 300-yrs samples, concluding that there is a sample length threshold from which the estimates do not improve. Finally, even observing a clear improvement in all estimates when increasing the sample length, a systematic underestimation of the higher quantiles in all cases was still observed, which remarks the importance of seeking extra sources of

information (e.g. regional max. Pd. studies) for a better parameterization of the WG, especially for arid/semiarid climates.