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Sample Uncertainty Analysis of Daily Flood Quantiles Using a Weather Generator

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Due to its potential, Synthetic Continuous Simulation (SCS) (i.e. the use of Weather Generators (WGs) coupled with Hydrological Models (HMs)) is gaining interest among the hydrological community in order to extend the available hydrometeorological records. The limitations of this approach stem from the paucity of available observations that allow obtaining the characteristics of extreme storms. This situation makes WGs struggle to obtain reliable low-frequency quantile estimates, generating uncertainties that in turn are transferred to flood discharges. The present study aims to quantify the sample uncertainty of high flood quantile estimates generated by SCS for different: (1) degrees of precipitation extremality; (2) climates; and (3) catchment hydromorphologies. Results will be compared with uncertainty of the higher flood quantile quantified as a function of a selected realistic period of the simulated flow generated by the HM.

A synthetic one-rain gauge case study was implemented in a medium-size basin (180 km2). The WG used for the experiment was GWEX, which includes the three-parameter (σ, κ, and ξ) cumulative distribution function E-GPD to model precipitation amounts, being the shape parameter ξ the one directly governing the upper tail of the distribution function. The fully-distributed HM TETIS was used to derive discharges.

The methodology consists of a Monte Carlo simulation with packages of 50 x 60-year rainfall samples, estimating the parameters with GWEX for each and calculating the simulated flood quantiles. The considered information scenarios were studied by incorporating a Regional Study of Annual Maximum Daily Precipitation (RSAMDP) in the WG calibration process, ascertaining in a preliminary study that it yields better results. The analysis of three degree of extremality (1) was performed on both base populations, semi-arid and humid (2) and by introducing two different hydromorphologies (3). The Relative Root Mean Square Error (RRMSE), Relative Bias (RB) and the Coefficient of Variation (CV) were calculated and analysed for each package. To define the reliability of the results obtained, a sufficiently long synthetic series was selected from a realistic set of consecutive data (75-100 years) but with a random starting year. Repeating this process enough times for each of them, and fitting a distribution function, flood quantile estimates will be obtained and uncertainty will be compared with that obtained through the first methodology.

Results show an important reduction on both RRMSE and CV of flood quantile estimates in less

extreme climates, confirming that the higher the precipitation extremality, the higher the uncertainty of the estimated flood discharges, especially those associated with high return periods. These flood estimates presented much less uncertainty in a humid precipitation regime than in a semiarid climate, which remarks the importance to focus the studies on the latter. Lastly, permanent flow regimes presented lower values of both metrics, especially in terms of CV, than in the case of ephemeral conditions, but not significantly.