Uncertainty analysis of extreme flood daily discharges using a Weather Generator

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Synthetic Continuous Simulation (SCS) (i.e. the use of Weather Generators (WGs) coupled with Hydrological Models (HMs)) is becoming a common practice among the hydrological community in order to extend the available hydrometeorological records. Yet, this approach is very much dependent on the available observations, especially in arid and semiarid climates, where most of the rainfall is concentrated in short periods of time (mostly in the form of heavy rainfall episodes), and these are followed by long drought conditions. The short available records and the high spatio-temporal variability of these extreme events make WGs struggle to obtain reliable low-frequency quantile estimates, which in turn, are transferred to discharges.

The present study aims to quantify the uncertainty of the higher flood quantile estimates generated by SCS for different: (1) practical available precipitation information scenarios; (2) degrees of precipitation extremality; (3) climates; and (4) catchment hydrologies.

A synthetic one-rain gauge case study was implemented in a medium-size basin (180 km^2). 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. TETIS incorporates a split effective parameter structure, allowing for a significant reduction on the number of variables to be calibrated (only nine correction factors) while maintaining the spatial pattern of the parameter maps.

A synthetic "base" population was created from a 66-years sample recorded in the Spanish Mediterranean coast and in the Basque Country, semiarid and humid climates respectively.

The methodology consists of a Monte Carlo simulation with packages of 50 x 60-year samples, estimating the parameters with GWEX for each and calculating the simulated flood quantiles. The considered information scenarios (1) were studied by incorporating (or not) a Regional Study of Annual Maximum Daily Precipitation (RSAMDP) in the WG calibration process. The analysis of the degree of extremality (2) was performed by applying different ξ values to the base populations. (3) Compares results obtained from both base populations (i.e. semiarid and humid) whereas (4) was carried out introducing different hydrologies by means of modifying the HM correction factors. The Relative Root Mean Square Error (*RRMSE*), Relative Bias (*RB*) and the Coefficient of Variation (*CV*) were calculated and analyzed for each package.

Preliminary results show an important reduction on both *RRMSE* and *CV* of flood quantile estimates when using a RSAMDP in the WG calibration process. This reduction, however, has been proved to be less significant with the precipitation extremality, 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 significantly lower values of both metrics, especially in terms of *CV*, than in the case of ephemeral conditions.