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Synthetic generation of arbitrarily long series of flood hydrographs for flood risk assessment

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Flood risk assessment is an essential component of natural disaster management. Flood frequency analysis has traditionally been approached by fitting relatively short series of annual maxima of observations to a parametric probability distribution. Under this approach, only one relevant variable (usually peak discharge) can be analyzed, while in many practical applications, like dam safety analysis, the entire flood hydrograph is of interest. Obtaining a good representation of the ensemble of hydrographs would require extremely long historical flood series which almost never exist. Hydrometeorological modelling tools can be applied to extend the relatively short series of observations and generate an arbitrarily long series of synthetic events that can be used in flood risk assessment. The heavy computational burden of these processes requires the contribution of Information and Communication Technology (ICT) developments to enable the practical application of the hydrometeorological modelling chain for this purpose. In this paper, an example of this methodology is applied to the Santillana reservoir, located in the Manzanares basin, in Spain. The methodology is based on the Monte Carlo generation of synthetic hydrographs from rainstorms events extracted from arbitrarily long synthetic rainfall time series. The rainfall series are generated with the RainSim software, a model based on a spatial-temporal Neyman-Scott rectangular pulses process. The highest event of every year is chosen, based on three different criterions. The selected rainstorm events are transformed into runoff by the RIBS distributed rainfall-runoff event model, obtaining the ensemble of hydrographs which make possible to evaluate the associated flood risk. The procedure has been validated by comparing the observed flood frequency series in the Santillana reservoir with the synthetic ones, obtaining a good agreement.