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A methodology for continuous a flood frequency analysis with weather generator and rainfall-runoff model

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When solving various problems of water management one can quite often face a problem of insufficient data. This problem is very common especially in areas such as flood frequency analysis and the estimation of N-year floods, where even the longest records are short for the estimation of extreme floods with high return period. In the last decade a substantial effort has been put into the development of new methods for flood frequency analysis (FFA), which would utilize continuous simulation of catchment runoff. This work presents a recent trend in FFA combining single-site stochastic weather generator the enabling generation of continuous of mean areal daily rainfall amounts and air temperatures time series of arbitrary length with a lumped rainfall-runoff model to transfer the outputs of the stochastic models into a series of corresponding river discharges.
In this work, the methodology was used to generate a time series of 10,000 years of mean daily discharges, which was used to build a flood frequency curve and to estimate extreme flood discharges of given return periods. The methodology was applied in mountainous catchment of the Váh River in Slovakia. The results of the analysis showed that the stochastic weather generator proved to be robust enough to satisfactorily simulate observed precipitation and air temperature time series. In the rainfall-runoff modelling a separate simulation of low and high flows was introduced. This led to a significant improvement of the simulation of extreme flows while preserving a very good simulation of low and medium flows. However, the model did not performed very well when simulating the most extreme floods. The great steepness of the hypsometric curve called for a semi-distributed modelling approach, in which the model inputs would be divided into several elevation zones.