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Combining continuous and event based fully distributed hydrologic models for extreme flood estimation

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This study presents a methodology to estimate flood frequency curves for high return periods through stochastic rainfall simulation and rainfall-runoff modeling. The estimation of the flood frequency curve through simulation can be addressed through continuous or event-based hydrological modeling. Event-based models require shorter simulation times, which offer the possibility of obtaining longer synthetic series. However, initial soil moisture conditions are crucial when modeling the basin response to a storm event. This issue can be solved by using continuous models, but they need more data and computational effort than event-based models. This study develops a methodology to overcome the problem of initial conditions when determining flood frequency curves for high return periods combining continuous and event based-models. We used an hourly time-step distributed continuous hydrologic model (the TIN-based Real-time Integrated Basin Simulator (tRIBS)) to simulate the basin response through a set of 100 years obtained using a stochastic weather generator (calibrated with 30 years of available observed data). We analyzed the relevant storm events occurred during the continuous time series, characterizing the probability distribution of the initial soil moisture conditions. Within a Monte Carlo environment, we generated an arbitrary long set of rainfall events coupled with a set of synthetic initial conditions. Finally, by using a fully distributed event-based model we estimated the corresponding hydrologic response, deriving the flood frequency curve. The methodology was applied to Peacheater Creek, a small basin located in Oklahoma (United States). The procedure described combines the advantages of continuous modeling in the assessment of basin initial conditions to those associated to event-based modeling (for instance, computational efficiency) in the estimation of flood frequency curves for high return periods.