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Quasi-continuous stochastic simulation framework for flood modelling

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Typically, flood modelling in the context of everyday engineering practices is addressed through event-based deterministic tools, e.g., the well-known SCS-CN method. A major shortcoming of such approaches is the ignorance of uncertainty, which is associated with the variability of soil moisture conditions and the variability of rainfall during the storm event.In event-based modeling, the sole expression of uncertainty is the return period of the design storm, which is assumed to represent the acceptable risk of all output quantities (flood volume, peak discharge, etc.). On the other hand, the varying antecedent soil moisture conditions across the basin are represented by means of scenarios (e.g., the three AMC types by SCS),while the temporal distribution of rainfall is represented through standard deterministic patterns (e.g., the alternative blocks method). In order to address these major inconsistencies,simultaneously preserving the simplicity and parsimony of the SCS-CN method, we have developed a quasi-continuous stochastic simulation approach, comprising the following steps: (1) generation of synthetic daily rainfall time series; (2) update of potential maximum soil moisture retention, on the basis of accumulated five-day rainfall; (3) estimation of daily runoff through the SCS-CN formula, using as inputs the daily rainfall and the updated value of soil moisture retention;(4) selection of extreme events and application of the standard SCS-CN procedure for each specific event, on the basis of synthetic rainfall.This scheme requires the use of two stochastic modelling components, namely the CastaliaR model, for the generation of synthetic daily data, and the HyetosMinute model, for the disaggregation of daily rainfall to finer temporal scales. Outcomes of this approach are a large number of synthetic flood events, allowing for expressing the design variables in statistical terms and thus properly evaluating the flood risk.