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Model parameters conditioning on regional hydrologic signatures for process-based design flood estimation in ungauged basins.

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The use of rainfall-runoff models represents an alternative to statistical approaches (such as at-site or regional flood frequency analysis) for design flood estimation, and constitutes an answer to the increasing need for synthetic design hydrographs (SDHs) associated to a specific return period. However, the lack of streamflow observations and the consequent high uncertainty associated with parameter estimation, usually pose serious limitations to the use of process-based approaches in ungauged catchments, which in contrast represent the majority in practical applications. This work presents the application of a Bayesian procedure that, for a predefined rainfall-runoff model, allows for the assessment of posterior parameters distribution, using the limited and uncertain information available for the response of an ungauged catchment (Bulygina et al. 2009; 2011). The use of regional estimates of river flow statistics, interpreted as hydrological signatures that measure theoretically relevant system process behaviours (Gupta et al. 2008), within this framework represents a valuable option and has shown significant developments in recent literature to constrain the plausible model response and to reduce the uncertainty in ungauged basins. In this study we rely on the first three L-moments of annual streamflow maxima, for which regressions are available from previous studies (Biondi et al. 2012; Laio et al. 2011). The methodology was carried out for a catchment located in southern Italy, and used within a Monte Carlo scheme (MCs) considering both event-based and continuous simulation approaches for design flood estimation. The applied procedure offers promising perspectives to perform model calibration and uncertainty analysis in ungauged basins; moreover, in the context of design flood estimation, process-based methods coupled with MCs approach have the advantage of providing simulated floods uncertainty analysis that represents an asset in risk-based decision making and in hydraulic design. The obtained results highlight the relevant impact of uncertainty in regional estimates of hydrological signatures on posterior parameters distribution and on uncertainty bounds of simulated peak discharges. The results of the continuous simulation, generally, better matched those of the statistical flood frequency analysis, thus this approach is recommended for the flood frequency analysis in the study area.

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