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Flood simulation errors show an unexpected seasonal trend: results obtained on a set of 229 catchments and 11,054 flood events

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To improve the predictive capability of a model, one must identify situations where it fails to provide satisfactory results. We tried to identify the deficiencies of a lumped rainfall-runoff model used for flood simulation (the hourly GR5H-I model) by evaluating it over a large set of 229 French catchments and 11,054 flood events. Evaluating model simulations separately for individual flood events allowed us identifying a seasonal trend: while the model yielded good performance in terms of aggregated statistics, grouping results by season showed clear underestimations of most of the floods occurring in summer. The largest underestimations of flood volumes were identified when high-intensity precipitation events occurred and when the precipitation field was highly spatially variable. Low antecedent soil moisture conditions were also found to be strongly correlated with model bias. Overall, this study pinpoints the need to better account for short-duration processes to improve the GR5H-I model for flood simulation.