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Regionalisation of a distributed method for flood quantiles estimation: Revaluation of local calibration hypothesis to enhance the spatial structure of the optimised parameter

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The SHYREG method (Aubert et al., 2014) associates a stochastic rainfall generator and a rainfall-runoff model to produce rainfall and flood quantiles on a 1 km2 mesh covering the whole French territory. The rainfall generator is based on the description of rainy events by descriptive variables following probability distributions and is characterised by a high stability. This stochastic generator is fully regionalised, and the rainfall-runoff transformation is calibrated with a single parameter. Thanks to the stability of the approach, calibration can be performed against only flood quantiles associated with observated frequencies which can be extracted from relatively short time series. The aggregation of SHYREG flood quantiles to the catchment scale is performed using an areal reduction factor technique unique on the whole territory.

Past studies demonstrated the accuracy of SHYREG flood quantiles estimation for catchments where flow data are available (Arnaud et al., 2015). Nevertheless, the parameter of the rainfall-runoff model is independently calibrated for each target catchment. As a consequence, this parameter plays a corrective role and compensates approximations and modelling errors which makes difficult to identify its proper spatial pattern. It is an inherent objective of the SHYREG approach to be completely regionalised in order to provide a complete and accurate flood quantiles database throughout France. Consequently, it appears necessary to identify the model configuration in which the calibrated parameter could be regionalised with acceptable performances.

The revaluation of some of the method hypothesis is a necessary step before the regionalisation. Especially the inclusion or the modification of the spatial variability of imposed parameters (like production and transfer reservoir size, base flow addition and quantiles aggregation function) should lead to more realistic values of the only calibrated parameter.

The objective of the work presented here is to develop a SHYREG evaluation scheme focusing on both local and regional performances. Indeed, it is necessary to maintain the accuracy of at site flood quantiles estimation while identifying a configuration leading to a satisfactory spatial pattern of the calibrated parameter. This ability to be regionalised can be appraised by the association of common regionalisation techniques and split sample validation tests on a set of around 1,500 catchments representing the whole diversity of France physiography. Also, the presence of many nested catchments and a size-based split sample validation make possible to assess the relevance of the calibrated parameter spatial structure inside the largest catchments. The application of this multi-objective evaluation leads to the selection of a version of SHYREG more suitable for regionalisation.

References:
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