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Comparing simple methods for predictive uncertainty estimation over 1000 French catchments

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Proper quantification of uncertainty in hydrological modelling is a challenging task, for which various techniques, based on different philosophies and approaches, have been proposed over the last 20 years. The choice of a suitable framework to properly estimate uncertainty in hydrology is still controversial, especially regarding the differences between formal Bayesian methods and informal methods such as the GLUE and GLUE-like methods. While these two groups of methods are strongly related to the inference problem, several alternative methods aim at estimating the total predictive uncertainty of a calibrated model in an aggregated way. Those methods are especially attractive in a forecasting context, where they can be used as hydrological uncertainty processors (Krzysztofowicz and Kelly, 2000).

In this study, we compare three of the recently proposed techniques, namely the meta-Gaussian approach (Montanari and Brath, 2004; Montanari and Grossi, 2008), the Quantile Regression technique (Weerts et al., 2011) and the Model Conditional Processor (Coccia and Todini, 2011). We also introduce, as a benchmark, a distribution-free approach based on conditional quantile estimation. All these methods involve statistical learning (i.e. using training data to characterize a relationship between variables of interest to predict future behaviour) but differ in their hypotheses and the regression techniques they use.

To evaluate uncertainty estimates, we focus on the reliability and the sharpness of the predictive runoff distributions, since uncertainty analysis should provide prediction intervals as reliable and narrow as possible.

Discharge predictions are given by the GRP model (Berthet et al., 2009), an operational forecasting lumped model widely used in France. To overcome the limitations of past comparisons carried out on very few catchments, a large dataset of French catchments is used to evaluate the robustness of the tested methods. This will provide more general conclusions.

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