



## **Alternative configurations of Quantile Regression for estimating predictive uncertainty in water level forecasts for the Upper Severn River: a comparison**

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Hydrological forecasting is subject to many sources of uncertainty, including those originating in initial state, boundary conditions, model structure and model parameters. Although uncertainty can be reduced, it can never be fully eliminated. Statistical post-processing techniques constitute an often used approach to estimate the hydrological predictive uncertainty, where a model of forecast error is built using a historical record of past forecasts and observations. The present study focuses on the use of the Quantile Regression (QR) technique as a hydrological post-processor. It estimates the predictive distribution of water levels using deterministic water level forecasts as predictors.

This work aims to thoroughly verify uncertainty estimates using the implementation of QR that was applied in an operational setting in the UK National Flood Forecasting System, and to inter-compare forecast quality and skill in various, differing configurations of QR. These configurations are (i) 'classical' QR, (ii) QR constrained by a requirement that quantiles do not cross, (iii) QR derived on time series that have been transformed into the Normal domain (Normal Quantile Transformation – NQT), and (iv) a piecewise linear derivation of QR models. The QR configurations are applied to fourteen hydrological stations on the Upper Severn River with different catchments characteristics.

Results of each QR configuration are conditionally verified for progressively higher flood levels, in terms of commonly used verification metrics and skill scores. These include Brier's probability score (BS), the continuous ranked probability score (CRPS) and corresponding skill scores as well as the Relative Operating Characteristic score (ROCS). Reliability diagrams are also presented and analysed. The results indicate that none of the four Quantile Regression configurations clearly outperforms the others.