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The effectiveness of Quantile Regression for bias correction and uncertainty estimation in operational hydrological forecasting systems: Examples from the National Flood Forecasting System

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A technique for the operational assessment of the uncertainty of around discharge and water level forecasts is presented that conditions forecast uncertainty on the forecasted process itself, based on retrospective quantile regression of hindcasted discharge or water level forecasts and forecast errors. In an operational setting, the main advantage of quantile regression with respect to other uncertainty estimation methods is that it can be applied as post-processor on forecasted values without any additional input requirements. To take account of the heteroscedasticity of errors in hydrologic process descriptions, we derive the regression relations after a transformation of the training data set to the Gaussian domain. To test the robustness of the method, a number of retrospective forecasts for different catchments across the UK having different size and hydrological characteristics have been used to derive in a probabilistic sense the relation between simulated values of discharges and water levels at different lead times, and matching errors. Consequently, the derived regression relationships have been validated with an independent set of forecasts. From this study, we can conclude that using quantile regression for estimating forecast errors conditional on the forecasted water levels provides an extremely simple, efficient and robust means for uncertainty estimation of deterministic forecasts.