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Analyzing the effects of model formulation on the reliability of predictions

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The reliability of a model is a key issue when simulating and in particular when making predictions. This is especially important for water management and water availability assessments. Uncertainty in streamflow simulation and prediction can give valuable insight into the reliability of the model. This study aims to characterize and compare uncertainty sources in model predictions by studying the similarities and differences first in the model residuals, second in the performance of the model and third in the parameter associated uncertainty. As a basis an ensemble of hydrological models of different complexities and under the same framework is used. A transformed residual error model is applied to estimate the predictive uncertainty of the hydrological models in their different forms. The built model take into account heteroscedasticity and normality of the residuals. Performance and parameter uncertainty is investigated by a robust parameter set optimization (ROPE) algorithm. Results show clear differences in the statistical properties of the uncertainty in the predictions depending on the model setup and complexity. More complex models structures as well as more complex model formulations for evapotranspiration calculation show less predictive uncertainty ranges. This uncertainty increases by decreasing complexity. Added to this, a better performance is achieved by the more complex models although not in all cases. On the other hand, simpler models show clearly a substantial smaller parameter related uncertainty. This highlights the interplay between performance, predictive and parameter uncertainty and can be an important criterion when choosing an appropriate model structure.