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Reducing Streamflow Forecasting Uncertainty: A Sequential Bayesian Approach Inspired by Data Assimilation for Multi-model Combination and Forecasting

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The key step to enhance the accuracy of hydrologic prediction is the knowledge and realistic characterization of uncertainty. A method that has recently garnered the attention of researchers and practitioners is data assimilation (DA) aiming to improve the model's predictive skills and to explicitly characterize the uncertainty in water and energy balance computations. Although successful, DA methods are limited to the single model ignoring other plausible models. Analysis of predictive uncertainty in land surface fluxes and storages based on single hydrologic model are prone to systematic bias and underestimation of uncertainty. This results to overconfidence in model predictive capabilities even with the advanced data assimilation technique available to date. This motivates to employ various competitive models and use a combination technique that takes the most benefit from models for predicting the quantity of interest. Bayesian Model Averaging (BMA) has recently been used in few hydrologic prediction studies as an effective multi-model combination technique. However, BMA method is limited to the Gaussian likelihood assumption of individual model predictive distributions which may not result to optimum models combination and accurate prediction. In addition, BMA is limited to the fixed model weights ignoring the possibility that some models may behave differently at different periods of simulation/prediction owing to the merits of models for capturing the physics. To overcome these limitations we propose a sequential Bayesian multi-model combination method for prediction which is not limited to the fixed model weight as in the BMA method and comparative results are presented to demonstrate the effectiveness on the method.