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Ensemble Kalman Filter or Particle Filter for Estimating the Predictive Uncertainty? Comparing the Effectiveness and Robustness

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Ensemble based hydrologic data assimilation has the potential to accurately quantify the uncertainty in streamflow predictions by accounting for many sources of uncertainty within the modeling framework. The four main sources of error, input data, observation, model structure and parameter, can all be addressed directly with data assimilation. Due to recent improvements in parameter estimation using data assimilation, state-parameter estimation techniques have become a popular topic in the hydrologic data assimilation community. Several studies, using both the Ensemble Kalman Filter (EnKF) and the Particle Filter (PF) to estimate both model states and parameters have been published in recent years. Though there is increasing interest and a growing literature in this area, relatively little research has been presented to examine the effectiveness and robustness of these methods to estimate uncertainty. This study highlights the need for state-parameter estimation studies to provide a more rigorous testing of these techniques with respect to uncertainty quantification. Using multiple calibration and validation replicates, a detailed analysis of the robustness of the methods is performed. The results from this study show the complexity of information from both the EnKF and the PF, and explain aspects of these techniques that have not been well documented in the current scientific literature.