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Approximation Bayesian computation for calibration of water quality models considering the impact of observation uncertainty

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In water resource studies, simulations often neglect the impacts of observation uncertainty in model calibration. However, this error is frequently far from negligible, and can significantly impact the estimate of model parameters. In the simulation of Total Suspended Solids (TSS), the observational data of TSS concentration is typically surrogated by the measurement of turbidity. The use of surrogate data can introduce significant observational uncertainty and may influence traditional parameter calibration approaches. This study considers the modeling of TSS via a conceptual hydrologic/water quality model, and develops a calibration method using Approximate Bayesian Computation - Sequential Monte Carlo (ABC- SMC) to test the balance between observational uncertainty and parameter uncertainty. Based on the results from synthetic and real case study data, two key questions are addressed: (1) What is the impact of observation uncertainty on the simulation of TSS? and (2) How can modelers improve the estimation of water quality variables by adding known observation uncertainty into the calibration approach. The approach developed is general, flexible, and can easily be extended to other hydrologic models and other water resource predictions.