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A Bayesian Perspective on Ecohydrologic Model Uncertainties

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Abstract: It is clear that in recent years, Bayesian inference has emerged as a powerful tool in the environmental modeler's toolbox, providing a convenient framework in which to model parameter and observational uncertainties. However Bayesian approaches require explicit specification of the form of the model errors (via the likelihood function), which can be problematic for complex, non-linear and/or dynamic environmental systems. Here, we provide some insight into these issues in the context of ecohydrologic models. Ecohydrologic models typically integrate hydrological, ecological and energy transfer processes across a range of scales, and the inference of these models can be complicated by the increased model dimensionality and the complexity of hydrologic and vegetation observational errors. The availability of remotely sensed data sets provides new opportunity for inferring model parameters, but special care must be taken to account for different error characteristics. In our study, we develop a Bayesian approach to inferring model and observational errors, and demonstrate how approximate Bayesian methods can be helpful for high-dimensional and complex ecohydrologic errors. We evaluate the usefulness of the Bayesian approach across multiple catchments, emphasizing the information content of the data available to identify time-varying errors. Overall, our approach provides a flexible, inclusive approach to ecohydrologic model inference, which exploits remotely sensed observations for improved understanding of ecohydrologic systems and their uncertainties.

Keywords: *Ecohydrology; Bayesian inference; Multi-objective optimization; Uncertainty analysis*