Geophysical Research Abstracts, Vol. 9, 10846, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10846
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Integrated uncertainty estimation for distributed hydrological models

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Hydrologic models regardless of their sophistication and complexity are simplified representations of the complex, spatially distributed and highly nonlinear real world system. Consequently, their hydrologic predictions contain considerable uncertainty from different sources including: hydrometeorological forcing inputs, boundary/initial conditions, model structure, model parameters which need to be accounted for. To date, the effort has gone to independently address these sources of uncertainty. However, because of the nonlinear nature of the hydrologic systems, these sources of uncertainty need to be quantified in a more integrated way in order to produce more reliable predictions. This can be a challenge especially in the case of distributed hydrological models. Here, I present the Integrated Bayesian Uncertainty Estimator (IBUNE) which accounts for total uncertainties from all major sources: inputs forcing, model structure, model parameters. This algorithm explores multi-model framework to tackle model structural uncertainty while using the Bayesian rules to estimate parameter and input uncertainty within individual models. I will discuss the performance of the presented framework for improved treatment of uncertainty in semi-distributed hydrologic models and address the problem of parameter identification and parameter uncertainty estimation in this class of models via a case study.