Geophysical Research Abstracts
Vol. 12, EGU2010-14493, 2010
EGU General Assembly 2010

Reduction of Predictive Uncertainty by Merging the Data Assimilation and Bayesian Model Averaging

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Bayesian multi-model combination methods have shown to improve the streamflow forecasting upon the systematic bias and general limitations of a single model. This is done by establishing a new model by weighted average of several models with weights based on individual model performance over the calibration period. Early application of this technique for hydrological systems assumed a fixed distribution around an individual models forecast in establishing the prior and used a calibration time period to determine static weights for the new model. More recent work has focused on sequential model selection with time varying weights in an attempt to accentuate the dynamics of an individual model's performance. However these approaches still assume a fixed probability distribution (mainly Gaussian) around the individual model forecast. A new sequential Bayesian model averaging technique is developed incorporating a sliding window of individual model performance around the forecast, sized by the correlogram of historical data. Additionally this new technique relaxes the fixed distribution assumption in establishing the prior utilizing the probability distribution obtained by data assimilation (i.e., particle filtering) that reflects both the performance dynamics of the model's forecasts along with their uncertainty. Results show an increased skill and reduced uncertainty in model forecast for a variety of point-wise and distribution-oriented performance measures including a benchmark measure against the standard Bayesian model averaging technique.