IAHS2017-339
IAHS Scientific Assembly 2017


# Improving flood forecasting through accurate model uncertainty estimation in hydrologic data assimilation

Sahani Pathiraja (1), Hamid Moradkhani (2), Lucy Marshall (1), Ashish Sharma (1), and Gery Geenens (3)

(1) Water Research Centre, University of New South Wales, Sydney, Australia , (2) Department of Civil and Environmental Engineering, Portland State University, Portland, Oregon, USA, (3) School of Mathematics and Statistics, University of New South Wales, Sydney, Australia

Data Assimilation has recently seen a significant uptake by hydrologists looking to improve model predictions. Making the most of observations and model simulations through Data Assimilation requires accurate uncertainty quantification. Model uncertainty estimation for Data Assimilation remains a challenge, with many traditional methods relying on some level of subjectivity or potentially invalid assumptions (such as Gaussian statistics). Here we propose an objective data-driven approach to estimate the full distributional form of model uncertainty non-parametrically. No assumptions regarding the distributional form of model errors are required and higher order moments are inherently considered. All sources of uncertainty (such as input, parameter and structural uncertainty) are considered collectively, thereby removing the need to estimate the uncertainty of each component individually. The method works by utilising a training period to collate a sample of model errors in observed and hidden state variables. A sequential non-linear optimization technique is used to estimate the errors in the hidden state variables. Finally, conditional kernel density estimation is used to derive the distribution of additive errors conditioned on the hidden states from the previous time. The method is discussed in detail and application to a range of streamflow forecasting cases is demonstrated. Results show that the proposed approach leads to improved forecasts (based on a range of forecast skill scores) compared to standard Gaussian perturbation approaches typically used in hydrologic data assimilation.