Evolving Water Resources Systems: Understanding, Predicting and Managing Water–Society Interactions
Proceedings of ICWRS2014, Bologna, Italy, June 2014 (IAHS Publ. 364, 2014, 249-254).

Multi-model ensemble hydrologic prediction and uncertainties analysis

SHANHU JIANG, LILIANG REN, XIAOLI YANG, MINGWEI MA & YI LIU
State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University, Nanjing 210098, China
rll@hhu.edu.cn

Abstract Modelling uncertainties (i.e. input errors, parameter uncertainties and model structural errors) inevitably exist in hydrological prediction. A lot of recent attention has focused on these, of which input error modelling, parameter optimization and multi-model ensemble strategies are the three most popular methods to demonstrate the impacts of modelling uncertainties. In this paper the Xinanjiang model, the Hybrid rainfall–runoff model and the HYMOD model were applied to the Mishui Basin, south China, for daily streamflow ensemble simulation and uncertainty analysis. The three models were first calibrated by two parameter optimization algorithms, namely, the Shuffled Complex Evolution method (SCE-UA) and the Shuffled Complex Evolution Metropolis method (SCEM-UA); next, the input uncertainty was accounted for by introducing a normally-distributed error multiplier; then, the simulation sets calculated from the three models were combined by Bayesian model averaging (BMA). The results show that both these parameter optimization algorithms generate good streamflow simulations; specifically the SCEM-UA can imply parameter uncertainty and give the posterior distribution of the parameters. Considering the precipitation input uncertainty, the streamflow simulation precision does not improve very much. While the BMA combination not only improves the streamflow prediction precision, it also gives quantitative uncertainty bounds for the simulation sets. The SCEM-UA calculated prediction interval is better than the SCE-UA calculated one. These results suggest that considering the model parameters' uncertainties and doing multi-model ensemble simulations are very practical for streamflow prediction and flood forecasting, from which more precision prediction and more reliable uncertainty bounds can be generated.

Key words input error modelling; parameter optimization; Bayesian model averaging; uncertainty analysis