Role of Multi-model Combinations in Improving Streamflow Prediction

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Model errors are the inevitable part in any prediction exercise. One approach that is currently gaining attention in reducing model errors is by combining multiple models to develop improved predictions. The rationale behind this approach primarily lies on the premise that optimal weights could be derived for each model so that the developed multimodel predictions will result in improved predictability. In this study, we present a new approach to combine multiple hydrological models by evaluating their predictability contingent on the predictor state. We combine two hydrological models, 'abcd' model and Variable Infiltration Capacity (VIC) model, with each model's parameter being estimated by different objective functions to develop multimodel streamflow predictions. The performance of multimodel predictions is compared with single model predictions using correlation, root mean square error and Nash-Sutcliffe coefficient. To quantify precisely under what conditions the multimodel predictions result in improved predictions, we evaluate the proposed algorithm by testing it against streamflow generated from a known model ('abcd' model or VIC model) with errors being homoscedastic/heteroscedastic. Results from the study show that streamflow simulated from single models performed better than multimodels under almost no model error. Under increased model error, the multimodel consistently performed better than the single model prediction in terms of all performance measures. The study also evaluates the proposed algorithm for streamflow predictions in two humid river basins from NC as well as in two arid basins from Arizona. Through detailed validation in these four sites, the study shows that multimodel approach better predicts the observed streamflow in comparison to the single model predictions.