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Improvement of multisatellite real-time precipitation products for ensemble streamflow simulation in a middle latitude basin.

More recently, the real-time availability of several satellite-based precipitation products provides hydrologists with an unprecedented opportunity to improve current hydrologic prediction capability for medium-large river basins, especially for the ungauged regions. But the accuracy of the real-time satellite precipitation data is limited in some middle and high latitude basins. The aim of this study is to use three widely-used real-time satellite precipitation products, namely, TRMM 3B42RT, PERSIANN and CMORPH, to do ensemble streamflow simulation with a Gridded Xinanjiang model in a middle latitude Mishui basin. For adjusting the bias of the satellite precipitation data and considering their input uncertainty, two different methods, i.e., a precipitation error multiplier and a precipitation error model were introduced. For each precipitation input modeling, the posterior probability distribution of the parameters and their associated uncertainty were calibrated using the SCEM-UA algorithm, and 15000 ensemble streamflow simulations were calculated. Afterward, the simulations of the three satellite precipitation data were optimally merged using the Bayseian model averaging method (BMA). The result shows that in the Mishui basin, those three real-time satellite precipitation data had a large underestimation with respect to rainfall. Streamflow simulation performed bad as the raw satellite precipitation data are taken as input and the model parameters are calibrated with gauged data. By introducing the precipitation error multiplier and the precipitation error model, and recalibrating the model parameters, the behavior of the simulated streamflow and calculated uncertainty boundary were significantly improved. The BMA combination of the simulation from three satellite precipitation generated a much better prediction and a much more reliable uncertainty boundary, as compared to the simulaition from the TRMM 3B42V6 (the best satellite precipitation product at present). The methodology of bias adjustment, uncertainty analysis and BMA combination, makes the 3B42RT, PERSIANN and CMORPH data applicably prospective in the hydrological prediction, water balance estimation, and water resources evaluation over ungauged and data-spared basins.

Key words: Satellite precipitation; error adjustment; ensemble streamflow simulation; uncertainty estimation; Bayesian model averaging