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Effect of Calibration Data Variability on Hydrological Modeling Performance in Data-Limited Catchments

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Abstract: There is a question that would always come to the hydrological model user's mind: which segment of observation data should be used for calibration? Especially when model users face the case of applying models in ungauged or data-limited catchments. Calibration data variability is rarely considered in lumped conceptual hydrological models although it has significant impacts on modeling performance. In order to study the performance of hydrological models in data-limited catchments where data are non-continuous and fragmental, two widely used conceptual hydrological models, i.e., the SIMHYD model and the Xinanjiang model, are applied in this study. The differential split-sample method is used to choose non-continuous calibration periods in order to generate more independent runoff data.The Particle Swarm Optimization (PSO) optimization method is used to calibrate the hydrological models, and Nash–Sutcliffe efficiency (NSE) and percentage water balance error (WBE) are treated as performance measures. Average, dry and wet calibration periods are used for study on the impact of the calibration data variability. Fifty-five relatively unimpaired catchments across over Australia are tested to obtain more general conclusions. Results show that the hydrological models have more steady performance when being calibrated by using average or wet periods than using dry periods, and wet period data are more suitable for model calibration in all catchments. On the other hand, calibration data have more significant impact on arid and semi-arid catchments but have little impact on humid and semi-humid catchments. In this case, hydrological models perform better in humid and semi-humid catchments than in arid catchments. The results in this study may have useful and interesting implications when hydrological model users face the case of ungauged or data-limited catchments.

Keywords: calibration data; hydrological model; model performance; data-limited catchments