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Analyse the sources of equifinality in hydrological model using GLUE methodology

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Abstract The equifinality problem has been universally found in hydrological models. The Generalized Likelihood Uncertainty Estimation methodology (GLUE) is widely used to quantify the parameter uncertainty in a variety of hydrological models. This study makes a comprehensive discussion about the sources of equifinality in a distributed conceptual hydrological model. The study is performed using the model DTVGM on Chao River basin in north China. It analyses the impacts of three aspects on the equifinality, including the number of parameters, the systematic errors of input data and the object function. The Monte Carlo scatter figures of parameters, the relative width of 95% confidence intervals and the percent of observations bracketed by the 95% confidence intervals are used as criteria to estimate uncertainties in parameters and the simulated stream flow. In addition, the study gives an example of reducing the equifinality in the model by using a baseflow separation method; this can be used in basins that only have discharge data. The results indicate that: (a) overparametrization, systematic errors of input data and too little constraint conditions are the sources of equifinality in model DTVGM; (b) systematic errors of input data are not only increasing the predictive uncertainty caused by equifinality, but also reduce accuracy of the model; (c) the uncertainty of parameters has been greatly reduced through the secondary model objective which uses baseflow as an additional condition to constrain the model parameters.

Key words GLUE; equifinality; hydrological model; DTVGM; multi-objective function