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Sensitivity analysis of a distributed hydrological model: application of SWAT model in the upper stream of Yoshino River

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Due to the uncertainties of the hydrological model calibration associated with input-output data, model structure and parameters, the over-parameterization is a hot topic related to the hydrological model. Sensitivity analysis of those models is supported to set up least parameters for fitting with the input-output data in a best condition. This sensitivity analysis can identify parameters which do or do not have a significant effect on the model simulations. The purpose of this study is to understand the sensitivity of parameter when the model was calibrated under the present and future condition. Firstly, the Soil and Water Assessment Tool-Calibration and Uncertainly Programs (SWAT-CUP) model was used to analyze the global sensitivity of the Soil and Water Assessment model in a Japanese river catchment. Two approaches such as the Generalized Likelihood Uncertainty Estimation (GLUE) and the Sequential Uncertainty Fitting (SUFI-2) were used for the global sensitivity analysis. For calibrating and validating the SWAT model by using the observed stream flow data, we selected 10 parameters such as initial SCS runoff curve number (CN2), base-flow alpha factor (ALPHA_BF), groundwater delay time (GW_DELAY), Manning's "n" value for the main channel (CH_N2), effective hydraulic conductivity in main channel alluvium (CH_K2), base-flow alpha factor for bank storage (ALPHA_BNK), available water capacity of the soil layer (SOL_AWC), saturated hydraulic conductivity (SOL_K), moist bulk density (SOL_BD), and snowfall temperature (SFTMP). The calibration period is from 2003 to 2005, and the validation period is from 2006 to 2008. The calibration result by using GLUE shows better results than those by using SUFI-2. But the processing time of the GLUE approach was longer than the SUFI-2 approach when they were run in the SWAT-CUP. According to this global sensitivity analysis, it shows that CN2 and ALPHA_BF have the most sensitivity on the calibration of SWAT model for this catchment. The 5000, 10000 and 15000 samples of GLUE and 500, 1000, 5000 samples of SUFI-2 were tested in this study. Result shows the identifiability was increased with the increasing sample size of these two methods. Finally, the sensitivity analysis under the future condition was studied by using the output from Global Climate Model (GCM20).

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