Validity of discharge and parameters associated with groundwater in the hydrological model SWAT for the Mukawa River and the Saru River, northern Japan

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Prediction of water, sediment and nutrients discharge is important in assessing the impact of climate change and land use on watershed and coastal environments. SWAT (Soil and Water Assessment Tool) is one of the hydrological model platforms to simulate the dynamics of water, soil erosion, nutrient for agricultural land basin developed by the US Department of Agriculture (USDA). While there is an advantage that can be used for future prediction by a quasi-physical model in which the hydrological process is taken into consideration, difficulty is often accompanied by adjustment of enormous parameters. Therefore, it is important to reduce the number of indefinite parameters and consider the validity of the adjusted value by using by using the on-site information and observation data as much as possible, likely to contribute to improvement of model. In this study, we collected the local soil survey data and created a soil database for SWAT, and attempted to simulate the daily discharge in the Mukawa and Saru River basins. In the results of parameter tuning for 3 years (2010-2012), significantly high similarity was obtained with high Nash-Sutcliffe efficency (NS) of 0.78 and 0.79 for the Mukawa River and Saru River, respectively. In order to confirm the validity of the parameter set, the simulated discharge was compared to observed data for each seven subcatchments, showing good estimations that the NS values ranged from 0.56 to 0.72, R^2 ranged from 0.66 to 0.81, and the similarity in total runoff for 3 years ranged from 78% to 100%. Among the 18 parameters obtained in this study, such groundwater-associated parameters as groundwater delay time was found to be significant for better simulation by sensitivity analysis. For better simulation of discharge in various subcatchments, mean transit time or residence time of groundwater estimated by such tracers as tritium, stable isotope or CFCs could be incorpolated in the parameters to reduce the number of parameters and take into account the scale effect and spatial variability of underlying geology.

Keywords: Soil and Water Assessment Tool (SWAT), groundwater delay time, discharge

