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A method of estimating spatio-temporally distributed groundwater recharge using integrated surface-subsurface modelling

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In general, there have been various methods of estimating groundwater recharge such as baseflow separation approaches, water budget analyses based on lumped conceptual models, and the water table fluctuation method (WTF) by using data from groundwater monitoring wells. However, groundwater recharge rates show spatial-temporal variability due to climatic conditions, land use, and hydrogeological heterogeneity, so these methods have various limitations in dealing with these characteristics. To overcome these limitations, we present a novel application of estimating recharge based on water balance components from the combined SWAT-MODFLOW model, which is an integrated surface-ground water model. During the process of computing recharge, the time delay is very important factor. SWAT model uses single linear reservoir storage module with an exponential decay weighting function for accounting time delay through vadose zone. However, single reservoir module has limitation on the long delay time. So we suggest a multi-reservoir storage routing module instead of single one, which represents a more realistic time delay through the vadose zone. By using this module, the parameter related to the delay time could be optimized by checking the correlation between simulated recharge and observed groundwater levels. The final step of this procedure is to compare simulated groundwater levels as well as simulated watershed runoff with observed ones. This method is applied to several watersheds in Korea for the purpose of testing the procedure for proper estimation of spatio-temporal groundwater recharge distribution. As this application procedure of estimating recharge has the advantages of the effectiveness of a watershed model as well as the accuracy of the WTF method, the estimated daily recharge rate could be thought as an improved estimate reflecting the heterogeneity of hydrogeology, climatic conditions, land use, as well as the physical behavior of water in soil layers and aquifers.