



Hydrological modeling in non-conservative catchments in karst-dominated regions with the modified Soil and Water Assessment Tool

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Karst groundwater is a source of drinking water for about a quarter of the world's population. However, karst groundwater is highly vulnerable to over-exploitation and contamination. Therefore, understanding hydrogeological characteristics of karst aquifer is important to develop a proper groundwater management plan, especially in terms of intercatchment groundwater management. In karst-dominated areas, groundwater recharge into the karst aquifers in one catchment can be drained by a well-developed underground conduit system and re-emerge at springs located in other catchments. These catchments are referred to as non-conservative catchments. In this study, one of the most widely used and well tested eco-hydrological models, the Soil and Water Assessment Tool (SWAT), was modified to explicitly explain the sources and sinks in non-conservative catchments in karst-dominated areas. A multi-linear reservoir model (the fast storage and slow storage reservoirs) was used to represent the duality of recharge, infiltration, and discharge of the karst aquifer while the original SWAT model was used to simulate the allogenic recharge from non-karstic areas. The modified SWAT model was tested in a karst-dominated region in Niedersachsen, Germany, where one of the biggest springs in Europe is located, the Rhume spring. Despite of high complexity and heterogeneity of the karst aquifers, the modified SWAT model well represents processes in this karst-dominated area. The Nash–Sutcliffe efficiency ($NSE > 0.5$) and percentage bias ($PBIAS < \pm 25\%$) show that the model was calibrated and validated with acceptable to good results. Further research can apply the modified SWAT model to quantify the effect of climate and land use changes on karst groundwater resources.

Keywords: karst, SWAT, non-conservative catchments