An integrated hydrological model based on improved Green-Ampt model and HYDRUS model for semi-humid and semi-arid plain areas

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Abstract

Hydrology models of humid areas have always been studied deeply with higher model accuracy, but relatively less so for semi-humid and semi-arid areas, especially in plain. Here an integrated hydrology model (GA-HYDRUS model) was developed based on improved Green-Ampt model and HYDRUS model using the dataset of 7 rainfall events in Tianjin, China. The SCE-UA optimization algorithm was applied based on the data of soil moisture content to calibrate GA-HYDRUS model. The calibration and verification results demonstrated that the NSE values of the average soil moisture content were above 0.7. Meanwhile, the NSE values of the soil moisture content at the depths of 10, 20, and 40 cm were generally high and the R<2> were all greater than 0.75. The average runoff coefficient of permeable surface was 0.54. Furthermore, the relationships between different hydrological fluxes (rainfall, surface runoff, soil infiltration and vertical groundwater recharge) calculated by GA-HYDRUS model were analyzed. The results showed that rainfall characteristics such as rainfall, rainfall intensity and duration greatly affected the runoff, indicating that high rainfall intensity and short rainfall duration would produce more surface runoff. On the contrary, bimodal rainfall with small rainfall intensity and long duration made the effect of vertical groundwater recharge to supplement groundwater more significant. Therefore, the GA-HYDRUS model is a highly effective approach to simulate the transformation processes between surface runoff, soil water and groundwater in semi-humid and semi-arid plains. This study may have important applications in aiding water resources management.

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Running title

An integrated hydrological model

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