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Comparison of optimal irrigation scheduling and groundwater recharge at representative sites in the North China Plain

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The North China Plain (NCP) is an important food production area in China, facing an increasing water shortage and overexploitation of groundwater. It is critical to optimize the irrigation scheduling and accurately estimate groundwater recharge for saving water and increasing crop water use efficiency. However, the water cycle and crop responses to irrigation are quite various in different areas, because of the spatial variation of climatic, soil, water table and other management practices in the NCP. In this study, three representative sites (LC site in the piedmont plain, TZ site in the northern alluvial and lacustrine plain, YC site in the southern alluvial and lacustrine plain) were selected to compare the optimal irrigation scheduling and corresponding groundwater recharge under different hydrological years for winter wheat-summer maize double cropping system. At each site, a physically based agro-hydrological model (SWAP) was calibrated using field data of soil moisture. Then, scenarios under different irrigation time and amount were simulated. Results showed that the optimal irrigation scheduling and corresponding groundwater recharge were significant different between the three representative sites. The mean water table depth at the LC (33.0 m), YC (10.3 m), and TZ site (2.5 m) caused great different time lags of infiltrated water and groundwater contribution to evapotranspiration. Then, the most irrigation amount was required for the TZ site but the least requirement for the YC site at each hydrologic year. As most clay contents in the deep soils at the LC site increased tortuosity and limited water movement, which resulted in lower rates of recharge compared to more sandy soils at the other two sites. Averagely, using the optimal irrigation scheduling could save 2.04×109 m3 irrigation water and reduce about 84.3% groundwater over-exploitation in winter wheat growth period in the NCP. Therefore, comparison of the simulation results among the three representative sites could make reasonable optimal irrigation, which provided beneficial suggestions for improving agricultural water use efficiency and alleviating groundwater resources crisis in the NCP.