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A model for simulating coupled groundwater/surface water hydrology and impact of groundwater pumping in arid irrigated watersheds

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During recent decades, arid and semi-arid regions have faced the severe problem of depletion of groundwater resources due to over-pumping within aquifer systems. Moreover, groundwater and surface water are not isolated components of the hydrologic system, but instead interact in a variety of aspects in which development of one commonly affects the other. Therefore, developing comprehensive and long-term water management strategies to implement solutions to large-scale, basin-wide water problems is necessary. This study proposes an integrated coupled groundwater/surface water modeling framework to advance water resources management in the semi-arid Neishaboor watershed, Iran, under intensive groundwater-based irrigation. The model, based on the recently developed SWAT-MODFLOW model, applies the pumped groundwater from MODFLOW as irrigation water to the cultivated fields within the SWAT model, with deep percolation from the soil profile bottom applied to the MODFLOW model as recharge. The integrated SWAT-MODFLOW model was calibrated and validated for the 1997-2012 time period using daily time step data, with model results tested against streamflow and groundwater levels throughout the aquifer. The model is used to determine water management practices that can sustain groundwater resources for the coming decades. The developed modeling code can be used in other arid and semi-arid river basins where irrigation principally comes from the aquifer.