

Impacts of irrigation on groundwater depletion in the North China Plain

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Groundwater resources is an essential water supply for agriculture in the North China Plain (NCP) which is one of the most important food production areas in China. In the past decades, excessive groundwater-fed irrigation in this area has caused sharp decline in groundwater table. However, accurate monitoring on the net groundwater exploitation is still difficult, mainly due to a lack of complete groundwater exploitation monitoring network. This hinders an accurate evaluation of the effects of agricultural managements on shallow groundwater table. In this study, we use an existing method to estimate the net irrigation amount at the county level, and evaluate the effects of current agricultural management on groundwater depletion. We apply this method in five typical counties in the NCP to estimate annual net irrigation amount from 2002 to 2015, based on meteorological data (2002-2015) and remote sensing ET data (2002-2015) . First, an agro-hydrological model (Soil-Water-Atmosphere-Plant, SWAP) is calibrated and validated at field scale based on the measured data from flux towers. Second, the model is established at regional scale by spatial discretization. Third, we use an optimization tool (Parameter ESTimation, PEST) to optimize the irrigation parameter in SWAP so as the simulated evapotranspiration (ET) by SWAP is closest to the remote sensing ET. We expect that the simulated irrigation amount from the optimized parameter is the estimated net irrigation amount. Finally, the contribution of agricultural management to the observed groundwater depletion is assessed by calculating the groundwater balance which considers the estimated net irrigation amount, observed lateral groundwater, rainfall recharge, deep seepage, evaporation from phreatic water and domestic water use. The study is expected to give a scientific basis for alleviating the over-exploitation of groundwater resources in the area.