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Improvement of agriculture water resources management through an integrated hydrological modeling approach

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The ability to dynamically simulate the supply and demand of irrigated water is needed to thoroughly understand the interaction between surface water and groundwater in areas where the hydrological cycle is intensively impacted by agriculture activities. To meet this challenge, this study developed a agriculture water resources allocation (WRA) module and coupled this module to an integrated surface water-groundwater model GSFLOW. The original GSFLOW, developed by USGS, is able to simulate the entire hydrological cycle. The improved GSFLOW with the WRA module allows the simulation, analysis and management of nearly all components of agriculture water use. It facilitates the analysis of agricultural water use when limited data is available for surface water diversion, groundwater pumpage, or canal information. It can be used to simulate and analyze historical and future conditions. The improved GSFLOW program was applied to the Heihe River Basin (HRB), which is the second largest inland river basin in China. The calibration and validation results of the program shows that the program is capable of simulating both hydrological cycle and actual agriculture water use with limited data. Then the model was used to analyze a set of agriculture water use scenarios, for example, limiting groundwater pumpage, adjusting water allocations between the middle stream and the lower stream. Based on these scenarios, it was found that the improved model could be used as a decision tool to provide better agriculture water resources management strategies. The improved module could be easily used in other basins.