Sustainable Management of Irrigation Water Withdrawal in Major River Basins by Implementing the Irrigation Module of Community Land Model

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Abstract

Agricultural water demand is considered as the major sector of water withdrawal due to irrigation. The majority part of the global agricultural field depends on various irrigation techniques. Therefore, a timely and sufficient supply of water is the most important requirement for agriculture. Irrigation is implemented in different ways in various land surface models, it can be modeled empirically based on observed irrigation rates or by calculating water supply and demand. Certain models can also calculate the irrigation demand as per the soil water deficit. In these implementations, irrigation is typically applied uniformly over the irrigated land regardless of crop types or irrigation techniques. Whereas, the latest version of Community Land Model (CLM) in the Community Terrestrial Systems Model (CTSM) uses a global distribution map of irrigation with 64 crop functional types (CFTs) to simulate the irrigation water demand. It can estimate irrigation water withdrawal from different sources and the amount or the areas irrigated with different irrigation techniques. Hence, we set up the model for the simulation period of 16 years from 2000 to 2015 to analyze the global irrigation demand at a spatial resolution of 1.9° × 2.5°. The simulated irrigation water demand is evaluated with the available observation data from FAO AQUASTAT database at the country scale. With the evaluated model, this study aims to suggest new sustainable scenarios for the ratios of irrigation water withdrawal, high depending on the withdrawal sources e.g. surface water and groundwater. With such scenarios, the CFT maps are considered as the determining factor for selecting the areas where the crop pattern can be altered for a sustainable irrigation water management depending on the available withdrawal sources. Overall, our study demonstrate that the scenarios for the future sustainable water resources management in terms of irrigation water withdrawal from the both the surface water and groundwater sources may overcome the excessive stress on exploiting the groundwater in major river basins globally.

Keywords: Irrigation water demand, Land surface models, Simulation period

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