Development and enhancement of a global hydrological model to better contribute to the sustainable groundwater management and human water security

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Groundwater is an important water resource in the world. In recent decades, the observation of excessive groundwater depletion raised public concerns in many areas, highlighting the urgent need for sustainable management of groundwater resources. The over reliance on groundwater resources is primarily due to excess in water demand for recharge rate and limitation in alternative water source options. Therefore, in order to solve the groundwater problem, it is necessary to understand not only groundwater but also the entire hydrological cycle, including overall water use and surface water dynamics. The Global Water Resources Model H08 has been developed over the past 15 years to elucidate the overall picture of global water use and hydrological cycle. In this presentation, we will introduce some of the latest research achievements of H08 that will be potentially beneficial toward sustainable groundwater management. Then we will describe the prospects for the development and application of global water resources models.

H08 is currently focusing on the following research themes. The first is reservoir operation. Reservoir operation reduces the seasonal and interannual variability in surface water availability, but its expression in global hydrological models is still in infancy. After intensive investigation, we have succeeded in combining a global hydrological model with a global flood inundation model which brings us to the new horizon of expressing global surface water dynamics including human interventions. The second theme is agricultural productivity and irrigation. Most of the world's water is used for irrigation, hence estimating the requirement and understanding the effects of irrigation is key to global water resources modeling. We have focused on the productivity of biofuel crops and their irrigation and succeeded in expressing them in H08 which enables us to investigate the trade-offs among social decarbonization (bioenergy production), terrestrial ecosystem conservation (land use), and sustainable water use. The third theme is the enhancement of the accuracy and spatial resolution of the model. As many previous studies have suggested, in application to specific basins, the reproducibility of global water resources models is significantly poorer than that of basin-based hydrological models. By preparing high-precision input data and performing parameter calibration, in the Chao Phraya River in Thailand and other multiple basins in various climate zones, we have succeeded in achieving good performance of H08 which satisfy practitioners. Based on these research results, I would like to describe how the global water resources models can contribute to the solution of groundwater problems and enhancing water security, and what should be added in the future.

Keywords: reservoir operation, irrigation, high spatial resolution

