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# Development of a global integrated model for predicting both crop production and water resources

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Crop growth mainly depends on a climate condition such as temperature, precipitation and solar radiation. Therefore, to assess climate change impacts on crop production, many studies have utilized a large-scale crop model which empirically and/or mechanistically can describe phenological development and crop production under a climate condition and an agricultural management. On the other hand, crop growth and production are largely affected by regional available water resources though an irrigation process. Future climate changes and increasing demand due to population increases and economic developments would intensively affect the availability of water resources for agricultural production. However, there are few large-scale crop models that can describe dynamically account for changes in crop production and water resources.

Therefore, we developed an integrated model for predicting both crop production and water resources. We coupled a large-scale crop model, PRYSBI2 (Sakurai *et al.* in prep), with a global water resources model, H08 (Hanasaki *et al.* 2008). The newly designed integrated model was consisting of five sub-models for the following processes: land surface, crop growth, river routing, reservoir operation, and anthropogenic water withdrawal. The land surface sub-model was based on a watershed hydrology model, SWAT (Neitsch *et al.* 2009). Surface runoff and percolation to aquifer simulated by the land surface sub-model were input to the river routing sub-model of the H08 model. A part of regional water resources available for agriculture, simulated by the H08 model, was input as irrigation water to the land surface sub-model. All processes in the integrated model were calculated on the daily time-step. The integrated model was applied to Northeast China, which has extensive crop land in China including present semi-arid climatic areas, and the region will be strongly affected by future climate change. This study verified the reproducibility of modeled elements in water balance over Songhua river watershed, which is main river watershed in Northeast China.

As the result, it was confirmed that biases between observations and estimations of soil water content and evapotranspiration were comparatively small, thus the integrated model can relatively reproduce the water balance over the watershed. Additionally, the large-scale crop model with estimated parameters at regional scale can faithfully reproduce the long-term trend and annual fluctuations in yield, especially in Northeast China Plain.

It is essential to estimate the regional water resources available in the contiguous watershed for evaluating actual crop productivity especially in drier region. Therefore, integrated model of crop productivity and water resources circulation in watershed is powerful tool for projecting climate change impacts on crop production.

Keywords: crop production, water resources, integrated model, large-scale