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Evaluation of irrigation in global hydrological models

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Global population is rapidly growing, which, coupled with changing consumption patterns, is increasing food demand, causing concern around the world about food security. Roughly 40 to 45 percent of crops are produced from irrigated areas, which consume between 60 to 70 percent of total global water withdrawals. Therefore, evaluation of available irrigation water is essential to ensure a stable food supply. Recently, several global hydrological models have been developed that can be used to assess irrigation. The challenges of applying these models for calculating irrigation water requirements at the global scale include (1) differentiation in available freshwater resources, (2) losses, and (3) irrigation water efficiency. Aim of our study is to provide an overview of the outcomes of previous studies with a specific focus on evaluating these irrigation related challenges. Our review indicated that recent improvements have been made to the capabilities of global hydrological models for computing irrigation water use. For example, out of the 9 models evaluated, several models now take into account aqueduct water transfer as irrigation water resources (n = 1), evaporation from open waterbodies (e.g. lakes, reservoirs, wetlands, swamps, rivers and floodplains) (n = 4), evapotranspiration from bare soil (n = 2), evaporation from meltwater stored in the snowpack (n = 1), capillary rise (n = 2), dynamic irrigation efficiency (n = 2), and differentiation between irrigation efficiency of surface water and groundwater (n = 1). However, differences in parameterization and model assumptions coupled with varied and possibly unreliable input data, especially for precipitation and evapotranspiration, still cause a lot of imperfections. Additionally, shortage of in situ data is still a major challenge for calibrating and validating global hydrological models.