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Simulating Regional Plant Water Availability and Irrigation Demand using SWAT in Different Agro-Climatic Zones

Bhumika Uniyal and Jörg Dietrich

Leibniz University Hannover, Institute of Hydrology and Water Resources Management, Hannover, Germany (uniyal@iww.uni-hannover.de)

Agricultural irrigation is the most important water use worldwide. Water resources studies at different scales include simulations of irrigation water availability and demand. Both are highly variable in space and time. The current study evaluates the suitability of the agro-hydrological model SWAT (Soil and Water Assessment Tool) for simulating irrigation at four different catchments in different agro-climatic zones (Baitarni-India; Ilmenau-Germany; Itata-Chile; Thubon-Vietnam). The model simulated spatio-temporal evapotranspiration (ET) was compared with MODIS ET (Moderate Resolution Imaging Spectroradiometer) data at HRU level. Apart from this, the model performance and simulated irrigation were evaluated under uncorrected and biased corrected reanalysis datasets (National Centers for Environmental Prediction (NCEP); ERA-interim) for the four catchments. Modelling results indicated that the model performance during calibration of all the developed models at their respective outlets were in good to very good range with Kling-Gupta Efficiency varies from 0.75-0.90 and percentage bias from 3.05 to 5%. The average monthly spatio-temporal comparison of MODIS ET with SWAT simulated ET showed an underestimation of MODIS ET in Germany, India and Chile and overestimation in Vietnam with an overall percentage bias ranging from -3 to 25%. It was assessed from the results that the amount of irrigation simulated by SWAT under soil water deficit control strategy was under the range of annual average irrigation applied in the agricultural fields during actual practice in most of the studied catchments. The results corresponding to the use of two reanalysis datasets were evaluated for daily streamflow as well as for the average annual irrigation simulated by SWAT with the daily streamflow and annual average irrigation simulated by SWAT using gauged weather data. Results showed that the simulated irrigation in case of bias corrected ERA-interim data was much closer to the irrigation simulated by SWAT using gauged weather data than that of bias corrected NECP data. In general, it can be said that the overall variability in irrigation demand simulated by different models depend majorly on climatic conditions and soils in a specific catchment. Further research is needed to improve the plant parameters and also to incorporate dynamic cropping systems in the catchments as in the current study same cropping patterns as well as crop parameters were only available as standard values.

Keywords: Irrigation Water demand, Agro-climates, SWAT, MODIS, Reanalysis data.