Geophysical Research Abstracts
Vol. 15, EGU2013-9552, 2013
EGU General Assembly 2013

Modeling water scarcity over south Asia: Incorporating crop growth and irrigation models into the Variable Infiltration Capacity (VIC) model

Tara J. Troy (1), Amor V.M. Ines (2), Upmanu Lall (1), and Andrew W. Robertson (2)

(1) Columbia Water Center, Columbia University, New York, United States (tarajtroy@gmail.com), (2) International Research Institute for Climate & Society, Columbia University, New York, United States

Large-scale hydrologic models, such as the Variable Infiltration Capacity (VIC) model, are used for a variety of studies, from drought monitoring to projecting the potential impact of climate change on the hydrologic cycle decades in advance. The majority of these models simulates the natural hydrological cycle and neglects the effects of human activities such as irrigation, which can result in streamflow withdrawals and increased evapotranspiration. In some parts of the world, these activities do not significantly affect the hydrologic cycle, but this is not the case in south Asia where irrigated agriculture has a large water footprint. To address this gap, we incorporate a crop growth model and irrigation model into the VIC model in order to simulate the impacts of irrigated and rainfed agriculture on the hydrologic cycle over south Asia (Indus, Ganges, and Brahmaputra basin and peninsular India). The crop growth model responds to climate signals, including temperature and water stress, to simulate the growth of maize, wheat, rice, and millet. For the primarily rainfed maize crop, the crop growth model shows good correlation with observed All-India yields (0.7) with lower correlations for the irrigated wheat and rice crops (0.4). The difference in correlation is because irrigation provides a buffer against climate conditions, so that rainfed crop growth is more tied to climate than irrigated crop growth. The irrigation water demands induce hydrologic water stress in significant parts of the region, particularly in the Indus, with the streamflow unable to meet the irrigation demands. Although rainfall can vary significantly in south Asia, we find that water scarcity is largely chronic due to the irrigation demands rather than being intermittent due to climate variability.