Assimilating SMAP-Sentinel1 High-Resolution Soil Moisture Data in Numerical Modeling to Quantify the Irrigation Water Use

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Abstract

Irrigation is the largest consumer of freshwater resources that has a strong impact on the global water and energy budget and can modulate the climate extremes. Irrigated agriculture has experienced a rapid expansion at a rate higher than the population growth due to the shift in the nations diet toward more water-intensive crops. This resulted in unsustainable water withdrawal in many parts of the world that can have an irreversible impact on the environment in the long run. Despite the importance of irrigation, there is little information on the amount of water used for irrigation. In this study, we test a method to quantify the irrigation water use (IWU) by assimilating high resolution (~1km) SMAP-Sentinel1 remotely sensed soil moisture into a hydrologic model. We used a particle batch smoother (PBS) data assimilation approach for assimilation. To achieve the objective of quantifying irrigation water use, we first evaluate the ability of SMAP-Sentinel1 1km soil moisture product (SMAP-S1) to capture the irrigation signal and then used the PBS to assimilate the SMAP-S1 soil moisture data with the VIC (4.2d) land surface model over an irrigated area in northwestern Iran where in situ irrigation data is available. We also evaluate uncertainty related to limited information about the irrigation timing by comparing a control simulation that uses the observed time of irrigation in the model versus simulations that assume this information is unknown. The results show that irrigation signals are present in the first (mean) and the second (variability) moments of the SMAP-S1 soil moisture time series. We hypothesize that assimilation of the SMAP-S1 soil moisture product within a land surface model will allow for quantification of irrigation using globally applicable tools. We will present the results of these studies.

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