Integrating partitioned evapotranspiration data into hydrologic models: vegetation parameterization and uncertainty quantification of simulated plant water use

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Abstract

Accurate simulation of plant water use across agricultural ecosystems is essential for various applications, including precision agriculture, quantifying groundwater recharge, and optimizing irrigation rates. Previous approaches to integrating plant water use data into hydrologic models have relied on evapotranspiration (ET) observations. Recently, the flux variance similarity approach has been developed to partition ET to transpiration (T) and evaporation, providing an opportunity to use T data to parameterize models. To explore the value of T/ET data in improving hydrologic model performance, we examined multiple approaches to incorporate these observations for vegetation parameterization. We used ET observations from 5 eddy covariance towers located in the San Joaquin Valley, California, to parameterize orchard crops in an integrated land surface – groundwater model. We find that a simple approach of selecting the best parameter sets based on ET and T performance metrics works best at these study sites. Selecting parameters based on performance relative to observed ET creates an uncertainty of 27% relative to the observed value. When parameters are selected using both T and ET data, this uncertainty drops to 24%. Similarly, the uncertainty in potential groundwater recharge drops from 63% to 58% when parameters are selected with ET or T and ET data, respectively. Additionally, using crop type parameters results in similar levels of simulated ET as using site-specific parameters. Different irrigation schemes create high amounts of uncertainty and highlight the need for accurate estimates of irrigation when performing water budget studies.

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