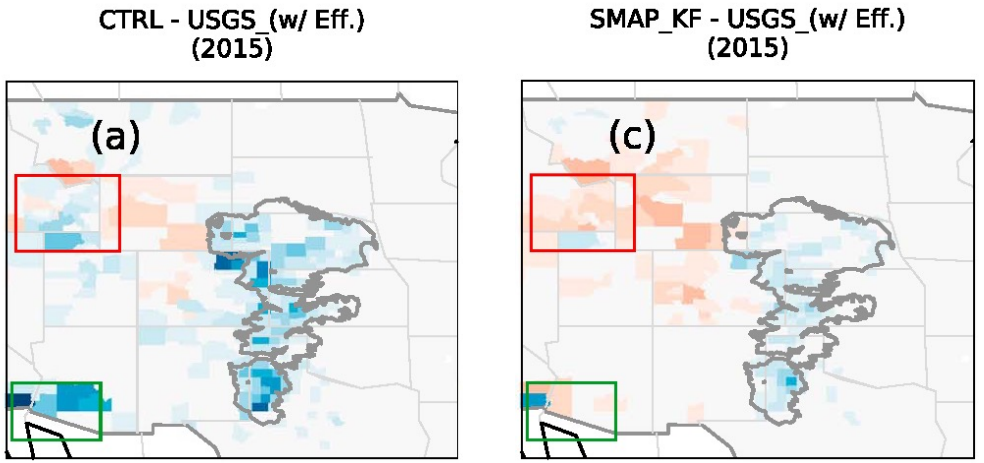
Utilizing SMAP Soil Moisture Data to Constrain Irrigation in the Community Land Model

Problem: About 90% of consumptive water use is allocated for irrigation sector globally. Irrigation not only affects water resources and hydrology but also alters local to regional climate and weather systems. Given the lack of global irrigation data, irrigation schemes currently included in large-scale land surface models often use simplified representation to simulate irrigation.



County-level difference between annual total IWR from different simulation settings and U.S. Geological Survey (USGS) data in 2015. The dark black outline indicates the High Plains Aquifer, and the red and green rectangles show the Snake River Plain and Southwest Alluvial Basins in Arizona regions, respectively.

Finding: The potential of improving irrigation representation in the Community Land Model version-4.5 (CLM4.5) is investigated by assimilating SMAP data. Simulations are conducted over the heavily irrigated central U.S. region. We find that constraining the target SM in CLM4.5 using SMAP data assimilation with 1-D Kalman filter reduces the root-mean-square error of simulated irrigation water requirement by 50% on average (for Nebraska, Kansas, and Texas) and significantly improves irrigation simulations by reducing the bias in irrigation water requirement by up to 60%.

Impact: SMAP data assimilation yields a significant improvement in the simulation of irrigation water use. These results have important implications for better assessment and prediction of irrigation water use and for studying human-climate interactions.

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