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Field-scale Assessment of Land and Water Use Change using Remote Sensing Data Fusion

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The ability to accurately monitor and anticipate changes in consumptive water use associated with changing land-use and land-management is critical to developing sustainable water management strategies in water-limited climatic regions. In this paper, we present an application of a remote sensing data fusion technique for developing high spatiotemporal maps of evapotranspiration (ET) at scales that can be associated with changes in land use. The fusion approach combines ET map timeseries developed using thermal data from Earth observation platforms with high spatial but low temporal resolution (e.g.,Landsat) with information from moderate resolution but frequent temporal coverage (e.g, MODIS). The system is applied over the Sacramento-San Joaquin Delta region in California – an area critical to both agricultural production and drinking water supply within the state that has recently experienced stresses on water resources due to a multi-year extreme drought. Daily 30-m resolution ET "datacubes" were constructed for the 2015-2016 water years and related to detailed maps of land-use developed at the same spatial scale. The ET retrievals are evaluated at flux sites over multiple land covers to establish a metric of accuracy in the annual water use estimates, yielding root-mean-square errors of 1.0, 0.8 and 0.3 mm d-1 at daily, monthly and yearly timesteps, respectively. The analysis investigates relationships between land and water use over this region, and how interannual changes in these properties correlate. A water-use accounting is developed for major land-use classes and crop types active within the Delta region. We also examine characteristic annual water use curves for different land uses, and explore types of information about land and water management decisions that can be inferred from the combined datasets. Potential for integrating additional sources of medium-to-moderate resolution thermal and surface reflectance data from existing and future satellite systems (e.g., VIIRS, Sentinel-2, ECOSTRESS) will be discussed.