# Advancing Block-Level Irrigation Management through Enhanced Evapotranspiration Estimation by Integrating Satellite and Proximal Sensing in California Specialty Crops

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Satellite-based evapotranspiration (ET) estimates have demonstrated significant value for optimizing block-level irrigation management in California specialty crops. Recent findings from the Tree-Crop Remote Sensing of Evapotranspiration Experiment (T-REX) indicate that publicly available satellite ET products can provide reliable estimates of actual ET in almond orchards, but important limitations remain in resolving short-term variability. In particular, Landsat-based approaches are constrained by revisit frequency and interpolation, which can miss rapid changes in crop water use, such as the decrease in ET during hull split and harvest. To address these limitations, a pilot study is underway to test low-cost proximal sensing technologies to provide high-frequency observations that can better inform physically-based ET modeling. These include stationary thermal infrared sensors, multispectral cameras for vegetation indices, and compact weather stations for meteorological inputs, all deployed on towers in selected orchards and vineyards with sub-daily data collection.

The study uses the Two Source Energy Balance (TSEB) model, which partitions the land surface into soil and canopy components and solves separate energy balances for each. Using radiometric surface temperature, vegetation cover, and leaf area index, TSEB can estimate total ET as well as transpiration and soil evaporation components, making it particularly well-suited for the structured and partially covered canopies typical of specialty crop systems. Here, proximal thermal, spectral, and meteorological measurements are used to drive and evaluate TSEB, with the broader goal of improving the representation of field-scale ET dynamics that are often missed by satellite-only approaches. Preliminary results from vineyards and almond orchards show reasonable agreement between daily TSEB-derived ET and values derived from micrometeorological methods, such as eddy covariance and surface renewal. Results also indicate that the effective sensor footprint for radiometric temperature and spectral measurements strongly influences model performance and uncertainty, highlighting the importance of sensor placements and deployment design for scalable, near-real-time ET monitoring in specialty crops

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