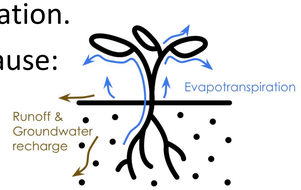
Field-scale crop water consumption estimates reveal potential water savings in California agriculture

Anna Boser[1], Kelly Caylor[1], Ashley Larsen[1], Madeleine Pascolini-Campbell[2], JT Reager[2], Tamma Carleton[1]
Bren School of Environmental Science and Management, UCSB; NASA Jet Propulsion Laboratory

INTRODUCTION

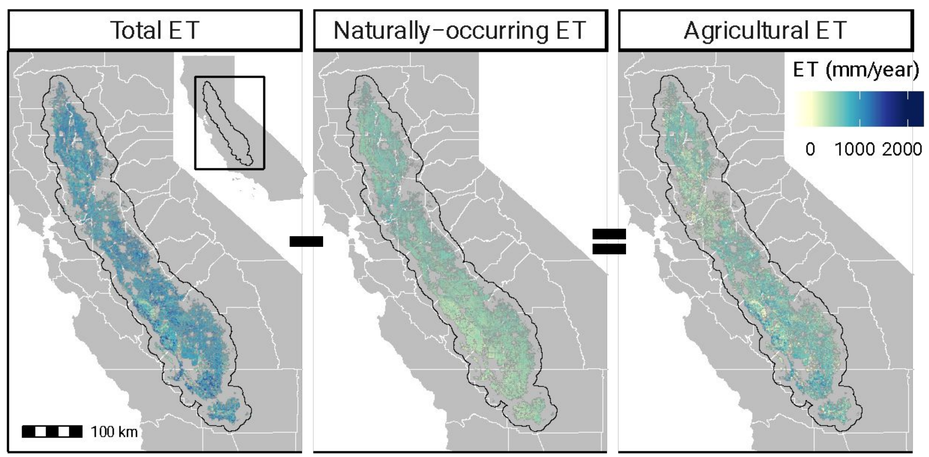
- Field-scale data on crop water consumption is vital for water management, food security and environmental conservation.
- However, such data remain challenging to quantify because:
  1. Not all water inputs result in consumption (ET).
  2. Not all ET is agriculturally driven water consumption.



- We estimate crop water consumption in the California Central Valley, one of the most agriculturally productive and water stressed regions in the world.

ESTIMATING CROP WATER CONSUMPTION

- **Agricultural ET** = Total ET – Naturally-occurring ET
- **Total ET** is retrieved from OpenET.
- **Naturally-occurring ET** is estimated by training a gradient boosted tree algorithm to predict the ET over fallow lands. Latitude, longitude, soil quality, topography, and potential ET are used as predictors. R^2 = 0.87.

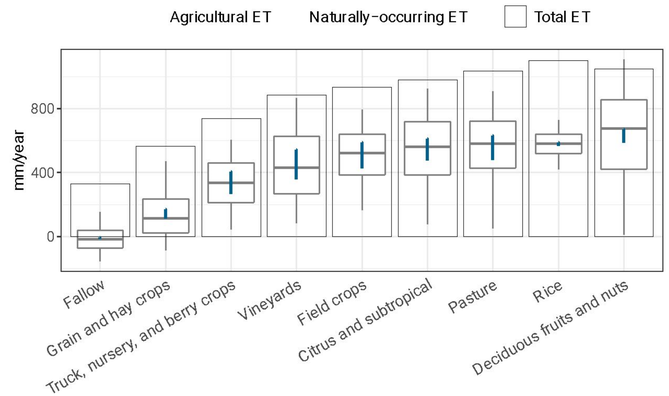


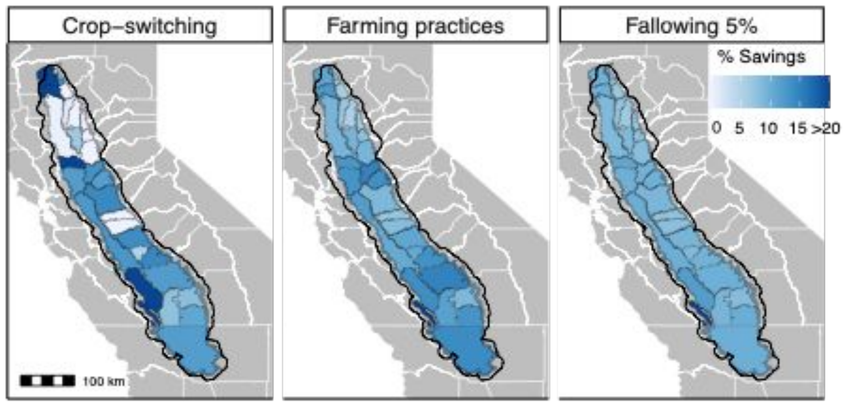
Nature Communications paper (accepted 2024)

annaboser@ucsb.edu
anna-boser.github.io

VARIATION WITHIN AND BETWEEN CROPS

- Crop type explains 34% of the variation in agricultural ET.
- Substantial variation within crops remains, even when accounting for the effects of orchard age, climate, topography, and soil quality.





Substitute high-ET crops for the median water-consuming crop.

Reduce agricultural ET of high consumers to the median consumption level for their crop.

Fallow the 5% of lands with the highest estimated agricultural ET.

POTENTIAL WATER SAVINGS

- We simulate the potential of three strategies to save water.
- We control for orchard age, climate, topography, and soil quality.
- Each strategy reduces agricultural ET by ~10%.

IRRIGATION EFFICIENCY

- Irrigation efficiency = Agricultural ET / Irrigation
- We use our estimates of Agricultural ET and estimates of irrigation amounts from the USGS National Water Information System.
- On average, Central Valley irrigation is 62% efficient.