



— BUREAU OF —
RECLAMATION

Development of a new CalSimHydro crop ET dataset and comparisons with OpenET

CWEMF Annual Meeting, April 2026

Lauren Thatch (USBR)

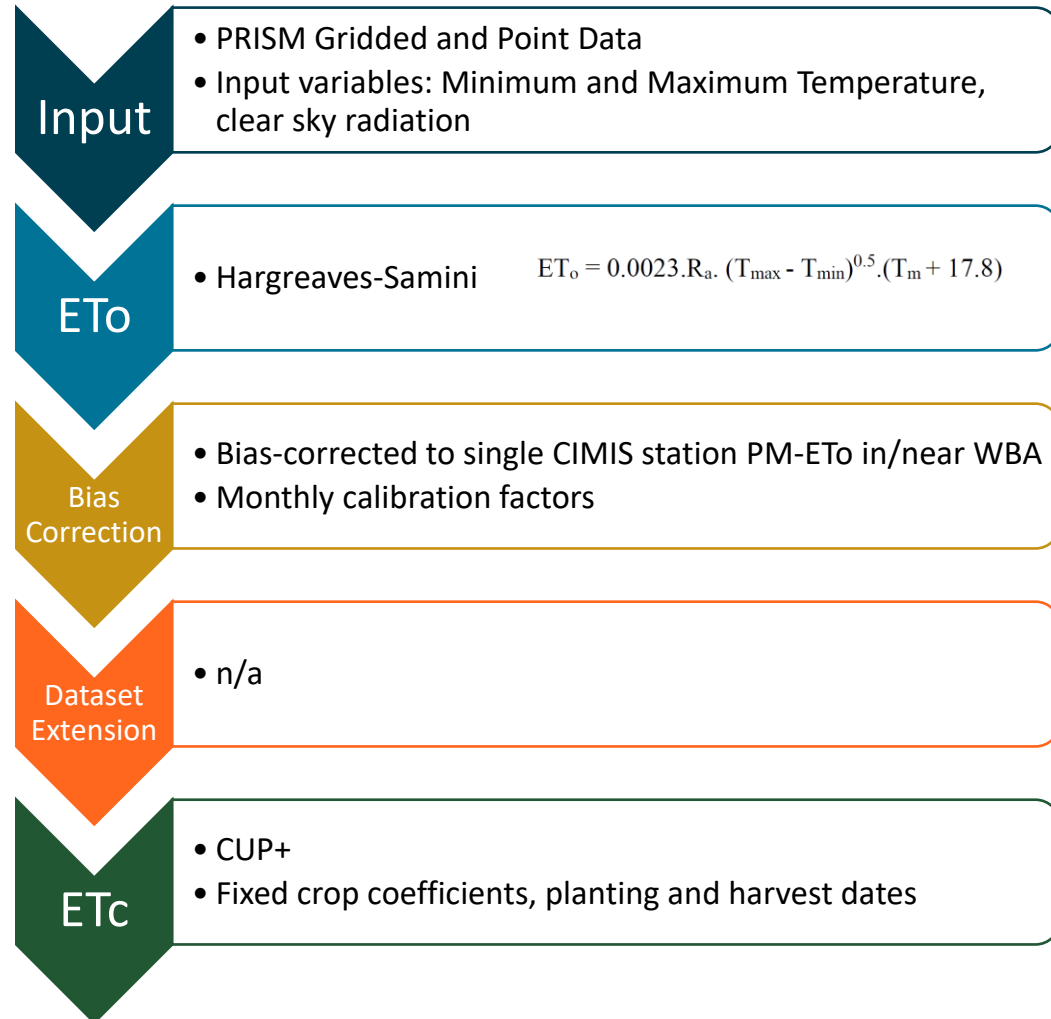
Chris Pearson (DRI), Justin Huntington (DRI), Peter ReVelle (DRI) and
Sayantan 'Monty' Majumdar (DRI)

Study Objective: Improve estimates of crop ET and water use for CalSim 3

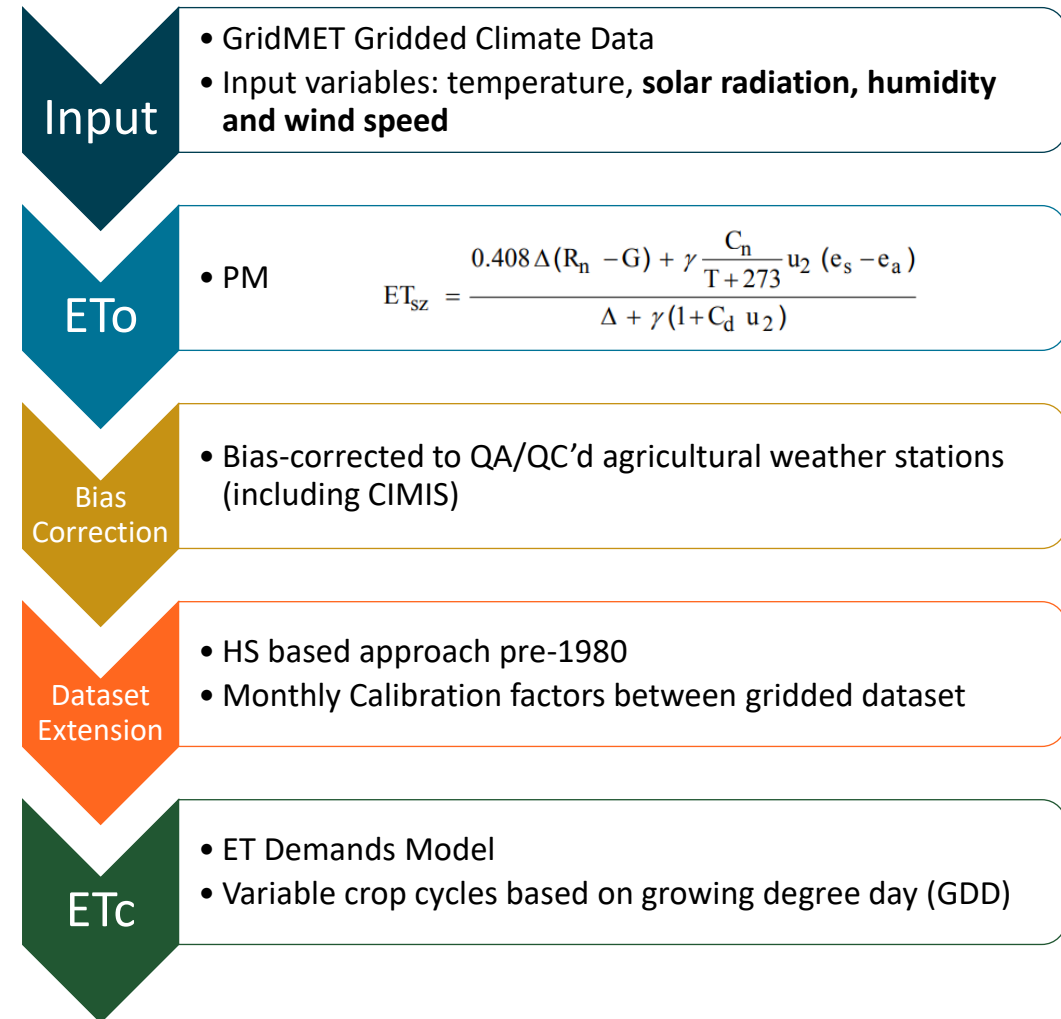
- Update reference ET (ET_o) datasets to standardized and updated methodology
 - Evaluate available gridded weather datasets for estimating ASCE-PM ET_o
- Develop and apply the ET Demands model
- Conduct a thorough evaluation and comparison of the methods and available ET datasets
 - Comparison of ASCE-PM ET_o and ET Demands ET_c with existing CalSimHydro datasets
 - Evaluate modelled ET_c with satellite-based ET_a estimates to assess differences between potential and actual ET



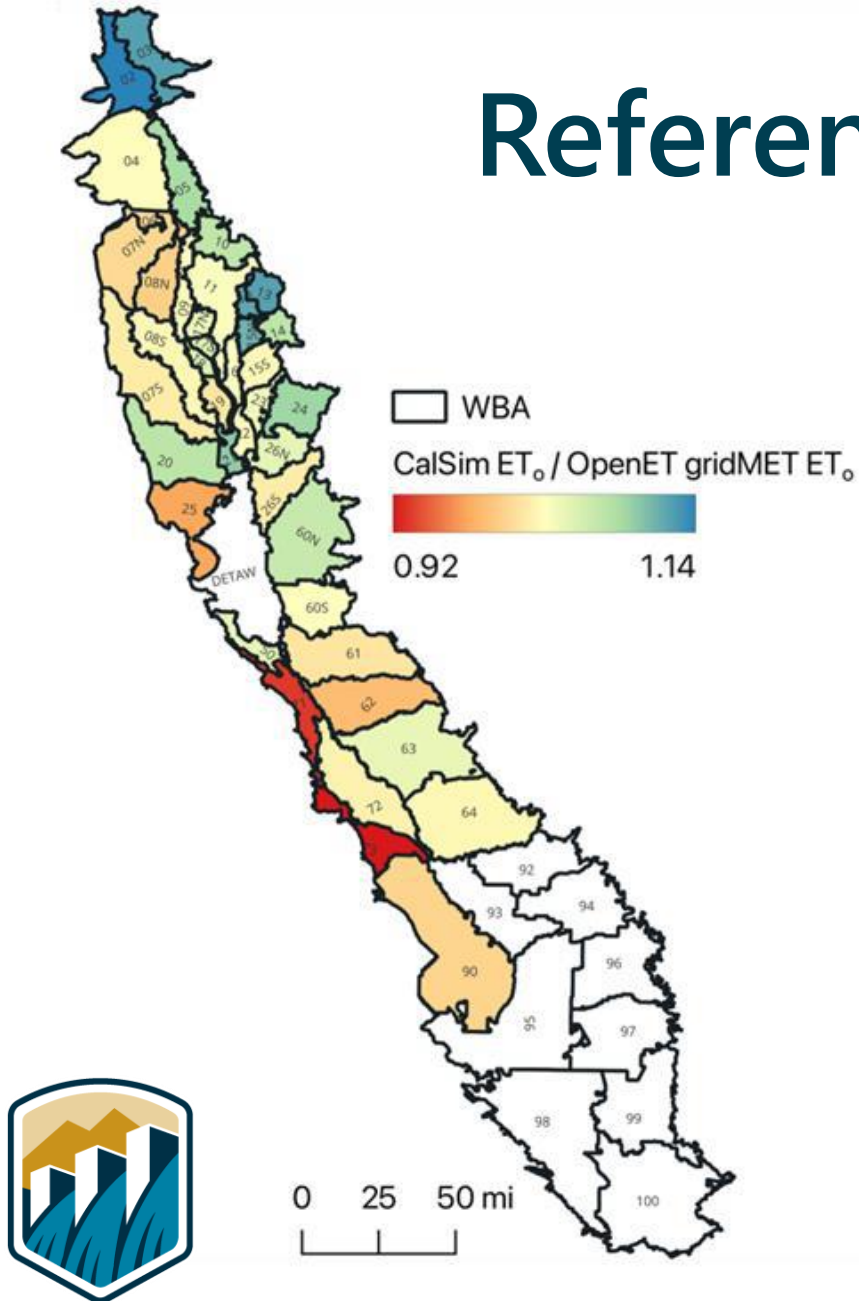
Existing ETc Development Method



New Method



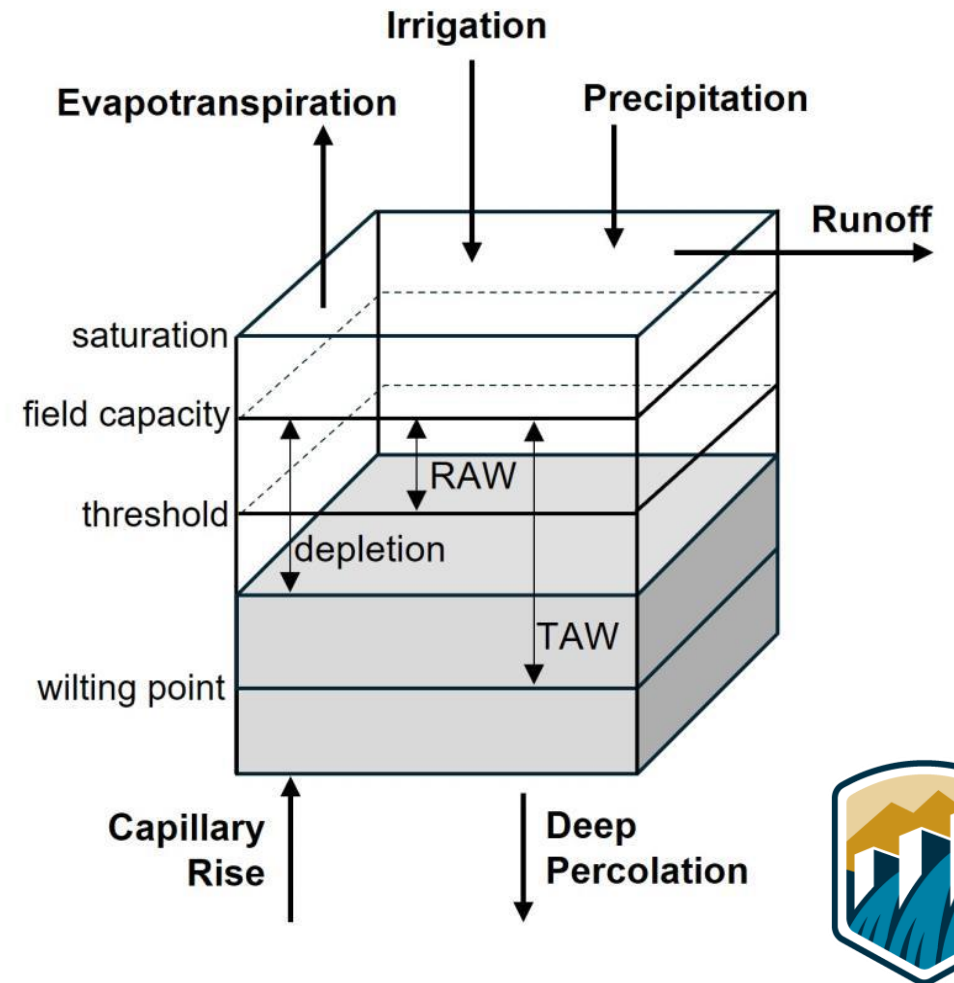
Reference ET dataset differences



- Existing CalSim ETo and OpenET gridMET Eto show good seasonal agreement in spring and summer, with larger differences in fall and winter months.
- Spatial differences are notable in northern and west valley regions with maps showing bias and RMSD metrics.
- OpenET gridMET Eto shows a stronger annual trend in ETo increases from 1981 to 2021 compared to CalSim

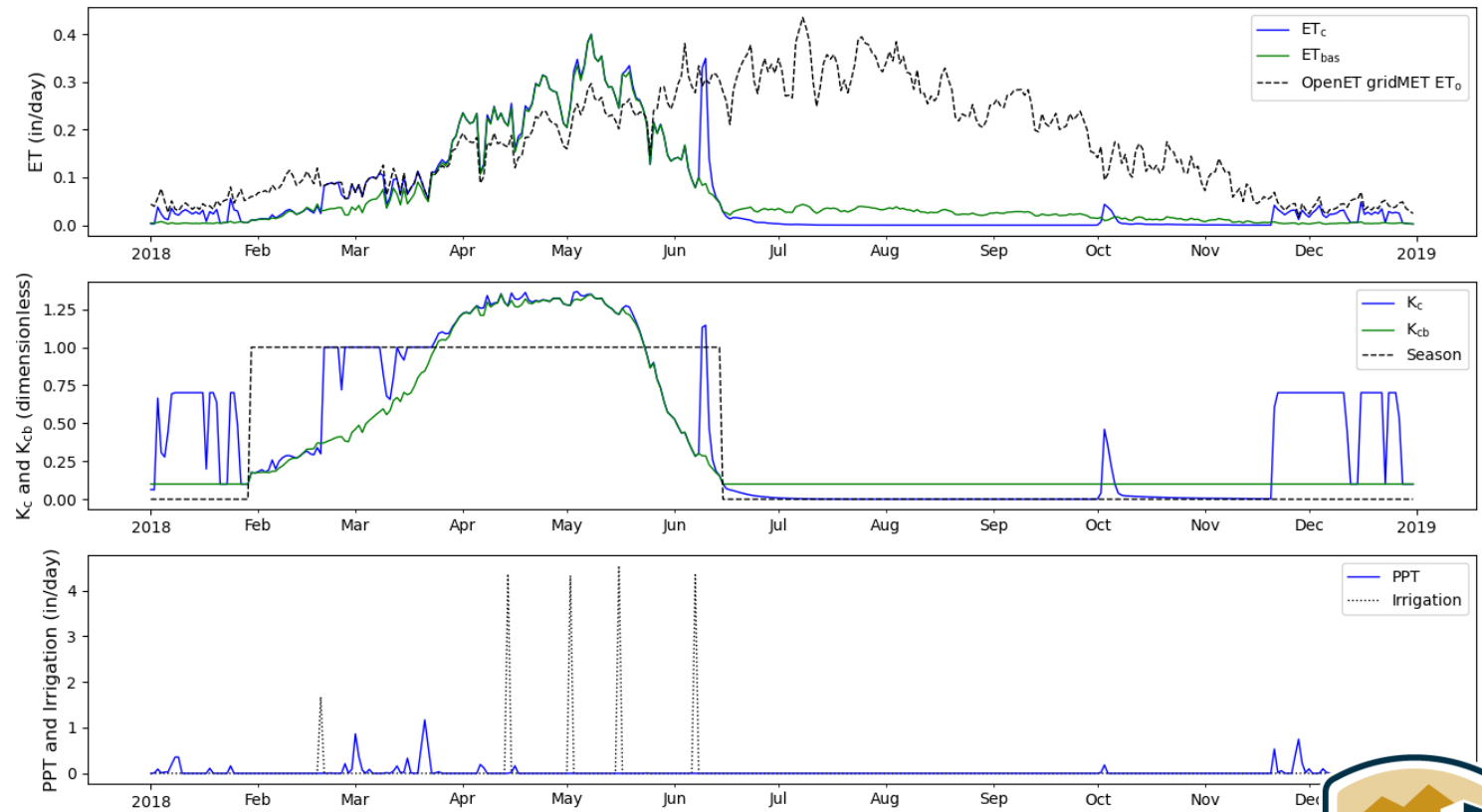
ET Demands Model Overview

- Daily Crop ET
 - ASCE Standardized PM Reference ET
 - FAO-56 Dual Crop Coefficient Method
 - Daily soil water balance
- Previous Applications:
 - West-wide Climate Risk Assessments, Upper Colorado River Basin Oregon, Klamath Natural Flow Study, Nevada, Idaho
- <https://github.com/WSWUP/et-demands>



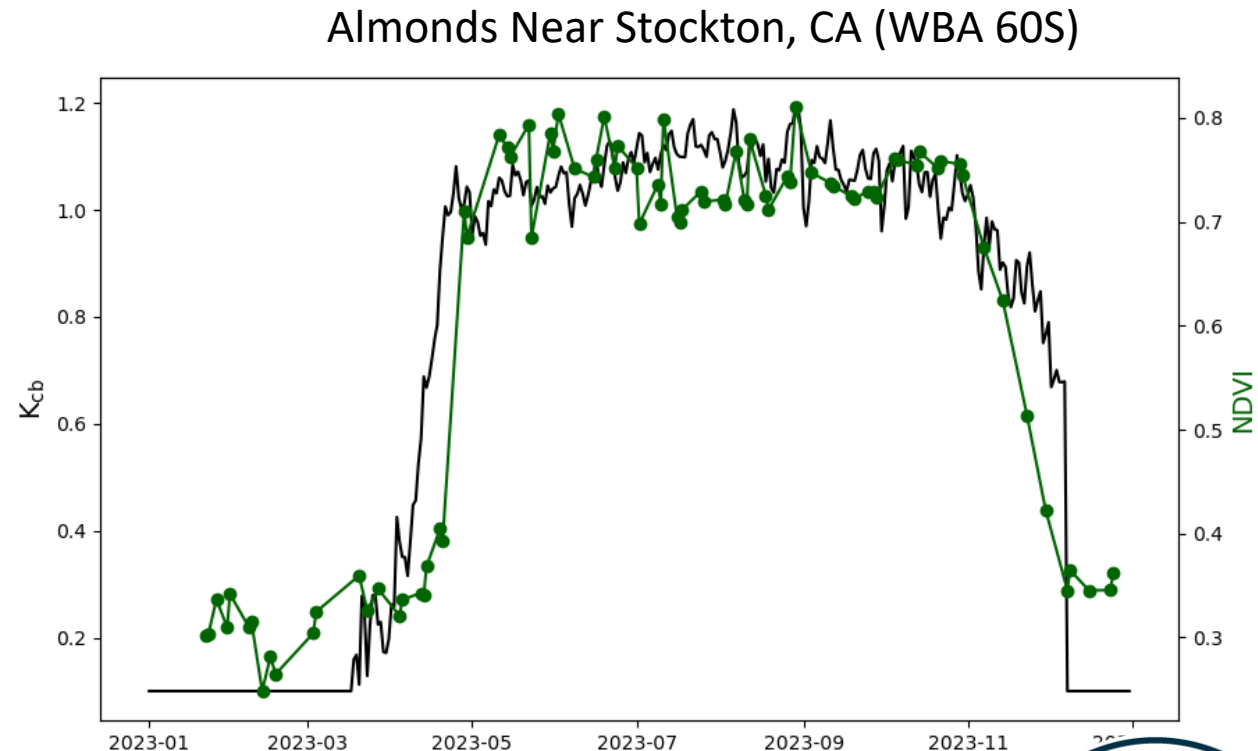
ET Demands Dual Crop Coefficient Approach

- Temperature based model
 - Green Up: T30 or CGDD
 - Effective Full Cover: CGDD or Time
 - Harvest/Killing Frost: CGDD, Time, KF
- Irrigation Scheduling
 - $MAD < \text{Threshold}$
- Each crop/grid cell is simulated separately.



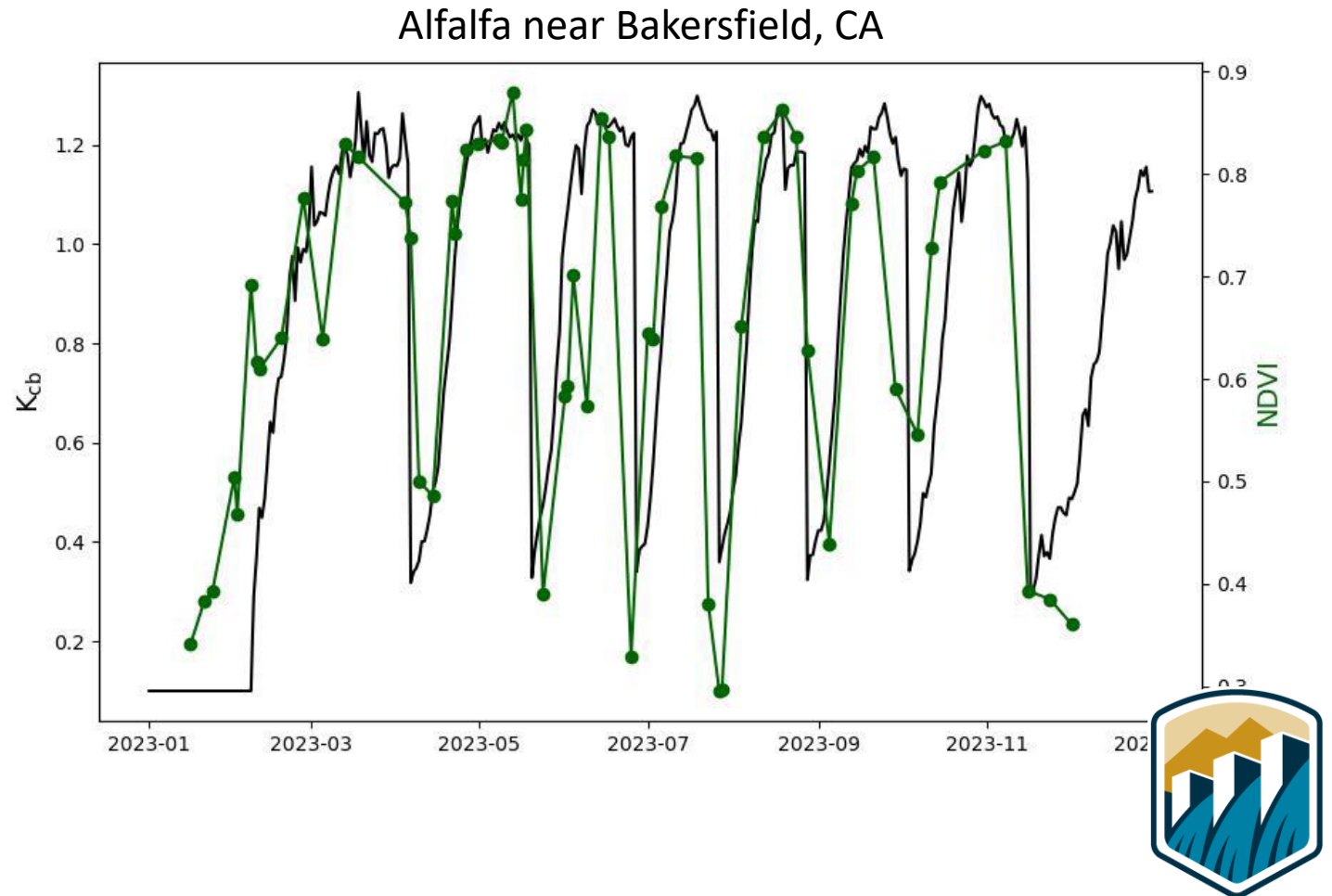
ET Demands Model Calibration Methods

- Manual, crop specific calibration
- Leverage typical growing season start and end dates, when available
- NDVI comparisons using Landsat and HLS imagery
 - Adjust Kc curve timing based on NDVI phenology
- Goal is to capture average signal and interpolate throughout the entire study area.

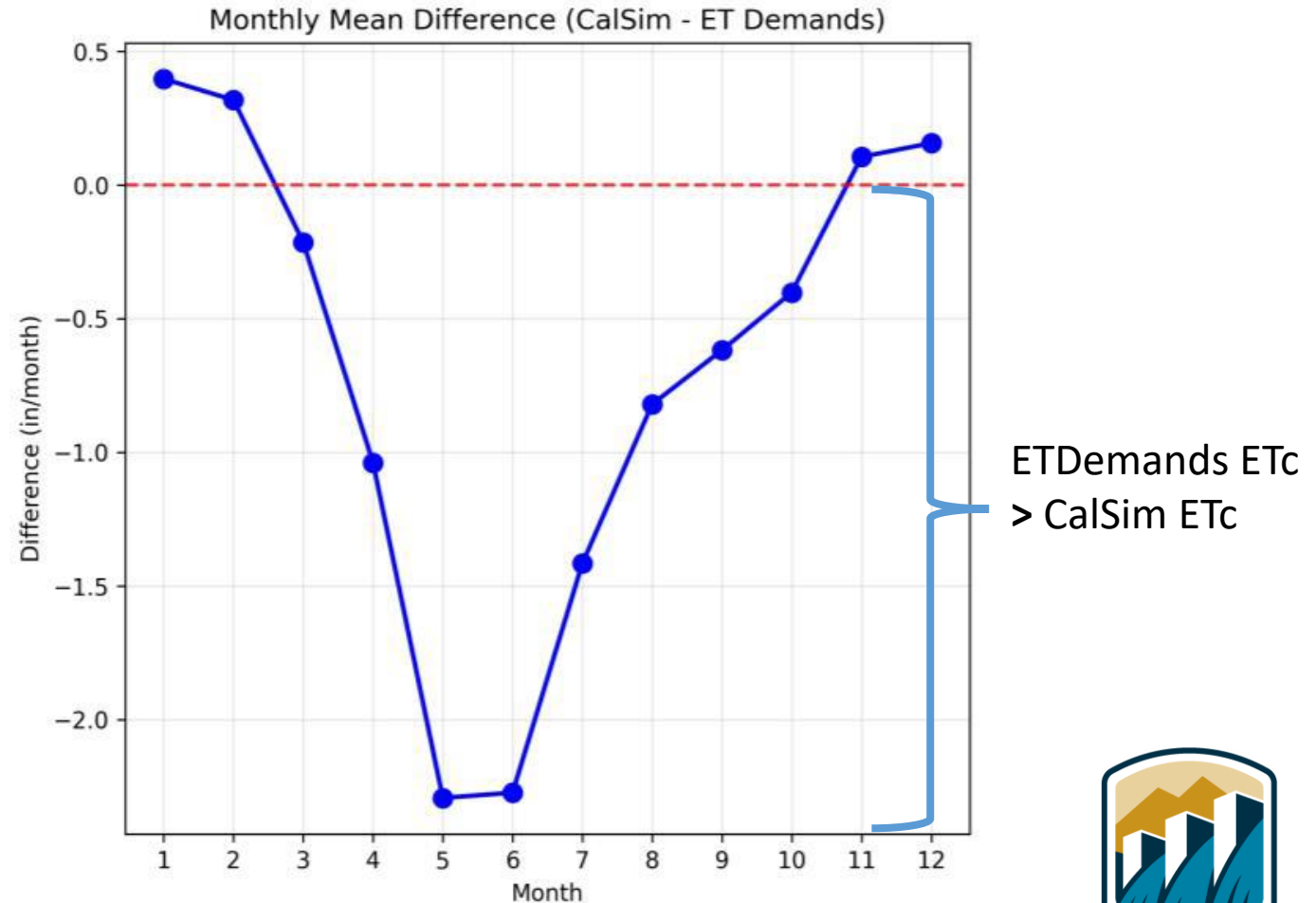
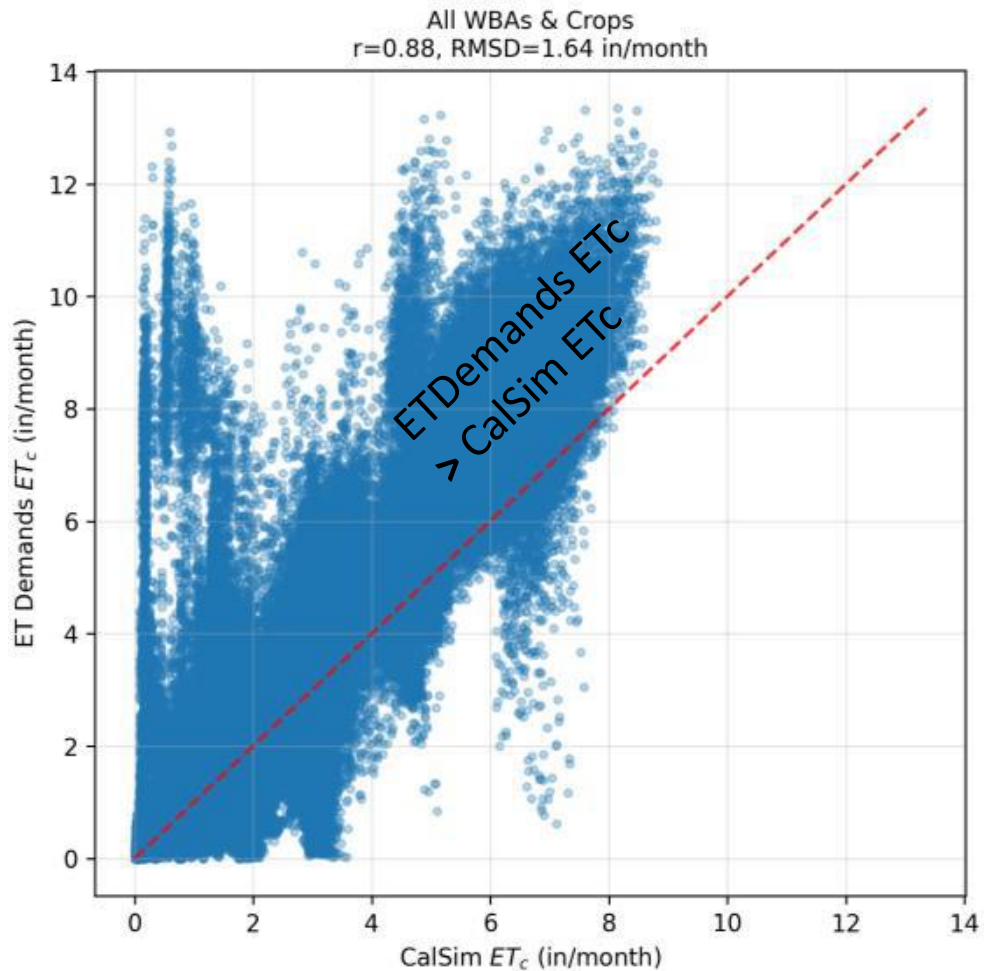


ET Demands Model Calibration Methods

- ET Demands captures varying crop cycle lengths
 - Slower growth in early spring
 - More rapid and shorter crop cycles in summer

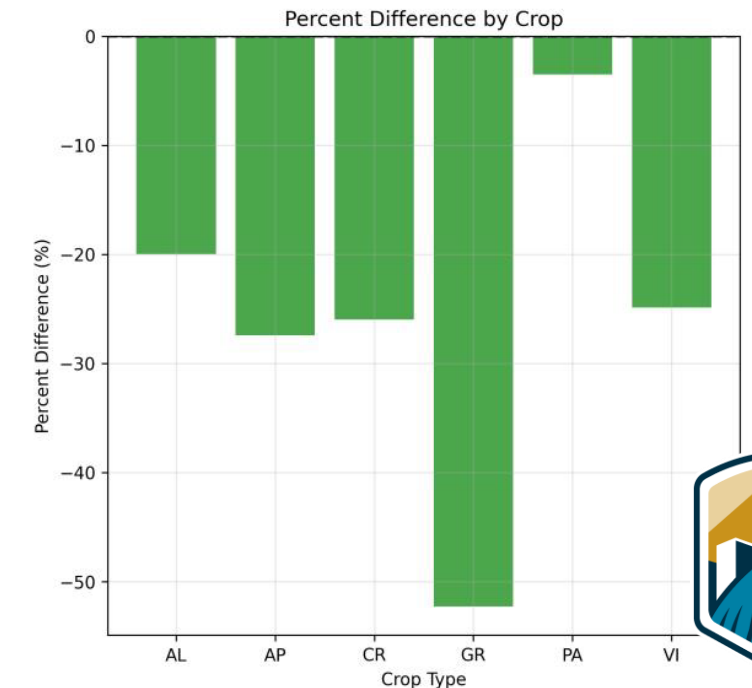
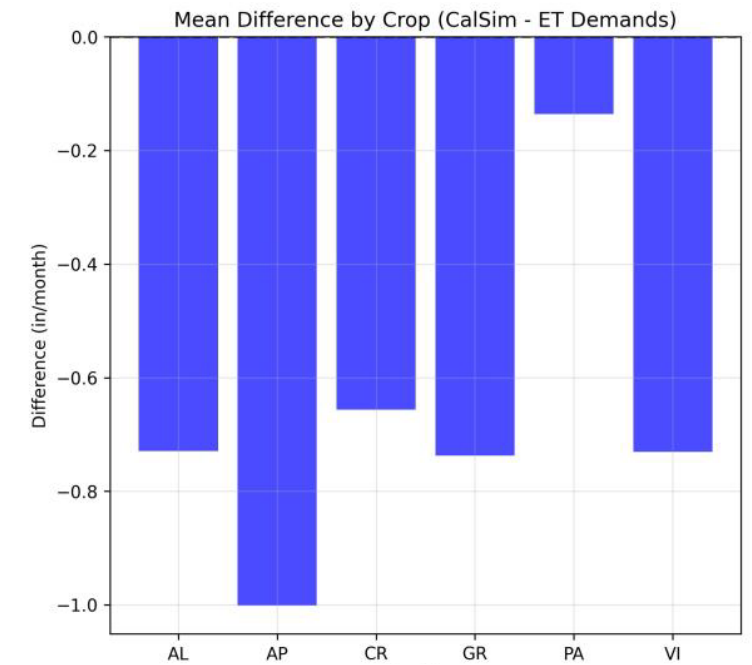


Big Picture Differences



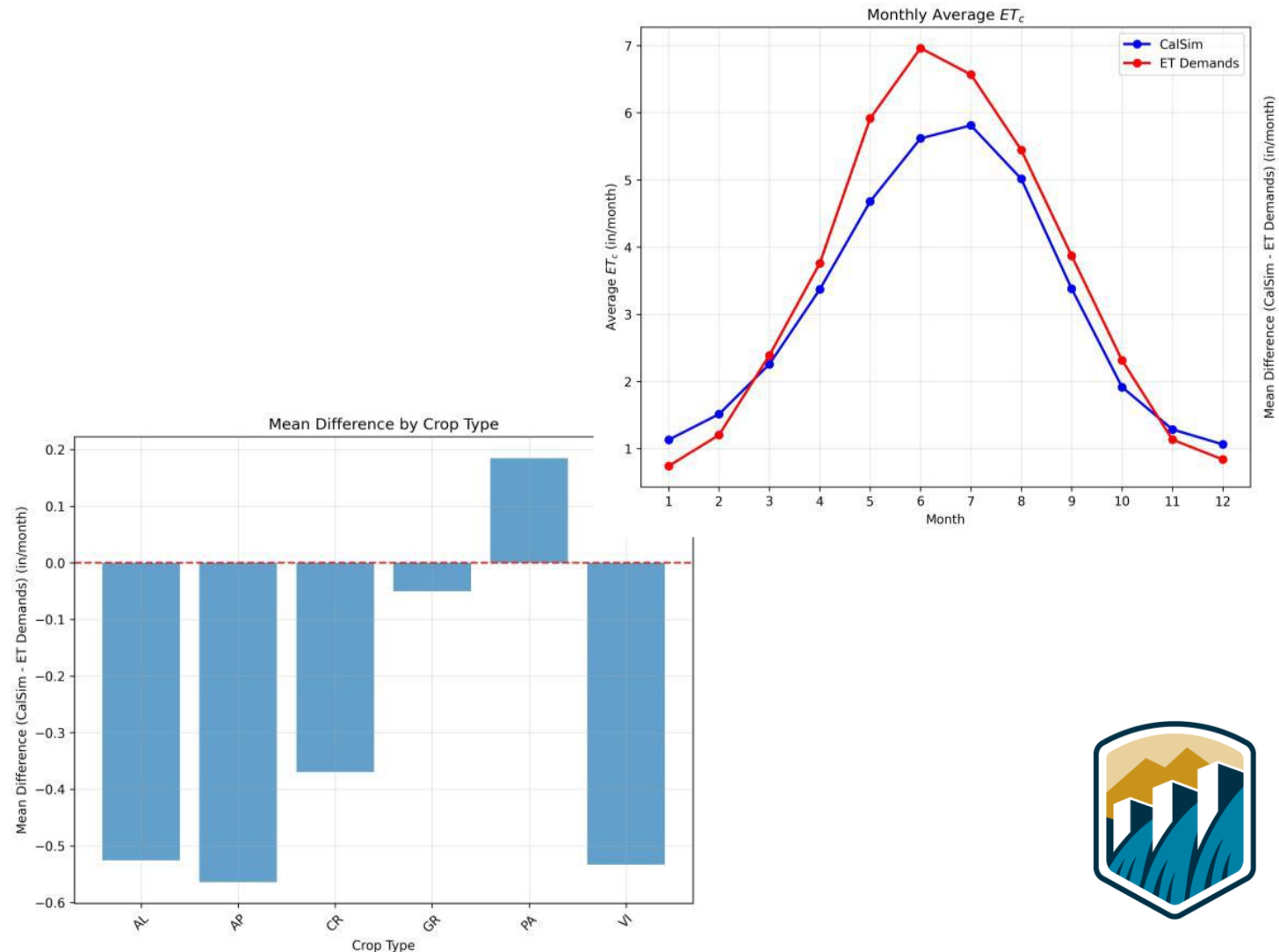
ET Demands ETc estimates higher than CUP+ for all land use types

- Highest percent difference between the two datasets for grain
- Largest mean difference for Almonds and Pistachios
- Likely due to differences in growing season length, irrigation scheduling, and crop classification approaches



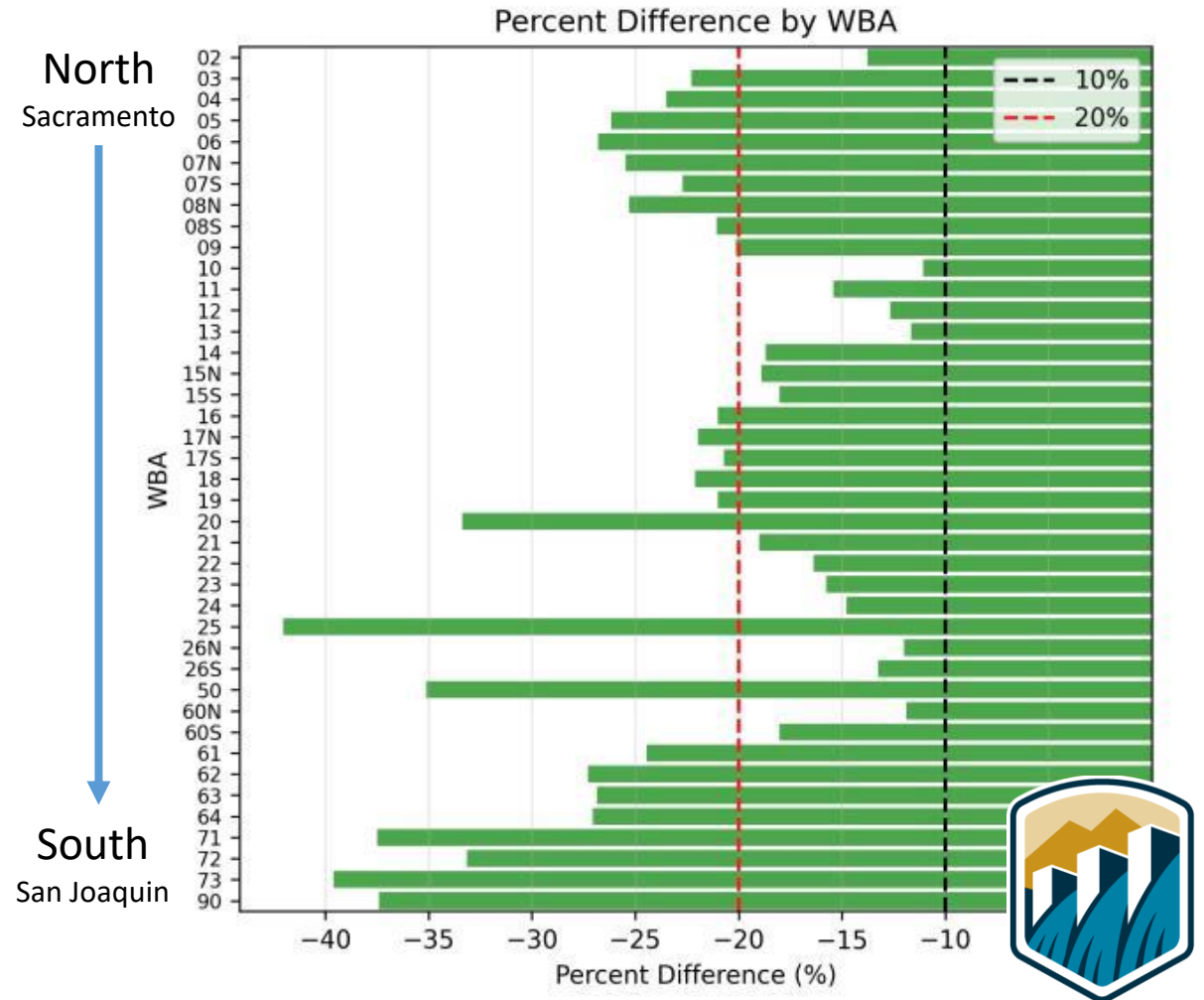
Detailed regional comparisons show some differences but generally match overall results

- WBA 02 near Chico, CA
- ET Demands ET_c mean monthly ET estimate is consistently higher than CalSim from April to August
- Most crop show large ET_c increases, except grain and pasture



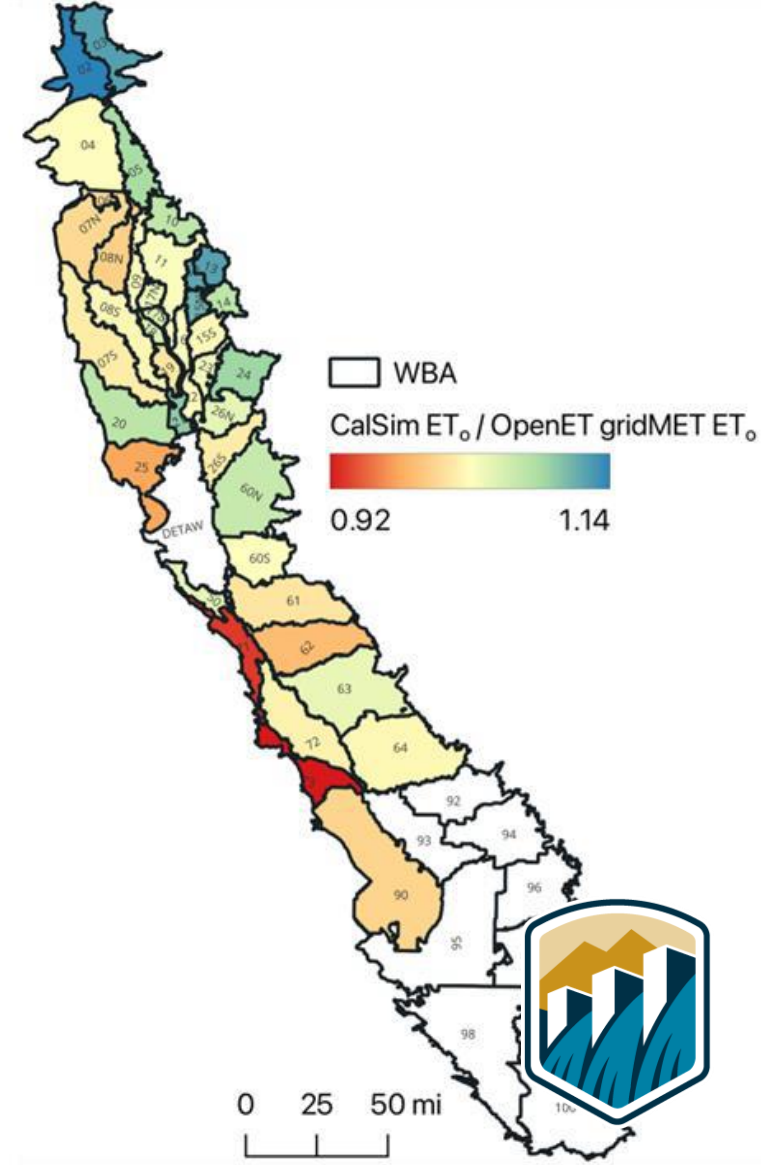
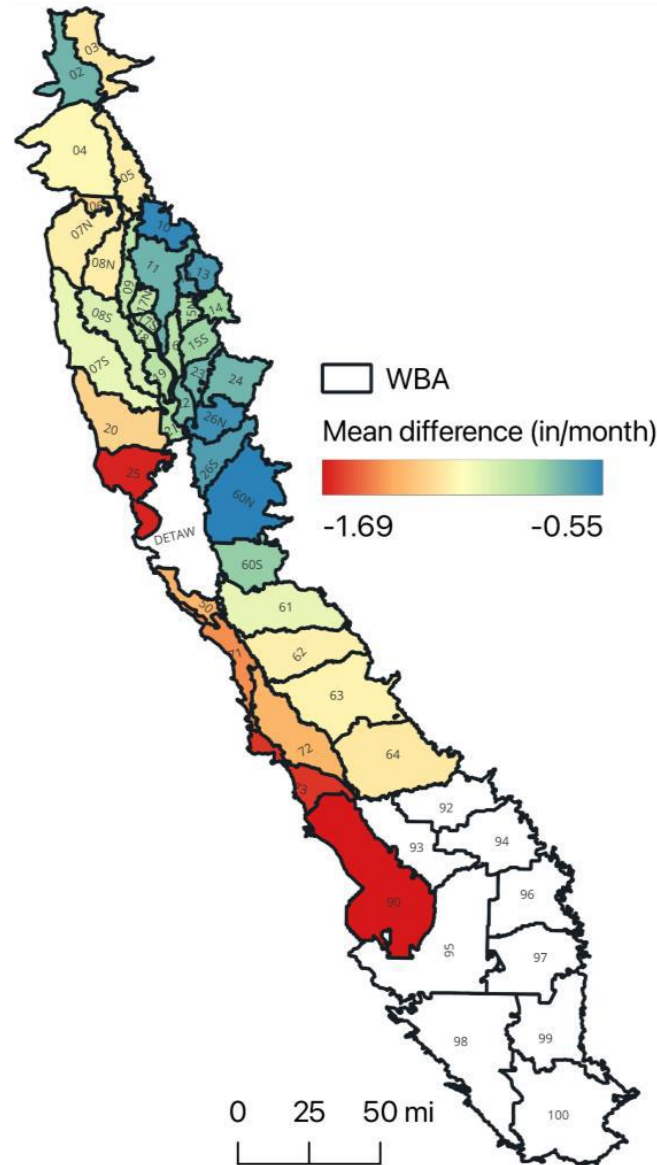
ET Demands ETc estimates are higher than CUP+ across the CalSimHydro domain

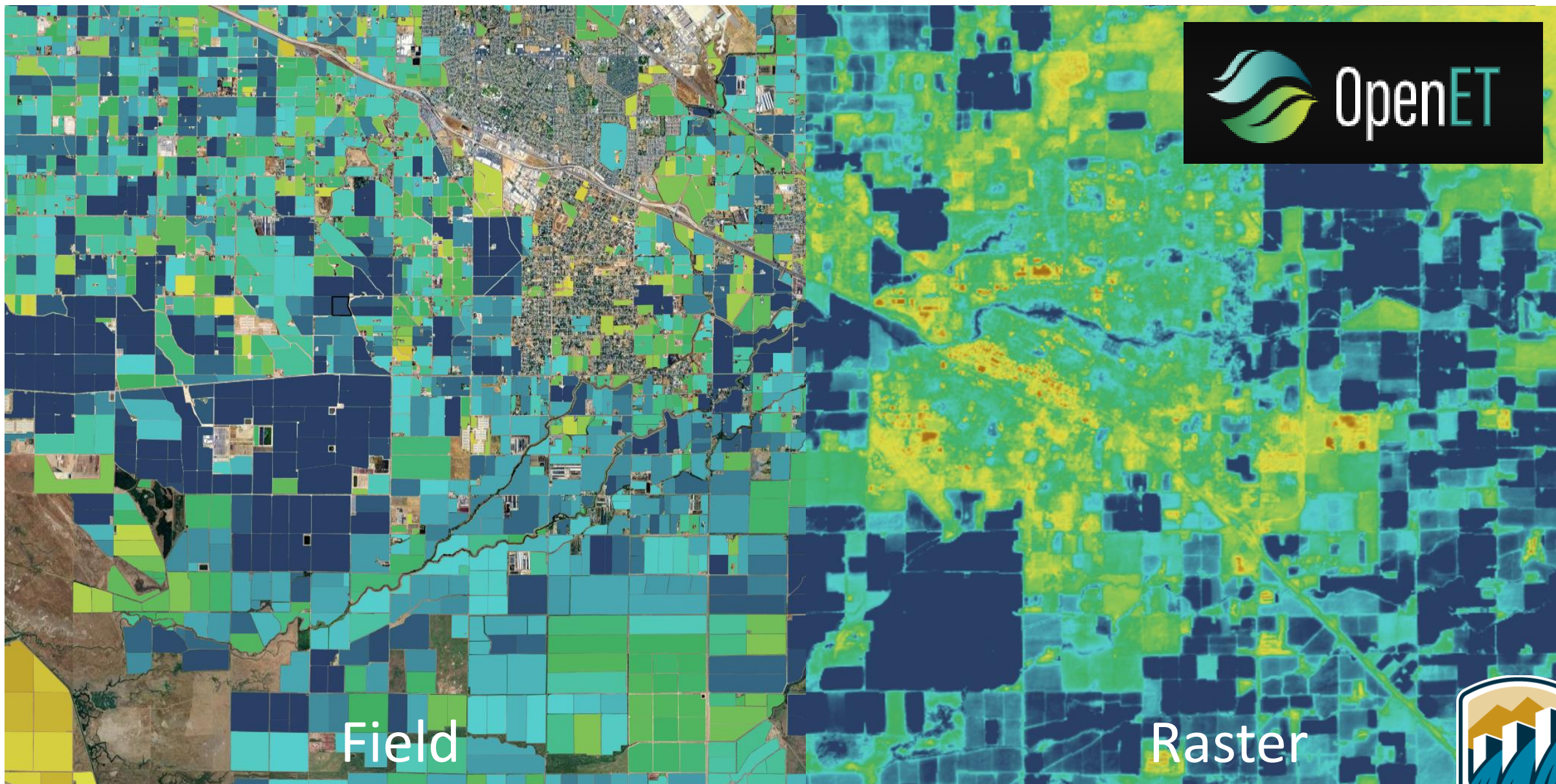
- Most of the largest differences occur in the most southern regions
- These regions also have the greatest increases in reference ET



Spatial comparison for almonds and Pistachios

- ET Demands ETc for almonds and pistachios is higher in all regions
- Largest increases in regions that also saw significant increases in ETo





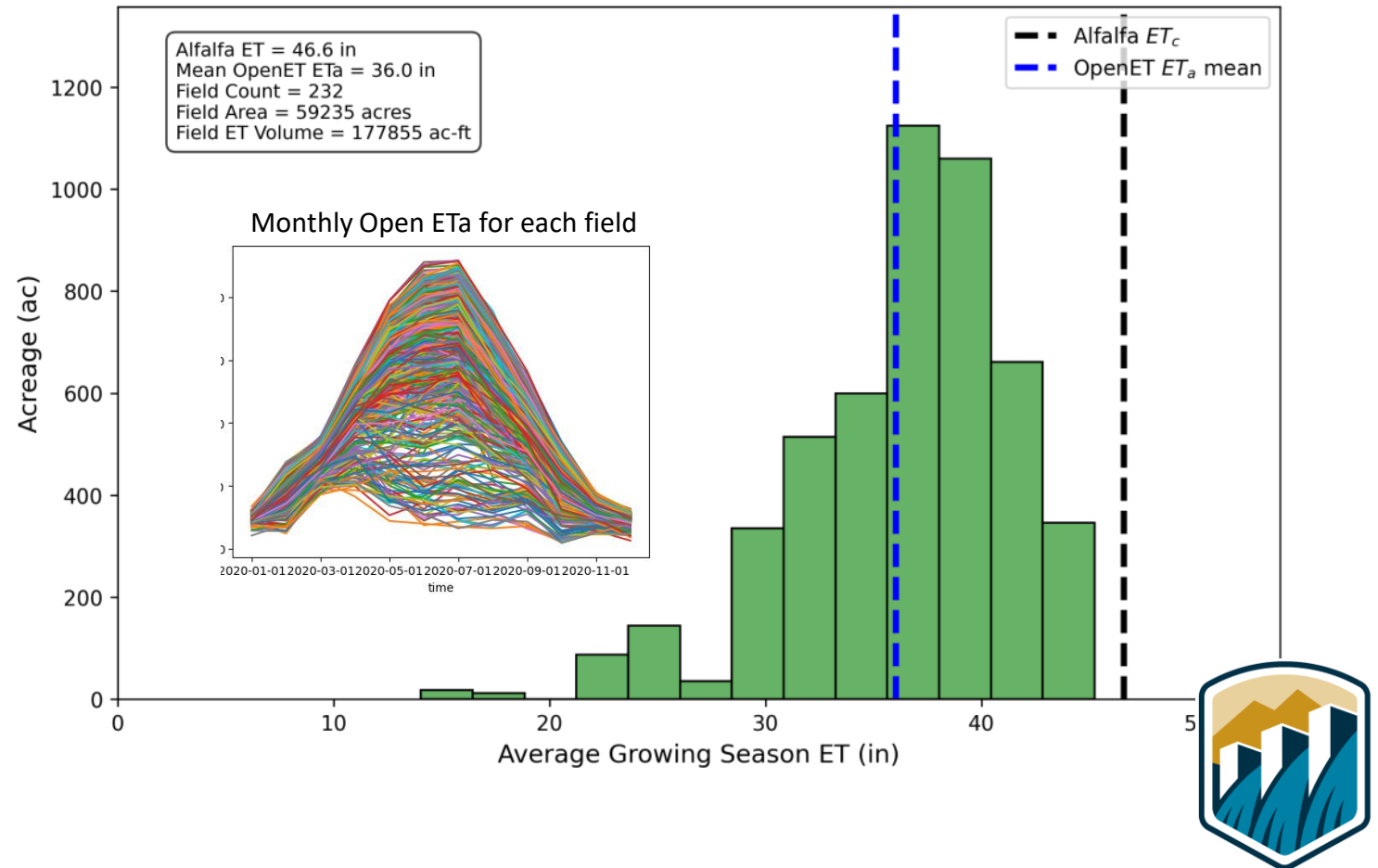
Field

Raster



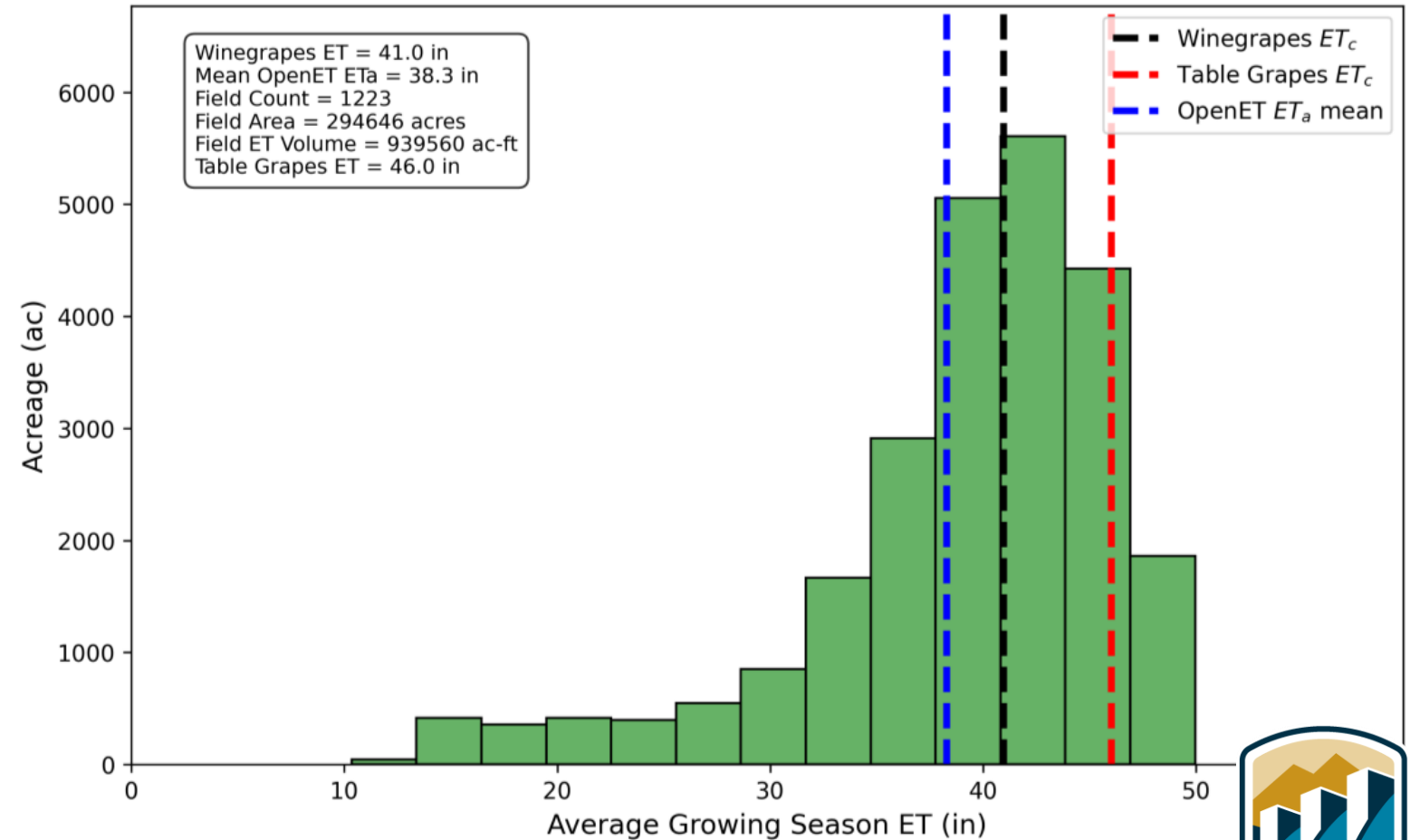
Comparisons with Satellite-Based Actual ET

- Satellite-based actual ET show significant variation across fields of the same crop types, impacted by:
 - Water availability/rights
 - Planting/harvest variation
 - Crop variations
- Comparisons show ET Demands rates exceed satellite-based actual ET, highlighting irrigation and water scarcity effects



Comparisons with Satellite-Based Actual ET

- Land use classifications provided by LandIQ and USDA may hide crop type variations
- Field comparisons provide insight into water use and uncertainty in water demands



Future Direction and Next Steps: Expansion, Model Integration, and Enhanced Data Comparisons

- **Pre-1980 ET Demands Expansion**
 - Expanding historical evapotranspiration demand data to better understand water use before 1980 for use with the CalSim3 Historical model.
- **Crop ET Geodatabase and Comparisons**
 - Creating a geodatabase for actual and potential crop evapotranspiration supports detailed water budget comparisons across regions.
- **Model Integration and Reporting**
 - Integrating models with CalSim 3 and coordinating engagement improves reporting and decision-making processes.



Questions?
lthatch@usbr.gov



— BUREAU OF —
RECLAMATION