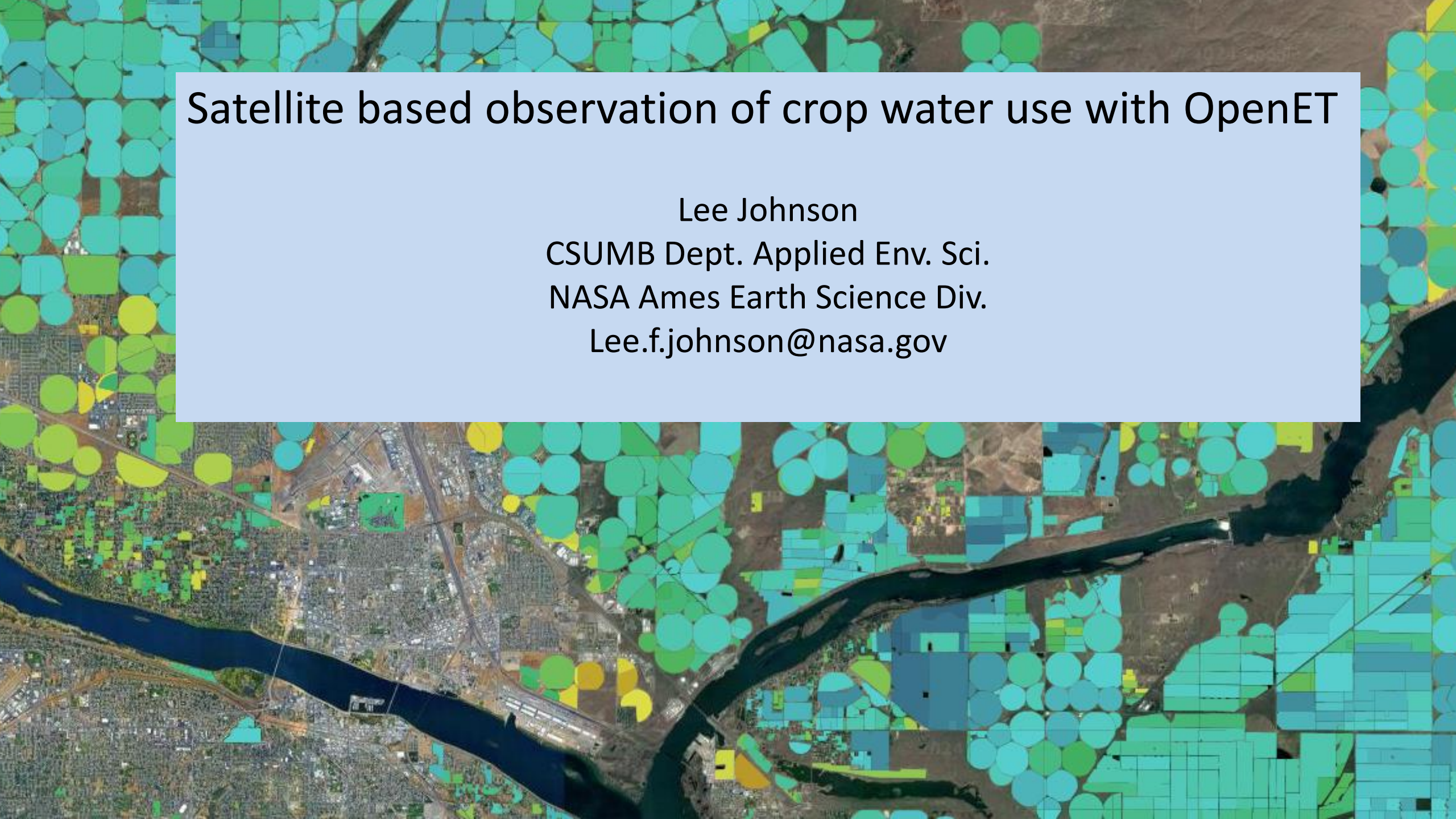
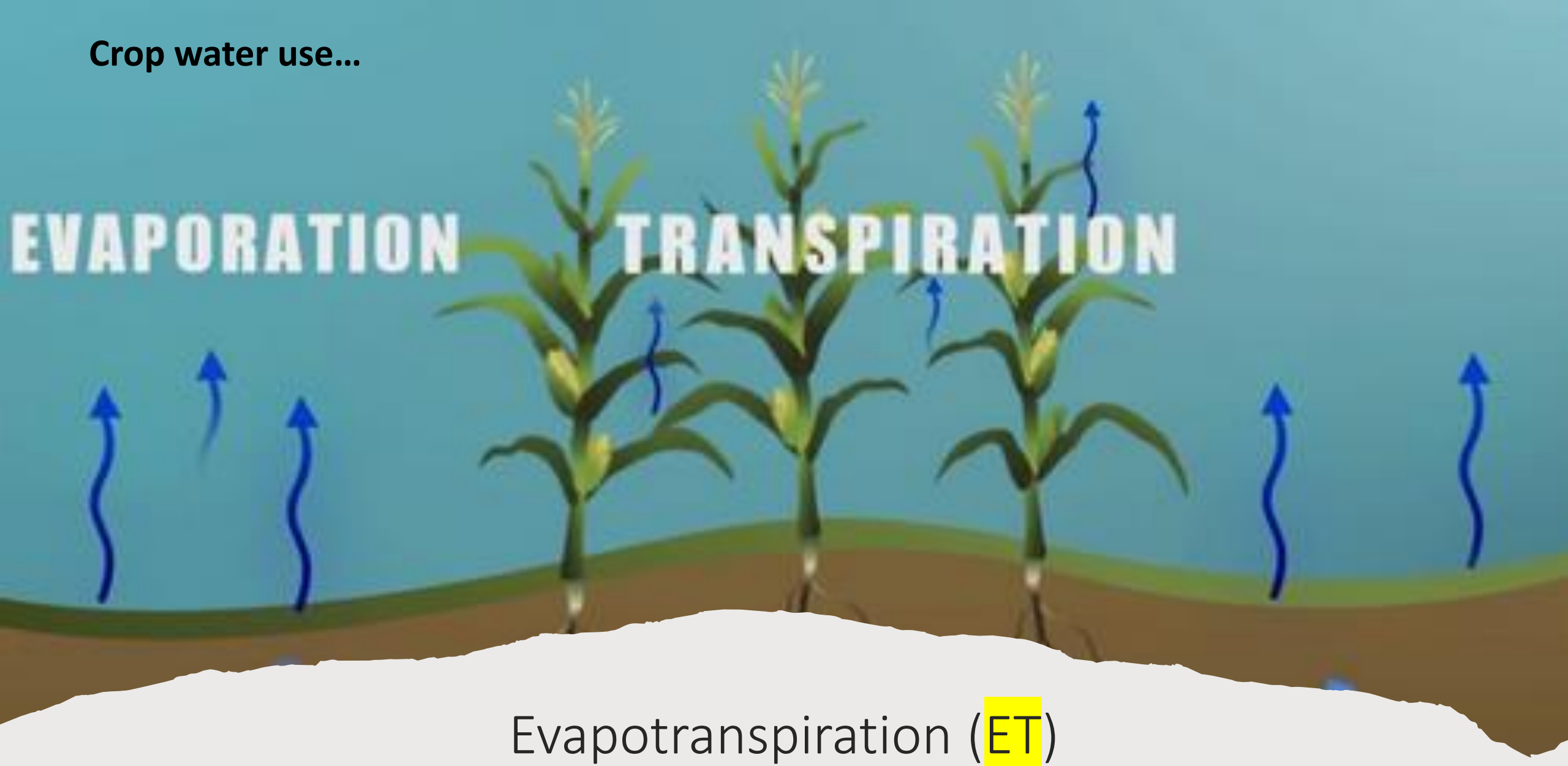


Satellite based observation of crop water use with OpenET

Lee Johnson
CSUMB Dept. Applied Env. Sci.
NASA Ames Earth Science Div.
Lee.f.johnson@nasa.gov

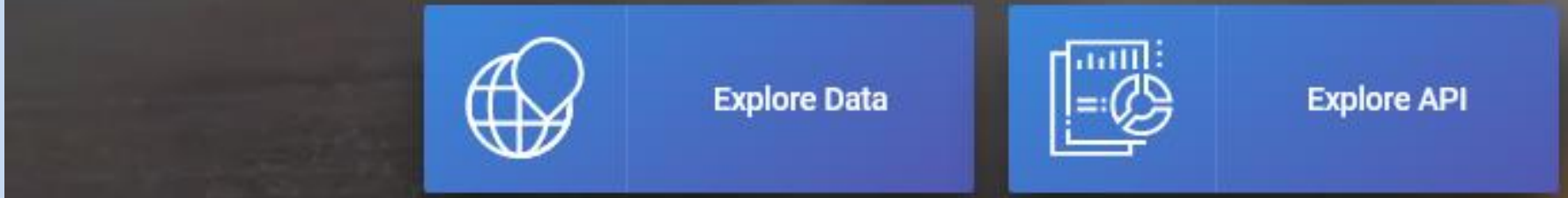
Crop water use…



Evapotranspiration (ET)

OPENET

OpenET uses best available science to provide easily accessible satellite-based evapotranspiration (ET) data for improved water management across the western United States. Using the Data Explorer or Application Programing Interface (API), users can accessET data at the field scale for millions of individual fields or at the original quarter-acre resolution of the satellite data.



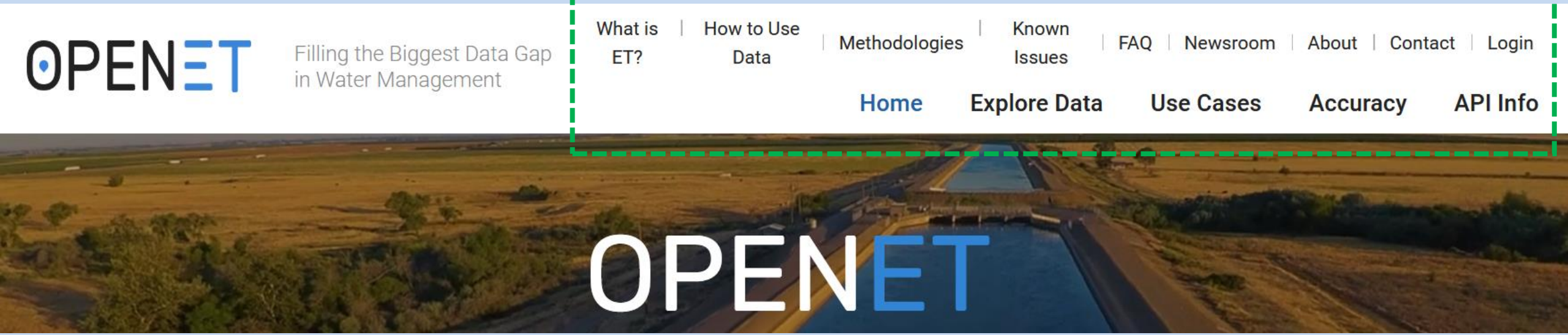
OPENET

Outline

- Description
- Accuracy
- Some possible uses

Much information available on webpage-

https://openetdata.org



for details…

JAWRA
JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

AMERICAN WATER RESOURCES ASSOCIATION

Technical Paper | Open Access

OpenET: Filling a Critical Data Gap in Water Management for the Western United States

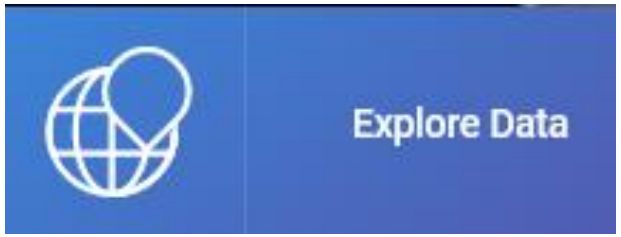
Forrest S. Melton, Justin Huntington, Robyn Grimm, Jamie Herring, Maurice Hall, Dana Rollison, Tyler Erickson, Richard Allen, Martha Anderson, Joshua B. Fisher, Ayse Kilic, Gabriel B. Senay, John Volk, Christopher Hain, Lee Johnson, Anderson Ruhoff, Philip Blankenau, Matt Bromley, Will Carrara, Britta Daudert, Conor Doherty, Christian Dunkerly, MacKenzie Friedrichs, Alberto Guzman, Gregory Halverson, Jody Hansen, Jordan Harding, Yanghui Kang, David Ketchum, Blake Minor, Charles Morton, Samuel Ortega-Salazar, Thomas Ott, Mutlu Ozdogan, Peter M. ReVelle, Mitch Schull, Carlos Wang, Yun Yang, Ray G. Anderson ... See fewer authors

First published: 02 November 2021 | https://doi.org/10.1111/1752-1688.12956 | Citations: 40

What is OpenET?

- Online resource
- Provides data on crop water use (and development)
- Does not offer direct advice or recommendations
- Released 2020; grower feedback welcome

User interface

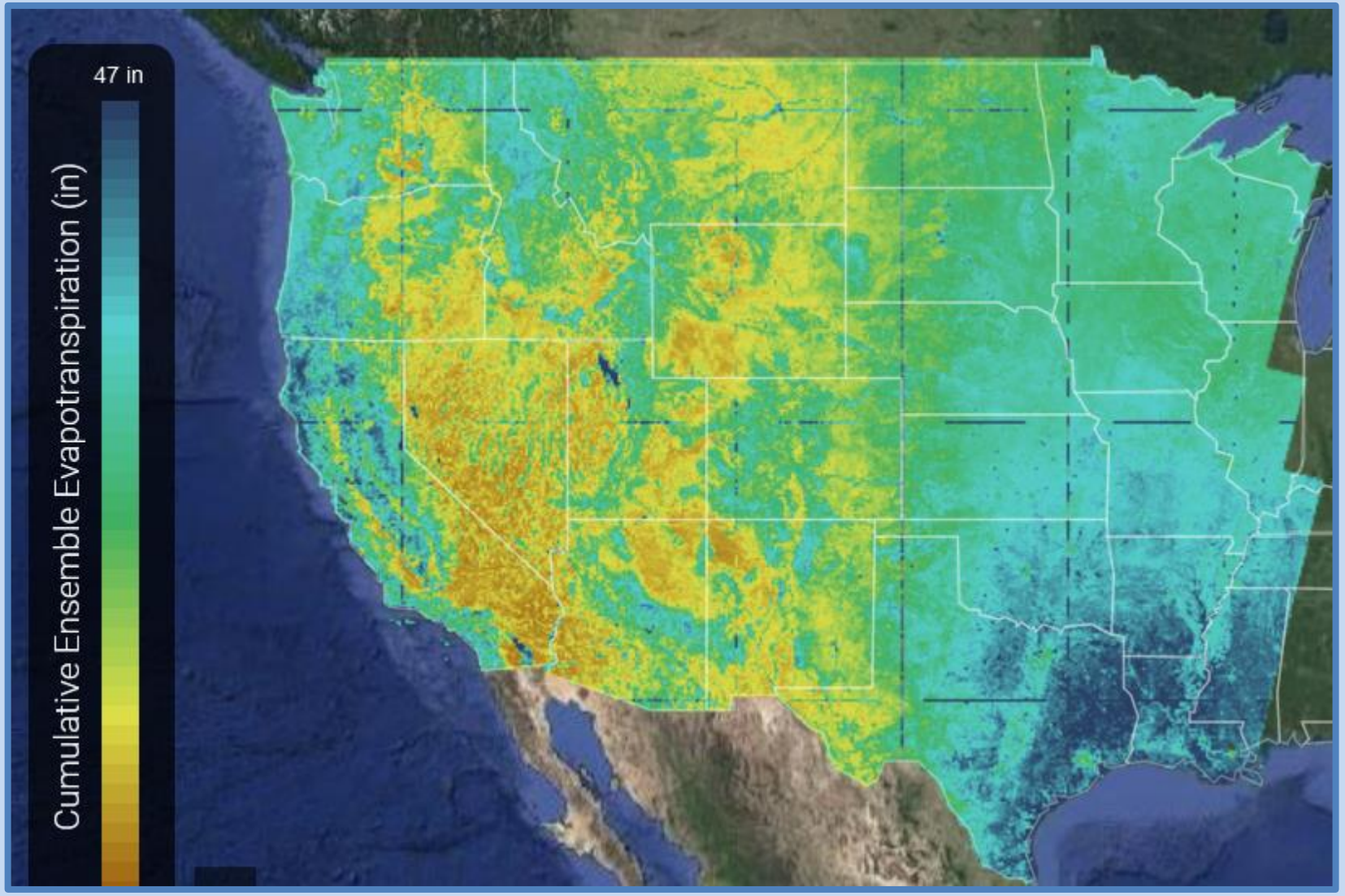


- See and interact with data
- Standard data requests

Raster View ⬤ Field View

Raster View:

- ¼ acre spatial resolution
- Spatially contiguous
- All landcover types



Raster View Field View

Western U.S

Salinas Valley

Field View:

Field-level aggregation for croplands

Access data for…

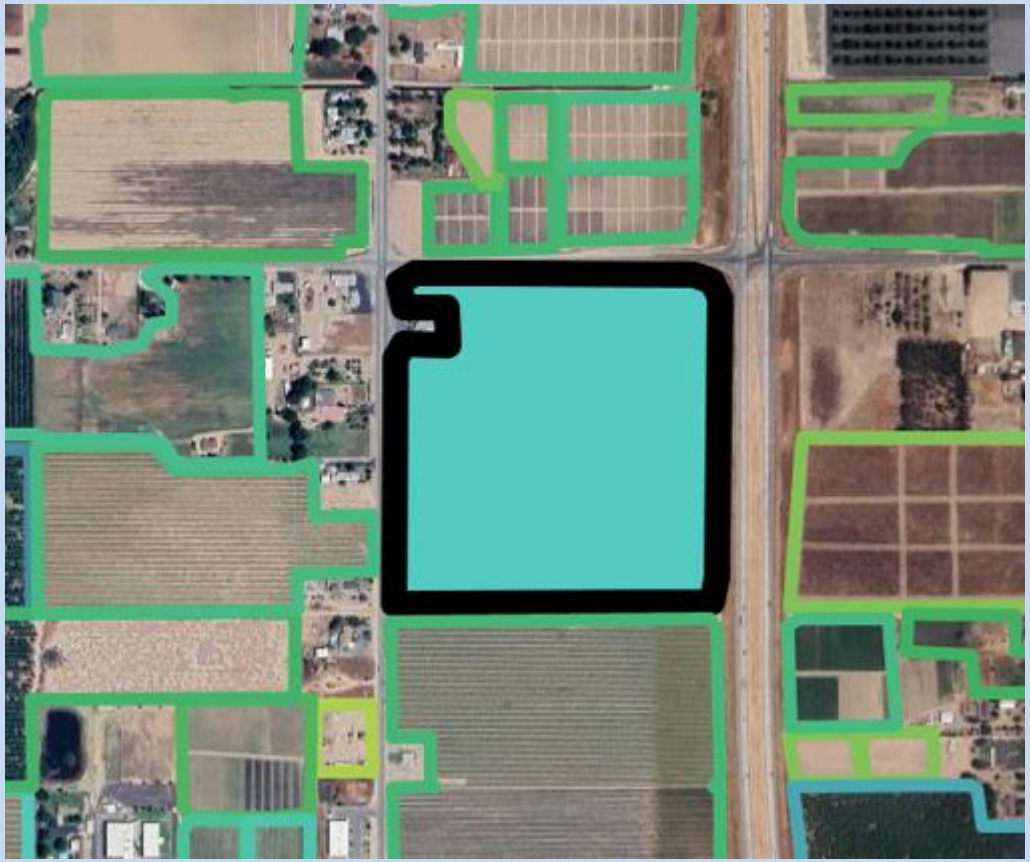
Raster View Field View

Part of a field

Draw custom area:

Rectangle or arbitrary polygon

Entire field



“Point-and-click”

Raster View Field View

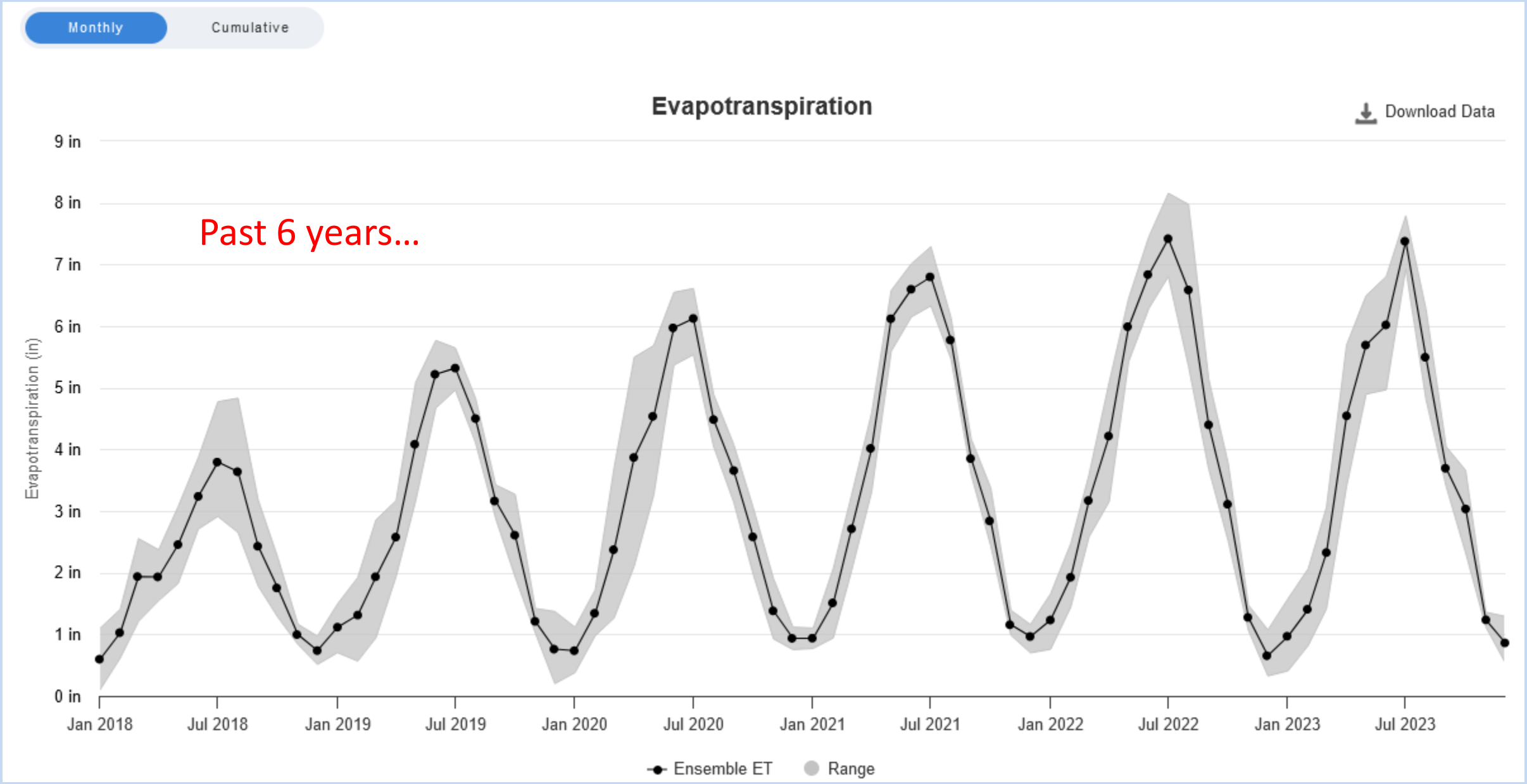
Several fields, farm

Draw custom area:

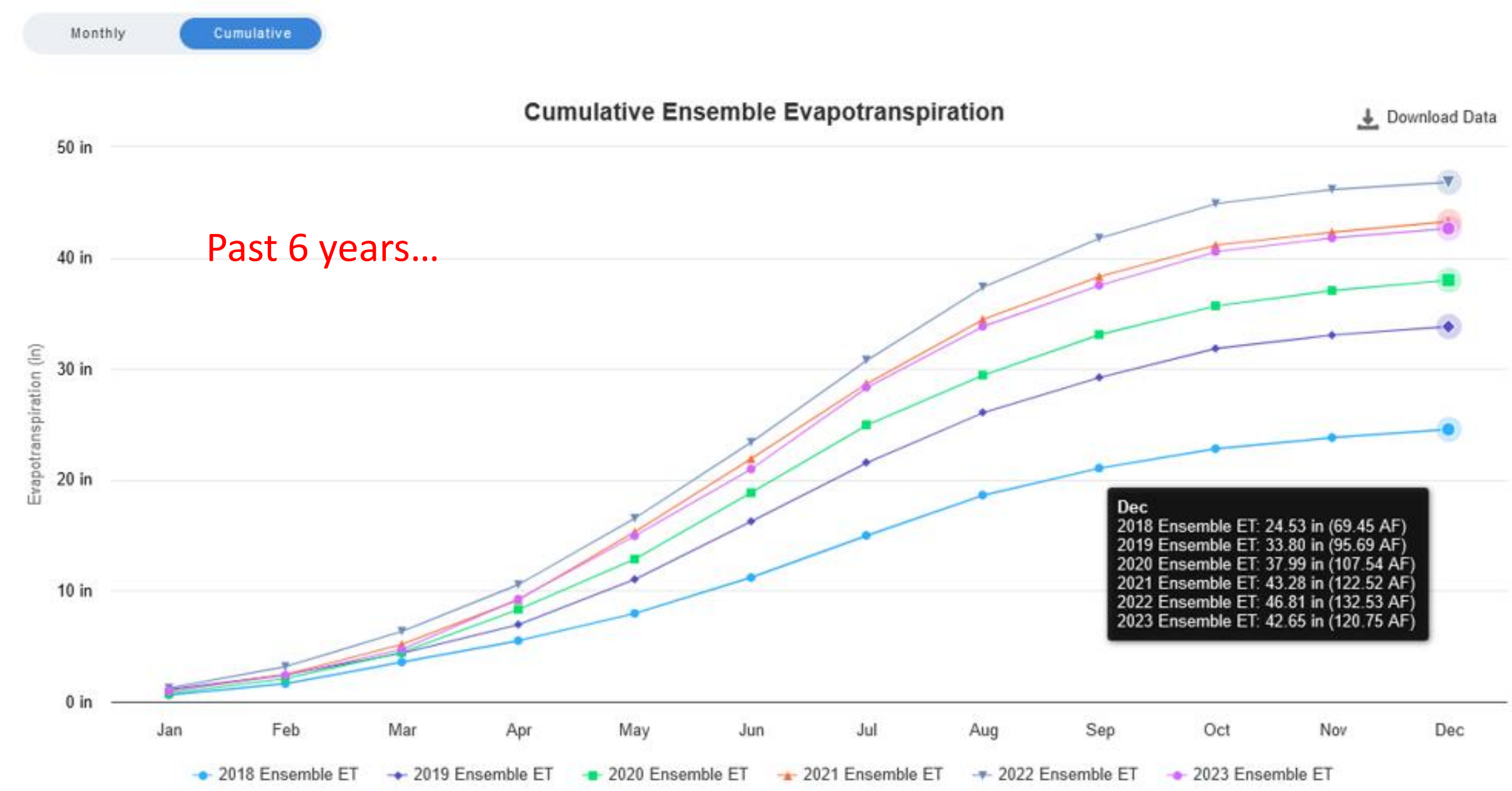
Rectangle or arbitrary polygon

Standard output…

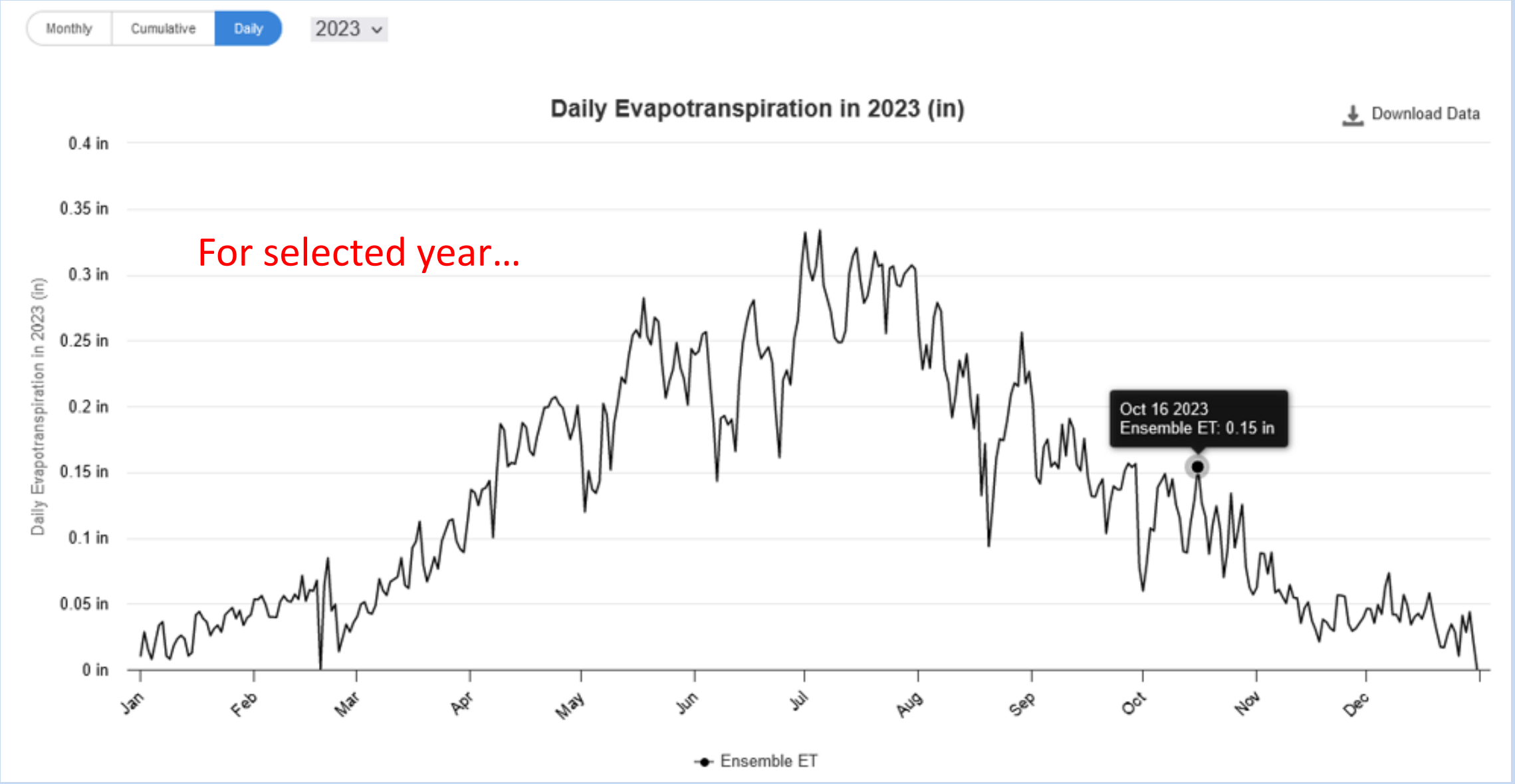
Monthly


Monthly
Cumulative
Evapotranspiration
Download Data
Past 6 years…
Evapotranspiration (in)
9 in
8 in
7 in
6 in
5 in
4 in
3 in
2 in
1 in
0 in
Jan 2018
Jul 2018
Jan 2019
Jul 2019
Jan 2020
Jul 2020
Jan 2021
Jul 2021
Jan 2022
Jul 2022
Jan 2023
Jul 2023
Ensemble ET
Range

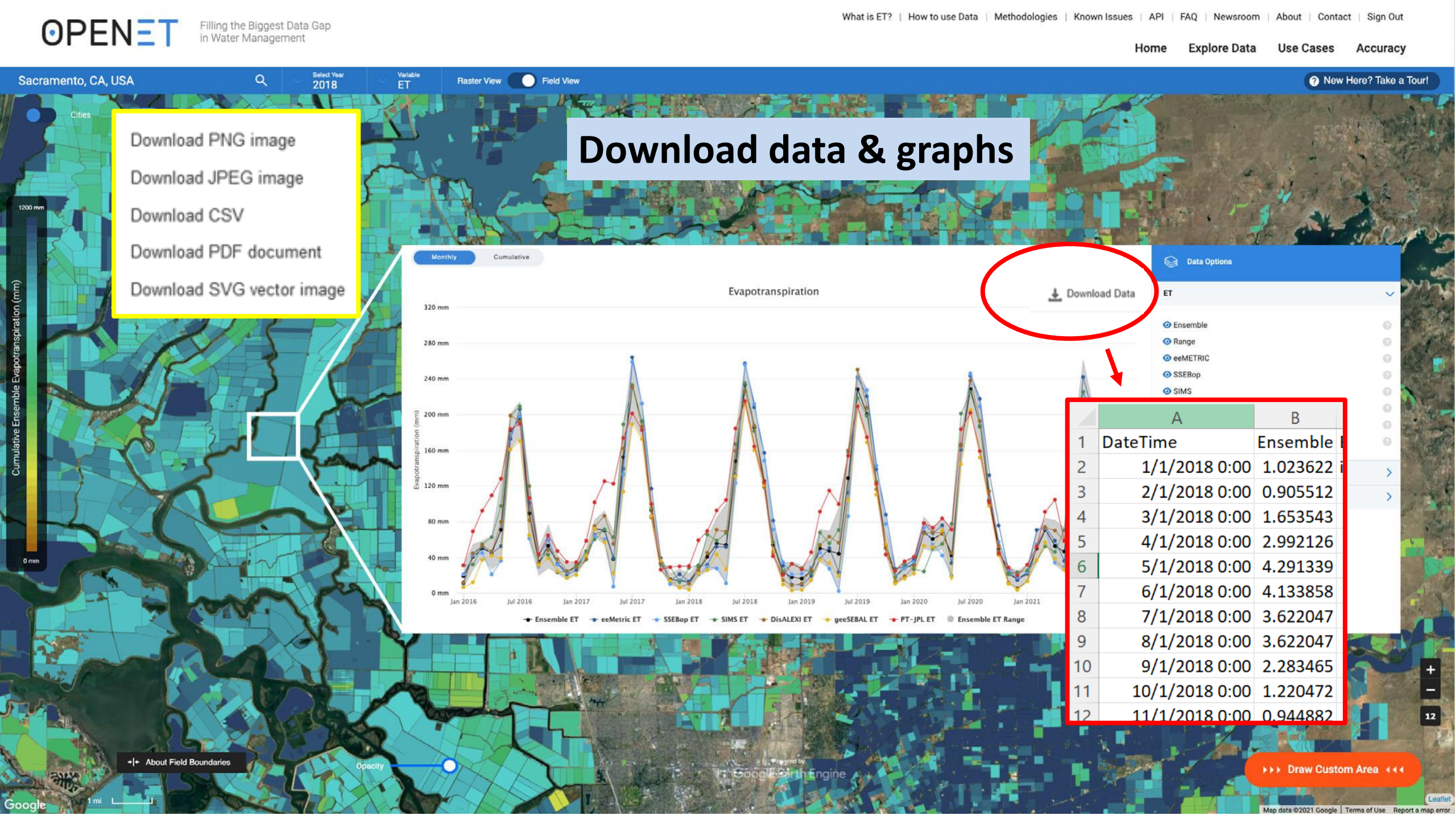
Annual cumulative



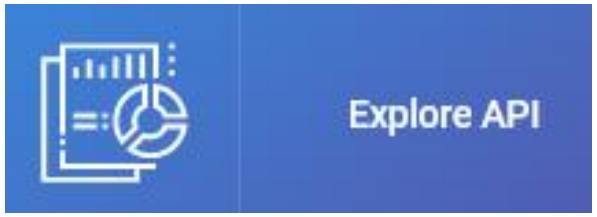
Daily


Monthly
Cumulative
Daily
2023
Daily Evapotranspiration in 2023 (in)
Download Data
For selected year…
Daily Evapotranspiration in 2023 (in)
0.4 in
0.35 in
0.3 in
0.25 in
0.2 in
0.15 in
0.1 in
0.05 in
0 in
Oct 16 2023
Ensemble ET: 0.15 in
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Ensemble ET

Download data & graphs



Application Programming Interface



- Flexible
- Supports data requests that are:
  - Automated
  - Recurring
  - Complex (non-standard)
  - Customized
- Supports machine-to-machine transfer

Expected accuracy

for details…

nature water

Analysis

https://doi.org/10.1038/s44221-023-00181-7

Assessing the accuracy of OpenET satellite-based evapotranspiration data to support water resource and land management applications

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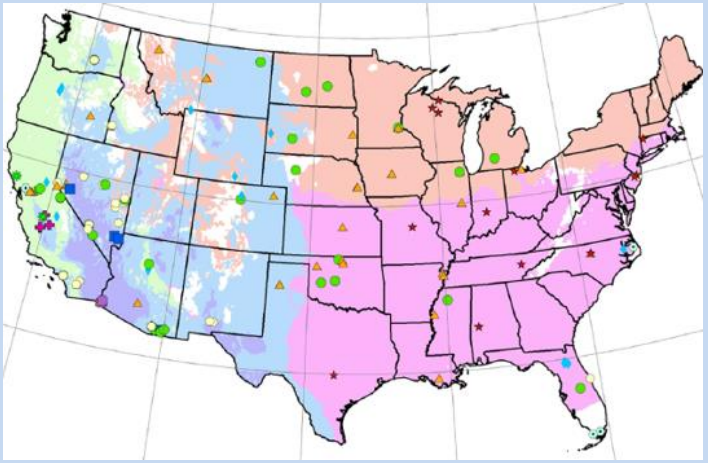
Check for updates

John M. Volk[1], Justin L. Huntington[1], Forrest S. Melton[2,3], Richard Allen[4], Martha Anderson[5], Joshua B. Fisher[6], Ayse Kilic[7], Anderson Ruhoff[8], Gabriel B. Senay[9], Blake Minor[1], Charles Morton[1], Thomas Ott[1], Lee Johnson[2,3], Bruno Comini de Andrade[8], Will Carrara[2,3], Conor T. Doherty[2], Christian Dunkerly[1], MacKenzie Friedrichs[10], Alberto Guzman[2,3], Christopher Hain[11], Gregory Halverson[12], Yanghui Kang[13], Kyle Knipper[14], Leonardo Laipelt[8], Samuel Ortega-Salazar[7], Christopher Pearson[1], Gabriel E. L. Parrish[15], Adam Purdy[2,3], Peter ReVelle[7], Tianxin Wang[13] & Yun Yang[16]

Ground data



Multiple stations across U.S., all landcover

Eddy covariance

Micro-meteorological data

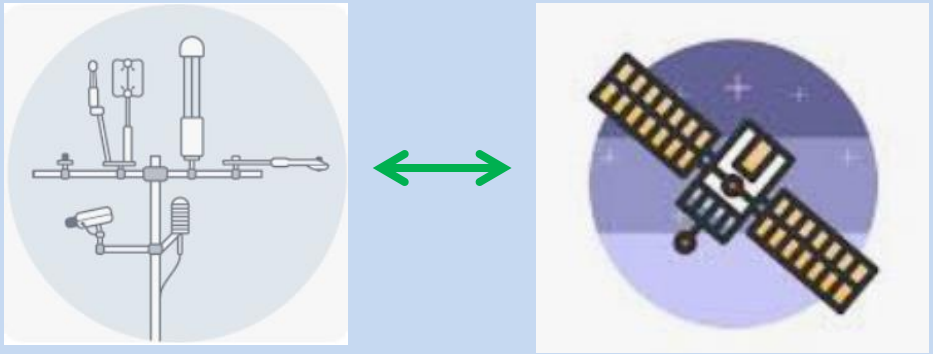
Soils data

ET

Nature Water, January 2024

Cropland results

Timestep	Number of sites	Number of datapoints	Avg agreement	Avg bias
Year	16	72	11.3%	-7.5%
Growing season	39	177	12.9%	-2.0%
Month	44	1638	17.3%	-5.8%
Day	52	5225	23.6%	-10.0%



Nature Water, January 2024

Local results

Eddy covariance: 137 mm
OpenET ensemble: 138 mm
Difference: <1%
Number of days: 46

Lettuce

Eddy covariance: 216 mm
OpenET ensemble: 238 mm
Difference: 10%
Number of days: 65

Broccoli

CSUMB WATRS Lab

Local results

Eddy covariance: 137 mm
OpenET ensemble: 138 mm
Difference: <1%
Number of days: 46

Lettuce

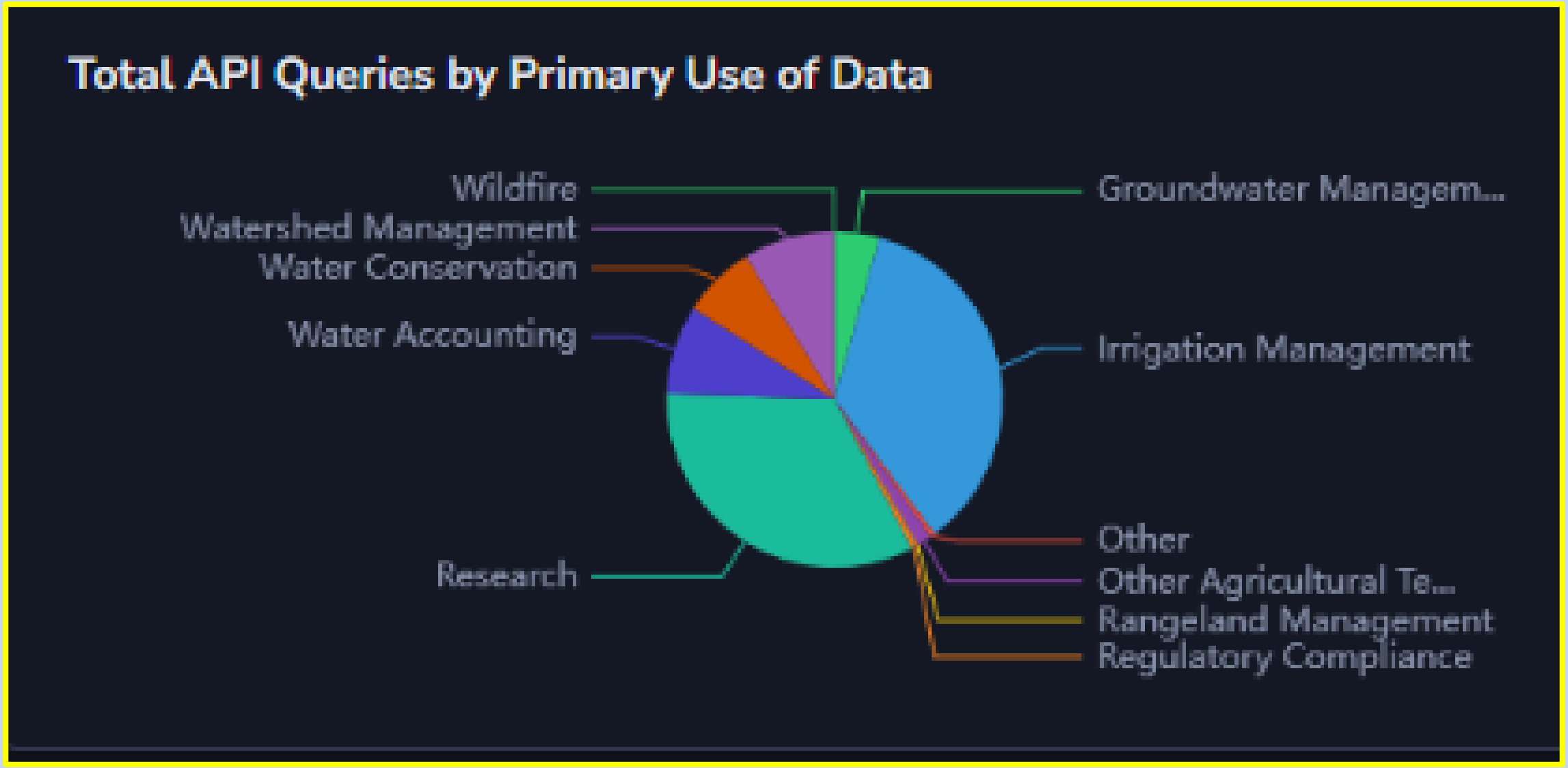
Additional sites coming 2024-25…

Eddy covariance: 216 mm
OpenET ensemble: 238 mm
Difference: 10%
Number of days: 65

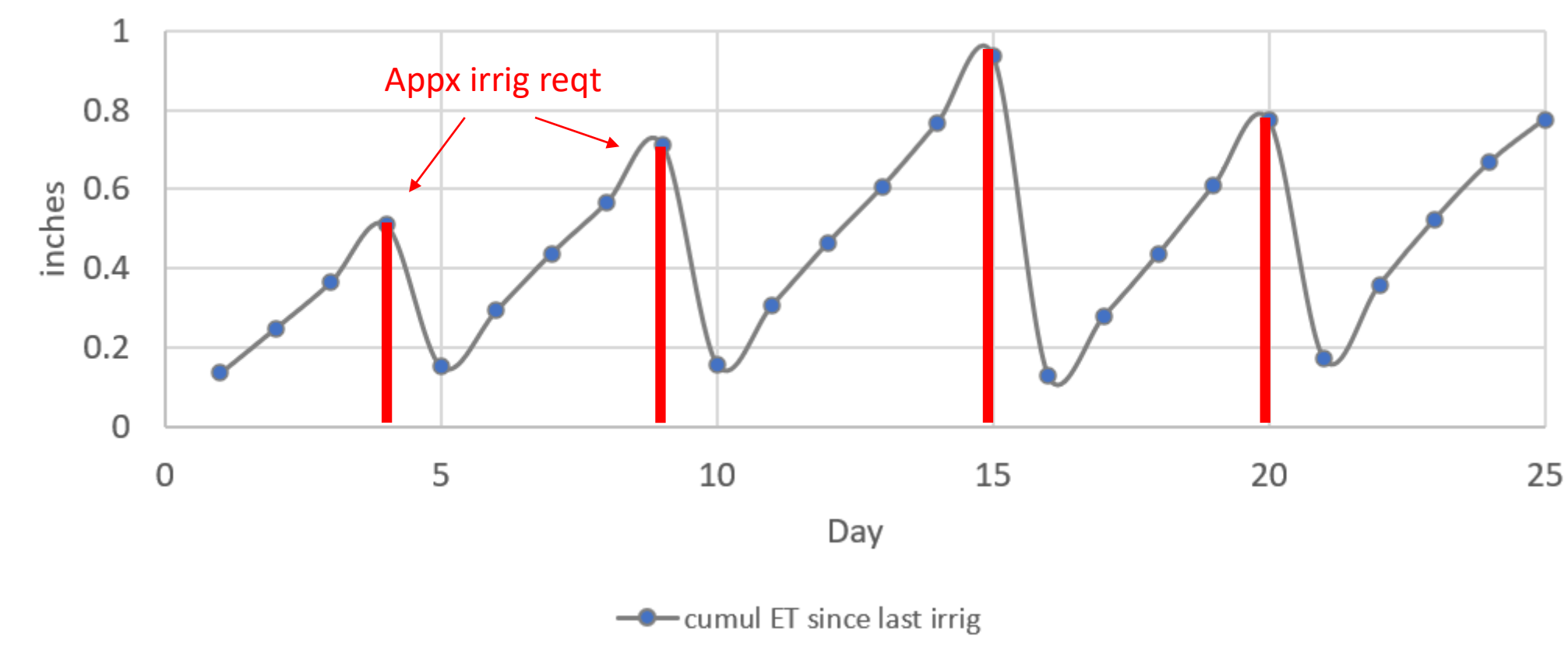
Broccoli

CSUMB WATRS Lab

Example uses



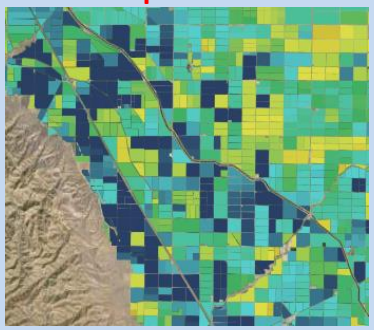
Irrigation management



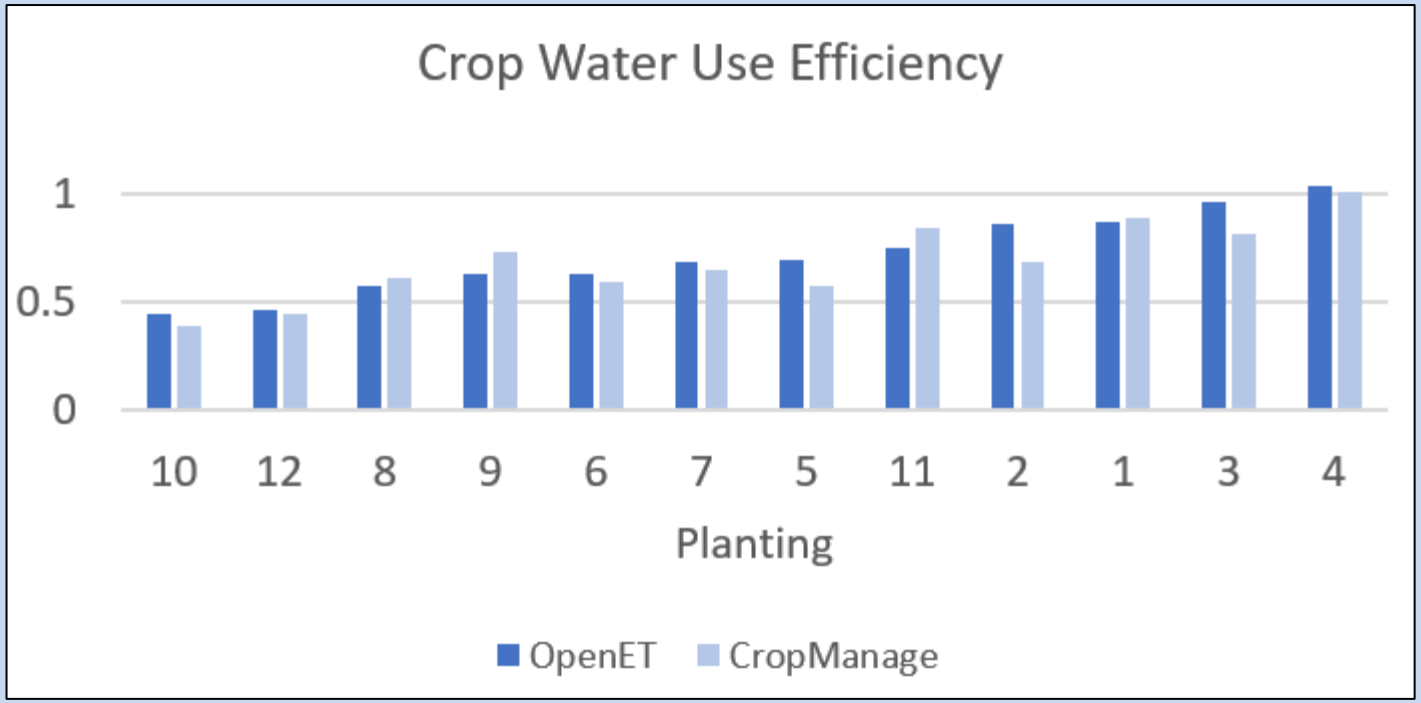
Water use efficiency

- Salinas lettuce
- ~60 day plantings
- 2022, 2023

OpenET



Flowmeter

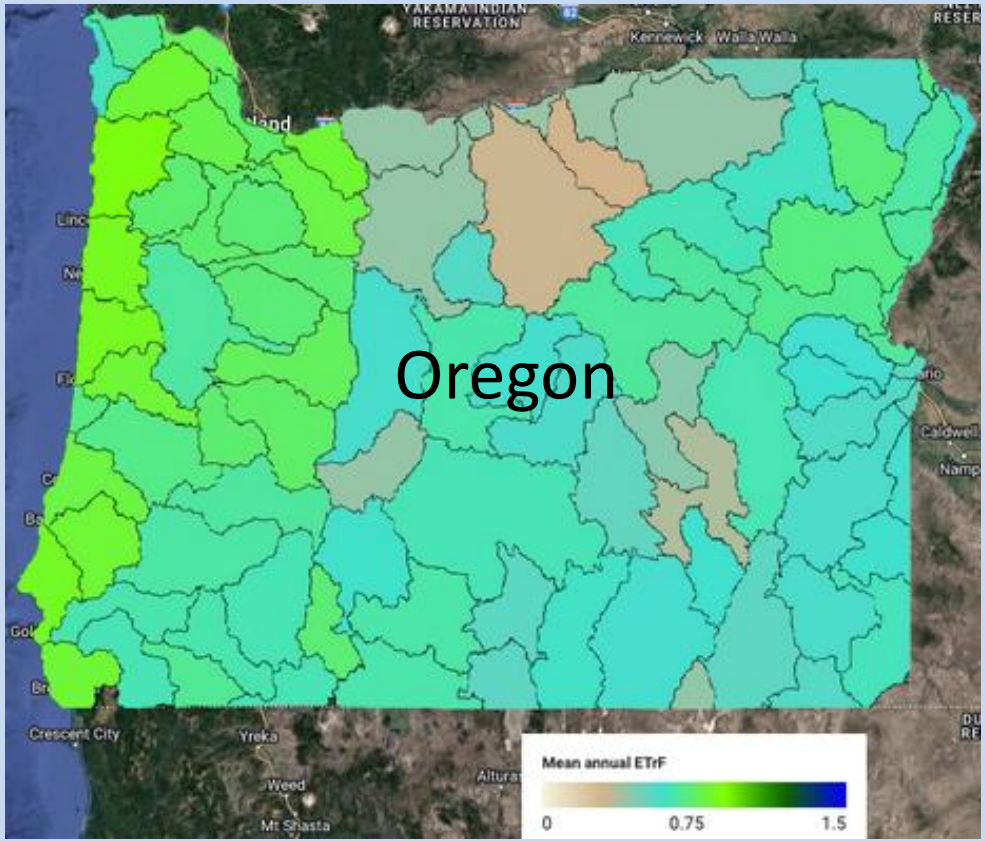


$WUE_c = ET/(P+I)$

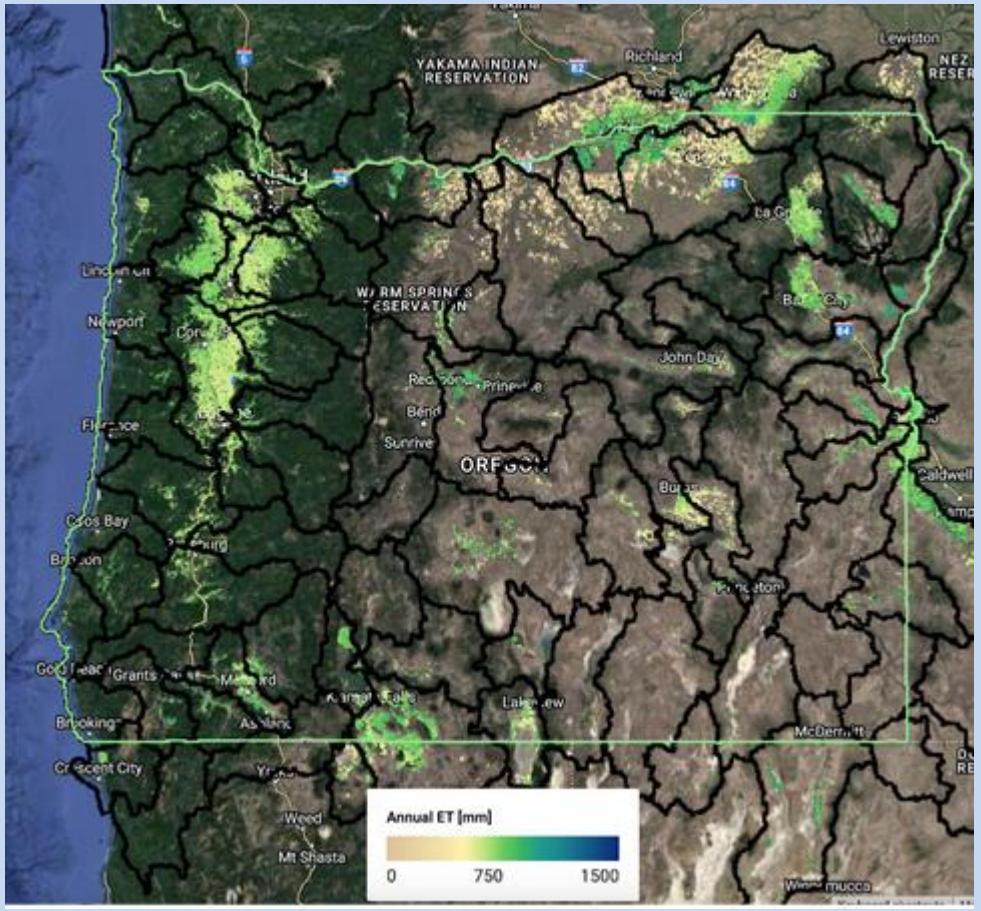
California State University MONTEREY BAY Extraordinary Opportunity

UC CE University of California Cooperative Extension

Basin-level, regional analyses



Mean annual ETrF by watershed, 1990-2020



Mean annual cropland ET, 1990-2020

Regulatory

- AgOrder: supports ET reporting at field-to-farm level
- SGMA: evaluation of groundwater depletion at watershed scale
- AB1668: preparation of water supplier Ag Water Management Plans

Thank you – questions/comments?