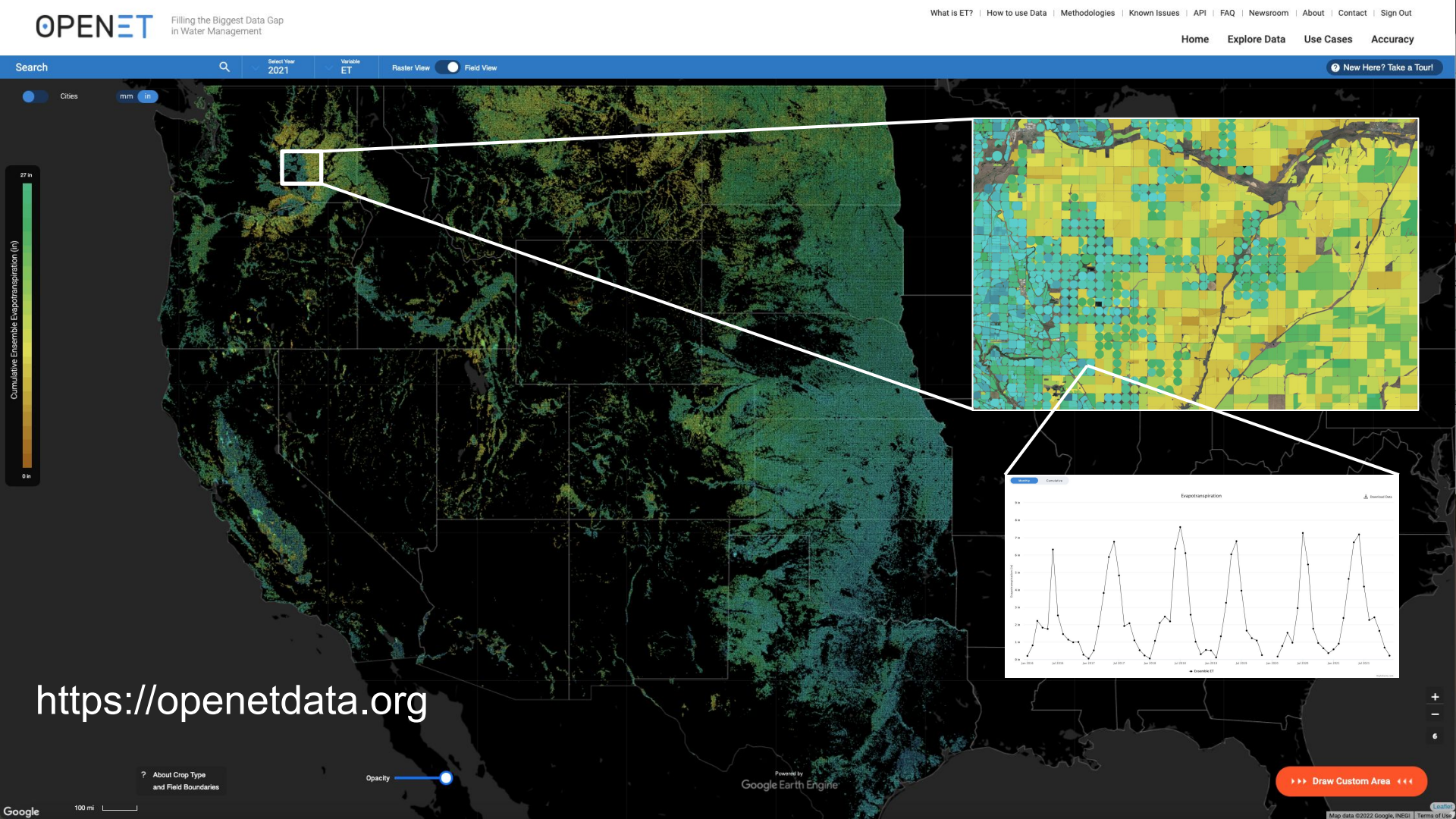
OPENET

Evapotranspiration Data for Water Management and Precision Agriculture

NASA · Google Earth Engine · EDF Environmental Defense Fund · DRI · USGS science for a changing world · USDA ARS

University of Idaho · Wisconsin University of Wisconsin–Madison · University of Maryland · University of Nebraska Lincoln · California State University Monterey Bay · HabitatSeven · UFRGS Universidade Federal do Rio Grande do Sul

OpenET and the Value of Open Data


OPENET
Filling the Biggest Data Gap in Water Management
What is ET? | How to use Data | Methodologies | Known Issues | API | FAQ | Newsroom | About | Contact | Sign Out
Home
Explore Data
Use Cases
Accuracy
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Field View
New Here? Take a Tour!
Cities
mm
in
27 in
Cumulative Ensemble Evapotranspiration (in)
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Evapotranspiration
https://openetdata.org
About Crop Type and Field Boundaries
Opacity
Powered by
Google Earth Engine
Draw Custom Area
Google
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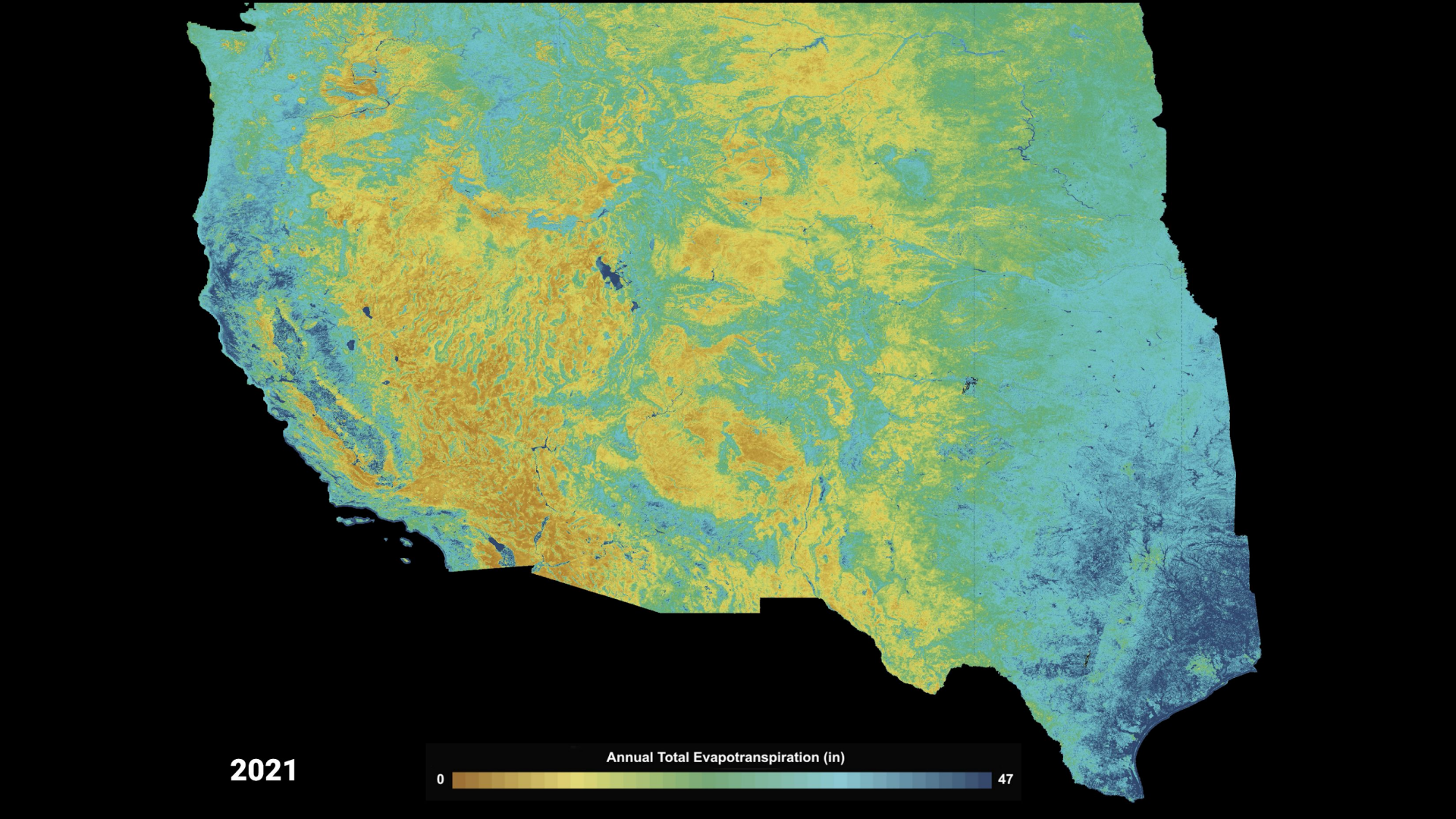

2021
Annual Total Evapotranspiration (in)
0
47

Founded on Open Science

DRI, NASA Ames, Habitat Seven (Multimodel Development, Integration, API, UI) Forrest Melton, Jamie Herring, Charles Morton, Britta Daudert, Alberto Guzman, Jody Hansen, Jordan Harding, Matt Bromley, Justin Huntington

USDA, NASA Marshall Space Flight Center, U. Maryland, U. Wisconsin (ALEXI/DisALEXI) Martha Anderson, Yun Yang, Christopher Hain

U. of Nebraska, U. of Idaho, DRI (EE METRIC) Ayse Kilic, Rick Allen, Peter Revelle, Samuel Ortega

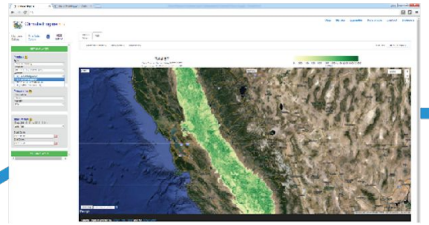
NASA JPL (PT JPL) Josh Fisher, Gregory Halverson

NASA Ames, CSUMB, Stanford University (SIMS) Forrest Melton, Alberto Guzman, Lee Johnson, Will Carrara, Conor Doherty

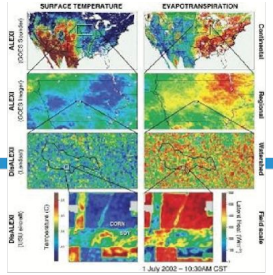
USGS (SSEBop) Gabriel Senay, MacKenzie Friedrichs, Gabe Parrish

Google Earth Engine Tyler Erickson

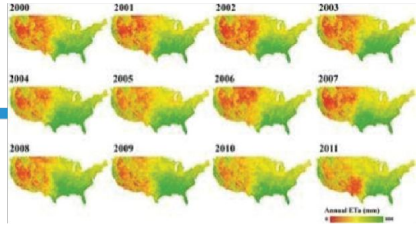
OpenET Uses Well-Established Methods



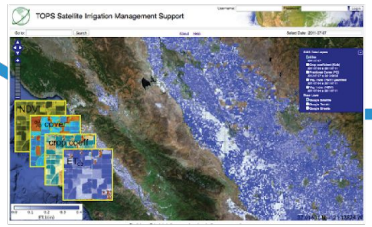
EE METRIC
University of Nebraska,
University of Idaho



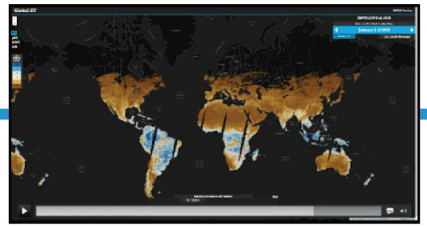
ALEXI/DisALEXI
USDA, NASA, University of Maryland,
University of Wisconsin



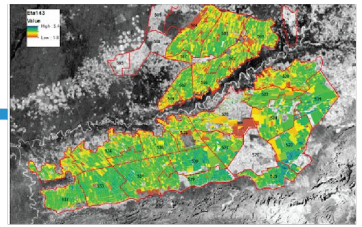
SSEBop
USGS



SIMS
NASA, CSUMB, Stanford University

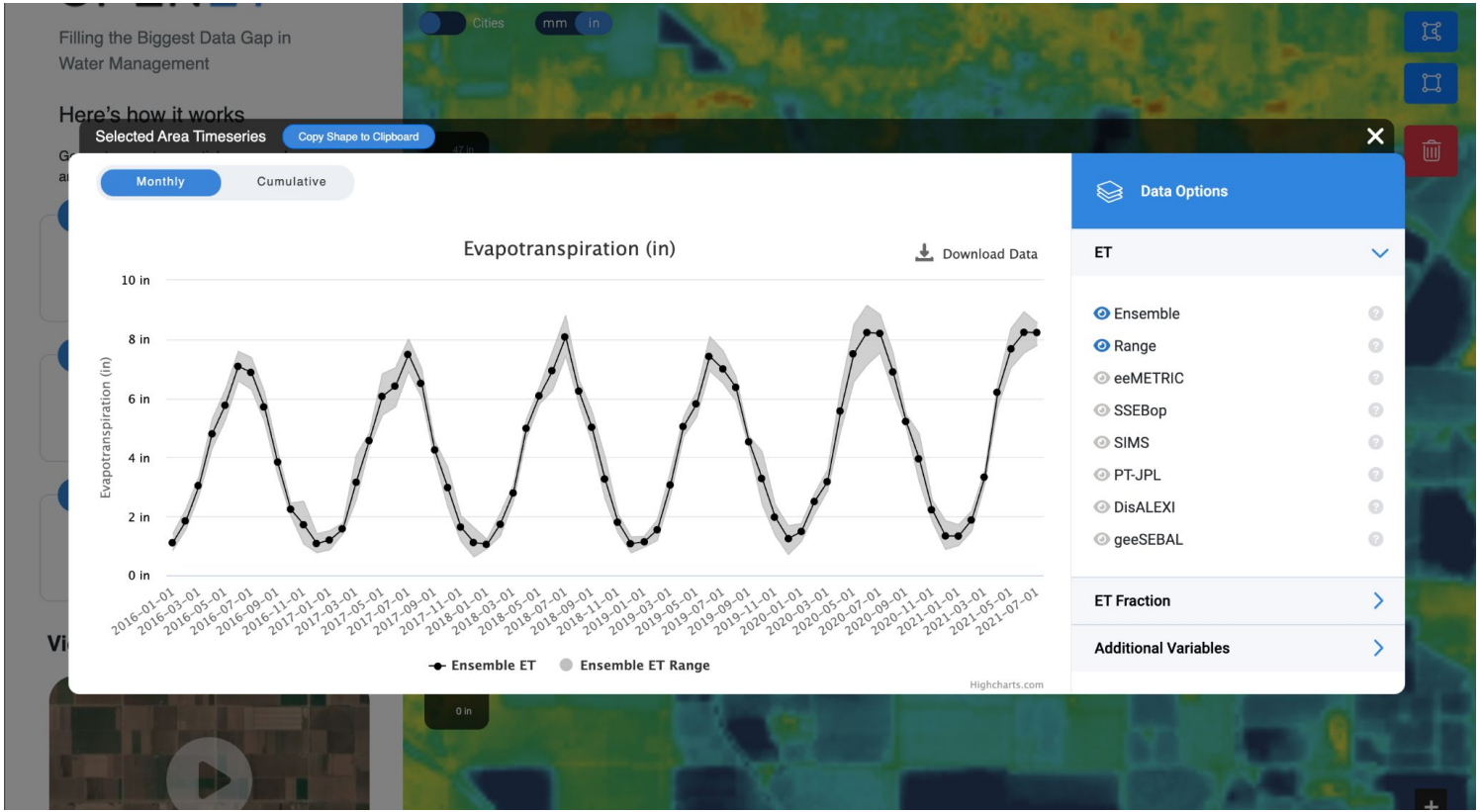


PT-JPL
NASA

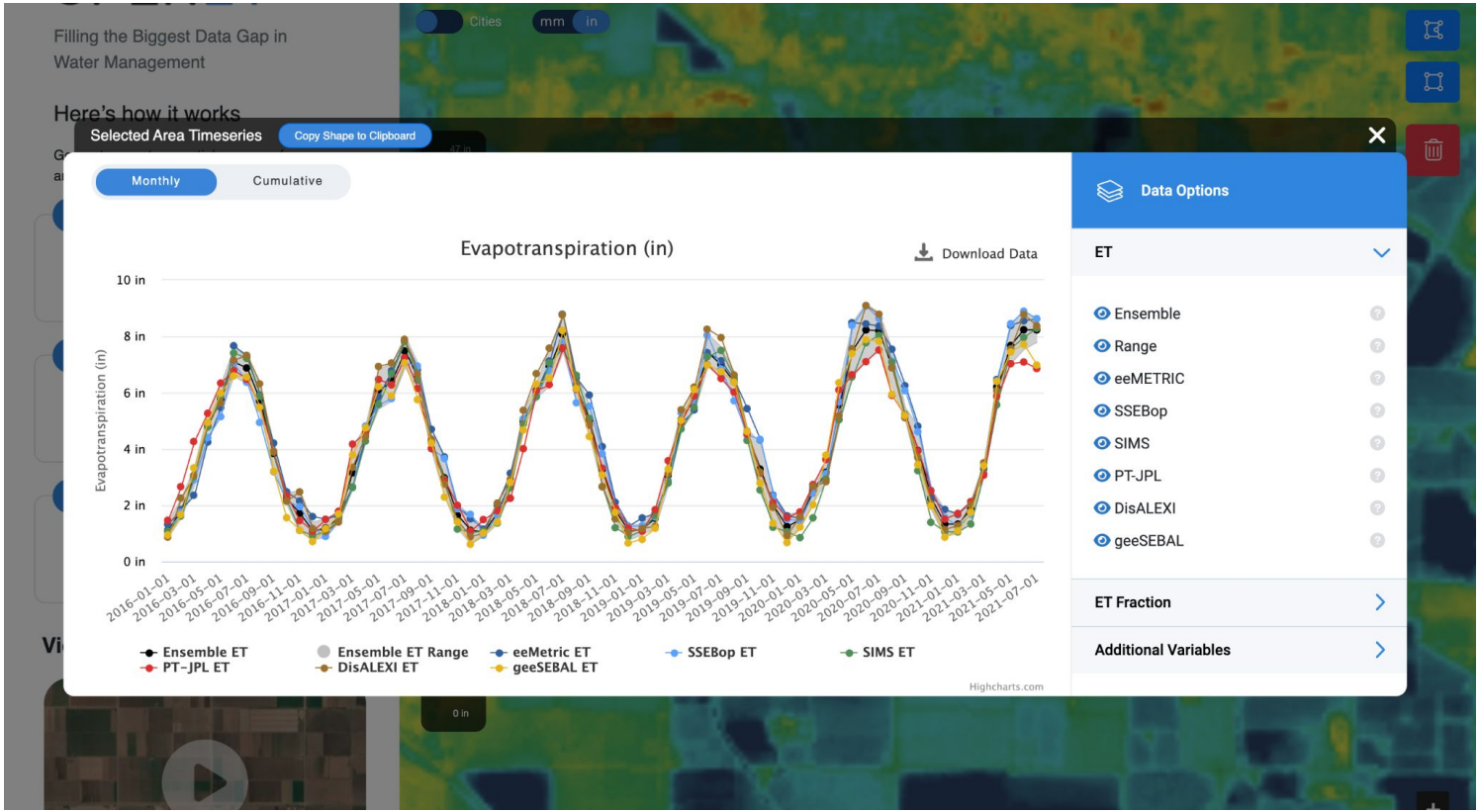


SEBAL
Universidade Federal
do Rio Grande do Sul

OpenET Ensemble Approach



OpenET Ensemble Approach



Use Cases and Partnerships

OpenET can help:

- Rural communities to design locally driven water conservation and trading programs.
- Water managers to develop more accurate water budgets, incentive programs and other innovative strategies.
- Policymakers to more accurately track water supplies, simplify regulatory compliance, and co-develop solutions with local communities.
- Farmers to expand use of data-driven irrigation practices to maximize “crop per drop” and reduce costs for fertilizer, water, and energy.

OpenET Use Cases

State Partnerships

California DWR

1) Drought response and planning
2) Production of 20+ year data archive
3) Local and state agency support for implementation of the Sustainable Groundwater Management Act
4) Water Use Reporting in the CA Delta
5) CA focused accuracy assessment
6) Ongoing data production and public data access

Colorado River Auth. of Utah

1) Intercomparison study and ensemble ET data refinement for Utah
2) Calculation of effective precipitation and ET of applied water for Utah
3) Production of 30+ year data archive
4) Support for ongoing data production and public data access
5) Comparison against crop coefficient methods
6) Support for local and state agencies across a broad range of planning and water management applications

Federal Partnerships

USGS

1) Production of 20+ year archive of data for CONUS with SSEBop
2) API enhancements and support for ongoing data updates and public data access
3) SSEBop model evaluation and watershed-scale model intercomparisons
4) Evaluation of CONUS404 data for calculation of ETo data for the U.S.

Reclamation

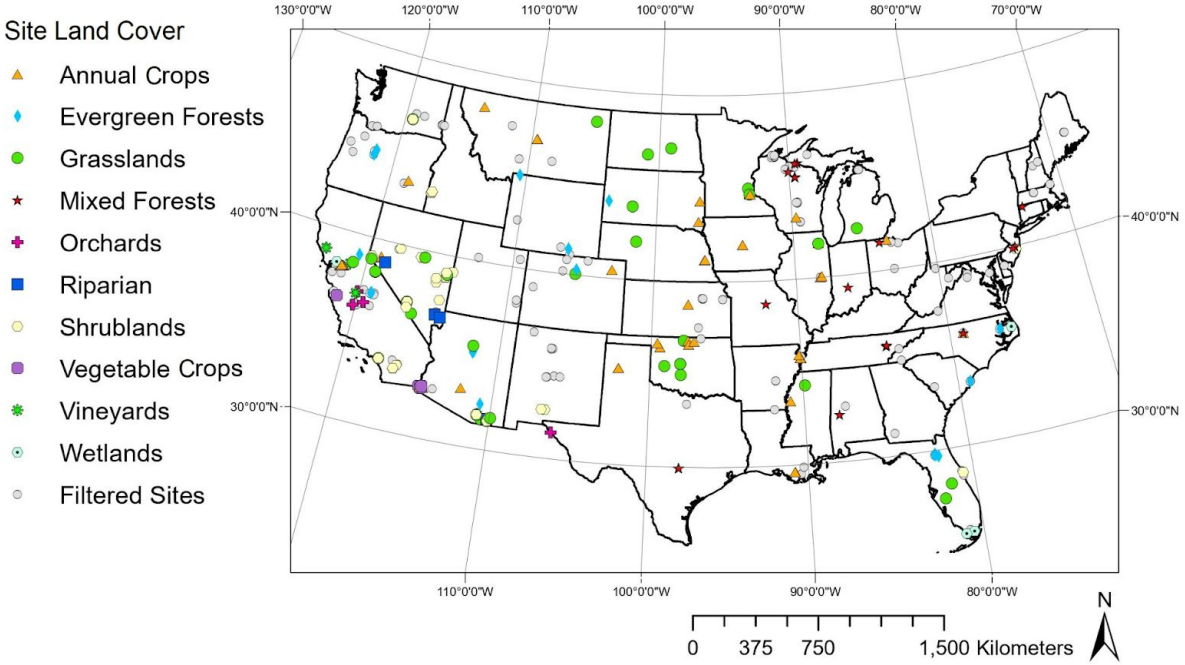
1) Supports implementation of the UCRC Resolution for Consumptive Use Measurement in the Upper Colorado River Basin (adopted June 14th, 2022)
2) Production of 20+ year data archive for the Upper Colorado River Basin with the eeMETRIC model
3) Production of data updates for the Upper Colorado River Basin in 2022 with the eeMETRIC model and additional accuracy assessments for eeMETRIC

NASA Western Water Applications Office (WWAO) Supported Activities:

- **Reclamation:** Detailed model intercomparison study and explanation of model differences across the Upper Colorado River Basin
- **Columbia River Basin (WA, OR, ID):** Production of HUC 12 data summaries for the Columbia River Basin; integration of HUC 12 summaries into state water data portals; and support for outreach and training workshops
- **Idaho Department of Water Resources:** Evaluation of OpenET data against Idaho Department of Water Resources METRIC ET data; deployment and collection of flux tower ET data in Magic Valley, Idaho

Accuracy of the OpenET Approach

Intercomparison and Accuracy Assessment



- Phase I comparison complete (70 flux tower sites; 24 ag sites)
- Phase II comparison (142 flux tower sites; 70 ag sites)

JAWRA, Melton et al., 2021
Volk et al., i*n prep*

Next Steps for OpenET

What’s next for OpenET?

- OpenET Collection 2.0 and 2022 Data Update (Aug. 19)
- Addition of OpenET Historic Data to the Earth Engine Public Data Catalog (Fall 2022)
- Addition of daily data and integration with irrigation scheduling tools (Sept. 2022)
- Public release of the API (late 2022)
- Completion of the custom reporting tools (early 2023)
- Best Practices Manual and updates to the ensemble ET value (OpenET Collection 2)
- Further development in the underlying science
  - Evaluating the models for mature tree crops, open water evaporation, and for forested and other non-agricultural landscapes

Lessons Learned / Best Practices

Look for win-win solutions

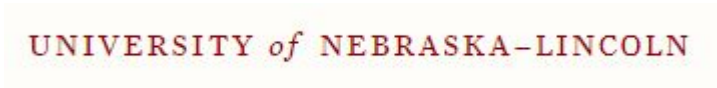
- New water data can be sensitive
- Important to listen to concerns from all stakeholders
- Identify and prioritize “win-win” solutions

Open science and open data are not free

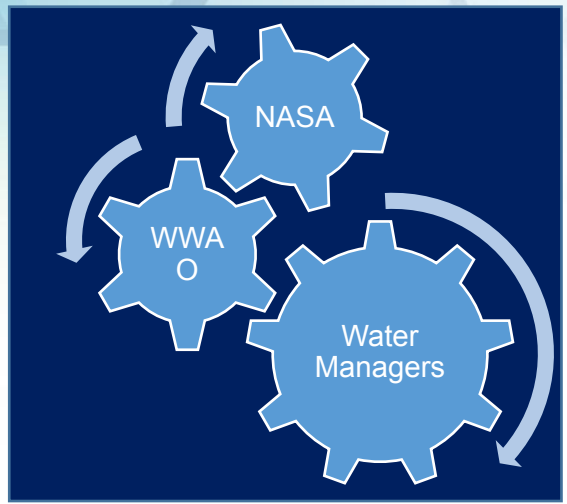
- Free to the user ≠ free to the provider
- Plan far ahead
- Start early
- Of course, nothing will go according to plan

OPENET

Partnerships matter!



NASA Applied Sciences Program: Western Water Applications Office (WWAO)



WWAO's Mission

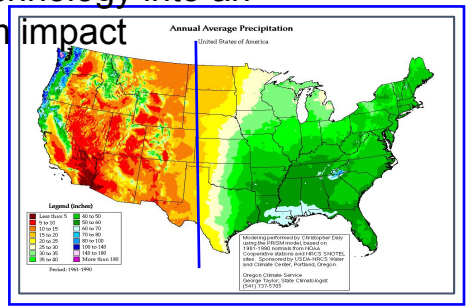
- **Improve how water is managed by applying NASA data, technology, tools in partnership with water managers and decision makers in the western U.S.**

WWAO does this by:

- **Identifying needs in western water management** for information and decision support
- **Making connections between stakeholders and NASA** scientists, technology, tools, and data
- **Supporting projects tailored to meet those needs**, engaging with partners from beginning to end
- **Transition of water applications** and technology into an operational, sustainable state for long-term impact

Why WWAO?

- NASA's science, remote-sensing data and expertise can bring a unique set of capabilities to address water management challenges
- Remote-sensing data can help fill critical data gaps in the West
- WWAO leverages decades of investment in science and technology, as well as deep relationships with partners and stakeholders



Questions?

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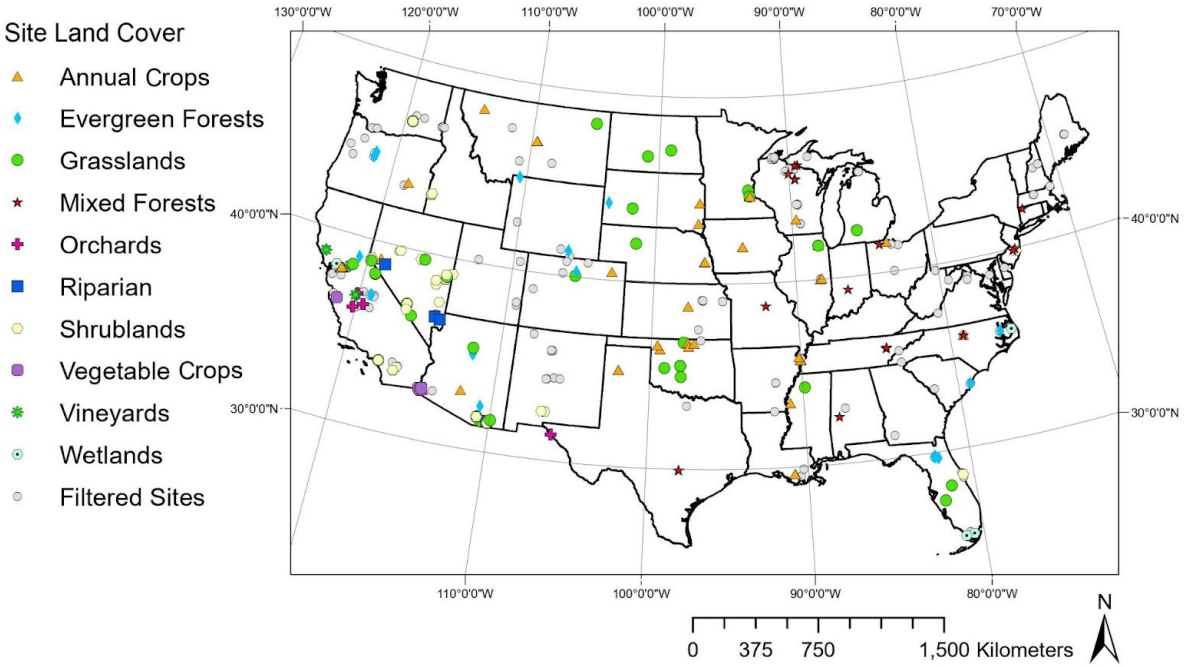
Intercomparison and Accuracy Assessment



- Phase I comparison complete (70 flux tower sites; 24 ag sites)
- Phase II comparison for 142 flux tower sites; 55 ag sites

JAWRA, Melton et al., 2021

OpenET Ensemble Value: Croplands

Accuracy Summary for Croplands for the OpenET Ensemble ET Value						
Time Period	**Slope**	**Mean Bias Error)**	**Mean Absolute Error**	**Root Mean Squared Error**	**r-squared**	**Mean flux tower ET**
Water Year: 14 sites / 48 total water years	0.93	-71.6 mm (-7.0%)	91.3 mm (8.9%)	100.5 mm (9.8%)	0.88	1024 mm
Growing Season: 38 sites / 151 growing seasons	1.0	-10.1 mm (-1.7%)	80.3 mm (13.2%)	92.7 mm (15.2%)	0.88	609.5 mm
Monthly: 45 sites / 1,682 months	0.95	-3.6 mm (-3.9%)	15.6 mm (16.6%)	20.0 mm (21.3%)	0.91	93.7 mm
Daily: 49 sites / 4,804 days	0.88	-0.3 mm (-7.4%)	0.8 mm (22.8%)	1. 1 mm (29.7%)	0.82	3.6 mm

Melton et al., JAWRA, 2021

Slope: Measure of overall bias; 1.0 is perfect
Mean Bias Error (MBE): Measure of bias; 0.0 is perfect
Mean Absolute Error (MAE): Measure of expected error; 0.0 is perfect
Root Mean Squared Error (RMSE): Measure of expect error with additional weight for outliers; 0.0 is perfect
r-squared: Measure of the ability of the model to reproduce observed variability; 1.0 is perfect

OpenET Ensemble Value: Croplands (OpenET Col. 2)

Accuracy Summary for Croplands for the OpenET Ensemble ET Value						
Time Period	**Slope**	**Mean Bias Error)**	**Mean Absolute Error**	**Root Mean Squared Error**	**r-squared**	**Mean flux tower ET**
Water Year: 15 sites / 71 total water years	0.91	-90.8 mm (-9.0%)	101.7 mm (10.1%)	111.8 mm (11.1%)	0.88	1008 mm
Growing Season: 39 sites / 175 growing seasons	0.98	-15.1 mm (-2.5%)	78.3 mm (12.9%)	93.2mm (15.3%)	0.87	608.9 mm
Monthly: 46 sites / 1,791 months	0.93	-5.9 mm (-6.4%)	15.9mm (17.2%)	20.4 mm (22.2%)	0.9	92.0 mm
Daily: 55 sites / 5,629 days	0.86	-0.4 mm (-10.2%)	0.8 mm (23.5%)	1. 1 mm (30.9%)	0.81	3.53 mm

Volk et al., in prep

Preliminary results (under review)