OPENET

Filling the Biggest Data Gap in Water Management

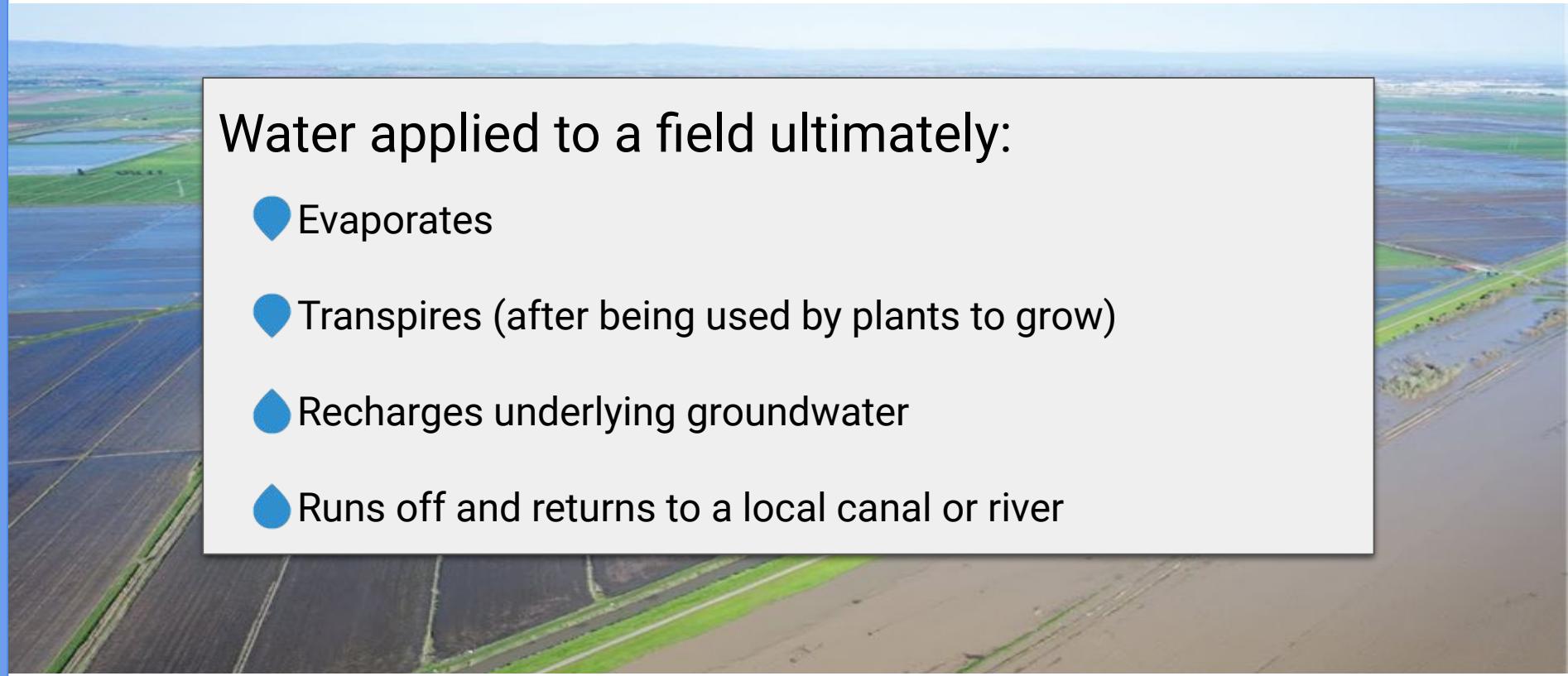
EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

DRI Desert Research Institute

NASA

Google Earth Engine

Evapotranspiration and Consumptive Use



Water applied to a field ultimately:

- Evaporates
- Transpires (after being used by plants to grow)
- Recharges underlying groundwater
- Runs off and returns to a local canal or river

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Methodology | API | Known Issues | FAQ | About

(Coming Soon) Account Name

Home | Explore Data | (Coming Soon) Customize Data | (Coming Soon) Training | (Coming Soon) Case Studies

Search | Select Year 2019 | Variable ET | Raster View | Field View | New Here? Take a Tour!

Cities

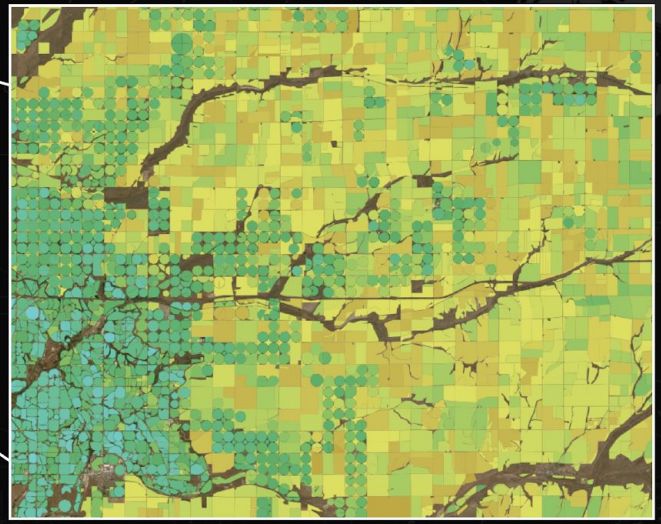
mm | in

47 in

Cumulative Ensemble Evapotranspiration (in)

0 in

Create Custom Data (Coming Soon)



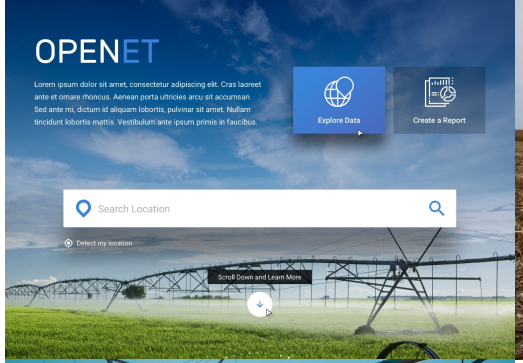
About Field Boundaries | 100 mi | Opacity | 1

6

Leaflet | EarthEngine CARTO, GeoServer

Measuring ET enables:

- Development of realistic water budgets
- Incentives for conservation and innovation
- Proper credit for reduced use
- Reduced transaction costs for water trading programs
- Increased on-farm efficiencies







OpenET Goals:

Reliable ET data are produced and available at low cost, and are **easily accessible via openetdata.org** for any area within the Western US.

There is trust in the validity of the data and information provided by the platform, and it is utilized by farmers, and private and public resource managers at the local, state and federal levels.

A variety of **sustainable resource management practices are enabled** at a much larger scale than currently possible.

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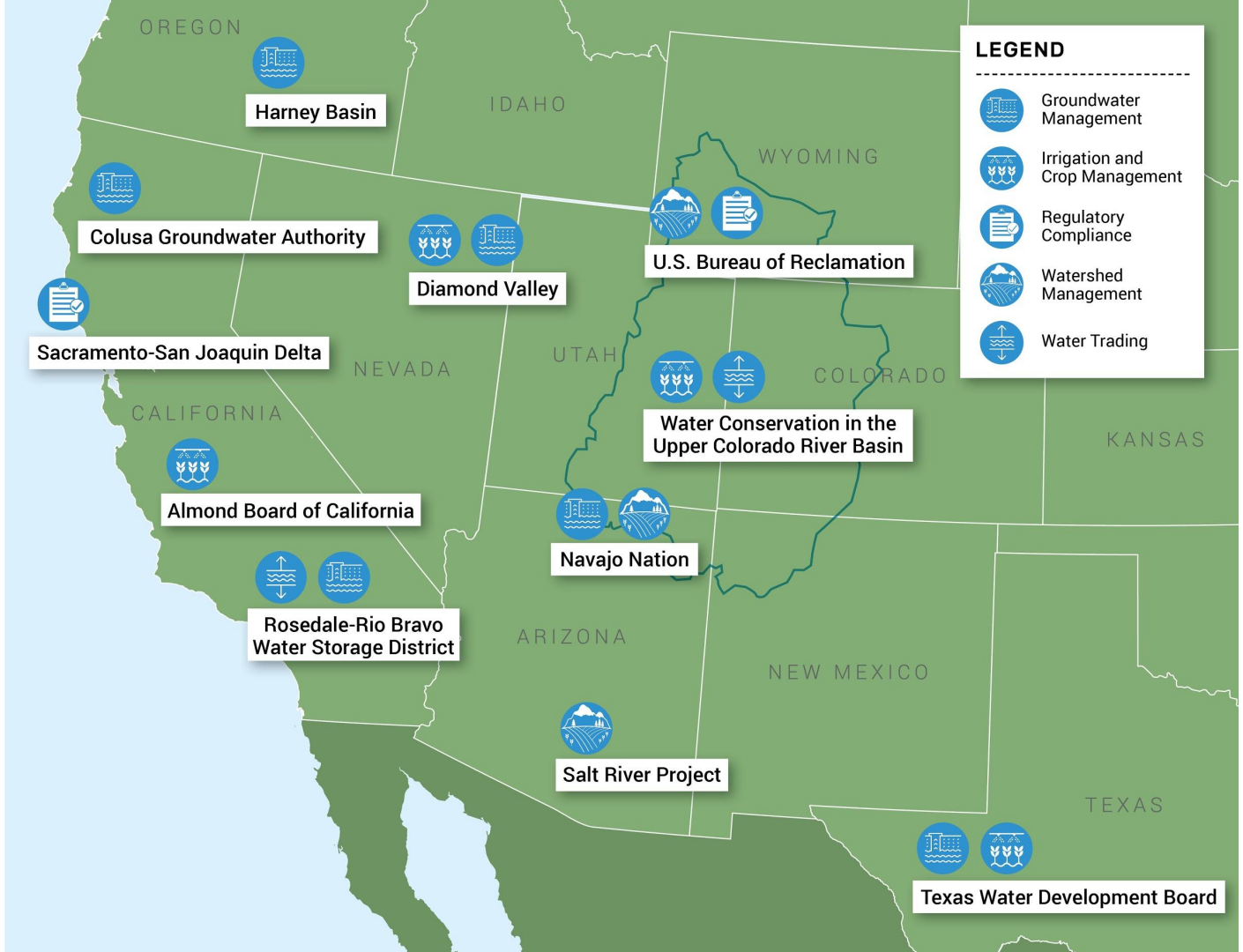
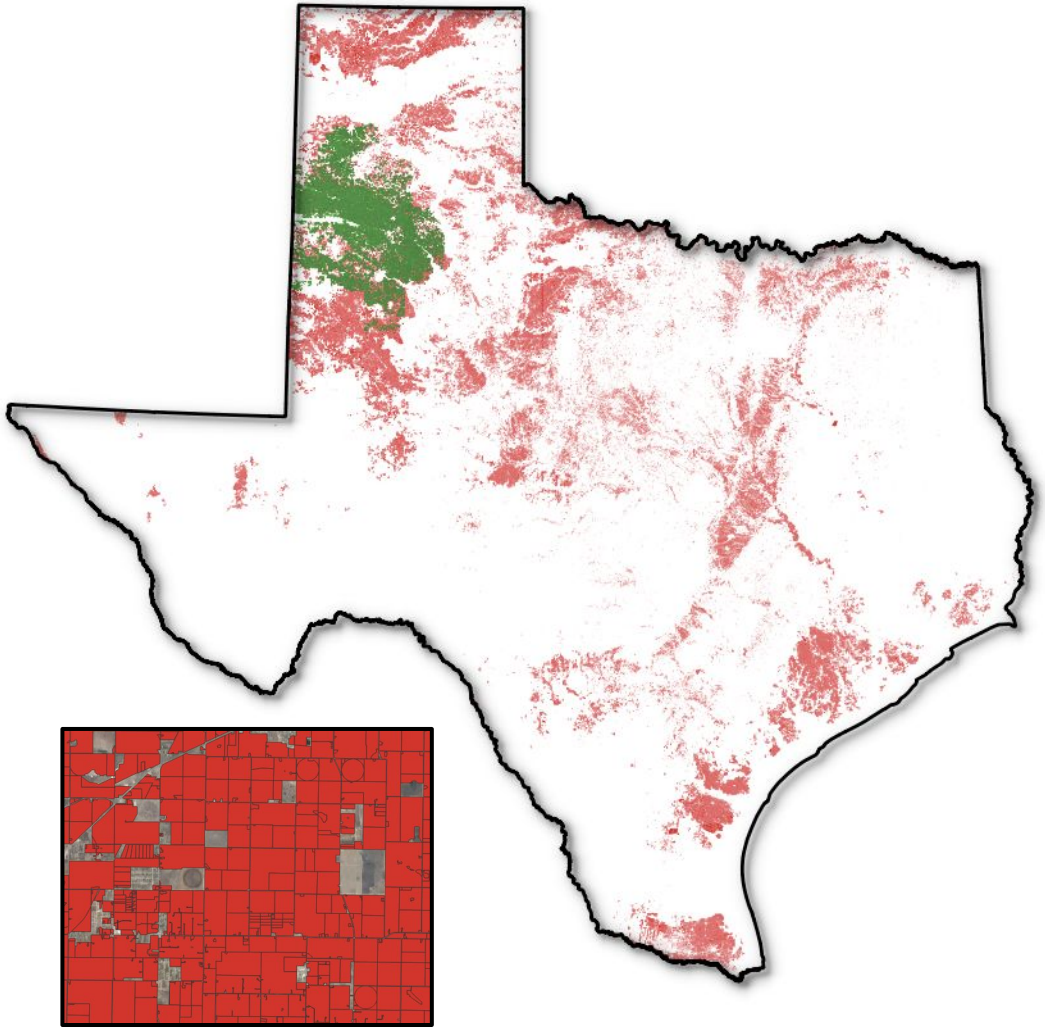
FILLING THE BIGGEST DATA GAP IN WATER MANAGEMENT

The OpenET Approach

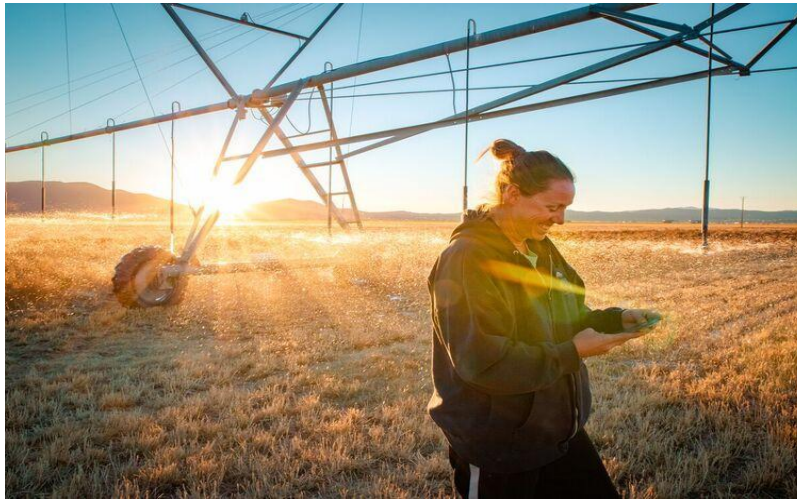

OREGON
Harney Basin
IDAHO
WYOMING
Colusa Groundwater Authority
Diamond Valley
U.S. Bureau of Reclamation
Sacramento-San Joaquin Delta
NEVADA
UTAH
COLORADO
CALIFORNIA
Water Conservation in the Upper Colorado River Basin
KANSAS
Almond Board of California
Navajo Nation
Rosedale-Rio Bravo Water Storage District
ARIZONA
NEW MEXICO
Salt River Project
TEXAS
Texas Water Development Board
LEGEND
Groundwater Management
Irrigation and Crop Management
Regulatory Compliance
Watershed Management
Water Trading

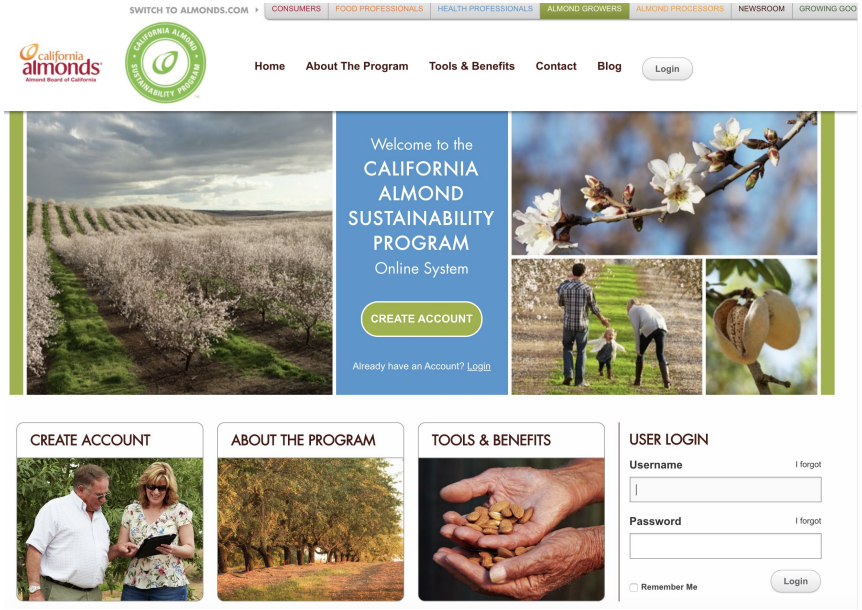
Field Boundaries

- Currently 368,541 features
- Dataset based off of the 2008 Farm Service Agency - Common Land Unit (CLU)
- CLU data has been found to contain geometry errors
- Semi-automated processing to “clean” the data
- Does not reflect land cover changes since 2008



Improving Irrigation Scheduling Tools

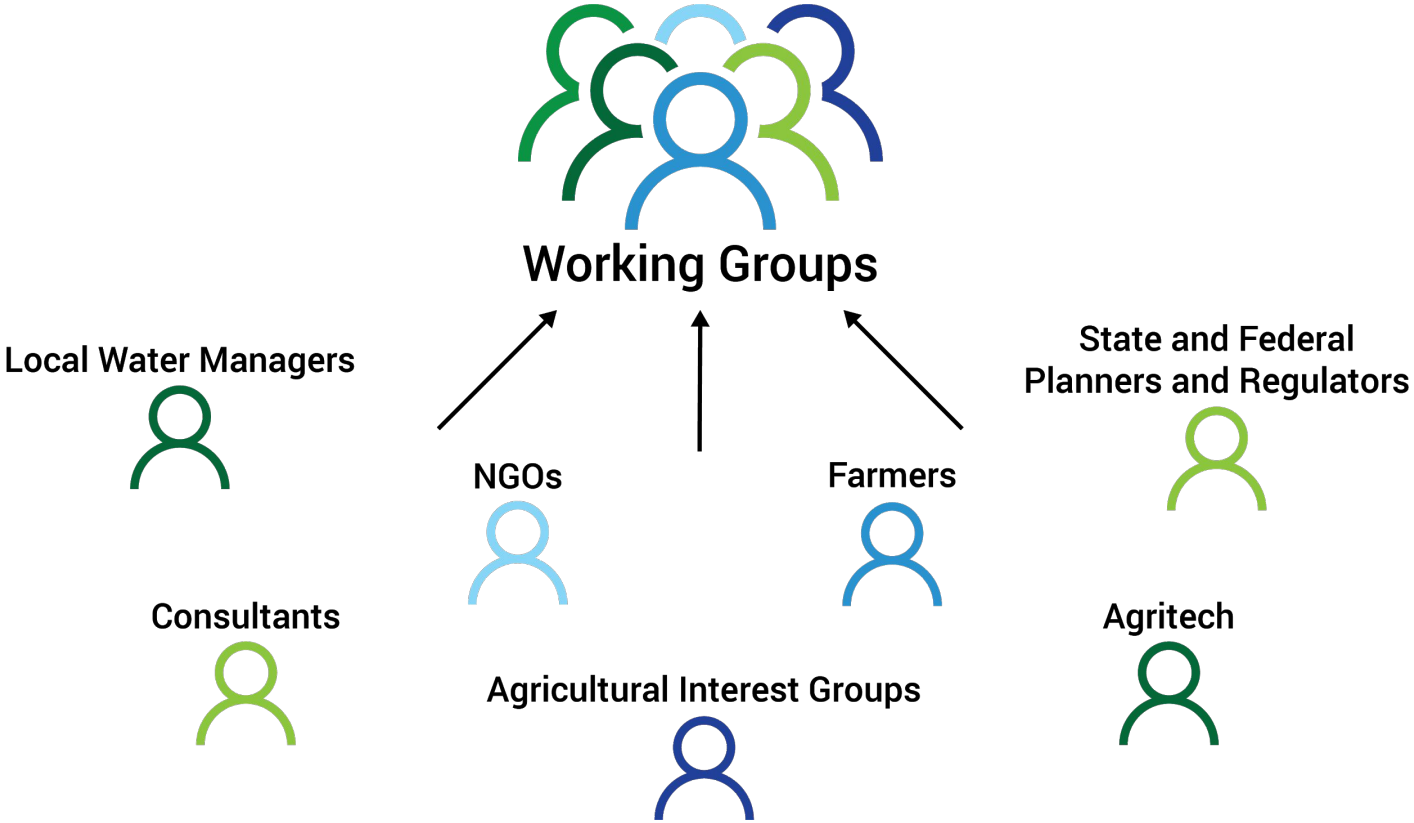




"If you give farmers better information on when they should and shouldn't have their water on, you're going to save water. I think that's the greatest asset of OpenET"

-Denise Moyle, Diamond Valley Nevada

Partnering with Other Experts to Guide Development



Community Support for OpenET

"We have used ET data to gain a better understanding of our water consumption and design more efficient irrigation systems that use about 15% less water. With the demands on water from a growing population and feeding more people, we have to figure out how to get the best value from every drop of water. ET data is crucial to providing this information."

MARK OWENS
OREGON STATE REPRESENTATIVE/GROWER

"Right now, we use aerial imagery and infrared technology, and we pay for it. If we had another tool, it would be really helpful."

DON CAMERON
VICE PRESIDENT
TERRANOVA RANCH, HELM, CA

"OpenET allows planning for agricultural water needs in a way that just wasn't possible before"

E. JOAQUIN ESQUIVEL
CHAIR
CA SWRCB

"OpenET could be revolutionary."

BUZZ THOMPSON
STANFORD UNIVERSITY'S
WATER IN THE WEST PROGRAM

"Saving water saves farmers money, so they have a strong incentive to conserve. If a program like OpenET makes cents — as in dollars and cents — then make it available to farmers, move out of the way and they'll adopt it. I've talked to farmers who are eager to get their hands on this data,"

DON PARRISH
AMERICAN FARM BUREAU

The OPENET Team

Environmental Defense Fund Robyn Grimm, Dana Rollison, Maurice Hall

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

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

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

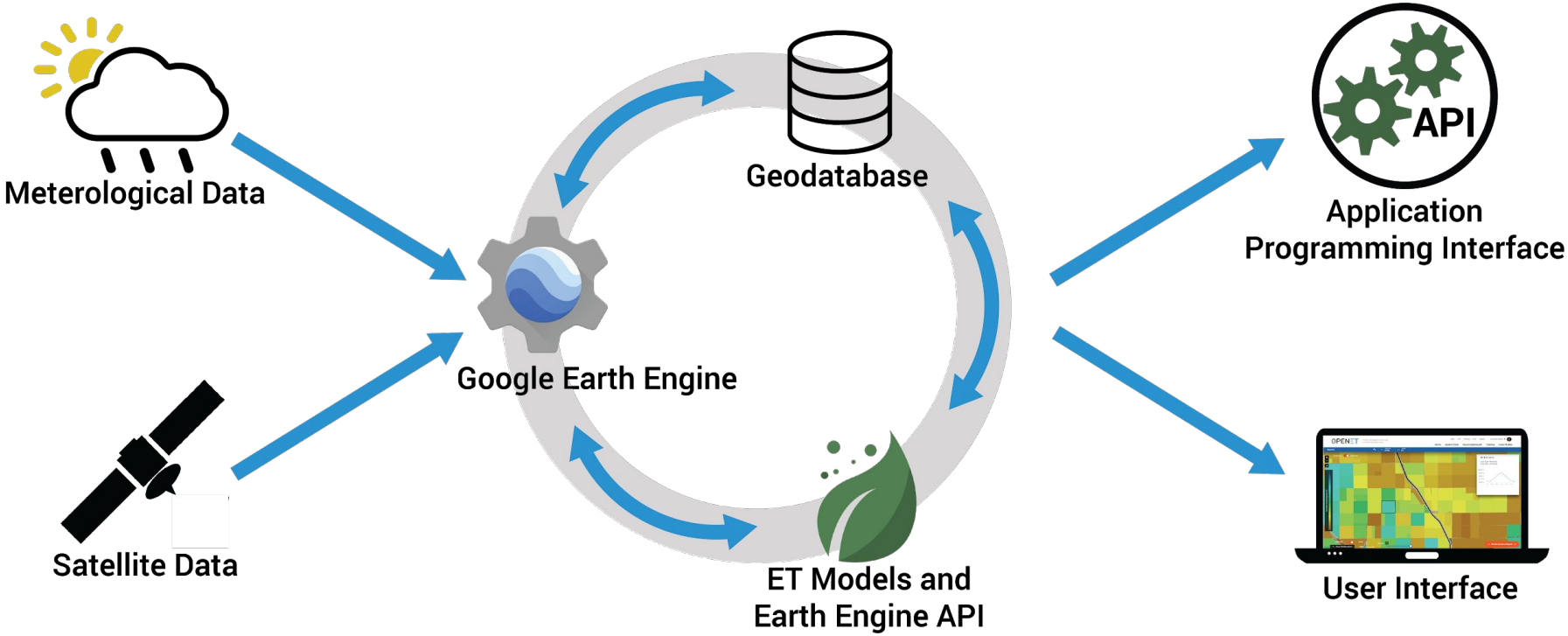
NASA JPL (PT JPL) Josh Fisher, Gregory Halverson

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

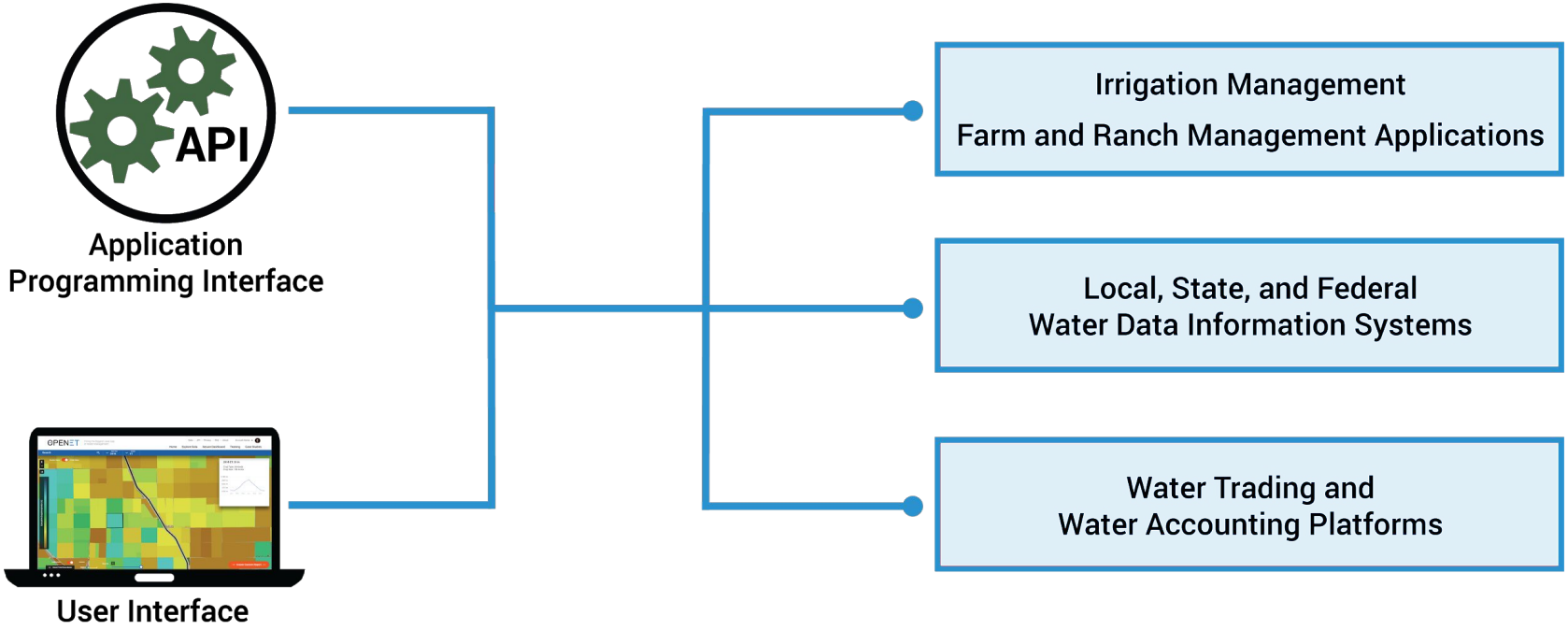
USGS (SSEBop) Gabriel Senay, MacKenzie Friedrichs

Google Earth Engine Tyler Erickson

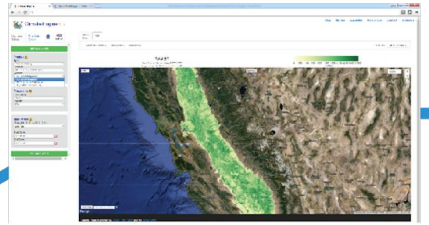
How OpenET Works



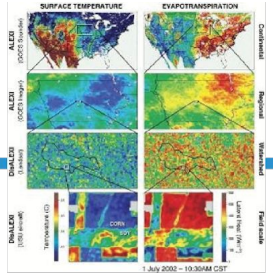
OpenET API for Integration with Other Software



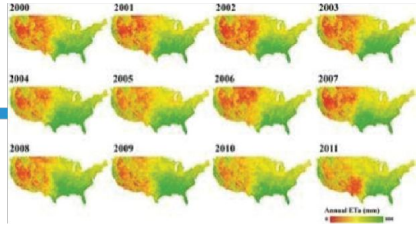
OpenET Uses Well-Established Methods



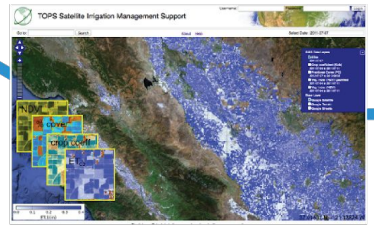
EE METRIC
University of Nebraska,
University of Idaho



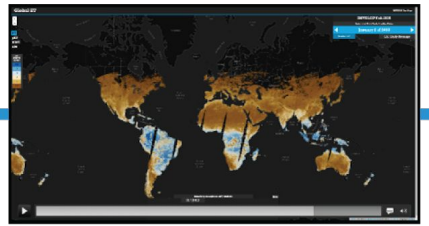
ALEXI/DisALEXI
USDA, NASA, University of Maryland,
University of Wisconsin



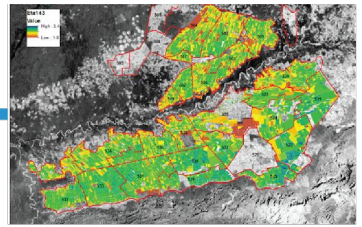
SSEBop
USGS



SIMS
NASA, CSUMB, Stanford University



PT-JPL
NASA



SEBAL

OpenET Uses Data from a Constellation of Satellites

Image credit: NASA/Goddard Space Flight Center Conceptual Image Lab

USGS-NASA Landsat 5/7/8 (TM / ETM+ / OLI)
30m/0.22 acres | overpass every 8-16 days

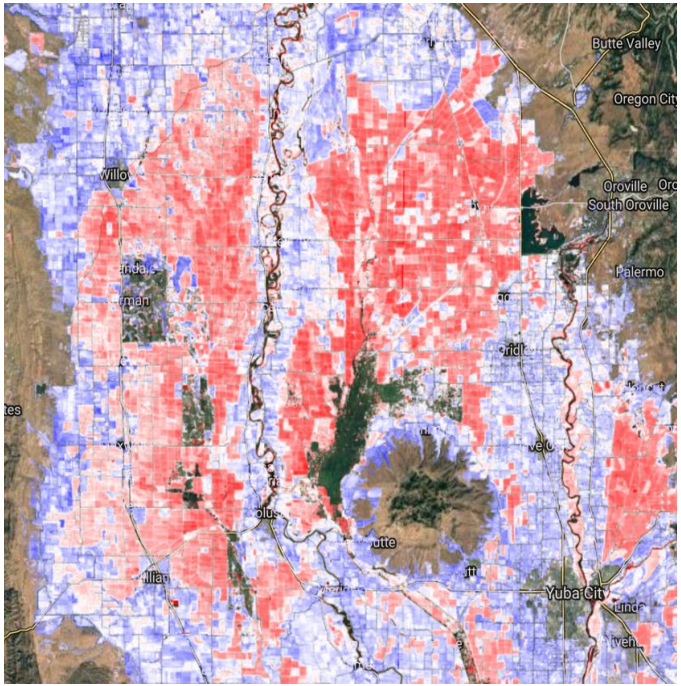
NASA Terra / Aqua
1 km | daily overpass

NASA-NOAA Suomi NPP
~300-375m | daily overpass

NOAA GOES-15/16/17
0.5-4 km | < hourly

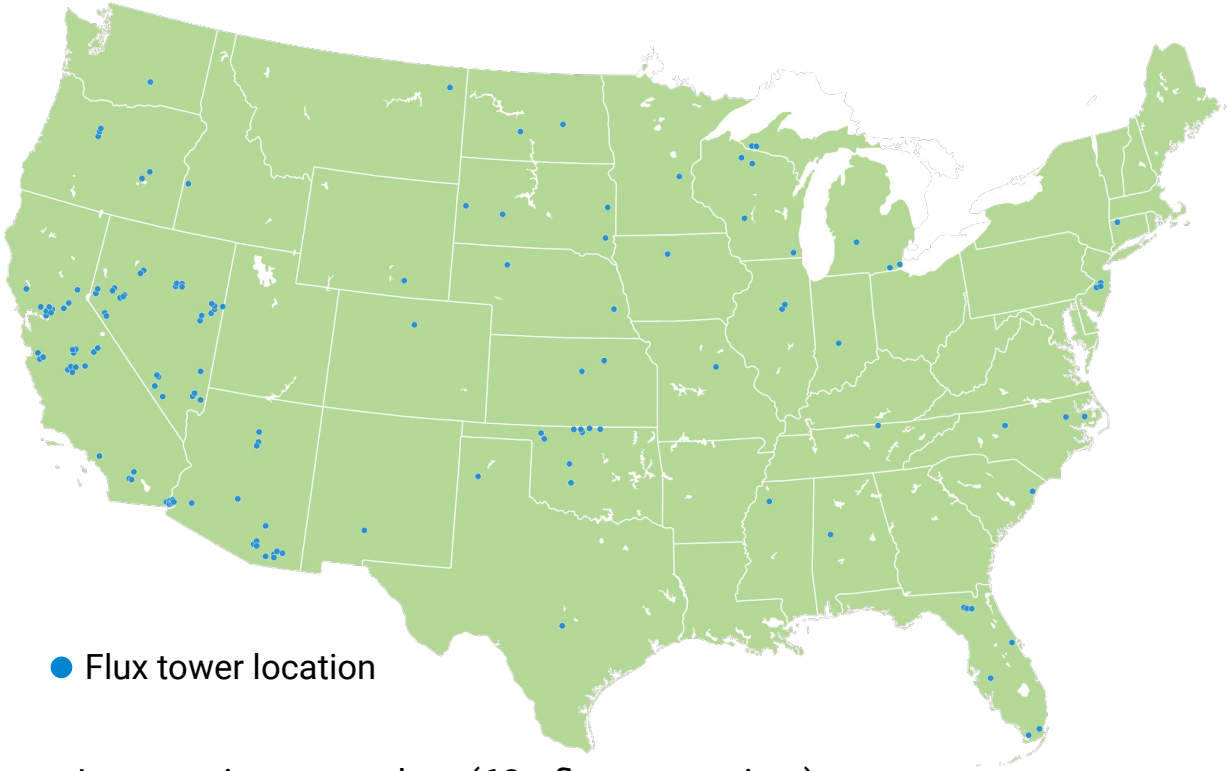
ESA Sentinel-2A, 2B
20m/0.1 acres | overpass every 5-10 days

The Value of a Community Effort



- Ability to rapidly compare results from different models to identify consistent differences
- Identification of opportunities to improve methods / models
- Collaboration to improve consistency of data inputs and reduce redundancy
- Collaboration on evaluation and intercomparison → larger pool of ground measurements and approaches

Intercomparison and Accuracy Assessment



Phase I comparison complete (60+ flux tower sites)
Phase II ‘blind’ comparison ongoing for 130+ flux tower sites

Phase I Results for Cropland Sites

Fig. 1: Model agreement for total seasonal ET for croplands

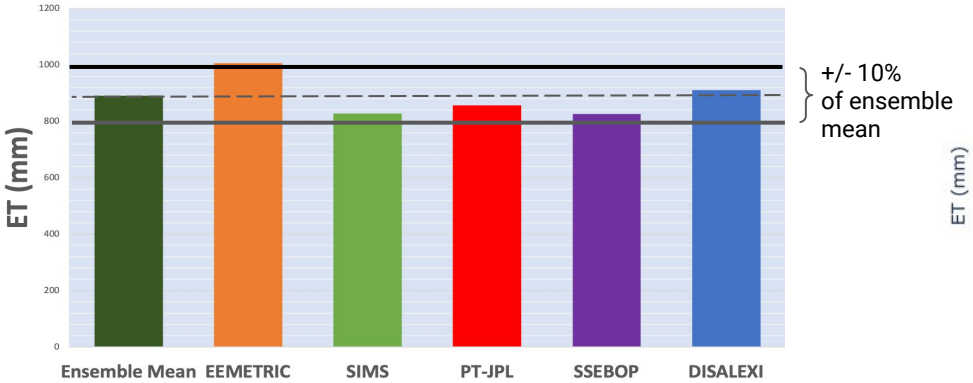
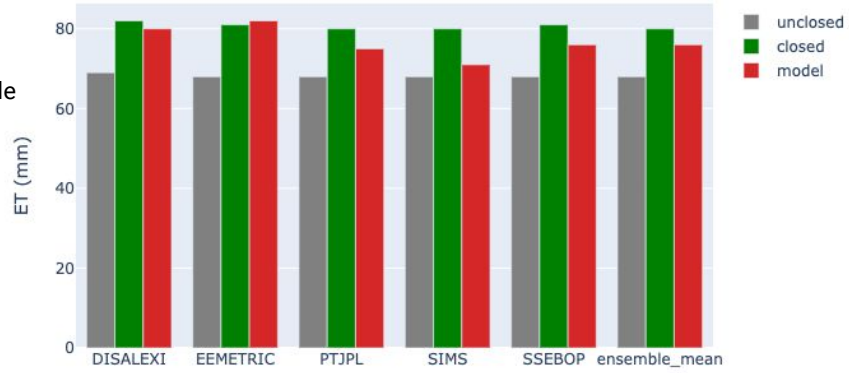
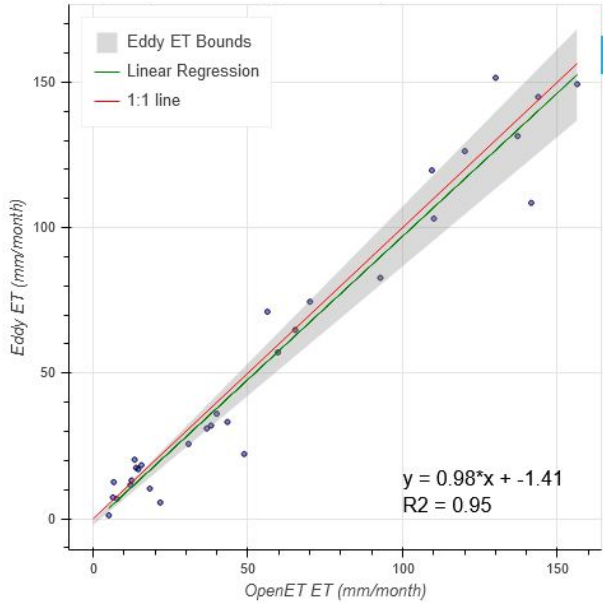


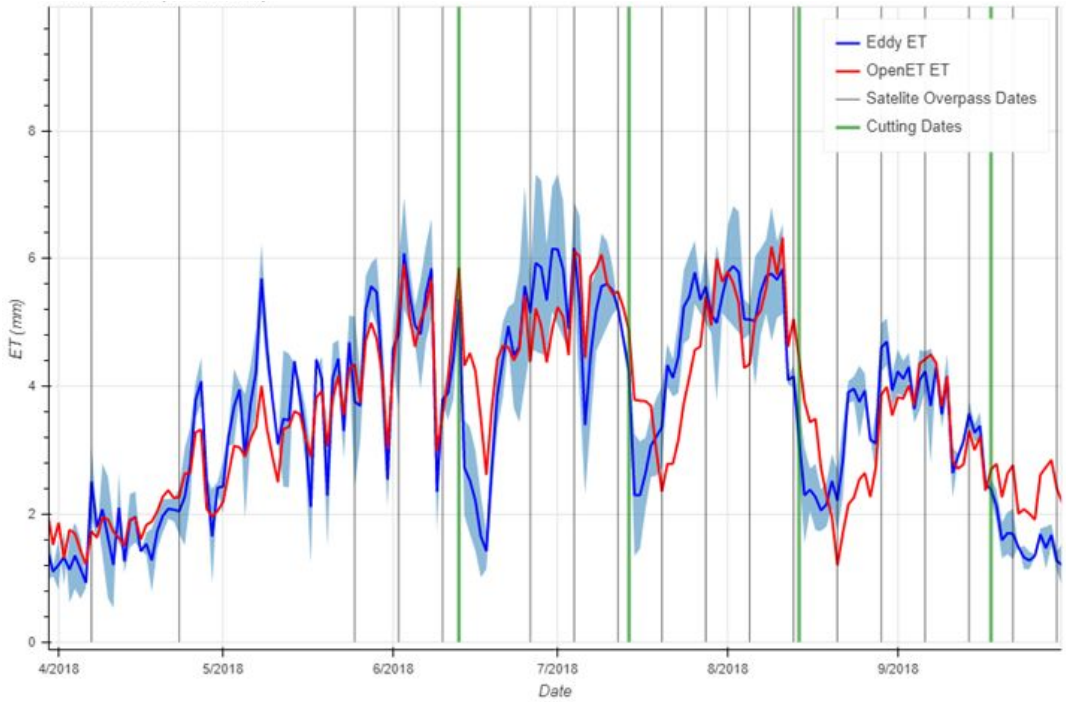
Fig. 2: Model agreement with flux towers (croplands, full period)



n = 24 sites	Ensemble Mean	EE-METRIC	SIMS	PT-JPL	SSEBOP	DisALEXI
Slope	0.98	1.05	0.97	0.94	0.92	1.03
MAE (mmd/day)	0.49	0.71	0.70	0.61	0.79	0.62
RMSE (mmd/day)	0.62	0.88	0.87	0.81	0.99	0.79
R-squared	0.92	0.85	0.89	0.87	0.81	0.89

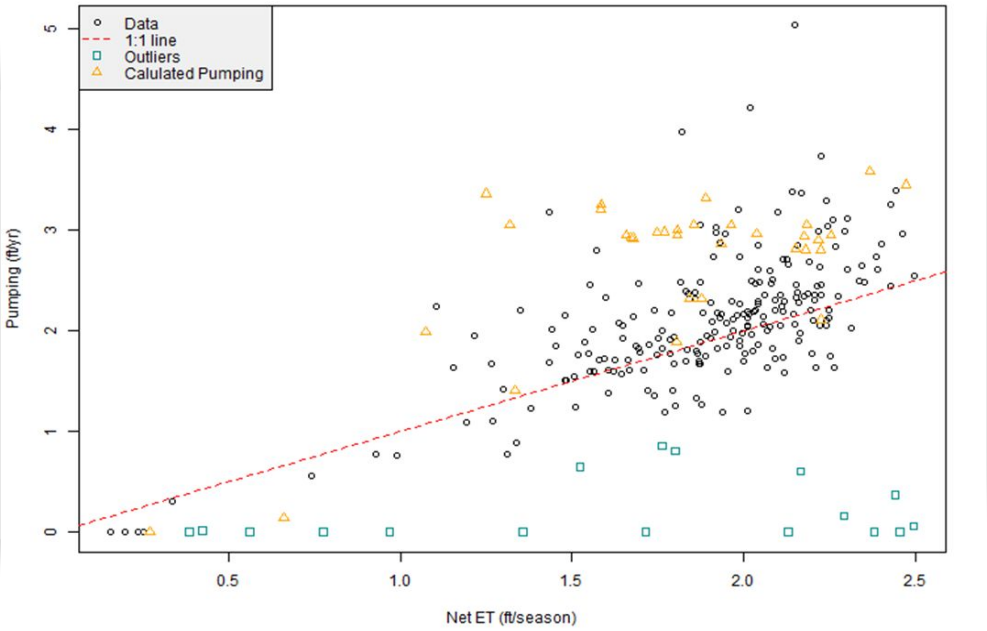
Alfalfa | Harney County, SE Oregon





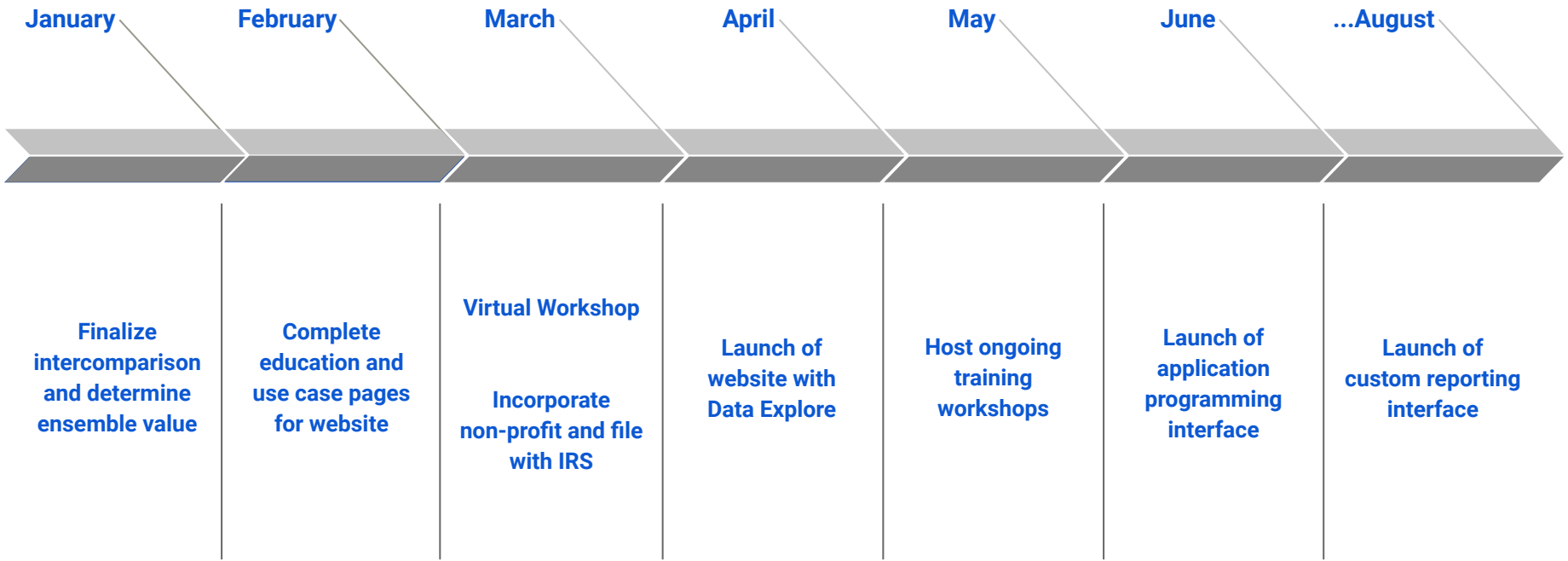
Comparison to Pumping

Working with State water agencies linking pumping records (magnetic flow meters) with water right permits, actual places of use, and OpenET data



Joined Fields	Pumping Data	OpenET Fields
AoI ID	Application Number	Field ID
0	['43270', '43268', '43836']	['NV_8705', 'NV_8673']
1	['21930']	['NV_8734']
2	['35012']	['NV_683']
3	['22194']	['NV_8636']
4	['21428']	['NV_8749']
5	['33670', '33671']	['NV_5012']
6	['46505']	['NV_8756']
7	['23739', '41884', '23711', '41883', '23738']	['NV_13343', 'NV_13342']

Key Milestones for Next 6 Months



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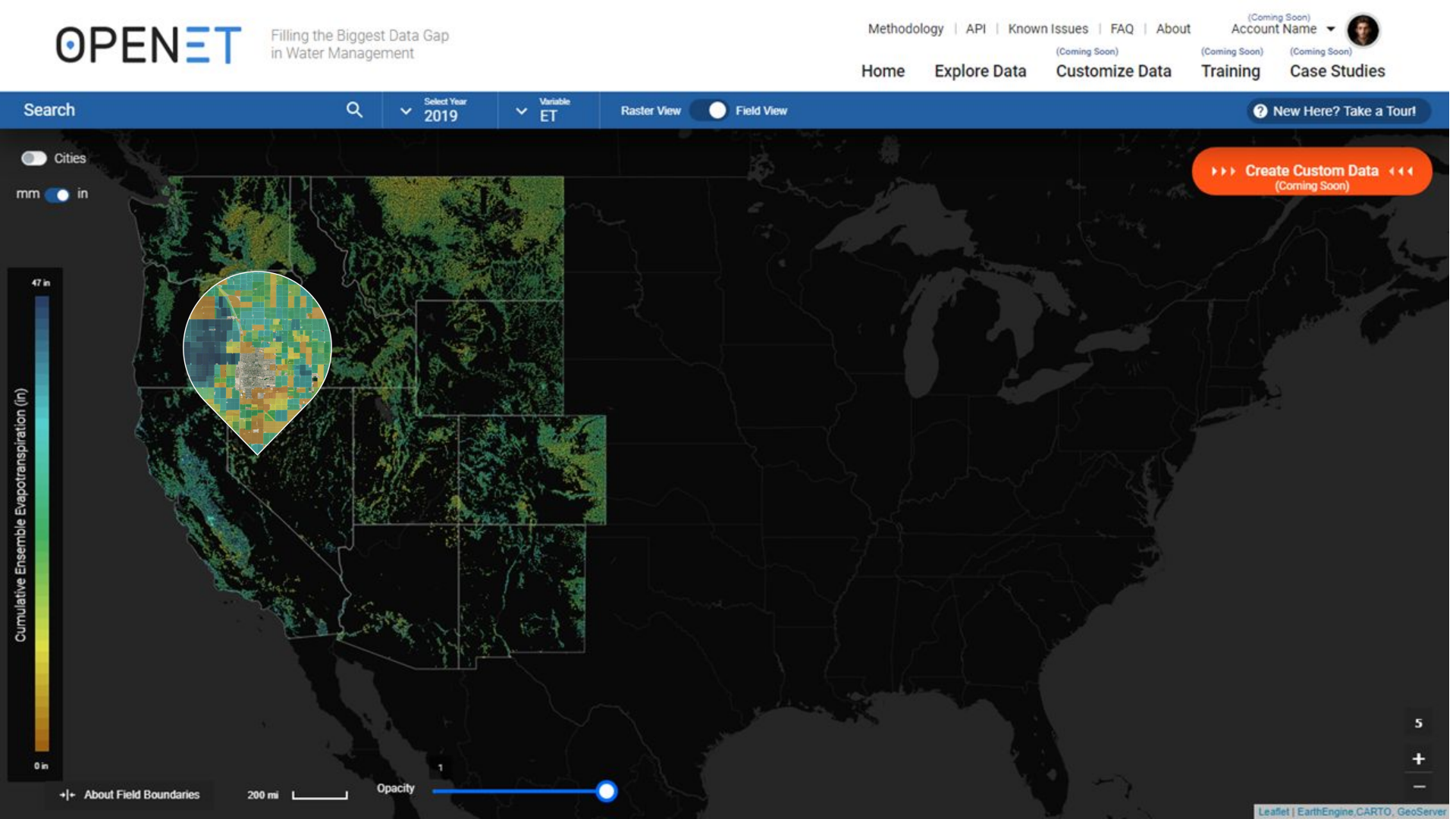
OpenET will go live in 2021

Additional Slides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mm in
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47 in
Cumulative Ensemble Evapotranspiration (in)
0 in
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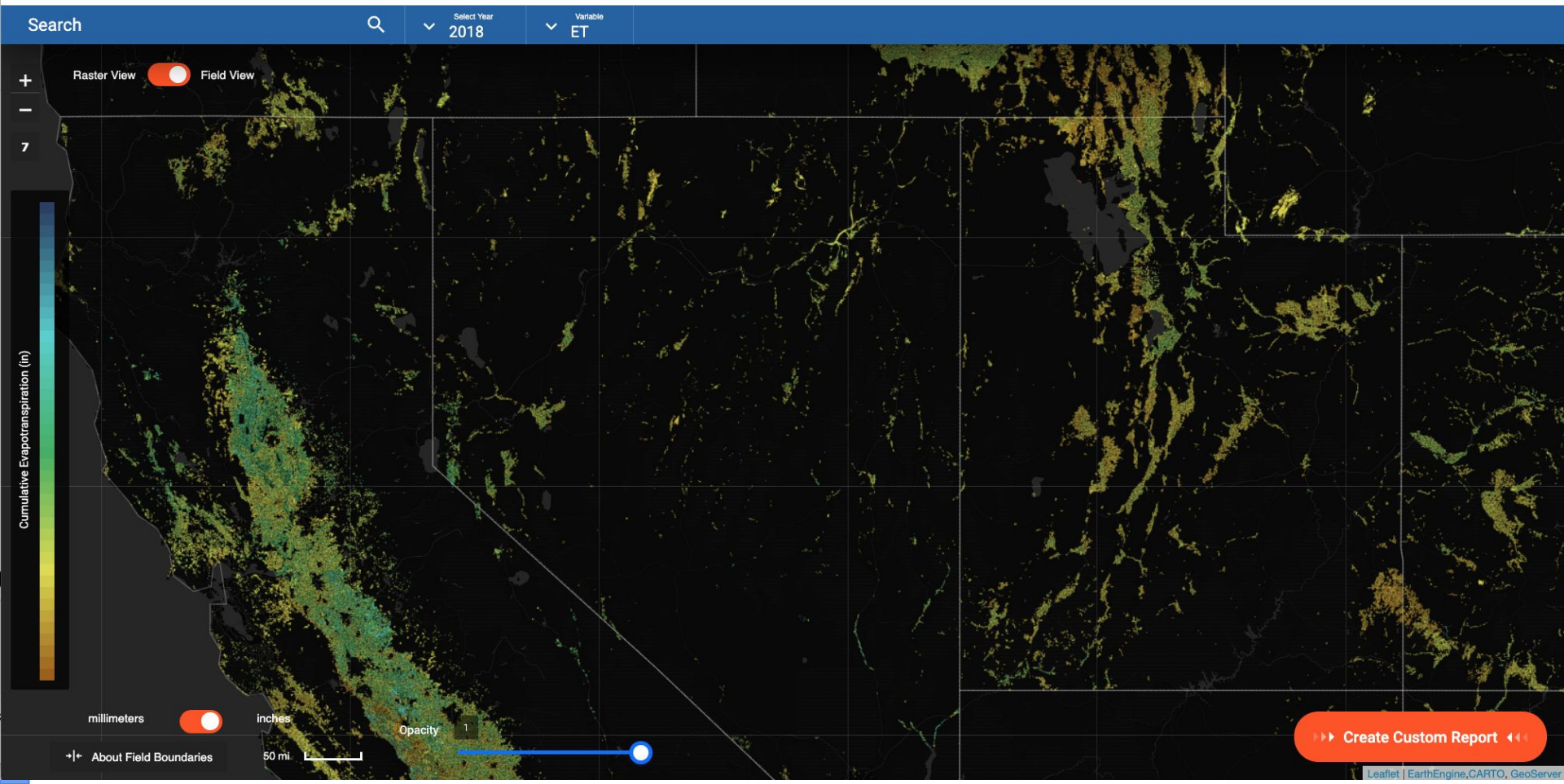
200 mi
Opacity
1
5
Leaflet | EarthEngine,CARTO, GeoServer


Search
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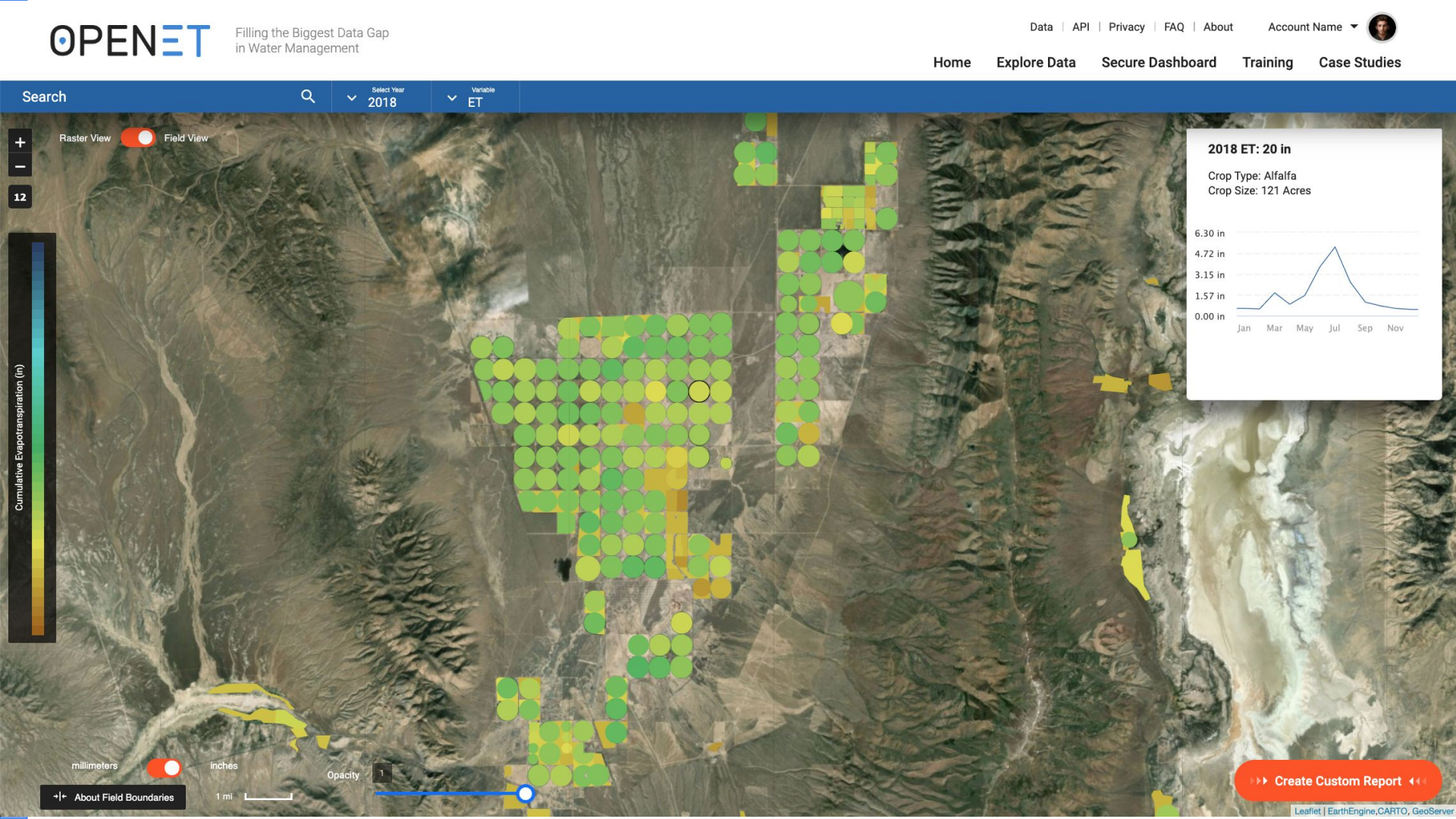
7
Cumulative Evapotranspiration (in)
millimeters
inches
Opacity
1
About Field Boundaries
50 mi
Create Custom Report
Leaflet | EarthEngine,CARTO, GeoServer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Field View
12
Cumulative Evapotranspiration (in)
2018 ET: 20 in
Crop Type: Alfalfa
Crop Size: 121 Acres
6.30 in
4.72 in
3.15 in
1.57 in
0.00 in
Jan
Mar
May
Jul
Sep
Nov
millimeters
inches
Opacity
1
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1 mi
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Search

Select Year 2018

Variable ET

Raster View | Field View

Monthly | Cumulative

Evapotranspiration

Click and drag in the plot area to zoom in

Aug 16
ET Ensemble: 160 mm

Evapotranspiration (mm)

180 mm
150 mm
120 mm
90 mm
60 mm
30 mm
0 mm

Jan 16 Feb 16 Mar 16 Apr 16 May 16 Jun 16 Jul 16 Aug 16 Sep 16 Oct 16 Nov 16 Dec 16 Jan 17 Feb 17 Mar 17 Apr 17 May 17 Jun 17 Jul 17 Aug 17 Sep 17 Oct 17 Nov 17 Dec 17 Jan 18 Feb 18 Mar 18 Apr 18 May 18 Jun 18 Jul 18 Aug 18 Sep 18 Oct 18 Nov 18 Dec 18 Jan 19 Feb 19 Mar 19 Apr 19 May 19 Jun 19 Jul 19 Aug 19 Sep 19 Oct 19 Nov 19 Dec 19

ET Ensemble | ETrF | ETr | NDVI

Highcharts.com

Data Options

ET

ETrF

Additional Variables

NDVI

ETr

Cumulative Evapotranspiration (mm)

millimeters | inches

About Field Boundaries

1 mi

Create Custom Report

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Select Year 2018

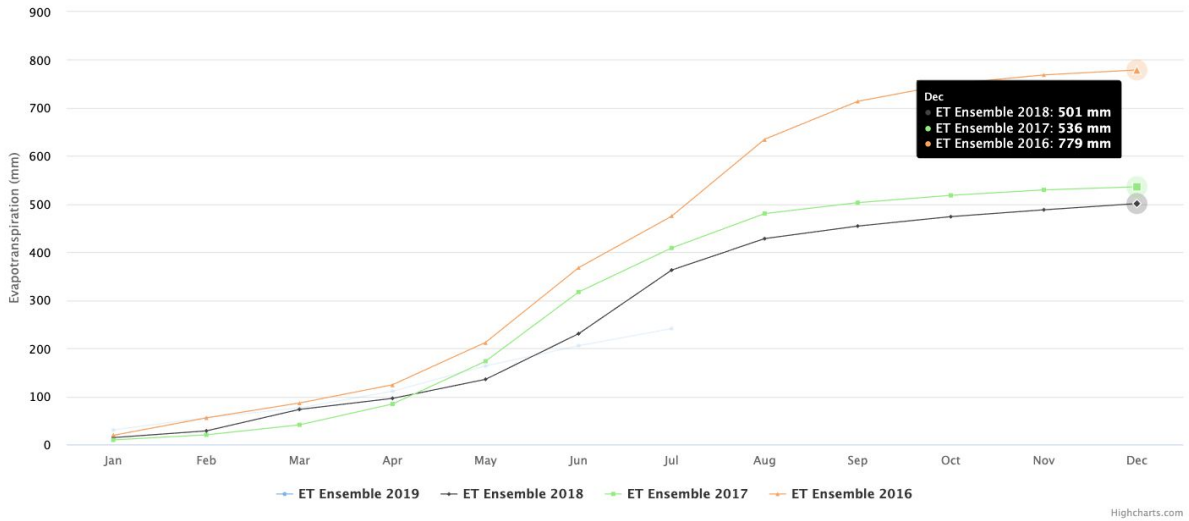
Variable ET

Raster View | Field View

Monthly | Cumulative

Cumulative Evapotranspiration

Click and drag in the plot area to zoom in



Cumulative Evapotranspiration (mm)

millimeters | inches

About Field Boundaries

1 mi

Data Options

ET

- Ensemble
- Range
- METRIC
- SEBAL
- DisALEXI
- SSEBop
- PT-JPL
- SIMS

ETrF

Additional Variables

Create Custom Report

Partnering with Other Experts to Guide Development

California

- **Jack Rice**, Western Resource Strategies LLC
- **Mark Cady**, California Department of Food and Agriculture
- **Daniel Mountjoy**, Sustainable Conservation
- **Maria del Mar Alsina**, E. & J. Gallo Winery
- **Brent Vanderburgh**, California State Water Resources Control Board
- **Josué Medellín-Azuara**, University of California Agricultural Issues Center
- **Byron Clark**, Davids Engineering, Inc.
- **Debbie Franco**, California Governor's Office of Planning and Research
- **Bekele Temesgen, Chris McCready, and Paul Shipman**, California Department of Water Resources

Colorado River Basin

- **Jennifer Pitt**, National Audubon Society
- **Charlie Ferrantelli**, Wyoming State Engineer's Office
- **Lauren Steely**, Metropolitan Water District of Southern California
- **Rabi Gyawali**, Arizona Department of Water Resources
- **Erin Wilson**, Wilson Water Group
- **Niel Allen and Alfonso Torres-Rua**, Utah State University
- **Levi Kryder**, Nevada Division of Water Resources
- **Molly Magnuson**, New Mexico Office of the State Engineer
- **Jim Prairie, Troy Wirth, and David Eckhardt**, U.S. Bureau of Reclamation
- **Luke Gingerich**, J-U-B Engineers
- **Sara Larsen**, Upper Colorado River Commission
- **Adel Abdallah**, Western States Water Council
- **Sean Collier**, Southern Nevada Water Authority
- **Kari Burgert**, Nebraska Department of Natural Resources