

OPENET

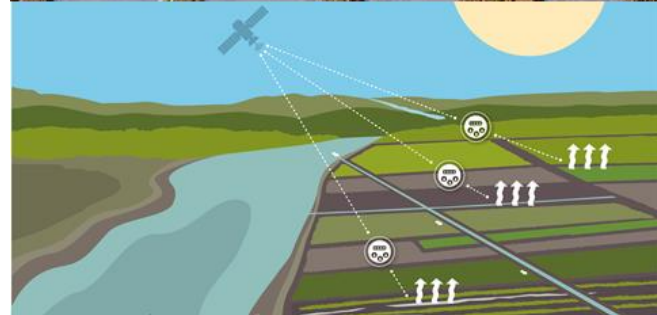
Filling the Biggest Gap in Water Data



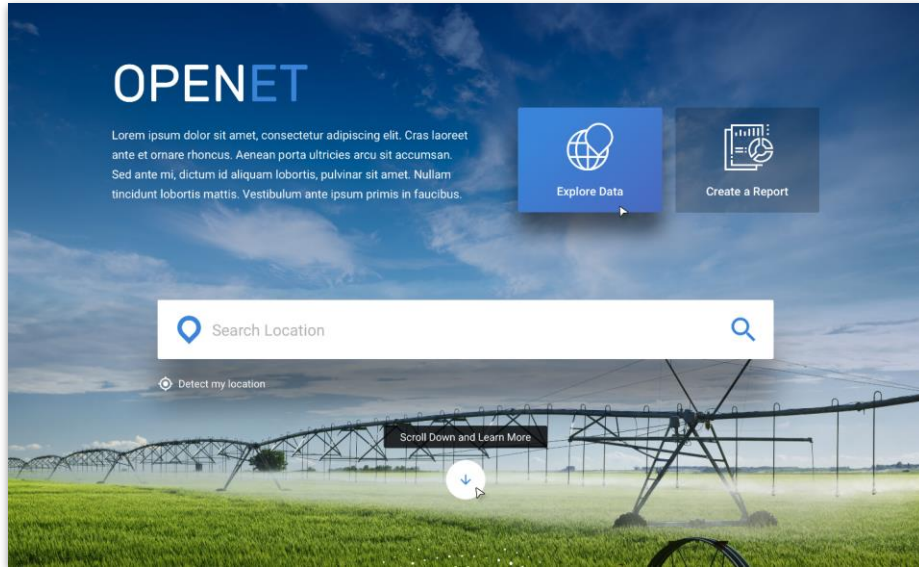
Why is ET Useful?

Measurement of evapotranspiration (ET) enables us to...

- Match irrigation to plant water requirements
- Establish water budgets using best-available-science derived actual consumptive use instead of potential consumptive use
- Support conservation and innovation
- Give proper credit for reduced use
- Reduce the transaction and monitoring costs for water trading and water use reduction programs
- Document and improve on-farm efficiencies



OpenET Goals



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

OpenET Goals



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

OpenET Goals



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

OpenET Team

Environmental Defense Fund: Robyn Grimm, Dana Rollinson, Maurice Hall

Google Earth Engine: Tyler Erickson

ALEXI / disALEXI Team (USDA, NASA, U. Maryland, U. Wisconsin): Martha Anderson, Mutlu Ozdogan, Christopher Hain, Mitch Schull, Yun Yang

SEBAL Team (UNESCO IHE): Wim Bastiaanssen, Tim Hessels

METRIC / EE Flux (DRI, U. Nebraska): Justin Huntington, Rick Allen, Charles Morton, Ayse Kilic

SSEBop Team (USGS): Gabriel Senay, Mac Friedrichs

Priestley-Taylor JPL Team (NASA JPL Team): Josh Fisher, Greg Halverson

SIMS Team (NASA, CSUMB): Forrest Melton, Alberto Guzman, Lee Johnson

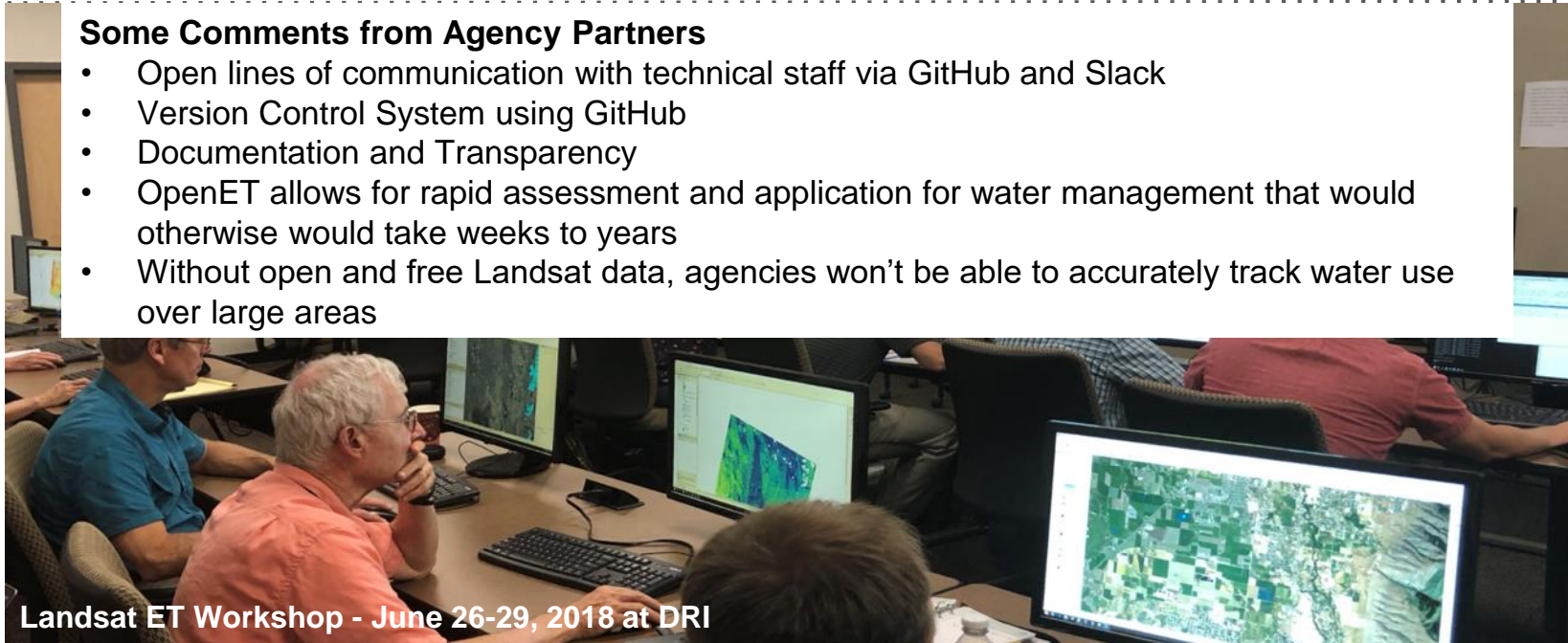
Multimodel Development, Integration, API, UI: Charles Morton (DRI), Britta Daudert (DRI), Alberto Guzman (NASA), Jordan Harding (HabitatSeven), Jamie Herring (HabitatSeven)

World Bank GWSP: Aleix Serrat-Capdevila

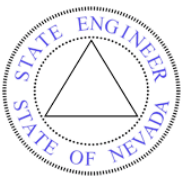
Building on State and Federal Partnerships

Some Comments from Agency Partners

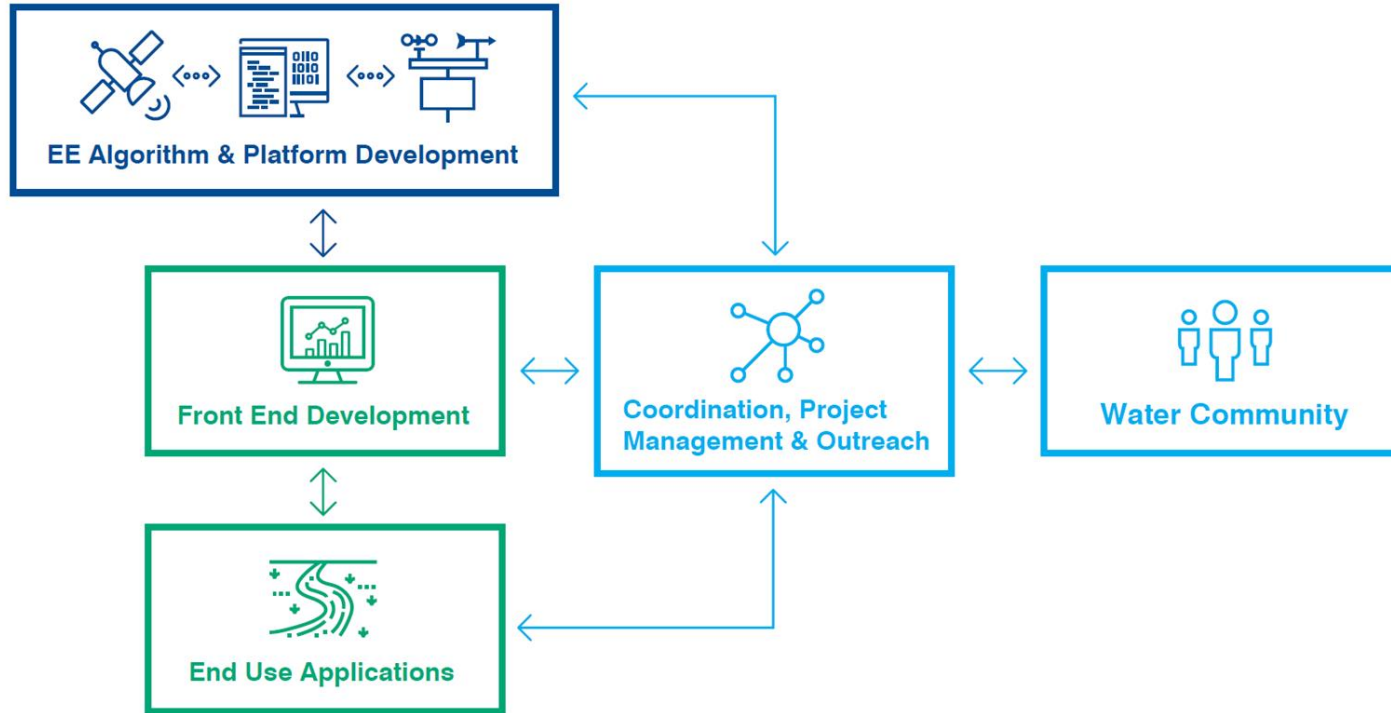
- Open lines of communication with technical staff via GitHub and Slack
- Version Control System using GitHub
- Documentation and Transparency
- OpenET allows for rapid assessment and application for water management that would otherwise would take weeks to years
- Without open and free Landsat data, agencies won't be able to accurately track water use over large areas



Landsat ET Workshop - June 26-29, 2018 at DRI



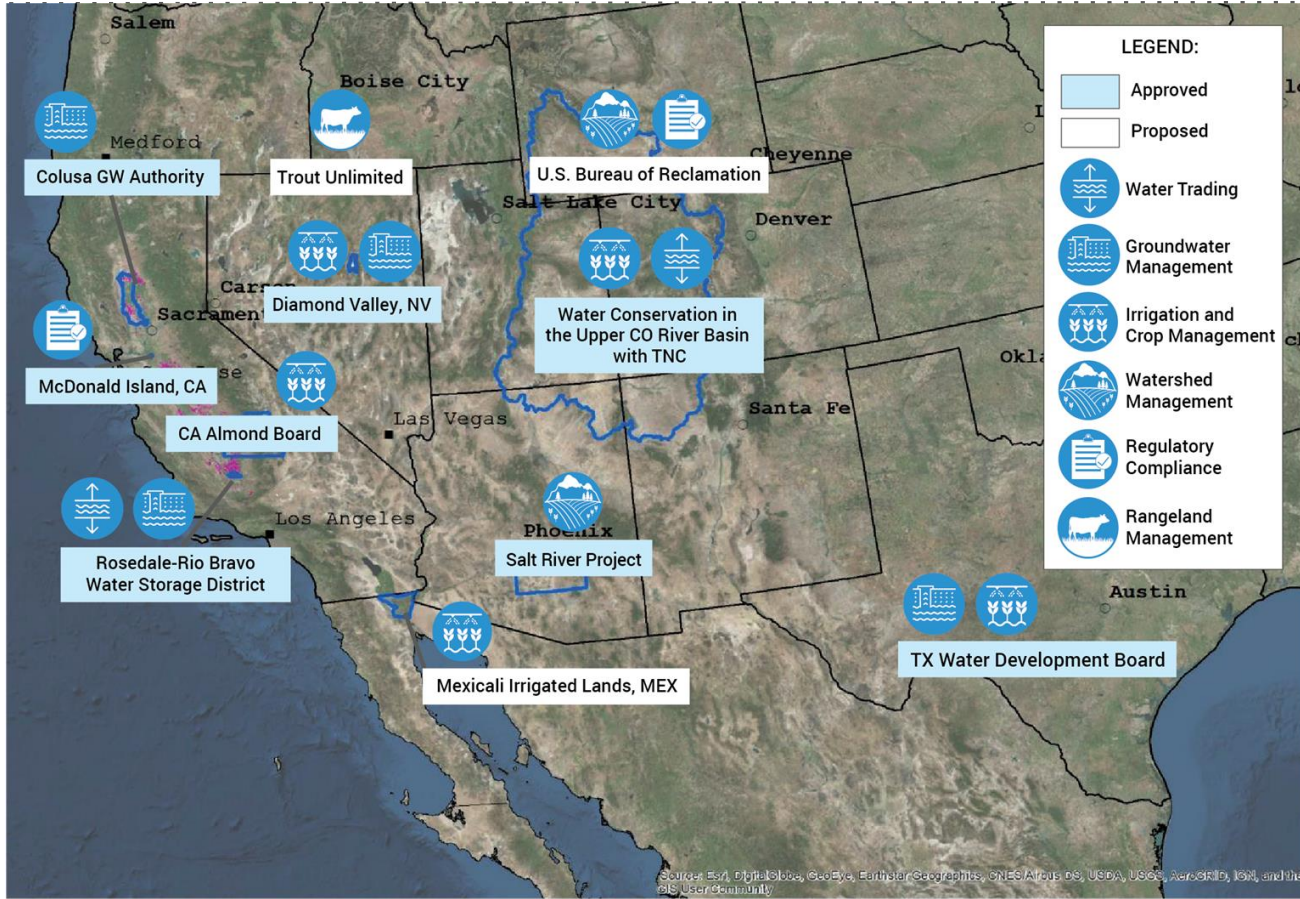
Project Design and Execution



OpenET Project Timeline

	Phase 1 Define User Requirements <i>Mid 2018 – Mid 2019</i>	Phase 2 Refine and Test the Technology <i>Mid 2019 – Late 2020</i>	Phase 3 Apply the Technology <i>Late 2020 – Mid 2021</i>	Phase 4 Transition to Sustained Operations <i>Mid 2021 – Mid 2022</i>
Front End Development	Finalize OpenET website design	Develop OpenET prototype website and process for user testing and refinement	Develop custom applications and launch OpenET website	Refine OpenET website and custom applications as needed
Platform Development	Implement ET Models on Google Earth Engine, develop shared API, and release User Requirements Report	Refine API/Website interface, develop Model Intercomparison Study	Add additional functionality for custom applications; develop Best Practices Manual	Develop training materials and host final workshop
Management, Coordination, and Outreach	Build partnerships and solicit input from various end use communities	Work with end users to refine the user interface and begin to develop end use case studies	Develop use case reports and transition plan for long-term sustainability	Transition OpenET to its long-term home and conduct trainings

Diverse Use Cases are Guiding Development



Partnering with experts to guide development

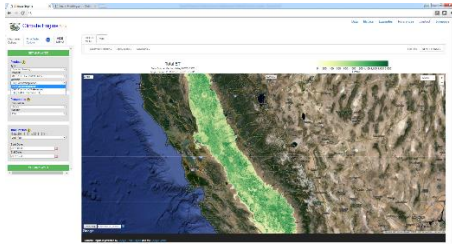
California Working Group - Organizations Represented

1. CA Farm Bureau Federation
2. CA Dept of Food and Ag
3. Sustainable Conservation
4. E&J Gallo
5. CA State Water Resources Control Board
6. UC Ag Issues Center
7. David's Engineering
8. Governor's Office of Planning and Research
9. CA Dept of Water Resources

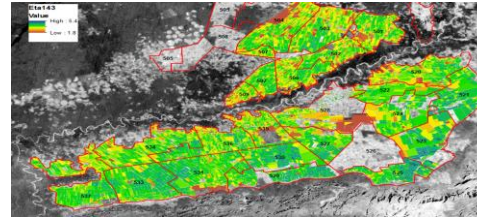
Colorado River Basin Working Group - Organizations Represented

1. Audubon
2. Wyoming Office of Engineers
3. Metropolitan Water District
4. Arizona Dept of Water Resources
5. Wilson Water Group
6. Utah State Univ.
7. Nevada Division of Water Resources
8. New Mexico Office of the State Engineer
9. US Bureau of Reclamation
10. Utah Division of Water Resources

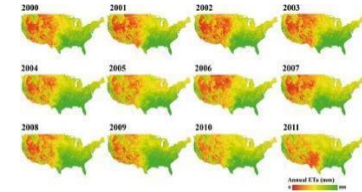
OpenET Methods



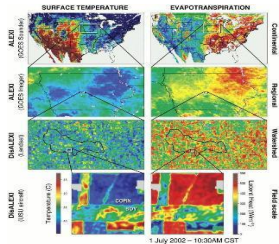
METRIC, 30m, 20+ state water mgmt agencies



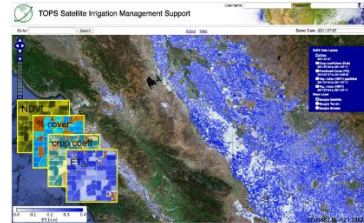
SEBAL, 30-300m, World Bank, UN FAO, eLeaf



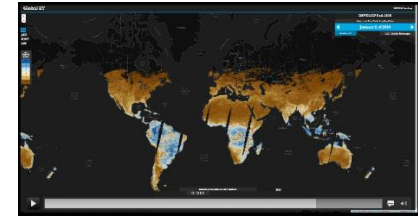
SSEBop, 30m-1km, USGS National Water Census



ALEXI/DisALeXI, 500m-5km, NOAA, USDA, NASA, U.S. Drought Monitor

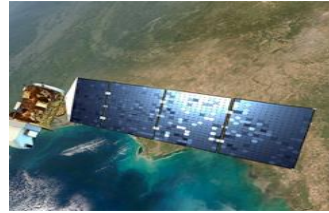


SIMS, 30m, CA Dept. of Water Resources, UCCE, +5 western states, NASA



JPL-PT, 30m-1km, New Mexico State Eng. Office, NASA

OpenET Satellite Data



Landsat 5/7/8 (TM / ETM+ / OLI)

30m / 0.25 acres; overpass every 8-16 days



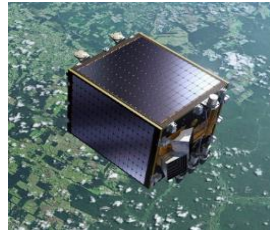
Terra / Aqua

1 km; Daily overpass



Suomi NPP

~300-375m, Daily overpass

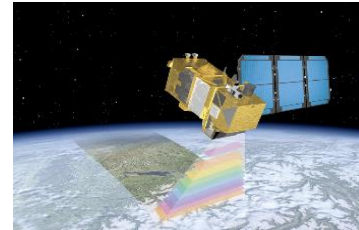


ESA Proba-V



NOAA GOES-15/16/17

0.5-4 km; < hourly



ESA Sentinel-2A, 2B

20m / 0.1 acres
Overpass every 5-10 days

MVP: Beta Version of the OpenET Data Explorer

Data

- Variables: ET, ET_{ref} , Et_{rf} , NDVI
- Data from at least two models
- Monthly data
- Years: 2016, 2017, 2018, 2019
- Region: California and Nevada (minimum)

Visualizations and Functionality

- Choropleth maps produced using publicly available field boundary datasets
- Raster maps of monthly and annual data from the ensemble
- Hover over individual polygons or click on pixels to view graphs of time series

Additional Content

- Text and content for the homepage
- Documentation for models and explanations of data
- At least one use case example



Search



Date Range
June 2018

Data Layer
ETr

Field View Raster View

Year to Date

2018

2017



OpenET provides data at a variety of scales. You can view data summarized at field scales, view the raw data outputs or create your own custom report.



View Field Summaries



View Raw Data



Create Custom Report

Yearly Cumulative Total ET (mm)

10mm

100mm

Clint

E Mt Whitney Ave

Cedar St

Cedar St

E Mt Whitney Ave

E Mt Whitney Ave

E Mt Whitney Ave

Laton-K
Pa

Search 2018 ▾ et ▾



Raster View



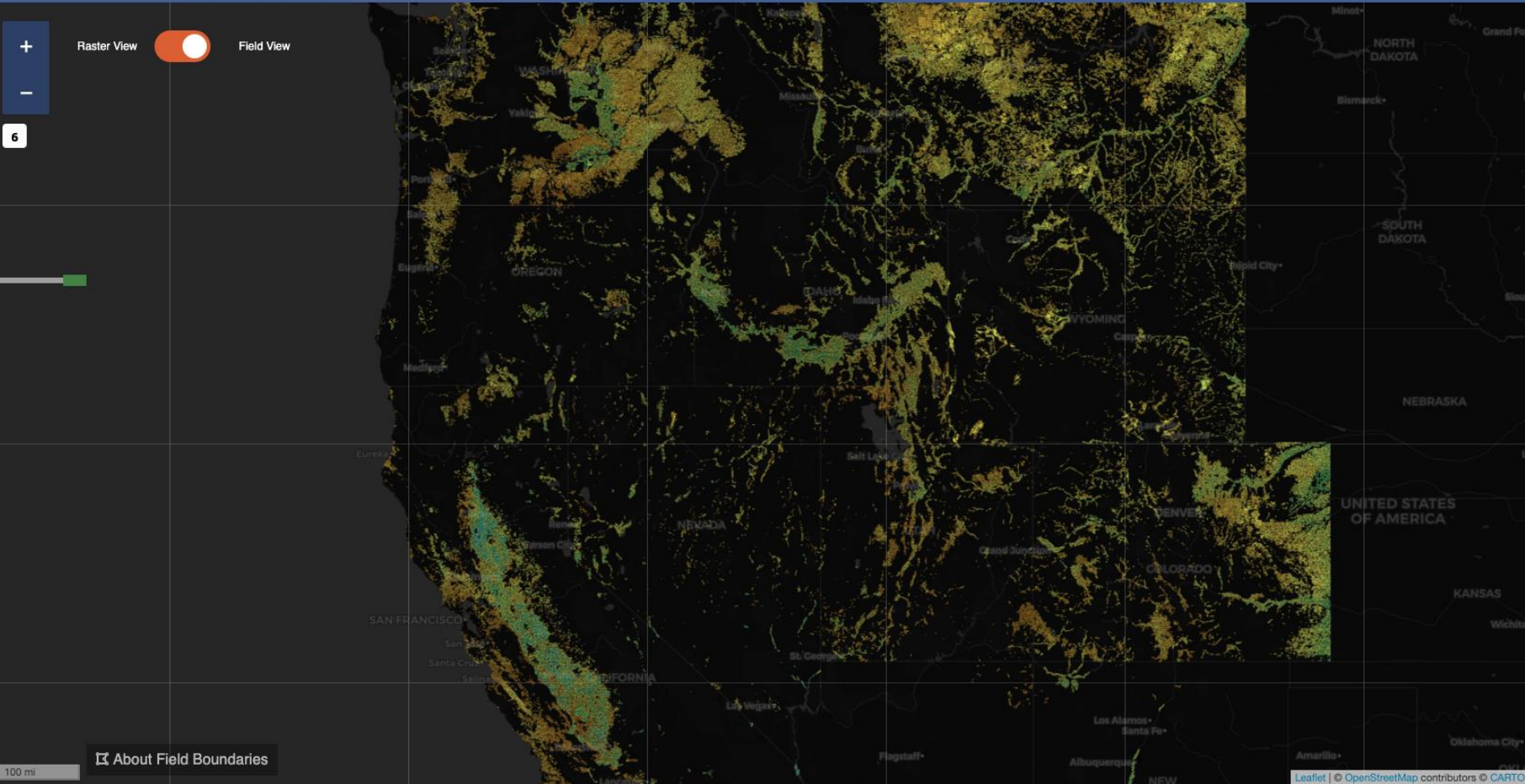
Field View

6



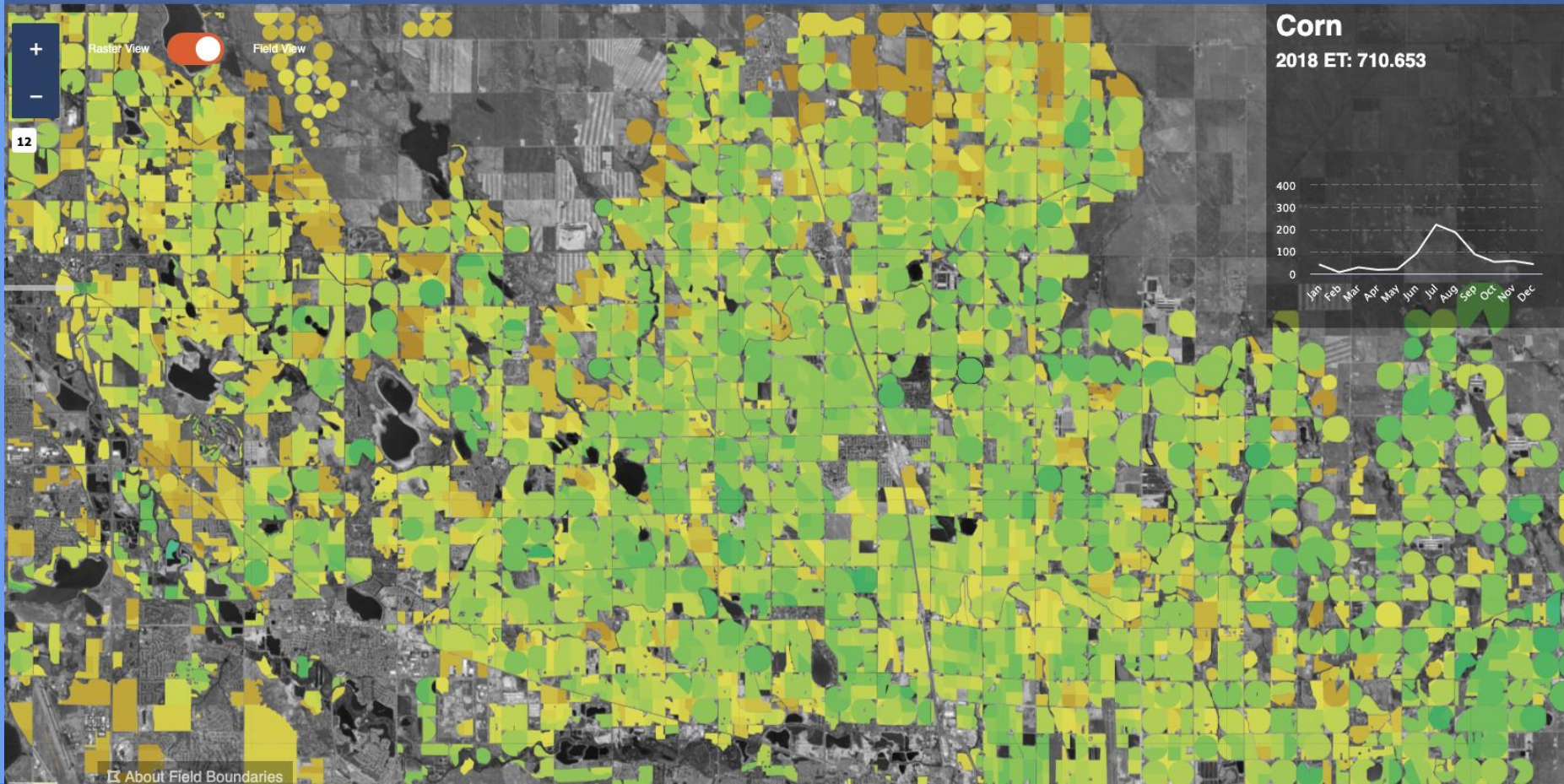
100 mi

About Field Boundaries

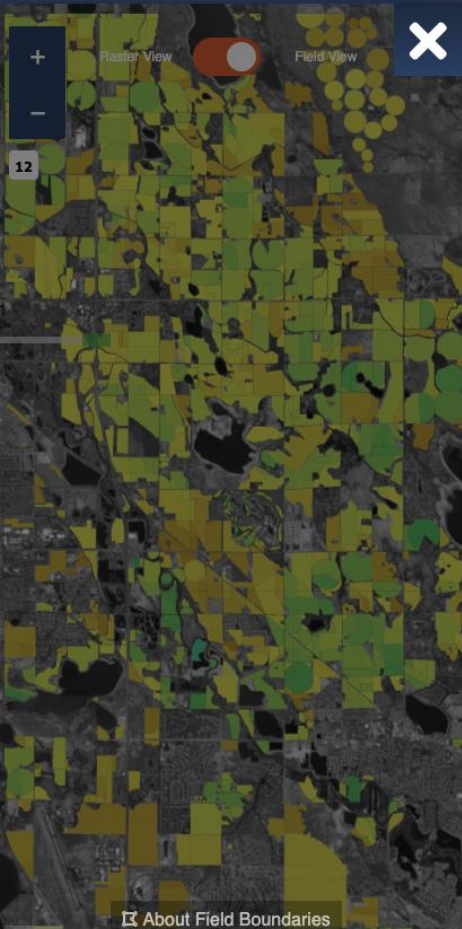


Search

2018 ▾ et ▾



Search 2018 ▾ et ▾

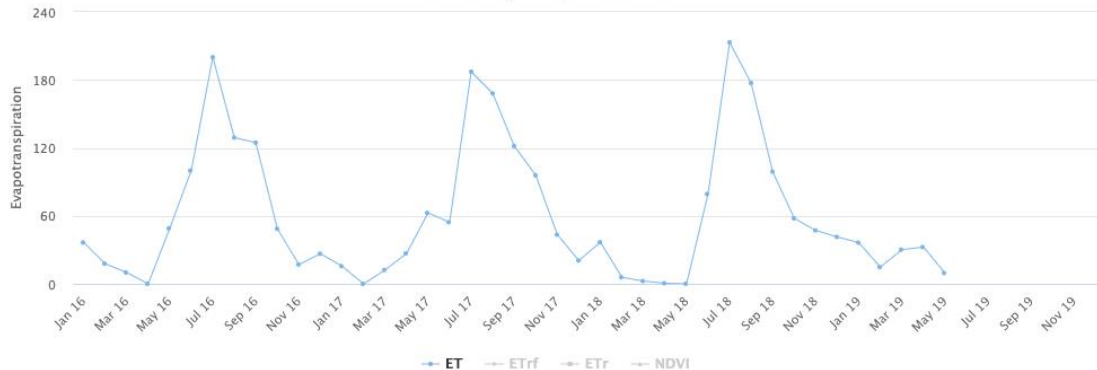


Monthly

Cumulative

Evapotranspiration

Click and drag in the plot area to zoom in



Highcharts.com

Models






ET ETr

- Range
- Ensemble
- Metric
- Sebal
- DisALEXI
- SSEBOP
- PT-JPL
- SIMS

Additional Variables

- NDVI
- ETr

Create Custom Report

-  My Account
-  My Reports
-  Notifications
-  Settings
-  Sign Out

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My Secure Dashboard

Add New Report

All information uploaded through your dashboard is only viewable by you. For more information, view our [Privacy Policy](#).

Is this report based on Polygons or Raster data? 


Raster
 Polygon

Is this report one-time or recurring? 

One-Time
 Recurring





1 Name of this Report

2 Pick a Point, Draw a Polygon or...

-  Upload Shape File
-  Use Previously Uploaded Shape File
-  Use My Earth Engine Feature Collection



Use Previously Uploaded Shape File

- Shape File Name 
Created January 12, 2019
- Shape File Name 
Created January 12, 2019
- Shape File Name 
Created January 12, 2019
- Shape File Name 
Created January 12, 2019



My Secure Dashboard

Saved Reports

19 Saved Reports

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8 Recently updated Reports

Updated within the last 7 days
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Report Name

Created January 20, 2019 | Last Updated January 24, 2019

Start Date January 21, 2019
Time Interval Weekly

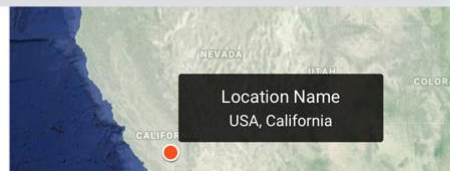
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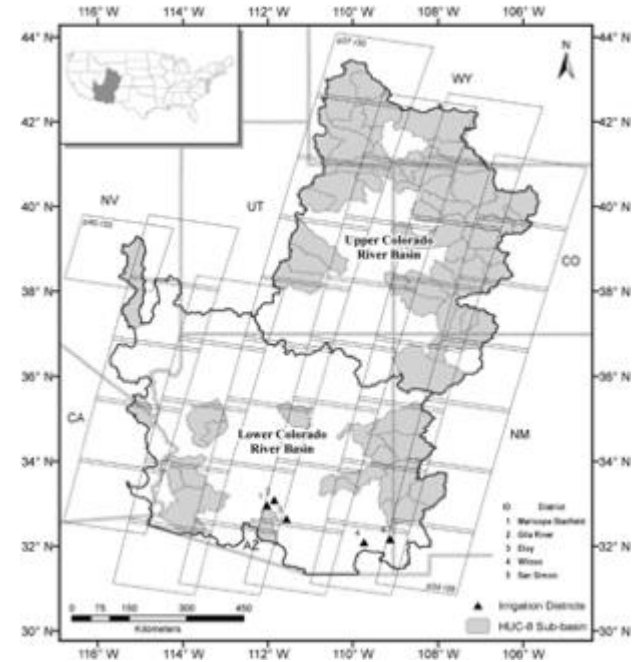
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OpenET Accuracy Assessment

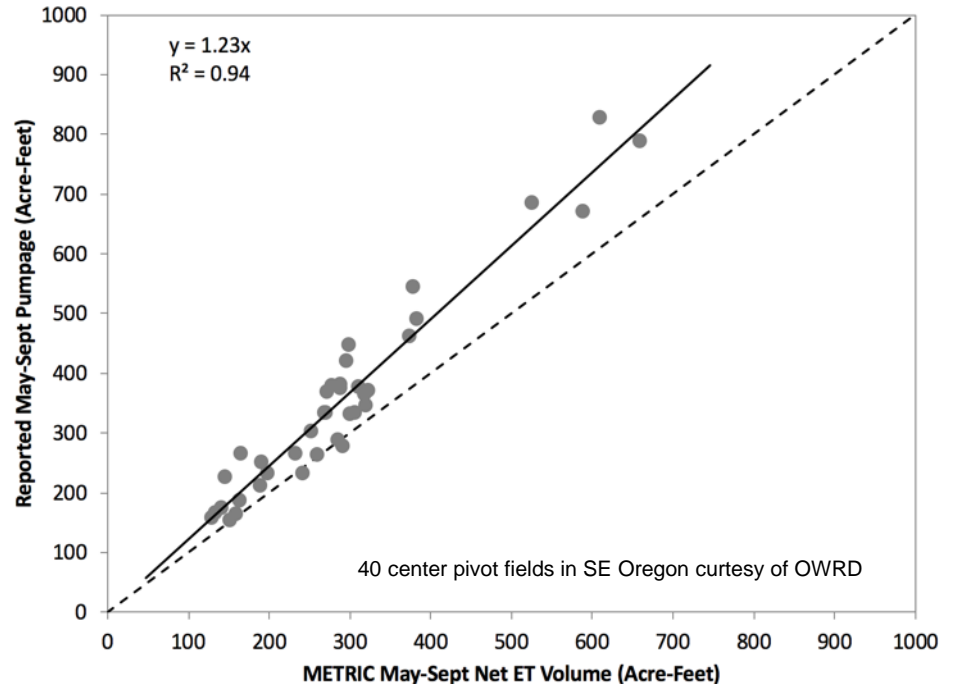


Senay et al., RSE, 2016

Images courtesy of Ray Anderson, USDA ARS

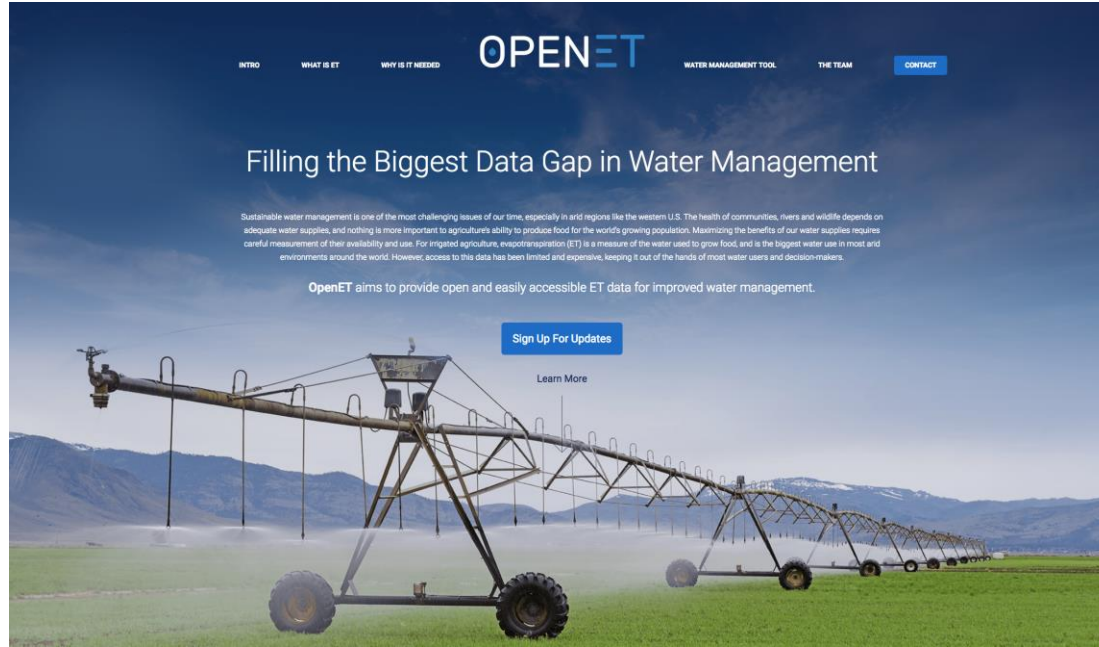
OpenET Accuracy Assessment

- Validating at AmeriFlux, FLUXNET2015, other research flux sites, and comparing to groundwater pumping
- Developed standardized QAQC and energy balance closure software to apply across all flux sites
- Intercomparison of model results at scale proving useful for understanding results and improving our models



OpenET Technical Requirements

Application	Baseline Accuracy	Ideal Accuracy	Time of Use	Ensemble of Values or One Value?
Irrigation scheduling	+/- 25% daily	+/- 10-15% daily	1-3x per week	One value
Water accounting / demand projections	+/- 20% monthly +/- 15% annual	+/- 15%	Monthly to annual	Ensemble
Drought monitoring / impact assessment	+/- 20% monthly +/- 15% annual	+/- 15%	Monthly or seasonal reports	One value
Water transfers	+/- 20% monthly +/- 15% annual	+/- 10%	Monthly and annual reports	One value
Water budgets	+/- 15% annual	+/- 10%	Annual reports	One value
Calibration of groundwater models	+/- 15% annual	+/- 15%	Retrospective analyses	Ensemble
Conservation planning	+/- 15% annual	+/- 15%	Retrospective analyses	Ensemble
Water rights admin / Regulatory compliance	+/- 20% monthly +/- 15% annual	+/- 5-10%	Monthly and annual reports	One value



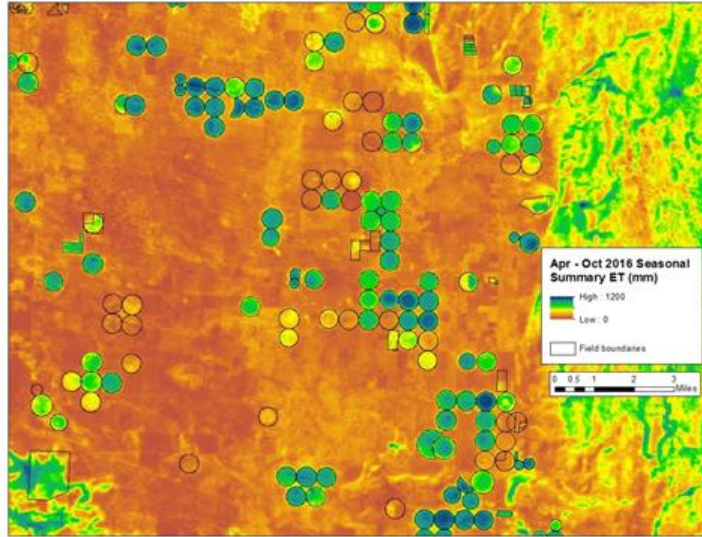
We gratefully acknowledge support by the Windward Fund, the S.D. Bechtel, Jr. Foundation, the Gordon & Betty Moore Foundation, the Walton Family Fund, and the NASA Applied Sciences Program.

Back-up

Bringing Communities Together and Building Trust



The Value of Partnerships and Open, Transparent Data



Transparency of water use through ET maps support conservation and groundwater management - example from OWRD who are using OpenET based ET maps and meeting with farmers about their water use.

Similar work in Kansas - “The results of this analysis demonstrate that conservation programs that are irrigator-driven with regulatory oversight can provide a path toward sustainability in stressed aquifers.” - Deines et al., 2019 - <https://iopscience.iop.org/article/10.1088/1748-9326/aafe39>