February 2018

OpenET

Filling the Biggest Data Gap in Water Management

A Collaborative Effort

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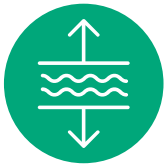
EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

NASA

Google Earth Engine

DRI Desert Research Institute

Careful management requires careful measurement

Applications:	Key to: Local Water Managers	Key to: Growers
Create local water budgets & incentivize conservation 	✓	
Increase flexibility 	✓	✓
Increase on-farm efficiencies 		✓
Track and learn from the impact of actions taken 	✓	✓

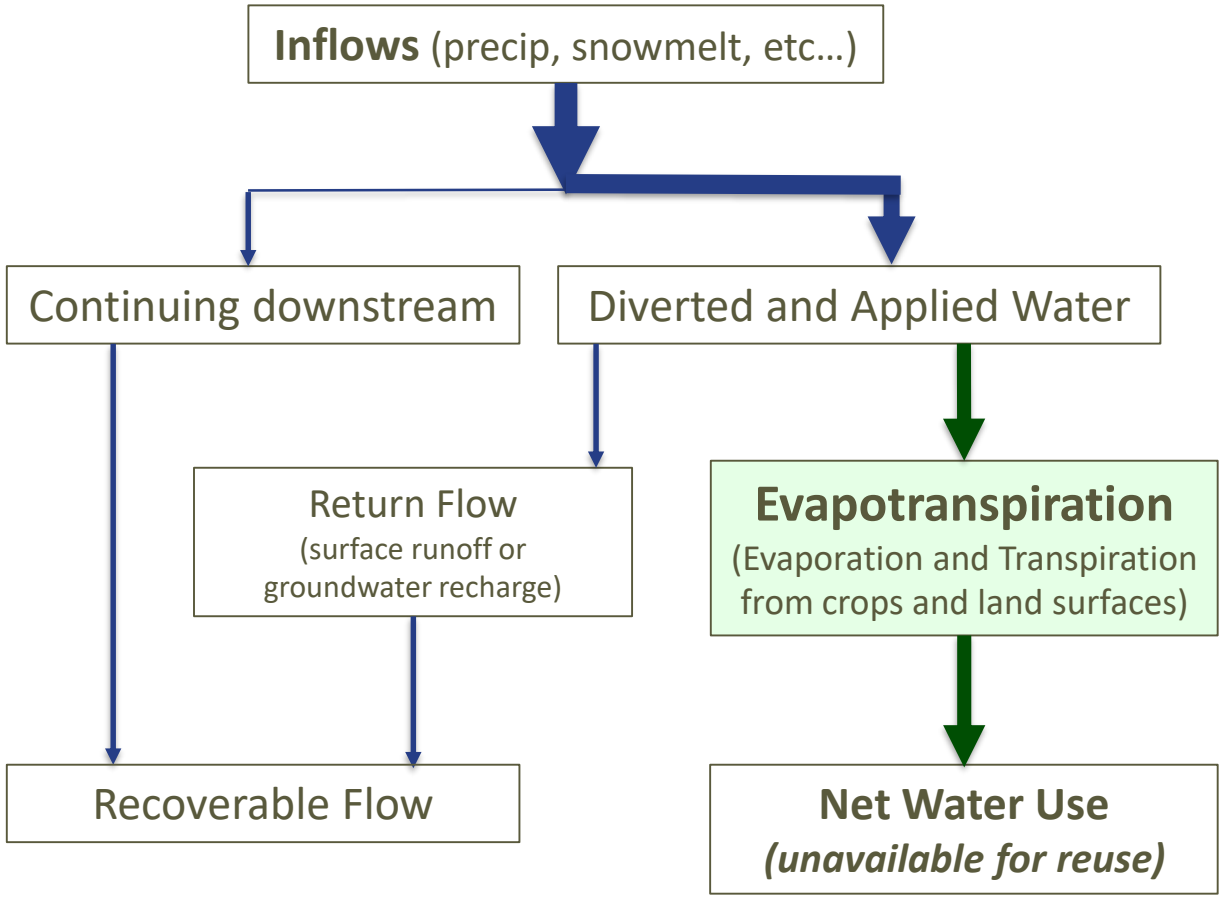
Water use in ag is challenging to measure

Water applied to a field does one of four things:

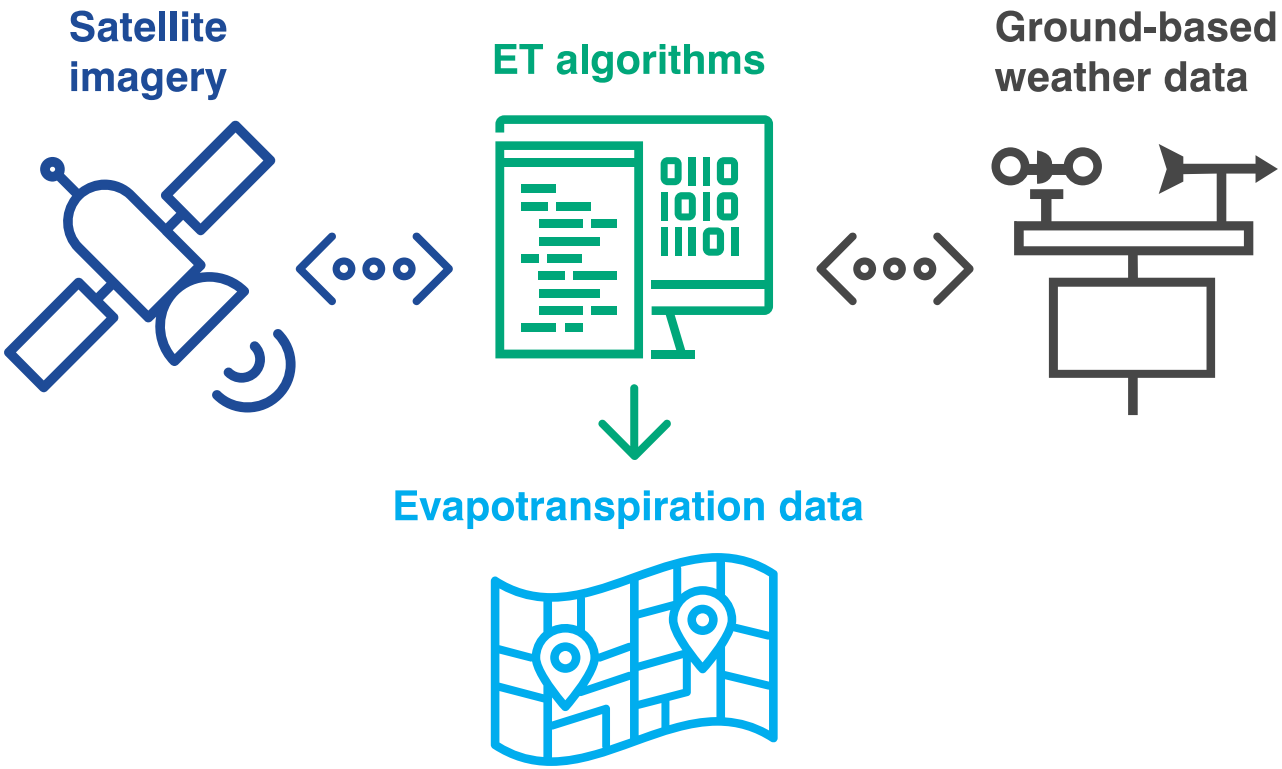
- Transpires (after being used by plants to grow)
- Evaporates
- Recharges groundwater basins
- Runs off and returns to a local canal or river

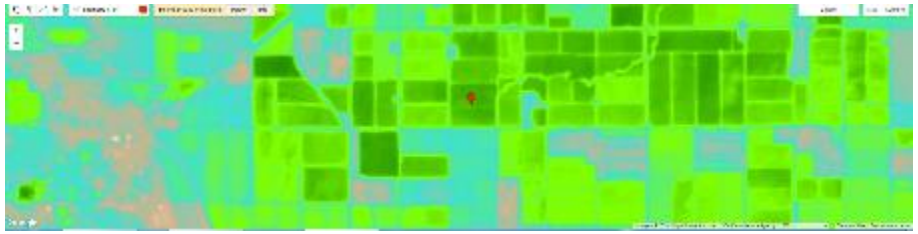
Water use in ag ~ Evapotranspiration (ET)

- 40 – 90% of all water applied to a field eventually leaves as ET.
- When a system is in balance, ET does not exceed inflows (over extended time periods).



A Proven Method





The technology exists, but barriers remain

Accessible ET Information…	Today
Cost	High
Comparability and Trust	Variable
Scope	Limited
Accessibility	Low

The capability is there, but its full potential goes unrealized.

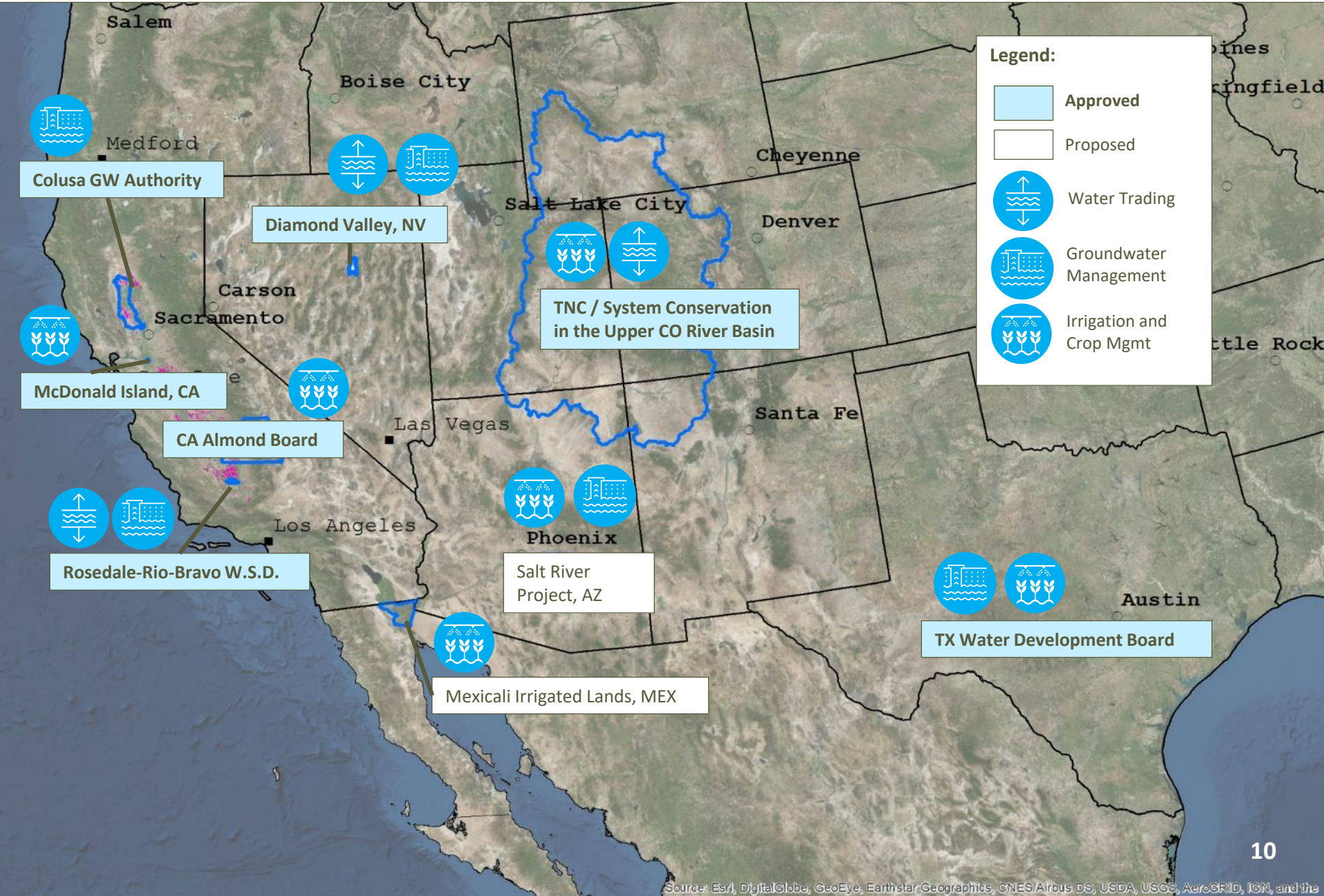
OpenET solves for these obstacles

Accessible ET Information…	Today	With OpenET
Cost	High	Low
Comparability and Trust	Variable	High
Scope	Limited	Broad
Accessibility	Low	High

OpenET will change that.

With the OpenET Platform, a free or low-cost website will unlock reliable ET data for a host of critical uses.

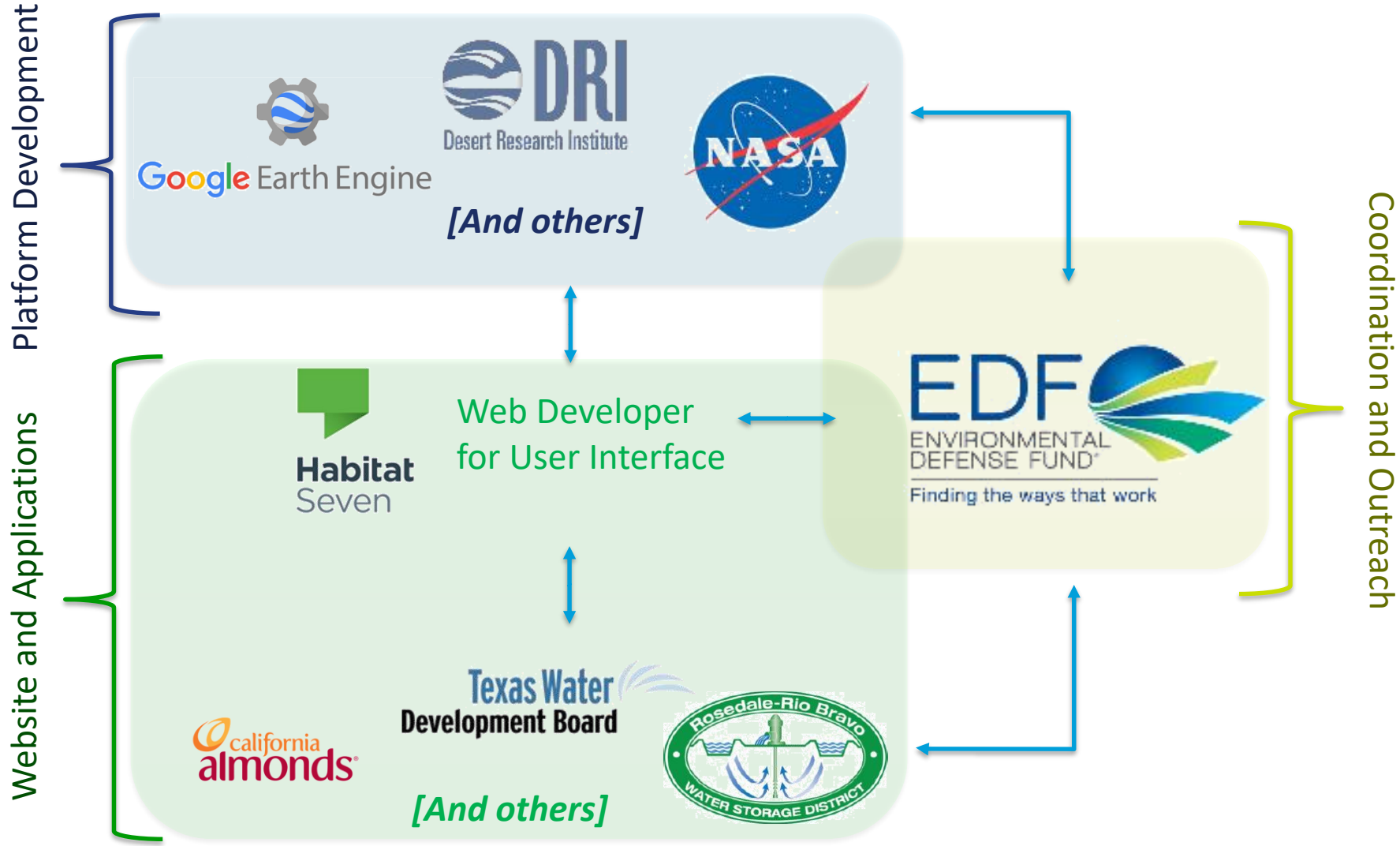
OpenET Use Cases



McDonald Island, CA

Objective	**Test the use of satellite-based measurement of evapotranspiration (ET) as an alternative to measuring diversions at each of the syphons.**
Description	Policy hypothesis: that remote sensing of actual ET will eventually provide superior water use/water management insight (compared to measuring diversions through each syphon) within the Delta because of (a) improved comparability of data; (b) reduced incidence of mechanical failure and human error; (c) dramatically lower cost (both initially and over equipment life cycles); (d) closer to real time reporting; (e) improved systemic QA/QC; and (f) better acceptance/use by all parties interested in the actual consumptive use of water. Technical hypothesis: that the OpenET platform will provide comparably accurate consumptive use measurements compared to field level measuring devices (eddy covariance, pan evaporation, CIMIS, etc.), but at a reduced up-front and long-term cost to Delta landowners and growers.
Liaison	Trey Steinhart
Regulatory Context	SB88 requires measurement and reporting of diversions, currently using expensive and difficult to maintain meters
ET Requirements (time step, spatial resolution, etc…)	• Monthly time step • Presumably the spatial extent would be distinguished by water right (probably the whole island has one right in this case)

Program Design/Execution

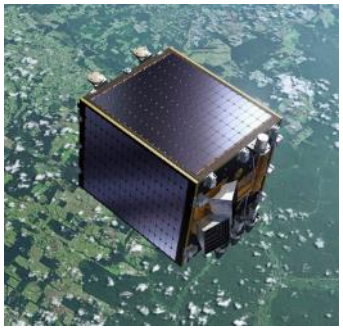


OpenET leverages a constellation of satellites

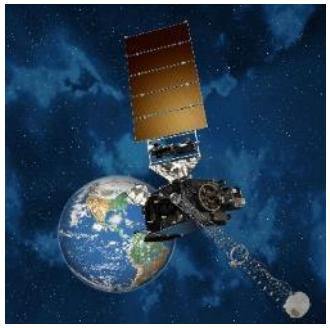


Landsat 5/7/8 (TM / ETM+ / OLI)
30m / 0.25 acres; overpass every 8-16 days

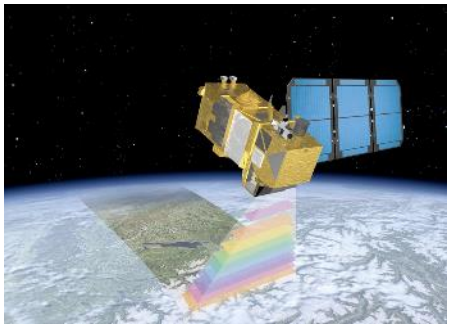

Terra / Aqua
1 km; Daily overpass

Suomi NPP **ESA Proba-V**
~300-375m, Daily overpass

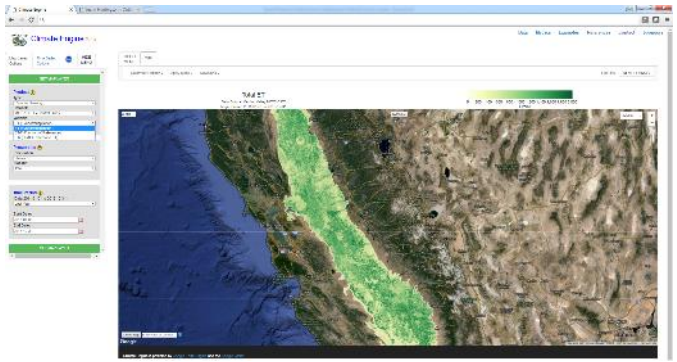


NOAA GOES-15/16
0.5-4 km; < hourly

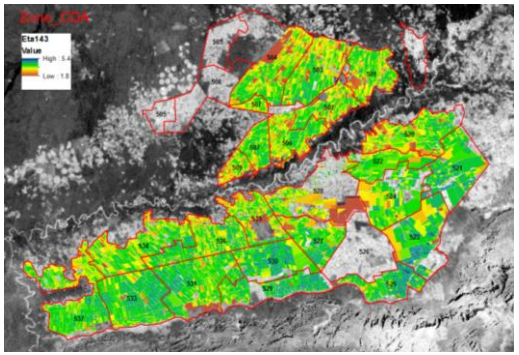


ESA Sentinel-2A, 2B
20m / 0.1 acres
Overpass every 5-10 days

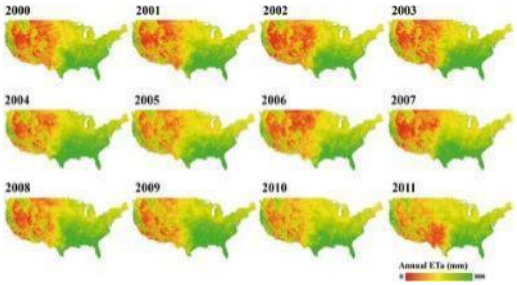
OpenET uses trusted models



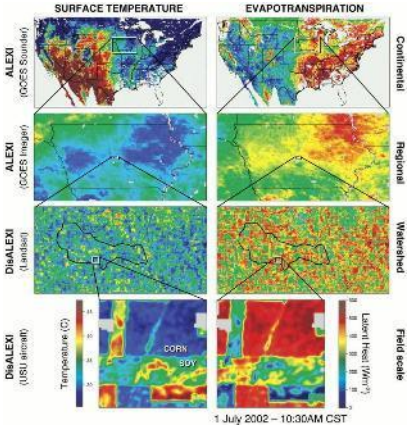
METRIC, 30m, 20+ state water management agencies



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

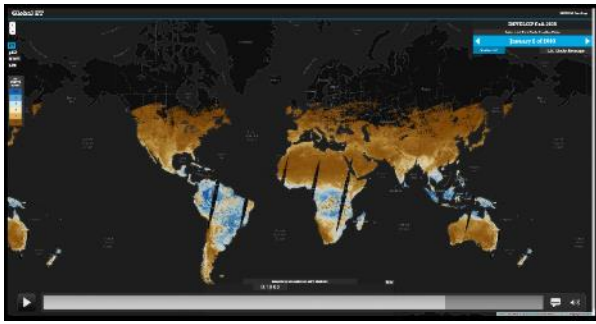


SSEBop, 30m-1km, USGS National Water Census



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

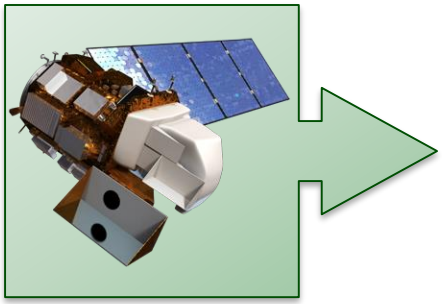
SIMS, 30m, CA Dept. of Water Resources, UCCE, +5 western states, NASA



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

OpenET bridges the gap between data and user

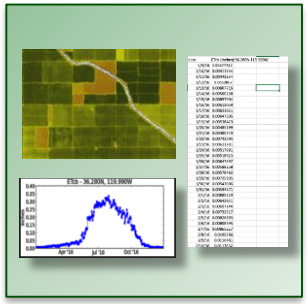
Satellites



Ground Stations

NASA/USGS/ESA Data Center

Google Cloud / Earth Engine



User Interface (retrieval of data and summaries)

Geodatabase

API for ET Model Queries (Cron + On-demand)

ET Models / Earth Engine API

OpenET: Enabling a more sustainable future

With the **OpenET platform**, **trusted, field scale water use measurements** will pave the way for:

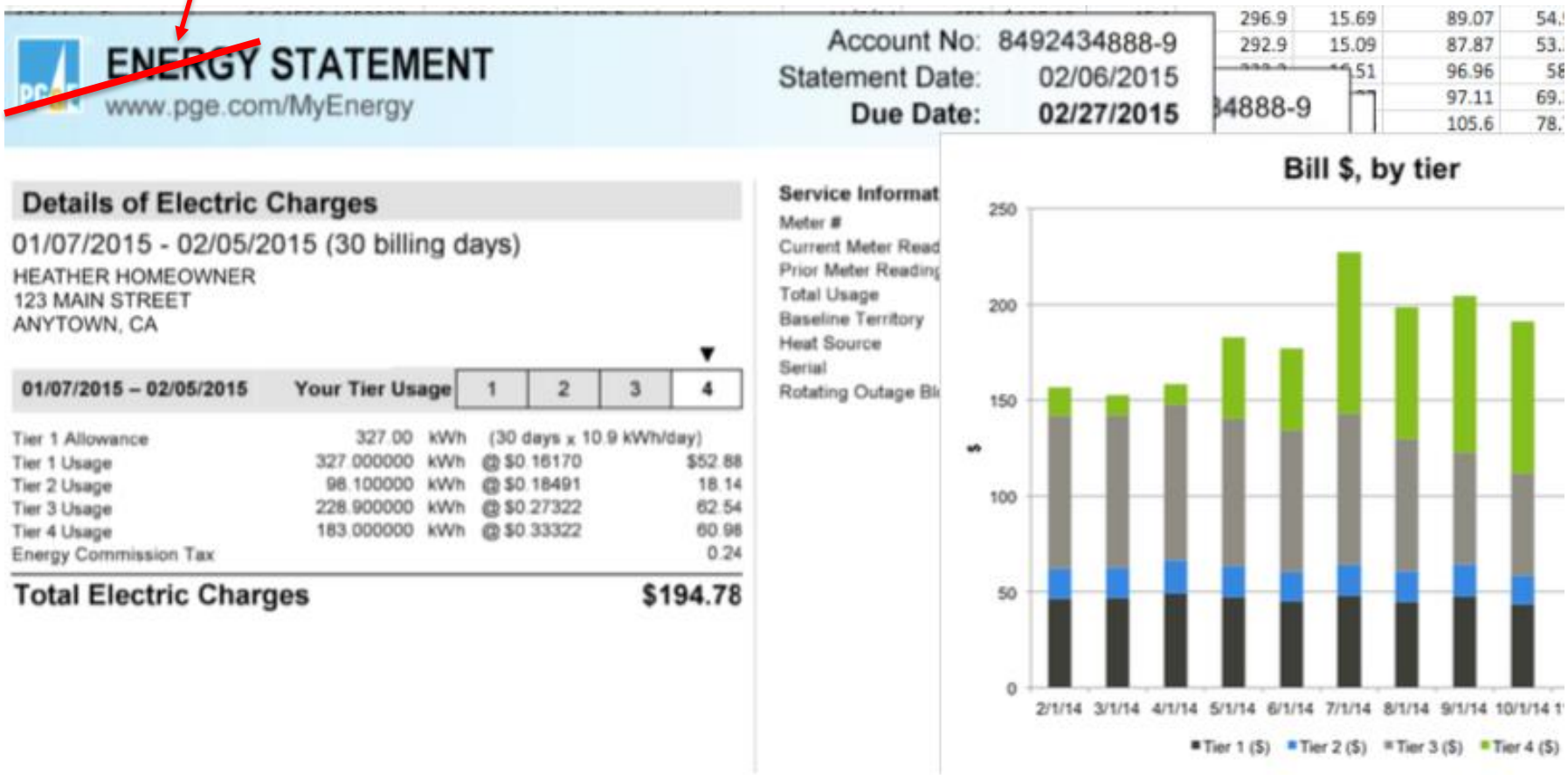
Thriving agricultural communities

Resilient ecosystems

Extra Slides

Rosedale Rio Bravo Use Case

[Water Use]



ENERGY STATEMENT
www.pge.com/MyEnergy

Account No: 8492434888-9
Statement Date: 02/06/2015
Due Date: 02/27/2015

Details of Electric Charges

01/07/2015 - 02/05/2015 (30 billing days)

HEATHER HOMEOWNER
123 MAIN STREET
ANYTOWN, CA

01/07/2015 – 02/05/2015	Your Tier Usage	1	2	3	4

Tier 1 Allowance	327.00 kWh	(30 days x 10.9 kWh/day)		
Tier 1 Usage	327.000000 kWh	@ $0.16170		$52.88
Tier 2 Usage	98.100000 kWh	@ $0.18491		18.14
Tier 3 Usage	228.900000 kWh	@ $0.27322		62.54
Tier 4 Usage	183.000000 kWh	@ $0.33322		60.98
Energy Commission Tax				0.24
Total Electric Charges				**$194.78**

Service Informat
Meter #
Current Meter Read
Prior Meter Reading
Total Usage
Baseline Territory
Heat Source
Serial
Rotating Outage Bl

296.9	15.69	89.07	54.
292.9	15.09	87.87	53.
	51	96.96	58
		97.11	69.
		105.6	78.

4888-9

Rosedale Rio Bravo WSD, CA

Objective	Enable tiered rates and a trading program within the district.
Description	RRB must have some unit of measurement by which to apply their rates, and by which to set allocations and determine volumes of water that can be legally traded. Landowners need to understand how their use is being charged, and have an understanding of what they have available to sell or what they need to buy, based on their account status.
Liaison	Eric Averett
Regulatory Context	RRB will need to incentivized reduced pumping rates in the context of SGMA and a Sustainable Groundwater Management Plan for the Kern Basin. Tiered rates and trading are promising methods for doing so.
Workflow	
ET Requirements (time step, spatial resolution, etc…)	• monthly time step • Field-level polygons linked to land ownership polygons • uncertainty ideally no greater than +/-10%
Other Needed Data	Land ownership, pumping data, water trade accounting system

Almond Board, CA

Objective	• Improve corrections for irrigation of immature orchards; • Identify optimal maximum crop-coefficients in different climatic zones; • Identify irrigation strategies under different weather conditions that maximize both on-farm water use efficiency and crop yield in almonds
Description	Integration of satellite data on crop canopy conditions into web-based irrigation and nutrient management tools being developed by UC Cooperative Extension and the Almond Board; Integration of satellite- and ground-based measurements of ET in mature and immature orchards; Integration of satellite-based estimates of ET with yield and applied water data
Liaison	Spencer Cooper
Regulatory Context	
Workflow	
ET Requirements	• Weekly and daily time steps • Field scale
Other Data	

Colusa Groundwater Authority, CA

Objective	• Develop water budgets for the Colusa sub-basin • Track groundwater pumping within the basin
Description	
Liaisons	Mary Fahey, Jim Wallace, and Darrin Williams
Regulatory Context	The Colusa Groundwater Authority must develop a Groundwater Sustainability Plan under SGMA. Currently using consultants to estimate consumptive use, but hope this can become a more cost-effective way to do this for future GSPs
Workflow	
ET Requirements (time step, spatial resolution, etc…)	• Monthly or even seasonal time steps • Sub-basin scale, and potentially also by land ownership to track pumping
Other Needed Data	• Water deliveries • Pumping data

Diamond Valley, NV

Objective	Enable programs and practices that incentivize and give credit for reduced pumping in the basin. Allow for the quick sale, lease, and trade of groundwater in times when needed by willing participants
Description	• Increase understanding of water budget and % pumping reductions • Develop an empirical relationship between pumping and ET, and use ET maps to predict pumpage when no pumpage data exists • Identify reductions in ET in the early and late season from reduced irrigation • Identify within field variability and problem areas
Liaison	Jake Tibbitts, Eureka County Natural Resources Manager
Regulatory Context	Groundwater levels within Diamond Valley are rapidly declining, recently prompting the Nevada State Engineer's Office to designate the valley as a Critical Management Area.
Workflow	
ET Requirements (time step, spatial resolution, etc…)	• Weekly time steps • Mapped to water right / land ownership and to field outlines
Other Needed Data	Pumping volumes, land ownership and water rights, irrigated areas

System Cons. / TNC in Upper CO Basin

Objective	• A long-term, sustained system conservation program in the Upper Basin • Monitor water savings from changed irrigation or cropping practices at some of the TNC pilot project sites • Predict potential future water savings from various irrigation or cropping practices under consideration at various pilot sites
Description	
Liaison	Aaron Derwingson
Regulatory Context	• TNC is participating in the Bureau of Reclamations' System Conservation Pilot Program in the Colorado River's Upper Basin
Workflow	
ET Requirements (time step, spatial resolution, etc…)	• TBD
Other Needed Data	• ET Demands model to compare actual ET to what would otherwise have been the ET on that parcel for that given season • Parcel outlines