January 2018

OpenET

A Water Community Focused Open Source ET Project

Towards Filling the Biggest Gap in Water Information

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Chris Hain, NASA MSFC, Wim Bastiaanssen, IHE-DELFT . . . and many others . . .

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

NASA

DRI Desert Research Institute

California State University MONTEREY BAY

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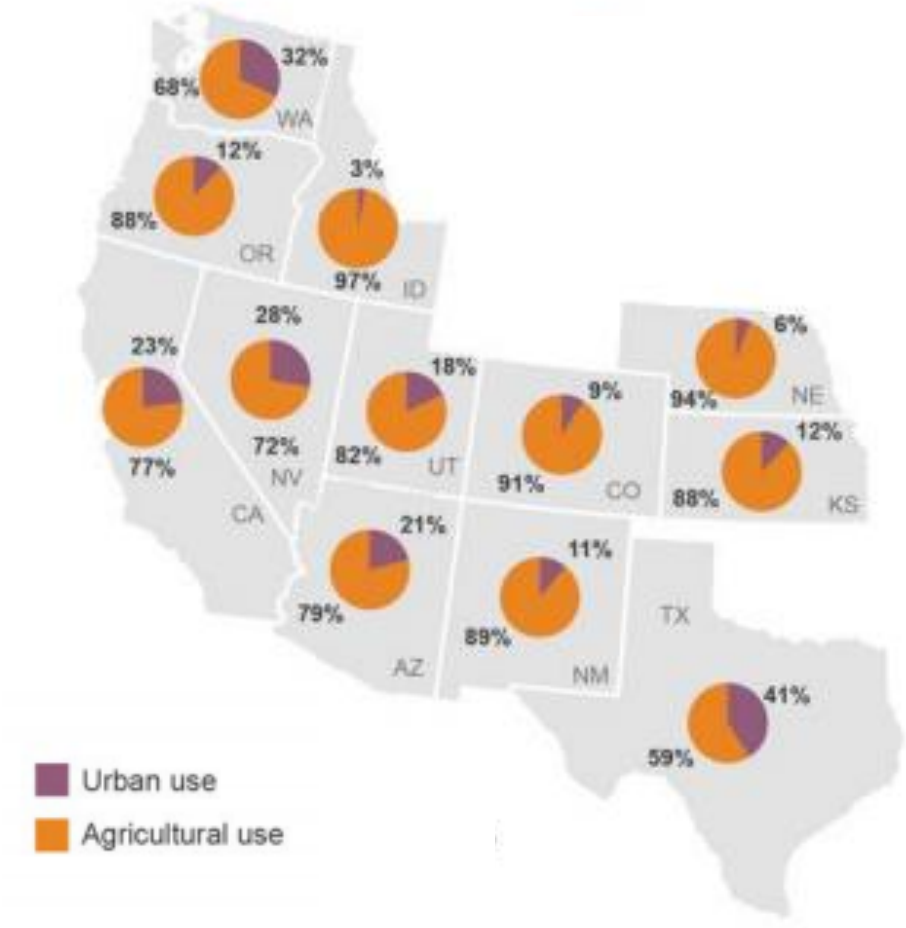
The Information Gap

The question of “how much water is being used?” in agriculture remains largely unanswered. Hard to manage what we are not measuring..

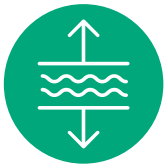


The water use information gap makes it difficult to effectively manage water and adopt new management strategies (reduction, trading, banking, etc…)

Map: PPIC, 2016; Photo: DWR, 2015

Importance of Open ET Data

Open ET data will inform sustainable water management

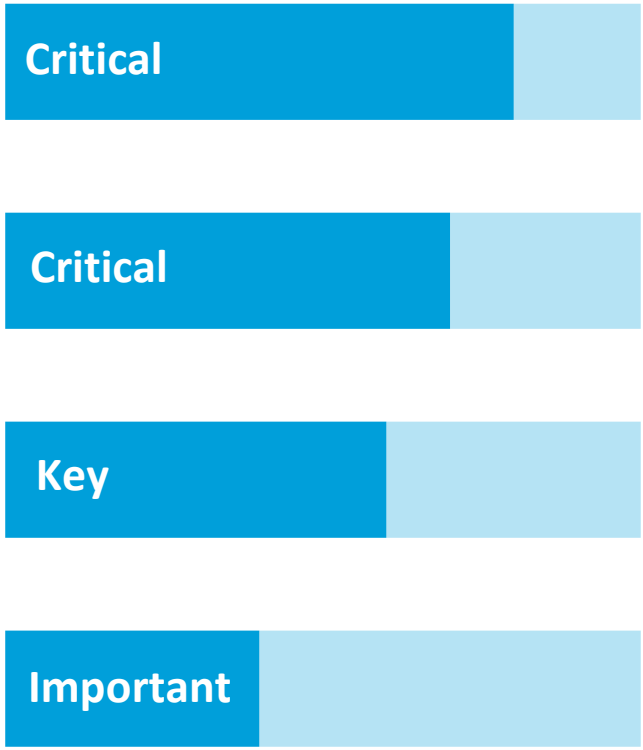


Healthy Water Trading Program

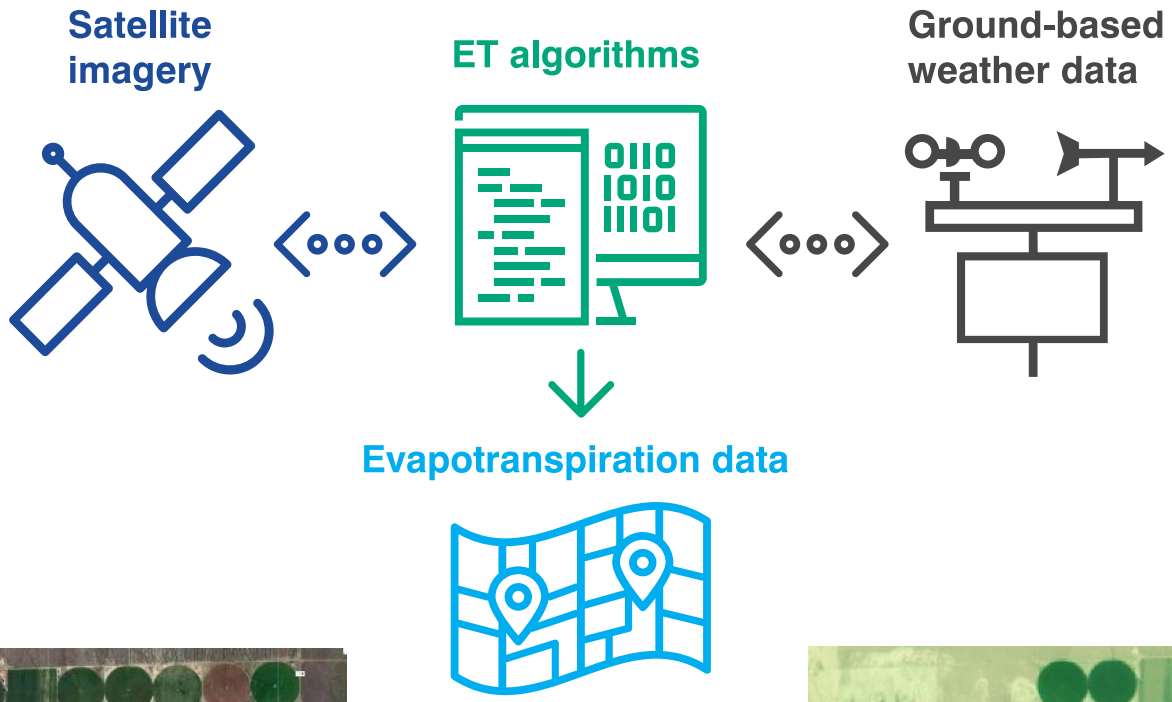
Groundwater Management (including SGMA)

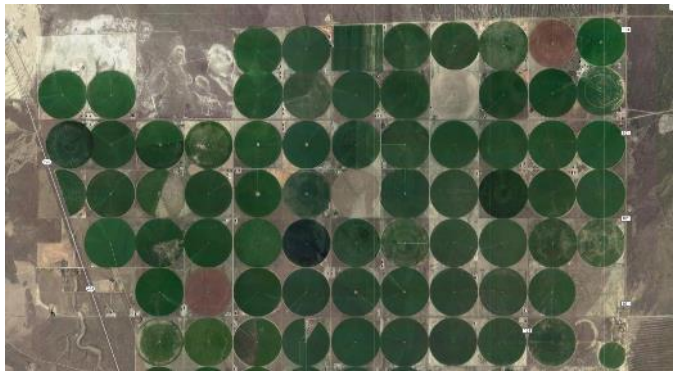
Irrigation and Crop Management

Sustainable Supply Chains

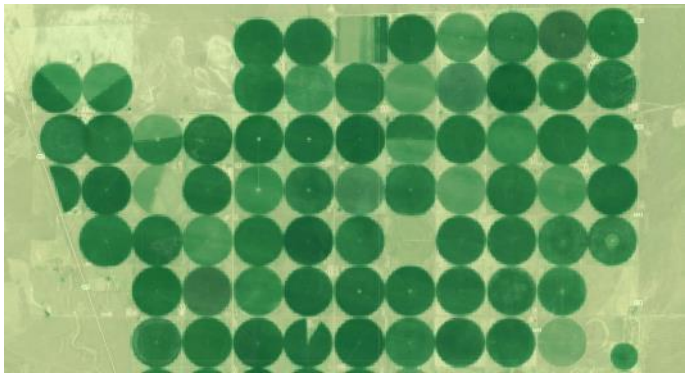


Proven Approach





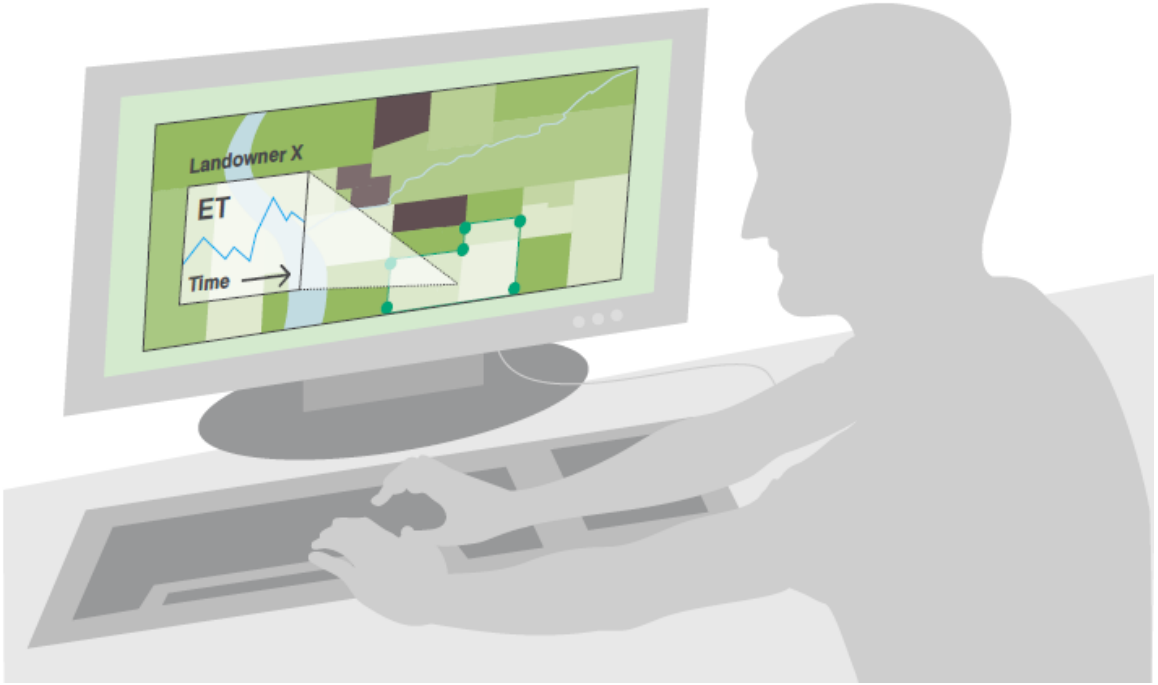
Satellite Archives



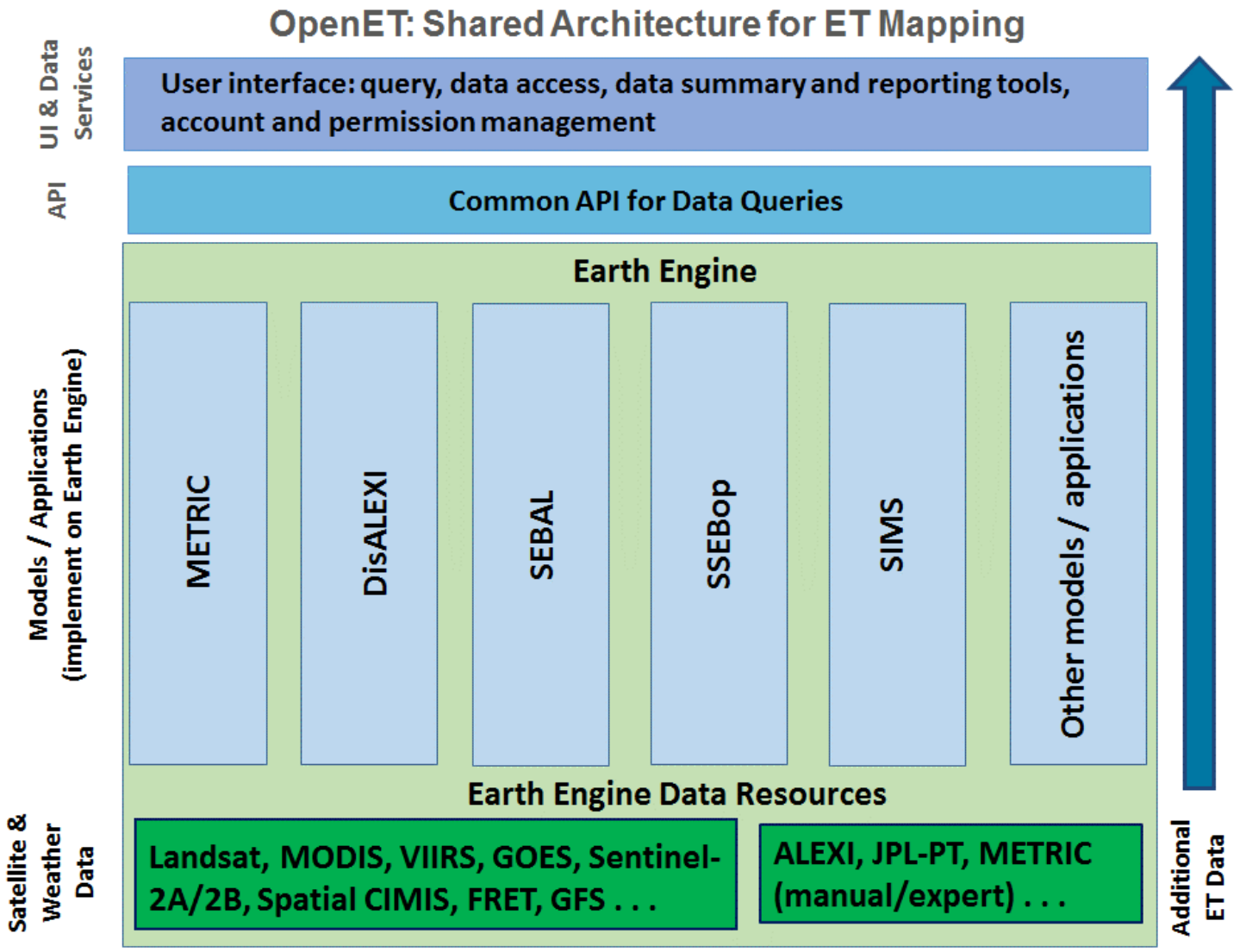
Consumptive Use

The Vision: An OpenET Software and Data Platform

- A web-based platform (OpenET) provides automated, and widely accessible ET data available to end users across the western U.S. for user-defined areas and time frames
- Open source software on GitHub so the water community can contribute, collaboratively code, or just look under the hood



One Platform, Multiple Operational Models



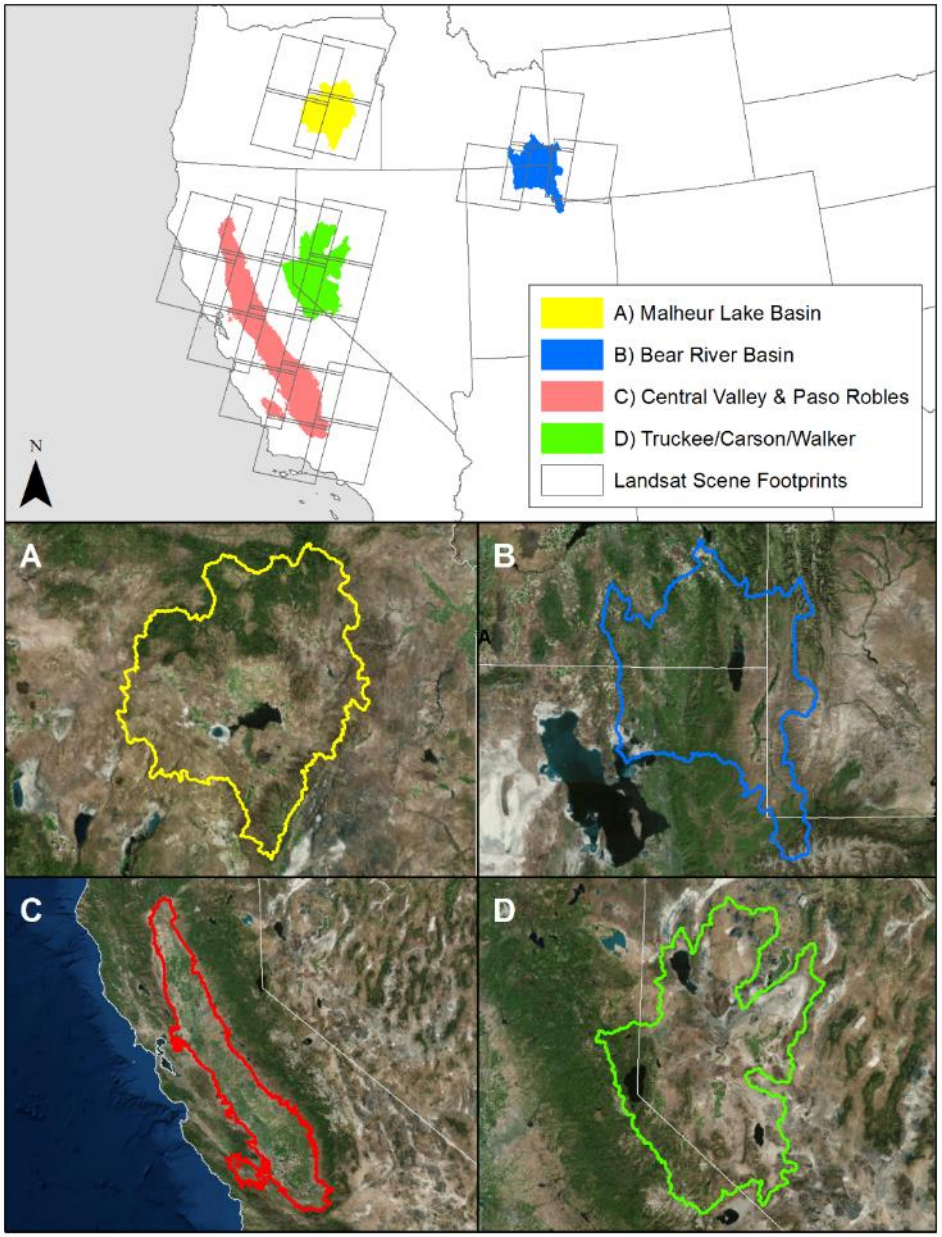
Initial Case Study Locations

OpenET

NASA ASP Project Stakeholders and Study Locations

NASA Applied Sciences Program – Water Resources: DRI/NASA ET Project

- Goal - Enable agency staff to gain a thorough understanding of models, assumptions and limitations, software operation and post-processing, and ultimately sustain in-house ET mapping over the long-term
- Focus on specific study areas for software development, testing, training, and initial implementation



State of Nevada
Department of Conservation & Natural Resources
Division of Water Resources
Jason King, P.E., State Engineer

Moving Past Engagement to Trainings

- The days of “loading dock science” are gone…
- Open sharing of codes and trainings on how to use the codes and web applications is a must if we want end users to actually adopt our products

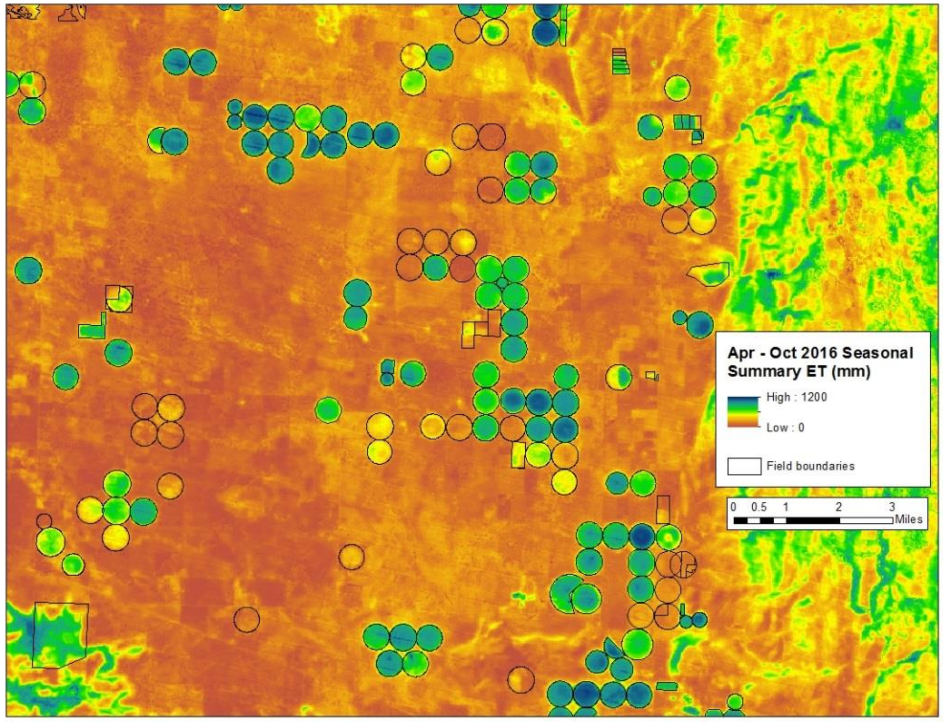
September 12-15, 2017 – DRI computer lab

NASA/DRI ET Workshop with 21 state water agency staff from 8 western states

Funded by NASA ROSES ASP Western States Remote Sensing of ET Project

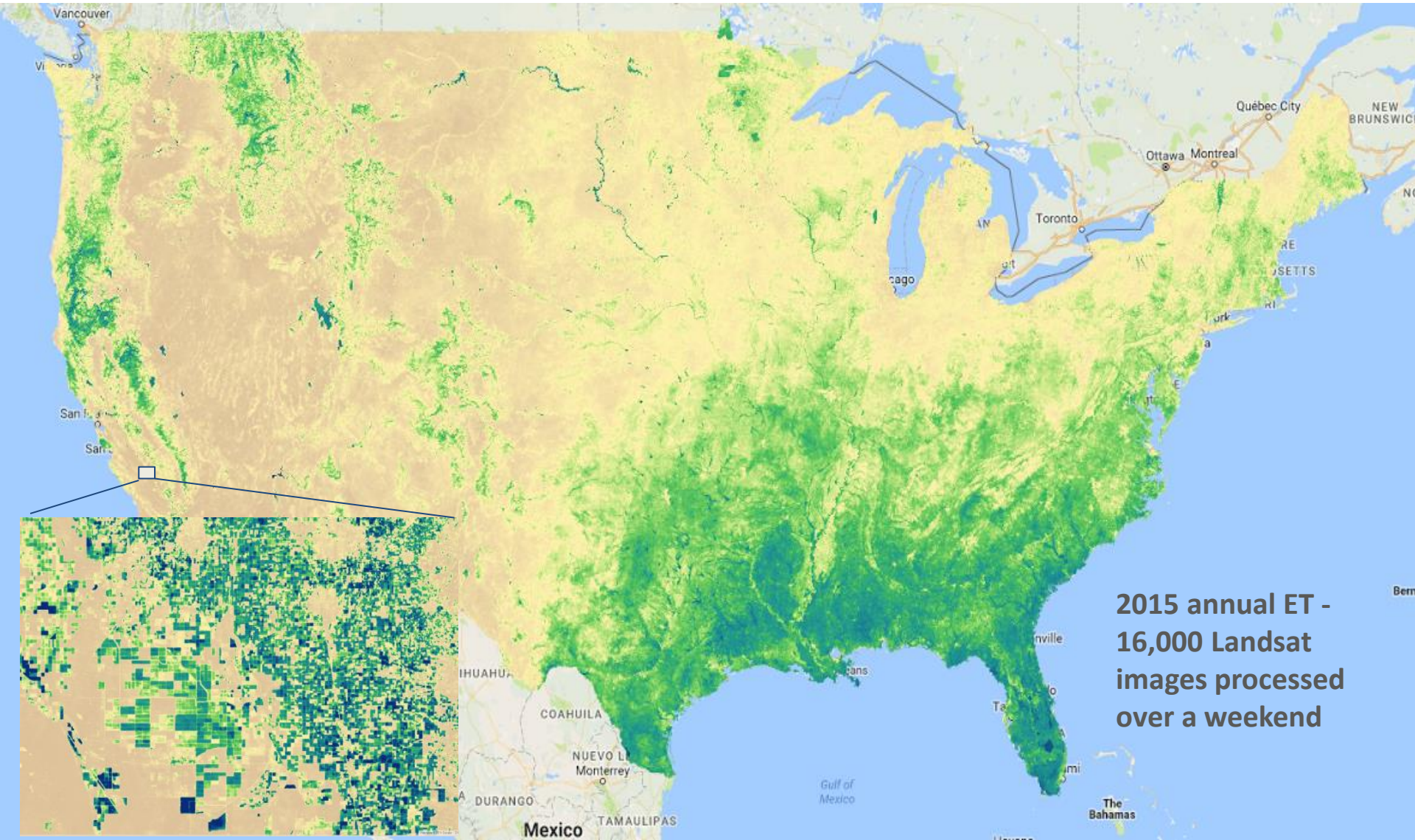
Quick Success Story

- Within a few weeks of the of the workshop, hydrologist at OWRD created a 2016 seasonal ET map with METRIC and ET Demands for the Malheur Lake Basin (SE OR) and provided maps to farmers for feedback



Our First Test

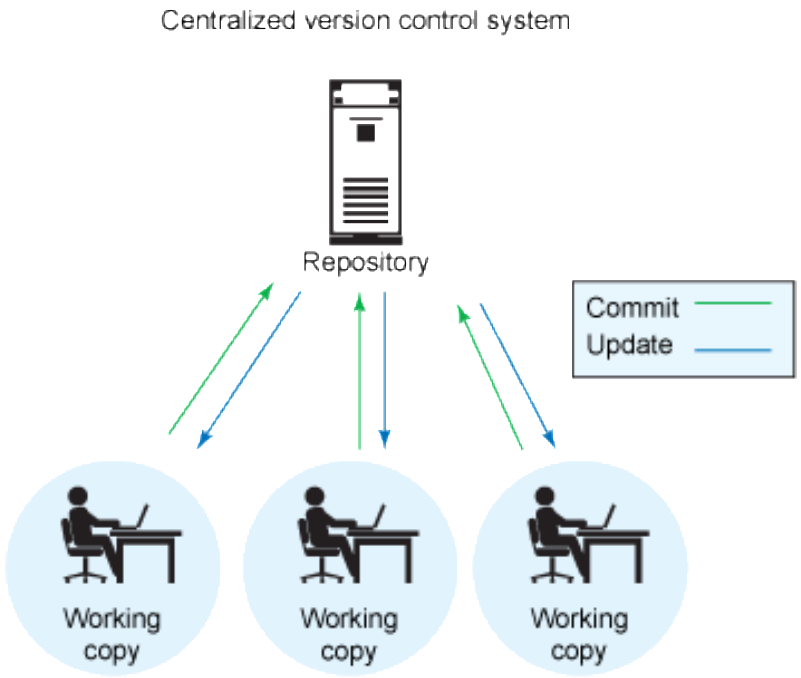
- Regional scale field level ET mapping on Google Earth Engine
- Example collaboration with Gabriel Senay, MacKenzie Friedrichs, and others at USGS EROS



Desired Breakthroughs

- For multiple ET research teams and water agencies to contribute to OpenET via the GitHub version control software
  - Goal of advancing science and providing end users with free to low cost ET data via a state-of-the-art web application

- Ensemble water use mapping to better understand model differences and co-variates in space and time
  - Climate models
  - Hydrologic models
  - Land cover land use
  - Why not ET models?... now that we can!

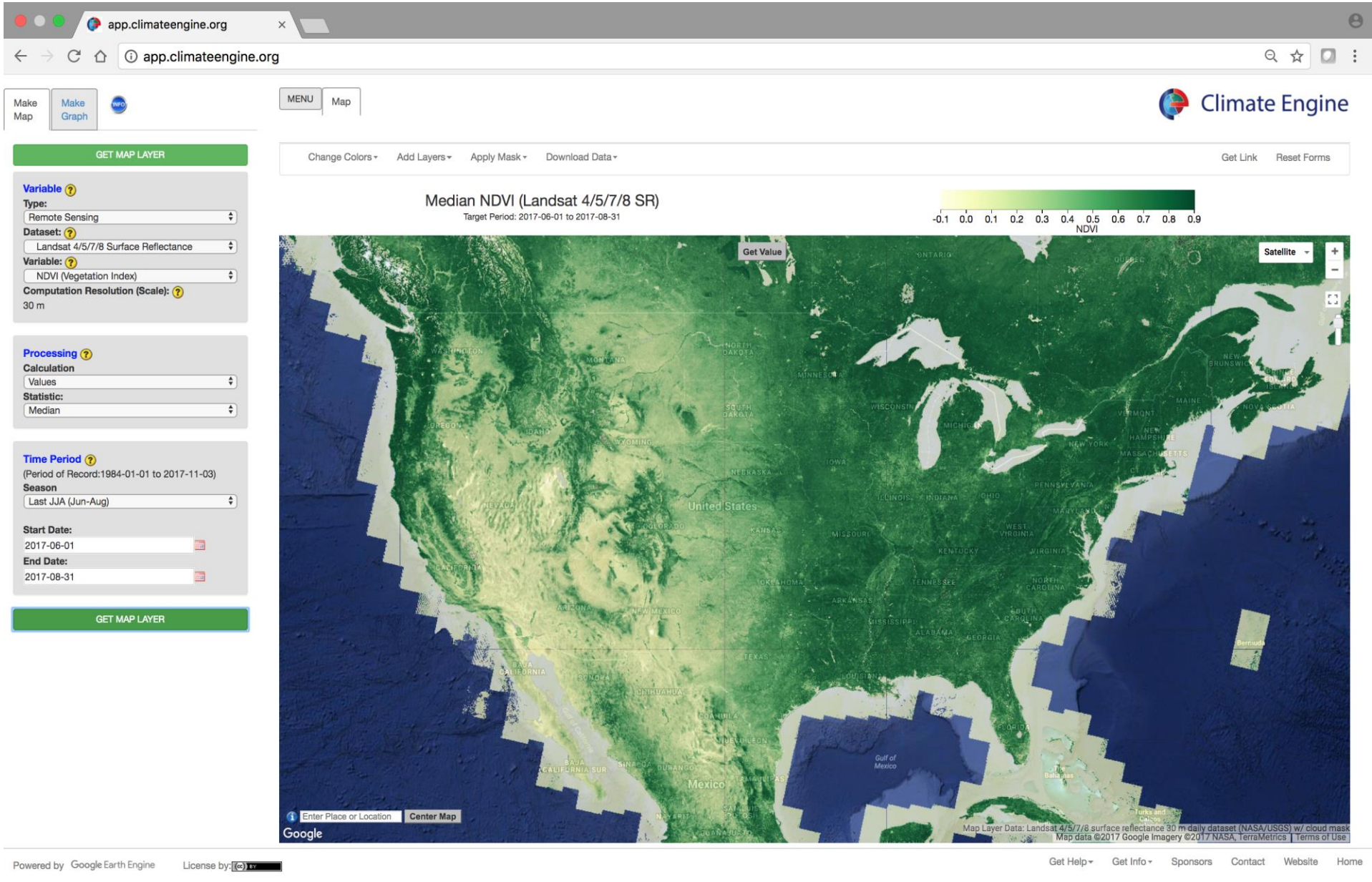


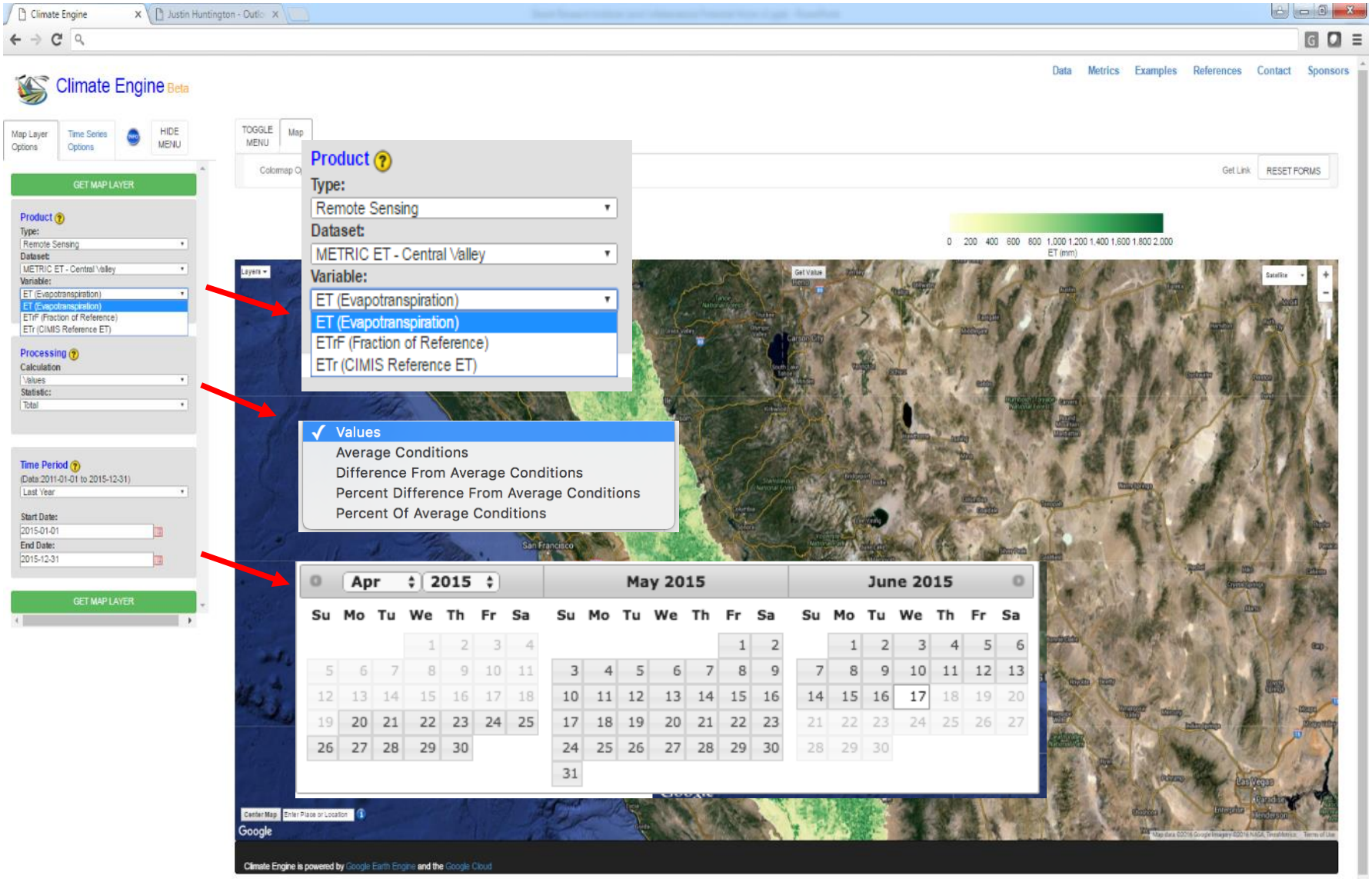
How can ET help Groundwater Management?

- Provide ability to assess 30+ years of water use (1984-current)
- Develop a more complete picture of baseline water consumption
- Complement groundwater pumpage inventories / metering program
- Fill in gaps in groundwater pumpage data
- Provide a backup and independent assessment of consumptive use
- Ability to assess within field variability / stressed / water short areas
- Provide readily available data to track and illustrate decreases in consumptive use as groundwater management plans are acted on
- Provide 7 day forecasts of reference ET / evaporative demand to improve irrigation scheduling
- Other ideas?

Example Interface - Climate Engine - app.climateengine.org

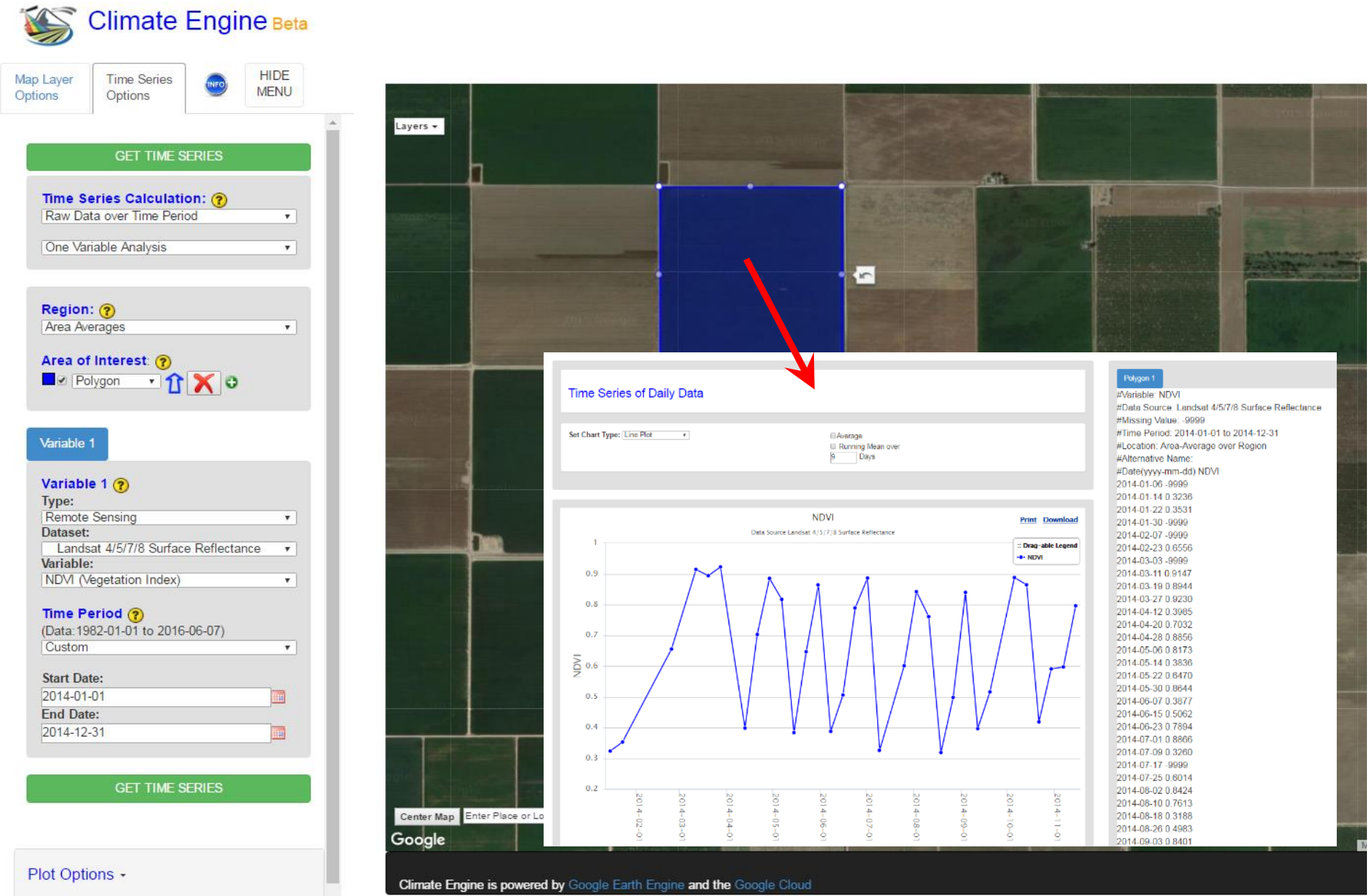
On-Demand Cloud Computing and Visualization of Climate and Remote Sensing Data




Climate Engine
Beta
Data
Metrics
Examples
References
Contact
Sponsors
Map Layer Options
Time Series Options
HIDE MENU
GET MAP LAYER
Product
Type:
Remote Sensing
Dataset:
METRIC ET - Central Valley
Variable:
ET (Evapotranspiration)
ETrF (Fraction of Reference)
ETr (CIMIS Reference ET)
Processing
Calculation
Values
Statistic:
Total
Time Period
(Data:2011-01-01 to 2015-12-31)
Last Year
Start Date:
2015-01-01
End Date:
2015-12-31
GET MAP LAYER
TOGGLE MENU
Map
Get Link
RESET FORMS
Product
Type:
Remote Sensing
Dataset:
METRIC ET - Central Valley
Variable:
ET (Evapotranspiration)
ETrF (Fraction of Reference)
ETr (CIMIS Reference ET)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000
ET (mm)
Values
Average Conditions
Difference From Average Conditions
Percent Difference From Average Conditions
Percent Of Average Conditions
Apr 2015
May 2015
June 2015
Su Mo Tu We Th Fr Sa
Center Map
Enter Place or Location
Google
Climate Engine is powered by Google Earth Engine and the Google Cloud

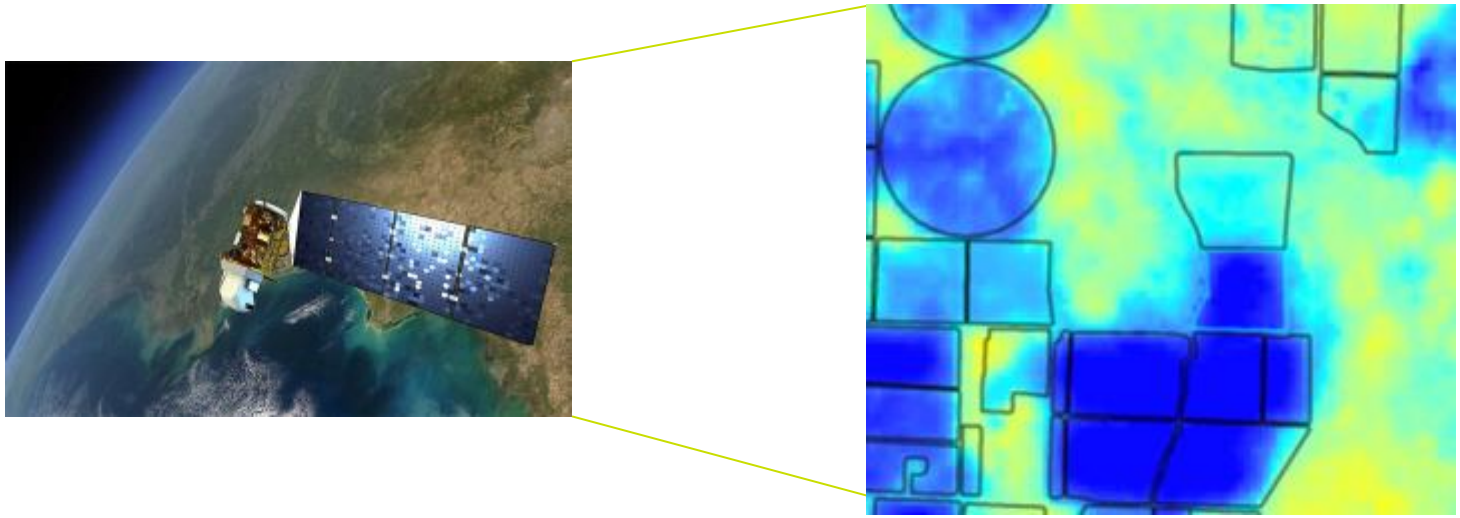
On-demand spatial averaging in time and plotting

-Time Series for 2014 – Alfalfa Field in Central Valley, CA



Summary

- Remote sensing is the only way to estimate actual ET over large areas and long time histories
- Field scale satellite archives combined with availability of climate data and cloud computing is creating transformative opportunities
- Rapid processing and visualization tools for simple consumptive use decision support
  - Will allow for all to perform field scale consumptive use analyis
  - Free and open access to objective data where everyone is treated equally will reduce the likelihood for disputes over data or lack of data
- Outreach through hands-on training is key for adoption
- Contact Justin.Huntington@dri.edu if interested in participating or for more details



Acknowledgements

November Issue of BAMS - climateengine.org

Huntington, J. L., K. C. Hegewisch, B. Daudert, C. G. Morton, J. T. Abatzoglou, D. J.McEvoy, and T. Erickson. 2017. Climate Engine: cloud computing and visualization of climate and remote sensing data for advanced natural resource monitoring and process understanding. Bulletin of the American Meteorological Society.

USGS

NASA

FEWS NET
FAMINE EARLY WARNING SYSTEMS NETWORK

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

CIRC
A NOAA RISA TEAM

NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

University of Idaho

Google

Program Design/Execution