

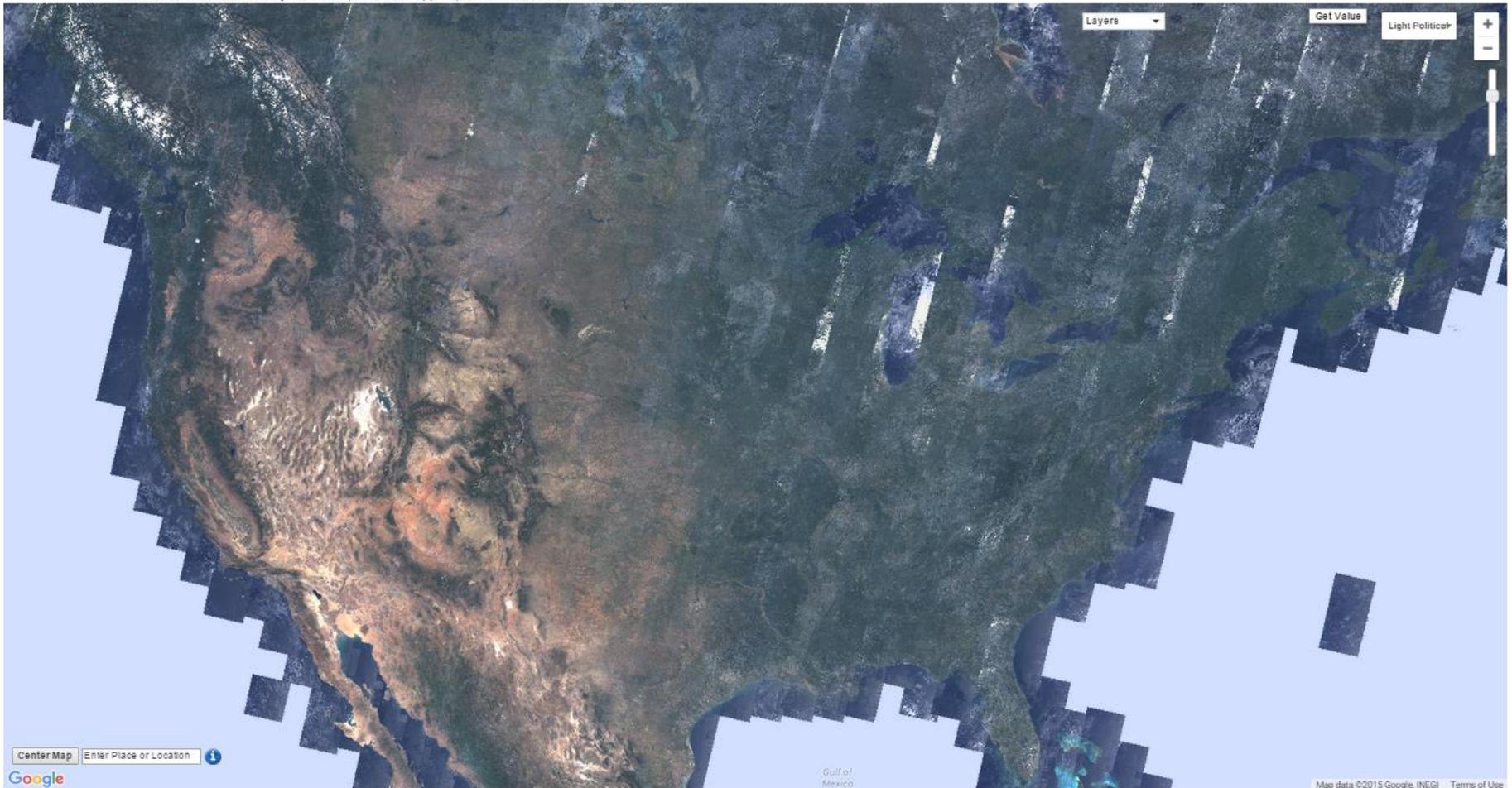
Justin Huntington, Desert Research Institute

ClimateEngine.org

- Climate Engine is a free web application that allows users to access and process global climate and remote sensing archives in the cloud

Median TrueColor

Data Source: Landsat 8, daily TrueColor (cloud mask applied) from 2015-08-15 to 2015-09-14



Landsat 8 true color composite for last 90 days

How We Started, Motivation, Our Team



How We Started

- Our project was funded through a **Google** Faculty Research Award in Summer of 2014

Motivation

- Develop a web application that allows the public to freely visualize global and place based maps and time series of climate and remote sensing archives together and in near real-time, for climate, drought, and vegetation, analyses, and most importantly, **data discovery**



Justin Huntington

Associate Research Professor, Hydrology
Desert Research Institute
University of Nevada, Reno
Justin.Huntington [at] dri.edu



Britta Daudert

Research Scientist
Desert Research Institute
University of Nevada, Reno
Britta.Daudert [at] dri.edu



Charles Morton

Research Scientist
Desert Research Institute
University of Nevada, Reno
Charles.Morton [at] dri.edu



Dan McEvoy

Graduate Student
Desert Research Institute
University of Nevada, Reno
Daniel.McEvoy [at] dri.edu



Andrew Joros

Research Scientist
Desert Research Institute
University of Nevada, Reno
Andrew.Joros [at] dri.edu



John Abatzoglou

Associate Professor, Geography
University of Idaho, Moscow
jabatzoglou [at] uidaho.edu



Katherine Hegewisch

Postdoctoral Fellow
University of Idaho, Moscow
khegewisch [at] uidaho.edu



Donovan VanSant

Graduate Student
University of Idaho, Moscow
vans1746 [at] vandals.uidaho.edu



Alex Peterson

Graduate Students
University of Idaho, Moscow
pete5506 [at] vandals.uidaho.edu

ClimateEngine.org

- Web application relies on Google App Engine, Google Maps API, and Google Earth Engine
- Google App Engine is linked to Google Earth Engine through the Python API and allows for on demand parallel cloud computing
- Users input collection and time parameters -> Google App Engine passes these parameters to Google Earth Engine -> results return to Google App Engine



Google
App Engine



Google earth engine
a google.org project

Google Cloud Datasets

Climate Engine

Data Metrics Examples References Contact Sponsors

Map Layer Options Time Series Options Map

Link RESET FORMS

Map Layer Request -

GET MAP LAYER

Product
Dataset:

- ✓ UI METDATA/gridMET
- CFS Reanalysis
- CHIRPS Precipitation
- Landsat 5 Remote Sensing
- Landsat 8 Remote Sensing
- MODIS Terra Remote Sensing

Calculation
Values
Statistic:
Total

GET MAP LAYER

Time Period
(Data: 1979-01-01 to Present)
Last 60 Days

- Start Date: 2015-04-20
- End Date: 2015-06-17

GET MAP LAYER

Google Cloud Datasets Accessed

- Landsat Remote Sensing
- MODIS Remote Sensing
- METDATA Gridded Meteorological
- CFS Reanalysis
- CHIRPS Precipitation

200 250 300 350 400
Precipitation (mm)

Layers Get Value Satellite

Variables Accessed

Climate Engine

Data Metrics Examples References Contact Sponsors

Map Layer Options Time Series Options

Map

Colormap Options-

Link RESET FORMS

Data Source: METDATA

Types of Variables Accessed

- Precipitation, Temperature
- Humidity, Wind, Radiation
- Reference ET (ASCE-PM ETo)
- Surface Temperature
- Fire Indices
- Vegetation Indices
- Drought Indices
- Snow Cover

GET MAP LAYER

Product

Dataset: UI METDATA/gridMET

Variable: PPT (Precipitation)

DPS (Dew Point Temperature)

ERC (Energy Release Component)

PDSI (Palm. Drought Sev. Ind.)

ETo (ASCE Grass Reference Evapotranspiration)

PPT (Precipitation)

RMIN (Min Rel. Humidity)

RMAX (Max Rel. Humidity)

SPH (Specific Humidity)

SRAD (Downward Radiation)

TMEAN (Mean Temperature)

✓ TMIN (Min Temperature)

TMAX (Max Temperature)

VS (Wind Speed)

PPT-ETo (Potential Water Deficit)

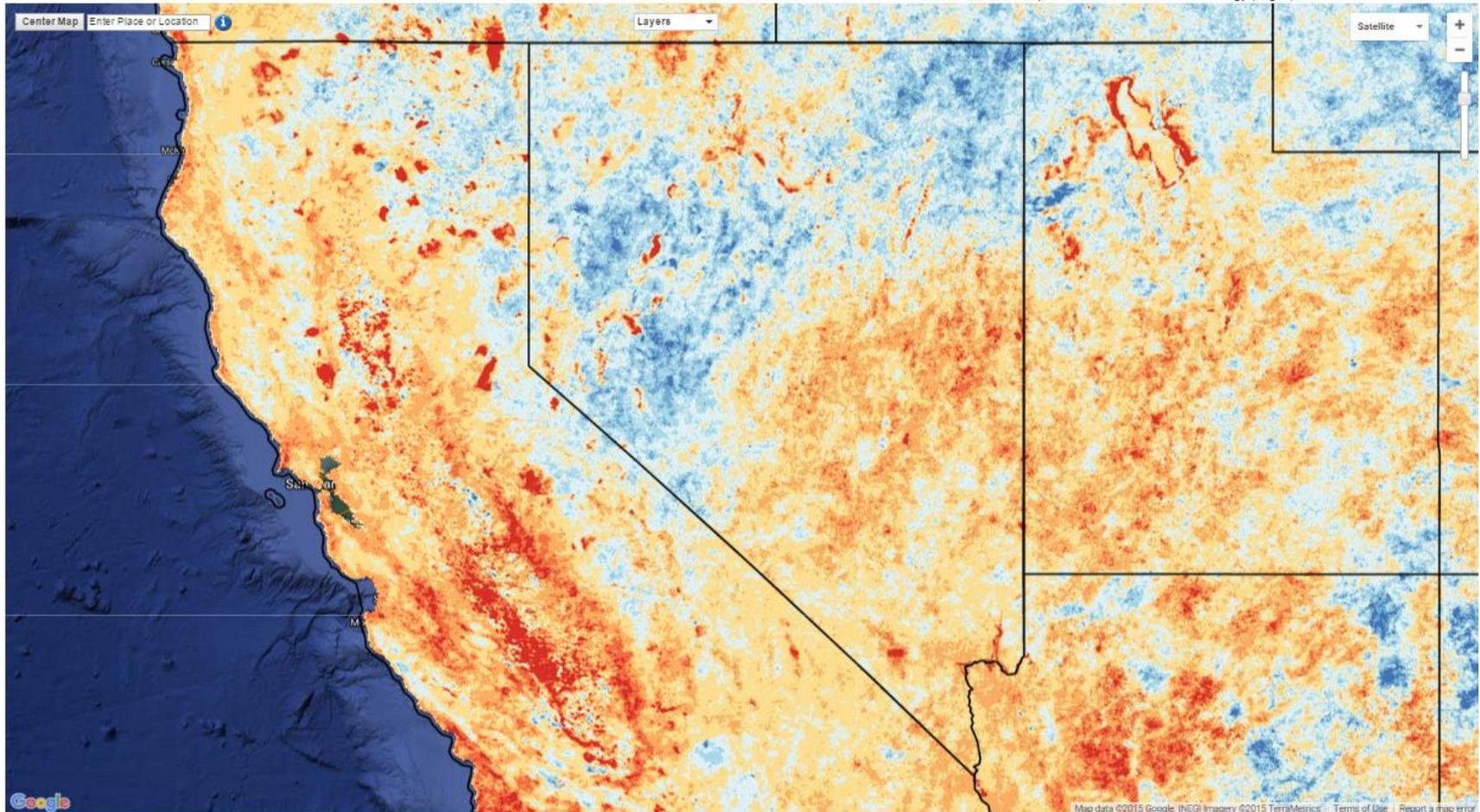
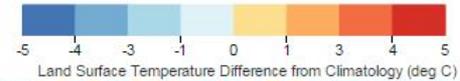
End Date: 2015-06-17

GET MAP LAYER

Application: 2015 Western US Drought

Median Land Surface Temperature during Day Difference from Average

Data Source: MODIS 8-day LST_Day_1km from 2015-07-01 to 2015-09-30
Average calculated from 2000-2015

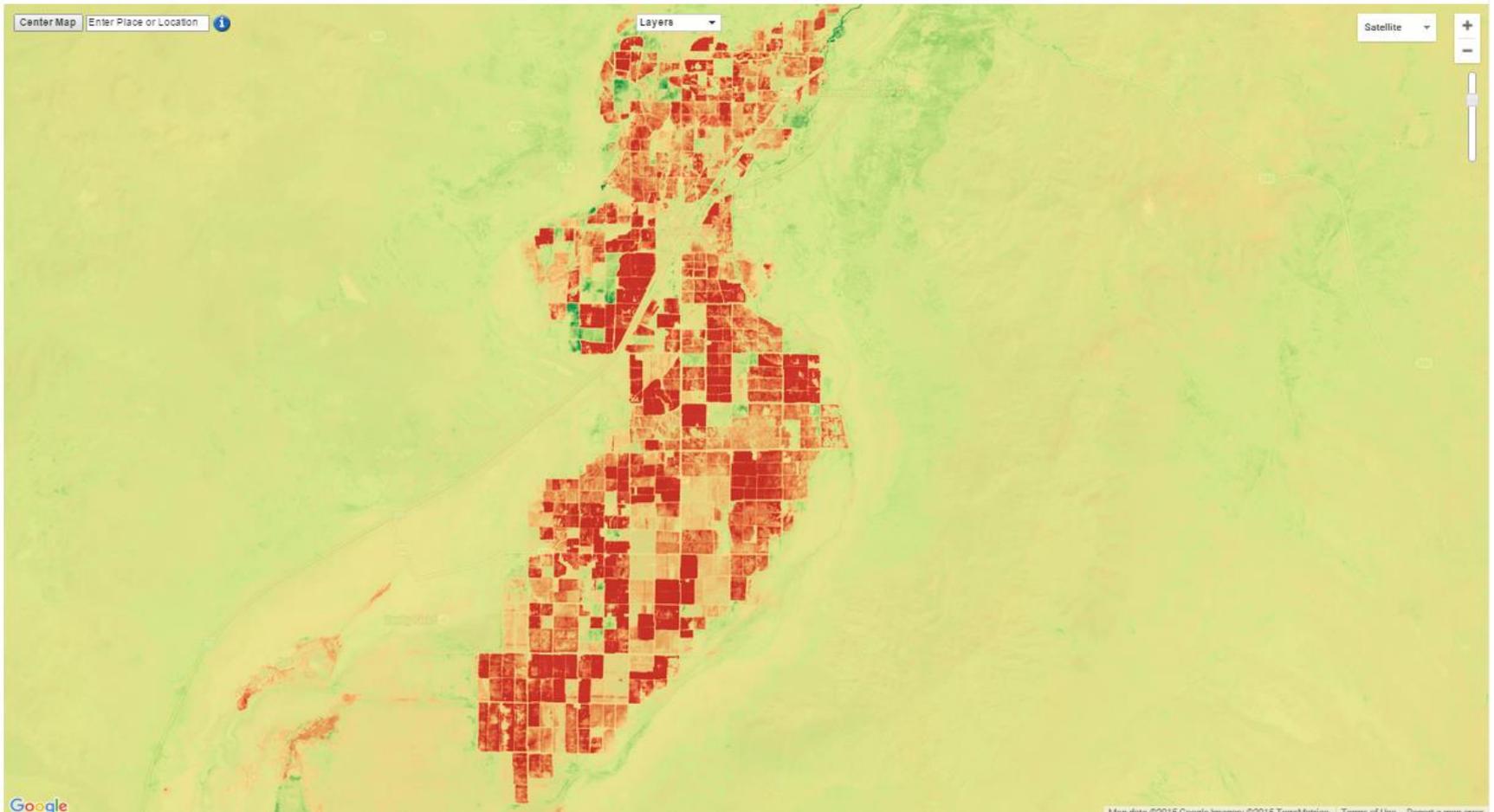
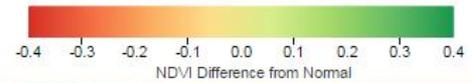


MODIS Surface Temperature Anomaly for July – Sept, 2015 -- <http://bit.ly/1MdPNHD>

Application: 2015 Nevada Drought

Median NDVI Difference from Average

Data Source: Landsat 8, daily NDVI (cloud mask applied) from 2015-04-01 to 2015-08-24
Average calculated from 2013-2013



Landsat 8 Difference from Average Conditions – April – August, 2015

Point Locations

Climate Engine

Data Metrics Ex

Map Layer
Options

Time Series
Options

Time Series Request -

GET TIME SERIES

Time Series Calculation:

Daily Data over Time Period

One Variable Analysis

Region:

Points

Point(s):

Marker	Zoom	Location	Name
<input checked="" type="checkbox"/>			<input type="text"/>
<input checked="" type="checkbox"/>			<input type="text"/>
<input checked="" type="checkbox"/>			<input type="text"/>
<input checked="" type="checkbox"/>			<input type="text"/>
<input checked="" type="checkbox"/>			<input type="text"/>

-121.8328,37.32

-120.6352,35.46

-119.0971,35.34

-119.7673,36.70

-120.4484,37.32

Product 1

Product 1

Dataset:

UI METDATA/gridMET

Variable:

PPT (Precipitation)

Time Period 1

(Data:1979-01-01 to Present)

Last 60 Days

Start Date:

2015-04-21

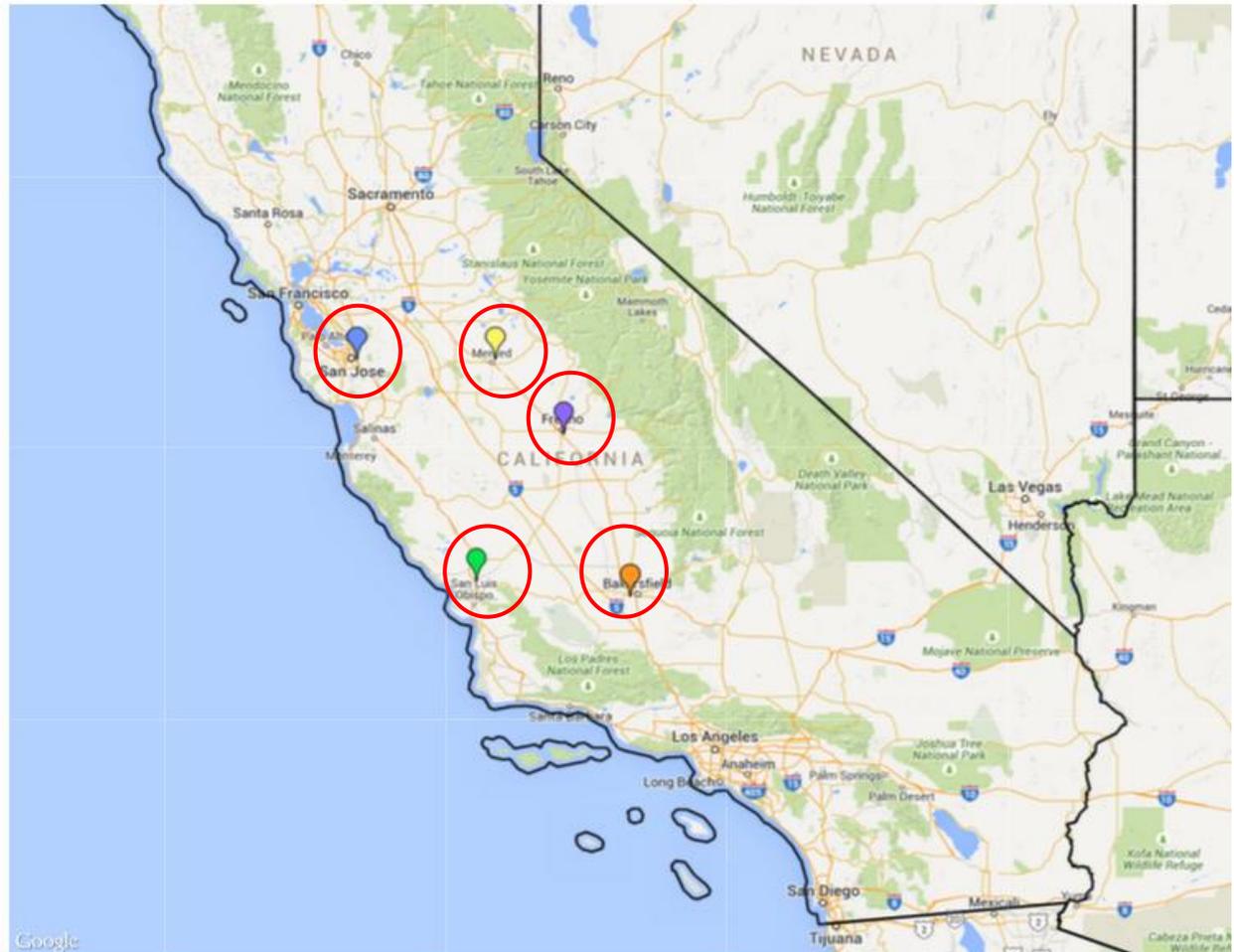
End Date:

Map

Colormap Options -

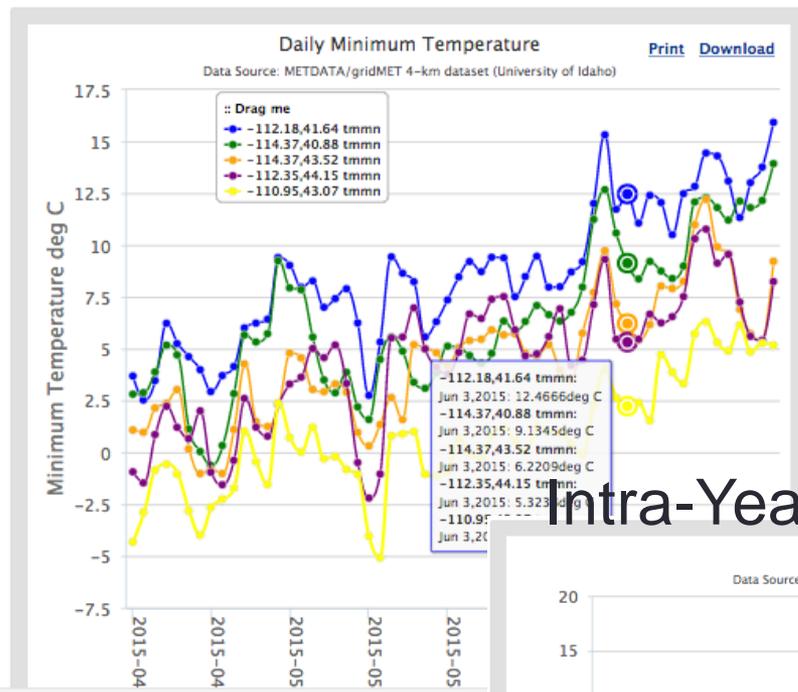
Apply Mask -

Download -

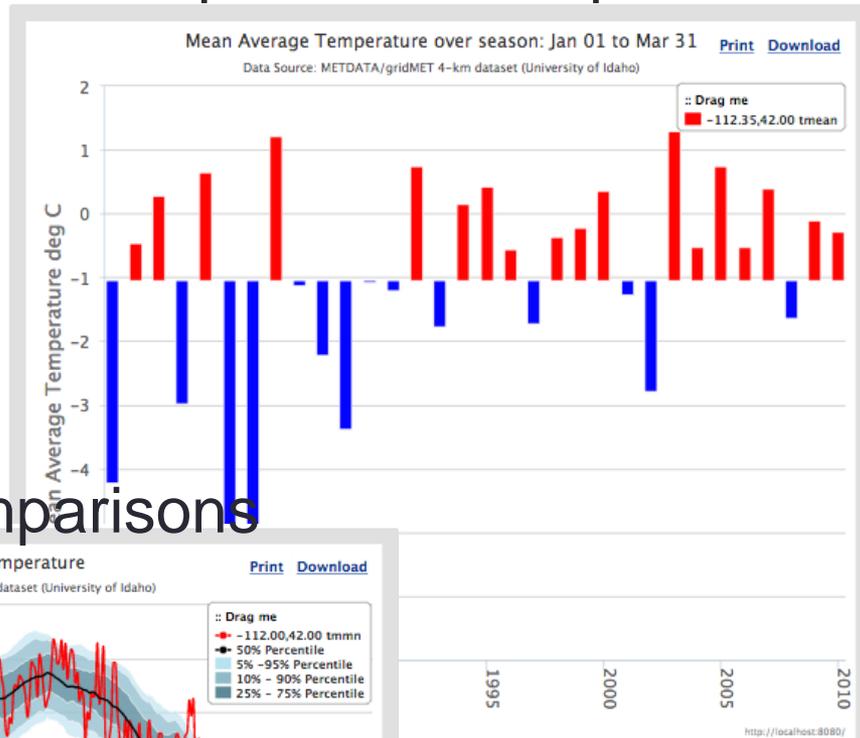


Time Series Analysis

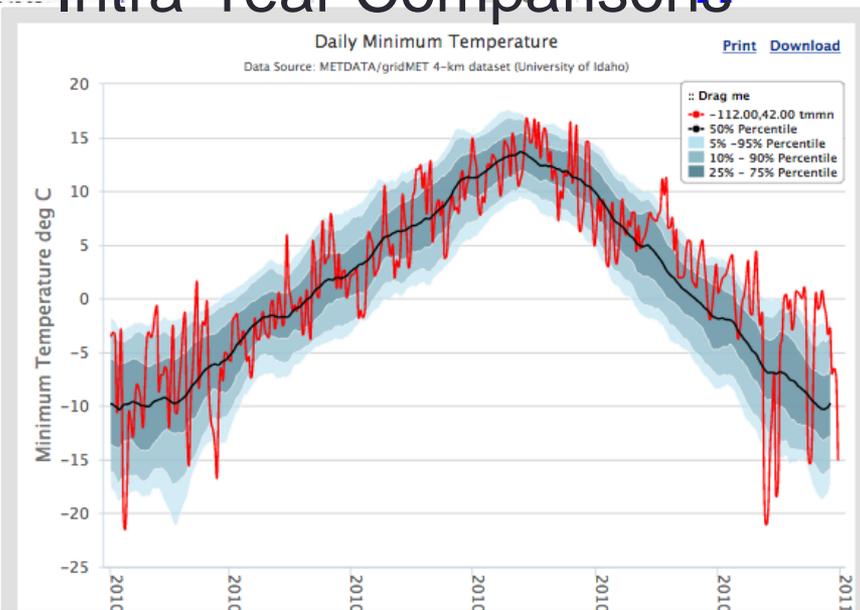
Multiple-Region Comparisons



Multiple-Year Comparisons



Intra-Year Comparisons



Point and Area Averages

The screenshot displays the Climate Engine web application interface. On the left, a sidebar contains configuration options for time series calculation, region selection, and product parameters. The main area shows a satellite map of agricultural fields with a blue polygon highlighting a specific area. A line graph in the bottom right corner shows the Daily NDVI for this area from 2013 to 2015.

GET TIME SERIES

Time Series Calculation:
Daily Data over Time Period
One Variable Analysis

Region:
Area Averages

Region(s):
Region Subregion
 Polygon

Product 1

Product 1
Type: Remote Sensing
Dataset: Landsat 8 Remote Sensing
Variable: NDVI (Vegetation Index)

Time Period
(Data: 2013-04-07 to Present)
Custom

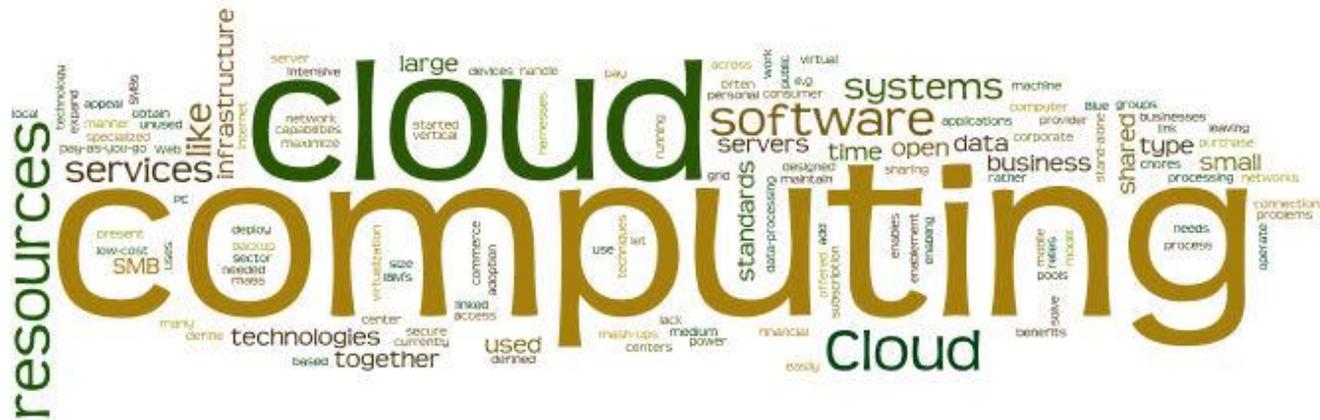
Start Date: 2014-01-01
End Date: 2015-09-15

GET TIME SERIES

Map Labels: W Pursel Ln, Merced River Ln, 927, Gage Ln

Graph: Daily NDVI
Data Source: Landsat 8, daily NDVI (cloud mask applied)
Y-axis: NDVI (0.0 to 0.9)
X-axis: Time (2013-04-07 to 2015-09-15)

Summary



- Creating never imagined opportunities for climate and remote sensing data discovery and applications
- Allowing easy access to data and products (developing countries, students, professors, managers, economists)
- Amazing teaching and learning tool

Contact Information:

Justin Huntington - justinh@dri.edu

John Abatzoglou - jabatzoglou@uidaho.edu

Some Nevada Example Links

The following links make maps of Landsat 8 difference in NDVI between the growing seasons of 2015 and 2013. The more you zoom and pan around the more data it pulls and computes on the fly J - Use the transparency bar on the right to fade in and out to see the background image for perspective.

Fallon – you can really see the field scale impacts of limited irrigations.. Also Lahontan Reservoir looks like a golf course because it is so full of grass instead of water..

<http://bit.ly/1K4dVz1>

Carson, Smith, & Mason Valley - You can clearly see where sub-irrigated areas on the west side of Carson Valley have above average greenness, and below average greenness in the down gradient flood irrigated and riparian areas. You can also see the combined effects of the fallowing / water right buyout program and drought in Mason Valley. Notice that many fields haven't been that impacted by the drought due to supplemental groundwater pumping.

<http://bit.ly/1Lxd3A1>

Lovelock – you can clearly see what a 0% water delivery year looks like in terms of alfalfa yields... too bad their groundwater is too salty to pump and use for irrigation water... it is probably the one place in Nevada where supplemental pumping would have minimal impact to surface water rights and the environment.. Also, notice the greener than normal rangeland areas to the north of Lovelock.

<http://bit.ly/1Nlnbsb>

Porter Canyon - you can see that the meadow area is quite dry this year; also the PJ uplands look stressed too..

<http://bit.ly/1hfXS3N>

Smith Creek Ranch – next door to Porter – you can see how the riparian areas along Smith Creek, and the ranch downstream have been stressed this growing season

<http://bit.ly/1EiyJzL>

Statewide 2015 growing season MODIS NDVI difference from the long term average (2001-2014). Lots of cool things to see in this image; green rangelands in Northern Nevada, irrigated areas are dry (red), recent fire scars in California and at Mt. Charleston in S. Nevada (red).. just to name a few interesting features..

<http://bit.ly/1fGT0DJ>

Same as above but for surface temperature. Amazing all the features that are in this surface temperature anomaly map, and how the features are tied to the current hydrologic drought, spring and summer rains, fires, and irrigation management. This tells a beautiful story of the average land surface energy balance for the last few months :)

<http://bit.ly/1NlrMui>

The beauty of all this cloud mapping stuff is that it is scalable across the globe and serves as such a great teaching tool.