Climate Engine - An Overview with a Focus on Drought and Restoration Use Cases

Adopting New Technologies and Earth Observations for Improved Early Warning, Natural Resource Management, and Decision Making

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Desert Research Institute - Climate Engine

Presentation to the Southwest Climate Adaptation Forum 2022

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Background

The Big Data Problem…..

- Dramatic increase in the use of Earth Observation (EO) datasets is happening
- Combining multi-source EO is challenging for scientists and practitioners alike
- Best practices should follow Findable, Accessible, Interoperable, and Reusable (FAIR) data principles

“If the data can’t work together, the scientists can’t either”

CREATING DATA TOOL KITS THAT EVERYONE CAN USE

BY ZHONG LIU, VASCO MANTAS, JENNIFER WEI, MENGLIN JIN, AND DAVID MEYER

Earth scientists need to make the growing wealth of data more accessible and build data services meant for interdisciplinary use.

As Earth science and the technologies it uses evolve and improve, the data and services that support the science also change and become more complex, often spanning multiple disciplines. The ability to easily find and seamlessly access these data and services in an open and integrated environment is essential to facilitating interdisciplinary research and applications and to broadening data user communities.

The sheer amount of available data is growing rapidly as the science community adopts the Findable, Accessible, Interoperable, and Reusable (FAIR) data principles [*Wilkinson et al.*, 2016] and emerging technologies such as cloud computing. Even with recent advances in data archiving and services (e.g., more data sets and related information are available online with customized data services and multiple data access methods), accessing heterogeneous inter-

Multiple special or discipline-oriented tools, often with steep learning curves, are required to handle heterogeneous, complex, and evolving Earth science data sets in interdisciplinary research and applications. Credit: Pixabay/Deborah Breen Whiting

Background

- Climate Engine began in 2014 with a grant from the Google Earth Engine Faculty Research Award Program

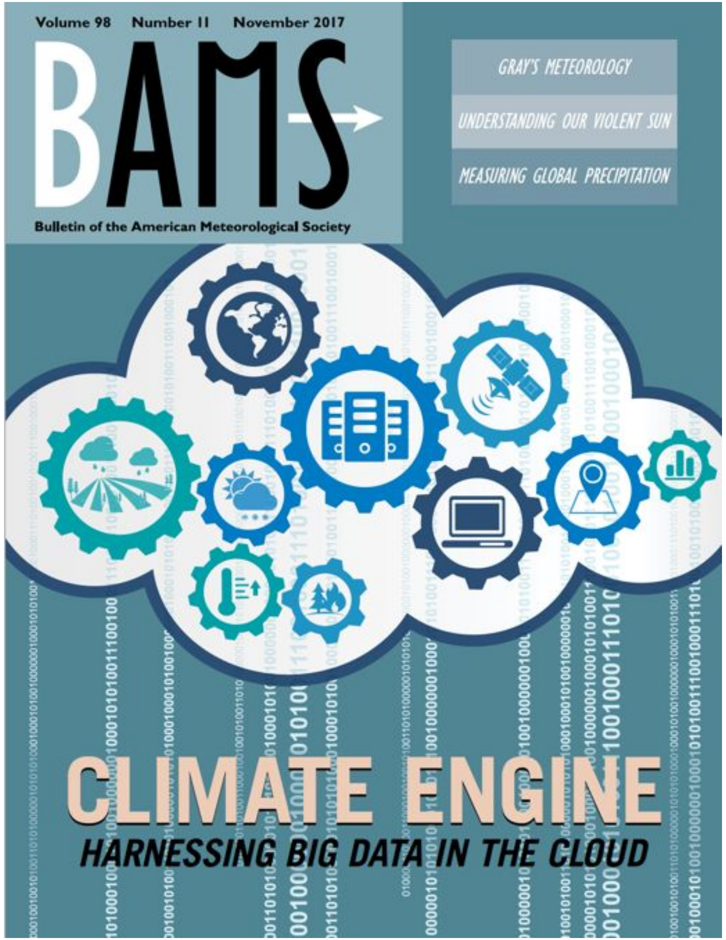
- Since, it has been primarily supported by NOAA-NIDIS, BLM, USFS, and other federal agencies

  * *Public <> Private Partnership* *

- Completed technology transfer in 2020 and partnered with Google Cloud to meet request of the private and public sector, and support technology problems and engagement

- Climate Engine helps to develop and deliver technology and geospatial data for actionable insights around sustainability, natural resources, climate risk, and early warning

DRI Desert Research Institute | ClimateEngine® | Google Cloud Partner

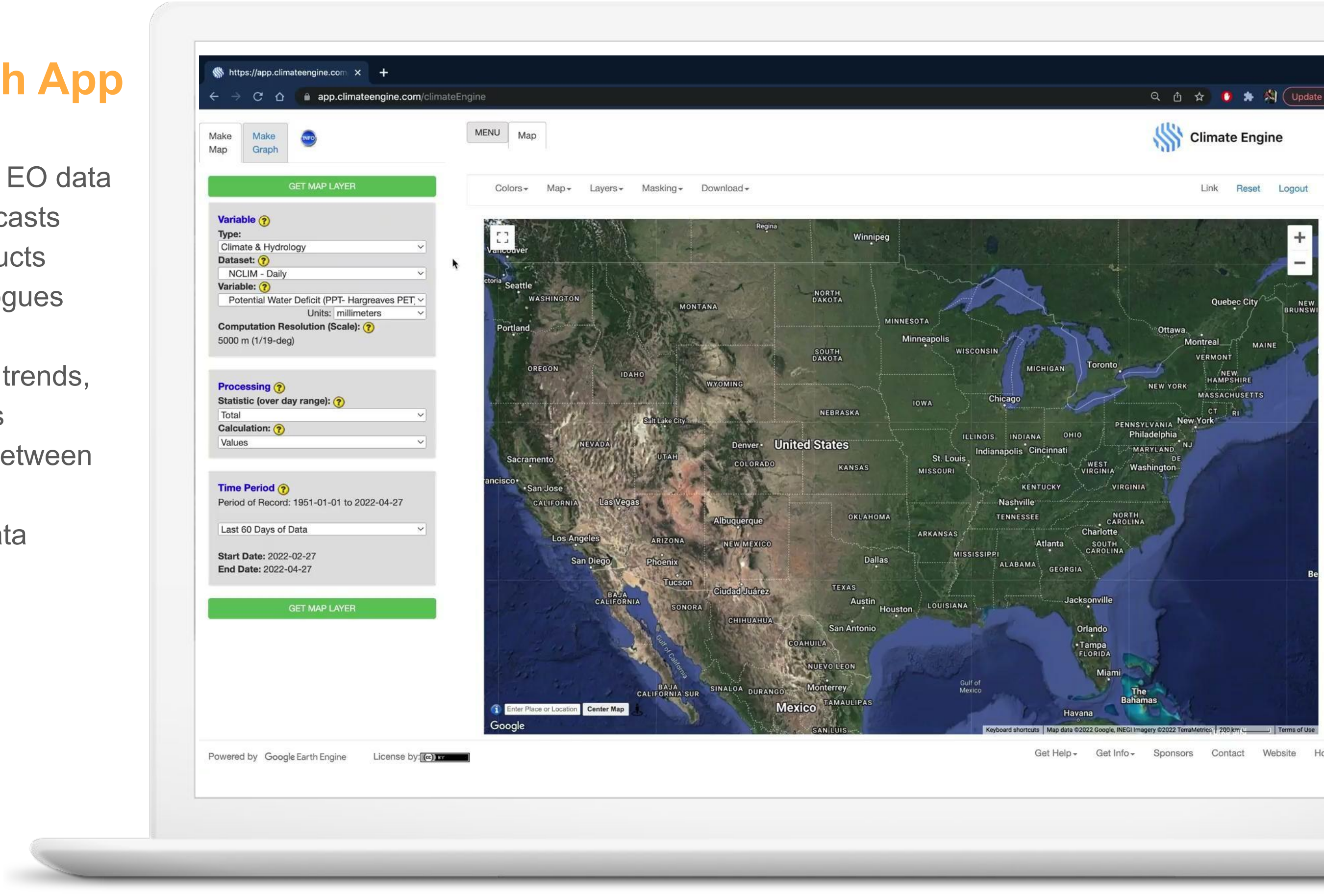


Huntington, J.L., Hegewisch, K.C., Daudert, B., Morton, C.G., Abatzoglou, J.T., McEvoy, D.J. and Erickson, T., 2017. Climate engine: Cloud computing and visualization of climate and remote sensing data for advanced natural resource monitoring and process understanding. *Bulletin of the American Meteorological Society*, *98*(11), pp.2397-2410.

Research & Visualize

Climate Engine Research App

- Access to petabytes of climate and EO data
  - Historical, current, and forecasts
  - Multi-platform satellite products
- Google, NOAA, custom data catalogues
- On-demand data Processing
  - Values, anomalies, indices, trends, probabilities, zonal statistics
  - Interoperable calculations between climate and satellite data
- Download maps and time series data



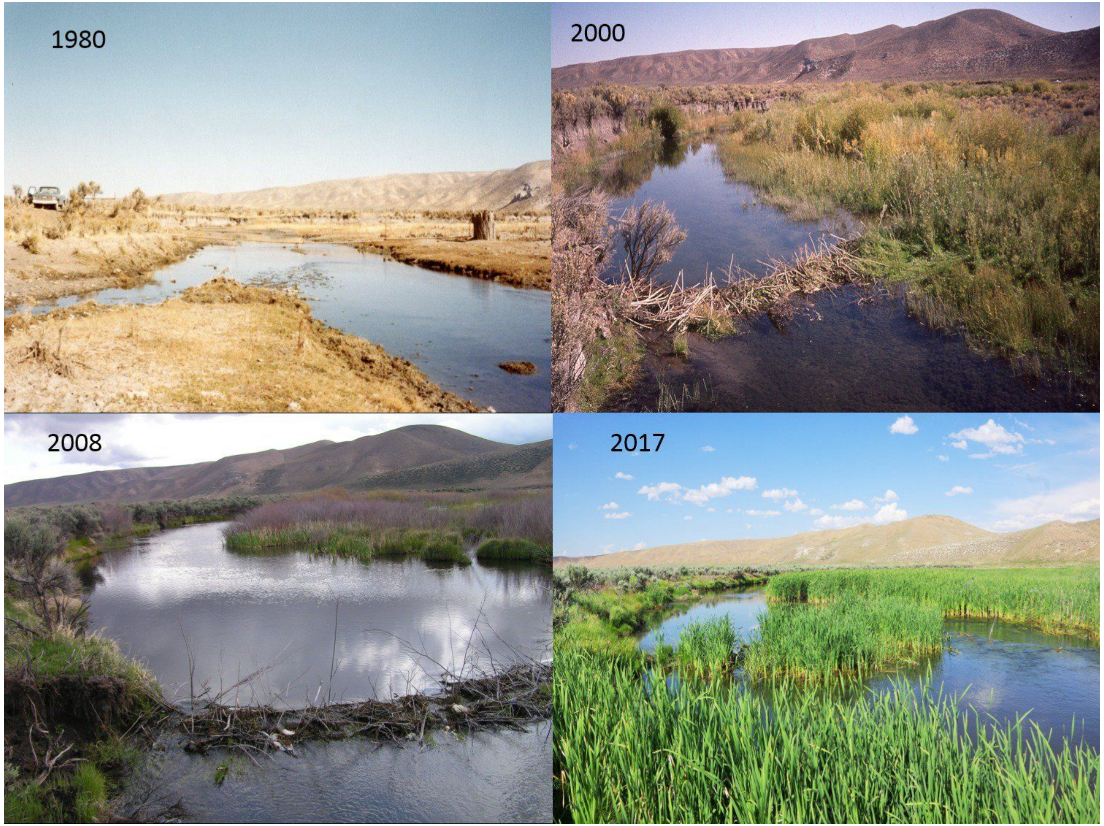
https://app.climateengine.com

Evaluating Restoration Outcomes
with Climate Engine

Four examples:

- Susie Creek, Nevada
- Upper Camp Creek, Oregon
- Upper Summit Spring, Nevada

Using remote sensing and climate data to evaluate outcomes of mesic restoration.

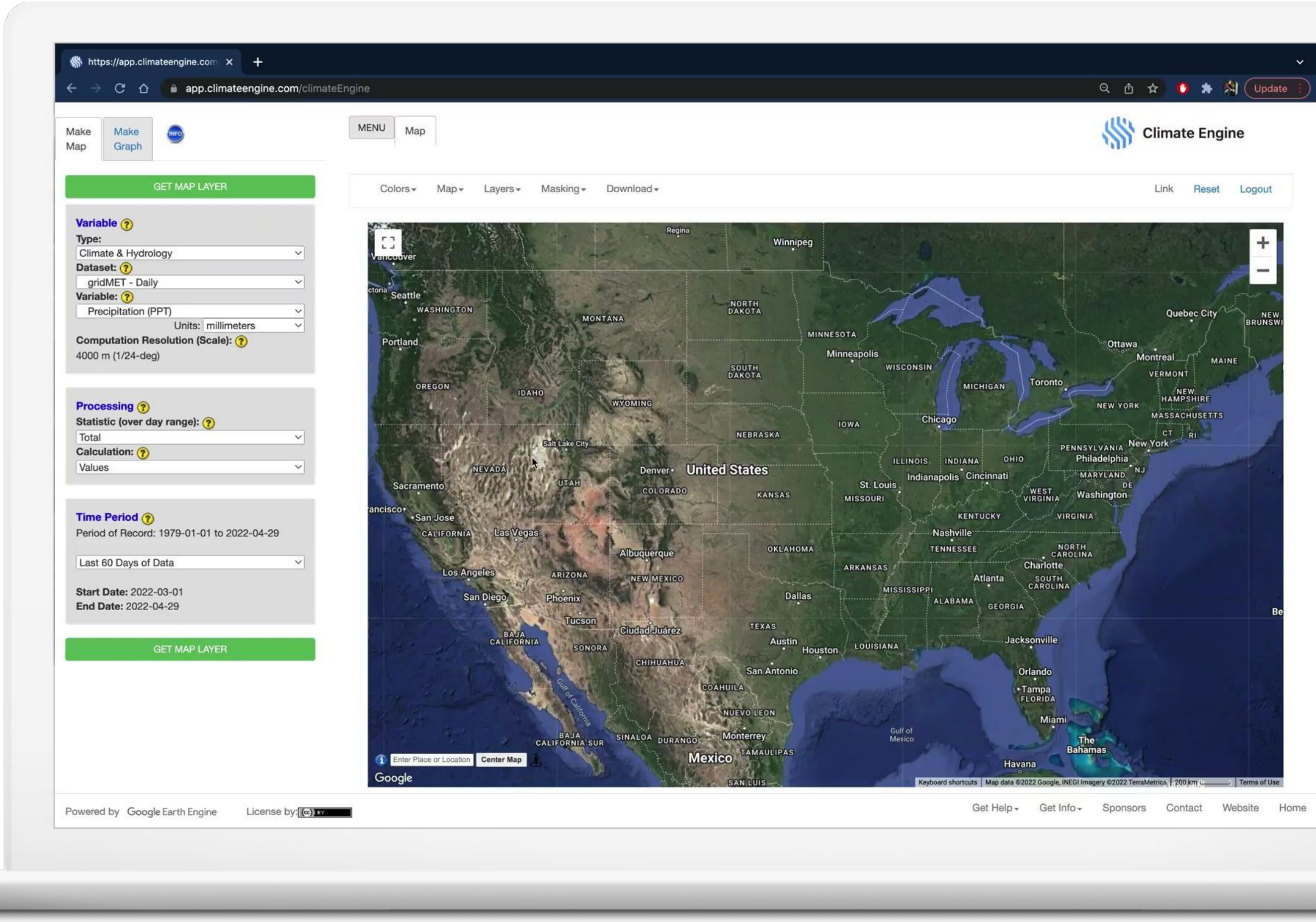


Susie Creek, Credit Zack Wurtzebach

Evaluating Restoration Outcomes | Susie Creek, Nevada

- Assess mesic vegetation **condition** during the summer months.
- Assess **trends** in summer vegetation production in mesic systems.
- Evaluate periods **before and after restoration** project to infer outcomes.
- Account for **climate drivers** by incorporating precipitation and drought metrics.

Restoration conducted in 1990s and 2000s, exclosures and changes to grazing.



Evaluating Restoration Outcomes | Upper Camp Creek, Oregon

- Assess mesic vegetation **condition** during the summer months.
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Restoration conducted between 2008-2011, beaver dam analogs.

Evaluating Riparian Condition | Upper Summit Spring, Nevada

U.S. Department of the Interior

Bureau of Land Management

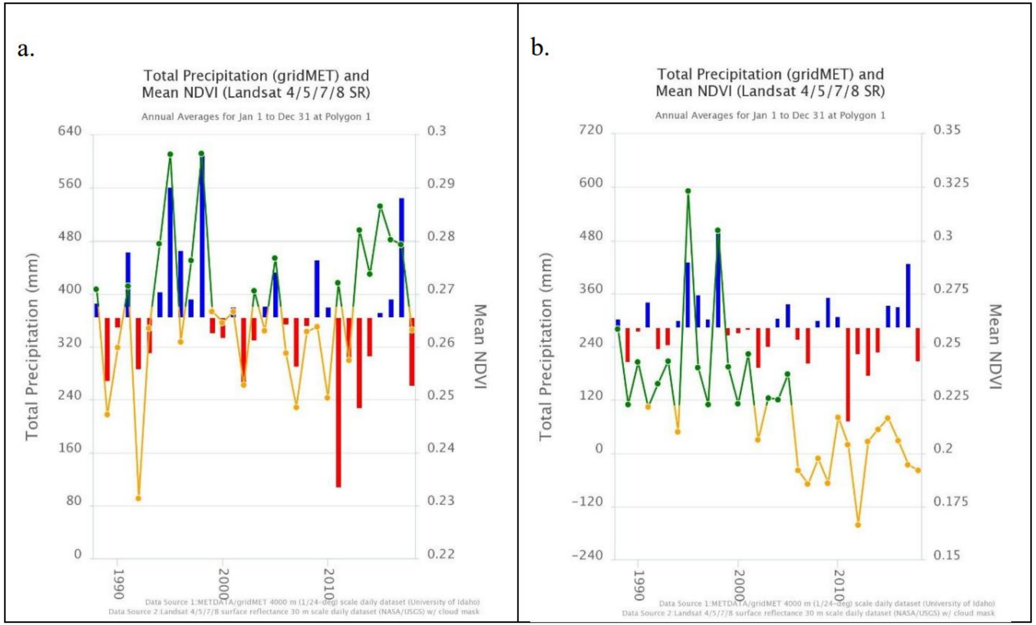
Rangeland Health Assessment and Evaluation Report

Pilot-Table Mountain Allotment

PREPARING OFFICE

U.S. Department of the Interior
Bureau of Land Management
Carson City District
Stillwater Field Office
5665 Morgan Mill Road
Carson City, NV 89701

Figure 13: NDVI Data Correlated to Precipitation for (a) Cornelius Spring and (b) Upper Summit Spring

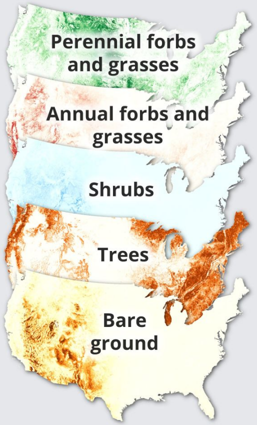


"Specifically, Upper Summit Spring appeared to have higher utilization rates and overall use of the spring, as indicated by the contributing factors for not meeting PFC listed in table 14. This included poor water quality and the lack of functional and structural plant groups due to overgrazing, which was not reported as a contributing factor at Cornelius Spring."

Analyze RAP in Climate Engine

Rangeland Analysis Platform

Climate Engine® Research App

	Vegetation Cover	Rangeland Production
Data layers		
Spatial resolution	30-meter	30-meter
Frequency	Annual	16-day Annual
Time period	1984–present	1986–present
Units	Percent cover	Pounds/acre

1 Analyze RAP alongside:

Drought metrics

- SPEI
- Drought monitor
- Short- and long-term blends

Hundreds of climate/veg variables

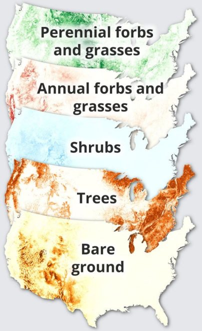
- Precipitation
- Extreme heat
- Evapotranspiration

2 Advanced visualization capabilities

- Trend maps
- Maps of departures from averages
- Percentile maps
- Advanced plotting capabilities with hundreds of variables

Research to Decisions

Bureau of Land Management

	Vegetation Cover	Rangeland Production
Data layers		
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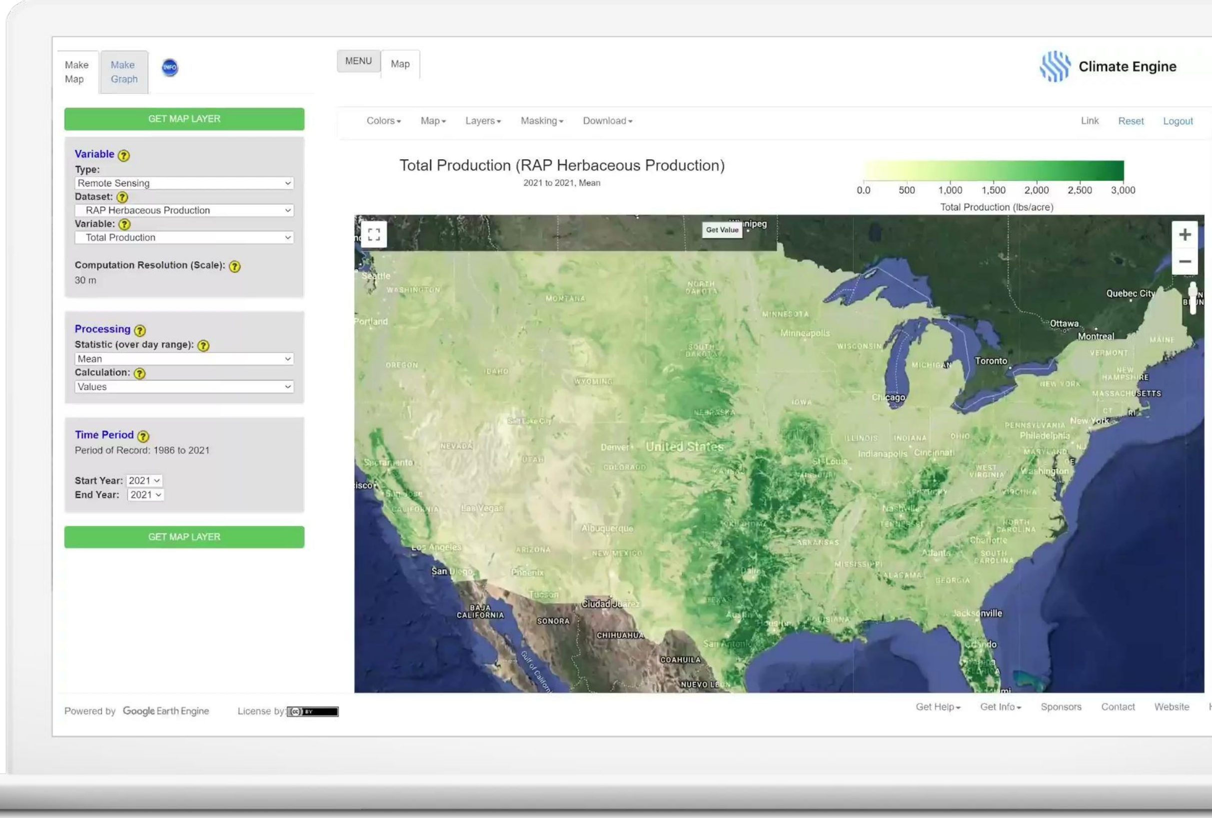
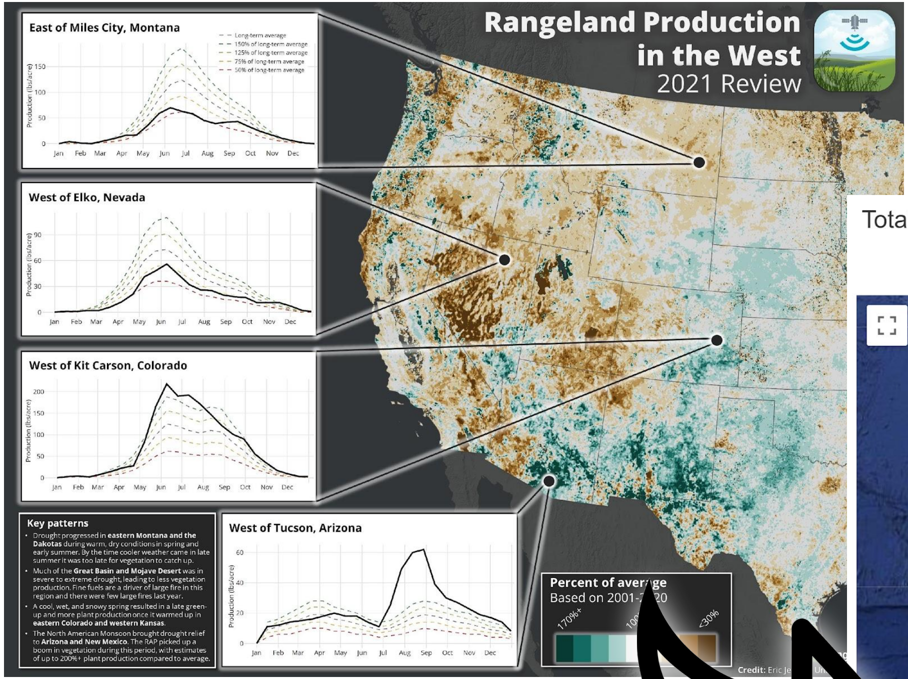
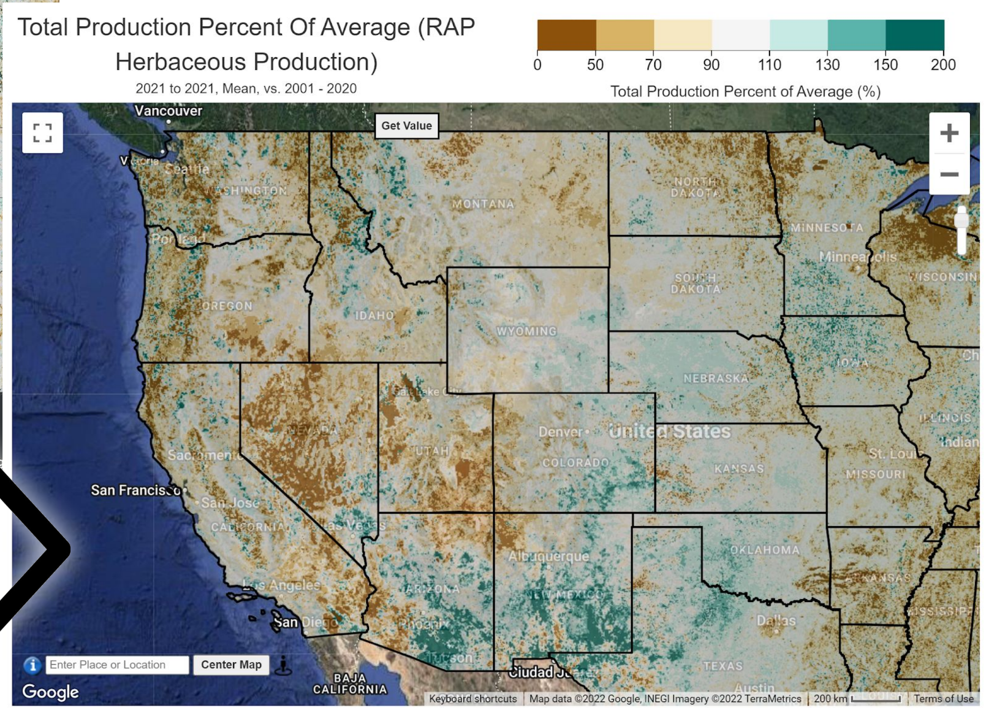


Map Rangeland Production Anomalies | Compared to 2001-2020



Coded out map in Earth Engine

Identical map produced without any code



Research to Operations

Climate Engine API

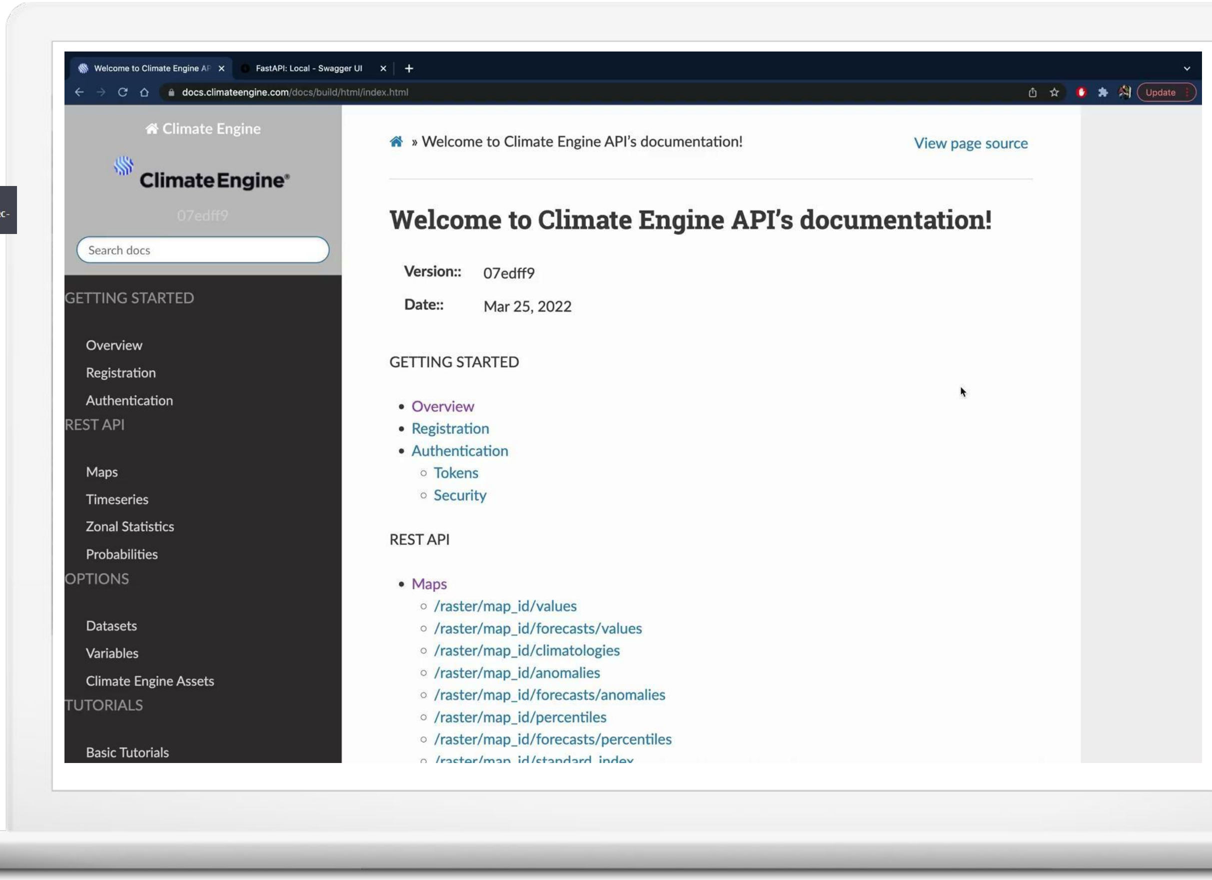
Google Earth Engine Script

Climate Engine REST API Call

```
https://geodata.dri.edu/raster/export/standard_index?
dataset=G&variable=eddi&start_date=2016-08-01&end_date=2016-10-
30&start_year=2014&end_year=2018&bounding_box=%5B-121.7%2C%2038.3%2C-
120.1%2C38.9%5D&export_path=ncei-nidis%2Fjody_test%2Fjh_test_norm
```

Operational Results

https://docs.climateengine.com



Questions and Discussion

Thank you!

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