

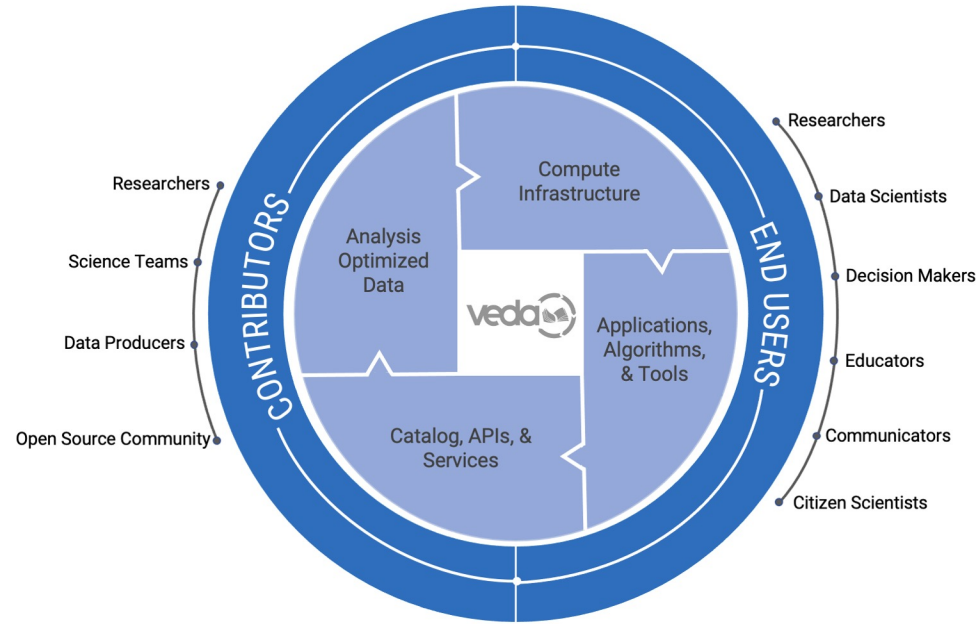


Visualization Exploration & Data Analysis

# Visualization, Exploration, and Data Analysis Platform

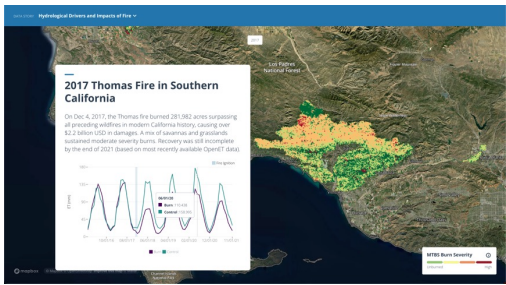
## Why?

- Interdisciplinary science depends on large amount of Earth science data and computational resources
- Working with these datasets is non-trivial
- Big data science requires advanced distributed computing knowledge

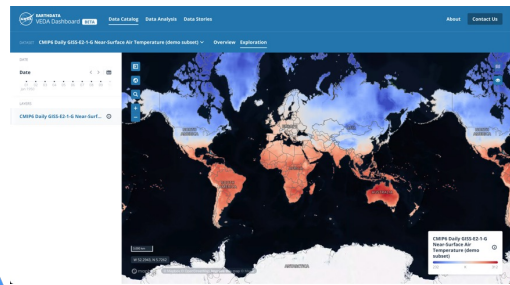


## What?

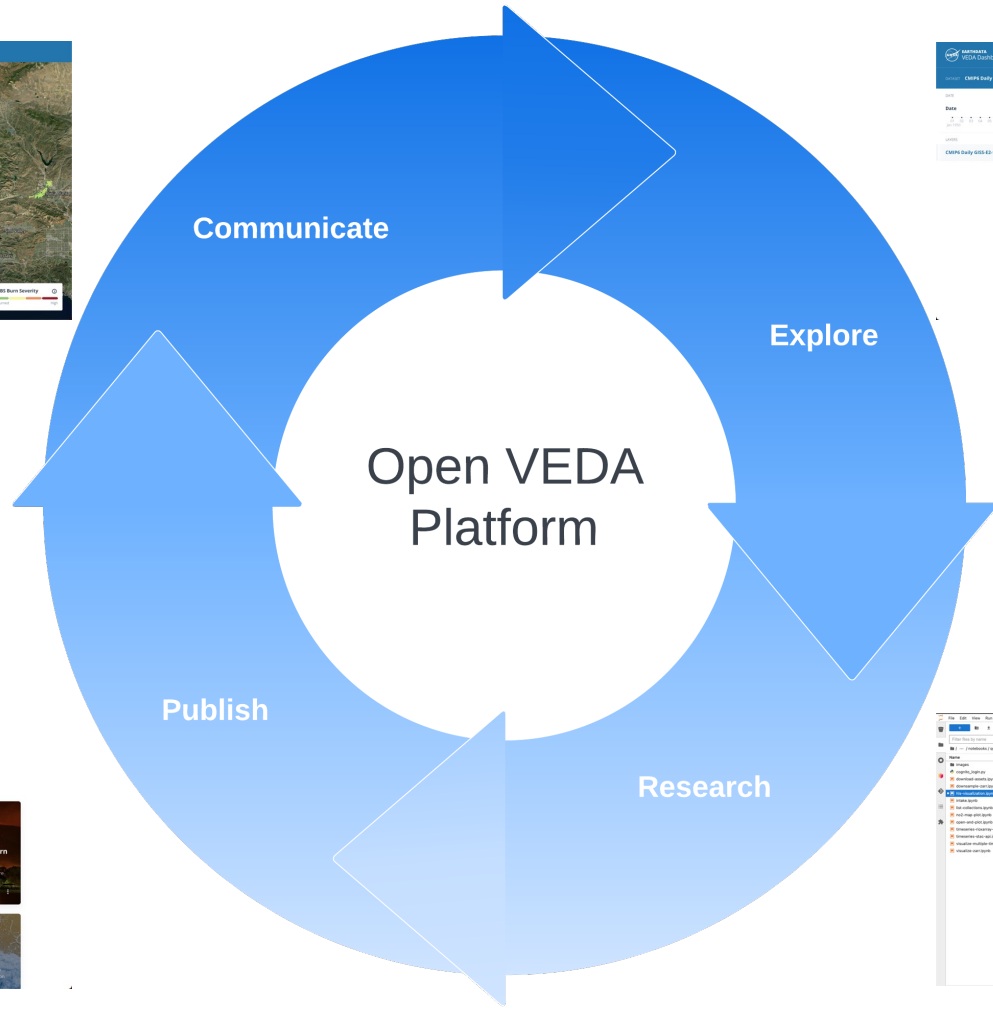
VEDA is an open platform that brings key Earth science datasets next to open source tools for data processing, analysis, visualization, and exploration in a NASA-managed and more accessible computing environment



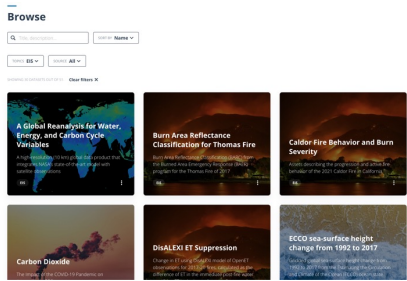
Data Driven Storytelling



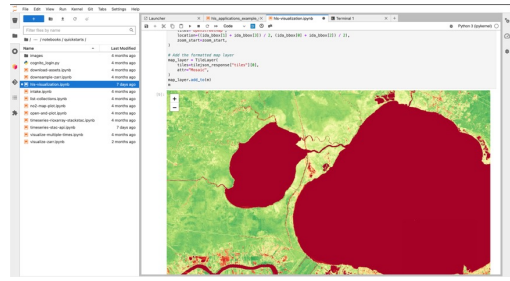
Map Exploration



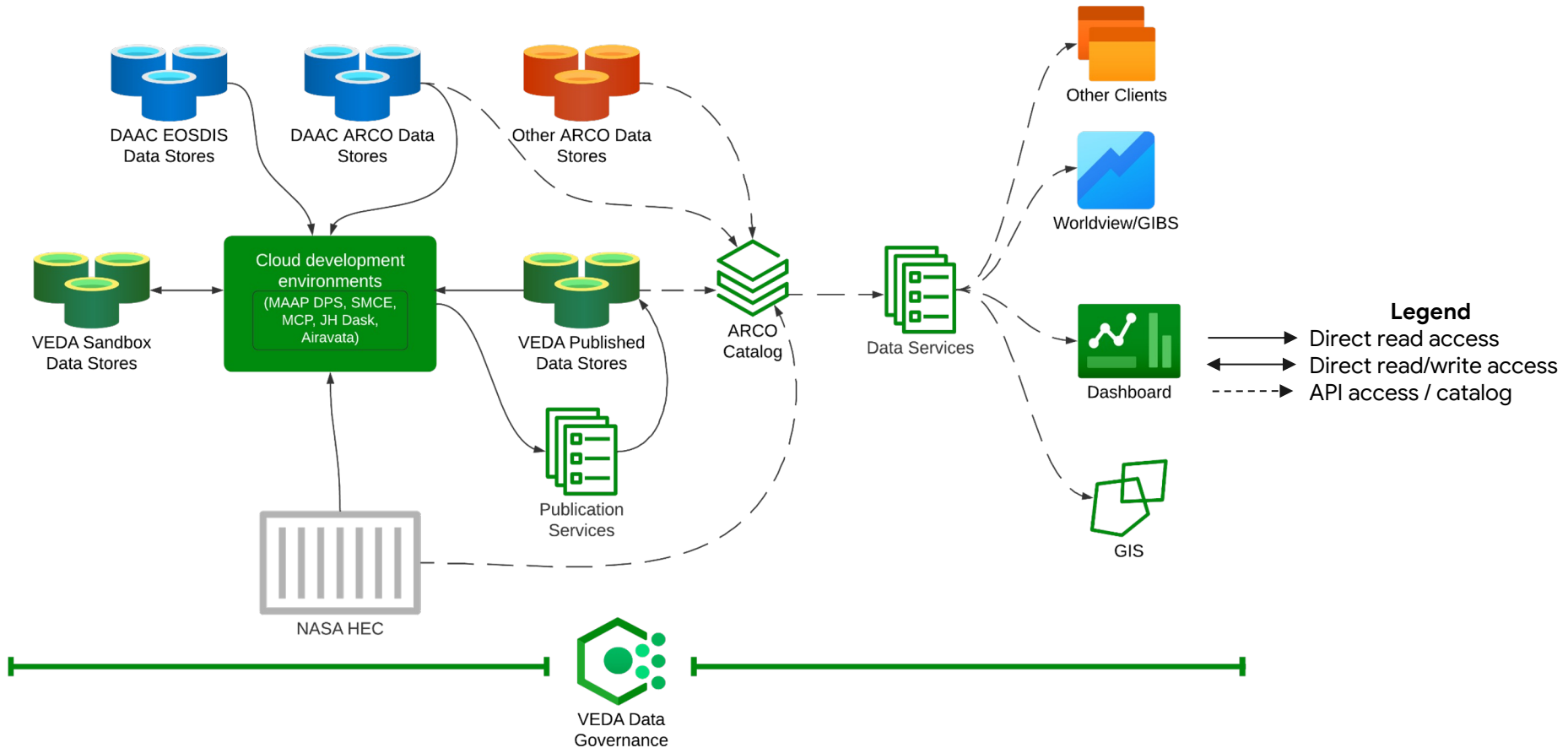
Data Catalog



Analysis Hub



# Data Architecture



# VEDA User Engagement

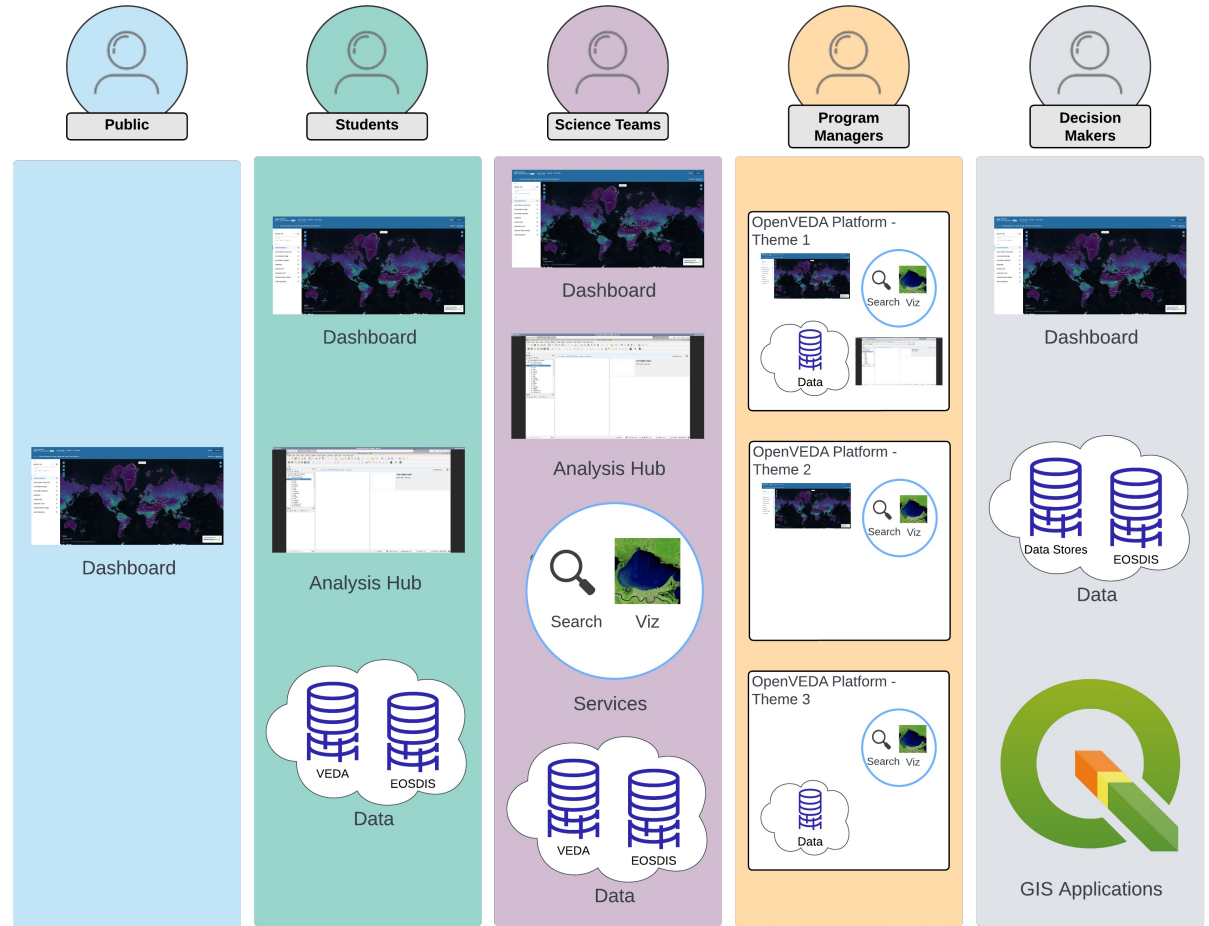
## Service Components

**Dashboard:** Map Explore, Dynamic Time-series analysis, Data Insights, Catalog Search Interface

**Analytics Hub:** Jupyter Notebooks (Python, R, Matlab (?)) and QGIS

**Services:** Search and Ingestion APIs, Raster APIs including statistics endpoint, and Features API

**OpenVEDA Platform:** Dashboard + Analytics Hub + Services + Data Stores + Catalog



# General Public



## Who?

Science Enthusiasts, Communicators, Educators, Press

## Interaction with VEDA Platform?

Map exploration and data insights

## Takeaway?

Knowledge of how NASA data is used to understand the Earth System. Earth science information relevant to their specific location (e.g. total rainfall after a disaster, number of fires within 100 miles, etc.)

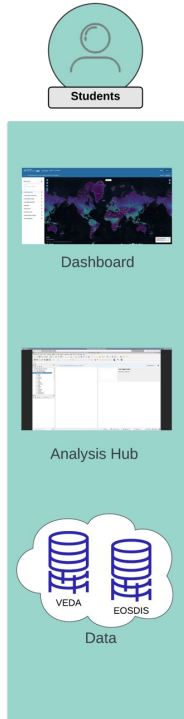
## Contribution?

None



Dashboard

# Students



## Who?

Student Researchers working on capstone, thesis, and dissertation work.  
Workshop participants

## Interaction with VEDA Platform?

Map exploration, data insights, dynamic time-series analysis, jupyterhub environment for detailed analysis on cloud-hosted data

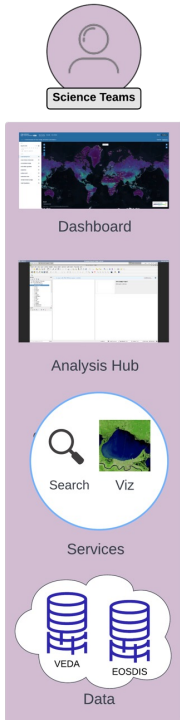
## Takeaway?

Enhanced scientific understanding of a particular topic or set of topics and modernized workflow leveraging compute in same region where data is hosted

## Contribution?

Datasets, data insights, notebook examples

# Science Teams



## Who?

NASA science teams developing a new algorithm or developing new data products

## Interaction with VEDA Platform?

Map exploration, data insights, jupyterhub environment for collaborative compute environment, ingestion APIs, raster APIs, features APIs

## Takeaway?

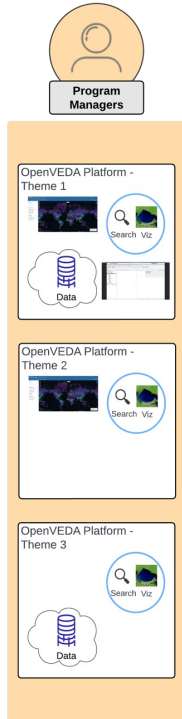
How collaborative compute environments in the cloud can accelerate scientific contributions and enhance mission success

## Contribution?

Funding (cloud resources), datasets, data insights, notebook examples



# Program Managers



## Who?

Program Managers managing Earth science applications

## Interaction with VEDA Platform?

Limited map exploration and data insights

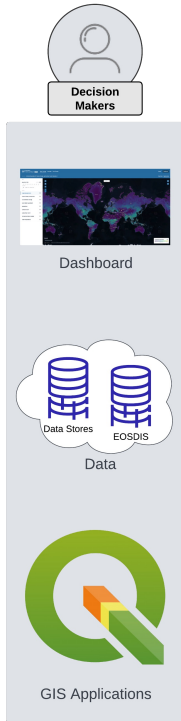
## Takeaway?

How VEDA capabilities can be leveraged within their program to address user needs, accelerate science, and communicate complex scientific concepts in an interactive, engaging manner

## Contribution?

Unknown – Hopefully development teams contributing back to OpenVEDA platform components

# Decision Makers



## Who?

Decision makers who need to leverage Earth observations to quickly assess rapidly evolving events

## Interaction with VEDA Platform?

Map exploration, dynamic time-series analysis, external data catalog (external = non-NASA data \*if necessary), GIS applications

## Takeaway?

How map exploration can be used to quickly assess a situation

## Contribution?

Datasets/Data catalog

# Others

## **Who?**

FIRMS, Worldview/GIBS, Application Developers

## **Interaction with VEDA Platform?**

Data services and visualization APIs

## **Takeaway?**

How VEDA APIs can be used to serve data and visualization (as needed) needs for their applications

## **Contribution?**

Improvements to backend services in OpenVEDA platform

# VEDA Deployments – U.S. Greenhouse Gas Center (Platform)



## Welcome

The U.S. Greenhouse Gas Center opens up access to trusted data on greenhouse gases. This multi-agency effort consolidates greenhouse gas information from observations and models. The goal of the US GHG Center is to provide decision-makers with one location for data

# VEDA Deployments – Earth Information Center (Dashboard)

Earth Information Center

Data Catalog Data Analysis Themes

Visit a Center Teach About **Contact Us**

Explore our changing planet



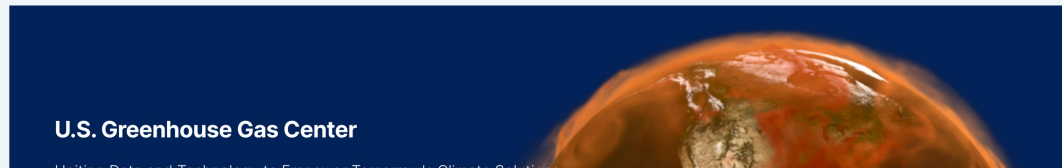
## One government working for one planet.

The Earth Information Center consolidates data and insights on how Earth is changing from across the US federal government. Earth.gov is also the gateway to other interagency cooperative efforts for our planet, like the U.S. Greenhouse Gas Center. Discover how these data are being used to prepare for climate change and mitigate, adapt and respond to environmental challenges across the country.



Earth.gov is also the gateway to other interagency cooperative efforts for our planet, like the [U.S. Greenhouse Gas Center](#)

**U.S. Greenhouse Gas Center**



# VEDA Deployments – NASA FIRMS (Visualization Services)

The screenshot displays the NASA FIRMS (Fire Information for Resource Management System) web interface. The main map shows a satellite view of a forest fire area, with a color scale indicating fire intensity. The interface includes a top navigation bar with the NASA logo, the text "FIRMS Fire Information for Resource Management System", and links for "Quick Search", "Announcements", and "Feedback". A search bar is located in the top right corner. The map area includes a latitude and longitude display (Lat: 41.327°, Lon: -123.362°) and a scale bar (5 km / 2 mi). A right-hand sidebar titled "ADVANCED MODE" provides options for "Today", "~24hrs", "3 days", and "7 days", along with a "DAILY" and "SUB-DAILY" toggle. Below this, there are sections for "Harmonized Landsat Sentinel-2 Imagery" and "Dynamic Imagery", each with a list of data layers and their respective icons. A bottom navigation bar includes buttons for "MEASURE", "LOCATION", "LAYERS", "TIMELINE", "CAPTURE", "SHARE", "HELP", and "MAXIMIZE". The timeline at the bottom shows dates from September 15 to October 1, 2023, with a "1 DAY" button and a "NASA" logo in the bottom right corner.

**NAVIGATION**   **FIRMS** Fire Information for Resource Management System   **Quick Search**   **Announcements**   **Feedback**

Lat: 41.327° , Lon: -123.362°

**ADVANCED MODE**   **Today**   ~24hrs   3 days   7 days   **DAILY**   SUB-DAILY

**Harmonized Landsat Sentinel-2 Imagery**

- ✓ Sentinel 2A/2B Adjusted Reflectance HLS S30 Nadir BRDF (true color)
- ✓ Sentinel 2A/2B Adjusted Reflectance HLS S30 Nadir BRDF (false color - vegetation)
- ✓ Landsat 8/9 Adjusted Reflectance HLS S30 Nadir BRDF (true color)
- ✓ Landsat 8/9 Adjusted Reflectance HLS S30 Nadir BRDF (false color - vegetation)

**Dynamic Imagery**

- VIIRS NOAA-20 Corrected Reflectance (true color)
- VIIRS S-NPP Corrected Reflectance (true color)
- MODIS/Aqua Corrected Reflectance (true color)
- MODIS/Terra Corrected Reflectance (true color)

**MEASURE**   **LOCATION**   **LAYERS**   **TIMELINE**   **CAPTURE**   **SHARE**   **HELP**   **MAXIMIZE**

**SEPTEMBER 2023**   **OCTOBER 2023**   **SEP 14 2023**   **1 DAY**   **NASA**

# VEDA Deployments – ESA/NASA MAAP (Data Services)

## MAAP STAC API (dev)

[Source](#) [Share](#) [Language: English](#)

[Browse](#) [Search](#)

### Description

STAC API for the MAAP STAC system.

### Additional Resources

- [OpenAPI service description](#)
- [OpenAPI service documentation](#)

### Catalogs 25

[Tiles](#) [List](#) [Ascending](#) [Descending](#)

Filter catalogs by title

#### AfriSAR UAVSAR Coregistered SLCs Generated Using NISAR Tools

This dataset contains multi-baseline Polarimetric Interferometric Synthetic Aperture Radar SLC (single-look-complex) data collected from multip...

2/25/2016, 12:00:00 AM UTC - 3/8/2016, 12:00:00 AM UTC

#### AfriSAR UAVSAR Geocoded Covariance Matrix product Generated Using NISAR Tools

The Geocoded Covariance Matrix dataset is the 4x4 Native Covariance Matrix geocoded to a spatial resolution of 25m using cubic interpolatio...

2/25/2016, 12:00:00 AM UTC - 3/8/2016, 11:59:59 PM UTC

#### AfriSAR UAVSAR Geocoded SLCs

[https://stac-browser.maap-project.org/collections/SRTMGL1\\_COD](https://stac-browser.maap-project.org/collections/SRTMGL1_COD)

#### AFRISAR\_DLR

The ESA BIOMASS mission was selected in 2013 as the 7th Earth Explorer mission. BIOMASS will provide estimates of forest biomass and height...

2/3/2016, 12:00:00 AM UTC until present

#### AFRISAR\_DLR2

The ESA BIOMASS mission was selected in 2013 as the 7th Earth Explorer mission. BIOMASS will provide estimates of forest biomass and height...

6/30/2015, 12:00:00 AM UTC until present

#### Arctic-Boreal Vulnerability Experiment Uninhabited Aerial Vehicle Synthetic Aperture Radar Polarimetric SAR

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign conducted from June through...

#### Global Ecosystem Dynamics Investigation (GEDI) Calibration/Validation Airborne Lidar Dataset (Compressed)

The Global Ecosystem Dynamics Investigation (GEDI) Forest Structure and Biomass Database (FSBD) is a collection of field and LIDAR datasets...

1/1/2001, 12:00:00 AM UTC - 12/31/2020, 12:00:00 AM UTC

#### Global Ecosystem Dynamics Investigation (GEDI) Calibration/Validation Field Survey Dataset

The Global Ecosystem Dynamics Investigation (GEDI) Forest Structure and Biomass Database (FSBD) is a collection of field and LIDAR datasets...

1/23/2003, 12:00:00 AM UTC - 8/27/2019, 11:59:59 PM UTC

#### Global Forest Change 2000-2017

#### ICESat2-Boreal Above Ground Biomass T-Index Average

ICESat2-Boreal Above Ground Biomass T-Index Average

1/1/2019, 12:00:00 AM UTC - 1/1/2021, 12:00:00 AM UTC

#### Landsat 8 Operational Land Imager (OLI) Surface Reflectance Analysis Ready Data (ARD) V1, Peru and Equatorial Western Africa, April 2013-January 2020

Landsat Analysis Ready Data (ARD) are consistently processed to the highest scientific standards and level of processing required for...

4/12/2013, 9:28:35 AM UTC - 1/29/2020, 12:00:00 AM UTC

#### NASA Shuttle Radar Topography Mission Global 1

NASA Shuttle Radar Topography Mission (SRTM)

# Demos



# VEDA Moving Forward – NASA Archive Integration

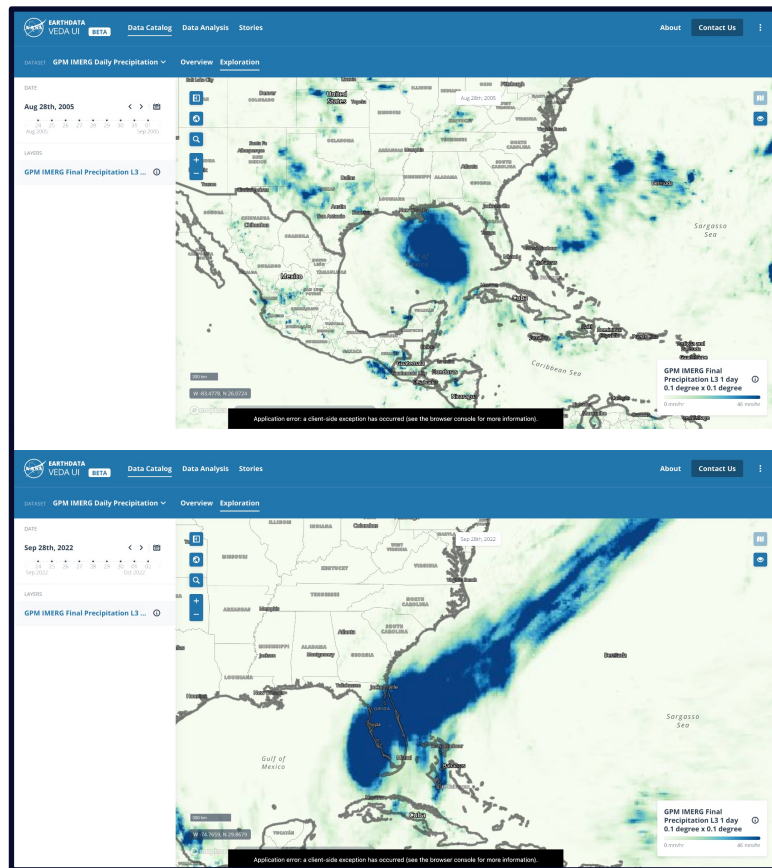
## Current

- VEDA data store supports targeted use cases with data transformed to COGs

## Future

- Dynamic rendering of NASA data archives for cloud-hosted data in non-cloud-optimized formats without need for intermediate data stores

Prototype using [TRMM](#)



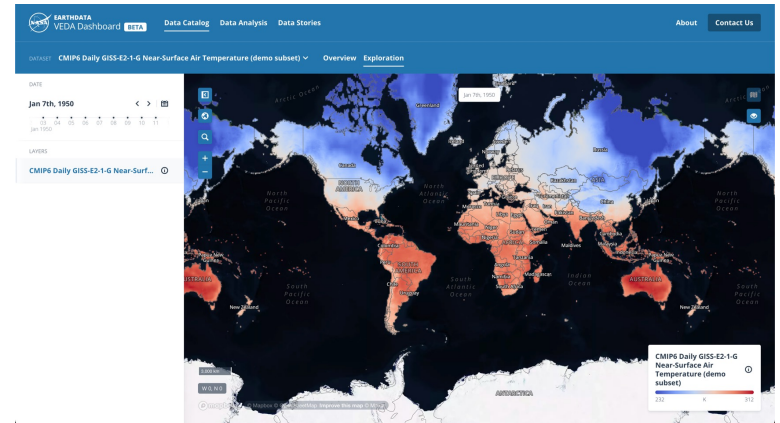
# VEDA Moving Forward – Zarr/Kerchunk/NetCDF Visualization

## Current

- Data Visualization currently supports COGs only

## Future

- Web-based visualization supporting NetCDF (example on previous slide) Zarr, Kerchunk, COPC data formats



[Dashboard example](#) with Kerchunk metadata on NetCDF

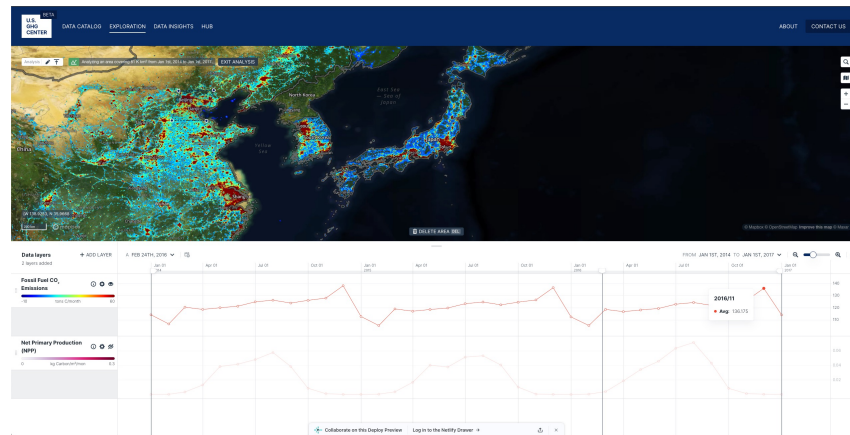
# VEDA Moving Forward – Integrated Explore/Analysis

## Current

- Explore and Analysis on separate tabs so users must toggle to see underlying data being used to generate analysis)

## Future

- Fully integrated explore and analysis capabilities with area-weighted statistics
- Capability to compare two datasets spatially and two locations of same dataset with time-series

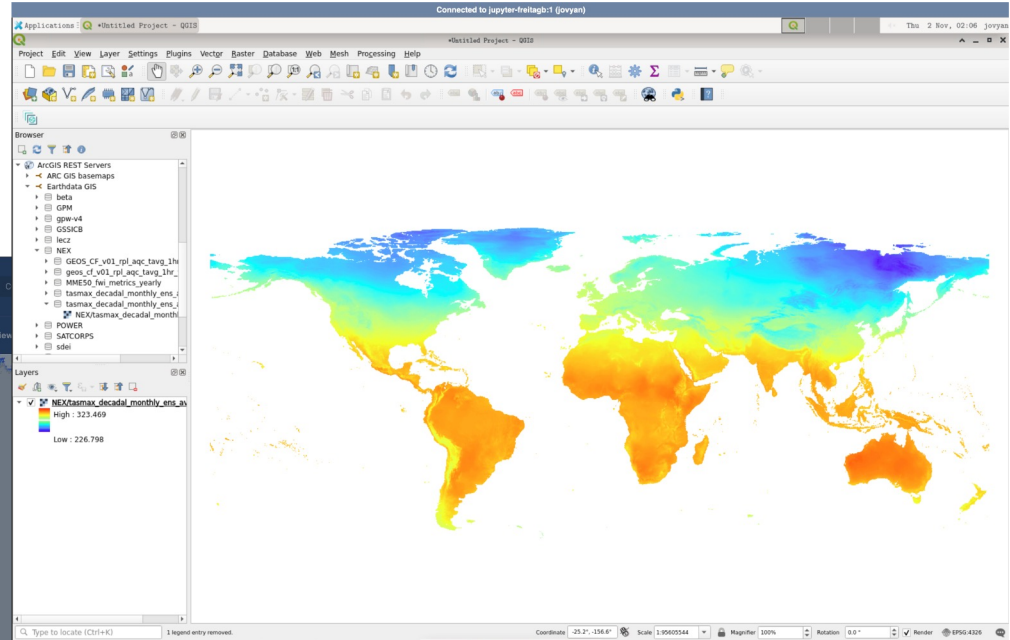
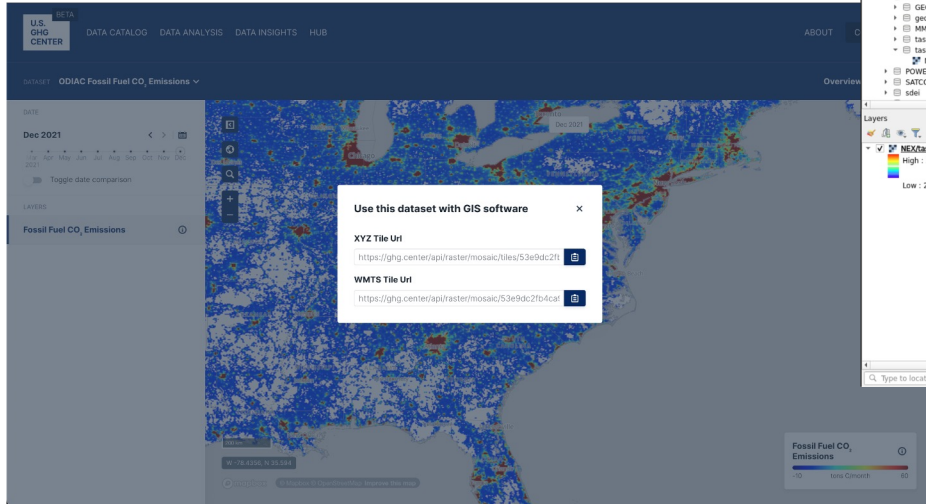


Current prototype

# VEDA Moving Forward – GIS applications

Tighter integration of hub-based QGIS with NASA GIS services

- EGIS Rest API,
- GIS-compatible tile layers in VEDA dashboard



# VEDA Moving Forward – GIS applications

## Current

- STAC-based data catalog allows for interoperability with GIS applications and STAC API Browser in GIS allows for searching VEDA data catalog

## Future

- Example QGIS/ArcGIS projects linked to the dashboard (similar to current notebook examples in the documentation)

