



National Aeronautics and
Space Administration

NASA SMD Initiatives to Lower the Boundaries to Science Research: *Activities in the Earth Science Division*

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Science Mission Directorate
NASA Headquarters





Reducing research barriers

1

Trilateral EO Dashboard

- Global collaboration
- Education and training
- Data sharing
- Open source software

2

VEDA

- Open source software
- Accessible platform
- Standards & interoperability
- Interdisciplinary science

3

AI Foundation Model

- Partnerships
- Collaboration
- Open large scale AI models
- Reduced cost to build downstream applications

4

Earth Information Center

- Public outreach
- Education
- Promoting scientific insights



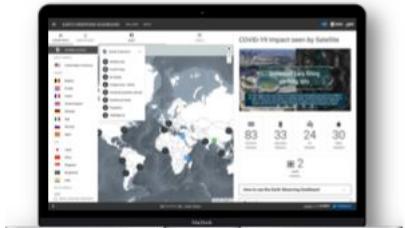
Trilateral EO dashboard



Trilateral EO Dashboard: objectives and timeline



First Release 2020



eodashboard.org

Objective 1

- Demonstrate joint capabilities of NASA-ESA-JAXA to observe COVID-19's environmental and economic impacts from space

Objective 2

- Convey indicators to the general public and decision makers; and maximize the value of curated information

Objective 3

- Engage the wider public via outreach & competitions, e.g. EO Dashboard Hackathon, SpaceApps

KEY ACHIEVEMENTS

Rapid release

3 months

Eodashboard.org released in June 2020

EO Indicators

12 EO missions

Indicators based on data from 12 EO missions of ESA, NASA, JAXA

Global Presence

146 countries

Global awareness with accesses across the world

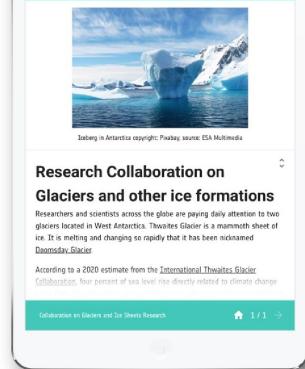
Communication

251 websites

Citations by 251 websites and joint participation in CEOS, AGU, SpaceApps, etc.

Trilateral EO Dashboard: ongoing

collaboration



2021 - ongoing



Objective 1

- Broaden scope for 7 thematic areas: atmosphere, oceans, biomass, cryosphere, agriculture, economy, covid-19, using open data and interoperability across agencies

Objective 2

- Communicate scientific findings via advanced visualization exploiting tri-agency EO data

Objective 3

- Promote Open Science best practices and engage with the community

KEY ACHIEVEMENTS

Open Data

25 EO missions

Expanded EO indicators covering 7 new domains

Storytelling with Open Data

19 stories

Jointly developed stories to communicate tri-agency scientific findings

Training and Education and Open Science

5 Workshops

IGARSS tutorials and workshops, FOSS4G, LPS, EGU, GEO ODK, etc.

Promote Cooperation

IAF Award

GLOC 2023 IAF Award

Users



eodashboard.org

600+ OPEN ACCESS DATASETS

193.700+ VISITS from 146 COUNTRIES

Open Access: Notebooks, Data, Tutorials

Used by

- Educators** – training in EO and Earth Science
- Developers** – open-source to build new dashboards such as GTIF
- Data Scientists** (4 competitions & hackathons e.g. NASA SpaceApps)
- Nat. Statistical offices** – to introduce EO in their practice
- Journalists** – to report on observed impacts e.g. of covid, air pollution, etc.

IAF special award on Space for Climate Protection

23 May 2023, Global Space Conference on Climate Change, Oslo, Norway

The **ESA-JAXA-NASA Earth Observing Dashboard** was chosen as: “*the most valid example of the ways in which remote sensing data can support climate protection and allow decision-makers, citizens and the scientific community to easily access information that may be fundamental to protect our planet.*”



User community



eo science for society

eesa

Trans-Atlantic Training 2022 (TAT-9): A Changing Eastern Europe: New Challenges for Science and Capacity Building in Land Remote Sensing

Theory and practical materials

NASA SPACE APPS CHALLENGE

Challenge COVID-19: CALCULATE THE RISK

DETAILS RESOURCES TEAMS (405)

eodash Public

Staging S1 branches 3 tags

Go to file Add file Code

About

Santilli Merge pull request #2272 from europaclub... 7755d55 last week 6,352 commits

chore: worked on conceptual UI changes prototyping for ... last year

test: new version of slack-github 3 months ago

Merge branch 'tcc-lakes-integration' of github.com:europa... last week

Initial commit 3 years ago

removed eodash-data submodule 2 years ago

Update Contributors.md last year

LICENSE Initial commit 3 years ago

Update README.md 8 months ago

README.md

Welcome to eodash

DOI: 10.5281/zenodo.4047699

eodash is the software powering <https://race.esa.int> as well as <https://eodashboard.org>

The Rapid Action for citizens with Earth observation presents the results of the joint cooperation between ESA and the European Commission to inform on societal global challenges using Earth Observations. The activity, initially called "Rapid Action for coronavirus EO" started in 2020, triggered by Covid-19 crisis and was expanded in scope in 2022.

The Earth Observing Dashboard combines the resources, technical knowledge and expertise of three partner agencies, ESA, JAXA, and NASA to strengthen our global understanding of global environmental changes and other societal challenges impacting our planet.

The platform demonstrates how the use of Earth observation data can help shed new light on societal and economic changes currently taking place owing to the coronavirus pandemic.

The information contained on this website are mainly provided by third parties based on environmental methods and without any warranty as to their veracity. The European Commission

Readme MIT license Activity 76 stars 10 watching 38 forks Report repository

Releases 3

Release v3.0 (Latest) on May 13, 2022

2 releases

Contributors 23

+ 12 contributors

SECOND EDITION

PRACTICAL HANDBOOK OF REMOTE SENSING

SAMANTHA LAVENDER ANDREW LAVENDER

CRC Press Taylor & Francis Group

SPACE NEWS

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Satellites reveal striking impact of COVID-19 on people and air quality

Debra Werner April 26, 2020

AIR POLLUTION OVER ITALY DROPS IN SATELLITE DATA

SPACE

January February March



DISTATIS Statistisches Bundesamt

Contact Deutsch Menu

Homepage → Experimental statistics → Satellite-based early estimate of short-term economic development

Experimental statistics

Satellite-based early estimate of short-term economic development

EXSTAT



Educators – training in EO and Earth Science

Developers – open-source to build new dashboards such as GTIF

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Nat. Statistical offices – to introduce EO in their practice

Journalists – to report on observed impacts e.g. of covid, air pollution,

NASA's evolution from trilateral dashboard

Contribution to trilateral dashboard:

- Datasets and interoperable services for data transformation, access, and visualization
- Science expertise
- Infrastructure and services
- Coordination and host for data science challenges (SpaceApps)
- Communication and outreach

NASA has utilized components developed for the trilateral dashboard (and other investments) to assemble a platform called VEDA (Visualization, Exploration, and Data Analysis), which:

- Leverages data in the cloud
- Provides interoperable data services for other priorities
- Lowers the barriers to computing platform that is next to data
- Enables advanced visualization and exploration with enriched science communication



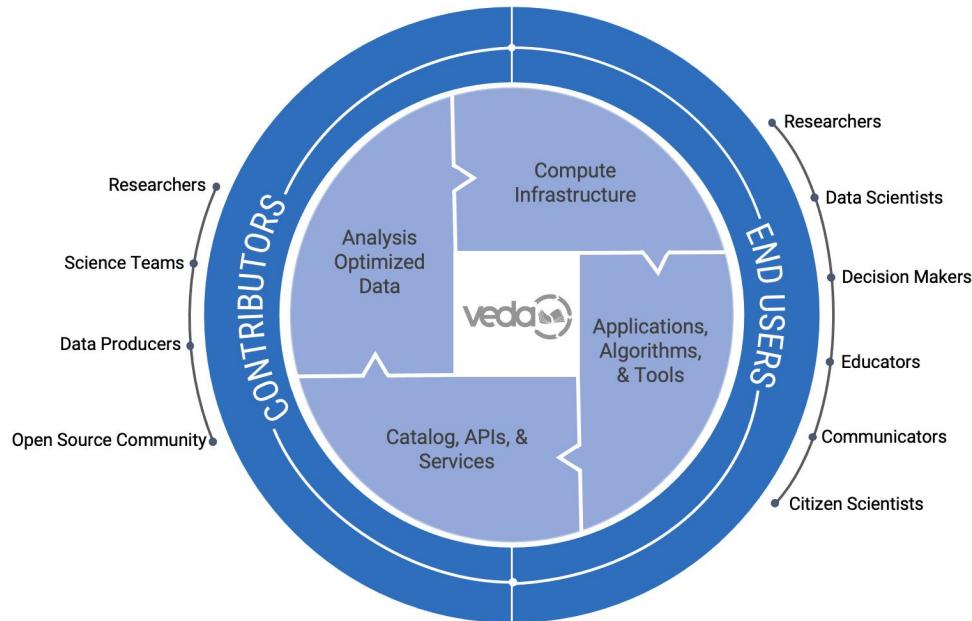
Visualization Exploration & Data Analysis



Visualization, Exploration, and Data Analysis

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 managed and **more accessible computing environment**

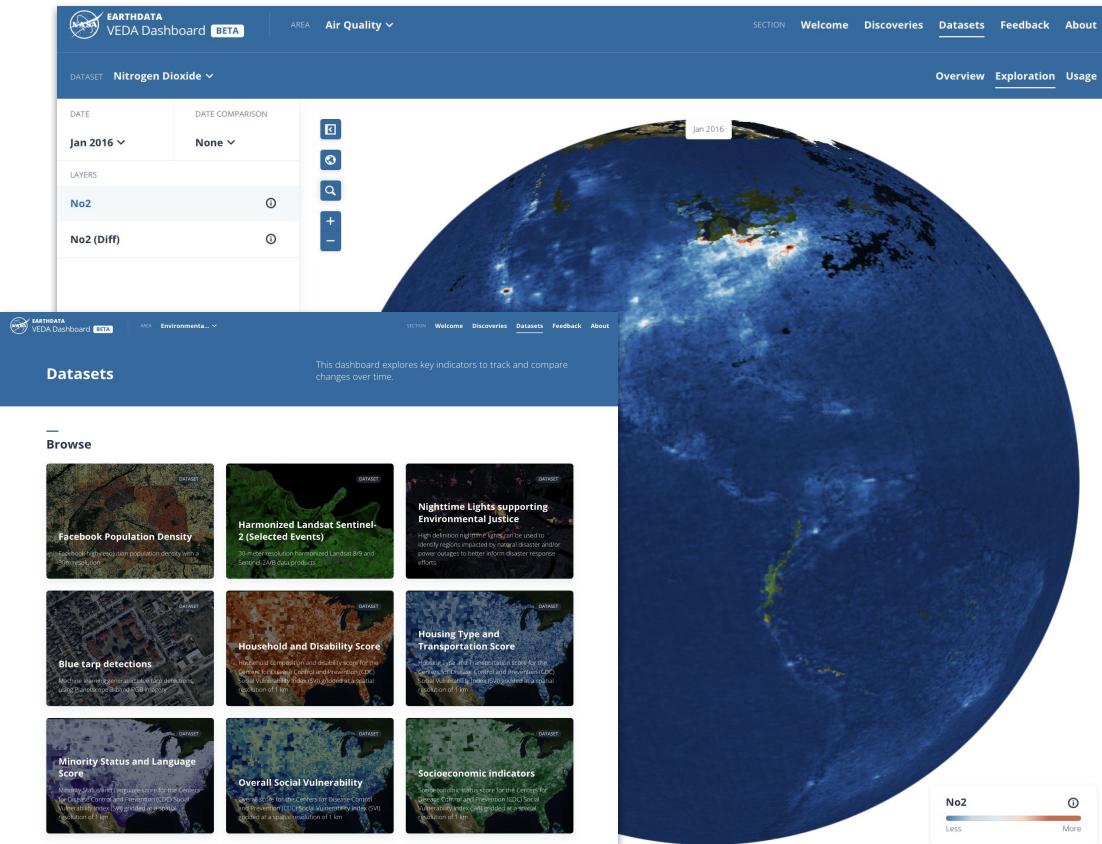
Built using existing investments in open source software

Explore

Analyze

Publish

Communicate



- Finding relevant data products
- Exploring data to identify interesting features

Explore

Analyze

Publish

Communicate

The screenshot shows a Jupyter Notebook interface with several tabs at the top: File, Edit, View, Run, Kernel, Git, Data Search, DPS/MAS Operations, DPS UI Menu, MAAP Login, Tabs, Settings, Help. The main area displays a code cell and its output.

Code Cell Output:

```
(9): fig, ax = plt.subplots(2,2,figsize=(11,5))

# visualize burn area values for all fires
ax[0].hist(gdf['farea'].values,bins=300)
ax[0].set_xlim(0,200)
ax[0].set_xlabel('Fire Area (km²)')
ax[0].set_ylabel('Count')

# plot only sample of fires because
# all of them will take a while to render
coms.sample(ax[1], edgecolor='black', color='none')
gdf.sample(10000).plot(ax=ax[1], edgecolor='red', color='red')
ax[1].set_xlabel('Longitude')
ax[1].set_ylabel('Latitude')
fig.show()

(10): # isolate large fires == > 500
large_fires = gdf[gdf['farea']>=500]
print("# of large fires:",len(large_fires))
# of large fires: 174

(11): # optional: interactive visualization
# timestamps must be dropped because they don't play
# well with the interactive map
large_fires.drop(['StartTime','EndTime'],axis=1).explore(column='fid',style_kwds={'fill':True})
# tiles=Stamen Terrain,crs=epsg:4326

(12): base_path = 's3://veda-data-store-staging'
fire_ids = set()
file_paths = []

fl_str = 'FL'
nfp_str = 'NFP'

for obj in s3.veda.objects.filter(Prefix='EIS/other/Feds-output/2022/Largefire'):
    file_path = os.path.join(base_path,obj.key)

    if fl_str in file_path or nfp_str in file_path:
        pass
        continue

    file_name = file_path.split('/')[-1]
    fire_id = file_name.split('_')[0]

    fire_ids.add(fire_id)
    file_paths.append(file_path)

fire_ids = list(fire_ids) # convert to list for indexing
```

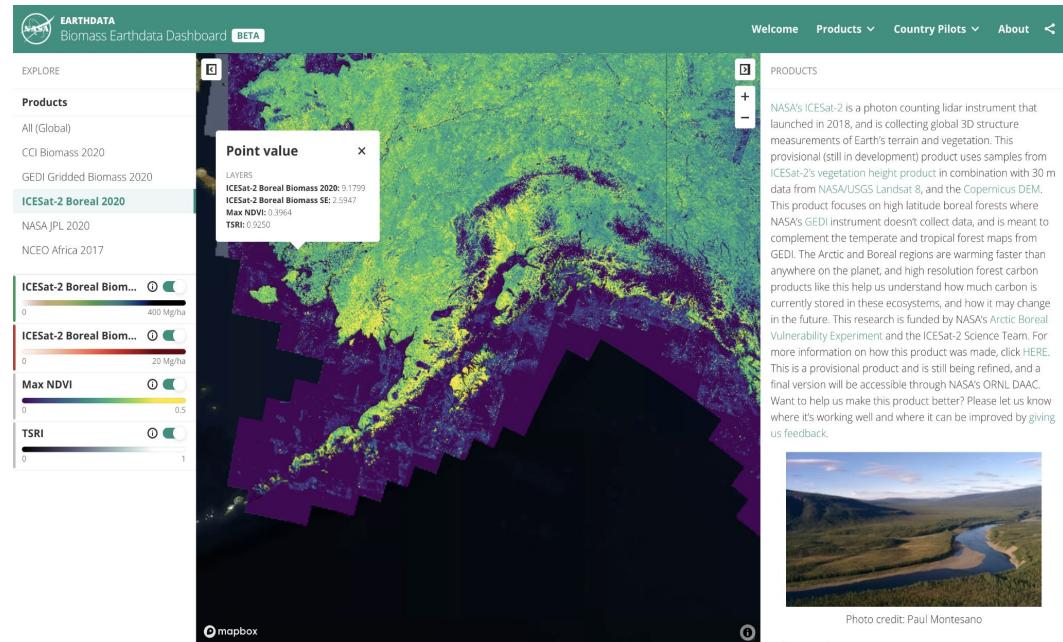
- Developing advanced data products and analysis
- Carrying out calculations "in place" without the need to download data
- Dynamically allocating resources for computationally demanding processing

Explore

Analyze

Publish

Communicate



- Conveniently delivering data through existing interfaces
- Providing automatic access to interactive visualization capabilities
- Allowing users to analyze your products within the environment



Photo credit: Paul Montesano

Explore

Analyze

Publish

Communicate

The screenshot shows the NASA VEDA Dashboard interface. At the top, there's a navigation bar with links for EARTHDATA, VEDA Dashboard (BETA), ARRA, Environmenta... ▾, SECTION, Welcome, Discoveries (which is underlined), Datasets, Feedback, and About. Below the navigation is a blue header bar with the text "Connecting Disaster Recovery with Environmental Justice". The main content area features two sections: "Connecting Disaster Recovery with Environmental Justice: Hurricane María" and "Connecting Disaster Recovery with Environmental Justice: Hurricane Ida". Each section includes a thumbnail image, a title, and a detailed description.

Connecting Disaster Recovery with Environmental Justice: Hurricane María

Hurricane María made landfall in Puerto Rico as a Category 4 or 5 hurricane on September 20, 2017, leaving a path of destruction in its wake. Over 1.5 million people on the island lost power, leading to the longest blackout in US history. Although efforts to repair the damage on the island were extensive, the areas with the most severe and prolonged impacts were areas of lower socioeconomic status. These communities lacked the resources and the representation to repair damage quickly, leading to long-term lack of access to electricity, water, and other critical supplies.

NASA hosts a wide variety of continuous Earth observation data useful in environmental justice research. This dashboard features a selection of NASA datasets from across the Agency, including socioeconomic data, Earth observation analysis, and other combined datasets. These tools allow users to visualize and download data to understand the environmental issues brought on by Hurricane María. Merging Earth data and socioeconomic data can help communities like those in Puerto Rico to better prepare for and respond to future natural disasters.

Connecting Disaster Recovery with Environmental Justice: Hurricane Ida

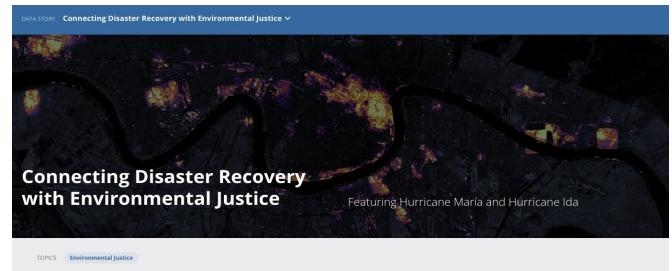
Known as the city that can barely catch its breath between storms, New Orleans experienced another devastating event on August 29, 2021 as Hurricane Ida made landfall as a Category 4 hurricane. The effects of the storm were widespread, causing millions of dollars worth of damage and affecting the lives and homes of millions of people.

Disadvantaged communities in Louisiana and across the country already struggle with higher rates of asthma, cancer, and COVID-19 infections. These communities are often hardest hit by storms like Ida. Research has shown that disadvantaged communities often receive less federal aid than other communities, only prolonging their hardships. NASA is prioritizing open access to environmental justice data such as the datasets in this dashboard in an effort to help communities better prepare for and respond to natural disasters and to help shed light on cases of environmental injustice.

- User friendly data-driven storytelling
- Enrich science and applications narratives with interactive exploration

Capabilities supported by VEDA

- Earth Information System
- Environmental Justice Initiative
- US Greenhouse Gas Center
- NASA/ESA/JAXA Trilateral Dashboard



Connecting Disaster Recovery with Environmental Justice: Hurricane María

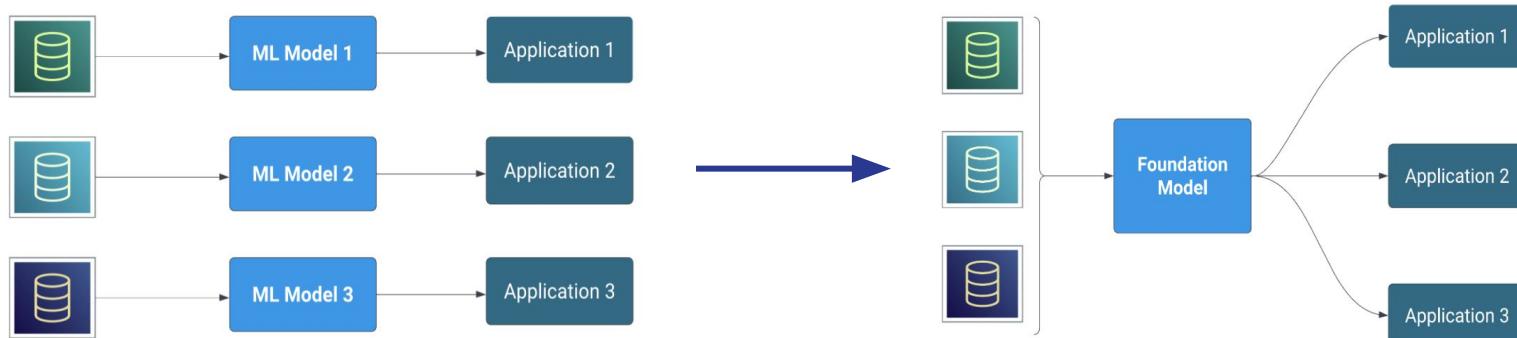
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Geospatial AI Foundation Model



AI Foundation Models

- Pre-trained on a comprehensive dataset and used for various downstream tasks
- Substantially reduce the downstream effort for building AI applications, including the need for large labeled training datasets
- Model captures emergent behavior within the modeled system from the data
- Creating a foundation model includes data curation, training, and validation



AI challenges in Earth science

Advancing Application of Machine Learning Tools for NASA's Earth Observation Data

Jan. 21-23, 2020 | Washington, D.C.
Workshop Report



- Training data is the main component of supervised machine learning techniques and is increasingly becoming the **main bottleneck to advance applications of machine learning** techniques in Earth science.
- Geoscience models must **generalize across space and time**; however, for supervised learning one needs large training datasets to build generalizable models.

Maskey et al. "Advancing AI for Earth Science: A Data Systems Perspective," AGU Eos 2020

Release of the First Geospatial Foundation AI Model

Developed in collaboration with IBM Research under an Space Act Agreement and NASA IMPACT project at MSFC

Pretrained on NASA Harmonized Landsat Sentinel-2 dataset - can be used for multiple tasks instead of building task specific AI models

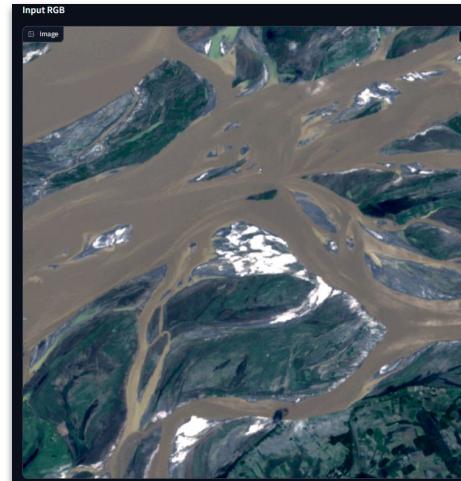
Examples of how it can be used:

- Burn scar mapping
- Flood detection
- Multi-temporal crop identification

Openly available at [Hugging Face](#) including Models, Datasets, and Code.

Released on **Aug 3rd, 2023**

- 75 clones
- Several applications have already been built by community



The pretrained [Prithvi-100m](#) model is fine-tuned to segment the extent of floods on Sentinel-2 images from the [Sen1Floods11](#) dataset.

(Example over India)



Collaboration with like minded partners IBM and Hugging Face

Earth Information Center



Earth Information Center

A physical and virtual space to engage and amplify impact – to show people our Earth as we see it. Visit the virtual site at go.nasa.gov/eic



**TUESDAY
APRIL 18, 2023**

Earth Now

NASA monitors our home planet using near-real time data and imagery made available fully and openly to the world.

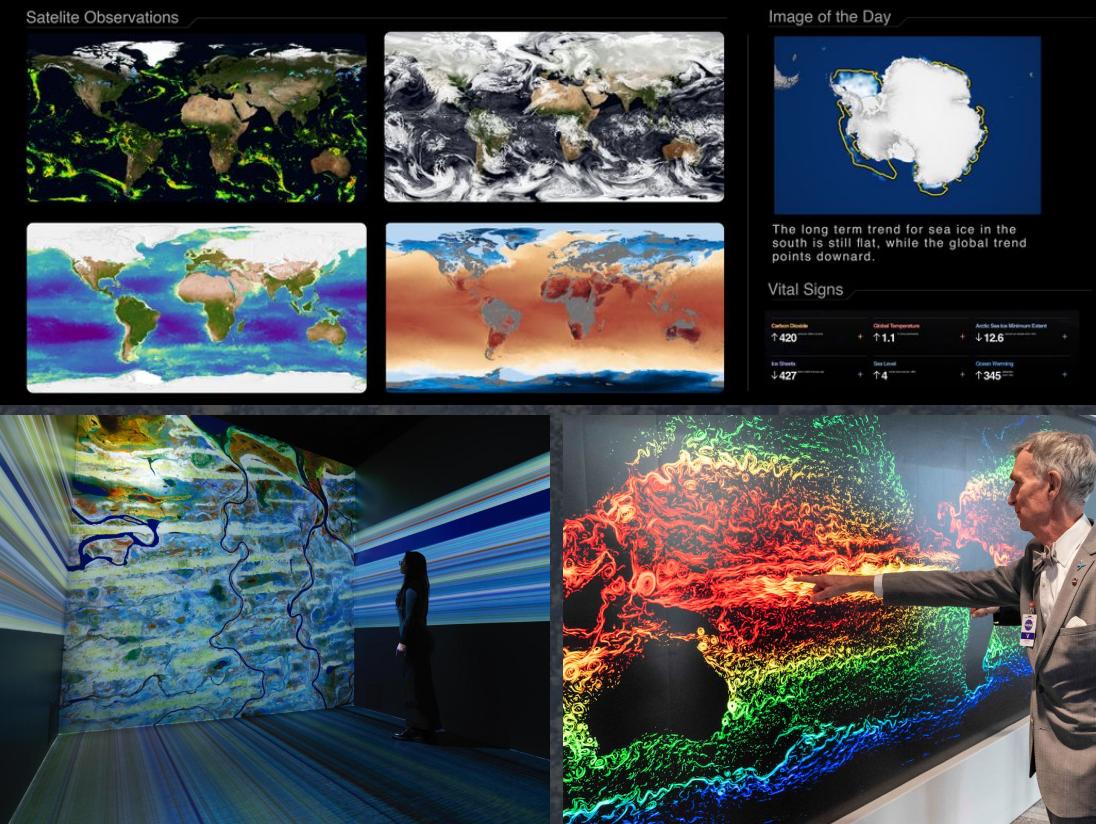
Earth Observing Fleet



A Hyperwall to highlight real time NASA data and stakeholder stories

Earth Pulse display showing Near Space Network NRT data collection

An immersive installation to allow visitors to go inside the data



Key takeaways

- Open data eases scientific research barriers
- Standards and interoperability enable wider collaboration and maximize of data use
- Core set of services based on open-source software offer agility needed for priority initiatives/projects
- Collaboration and partnerships accelerate research, especially through access to computation and technical expertise
- Community involvement enhances equitable and impactful scientific future

Thank you.

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