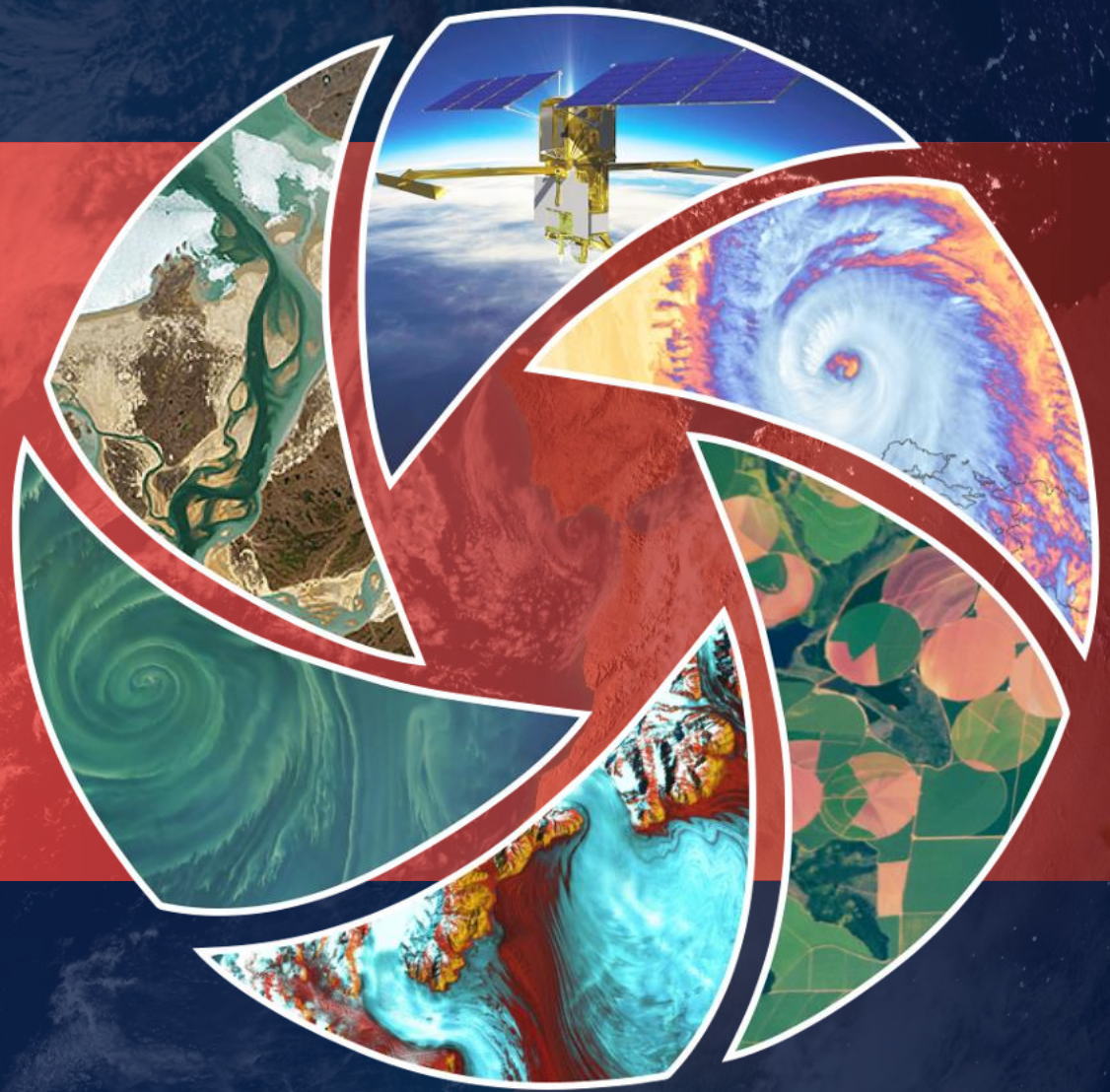
HQ Updates & Perspective

LANCE User Working Group | June 21, 2023

Katherine Saad
Support Scientist, Earth Science Data Systems
Chief Science Data Office
NASA Headquarters



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Discussion Highlights

- Why You’re Here
- Why I’m Here
- Where We’re Going
  - The Earth System Observatory
  - Open-Source Science
- How We’re Getting There

Why You're Here

- The LANCE UWG represents and advocates for user communities of practice and potential. Specifically, that means you…
  - Assess the quality and responsiveness of the data offerings to community needs
  - Recommend new data sets
  - Suggest improvements to UX
  - Recommend new capabilities and suggest priority activities
  - And more! (Y'all are awesome!)

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Why We're Here

Cerese Albers, Lead Program Executive
Earth Science Data Systems
NASA Headquarters

Joel Scott, Program Executive
Earth Science Data Systems
NASA Headquarters

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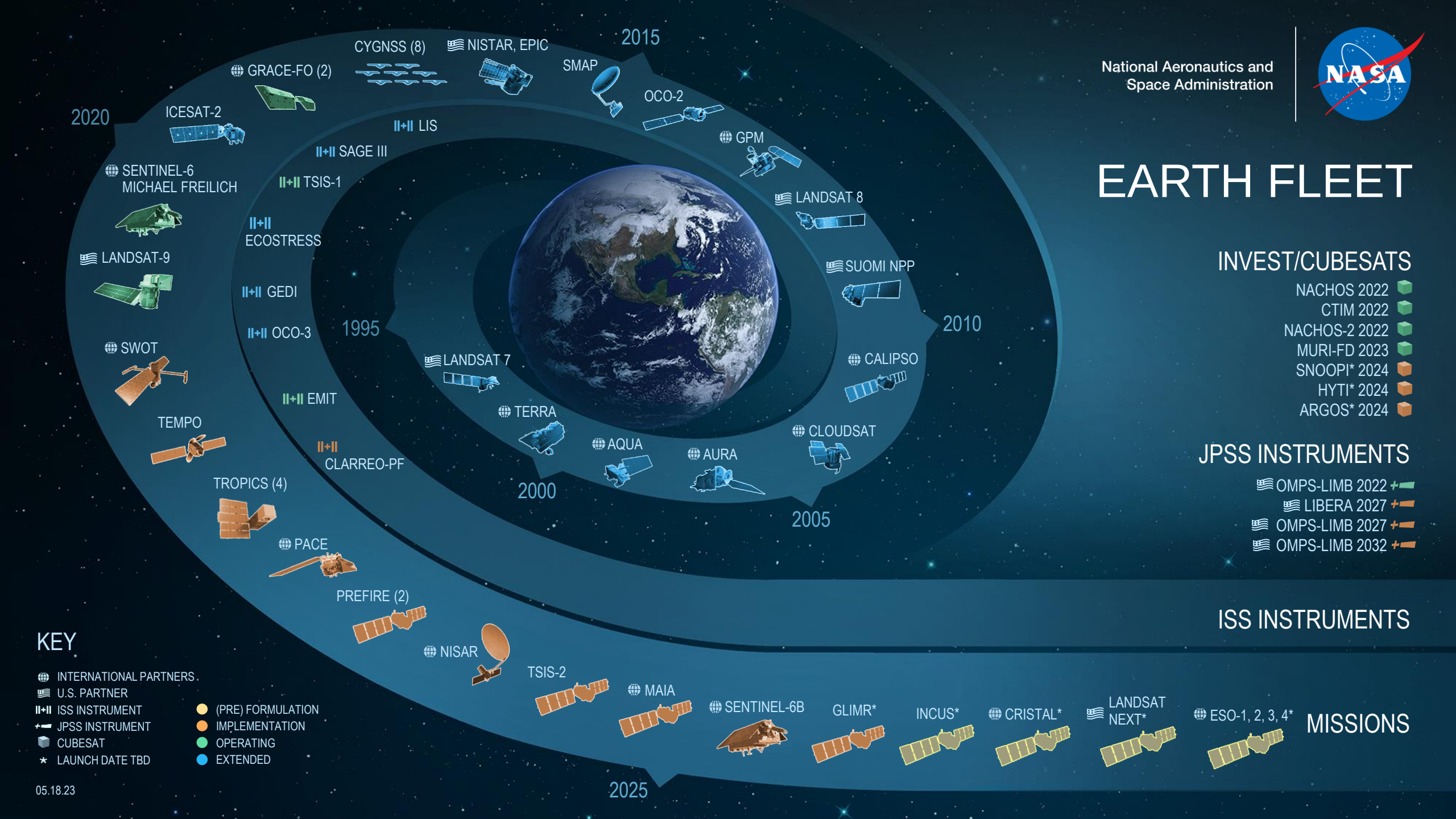
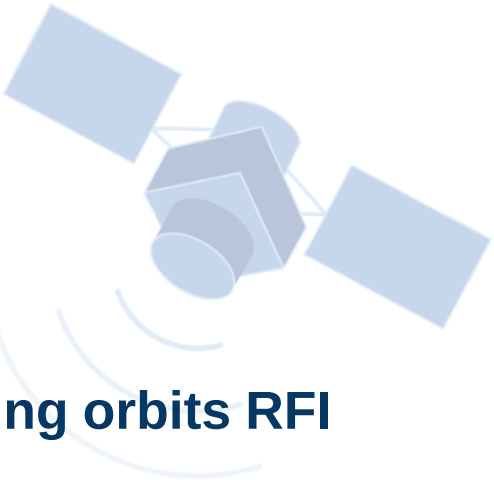
Where We’re Going

As NASA Earth Science Division &
Earth Science Communities


National Aeronautics and Space Administration
NASA
EARTH FLEET
2015
2020
1995
2010
2000
2005
2025
CYGNSS (8)
NISTAR, EPIC
SMAP
OCO-2
GRACE-FO (2)
ICESAT-2
LIS
SAGE III
GPM
SENTINEL-6 MICHAEL FREILICH
TSIS-1
LANDSAT 8
ECOSTRESS
LANDSAT-9
SUOMI NPP
GEDI
OCO-3
SWOT
LANDSAT 7
CALIPSO
EMIT
TERRA
TEMPO
AQUA
AURA
CLOUDSAT
CLARREO-PF
TROPICS (4)
PACE
PREFIRE (2)
NISAR
TSIS-2
MAIA
SENTINEL-6B
GLIMR*
INCUS*
CRISTAL*
LANDSAT NEXT*
ESO-1, 2, 3, 4*
INVEST/CUBESATS
NACHOS 2022
CTIM 2022
NACHOS-2 2022
MURI-FD 2023
SNOOPI* 2024
HYTI* 2024
ARGOS* 2024
JPSS INSTRUMENTS
OMPS-LIMB 2022
LIBERA 2027
OMPS-LIMB 2027
OMPS-LIMB 2032
ISS INSTRUMENTS
MISSIONS
KEY
INTERNATIONAL PARTNERS
U.S. PARTNER
ISS INSTRUMENT
JPSS INSTRUMENT
CUBESAT
LAUNCH DATE TBD
(PRE) FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED
05.18.23

Terra / Aqua / Aura



- NASA ESD is considering the inputs and feedback received from the **drifting orbits RFI** and corresponding fall 2022 **workshop**.
- A second RFI and workshop (held in May 2023) focused on the **continuity of science products**; particularly on how EOS mission products may align with continuity products deriving from partner missions, such as from JPSS or Sentinel.
- Feedback and information from the second RFI and workshop are currently being dispositioned and will be considered by NASA ESD.

The Aqua and Terra Missions will cease data collection no later than 2026 (Aqua) and early 2027 (Terra).

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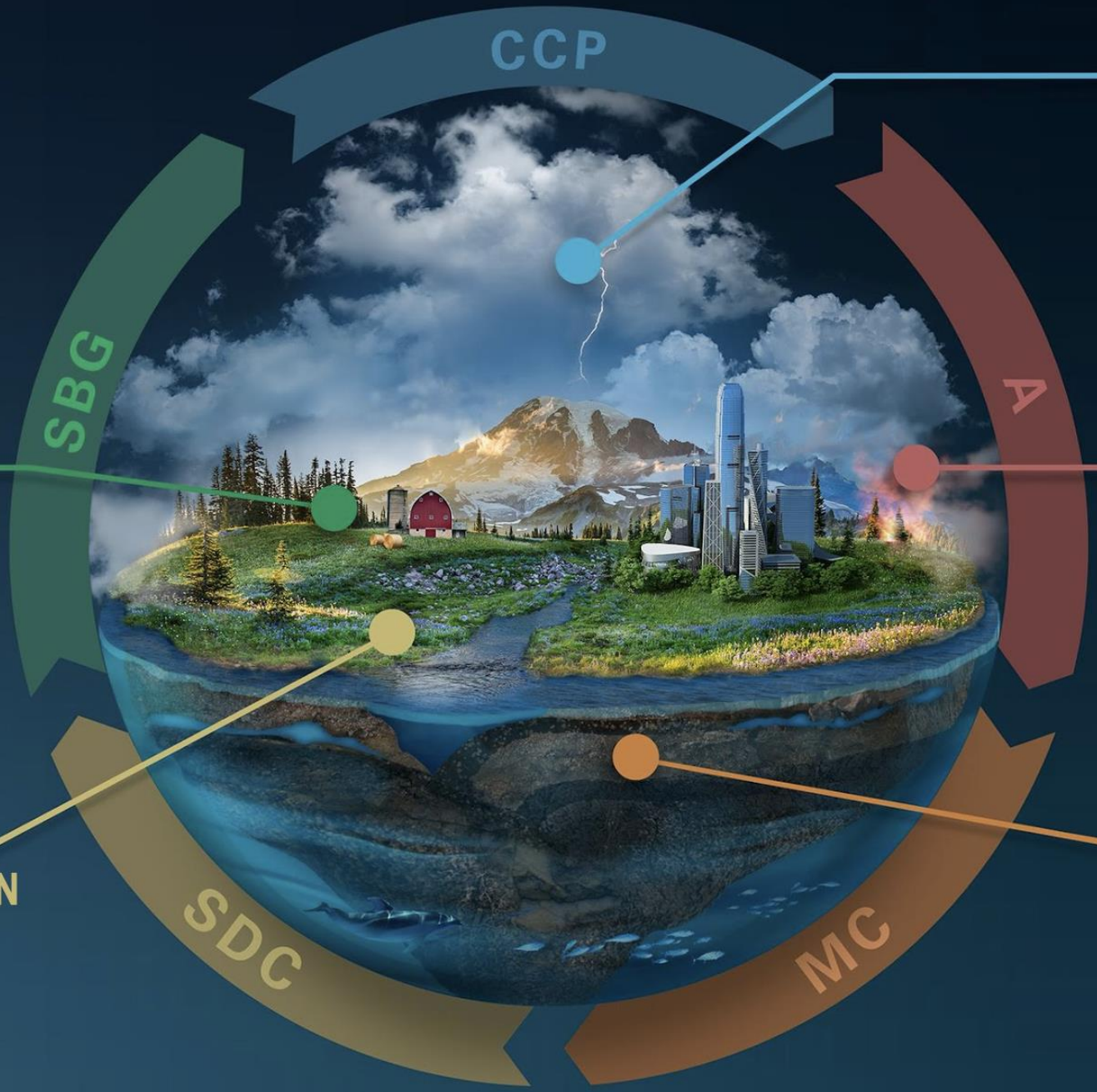
EARTH SYSTEM OBSERVATORY

INTERCONNECTED CORE MISSIONS



CLOUDS, CONVECTION AND PRECIPITATION

Water and Energy in the Atmosphere

AEROSOLS

Particles in the Atmosphere

MASS CHANGE

Large-scale Mass Redistribution

SURFACE DEFORMATION AND CHANGE

Earth Surface Dynamics

SURFACE BIOLOGY AND GEOLOGY

Earth Surface & Ecosystems

ESO Missions: Current Status

- Passed KDP-A and in Formulation:
  - Atmosphere Observing System (AOS-Storm and AOS-Sky)
  - Surface Biology and Geology (SBG)
  - Mass Change (MC)

- Surface Deformation and Change (SDC) remains in extended study phase, taking advantage of NISAR mission lessons learned.

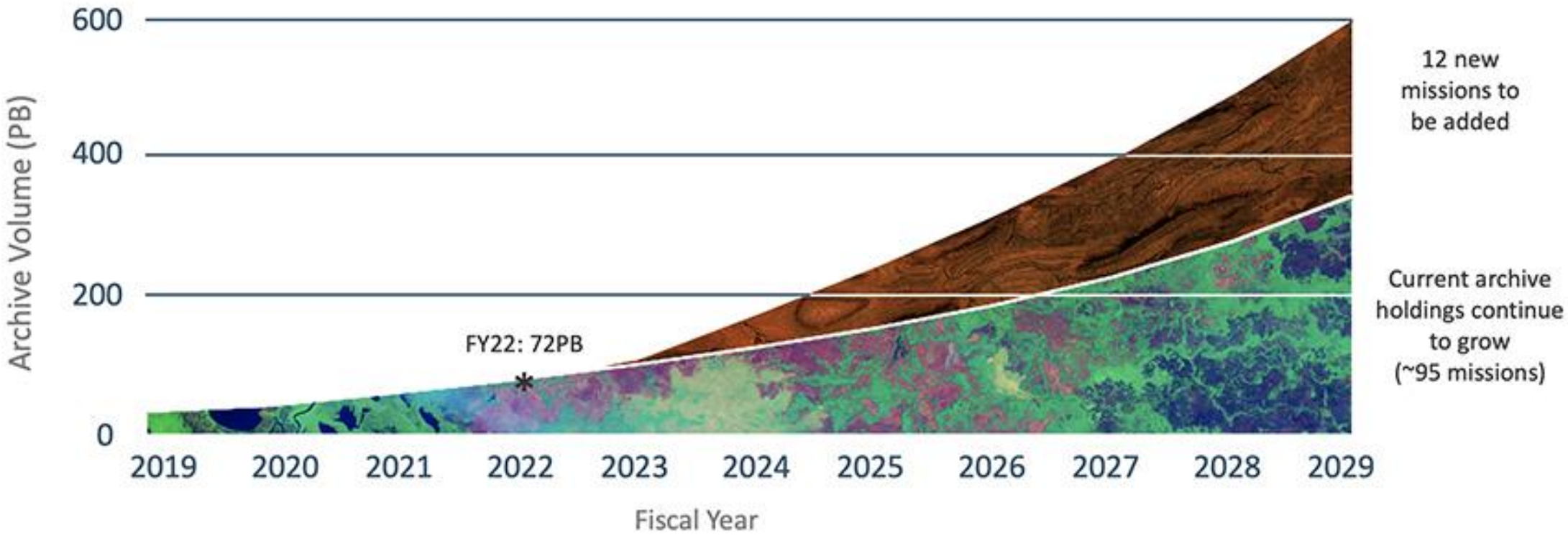
AOS
MCR: May 2022
KDP-A: Jan 2023

SBG
MCR: Jun 2022
KDP-A: Nov 2022

MC
MCR: Jun 2022
KDP-A: March 2023

SDC
Remaining in extended Study Phase

The Future of NASA Earth Science Data



Courtesy: ESDIS

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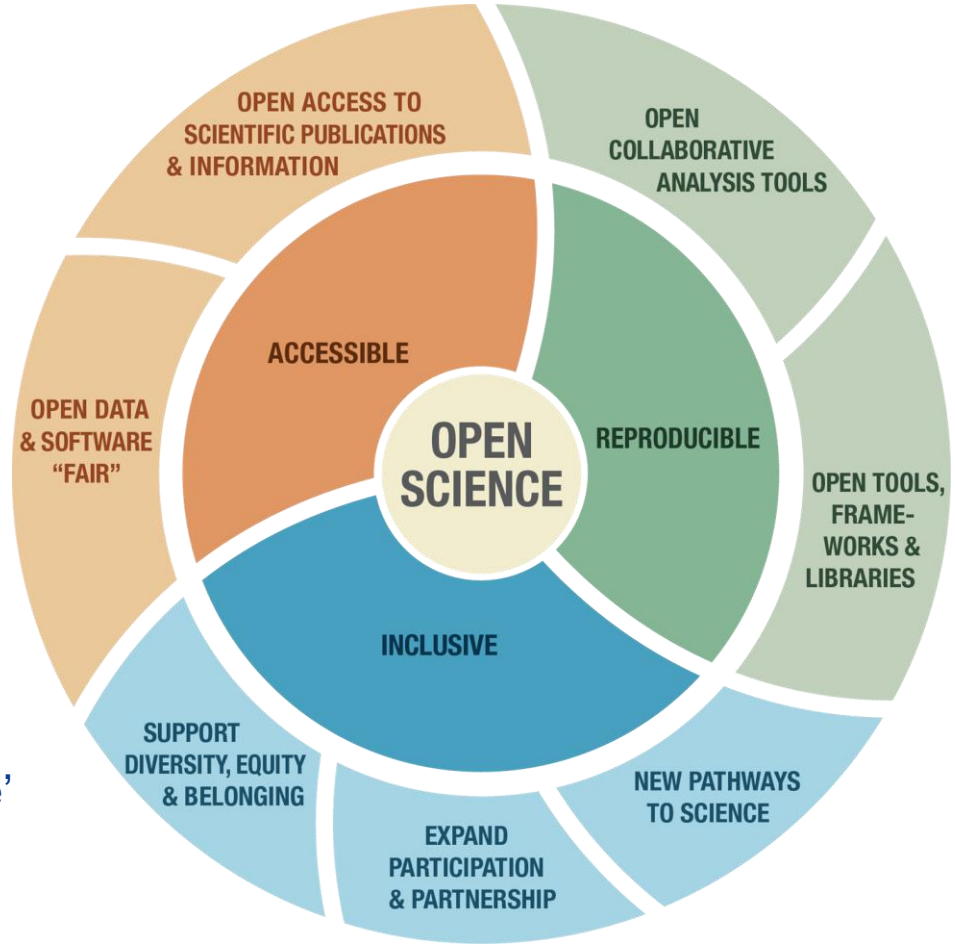
What is Open Science?

Open Science is the principle and practice of making research products and processes available to all, while respecting diverse cultures, maintaining security and privacy, and fostering collaborations, reproducibility and equity.



Creates research that is:

- Cited more
- Has a bigger impact
- Increases transparency
- More inclusive

Inclusive science means more:

- Collaborative projects
- Access to 'hidden knowledge'
- Equitable Systems
- Increased Participation

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Ramachandran, R., Bugbee, K., & Murphy, K. J. Moving from Open Data to Open Science. Earth and Space Science, Wiley Publication https://doi.org/10.1029/2020EA001562

The White House announces
2023 A Year of Open Science

CDC ✦ DOA ✦ DOC ✦ DOE ✦ DOS ✦ DOT ✦ NASA ✦ NEH ✦ NIH ✦ NIST ✦ NOAA ✦ NSF ✦ SI ✦ USDA ✦ USGS

A multi-agency (15) initiative across the US Federal Government to spark change and inspire open science engagement through events and activities that will advance adoption of open science.

Website: https://open.science.gov/

NASA Earth Science and Open-Source Science

- **Open** the entirety of the scientific process, ***from start to finish***
- **Broaden** and **diversify** community involvement in the scientific process
- Increase **accessibility** of data, software, & publications
- Facilitate inclusion, **transparency**, and **reproducibility** of science

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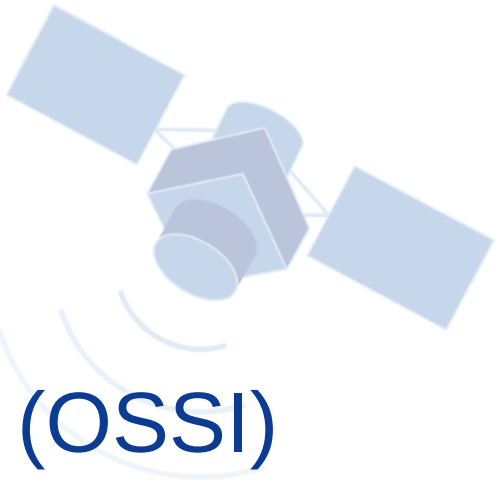
How We’re Getting There

ESDS Looking to the Future



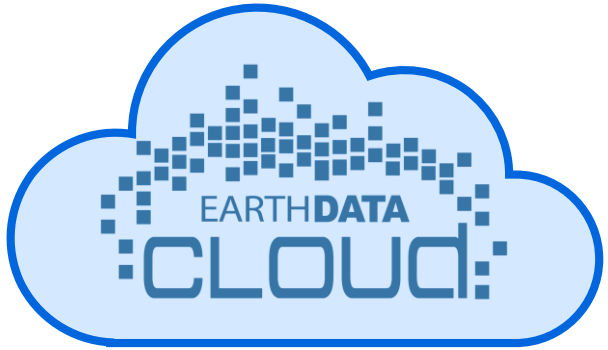
- Engaging with Open-Source Science Initiative (OSSI)
  - Policy, ***infrastructure***, ***funding***, and ***community***
- Cloud Data & Compute
  - Future missions will leverage cloud data & compute
  - Multi-mission, cloud-based, open-source visualization and analytics platform (VEDA)

ESO Mission Data Processing Study

- **Goal:** Identify and assess potential architectures that can meet the ESO mission science processing objectives, enable data system efficiencies, promote open science principles, and seek opportunities that support Earth system science.
- **Led by** a Steering Committee and a System Architecture Working Group
- **Status:** Held 2 workshops. Conducted a trade study yielding architectural recommendations. **Report released in February 2023.**
- **Recommendations:**
  - Use a common service-based processing architecture across ESO missions
  - Deploy a multi-mission organization as the defined architecture with a set of common managed services (e.g., compute infrastructure, data cataloging and analysis services, a generic processing service, etc.)
  - Leverage industry-based protocols and specs

Cloud Migration of Priority Earth Science Datasets

- Migration ***increases the utility*** of existing Earth Science datasets, by enabling NASA to ***meet users' needs*** for in-place computing, viz, and analysis as data volumes grow.
- The ***top 75*** most-downloaded datasets ***migrated to Earthdata Cloud***.
  - Six (of twelve) DAACs were involved in this migration of data from local, on-premise hardware to Earthdata Cloud.
  - Migrated data were verified by the DAACs.
  - This was an imperceptible transition to many users.
- Two DAACs are ***100% in the cloud*** – GHRC and PO.DAAC.
- As of 3 May 2023, ***2560+ collections*** and ***33+ Petabytes*** of data are in Earthdata Cloud (S3 standard + S3 IA).



Cloud migration continues to be a priority for NASA.
All DAACs will participate.

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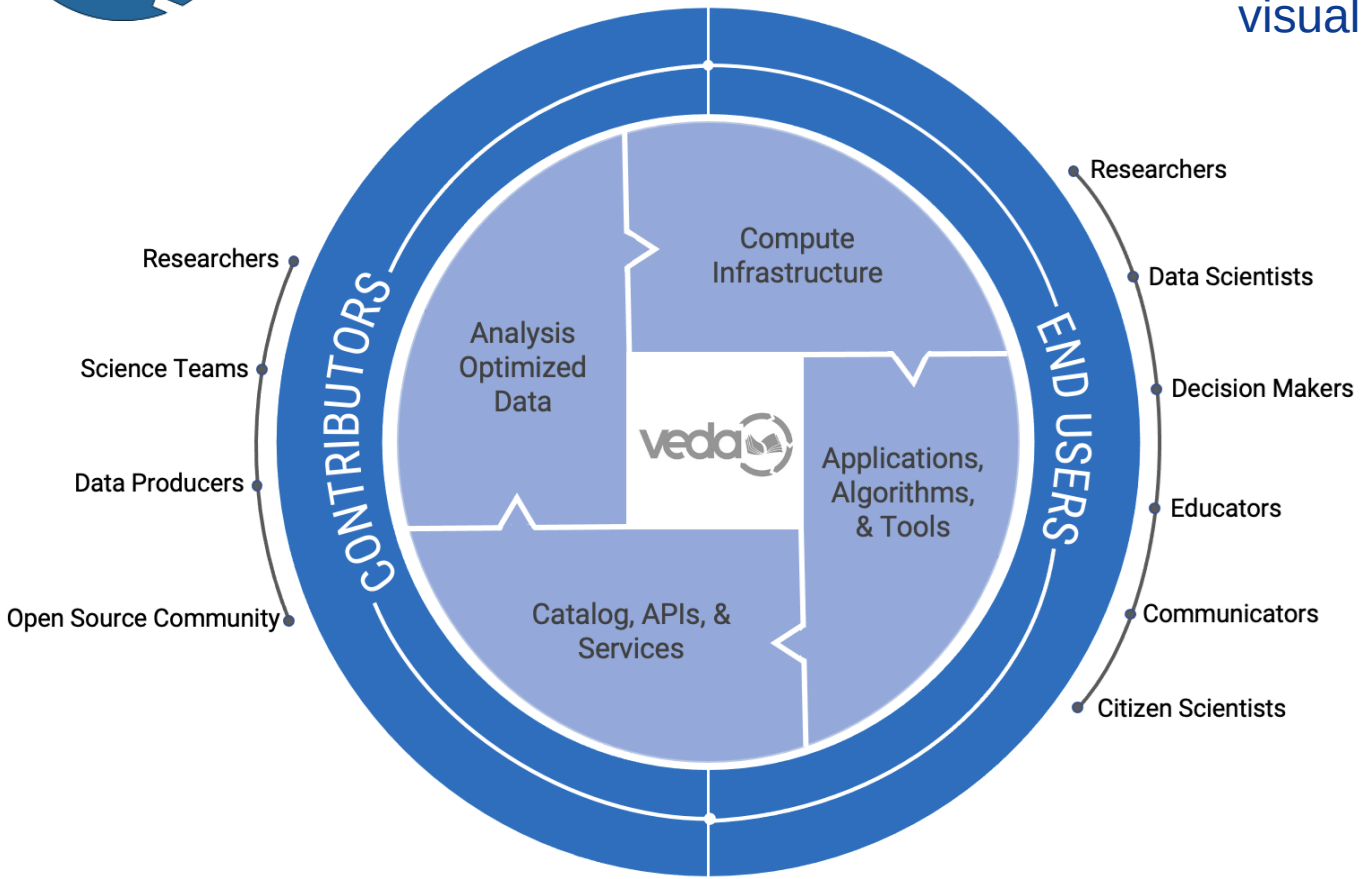
Visualization, Exploration, & Data Analysis (VEDA)

NASA’s Cloud-based, Open-Source, Earth Science, Multi-Mission Analytics Platform

- Open-source, cloud-based, multi-mission cyberinfrastructure
- In-place data discovery, analysis, visualization, and exploration



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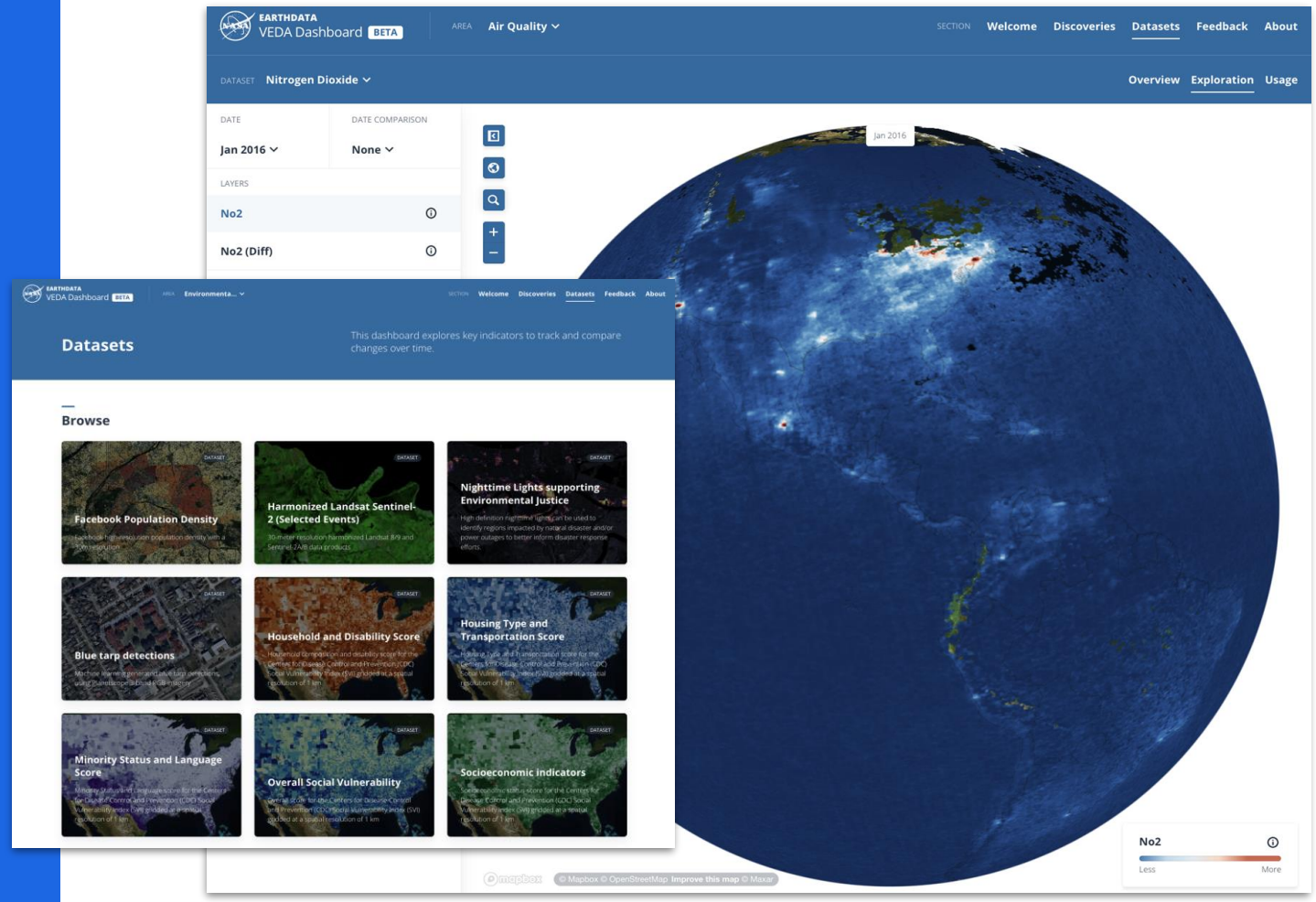
- Builds upon existing robust NASA technology, promoting interoperability

Explore | Analyze | Publish | Communicate



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

VEDA Dashboard on NASA Earthdata

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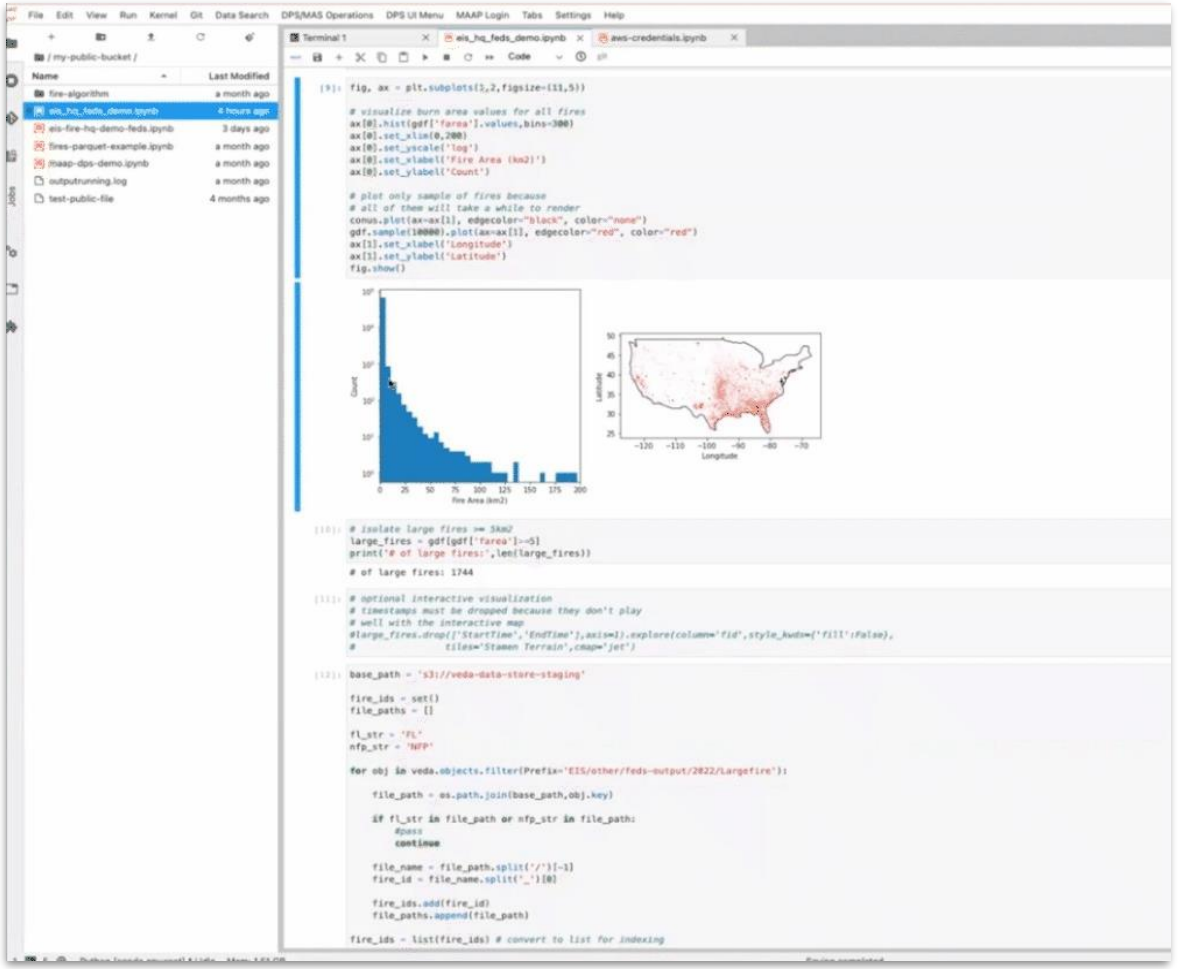
Explore | **Analyze** | Publish | Communicate



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

jupyter

MAAP

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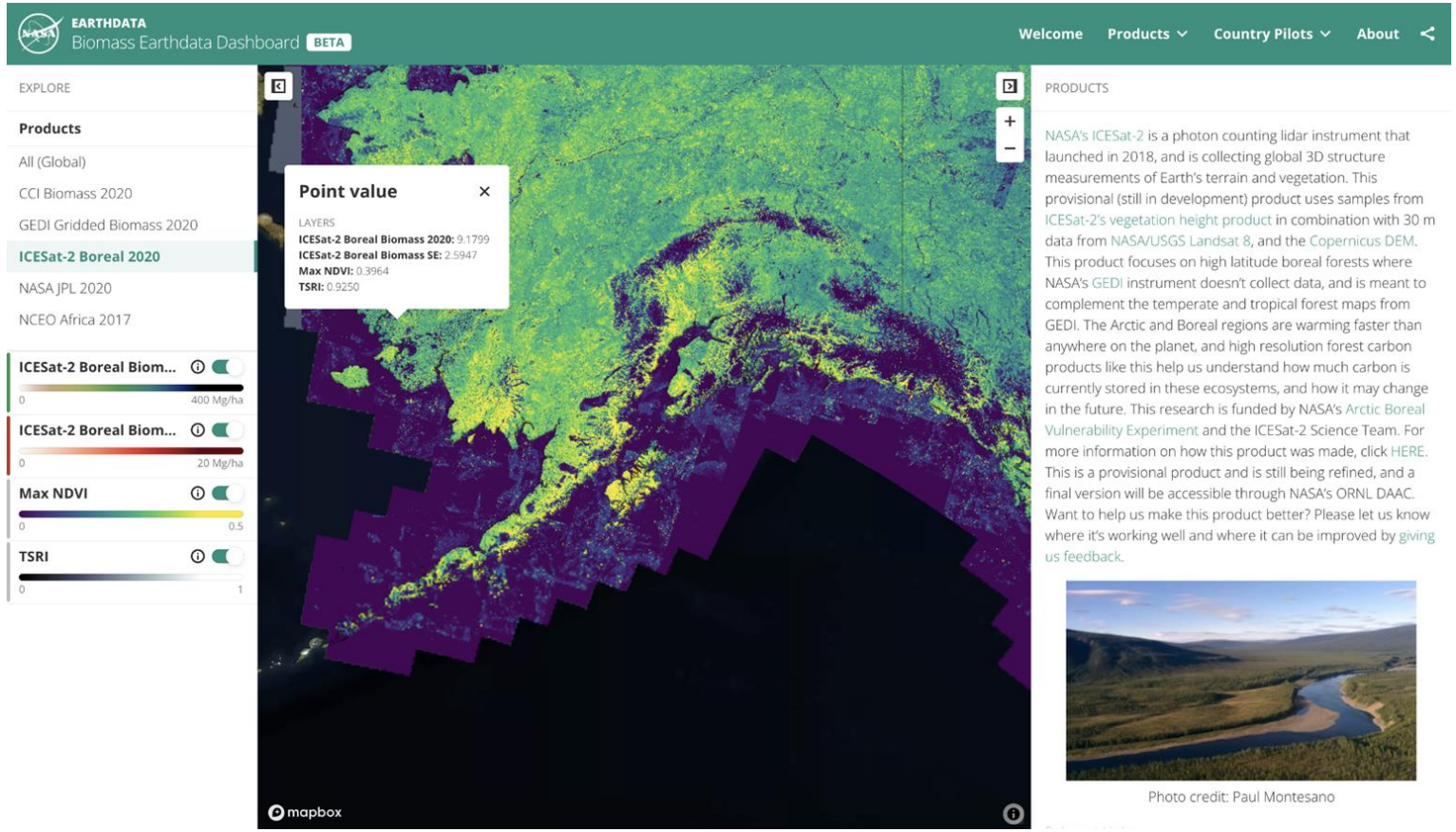
Explore | Analyze | **Publish** | Communicate



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

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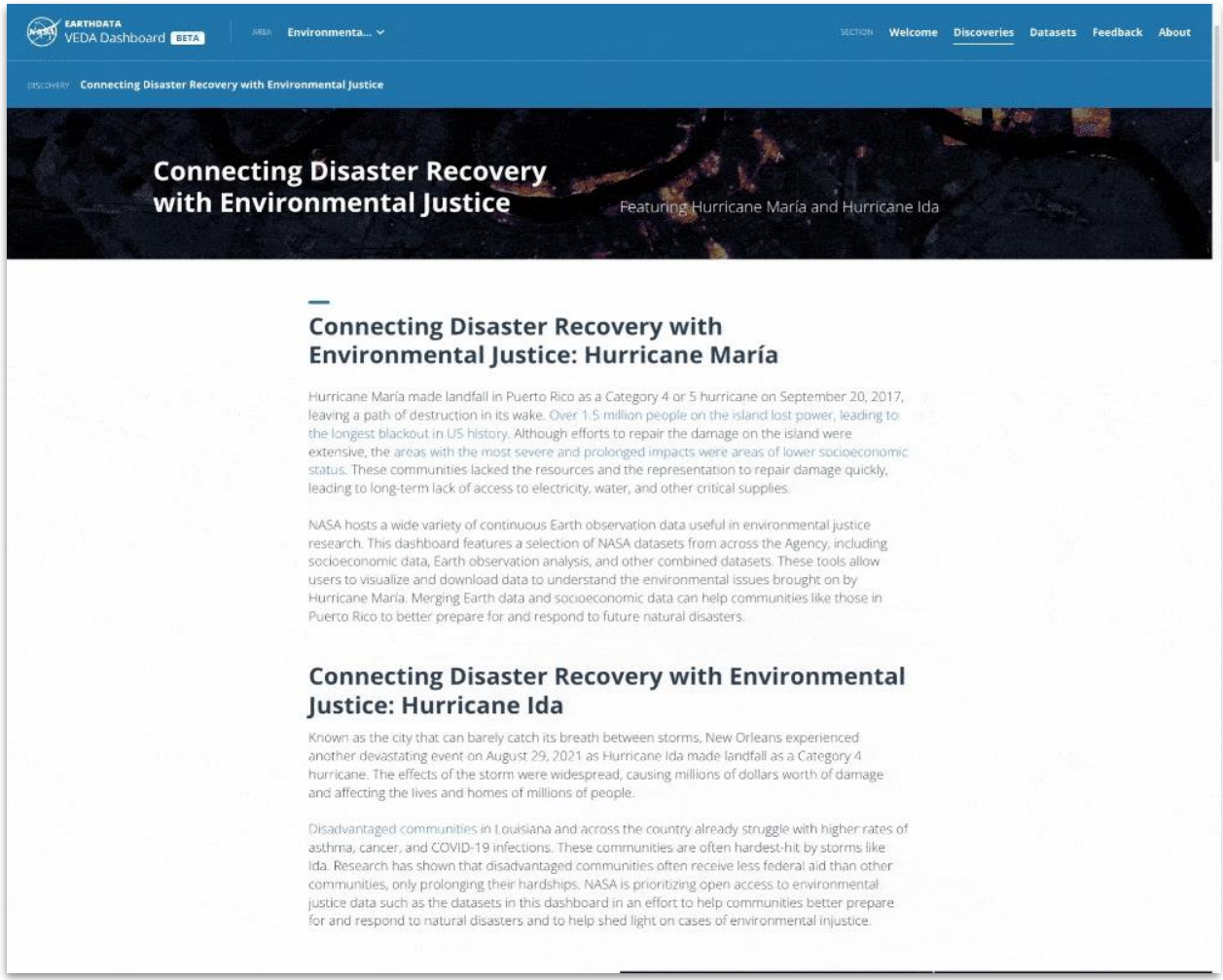

- User friendly and more engaging data-driven storytelling
- Enrich science and applications narratives with interactive exploration

ESDS Looking to the Future

Bottom line: ESDS Program elements and stewards of NASA Earth Science data will…

- Be trained to be ***user-facing*** advocates, communicators, and facilitators of ***open-source science***
- Maintain the tools, services, and software necessary for science communities to ***conduct science in the cloud***

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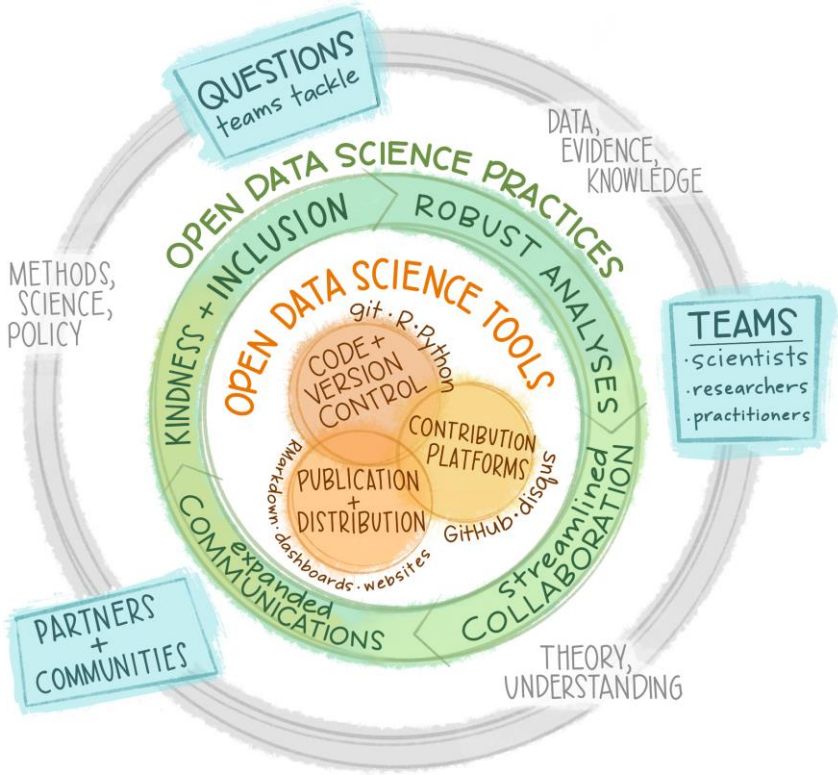
NASA Openscapes

- Multi-year activity to
  - Accelerate data-driven solutions
  - Increase diversity, equity, inclusion, and belonging in research and beyond
- By deploying the Openscapes movement building methodology within NASA DAACs
  - Champions program
  - Collecting and sharing resources, knowledge, workflows, and skills



https://nasa-openscapes.github.io/

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NASA Open-Source Science Initiative

NASA Transform to Open Science (TOPS)

A $40 million, 5-year mission to accelerate adoption of Open Science

Strategic Goals:

- Support 20K researchers to earn NASA's Open Science badge
- Double the participation of historically excluded groups across NASA science
- Enable five major scientific discoveries through open science principles

Join us in 2023 as a Year of Open Science with NASA TOPS!

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Transform to Open Science (TOPS) | Science Mission Directorate (nasa.gov)

NASA Open-Source Science Initiative

Why get a NASA Open Science Certification?

Designed to provide researchers with **core open science skills:**

- Discover the digital tools and resources to perform open science (e.g., GitHub, ORCID)
- Learn best practices for data and software management
- Connect with communities of open science practitioners

TOPS Open Science 101 *– a community-developed curriculum to open science built upon inclusivity, accessibility, and diversity.*

Learn More

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NASA Open-Source Science Initiative

Open-Source Science Funding Through ROSES

F.2 Topical Workshops, Symposia, and Conferences
Events, hackathons, un-conferences, and challenges that build open science skills.
(Rolling deadline in ROSES-22; to be released as a standalone NOFO after 21 Jul 2023)

F.7 Support for Open Science Tools, Frameworks, and Libraries
Improve and sustain open-source tools, frameworks, and libraries that are significantly used by the SMD community.
(ROSES-23 dates TBD; 3yr cadence)

F.8 Supplemental Open-Source Software Awards
Supplemental award to support open science including the conversion of legacy software to open source.
(ROSES-23 dates TBD; rolling deadline)

F.15 High Priority Open-Source Science
Innovative open-source tools, software, frameworks, data formats, and libraries that will have a significant impact on the SMD science community.
(Rolling deadline in ROSES-23)

F.16 Supplement for Software Platforms
Supplemental support of existing awards for scientific analysis platforms.
(ROSES-23 dates TBD)

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All NASA funding opportunities are posted on NSPIRES:
https://nspires.nasaprs.com/

NASA Commitment to Equity & Environmental Justice

Diversify Earth science research and applications with representation from all backgrounds.

Support Equity and Environmental Justice (EEJ) communities by growing the awareness, accessibility, and use of Earth science data, research, and applications for a broad array of users.

NASA ESD supports EEJ through a variety of activities – notable programs are **UNBOUND, Citizen Science,** and **Applied Science's EEJ** program.

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Take-Home Points

- The landscape: upcoming missions pose big data challenges AND NASA user communities are broadening and expanding
- Science in the cloud is priority for NASA: future missions will leverage cloud data and compute AND valuable heritage datasets will be migrated to Earthdata Cloud for interoperability
- NASA is committed to open-source science, which will accelerate scientific discovery, broaden and diversify our user communities, and increase transparency & reproducibility

Thank You!

Questions for ESDS: katherine.m.saad@nasa.gov
Questions on SPD-41a: HQ-SMD-SPD41@list.nasa.gov

Appendix

SPD-41a Policy Updates

Data

Scientific data should be FAIR and shall be made publicly available with a clear, open, and accessible data license no later than the publication of the research, **and be citable.**

Mission data shall be openly available with no period of exclusive access.

Software

Research software shall be publicly available no later than the publication of the research, assigned a permissive software license, **and be citable.**

Mission software shall additionally be developed openly in a publicly accessible, version-controlled platform that allows for contributions and engagement from the community.

Publications

Manuscripts versions of as-accepted manuscripts shall be deposited in a NASA repository and made publicly available within 12-months. **Publishing as open access is supported and posting preprints is encouraged.**

Mission publications shall additionally be made publicly available at the time of their publication.

Science workshops and meetings shall be open to broad participation and documented in public repositories.

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Open science activities will be considered in reviews of proposals.

White House Office Of Science and Technology Policy (OSTP)

Guidance to Make Federally Funded Research Freely Available Without Delay

- *Federal Agencies must update public access policies to make Publications and Research funded by taxpayers publicly accessible without embargo or cost.*
- *Compliance by Dec. 31, 2025*

"When research is widely available to other researchers and the public, it can save lives, provide policymakers with the tools to make critical decisions, and drive more equitable outcomes across every sector of society," said ***Dr. Alondra Nelson, head of OSTP****. "The American people fund tens of billions of dollars of cutting-edge research annually. There should be no delay or barrier between the American public and the returns on their investments in research."*

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Open-Source Science & NASA Policy (SPD-41a)

- ***Openness is fundamental, security is essential, and freedom and integrity are crucial.***
- Increase the accessibility, inclusion, and reproducibility of scientific activities
- When possible, minimize the burden.
- SPD-41a brings together existing NASA and Federal Guidance. It is ***forward looking***, applying to work going forward. Existing missions and investigations should adopt parts of this policy consistent with available resources.

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SPD-41a as it applies to ESO missions

A. **All mission data, metadata, software, databases, publications, and documentation shall be available on a full, free, open, and unrestricted basis starting in Phase B** with no period of exclusive access.
B. **Science workshops and meetings** shall be **open** to broad participation and documented in public repositories.

1	**Software shall be developed openly** in a publicly accessible, version-controlled platform using a **permissive software license allowing for community use and contributions.**	**4**	Scientific data, metadata, software, publications and documentation **shall be archived and made available by NASA and/or [Partner] starting in Phase B.**
2	**Manuscripts shall be published with open access licenses**; versions of as-accepted manuscripts shall be made available as open preprints and deposited in a NASA or [Partner] **repository upon publication.**	**5**	**NASA and [Partner]** software, documentation and data **shall be properly marked, cited, and/or attributed**. Metrics to measure and acknowledge open-source science contributions will be developed.
3	All mission **data, calibration information, and simulated products supporting development and validation of algorithms shall be made available without any conditions to use.**	**6**	**NASA and [Partner] will mutually develop an Open-Source Science Plan** that specifies details of collaboration.

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SPD-41a as it applies to ESD Open Data, Services, and Software Policies

Committed to advancing Open-Source Science in Research, Applications, Data, and Missions

ESD Data and Information Policy

- Full, free, and open data policy for all since 1994, in line with SPD-41a principles.
    - Updates to clarify responsibilities for ESD, repositories, researchers, and missions coming Spring 2023.

ESD Open-Source Software Policy

- All software developed through research and technology awards (e.g., ROSES) shall be made available to the public as open-source software to align with SPD-41a
    - https://www.earthdata.nasa.gov/engage/open-data-services-and-software/esds-open-source-policy
    - https://www.earthdata.nasa.gov/engage/data-management-guidance
    - https://www.earthdata.nasa.gov/engage/dmp-earth-science
    - Earth Science Division-specific OSDMP Template

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