

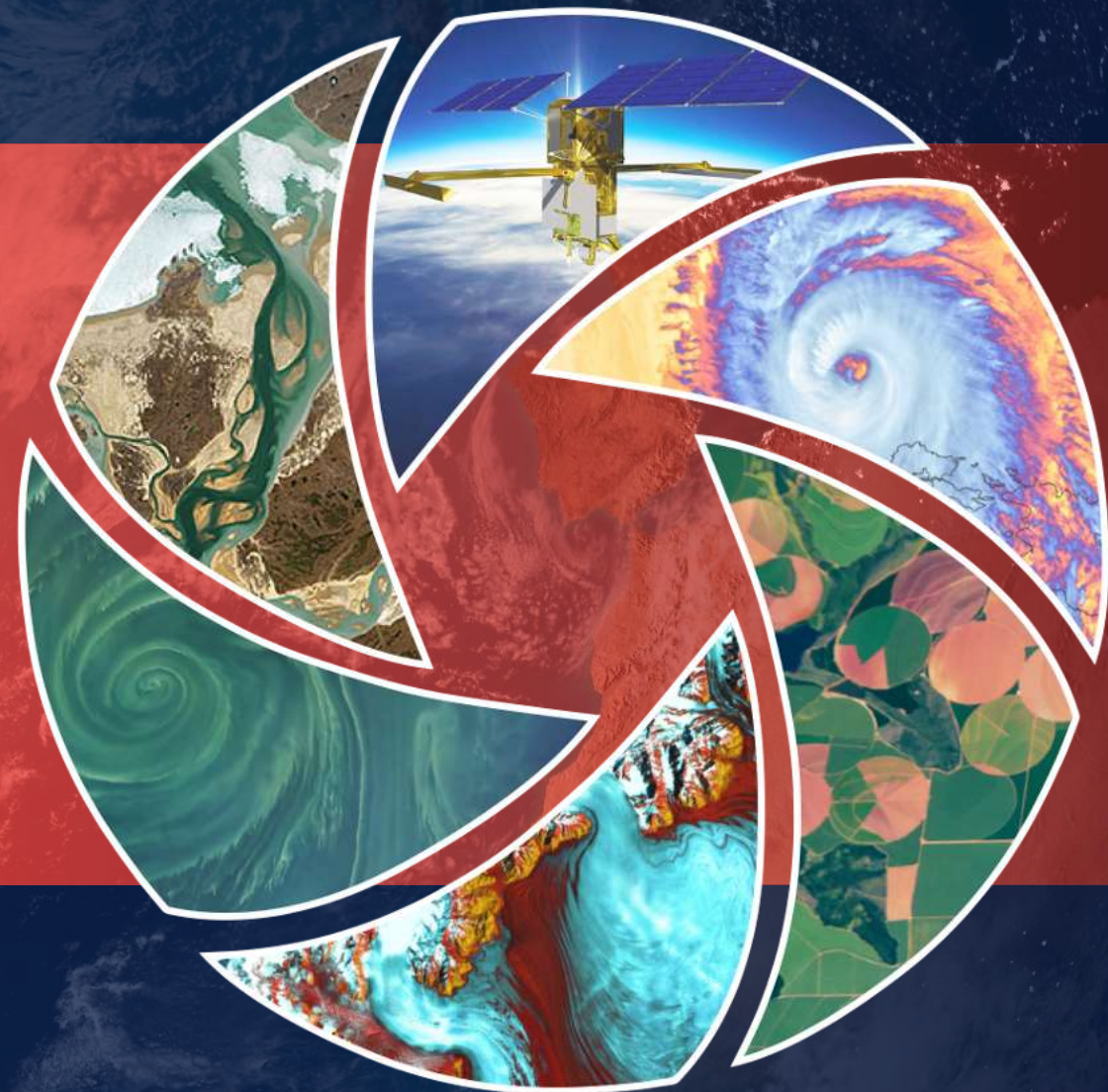
HQ Updates & Perspective

GHRC DAAC User Working Group | November 2, 2023

Cerese Albers, Ph.D.

Program Executive, Earth Science Data Systems

NASA Headquarters



EARTHDATA

OPEN ACCESS FOR OPEN SCIENCE

Discussion Highlights

- Why We're All Here
- Where We're Going
 - The Earth System Observatory
 - Open-Source Science
- Preparing for the Future
- New Initiatives: ES2A; VEDA; GHG Center; EIC
- TOPS and OSS Funding Opportunities
- Commitment to EEJ and Broadening NASA data usership
- Take-Home Summary

Why You're Here

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





Earth Science Data Systems (ESDS Program @ NASA HQ)



Katie Baynes, Earth Data Officer

← Cerese Albers, Program Executive

Joel Scott, Program Executive →

Yaitza Luna-Cruz, ESDS Connections

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Katherine Saad (Program Scientist)

Hannah Townley (Project Coordinator)

Earth Science Data & Information Systems (ESDIS)

Ted Sobchak (Project Mgr)

Includes DAACs, SIPS, & more

Interagency Implementation and Advanced Concepts Team (IMPACT)

Rahul Ramachandran (MSFC)

Manil Maskey (MSFC)

Web Strategy & Communications Team

Andi Thomas (Task Lead/Communications Mgr)

Program Scientists

Alexey Shiklomanov (GSFC)

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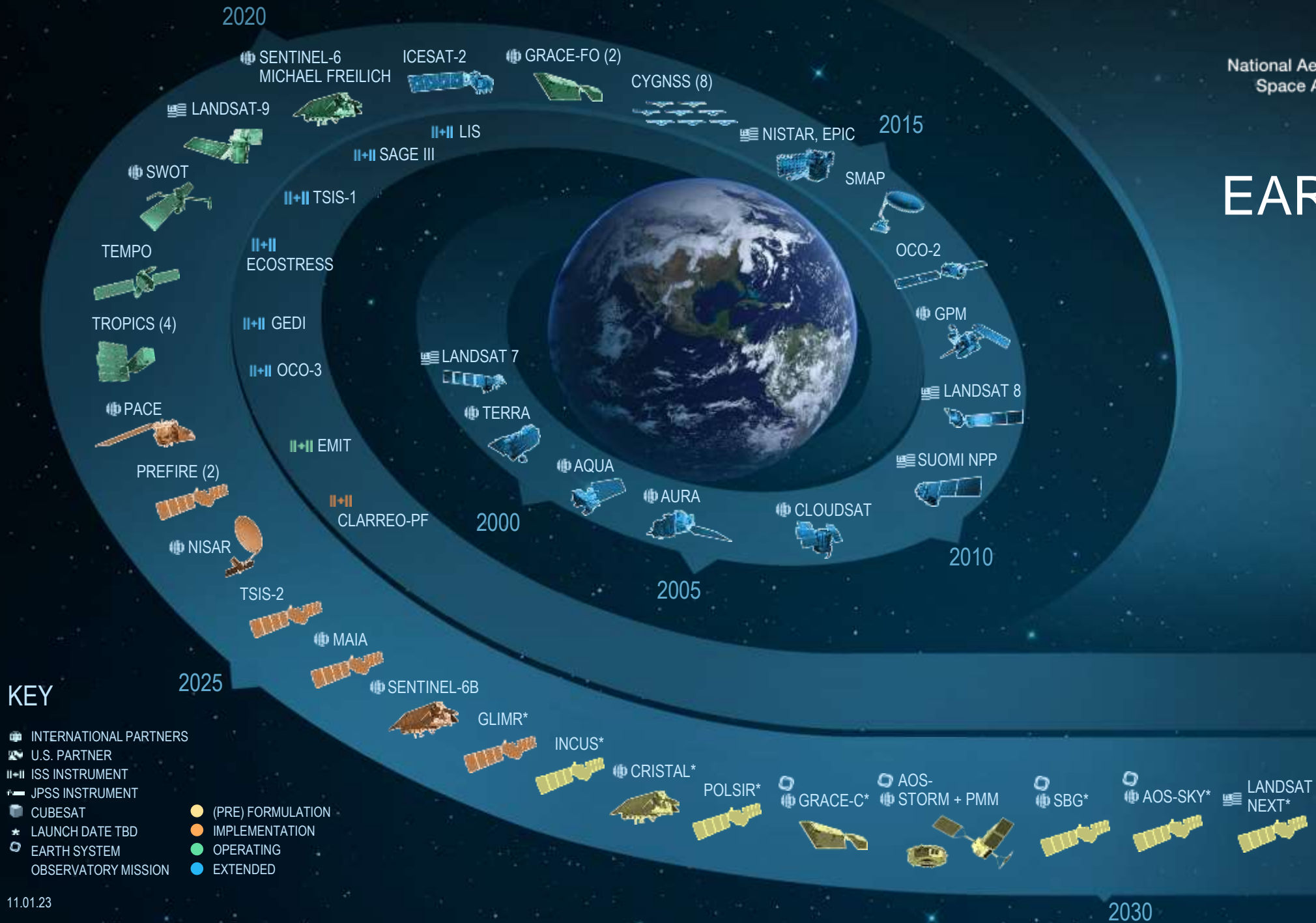
Where We're Going

As NASA Earth Science Division &
Earth Science Communities





EARTH FLEET



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
- EARTH SYSTEM
- OBSERVATORY MISSION
- (PRE) FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

EARTH SYSTEM OBSERVATORY

INTERCONNECTED CORE MISSIONS

SURFACE BIOLOGY AND GEOLOGY

Earth Surface & Ecosystems

SURFACE DEFORMATION AND CHANGE

Earth Surface Dynamics



CLOUDS, CONVECTION AND PRECIPITATION

Water and Energy in the Atmosphere

AEROSOLS

Particles in the Atmosphere

MASS CHANGE

Large-scale Mass Redistribution

ESO Core Missions

- Successfully completed Mission Concept Reviews summer 2022
- Missions passed KDP-A and now in Formulation
- ESO Independent Review Board, July-October
 - IRB report and NASA response posted at nasa.gov/reports
- AOS-Storm and AOS-Sky have Phase A trade studies under way.
- SDC will remain in extended study phase to take advantage of NISAR mission lessons learned

AOS-Storm

AOS-Sky

MCR: May 2022

KPD-A: Jan 2023

SBG

MCR: June 2022

KDP-A: Nov 2022

GRACE-C

MCR: Jun 2022

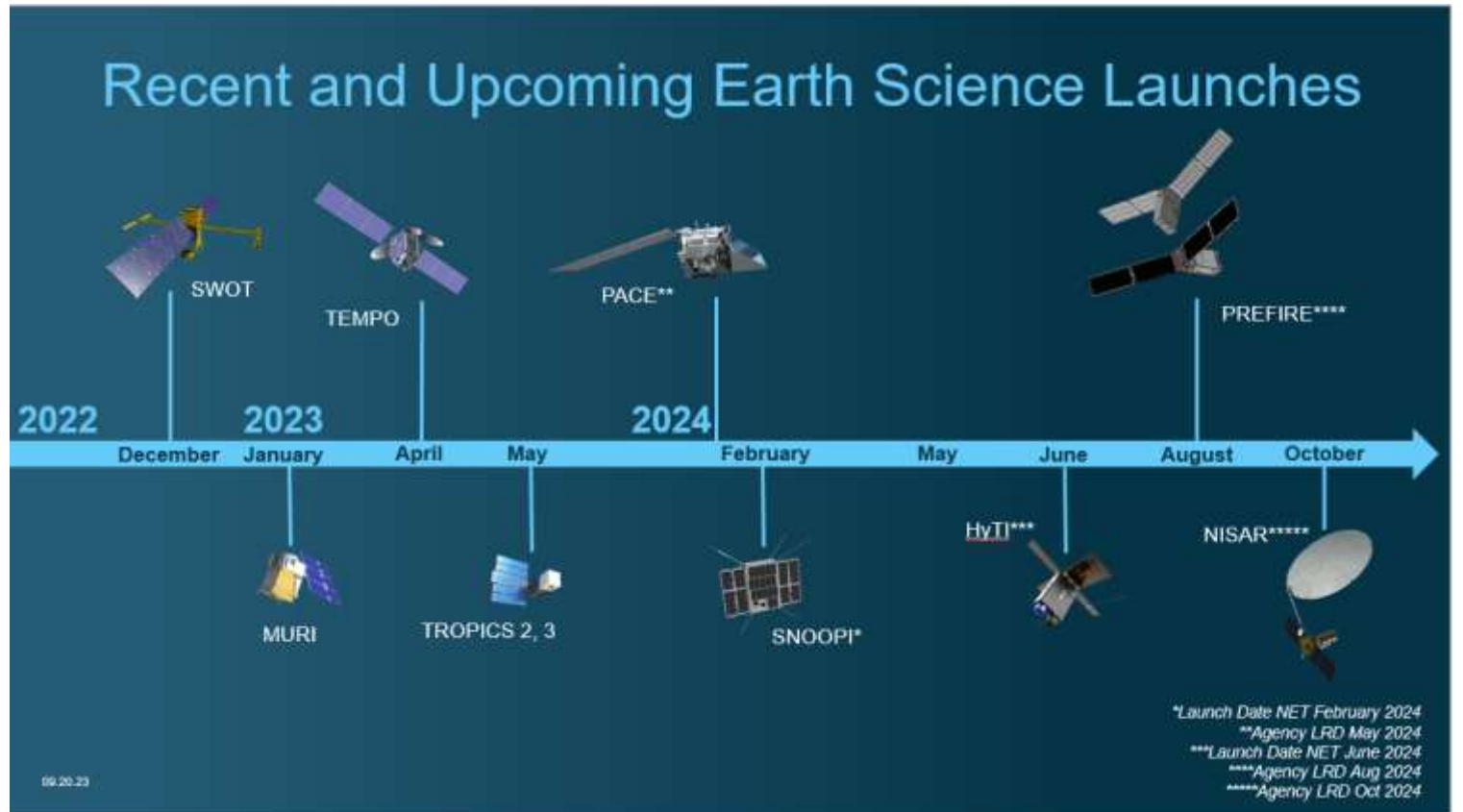
KDP-B: Sept 2023

SDC

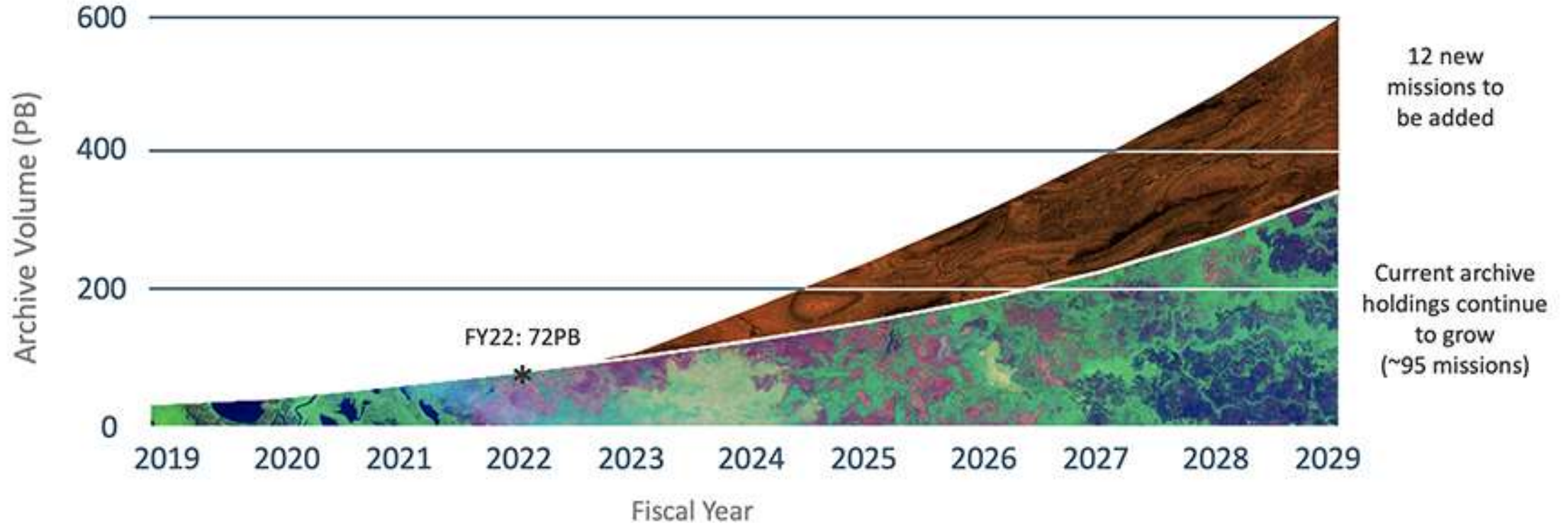
Remaining in
Extended Study
Phase

Near-Term Mission Data Volumes

- But large missions like NISAR and PACE are coming much sooner!
- We need to be prepared. What does that preparation mean to our user-facing elements such as our DAACs? We must prepare to meet the needs of users!



The Future of NASA Earth Science Data



Courtesy: ESDIS

Open-Source 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.

White House Office of Science, Technology, & Policy 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*



The White House announces
2023 A Year of Open Science
CDC • DOA • DOC • DOE • DOS • DOT • EPA • NASA • NEH • NIH • NIST • NOAA • NSF • SI • USDA • USGS

A multi-agency (16) 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.

Learn more: <https://open.science.gov/>

The graphic features a dark blue background with a glowing open book at the bottom center. Above the book, several hexagonal icons are arranged in a cluster, each containing a white symbol representing different scientific fields: a microscope, a globe, a rocket, a plant, a caduceus, a book, a DNA helix, and a wind turbine. The overall aesthetic is futuristic and scientific.



Learn more at:
<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



NASA Earthdata: Preparing for the Future

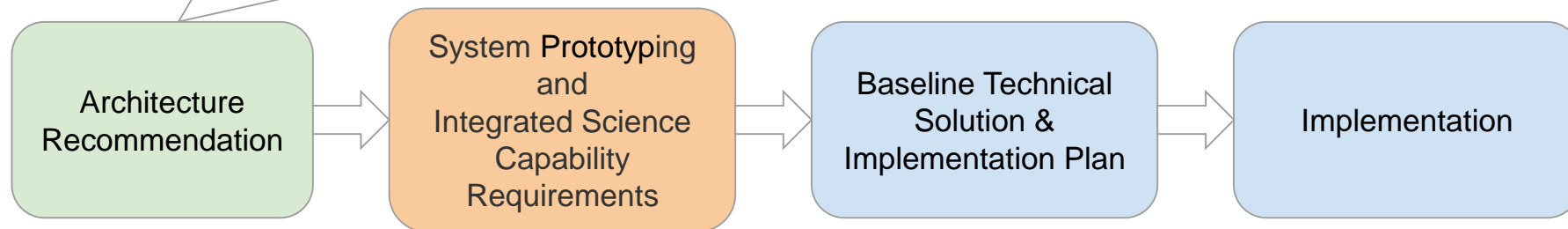
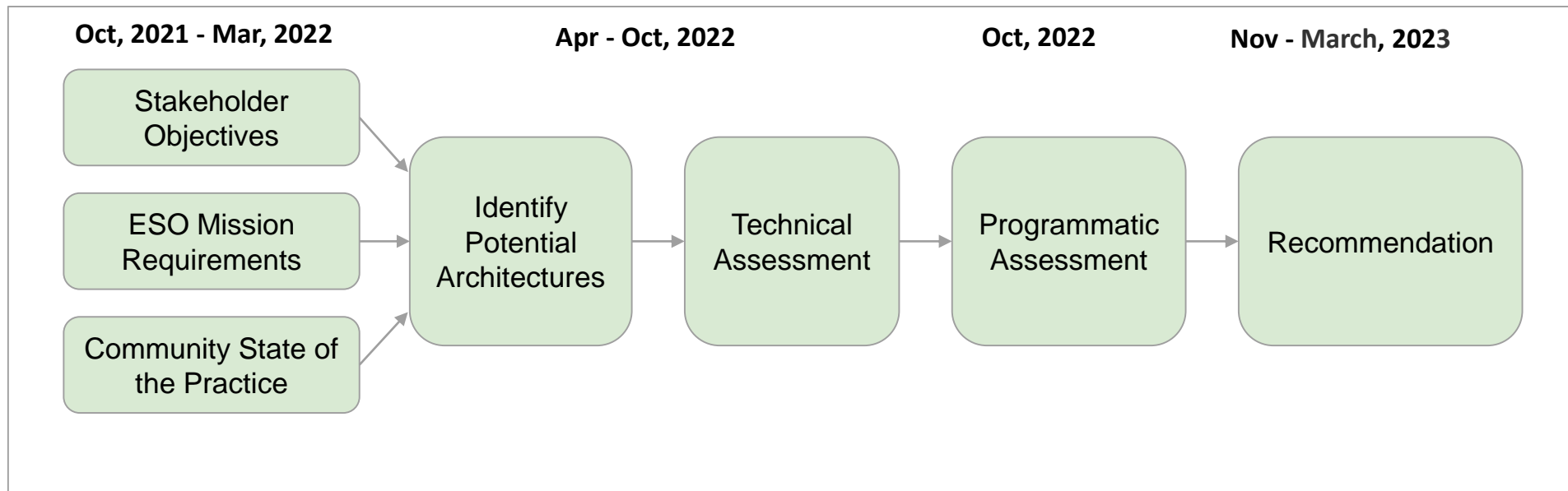


ESO Mission Data Processing Study



- **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
- **How:** Held 2 workshops, & a trade study yielding architectural recommendations. Report released in February 2023: <https://www.earthdata.nasa.gov/technology/open-science/oss-for-eso-workshops>
- **Phase 1 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
- **Phase 2 Just Kicked off!** Study timeline built to align with ESO mission milestones and will result in prototyping with the ESO missions. **Review was last week**

Initial Study Approach



Phase 2

through Sept
2024

Future Work

Cloud Migration of Priority Earth Science Datasets

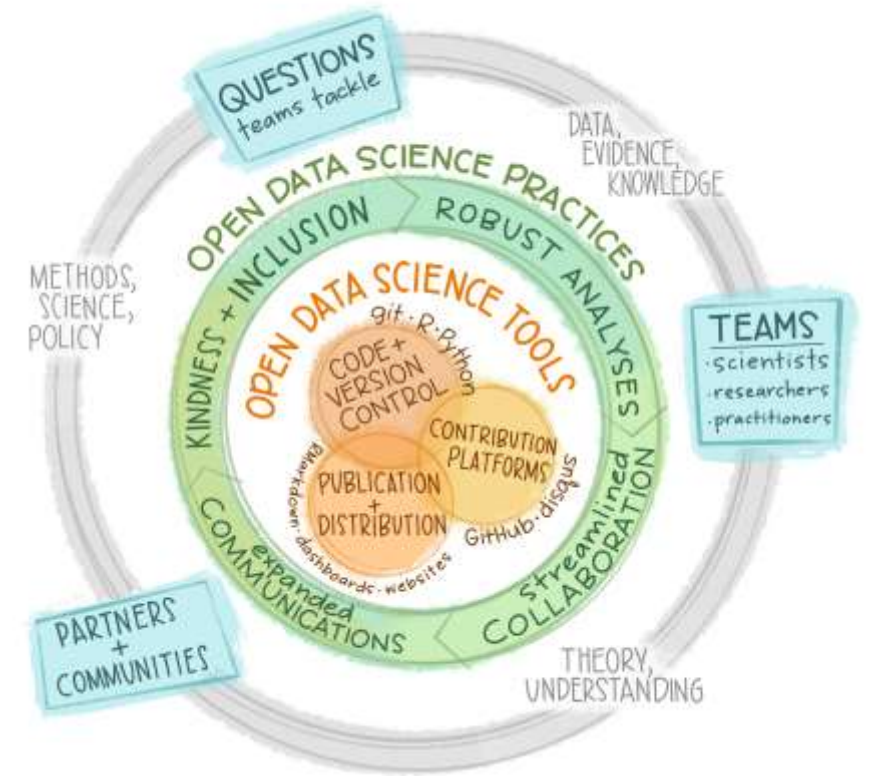
- Migration **increases the utility** of existing Earth Science datasets, by enabling NASA to **meet users' needs** for in-place computing, viz, and analysis as data volumes grow.
- The **top 75** most-downloaded datasets **migrated to Earthdata Cloud**.
 - Six (of twelve) DAACs were involved in this 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.
- Three DAACs are **100% in the cloud** with more on the way! **Go GHRC, PO, and LAADS DAACs!**
- As of July 2023, **2560+ collections** and **more than 33 Petabytes** of data are in Earthdata Cloud (S3 standard and S3 IA).



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

NASA Openscapes

- Multi-year activity accelerating data-driven solutions, increasing diversity, equity, inclusion, and belonging in research and beyond.
- [Openscapes](#) within NASA DAACs created a shared mission to move users to the cloud and adopt open, growth mindset that is collaborative and a comfortable working space.
 - Champions program
 - Collect and share resources, knowledge, workflows, and skills
 - A place to learn and explore in the transition
- Now includes 10 DAACs with a co-developed common set of resources
- Openscapes 2i2c JupyterHub has become a default space for some DAACs to develop, test, and teach tutorials and scripts they create.
- Held over 12 workshops, 2 Champions cohorts, *earthaccess* python library and Cheatsheets & Cookbook in response to user needs



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



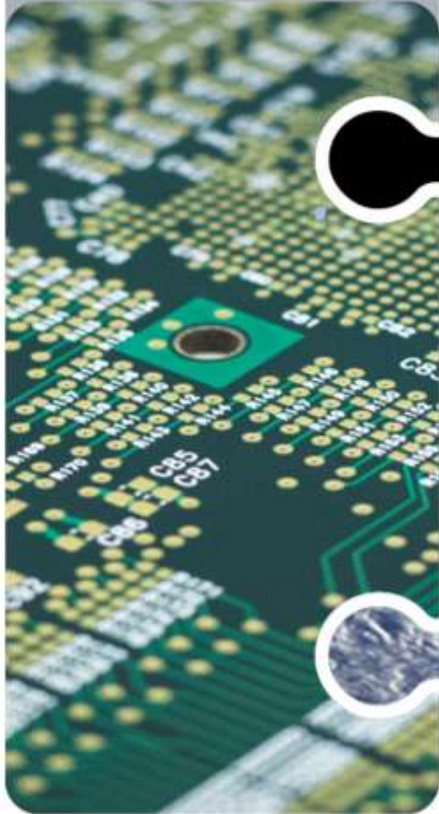
New Initiatives: Earth Science to Action Strategy (ES2A)

Delivering Actionable Science



Advancing Earth System Science End-to-End

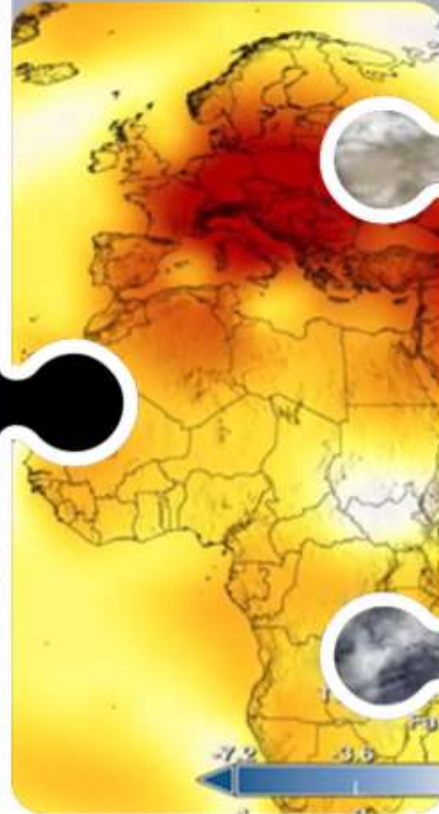
TECHNOLOGY



FLIGHT



RESEARCH
AND ANALYSIS



DATA
AND COMPUTE



APPLICATIONS



Research Focus Areas

Atmospheric Composition
Water and Energy Cycle
Carbon Cycle and Ecosystems

Earth Surface and Interior
Weather and Atmospheric Dynamics
Climate Variability and Change

Earth Science to Action Strategy



Visualization, Exploration, & Data Analysis (VEDA)

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



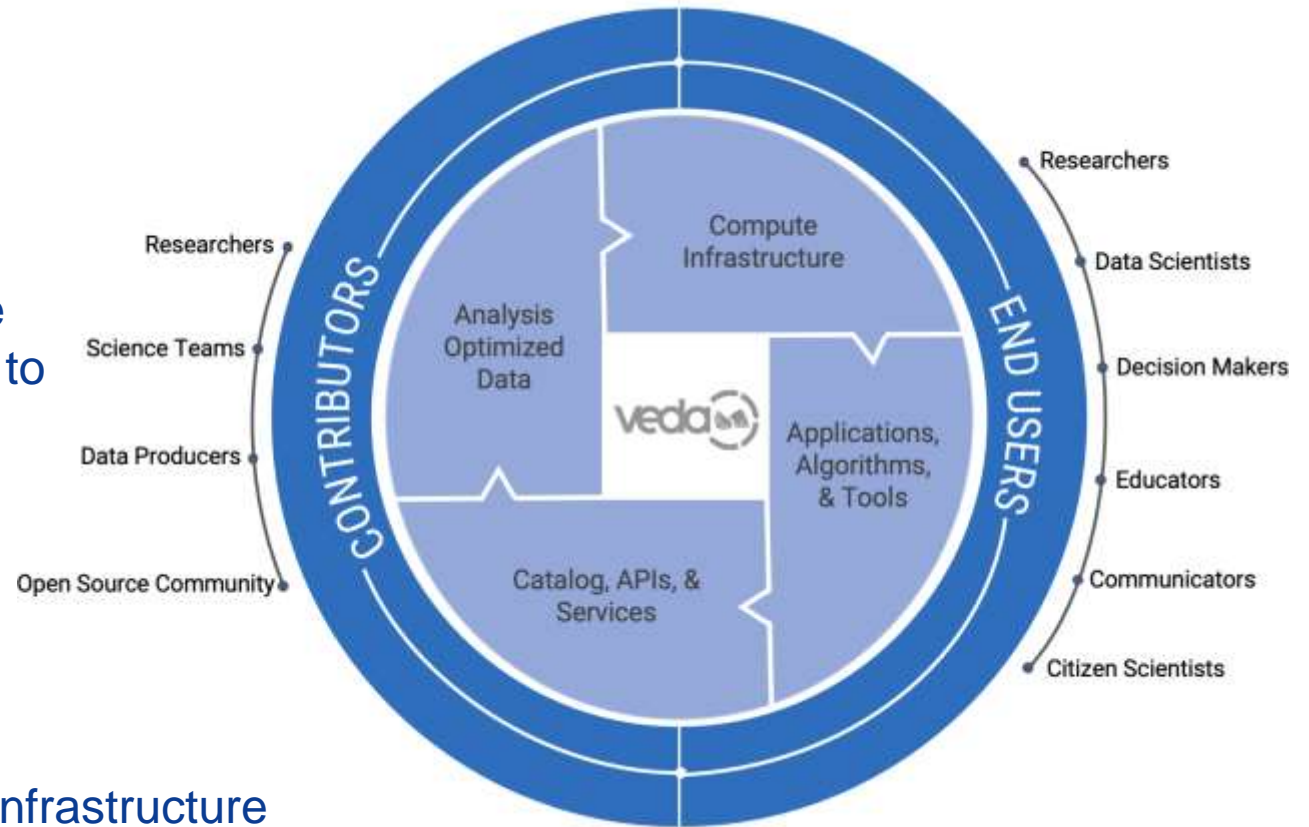
VEDA Highlights

Why?

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

What?

- Open-source science multi-mission cyberinfrastructure
- In-place cloud-native data processing, analysis, visualization, and exploration
- User-friendly scientific discovery via an accessible and reproducible computation framework
- Builds upon a robust heritage of existing NASA technology, promoting interoperability



The background of the slide is a satellite-style aerial map of a coastal region, likely a delta or estuary. The map shows a complex network of waterways and land parcels. A prominent red overlay is visible, highlighting a specific area of interest, possibly a wetland or a region of environmental concern. The overall color palette is dominated by blues, greens, and reds.

New Initiatives: GHG Center and Earth Information Center

Greenhouse Gas Monitoring and Information Center

Mission: To extend accessible and integrated greenhouse gas (GHG) data and modeling capabilities from U.S. Government and non-public sources for scalable impact

Strategic Goals

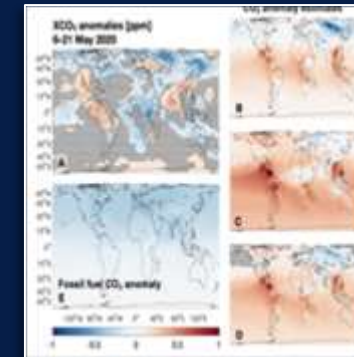
1. **Accelerate** GHG monitoring, measurement, reporting and verification **decision support**, connecting technology, tools, and data.
2. **Foster collaboration** with networks of interagency, intergovernmental and private sector partners to co-develop and increase adoption of impactful applications.
3. **Promote scientific innovation and transparency** by leveraging advanced data systems capabilities and open source science principles.
4. **Develop products needed by users**, updated on a regular basis, and enabled by advanced science-based capabilities.
5. **Establish bidirectional knowledge transfer** and engagement with federal, state, local and tribal governments, researchers, and the general public.
6. **Integrate diversity, equity and inclusion** in the Center's research, knowledge transfer, community engagement, management and operations functions.

Pilot Use Cases



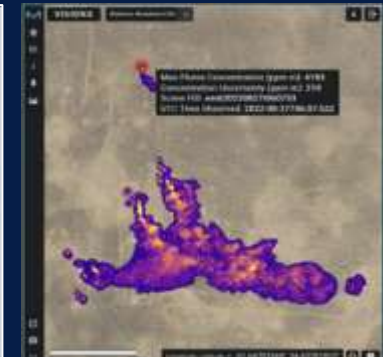
Use Case 1. Improve access and latency to gridding of anthropogenic methane inventory.

Credit: Maasakkers et al., *Env. Sci. and Tech.*, 2016



Use Case 2. Complement anthropogenic GHG emission natural GHG emissions and fluxes.

Credit: Weir et al., *Env. Res. Lett.*, 2022, submitted



Use Case 3. Identify, and quantify estimates from super emitting events, leveraging aircraft and satellite data.

Credit: Carbon Mapper, NASA Field Campaign Explorer

Earth Information Center

Improving access to key climate information is a priority for the Agency. Building on his previous announcement, NASA Administrator Bill Nelson released the first concept, and shared a new video for the Earth Information Center. The Center allows the public to see how the Earth is changing and guide decision makers to mitigate, adapt, and respond to climate change.



The image is a screenshot of a NASA press release page. At the top, there is a blue header with the text "Humans in Space". Below this is a photograph of three people seated at a table during a meeting. The table is covered with a blue cloth and has the NASA seal on it. Behind them are the American flag and the NASA flag. Below the photograph, the text reads "Sep 9, 2022" and "RELEASE 22-094". The main title of the press release is "NASA Hosts National Space Council Meeting, Vice President Chairs Event". To the right of the title are social media icons for Facebook, Twitter, LinkedIn, and Pinterest. Below the title, there is a quote from NASA Administrator Bill Nelson: "Just like we use mission control to monitor operations during spaceflight, we're embarking on this effort to monitor conditions here on our home planet, and it will be available to everyone in an easy-to-access format." Nelson said. At the bottom of the page, there is a paragraph of text: "Planning for the Earth Information Center is underway with the initial phase providing an interactive visual display of imagery and data from NASA and other government agencies. NASA Headquarters plans to house this initial interactive display with goals to expand in person and virtual access over the next five years."

Humans in Space

Sep 9, 2022
RELEASE 22-094

NASA Hosts National Space Council Meeting, Vice President Chairs Event

Facebook Twitter LinkedIn Pinterest +

Just like we use mission control to monitor operations during spaceflight, we're embarking on this effort to monitor conditions here on our home planet, and it will be available to everyone in an easy-to-access format." Nelson said.

Planning for the Earth Information Center is underway with the initial phase providing an interactive visual display of imagery and data from NASA and other government agencies. NASA Headquarters plans to house this initial interactive display with goals to expand in person and virtual access over the next five years.

For more than 50 years, NASA satellites have provided open-source and publicly available data on Earth's land, water, temperature, weather, and climate.

Earth Information Center



Earth Pulse:

Near real time tracking of data transfer between satellites and Earth

A physical and virtual space to engage and amplify impact – *to show people our Earth as we see it.*



Immersive installation allows viewers to experience Earth's interconnected systems and imagine Earth from Space.



The intent is to stimulate communities to explore solutions and provide opportunities for connecting science to action.



ESDS Looking to the Future

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

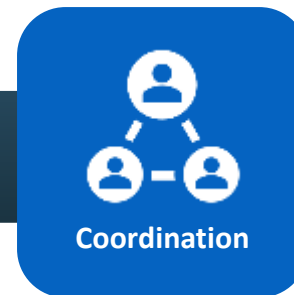
- Be trained to be ***user-facing*** advocates, communicators, and facilitators of ***open-source science***
- Maintain the tools, services, and software necessary for science communities to ***conduct science in the cloud***

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!*

Complete NASA's open science course!

Open Science 101: A community-developed introduction to **core open science skills**

- Know how to write a NASA open science and data management plan
- Learn about tools and best practices
- Increase the impact & visibility of your science
- Earn your digital NASA open science badge



Self-Paced
Online Course



Online & In-person
Workshops



Enroll now!



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



[Learn More](#)





NASA OSSSI Funding (ROSES)

F.2 Topical Workshops, Symposia, and Conferences

Events, Hackathons, un-conferences, and challenges that build open science skills, Training in open science. Rolling deadline.

F.7 Support for Open Source Tools, Frameworks, and Libraries

Support and maintain open source tools, frameworks, and libraries that are significantly used by the SMD community.

F.8 Supplemental Open Source Software Awards

Supplemental award to encourage the modernization of legacy software and release as open source.

F.14 Transform to Open Science Training

Tutorials showcasing open science in action and NASA cloud data, summer schools, virtual cohorts.

F.15 High Priority Open-Source Science

Supporting innovative open source tools, software, frameworks, data formats, and libraries.

F.16 Supplement for Software Platforms

Supplemental support to existing awards for usage of scientific platforms. Budget TBD.



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.



Take-Home Points

- The Landscape
 - NASA has upcoming missions and ESD priorities with big data challenges and high vis.
 - NASA user communities are broadening and expanding
- Science in the cloud is priority for NASA
 - Future missions will be leveraging cloud data and compute
 - Valuable heritage datasets will be migrated to Earthdata Cloud and transformed into ARCO formats to support interoperability and in-place analysis
- NASA is committed to **open-source science** and to promoting equity & environmental justice
 - Open-source science will **accelerate** scientific discovery, will **broaden** and **diversify** our user communities, and will increase **transparency** and **reproducibility** of our science
 - **TOPS** and **Openscapes** are community- and DAAC-oriented activities to achieve open source science, respectively

A satellite view of Earth from space, showing the Western Hemisphere. The image is dominated by a large, semi-transparent blue rectangular overlay that covers most of the frame. This blue area is framed by a thin red border. In the center of this blue area, the words "Thank You!" are written in a clean, white, sans-serif font. The background shows the Earth's surface with various shades of blue, green, and brown, representing oceans, landmasses, and clouds. The top and bottom edges of the image show the curvature of the planet and the blackness of space.

Thank You!