National Aeronautics and
Space Administration

NASA earth

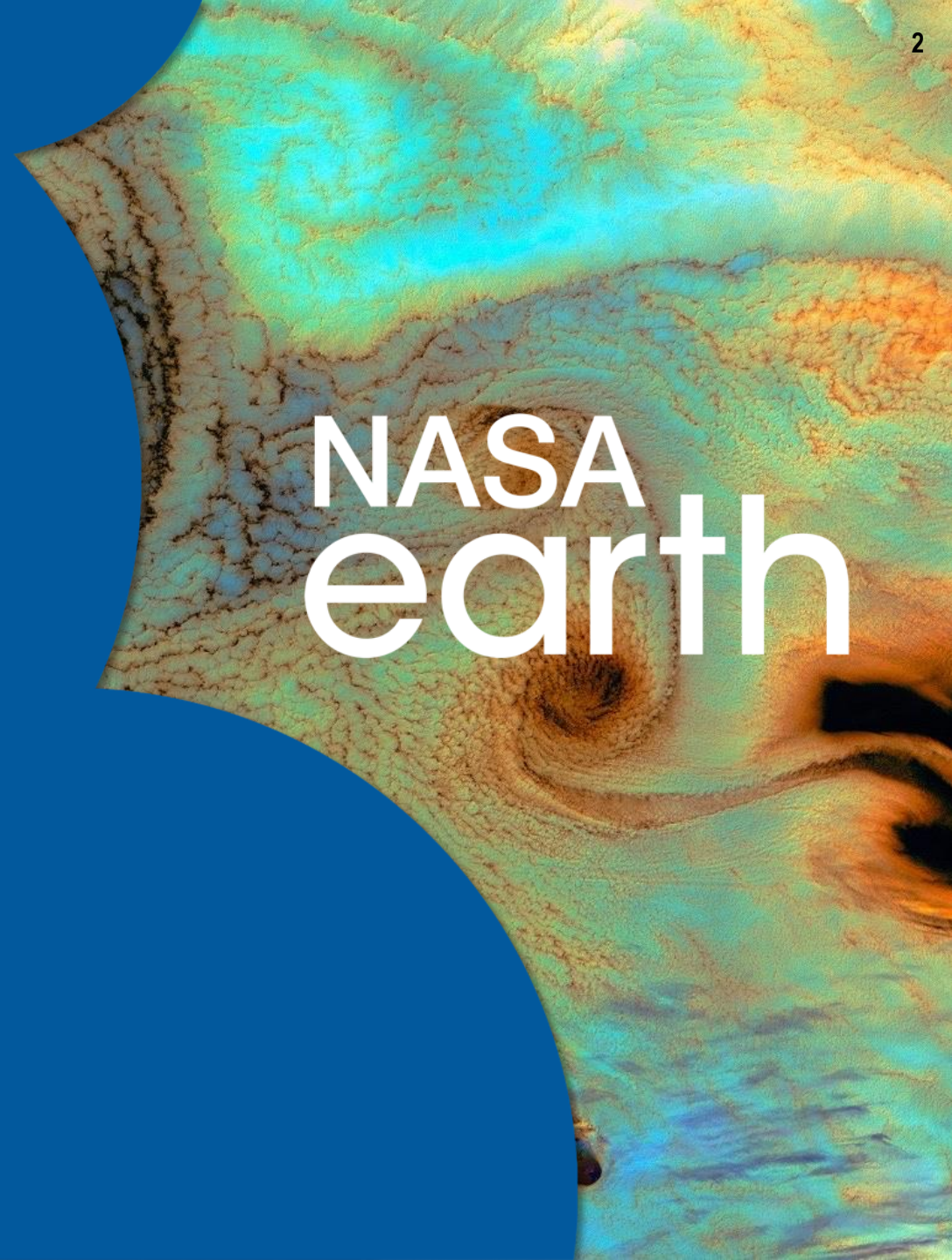
Earth Science Town Hall

AGU, December 2025

Karen St. Germain, PhD
Director
Earth Science Division

Agenda

- Overview of Earth Science Strategy
- Advancing Technology
- Satellite Missions and Recent Launches
- Driving Earth Science Data
- Advancing Scientific Understanding of the Earth System
- Delivering Actionable Science
- Discussion



NASA HQ Earth Science Division Leadership

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Division Director

Julie Robinson
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Deputy Associate Director (Acting)

Earth Action

Thomas Wagner
Associate Director

Emily Sylak-Glassman
Deputy Associate Director

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08.28.2025

Three Major Objectives in Implementing Earth Science in 2026

Drive Alignment with Presidential Priorities

- Advance Gold Standard Science and understanding of the Earth System
- Technology Innovation & Advancement
- Economic Growth
- Strengthen National, Regional and Local Preparedness and Resilience

Drive Efficiency and Focus on Impact

- Improved fidelity of planning for DAAC transition to Science Enabling Teams
- Consolidation of Flight Program Offices
- Reduce programmatic complexity of ES Research and Applied and Responsive Earth Sciences
- *Multi-source Integrated Observatory* to maximize science and applications value from NASA and commercial missions

Address Known Issues

- Analysis of potential active research grant reductions
- Risks associated with data system consolidation and dramatic data volume growth
- Managing mission closeout costs

Strategic Approach

- **Focus on NASA-unique**
  - Flight: Prioritize missions for which NASA is the global leader
  - Technology: Focus on quantum and targeted advanced sensing
  - Data: Focus on NASA data usability
  - Science & Applications: Focus on accelerating multi-mission/multisource discovery and pipeline to applications
  - Applications: Increase focus on economic sector stakeholder needs
- **Focus on National challenges**
  - Wildland fires
  - Water and food security
  - Economic growth and connections to the private sector
  - Resilience at state and local levels
- **Ensure executability**

Earth Science to Action Strategy

Virtuous Cycle
- User needs inform next iteration of programs, missions and initiatives

Public Understanding & Exchange
- Put more scientific understanding into public sphere
- Deliver applied science to users
- Participate in multi-way info exchange
- Use input to inform subsequent work

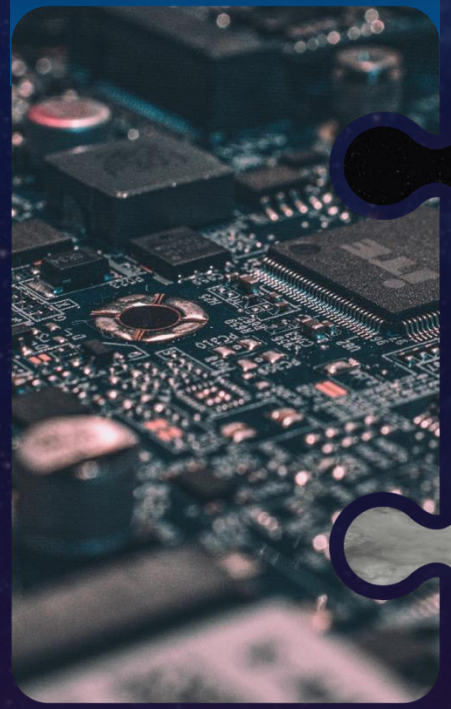
Solutions with Value to the Nation
- Offer models, scientific findings and info through Open-Source Science principles
- Support private sector development of applications of Earth observations
- Provide science applications and tools to inform decisions

Earth System Science & Applied Research
- Grow scientific understanding of Earth's systems
- Develop predictive models of dynamic Earth systems and tools to understand and adapt to changes

Foundational Knowledge, Technology, Missions & Data
- Technology innovation
- Earth observations missions
- Data collected from space, air and ground

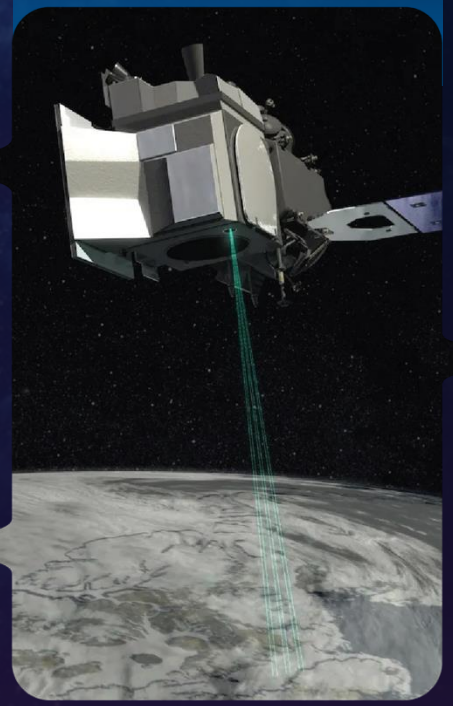
NASA's End-to-end Earth System Science Capability

Technology



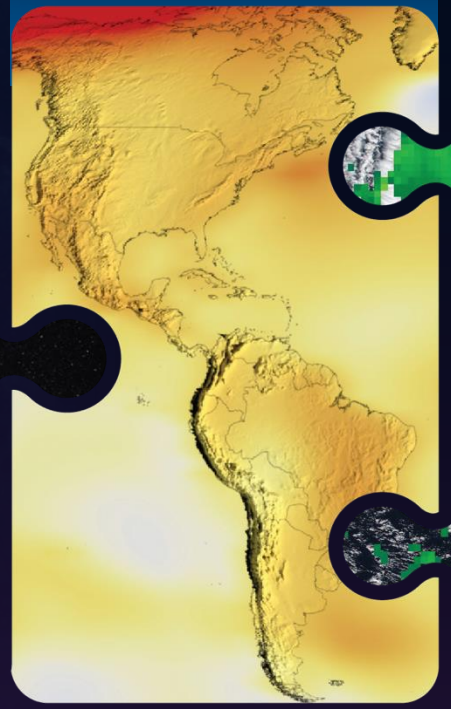
10 Tech Infusions/year

Flight



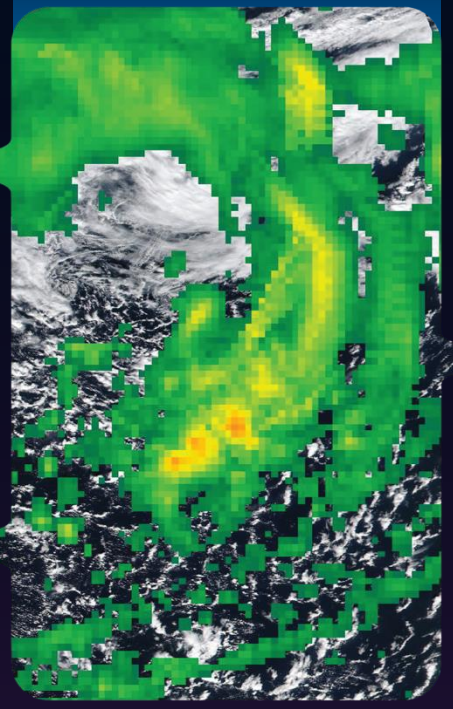
24 Missions on Orbit

Research



1,330 Active Research Projects
48 States

Data and Modeling



Collect 160 TB/Day
Serving 600 TB/Day
>10M Users
World-Class Models

Earth Action

Agriculture
Energy
Disasters
Wildfires
& more

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12.11.2025

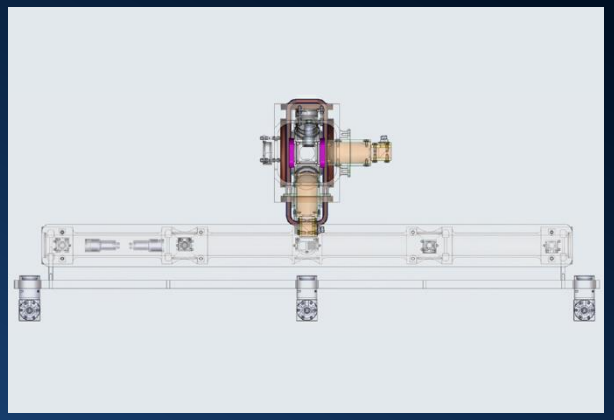
Advancing Technology

Earth Science Technology Office

ESTO Projects Overview

Instrument Incubator

- Breakthrough Earth observing instrument and system technologies
- Decadal Survey high priority observables – Planetary Boundary Layer (PBL) and Surface Topography and Vegetation (STV)

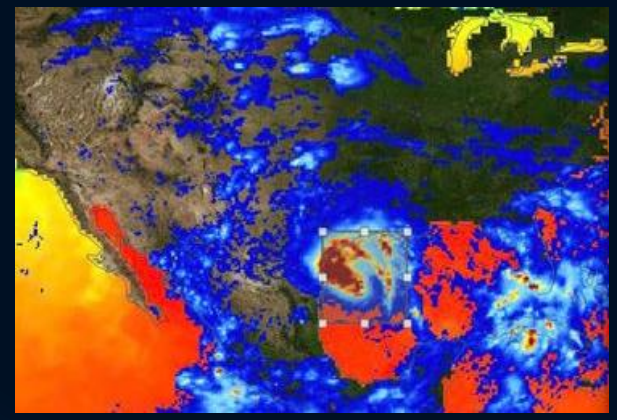


Quantum Gravity (QG) Gradiometer

- Demonstrate critical technologies and observation technique
- Unprecedented, higher-accuracy measurements of Earth's gravitational field from a single satellite

Advanced Technology Initiatives

- On-orbit demonstrations through In-Space Validation of Earth Science Technologies (InVEST)
- Prizes and challenges in partnership with venture capital, and technology studies



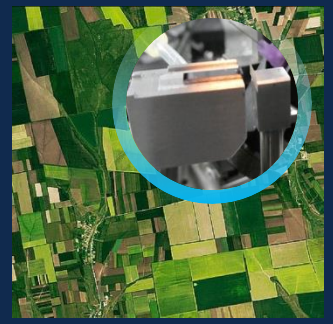
Advanced Modeling Technology

- Breakthrough artificial intelligence, machine learning, and computational techniques

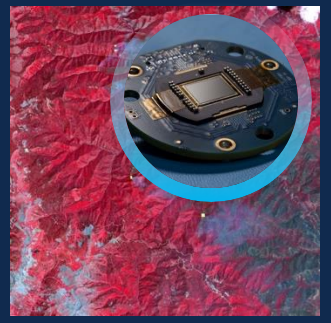
Key Technology Investment Areas

ESTO investments address a broad range of Earth observation needs. Maintaining some investment in all areas, with increased investment in QG Gradiometry:

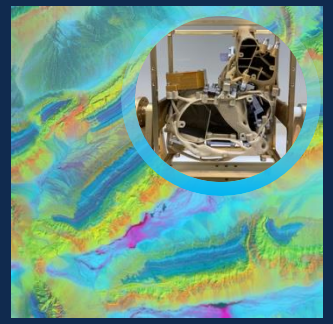
Electro Optical Earth Imaging



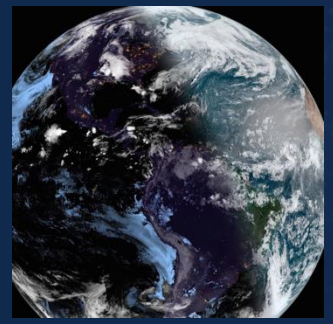
SW / MW / LW Infrared



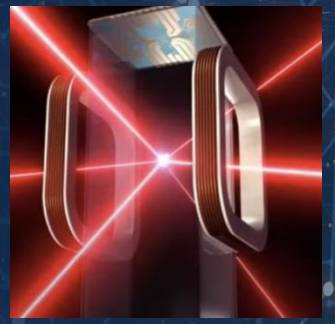
Hyperspectral



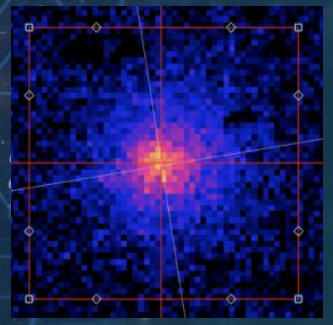
Multispectral



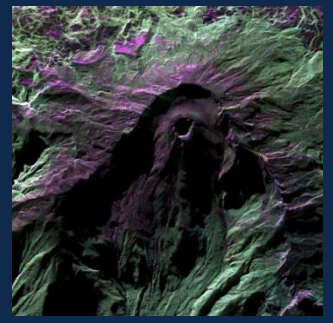
Quantum Sensing



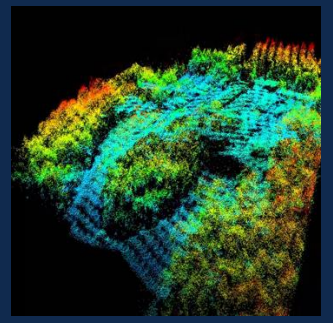
Quantum Gravity Gradiometry



Radar

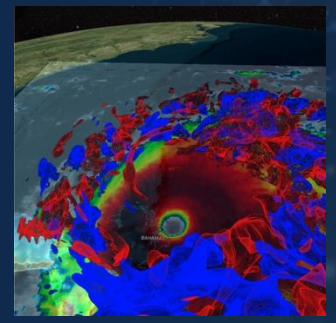


Laser / LiDAR



Quantum Computing

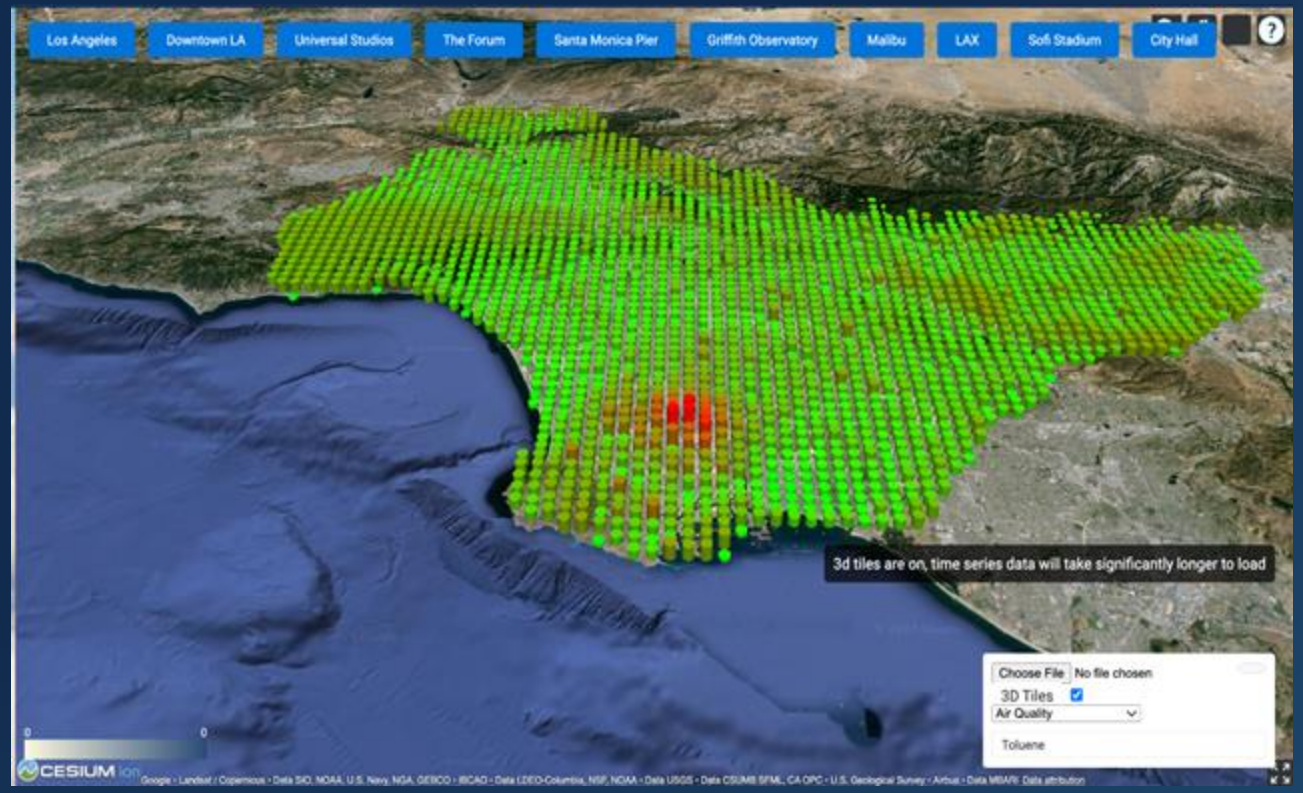
AI / ML Modeling

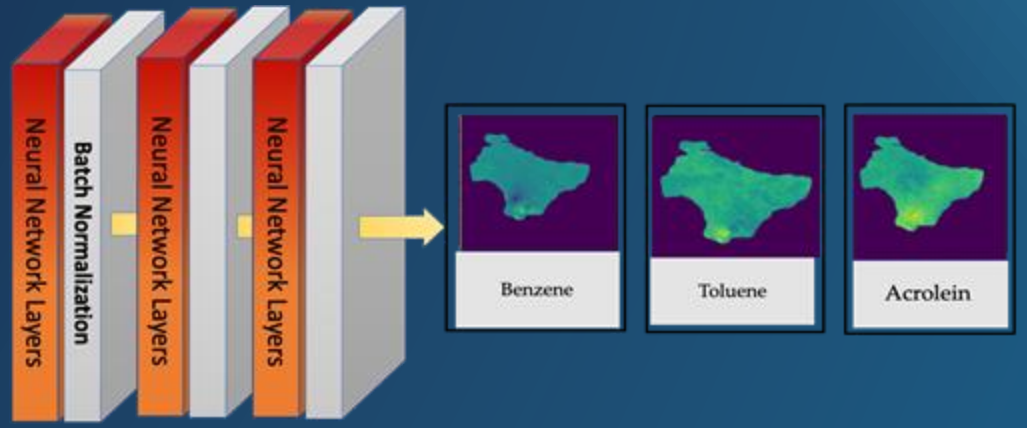


Digital Twins

Technology Highlight: Predicting What We Breathe

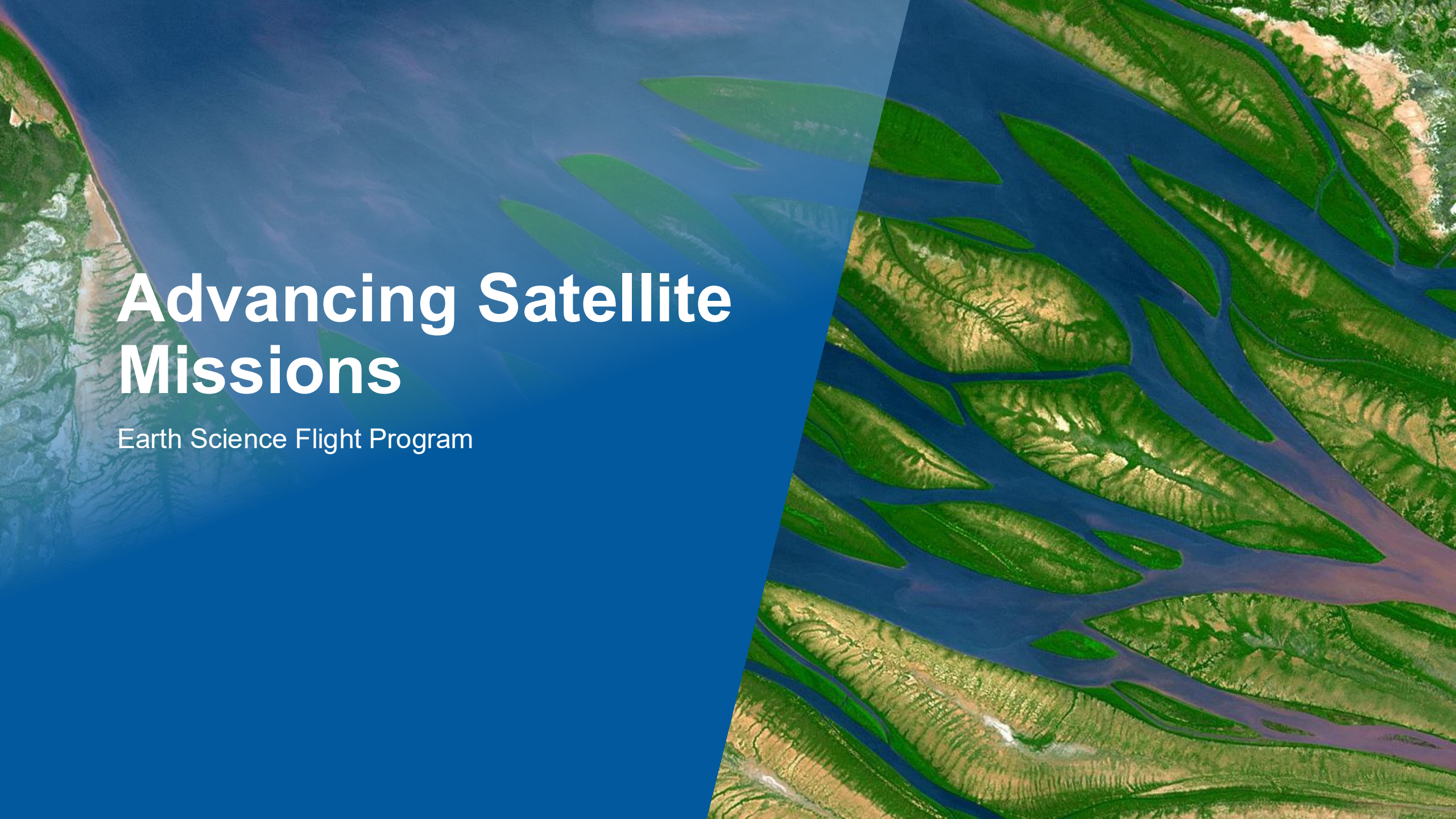
The City of Los Angeles used NASA data with machine learning to predict air quality in ways that can be acted upon to improve human health outcomes





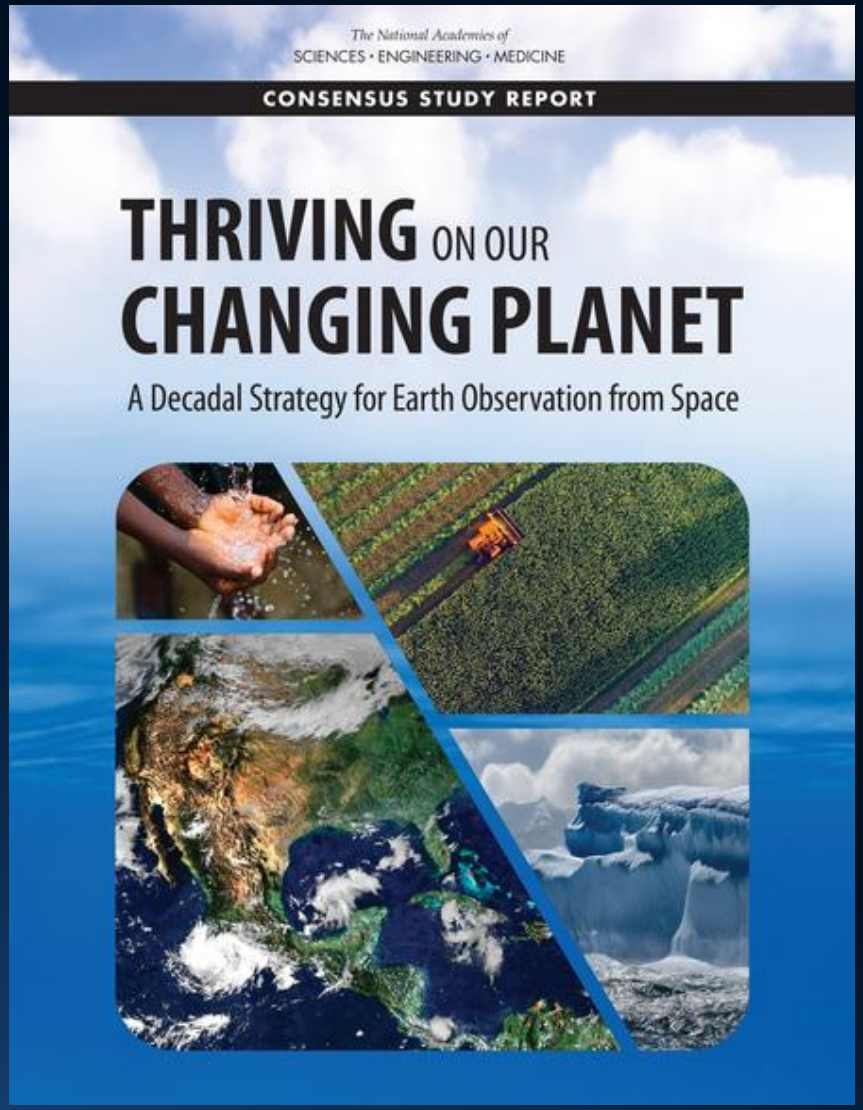
Advancing Satellite Missions

Earth Science Flight Program



Flight Mission Strategy

- Adopt a more streamlined approach to administering a portfolio that aligns with the PBR
- Increase efficiency by leveraging emerging commercial capabilities
- Consider past decadal recommendations for mission prioritization and decision making within budgetary guidance to the extent possible
- Ensure continuity of long-term observations only NASA can acquire



Earth Science Flight Opportunities (PBR26)

Mission	Mission Type	Release	Selection	Major Milestone
EVS-1 (EV-1) (AirMoss, ATTREX, CARVE, DISCOVER-AQ, HS3)	5 Suborbital Airborne Campaigns	2009	2010	Completed KDP-F
EVM-1 (CYGNSS)	Class D SmallSat Constellation	2011	2012	Launched December 2016
EVI-1 (TEMPO)	Class C Geostationary Hosted Instrument	2012	2012	Launched April 2023
EVI-2 (ECOSTRESS & GEDI)	Class C & Class D ISS-hosted Instruments	2013	2014	Launched June & December 2018
EVS-2 (ACT-America, ATOM, NAAMES, ORACLES, OMG, CORAL)	6 Suborbital Airborne Campaigns	2013	2014	Completed KDP-F
EVI-3 (MAIA & TROPICS)	Class C LEO Hosted Instrument & Class D CubeSat Constellation	2015	2016	MAIA Delivery 2022; TROPICS Launched in May 2023
EVM-2 (GeoCarb)	Class D Geostationary Hosted Instrument	2015	2016	Cancelled
EVI-4 (EMIT & PREFIRE)	Class C ISS-hosted Instrument & Class D Twin CubeSats	2016	2018	EMIT launched to ISS July 2022; PREFIRE launched May/June 2024
EVS-3 (ACTIVATE, DCOTSS, IMPACTS, Delta-X, SMODE)	5 Suborbital Airborne Campaigns	2017	2018	All in post-deployment phase.
EVI-5 (GLIMR)	Class C Geostationary Hosted Instrument	2018	2019	Delivery NLT 2024
EVC-1 (Libera)	Class C JPSS-Hosted Radiation Budget Instrument	2018	2020	Delivery NLT 2025
EVM-3 (INCUS)	Class D SmallSats	2020	2021	Launch ~2027
EVI-6 (PolSIR)	Class D CubeSats	2022	2023	Delivery NLT 2027
EVS-4 (FORTE, INSPYRE, HAMAQ, LACCE, Snow4FLow, FarmFlux)	Suborbital Airborne Campaigns	2023	2024	Selections announced April 2024
ESE (STRIVE, ODYSEA, EDGE, Carbon-I)	Explorer Mission (2-Step Proposal Process)	2023	2027	Launch ~2033

EVS
Sustained sub-orbital investigations

EVX
Small-size orbital instruments and missions

ESE
Medium-size orbital instruments and missions

Open solicitation/In review

Completed solicitation

Click here to download the latest version of the chart

Earth System Explorers-1 Selection

- **All site visits completed by end of FY2025**
- **Preparing to make inaugural ESE selection**

Ocean Dynamics and Surface Exchange with the Atmosphere (ODYSEA) - JPL

- **PI:** Sarah Gille; University of California in San Diego
- **Targeted Observable:** Ocean Surface Winds and Currents
- Would measure ocean surface currents and winds to improve our understanding of air-sea interactions and surface current processes that impact weather, climate, marine ecosystems, and human wellbeing

Stratosphere Troposphere Response using Infrared Vertically-Resolved Light Explorer (STRIVE) - GSFC

- **PI:** Lyatt Jaegle; University of Washington in Seattle
- **Targeted Observable:** Ozone and Trace Gases
- Would provide near global daily measurements of temperature, various atmospheric elements, and aerosol properties from the troposphere to the mesosphere.
- Would also measure vertical profiles of ozone and trace gasses to monitor and understand ozone recovery.

Earth Dynamics Geodetic Explorer (EDGE) - GSFC

- **PI:** Helen Amanda Fricker; University of California in San Diego
- **Targeted Observable:** 3D Ecosystem Structure; Ice Elevation
- Would observe the three-dimensional structure of terrestrial ecosystems and the surface topography of glaciers, ice sheets, and sea ice as they are changing in response to climate and human activity

Carbon Investigation (Carbon-I) - JPL

- **PI:** Christian Frankenberg; California Institute of Technology in Pasadena
- **Targeted Observable:** Greenhouse Gases
- Would enable simultaneous, multi-species measurements of critical greenhouse gases and potential quantification of ethane to provide unprecedented spatial resolution and global coverage that would help better understand the carbon cycle and the global methane budget

Partnerships on Some Current Missions

Situation:

NASA is exploring partnerships with external organizations for the operations and data collection of Earth Science satellite missions to enable more impactful exploitation of NASA resources and to advance the commercial remote sensing industry.

Missions on ISS:

- Request for proposals underway for the three ISS-based missions
- Full Proposals were due 12-December-2025

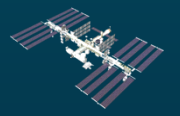
Free Flyer Missions:

NASA intends to issue open, public calls for proposals or expressions of interest

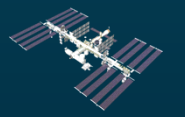
RFI: Request for Information
Use to collect information to gauge interest where interest is uncertain

AFPP: Announcement of Partnership Proposals
Use to solicit proposals where there appears to be multiple sources potentially interested. Following a review of proposals, NASA may select one or more partners and form Space Act Agreements

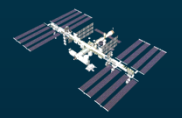
Missions on ISS



OCO-3: Orbiting Carbon Observatory-3



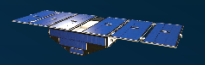
SAGE III: Stratospheric Aerosol and Gas Experiment



CLARREO-Pathfinder (planned for ISS)

Free-Flyer Missions

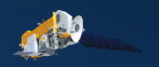
OCO-2: Orbiting Carbon Observatory-2



CYGNSS: Cyclone Global Navigation Satellite System

Terra

Aqua

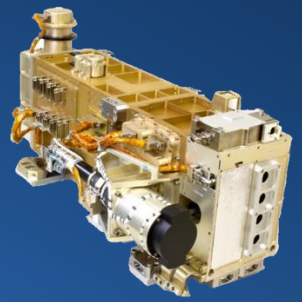


Aura

Highlights: TSIS-2

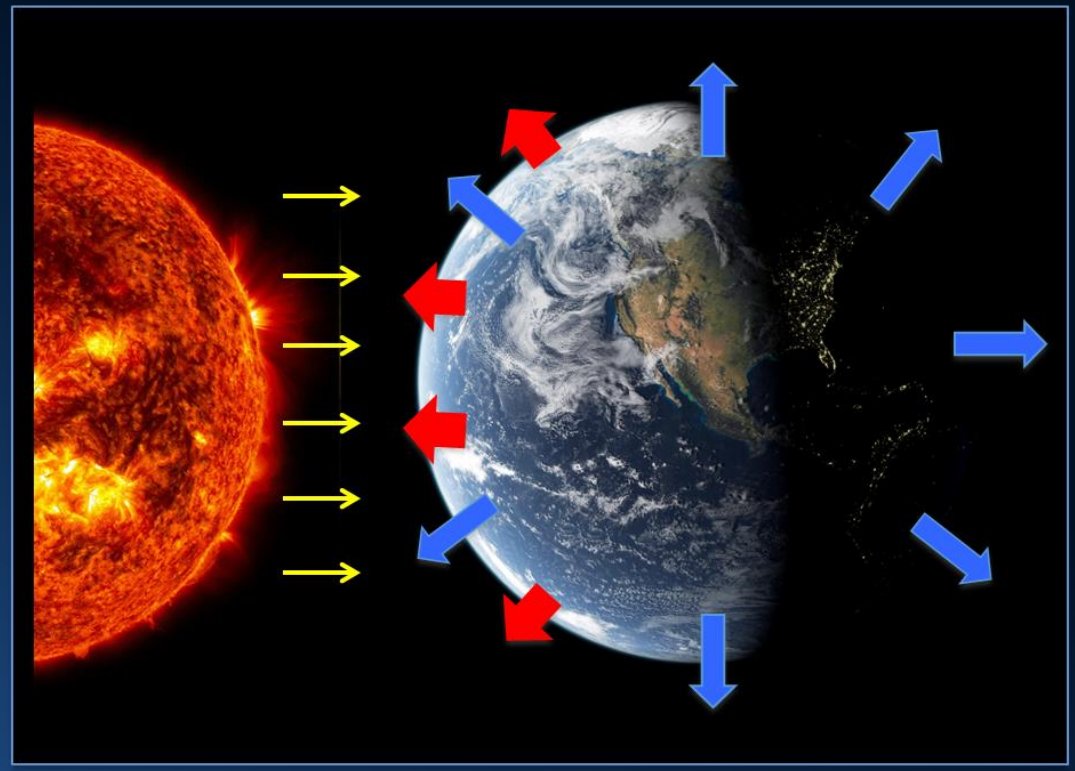
- Measures small changes in the power reaching the Earth from the Sun over time periods from days to months and years
- The Sun provides virtually all of Earth's energy, so even small changes can have an impact on the Earth system
- Enable the continued study of the Sun's natural influence on the ozone layer, atmospheric circulation clouds and ecosystems
- The record of solar irradiance measurements goes back 40 years
- **Instruments are complete and in storage**
- **Spacecraft vendor making measurable progress. Completed Instrument Integration readiness review in September 2025**

Total Irradiance Monitor (TIM)



Spectral Irradiance Monitor (SIM)

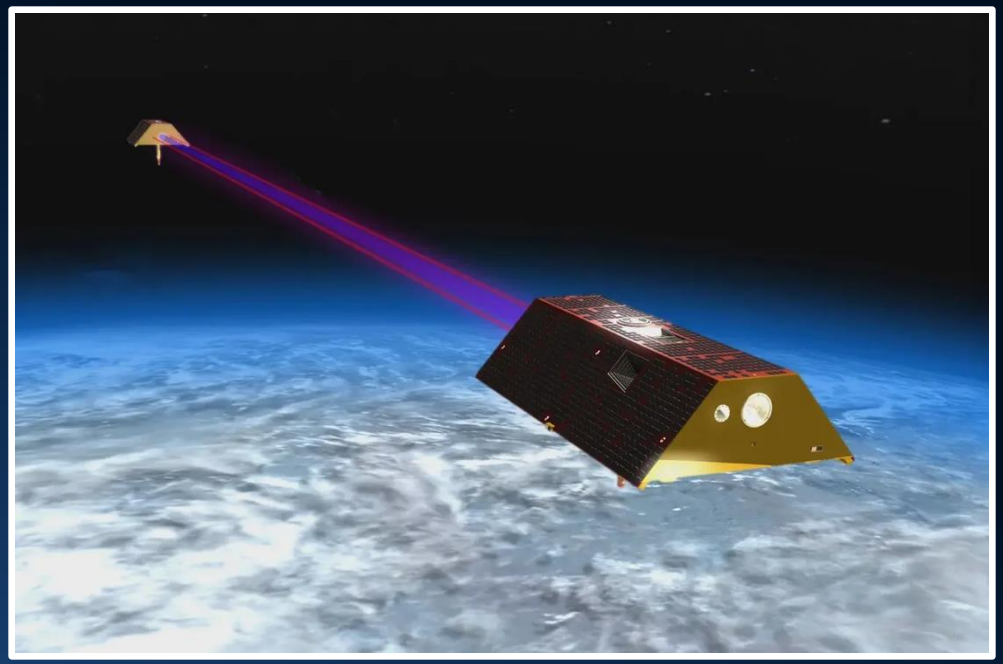
Total Solar Irradiance (TSI) ≈ Reflected Shortwave + Outgoing Longwave



Highlights: GRACE-Continuity

- Continue more than two decades of large-scale mass change observations (ice, water cycle, Earth dynamics) through gravimetric measurements
- Used for
    - Drought assessment & forecasting
    - Planning for water use by communities and agriculture
    - Understanding risks for coastal communities
    - Many other applications
- GRACE-C will use a more advanced Laser Ranging Instrument (LRI) to improve data precision.

KDP-D completed December 2025

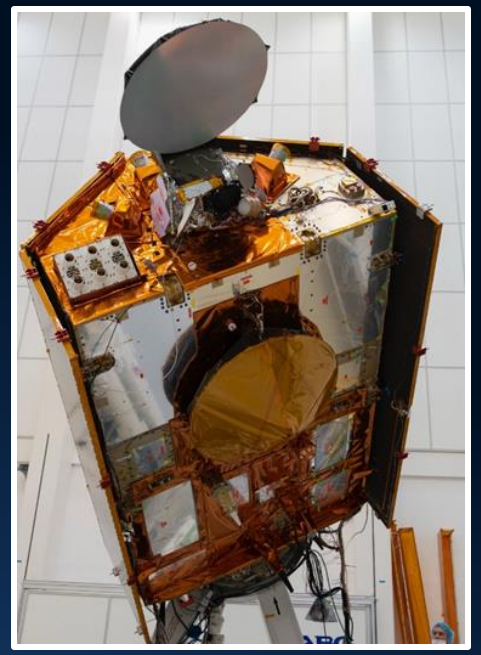


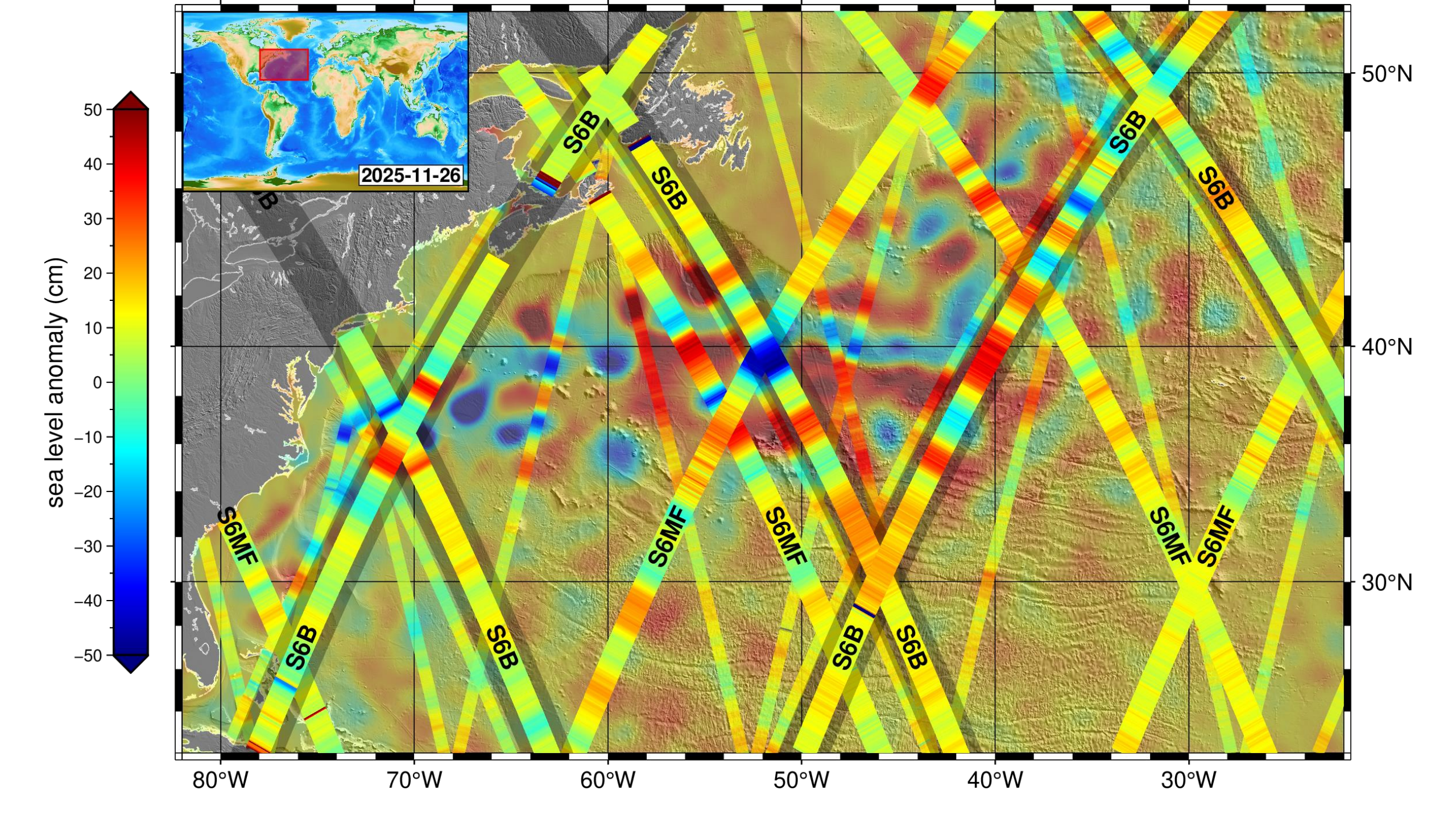
Recent Launches

Highlights: Sentinel-6B

- Launched from VSFB on Nov. 16, Sentinel-6B is the second satellite in a series of two (following Sentinel-6A)
- Ocean surface topography measurements by satellite altimetry for nearly 40 years
- Measurements form basis for flood predictions for coastal infrastructure, real estate, energy storage sites, & other coastal assets
- Data also supports:
  - Short-term forecasting for weather predictions and long-term forecasting for seasonal conditions
  - Operational oceanography,
    - Improving forecasts of ocean currents and wind
    - wave conditions
    - critical for navigation, search and rescue, and debris tracking

Instrument integrated to the spacecraft.




sea level anomaly (cm)
50
40
30
20
10
0
−10
−20
−30
−40
−50
2025-11-26
S6B
S6MF
50°N
40°N
30°N
80°W
70°W
60°W
50°W
40°W
30°W

NISAR Launch
July 30, 2025

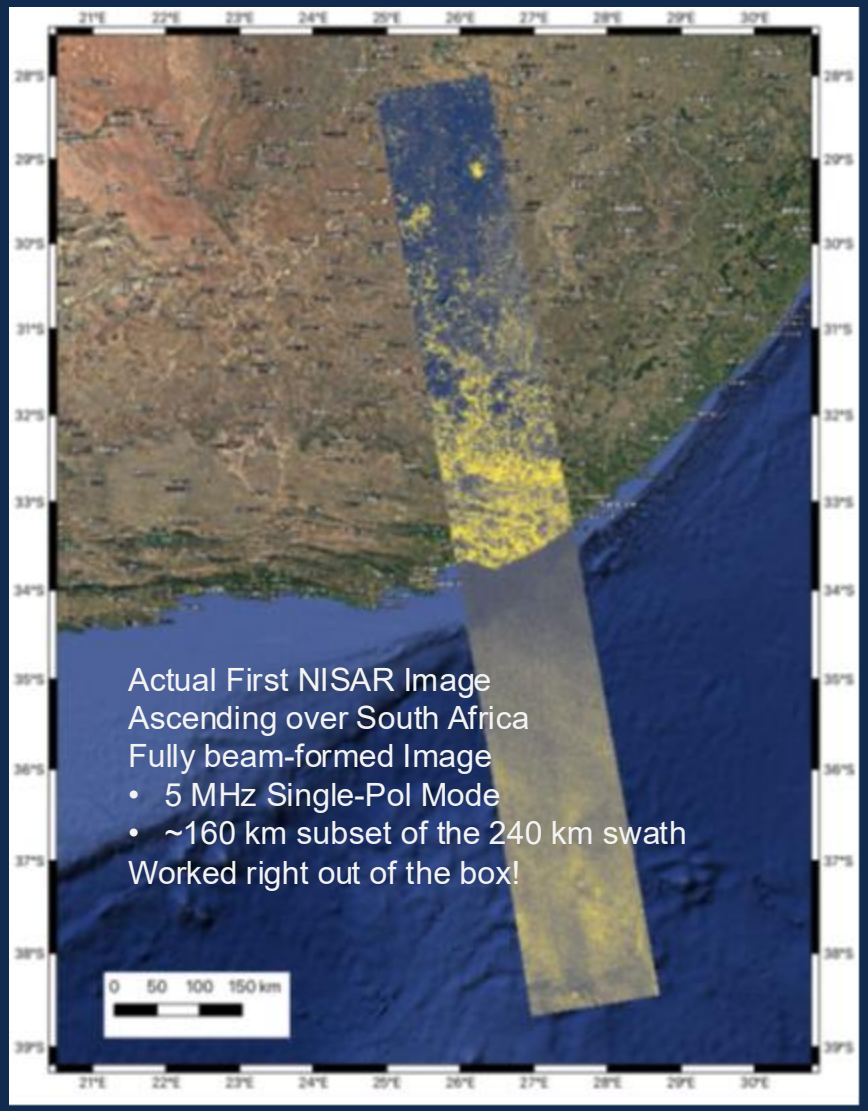
The NASA-ISRO partnership launched humanity's first-of-its kind dual-band satellite

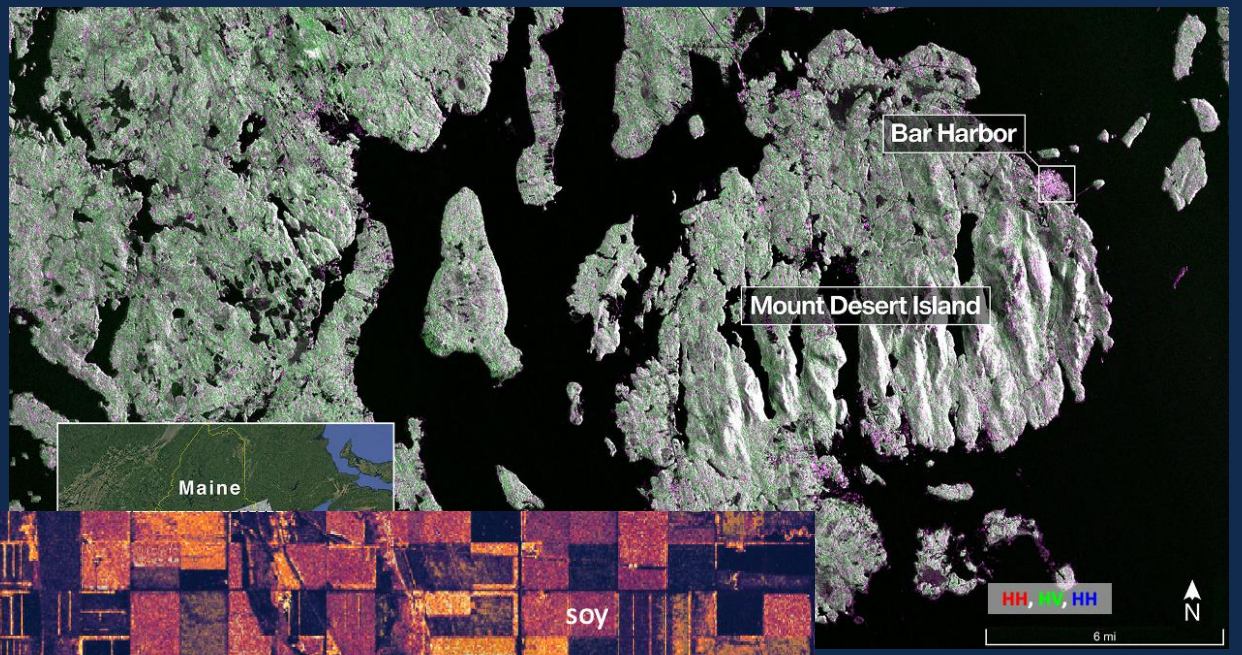
Actional information in:

- Disaster response
- Infrastructure monitoring
- Land-use planning
- Farming
- Water management

The Indian Space Research Organisation's Geosynchronous Satellite Launch Vehicle lifts off from Satish Dhawan Space Centre on India's southeastern coast at 8:10 a.m. EDT (5:40 a.m. IST), July 30, 2025. Credit: ISRO

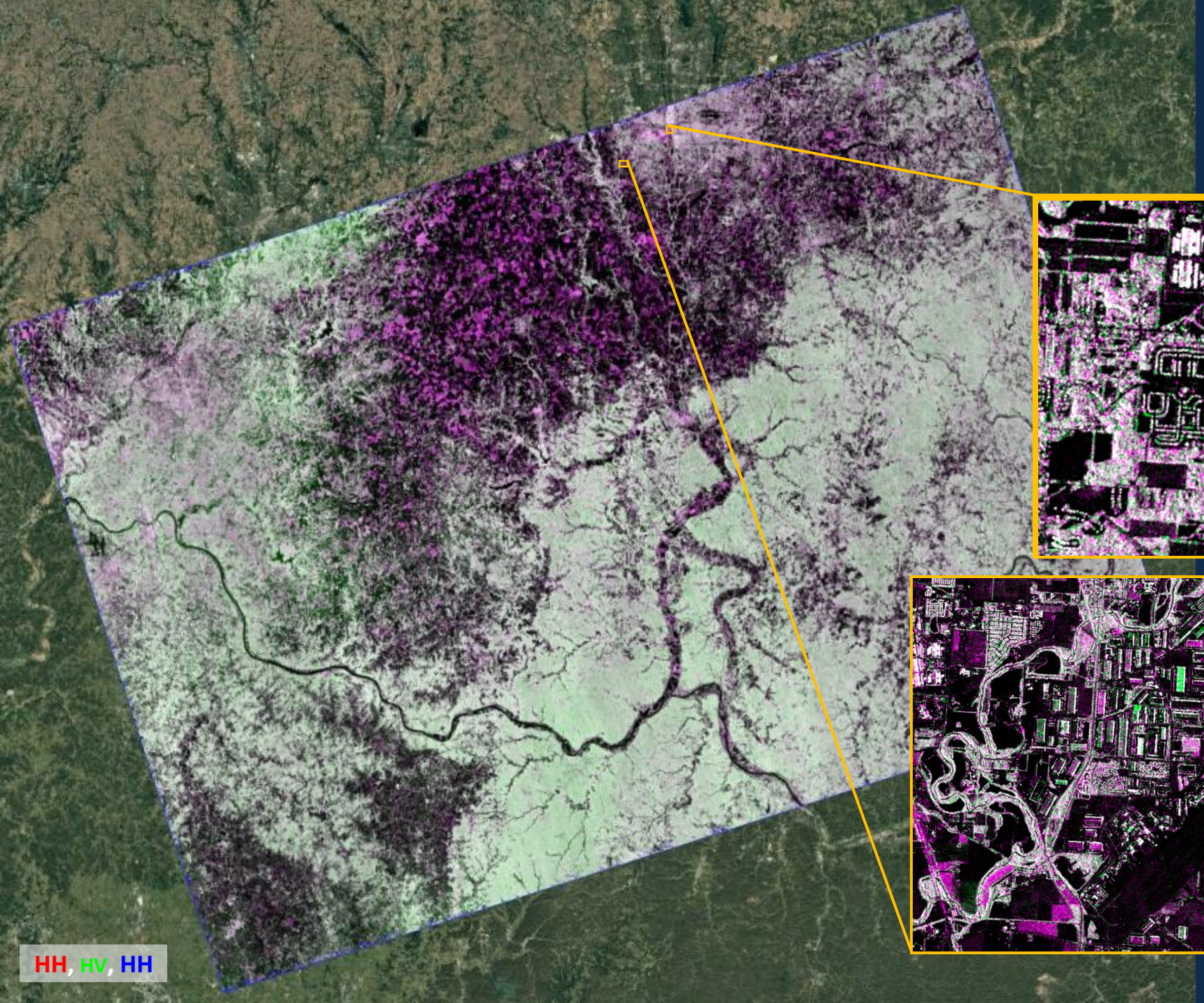
From first-light images to first science results

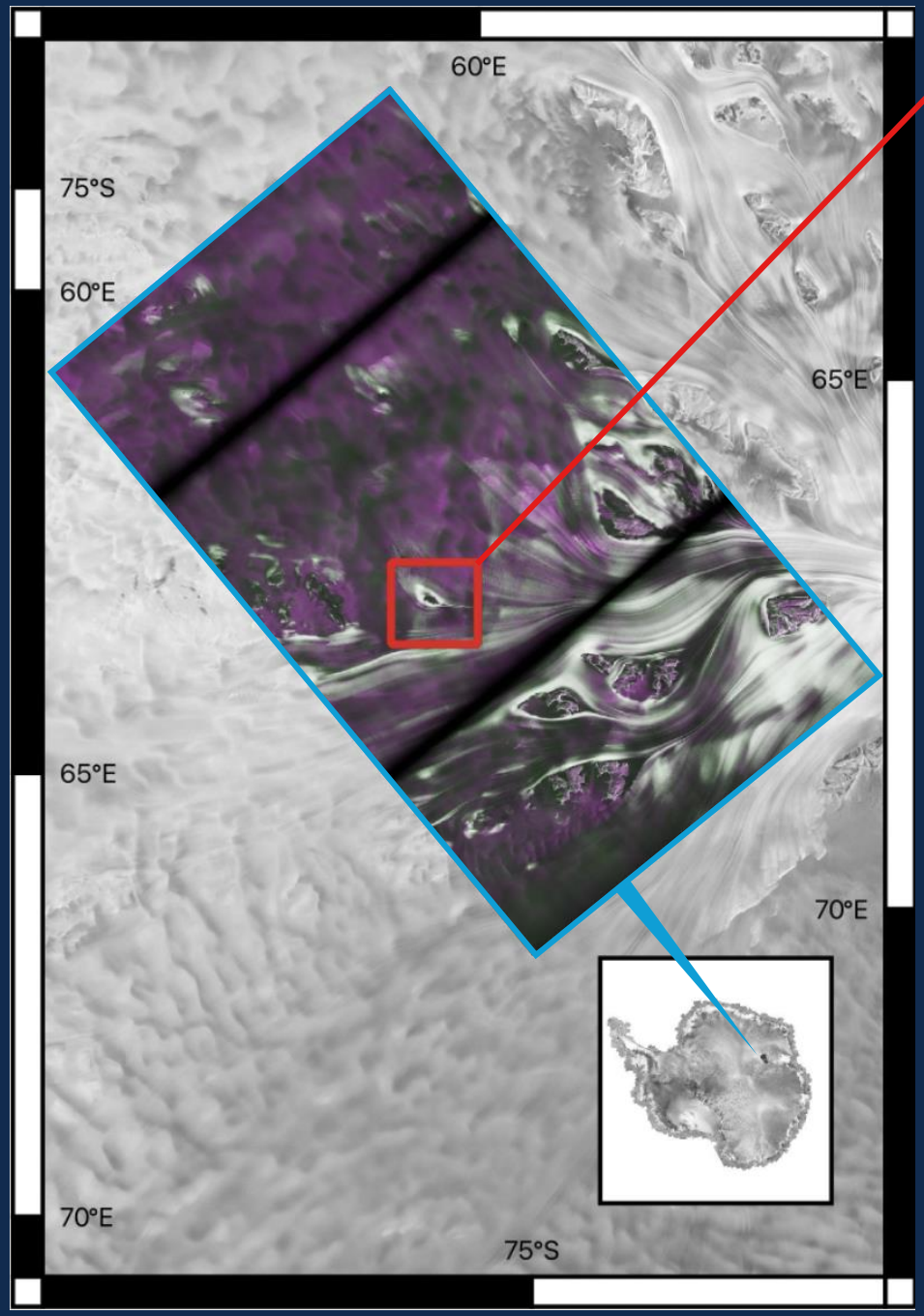


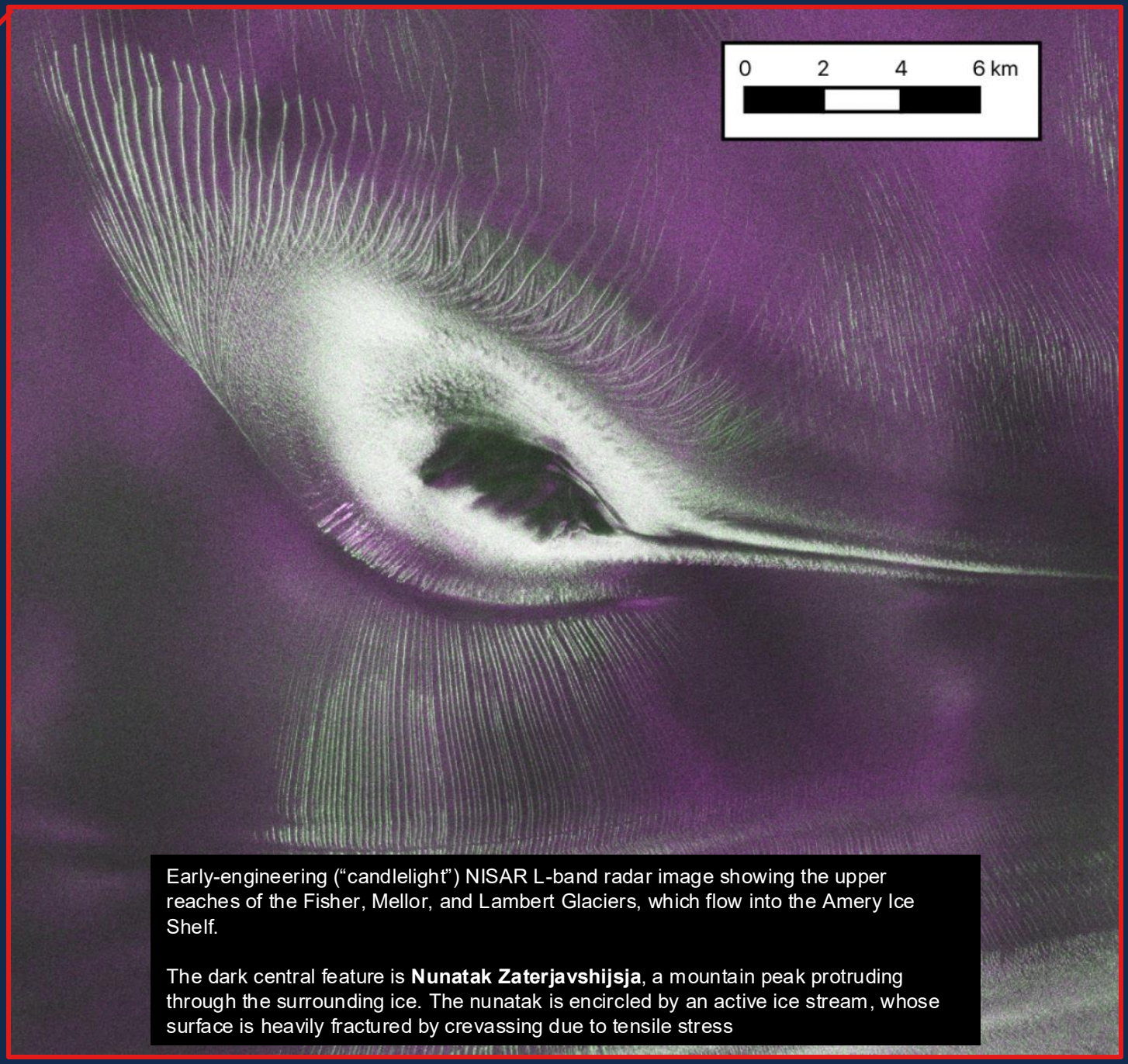


First released images (September 25)

NISAR L-band
Cincinnati, US, seen through US standard mode
(dithered-PRF, 40 MHz)



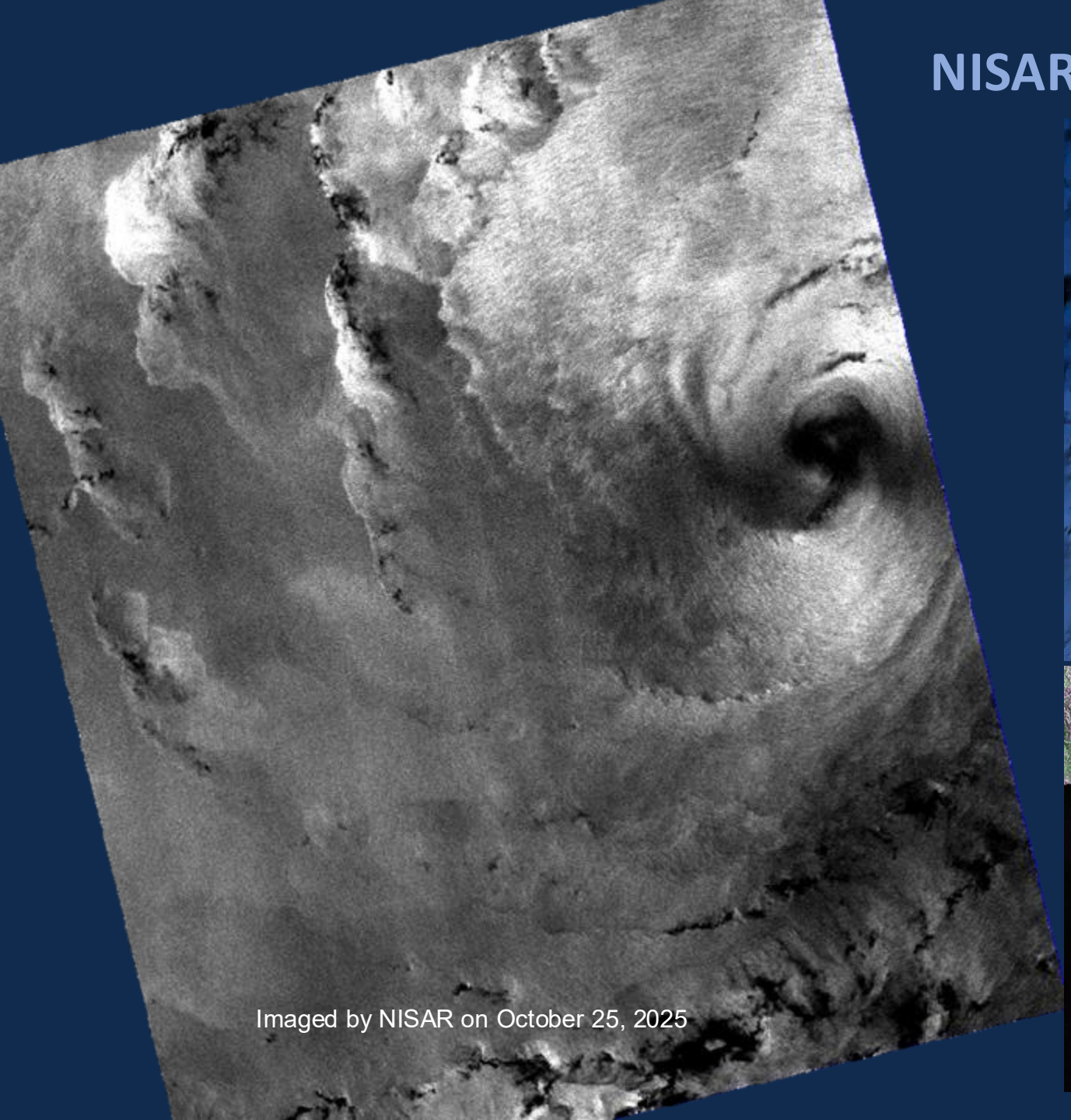


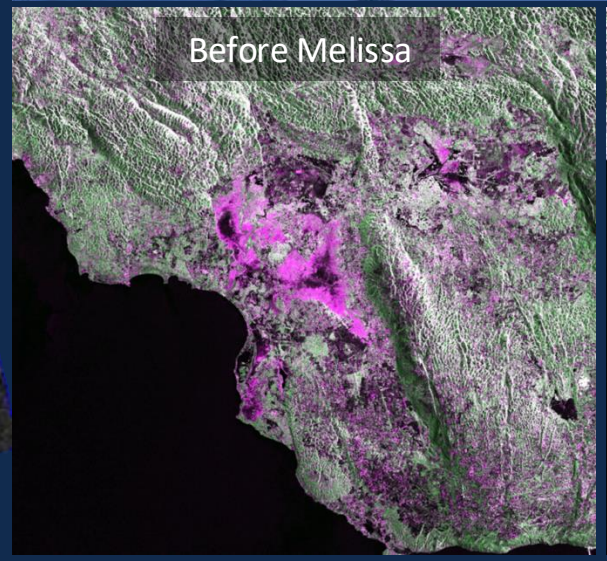


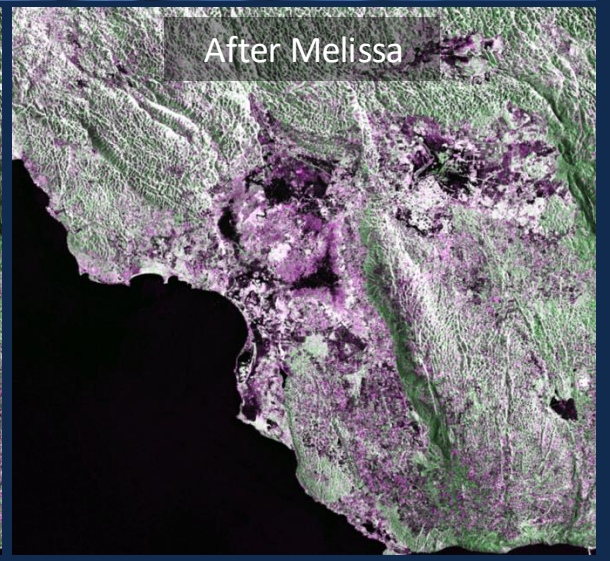
Early-engineering (“candlelight”) NISAR L-band radar image showing the upper reaches of the Fisher, Mellor, and Lambert Glaciers, which flow into the Amery Ice Shelf.

The dark central feature is **Nunatak Zaterjavshijsja**, a mountain peak protruding through the surrounding ice. The nunatak is encircled by an active ice stream, whose surface is heavily fractured by crevassing due to tensile stress

NISAR Sees Hurricane Melissa, Jamaica







NISAR co-eruptive interferogram
11/22 - 12/05

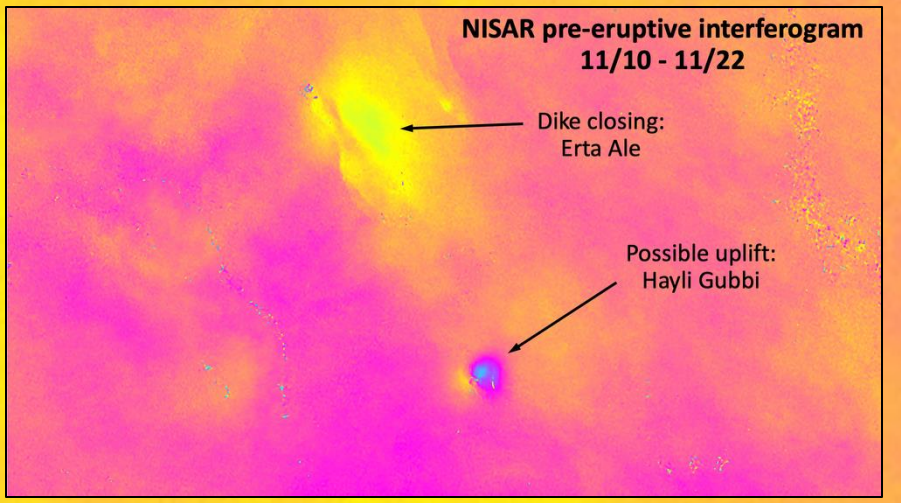
Range change

0 12.1 cm

5 km

Dike closing:
Erta Ale

Tephra
deposits: Hayli
Gubbi



NISAR's Actionable Science

More than 180 organizations ready to use NISAR science and data

To access the L Band science data…

- Science phase began early November 2025 after completing calibration
- Data and tools available thereafter at Alaska Satellite Facility DAAC: https://search.asf.alaska.edu
- Processing software to recreate these products available at https://github.com/isce-framework/isce3
- Get ready for 80 TBytes of products per day!

Driving Earth Science Data

Earth Science Data Systems

ESD Operates One of the Largest Open Archives on the Planet

EARTH DATA SUMMARY FY 25

End User Average Distribution Volume
600 TB/Day

End User Distribution Files incl. From Cloud
7.8 Billion (4.3B in Cloud)

Total Archive Volume Including in Cloud (not inc duplicate on-prem)
148.8 PB

Website Sessions (Google Analytics)
14.9 Million

Average Archive Growth
160 TB/Day*

EOSDIS Customer Satisfaction Index Score (2024)
78

Total Archive Volume In Cloud Only
116.2PB

Total Number of Files Cataloged (On-Prem and Cloud)
4.6 Billion

Unique Datasets
18,755

Distinct Users of EOSDIS Data & Services
28.6 Million

Service Users **17 Million**

Data & Web Users **11.6 Million**

*NISAR may add ~66TB/day

Data Systems Strategy

- Focus on Core Data Systems mission
  - Quality and Efficiency
  - Technological Evolution
  - Community Support and Open Science
- Emphasis on:
  - Ground-breaking science products
  - Foundational data products used by many different parts of the enterprise from research and modeling to applications
  - Near Real Time (NRT) products
- Consolidation of DAACs from 11 independent locations to thematic science enabling teams (Study underway to inform planning)
- Structure data systems to support AI/ML and processing innovation

Advancing Scientific Understanding of Earth

Earth Science Research

Research Strategy

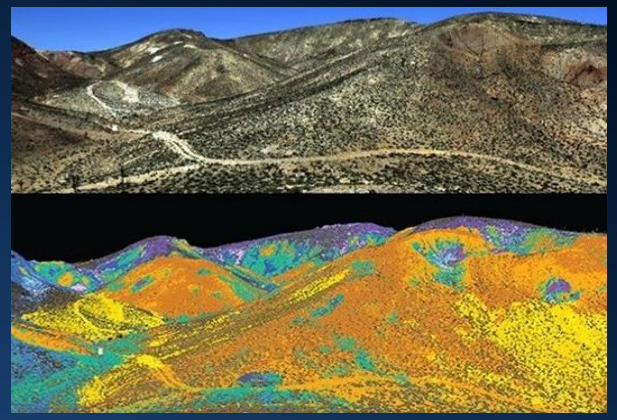
Prioritize Earth Science To Action (ES2A) strategy to advance scientific breakthroughs to better understand Earth and advance models that capture the intricacies of the Earth system

By focusing on things that only NASA can do, the Earth Science Research element strives to be the nation's premier knowledge incubator for understanding Earth's complex and interconnected atmosphere, biosphere, cryosphere, hydrosphere, and geosphere system

Earth Science Research Projects Overview

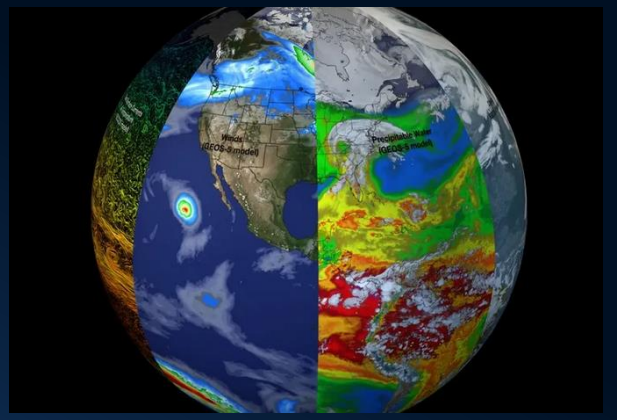
Space Geodesy

- Very Long Baseline Interferometry (VLBI)
- Satellite Laser Ranging (SLR)
- Global Navigation Satellite System (GNSS)



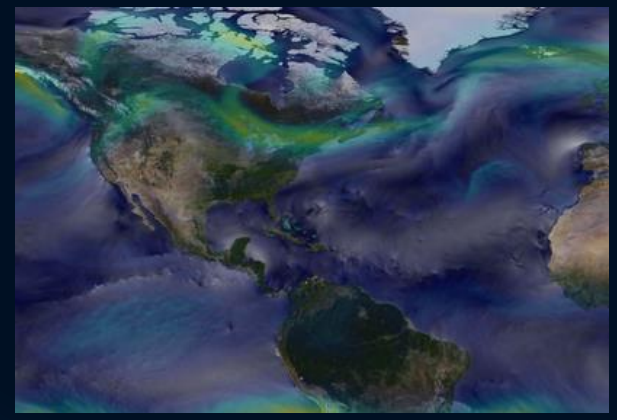
Airborne Science

- High altitude (ER-2, WB-57)
- Large airborne laboratory (B777)
- Remote sensing jets (G-V, UAVSAR, airSAR-ng)



Earth System Science Research

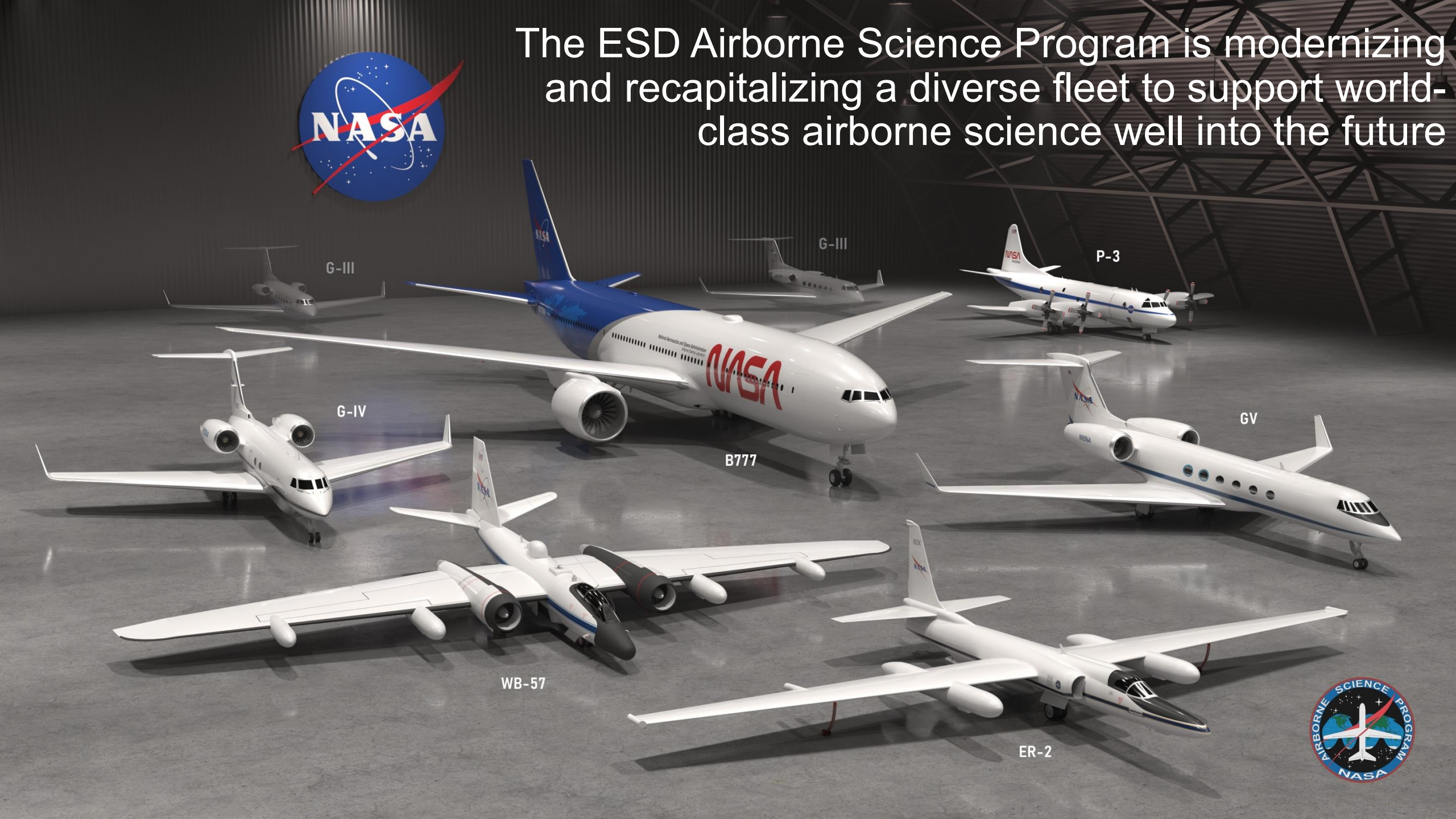
- Competed discipline and interdisciplinary research
- Early career research
- Field campaign support



Integrated Earth System Modeling

- Virtual Modeling Institute (was Model-E, GEOS, MAP, ECCO, others)
- Scientific Computing

The ESD Airborne Science Program is modernizing and recapitalizing a diverse fleet to support world-class airborne science well into the future



ESD Research Strategy Provides Flexibility to Adapt to Available Resources

- Simplify Research organization structure (transition to Spheres)
- Preserve current grants as practicable, work with PIs one on one to explore options
- Use directed funds to maintain critical capabilities at Centers
- Release selected solicitations in ROSES as budget allows and streamline the ROSES process

Integrated Earth System Modeling Strategy

- **Streamline NASA's modeling and scientific computing capabilities**
  - Coordinated leadership and alignment with one strategy involving the best experts nationwide
  - Workflows: Consolidate systems, code, software engineering, physical locations
- **Prioritized investments:** Aligned and coordinated research effort that advance priority model components using advanced technologies (e.g. HPC, AI and foundation modeling) and industry best practices
- **Flexibility and scalability** of models linked to supporting scientific computing systems

National leadership in modeling and model-based analysis of the Earth system to advance state-of-the-art prediction and risk assessment to support economic growth, national priorities and national security

Integrated Modeling Virtual Institute (IMVI)

Independent Models Today (examples)

Land

LIS (Land Information System)

Atmosphere

Global Modeling Initiative (GMI) Chemical Transport Model (CTM)

Ocean

ECCO (Estimating the Circulation and Climate of Oceans)

Cryosphere

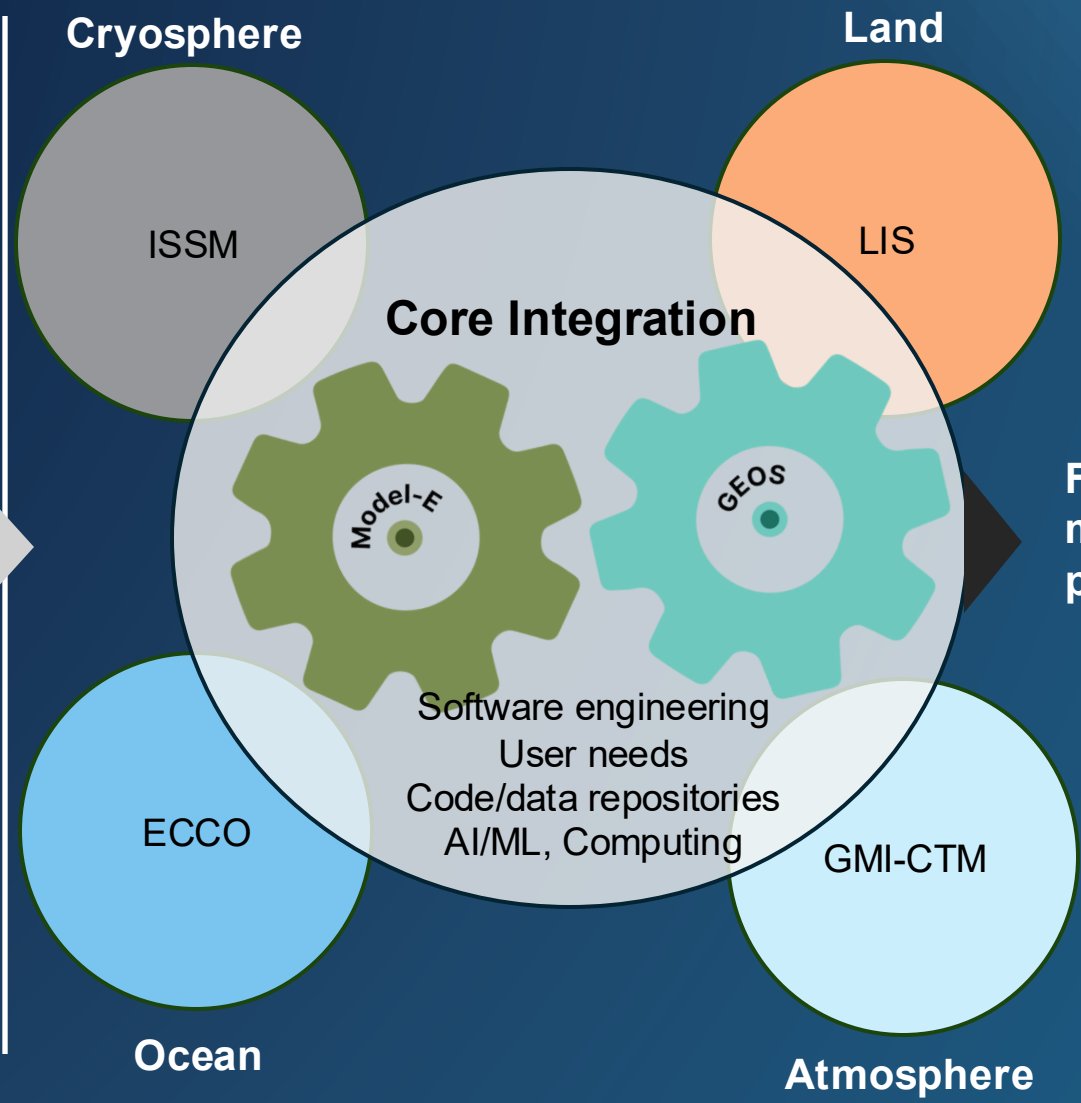
ISSM (Ice Sheet and Sea-Level System Model)

Earth System
Reanalysis and short-tern and seasonal prediction

GEOS (Global Earth Observing System Model)

Earth System
Decadal and long-term prediction and planetary atmospheres

Model-E



Foundation model partnerships

Advancing Use of Actionable Science

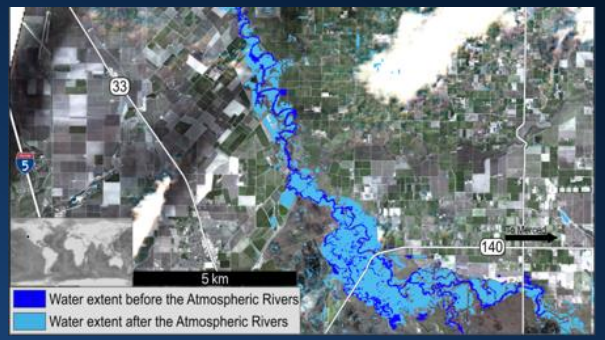
Applied Science and Responsive Science Initiatives

Earth Action Strategy

Prioritize Earth Science To Action (ES2A) strategy to co-design solutions and tools to support users and exploit Earth information as a national asset

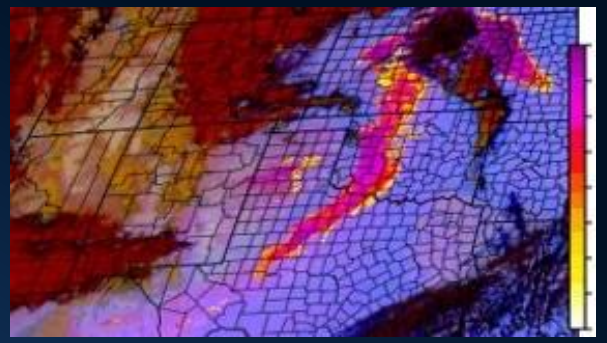
- Address Administration's priorities to focus on national issues, economy, resilience, and using AI to increase efficiency
- High quality data for decision-making at state and local levels is a major priority of the administration
- EA deeply integrated across ESD
  - Participation in R&A Spheres
  - Integrated with mission teams
  - Partnering with Data Systems to inform data user experience

Earth Action Projects Overview



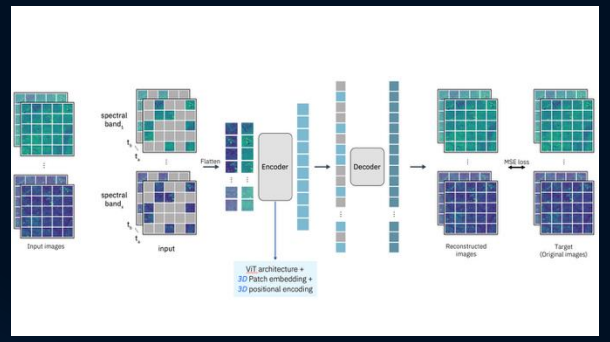
Application Innovation

- Tool development, workshops, and needs assessments
- Ecological Conservation, Energy and Infrastructure, Health and Air Quality, and Water Resources



RSI Crosscutting

- Maximizes outcomes from R&A and Applied Sciences
- Combines results and data from across the federal government

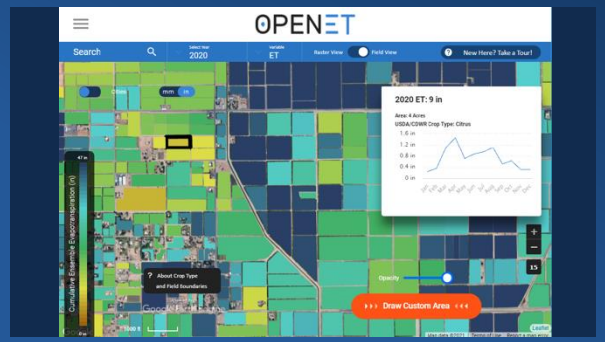


AI and Advanced Modeling Applications

- Improve decision-making with GeoAI and other advanced modeling

Disasters

- Reduced risk, faster recovery, greater resilience



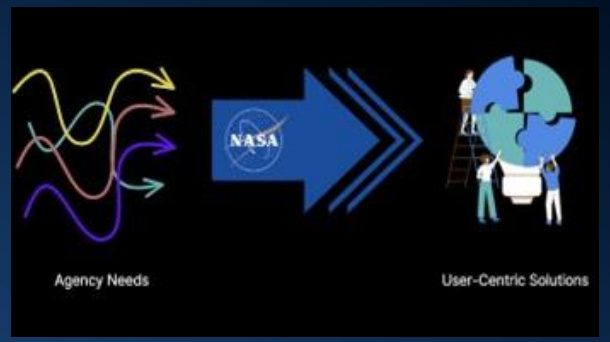
Agriculture

- Understanding food systems to enhance domestic productivity
- International food security
- Improved agricultural practices

ICEYE © 2023

Commercial Satellite Data Acquisition

- Supports growth emerging commercial Earth observations sector
- Data purchases, evaluation of products, and cal-val support



Interagency Satellite Observation Needs

- Assesses, fulfills Earth observation needs identified by federal agencies
- Publicly sharing resulting capabilities

Wildland Fires

- Improves prediction, management, and mitigation of wildfires both within the U.S. and globally

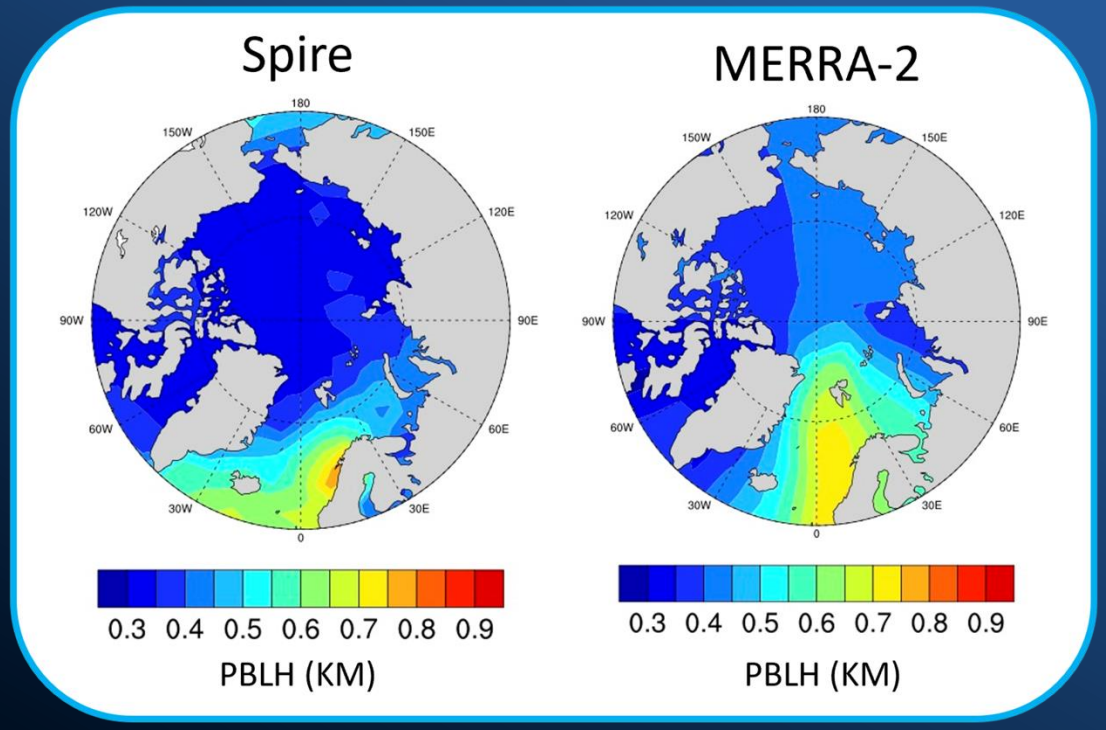
Commercial Satellite Data Acquisition (CSDA) Program Update

New Approaches

- Implementing new competitive task order process to allow vendors to competitively bid on tasks
- Developing calibration/validation capabilities to support sector in response to demand
- Expanding coordination with other agencies

Recent Highlights

- Supporting disaster response for Alaska coastal flooding

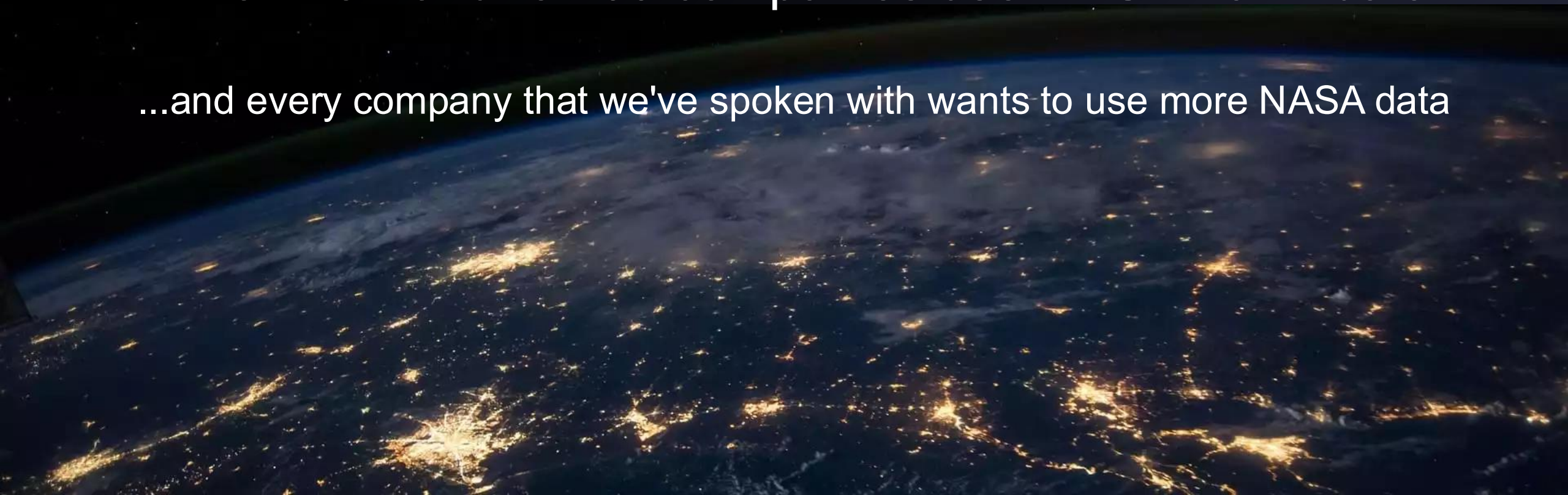


This image compares Arctic Planetary Boundary Layer Height (PBLH) from Spire (left) and NASA's MERRA-2 model (right). NASA acquired Spire's commercial radio occultation data as it provides more precise PBL measurements, especially in shallow Arctic layers, where traditional government satellites lack coverage. These observations improve global weather modeling and forecasts.

National Aeronautics and Space Administration

74 of the Fortune 100 companies use NASA Earth data

...and every company that we've spoken with wants to use more NASA data



Multisource Integrated Observatory (MIO)

Maximize our science through integration

MIO Goals and Objectives (In Formulation)

ESD sees growing opportunity in integrated Earth-observing to answer complex Earth system science questions

Goals

- Maximize use of NASA's Earth missions to promote a resilient, prosperous, and secure nation
- Maintain NASA's position as a leading global innovator in Earth science discovery

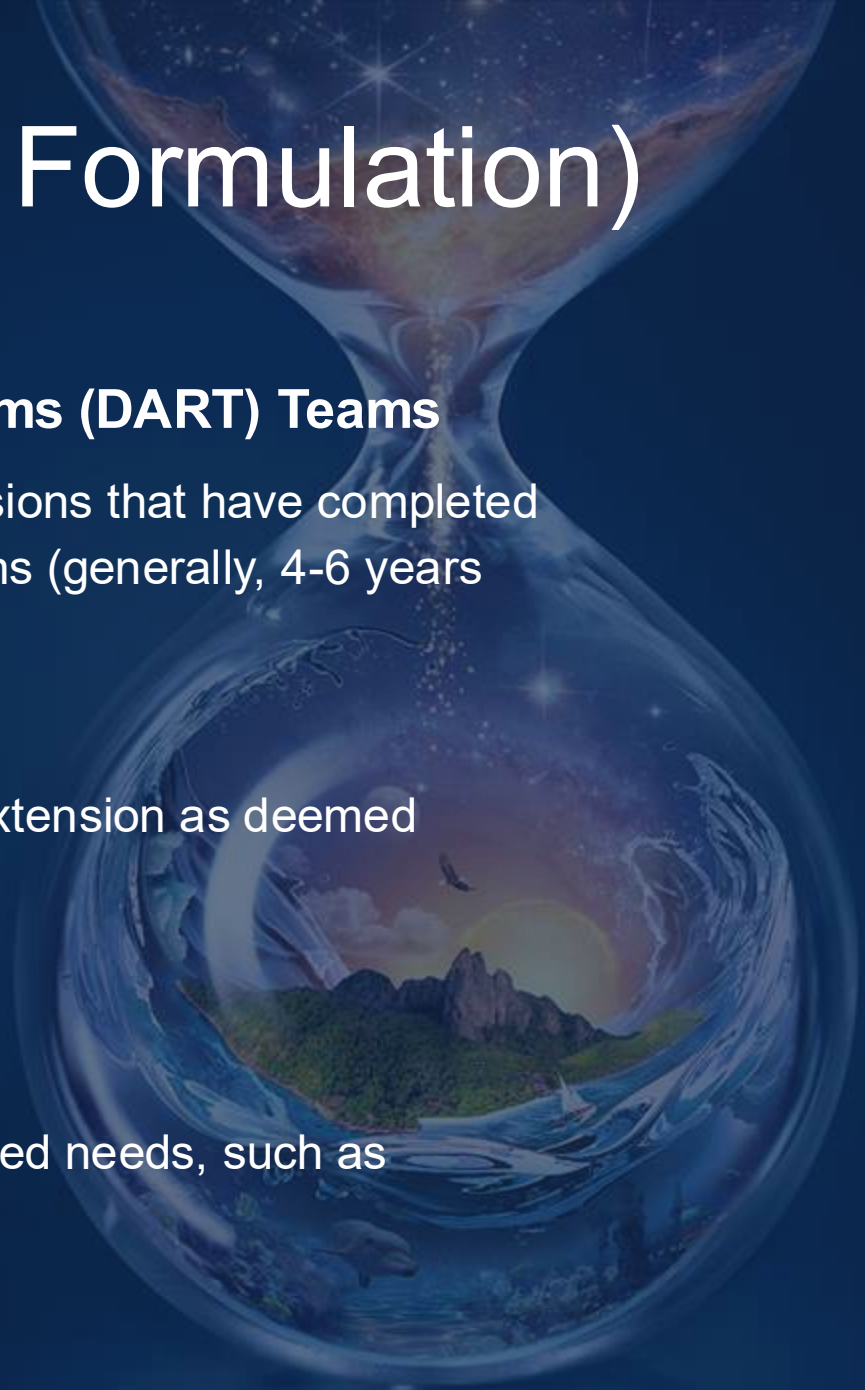
Objectives

- Integrate the broad spectrum of activities required to accelerate the pace of scientific discovery and innovation
- Deliver high-impact, actionable applications based on multisource data, technology, and science
- Advance science-to-application pipelines across public and private sectors

MIO Project and Teams (In Formulation)

MIO has three main components:

1. **Data, Applications, Research, and Technology teams (DART) Teams**
    - Thematic DARTs will replace individual teams for missions that have completed prime operations plus one cycle of extended operations (generally, 4-6 years post launch)
2. **Mission-Specific Teams**
    - Retained for missions in prime operations, plus one extension as deemed appropriate under Senior Review
    - Transition into DART teams over time
3. **Project Office**
    - Initiates projects to support emerging results and related needs, such as algorithm development, modeling, and cal-val



Multisource Integrated Observatory (MIO) Project

We want this!

Instead of this.

We won't scramble!

Images generated by Google's Gemini

Overview of GeoAI (and AI/ML) efforts across ESD

Geospatial Artificial Intelligence (GeoAI)

- **Data Systems:** Improving data discovery, accessibility, and usability
- **ESTO:** Pioneering new analytics methods and use of on-board AI for data processing
- **Research:** Developing new foundation models and improving the efficiency of Earth science modeling
- **Earth Action:** Finding ways to use GeoAI to improve and broaden support for decision-making

Foundation models were applied to HLS imagery, such as this true color composite image of irrigated agricultural fields near Sadat City, about 80 km northwest of Cairo, Egypt. *Credit: HLS/NASA IMPACT*

Questions?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science.nasa.gov/earth
Your Home. Our Mission.