



USGS National Land Imaging Program Update

NGAC

12 April 2023

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Landsat Operations Status

Landsat 9 (2021 -)

Collecting more than 700 new scenes per day; full mission transitioned to USGS in August 2022

Landsat 8 (2013 -)

Collecting more than 700 new scenes per day; night and off-nadir imaging of volcanos and fire imaging.

Landsat 7 (1999 - 2022)

Lowered into storage orbit; awaiting NASA satellite rendezvous and refueling; still collecting new imagery



Earth Resources Observation and Science Center (EROS)

Landsat Archive Operations

Reprocessed Landsat "Collection 2" available on the Amazon Cloud.

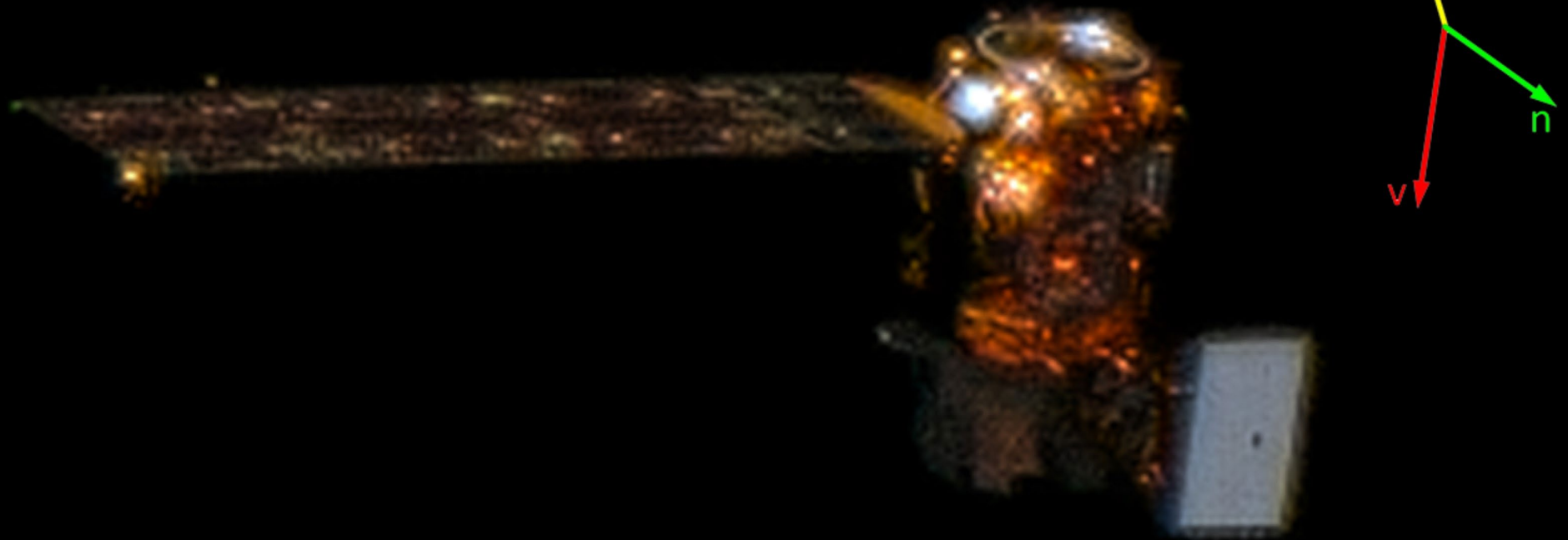
On track for more than **10 billion** user accesses this year!

Image of Landsat 8 in Space

2022.10.07 21:19:00Z

Range: 107.6 km

SSD: 5.4 cm



Courtesy: Maxar/WorldView 3

Multi-Decadal Sustainable Land Imaging Program

First Phase of SLI

Landsat 9



Second Phase of SLI

Landsat Next



Commercial/Interagency/
International Partnerships

SLI Technology Development and Infusion (NASA)
(USGS)

User Needs Development (USGS)

2010



SLI
Architecture
Study
2013-2014

11/22/2017

JSG

SLI
Architecture
Study
2018-2019

04/01/2020

JSG

2020



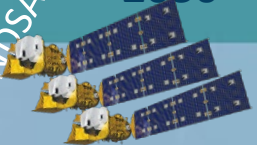
02/10/2022

JSG

SLI
Architecture
Study
2026-2027

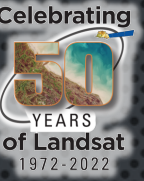
LANDSAT NEXT

2030



LANDSAT BEYOND

SLI “Second Phase” Program Activities

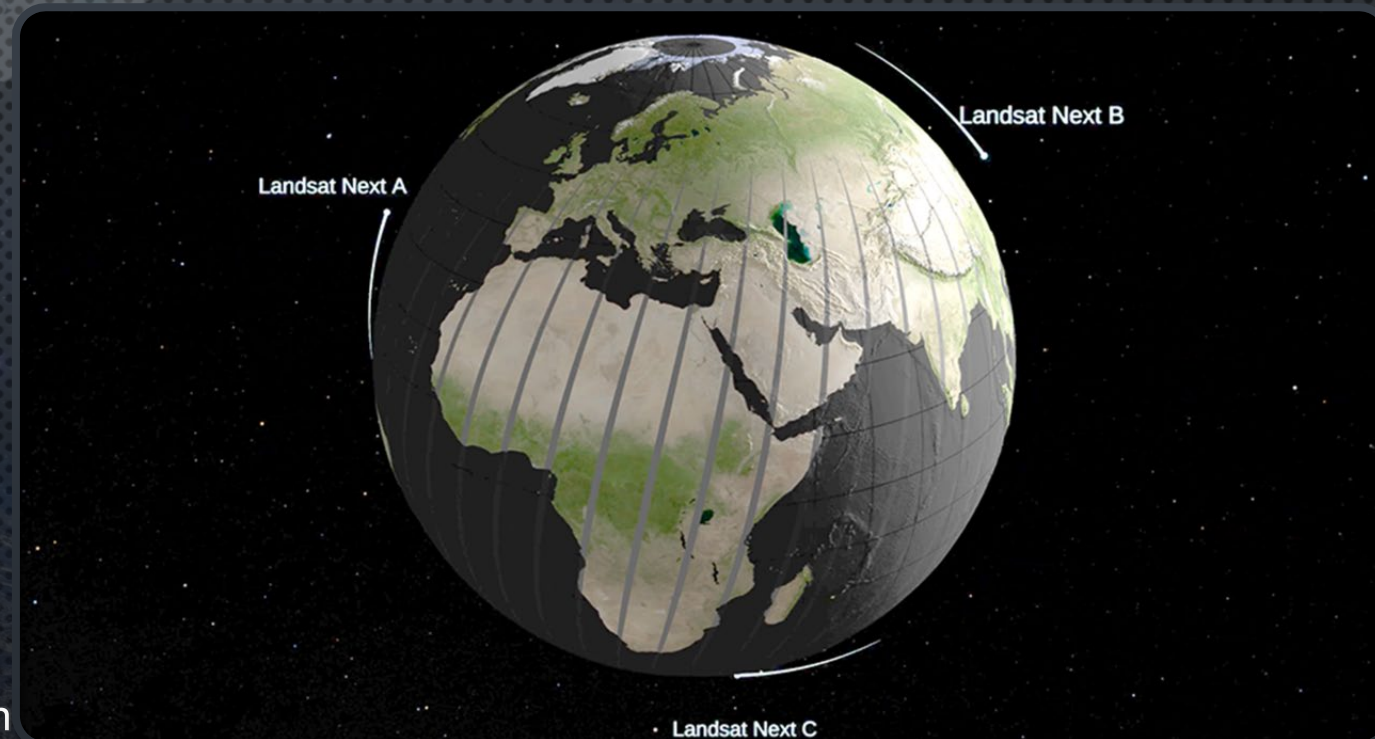


- SLI Phase 2 Architecture based on SLI Architecture Study conducted 2018-2020
- Three new elements
 - Landsat Next – Government-managed, contractor-built observing system
 - High-quality calibrated data continuity and traceability with 50-year Landsat data record
 - Supports current and emerging applications with validated user needs
 - Expanded International partnerships
 - Continue international data harmonization efforts with the European Copernicus Sentinel 2 mission and others
 - Provide technical assistance to the Satellite Cross-calibration Radiometer (SCR) project with Australia
 - Commercial Data Program
 - Exploring use of commercially available high spatial resolution / high revisit Visible-Near-Infrared data & services
- Continued investment in user needs assessment and technology development
 - Ensures the state of the art continues to advance for future Earth observation systems in order to meet evolving user needs

SLI Vision: Long-term operational availability of a wide range of government, commercial, and international land-imaging data and services to meet the Nation’s needs for environmental monitoring and forecasting

Landsat Next

- A robust spaceborne, land imaging system to ensure continued collection of data for processing into useful and efficient information products for use by the wide range of interested science communities
- **Mission Concept:** Collection of “superspectral” land observations featuring richer spectral information and higher spatial resolution than Landsat 8 and 9 with improved temporal frequency
 - Intended to replace Landsat 8 to ensure continuity of the Landsat data record in the event of an unexpected Landsat 9 failure on-orbit
- Enables users to:
 - Observe areas experiencing the most rapidly changing landscape from drought, glacier and permafrost melt, harmful algal blooms, and urban heat islands
 - Track and monitor Earth surface condition and change, including their drivers and impacts
 - Predict future risk and vulnerabilities for mitigation and adaptation strategies



NASA “Landsat’s Next Chapter” Video
<https://svs.gsfc.nasa.gov/14262>

Landsat Next Requirements Meet Emerging Needs



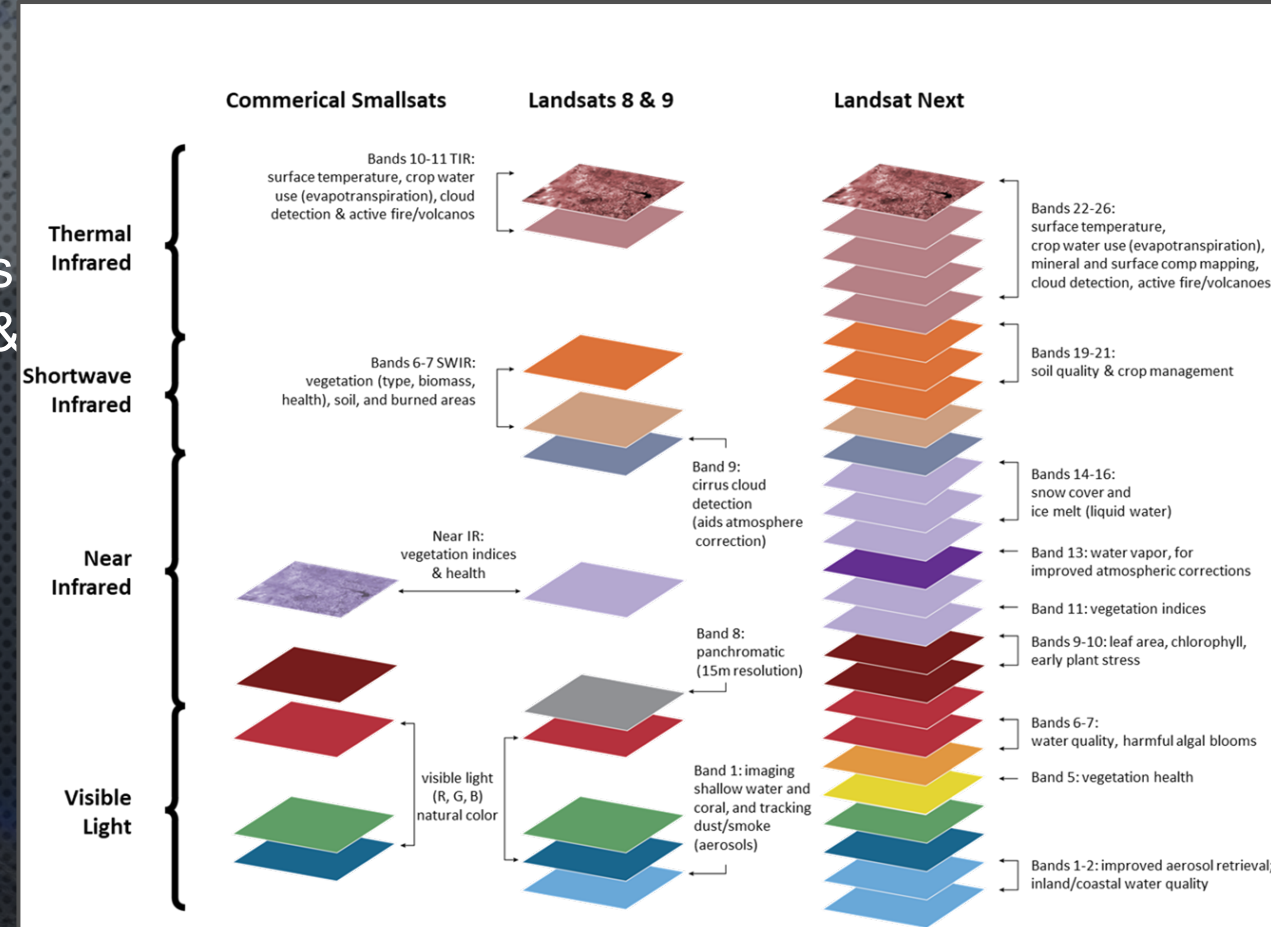
Multi-spectral → Super-spectral

The USGS spent several years engaging with the user community to develop and validate requirements and set priorities for Landsat Next to meet emerging needs while maintaining continuity:

Improved revisit frequency to support applications requiring ~weekly clear views, such as crop health & productivity, water quality, snow/ice state, wildfire
Higher spatial resolution (10/20-meter data for VSWIR and 60-meter for TIR) to support monitoring of small agricultural fields, forest disturbance, urbanization, and other applications

Additional spectral bands to support emerging applications in water quality, snow hydrology, soil mapping, and other areas; improve atmospheric correction and surface temperature retrieval

Maintaining radiometric quality established by Landsat 8/9



Landsat Next will provide more than twice as many spectral bands as Landsat 8/9, with spatial resolution improved by a factor of 2, and significantly improved repeat coverage



Landsat Next Summary

Landsat Next will continue and improve the 50-year Landsat data record

- Relied upon by Fed/State/local government, commercial, industrial, educational communities
- Landsat is the most widely used land remote sensing data source within Federal civil agencies
- Commercial data providers need Landsat's rigorous calibration standards to build/improve products

Provides a completely new and improved Landsat for the next generation

- Much better spatial resolution (10meter), twice as many spectral bands (new ones for agriculture, water use, HABs, mineral mapping, volcanos), and improved revisit (6-day) while retaining continuity
- Ensures projected climate change impacts on the land can be rigorously monitored & assessed

Continues substantial economic benefits to the U.S. economy (~\$2 billion/year)

- Much like GPS and weather data, Landsat data are used every day to help us better understand our dynamic planet – and to continue tracking the effects of global climate change
- Information from Landsat contributes to day-to-day decisions on land, water, and resource use that protect life and property; safeguard the environment; advance science, technology and education; support climate resiliency; and grow the U.S. economy

Landsat Next ensures future generations will continue to reap the benefits of the Landsat series of measurements--trusted scientific data guiding a myriad of science and operational applications

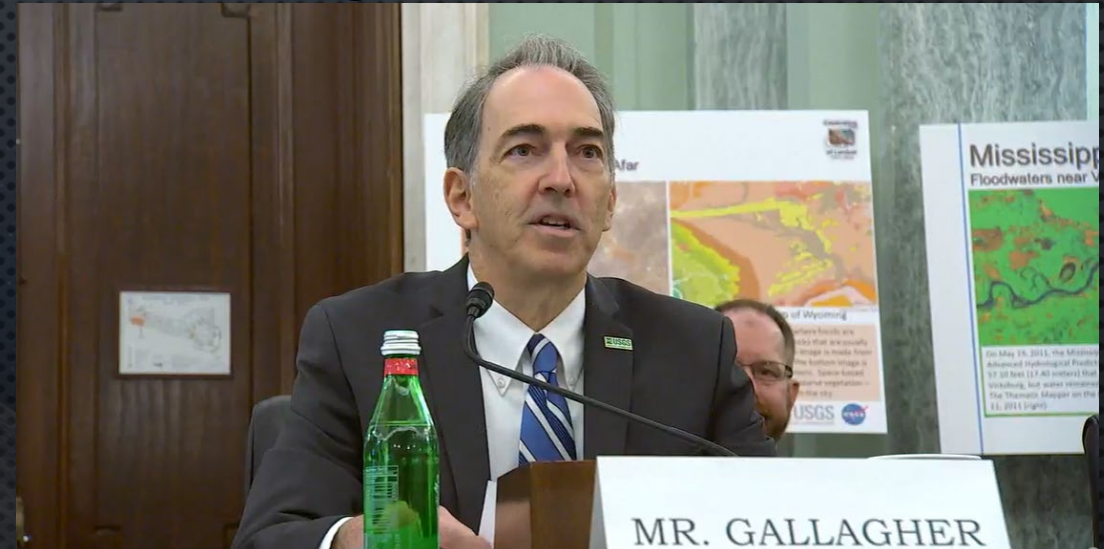
Congressional Communications Update

- USGS Director Applegate and NASA Earth Science Division Director St. Germain briefed staffers from the House Science, Space and Technology Subcommittee on Space and Aeronautics and from the House Committee on Natural Resources Subcommittee on Energy and Mineral Resources on 11/9/22
 - Included details on the planned Triplets architecture
- USGS Associate Director Kevin Gallagher participated on an expert panel with representatives of NASA, NOAA, Maxar and the University of Colorado at a Senate Commerce Committee Space and Science Subcommittee Hearing on 12/1/22: “Landsat at 50 & the Future of U.S. Satellite-based Earth Observation”
 - Senators Hickenlooper (D-CO) and Lummis (R-WY) presided; Senators Cantwell (D-WA), Blumenthal (D-CT), and Fischer (R-NE) attended at least some of the hearing

Briefing to House staffers on 11/9/22:

“NASA and USGS project teams recommended a Landsat Next mission concept with three identical smaller satellites launched together into a lower orbit than today's Landsats, meeting user requirements for improved spectral, spatial and temporal resolution”

Senate Hearing on Landsat 12/1/22



Landsat Programmatic



Federal Landsat activities are funded from two Congressional committees:

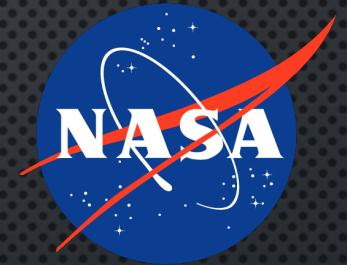
- Commerce, Justice, Science and Related Agencies for all NASA Landsat funding
- Interior, Environment, and Related Agencies for all DOI/USGS Landsat funding

NASA Landsat funding is managed within the Sustainable Land Imaging program of the NASA Earth Science Division

- Development of the space and launch segments
- Technology development

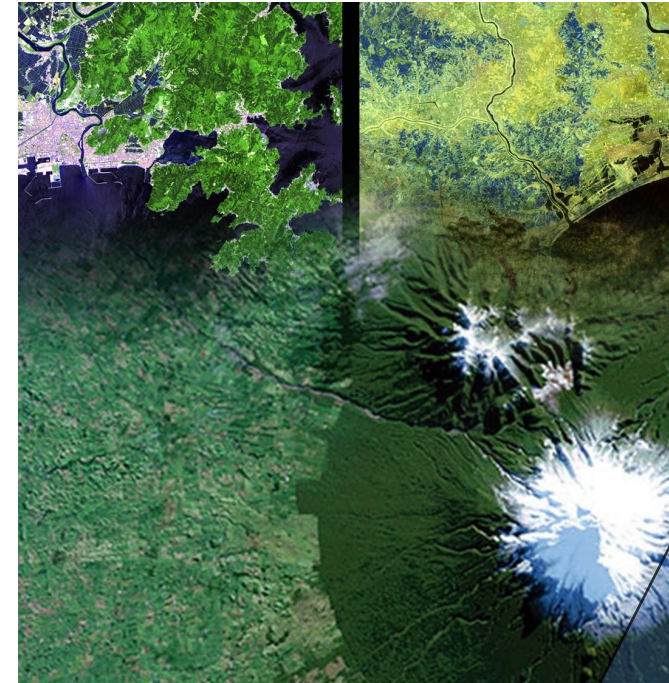
DOI/USGS Landsat funding is managed within the National Land Imaging Program of the USGS Core Science Systems Mission Area

- Development & operation of the ground systems and flight operations
- Development and enhancement of Landsat products
- Collection and analysis of user requirements and capabilities



USGS and US Civil Space Have a Big Data Problem

- Current USGS Landsat archive is 20PB (NASA's archive \approx 125PB)
- By 2030, the USGS Landsat archive will have grown to 35PB (NASA's archive \approx 325PB)
- In 2031, one year after LNext operations begins, the USGS Landsat archive will be close to 50PB
- NASA, NOAA and USGS together spend billions of dollars each year on Earth Observation (EO) satellite missions. Yet we largely conduct satellite flight operations, data dissemination/access and user needs collection completely independently of each other.
- Similarly, international space agencies (e.g., ESA) and commercial firms also have their own stovepipes for search, discovery and access.



We will not have the infrastructure or services to cost-effectively utilize global EO holdings in the 2030s

1970s

1980s

1990s

2000s

2010s

2020s

2030s

2030 Vision

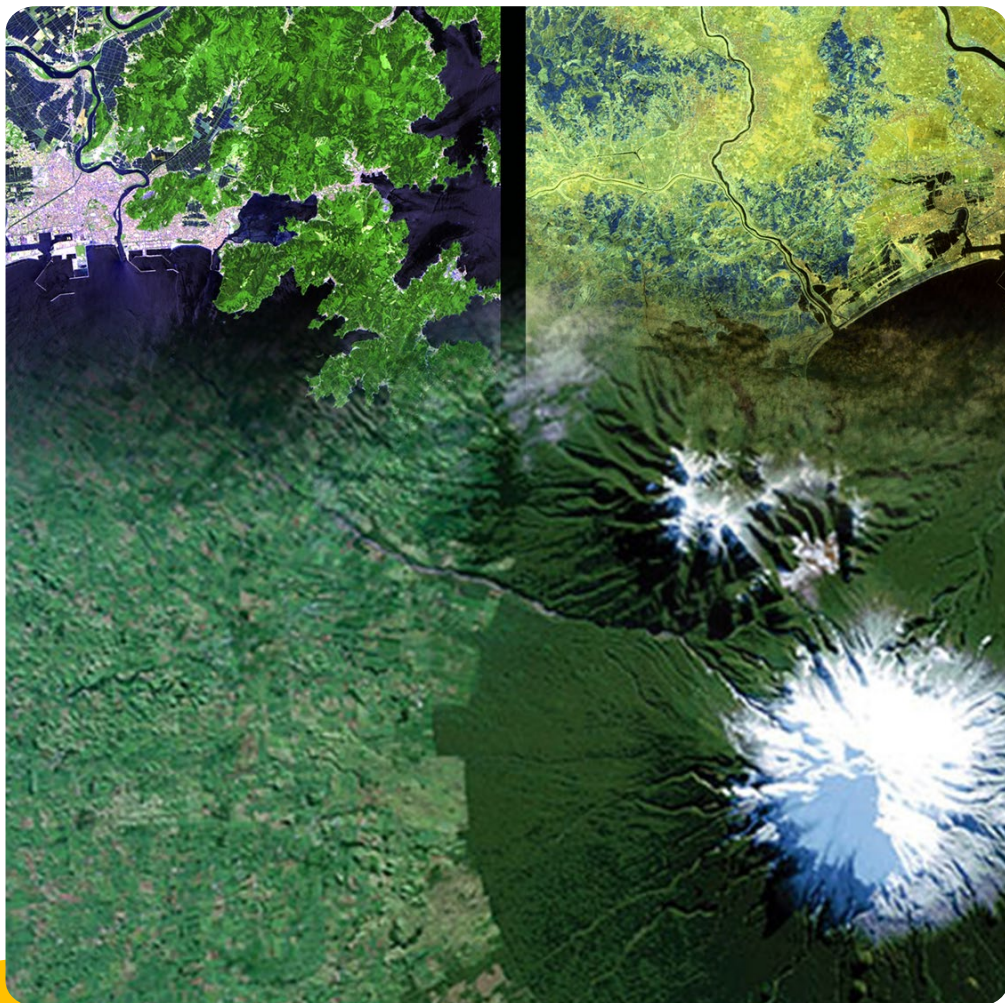
Remove Stovepipes: A new collaborative framework of U.S. Civil Earth Observation could truly integrate these activities and products, benefitting science and operational users of the data, and potentially freeing up tens/hundreds of millions of dollars a year that could be used to provide additional Earth Observation missions and data products to meet the ever-increasing needs of the users.

Cooperative Global Access Standards: Beyond the U.S. architecture comes the need for common search/discovery access to disparate global archives; cloud agnostic interoperability to enable and encourage multi-source/multi-modal access and exploitation of analysis ready data.

Start Now: An integrated U.S. architecture beginning in the 2030 timeframe would provide sufficient time for the agencies to plan for its implementation while not disrupting current missions and projects.

**Ubiquitous Cloud Access and Services
Across the Global Archive of Earth Observations**





Various Courses of Action Under Consideration

- **Earth Observation (EO) Product Interoperability**
 - ✓ Already in work through leadership in the Committee on Earth Observation Satellites (CEOS) Analysis Ready Data (ARD) Framework and Product Families
- **Common FedCiv EO Cloud?**
 - Combining the cloud-storage/processing requirements of NASA/NOAA/USGS
 - A private FedCiv cloud infrastructure may be a cost-effective solution...
 - Development of a common FedCiv *storefront* to simplify search/discovery/access of U.S. Government EO products/services
- **Varied business Models to Consider**
 - *'Delivery in the Cloud'* where product customization and egress become *user-pays* services
 - Constrained Product Sets: Only offer calibrated Top of Atmosphere Level 1 products and Level 2 (and Level 3?) products as on-demand *user-pays* service
 - Containerize advanced product algorithms for open science as *user-pays* service in commercial cloud or download to user-provided processing center
 - Move to a Digital Global Grid System (DGGS) as the standard product, moving the industry towards a new standard in data presentation

NGAC FedCiv Challenge:
Constrain Costs while Enabling/Encouraging Broad EO Exploitation