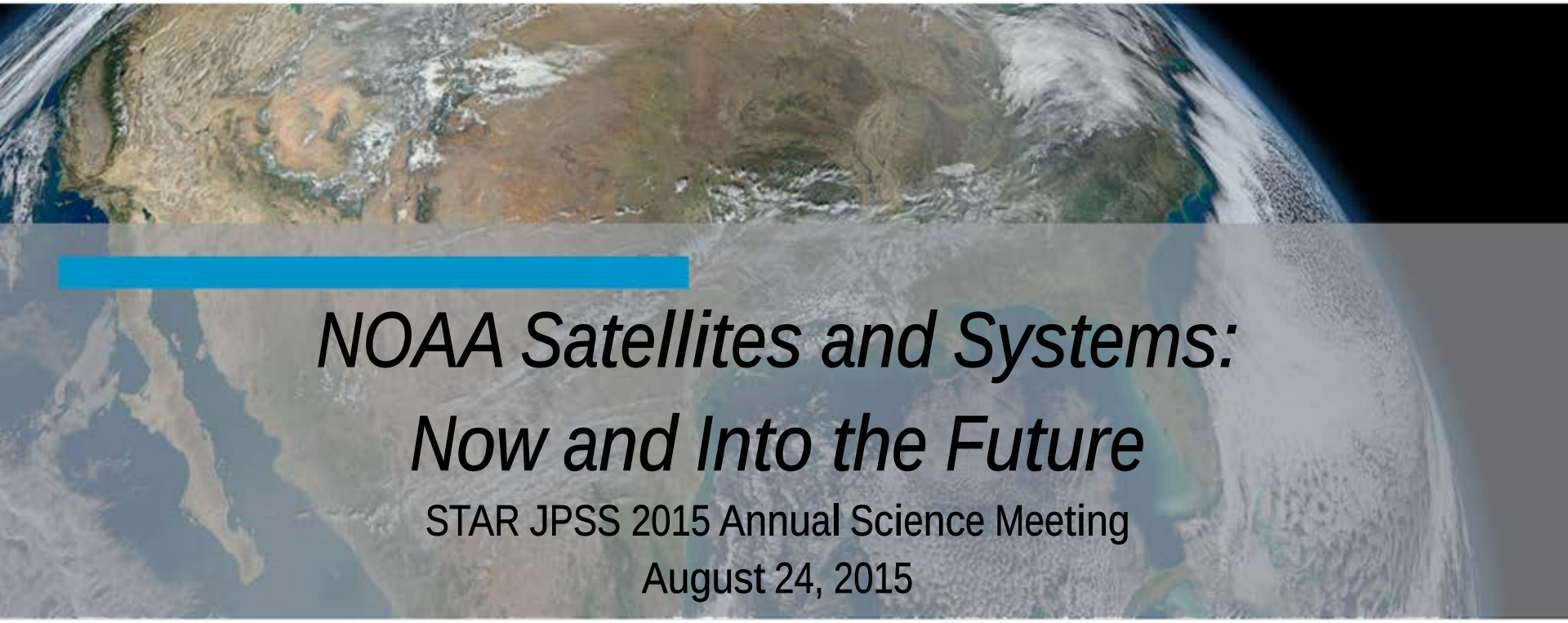


# *NOAA Satellites and Systems: Now and Into the Future*

STAR JPSS 2015 Annual Science Meeting

August 24, 2015


## NOAA Satellite and Information Service

*Dr. Stephen Volz, Assistant Administrator*

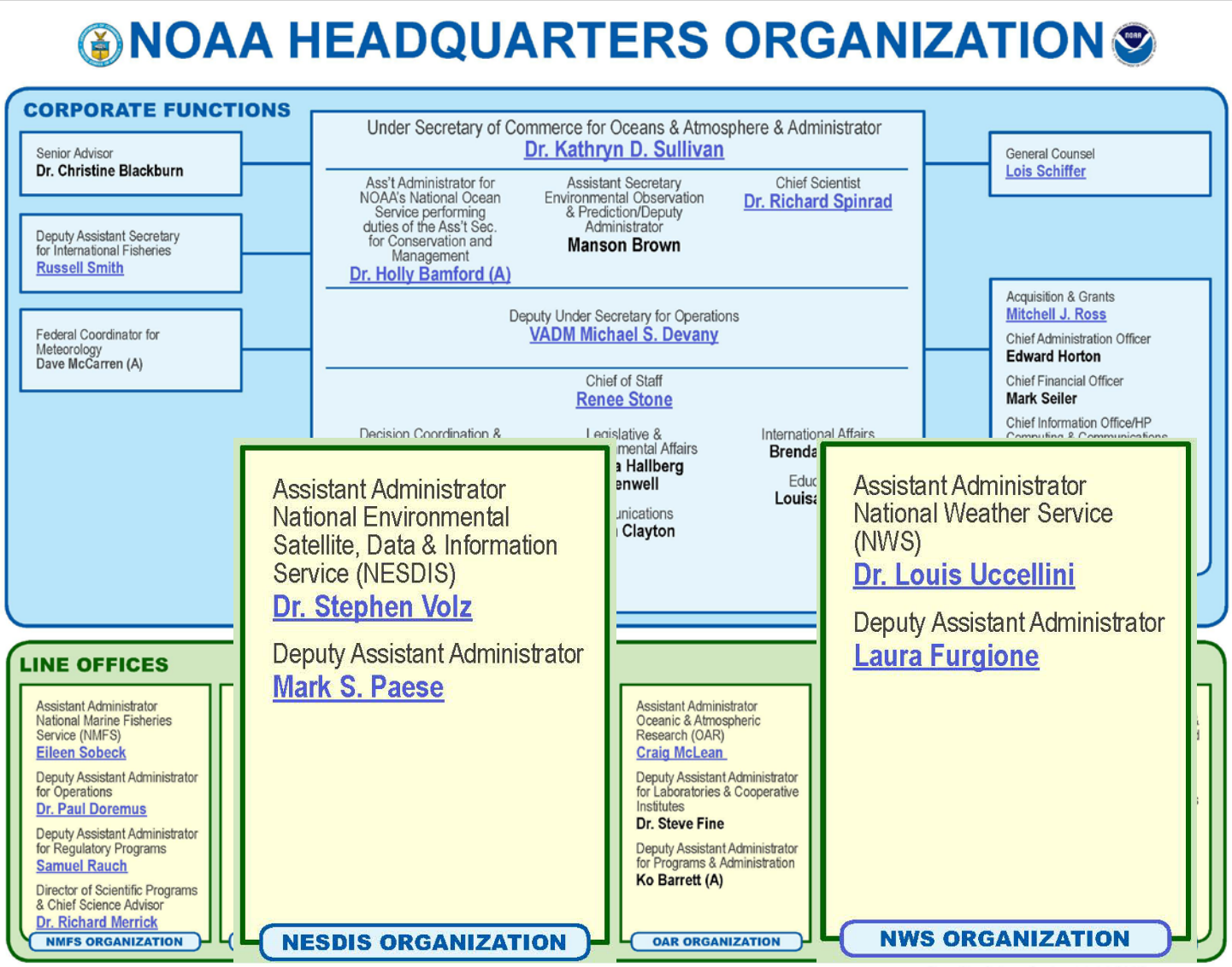
# Supporting NOAA's Mission

*NOAA is a science-based services agency engaged with the entire Earth system science enterprise.*

## NOAA's Top Four Priorities:

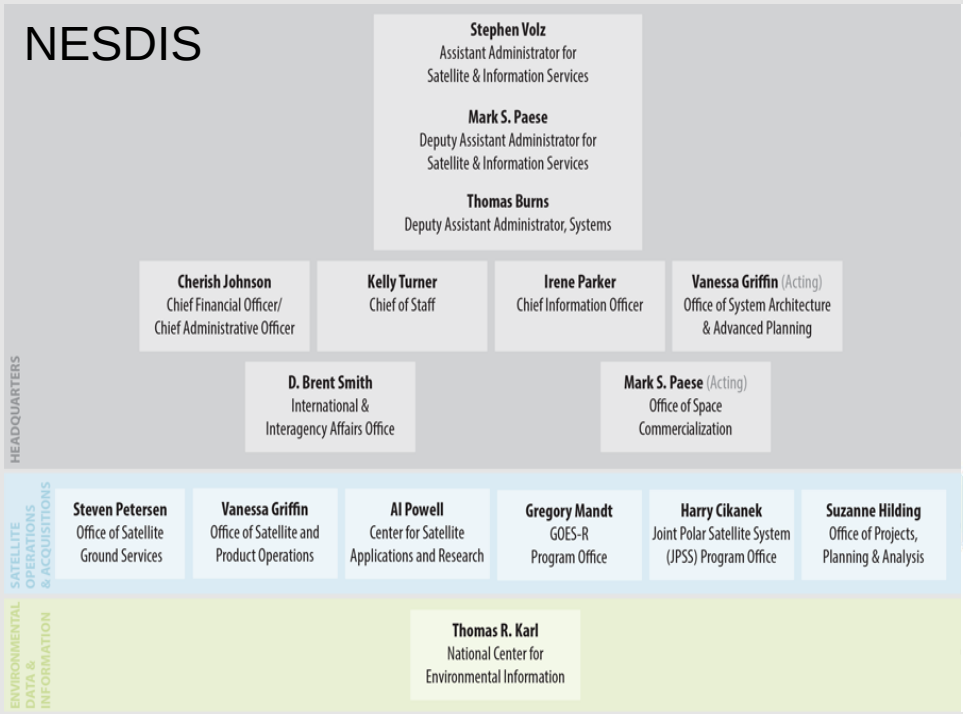
1. To provide information and services to make communities more resilient
2. To evolve the National Weather Service
3. To invest in observational infrastructure
4. To achieve organizational excellence

# Supporting NOAA's Mission

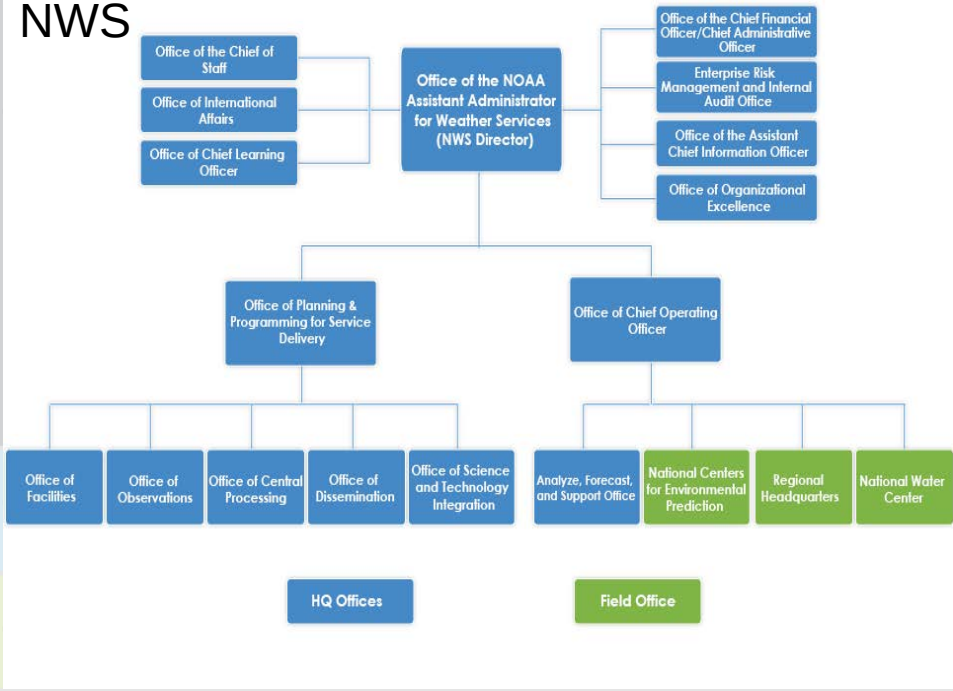


# Supporting NOAA's Mission

## NESDIS




## NWS

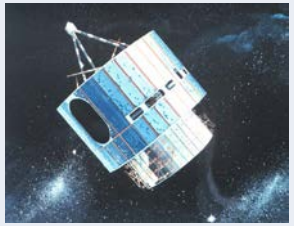



NESDIS works particularly close with NWS to ensure we meet the Weather Service data flow needs

- Acquires and manages the Nation's operational environ
- Operates the NOAA National Data Centers
- Conducts related research.

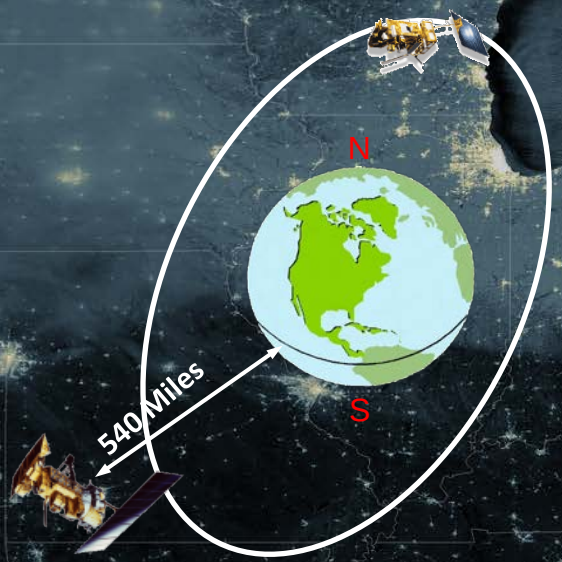
NESDIS satellite and data information services within NOA

# Weather Observations Have Seen Several Transitions

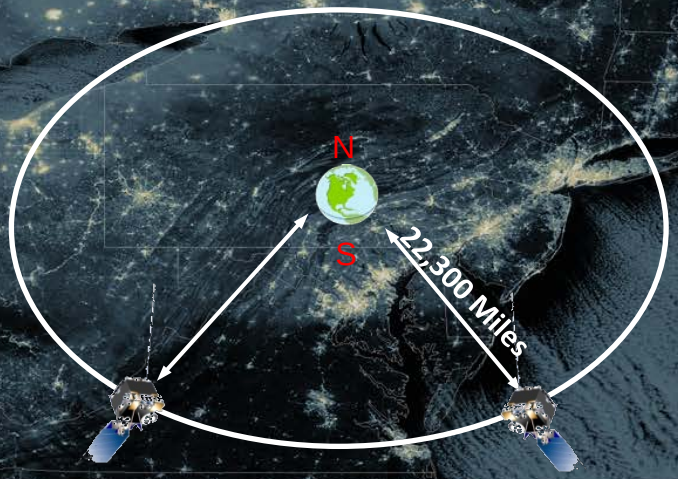
| 1960 | 1980 | 2000 | 2020 | 2040 |
|---|---|---|---|---|
| Tiros-1 launch in April 1960. 48º inclination.<br><br>Nimbus-1 launch in Aug. 1964.<br>First infrared sensor.<br><br>Tiros-9 launch in 1965.<br>"Cartwheel configuration."<br>First polar orbit. | NOAA-6 launch in June 1979. First AVHRR.<br><br>NOAA-8 launch in March 1983.<br><br>Physically larger and had more power than their predecessors | NOAA-15, 16, 17.<br>Heavier and more microwave channels.<br><br>NOAA-18, 19<br>Direct orbit insertion.<br><br>JPSS development.<br><br>NOAA + EUMETSAT IJPS agreement Nov. 19, 1998. | JPSS series operational.<br><br>22 channel imager.<br><br>Next-gen CrIS & ATMS.<br><br> <br>Jason-2/3<br><br>COSMIC-2 GNSS RO<br><br>EON-MW | |
| GOES-1 launch in 1975.<br><br>  | GOES-I (GOES-8) launch in 1994.<br><br>GOES-I through –M.<br>Three-axis stabilized.<br><br>First independently operating sounder and imager.<br><br>GOES-10 launched as on-orbit spare. | GOES-N/O/P operational.<br><br>Imager and Sounder with flexible scan control.<br><br> <br>GOES-R development. | GOES-R through –U operational.<br><br>Himawari 8<br><br>Next-gen ABI.<br><br>First lightning mapper from GEO.<br><br>Next generation development | |

# NOAA's Observational Paradigm Has Been: Two Orbits, One Mission

Polar-orbiting Operational Environmental Satellites (POES) Followed by S-NPP and JPSS-1 thru -4



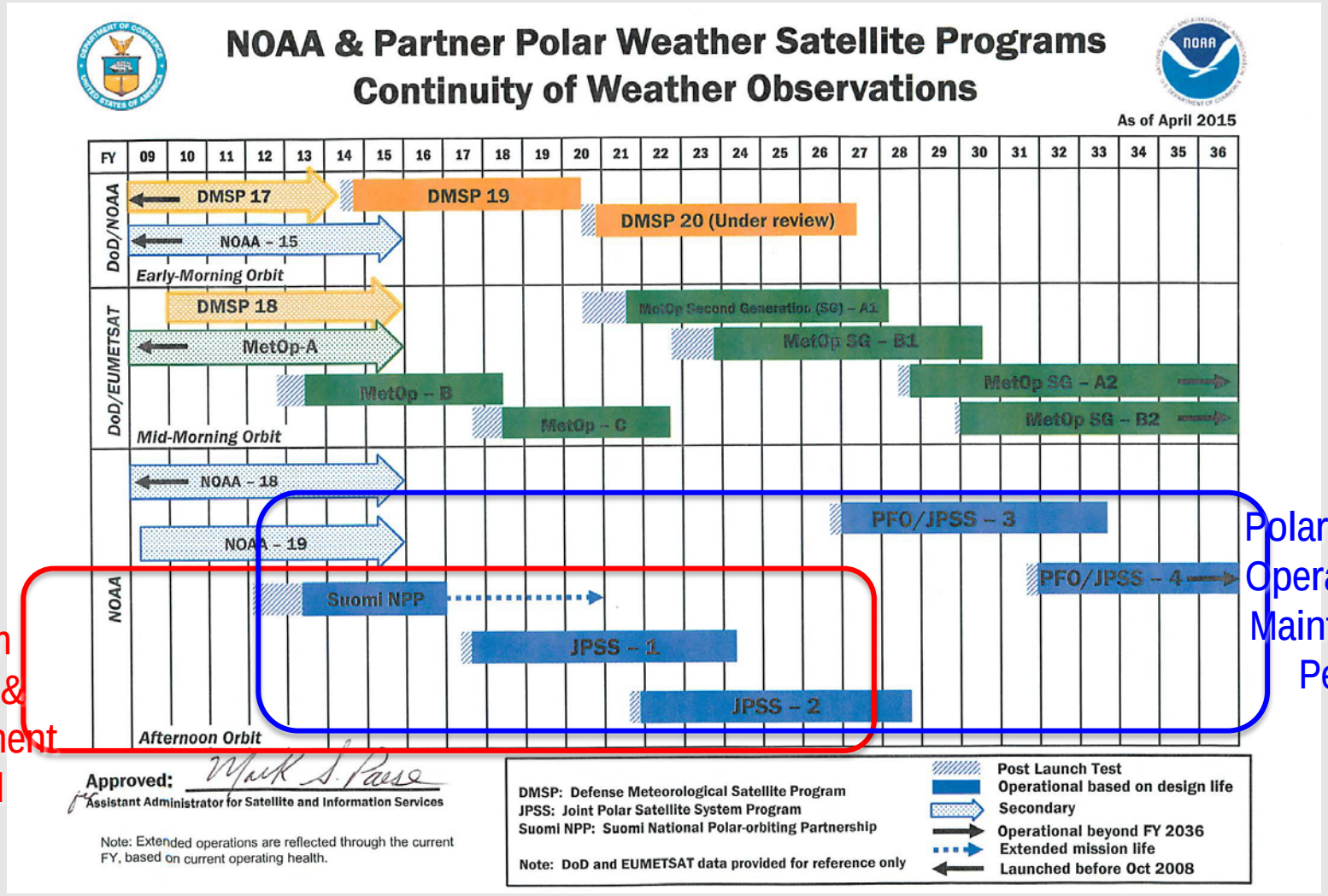

Geostationary Operational Environmental Satellites (GOES), Followed by GOES-R thru -U




NOAA/NASA

*S-NPP image of North America*

# Polar Flyout Chart



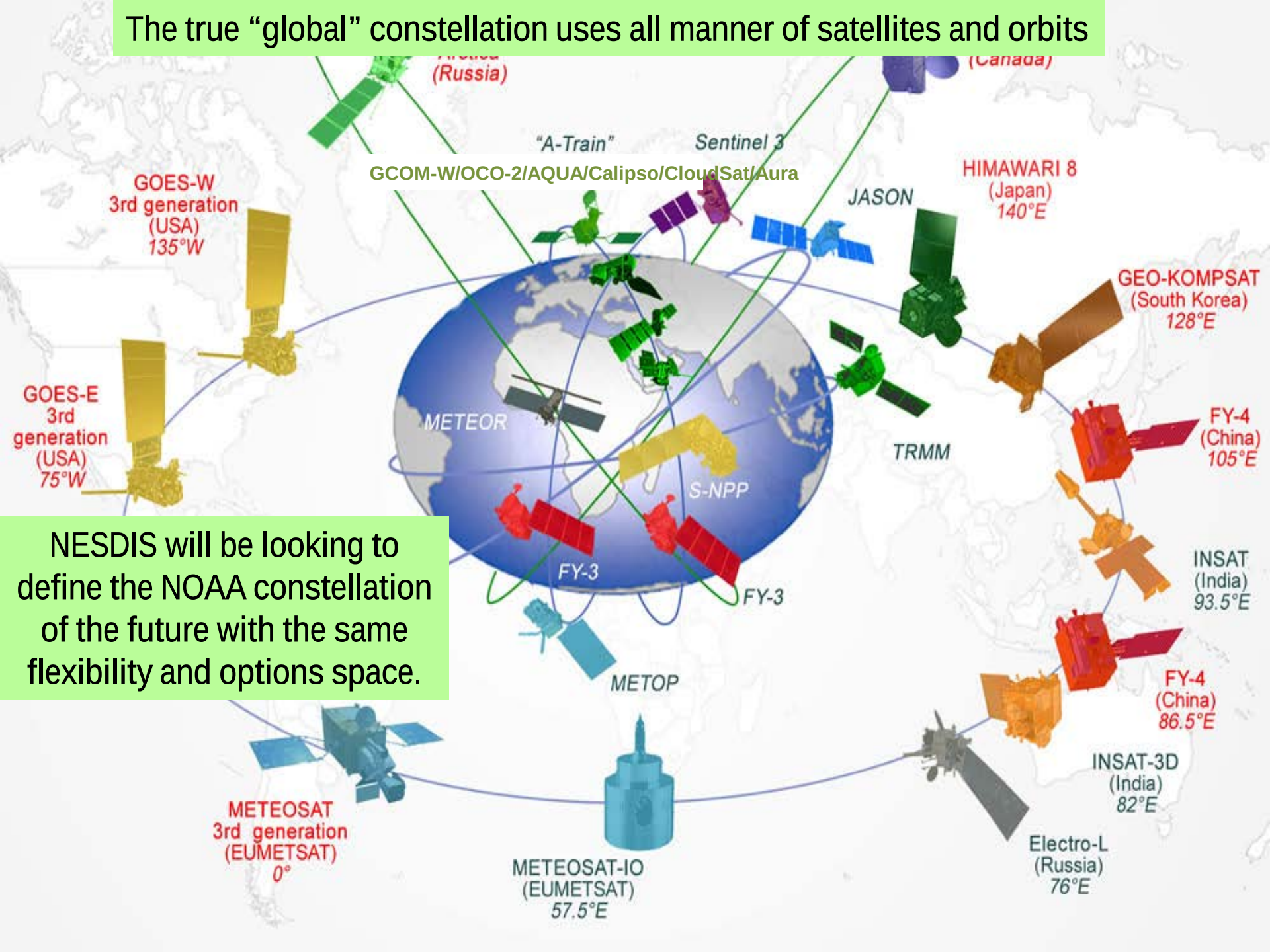

Polar System Design & Development Period

Polar System Operations & Maintenance Period

# Our Observations Involve Much More than NOAA

- NASA and ESA research satellites
- DOD, EUMETSAT & JMA operational satellites
- EC Sentinel satellites

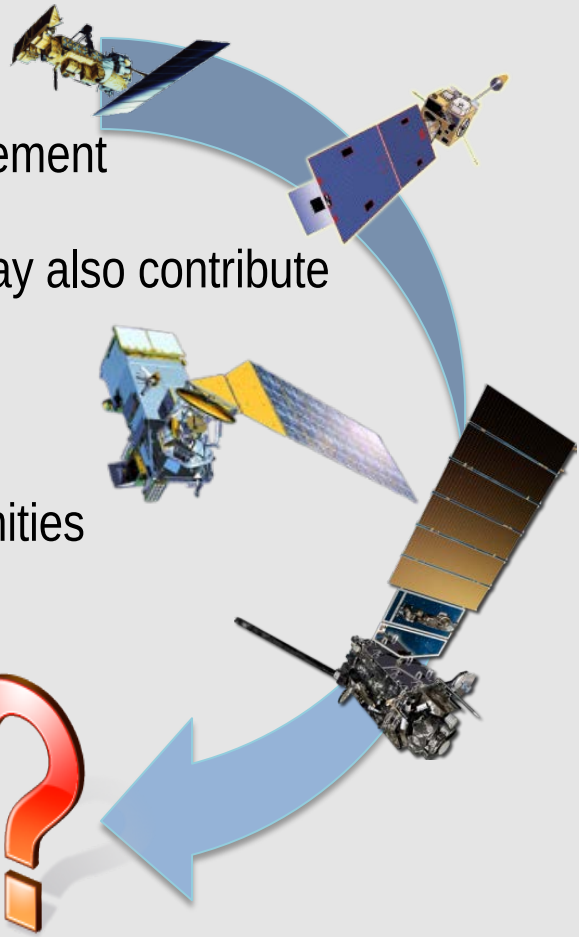
# The true “global” constellation uses all manner of satellites and orbits



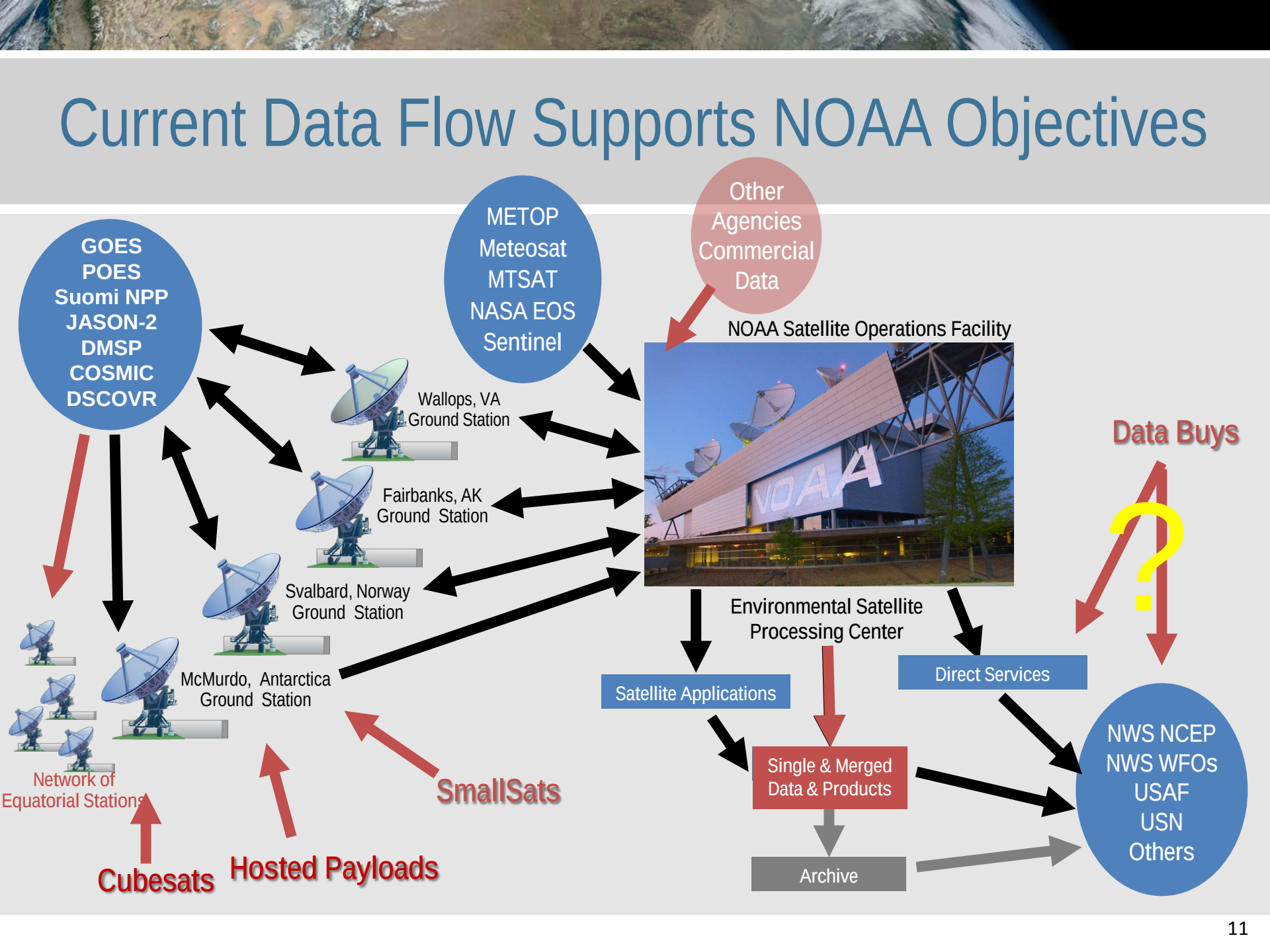

NESDIS will be looking to define the NOAA constellation of the future with the same flexibility and options space.

# What's Next? Moving Beyond "Two Orbits"

- We are broadening our "polar satellite" LEO perspective
  - Core POES/JPSS satellites through ~2038 augmented with:
    - Cosmic-2 RO mission, Earth Observing Nanosatellite-MW
    - Additional complementary evolving and emerging measurement capabilities, from NASA and elsewhere
    - Smallsats or hosted payloads, alone or in constellation, may also contribute
- We will also broaden our GEO perspective
  - GOES-R series through ~2036, possibly augmented with:
    - Alterative architectures, including hosted payload opportunities
    - Possibly to include alternative orbits
- Increasingly, the services we provide will be driving towards more integrated data products, merging:
  - Across platforms, both LEO and GEO
  - Across Agencies, using observations from multiple sources
  - Across public-private domain



# Current Data Flow Supports NOAA Objectives



# Achieving the New NESDIS Architecture

"Develop a space-based observing enterprise that is flexible, responsive to evolving technologies, and economically sustainable"

*-FY15 NOAA Annual Guidance*

- This will be implemented with a Paradigm shift affecting all aspects of NESDIS
  - NESDIS to develop plan for transition to future in FY15
  - Conduct Analysis of Alternatives, Build Architecture Options in FY15–16
  - Conduct Concept Development Studies, Technology Risk Reduction in FY17+ (budget permitting)

- We seek an End-to-End Solution, considering all elements of the Earth Observing System
  - Focus the space observation constellation to achieve flexibility, leverage technology, and achieve greater efficiencies
  - Establish Enterprise Ground to maximize efficiencies, minimize complexity, and reduce cost both in the ground system and in the development of operational data products
  - Establish program management and integration structures to minimize overhead, simplify interfaces, and enable flexibility in execution and acquisitions
  - Establish Enterprise Architecture and Enterprise Systems Engineering and Integration as a core competency of NESDIS
  - Partner with NASA, other Labs, Industry, and Academia to leverage investments in science and technology to enable more frequent and predictable refresh opportunities

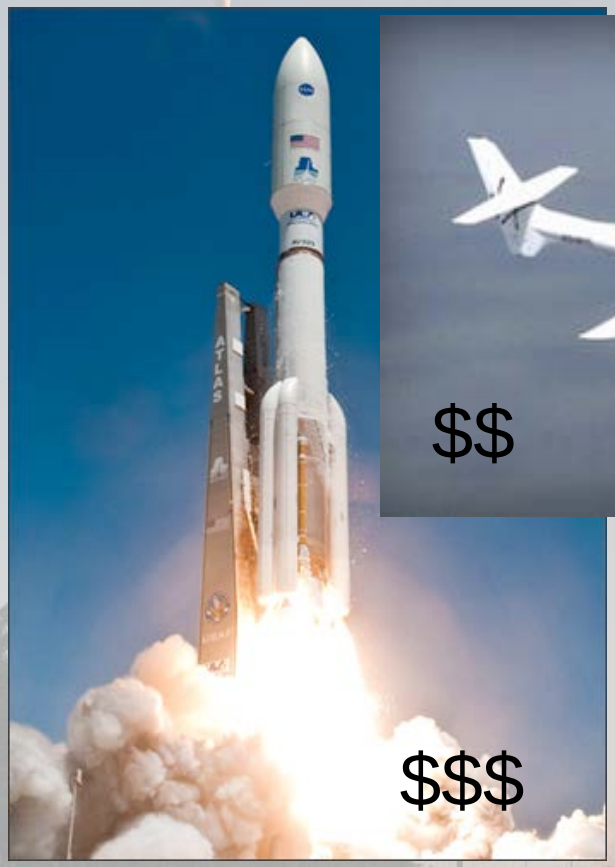
# Implementation Characteristics for Architecture Studies

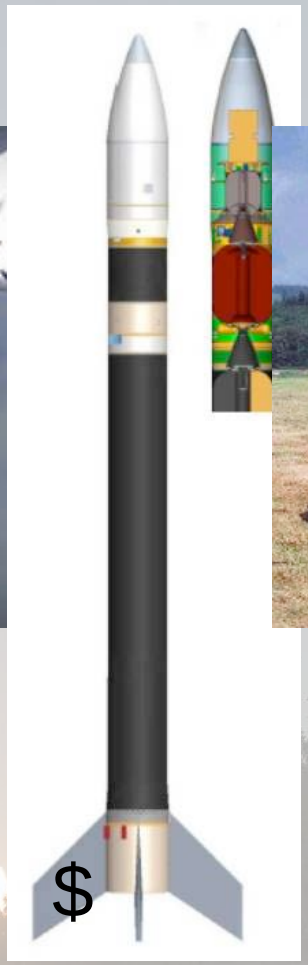
1. **Comprehensive.**
   The trade space must consider a wide range of possible options and solutions and not be anchored on the single satellite multiple measurement paradigm.
2. **Requirements Driven.**
   The studies must include an aggressive and comprehensive look at the requirements definition *AND* prioritization upfront and throughout. This area will require a broad NOAA and Administration commitment.
3. **Affordability.**
   We must consider the satellite and system end-to-end cost and technical readiness at the start and throughout the study, not only as a late activity assessment, to ensure we are building best value into the system.
4. **Traceable & Transparent.**
   We need to be transparent with our approach and execution, with pre-planned engagement activities with all NOAA LOs, within the USG (OMB, OSTP, NASA, DOD), and with the public (industry, users, customers) throughout the iterative study. The level of details shared and included will vary, but the spirit of engagement must be consistent.

# What Community Changes Could Change Our Operating Paradigm?

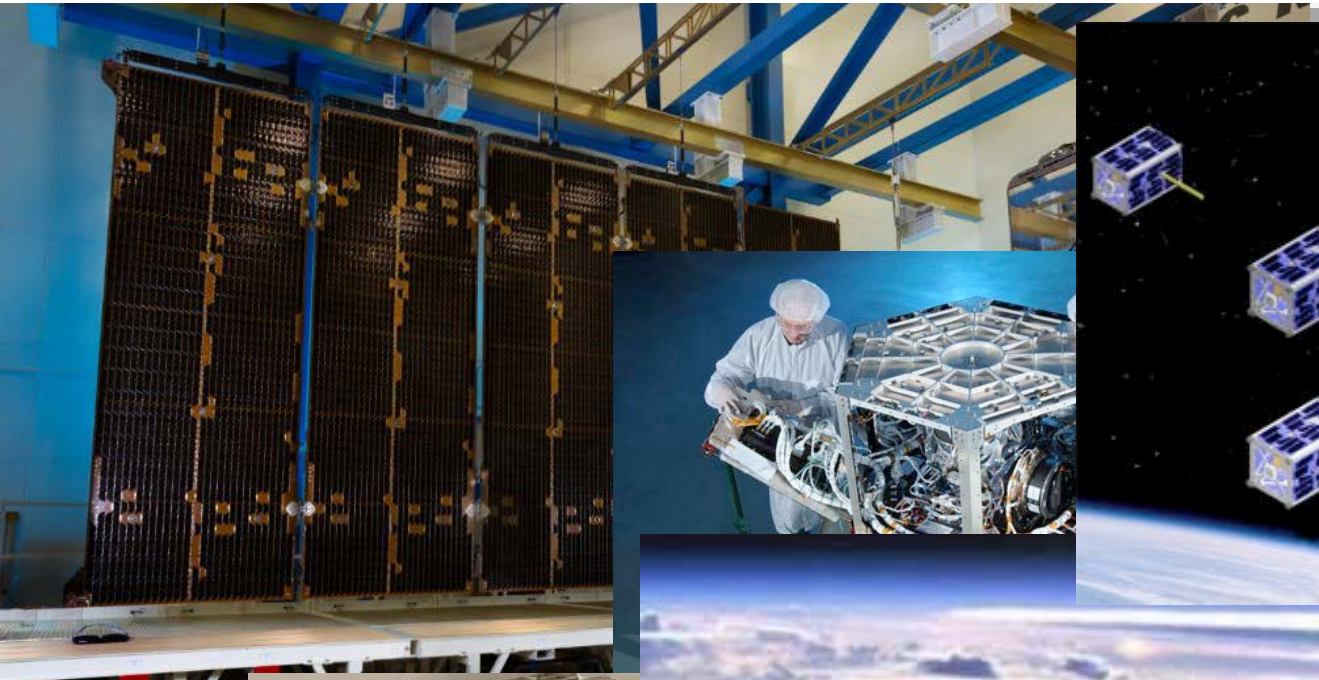
- Access to space
- Satellite technologies
- Data Integration, Quality, Ownership, Continuity

# Access to Space

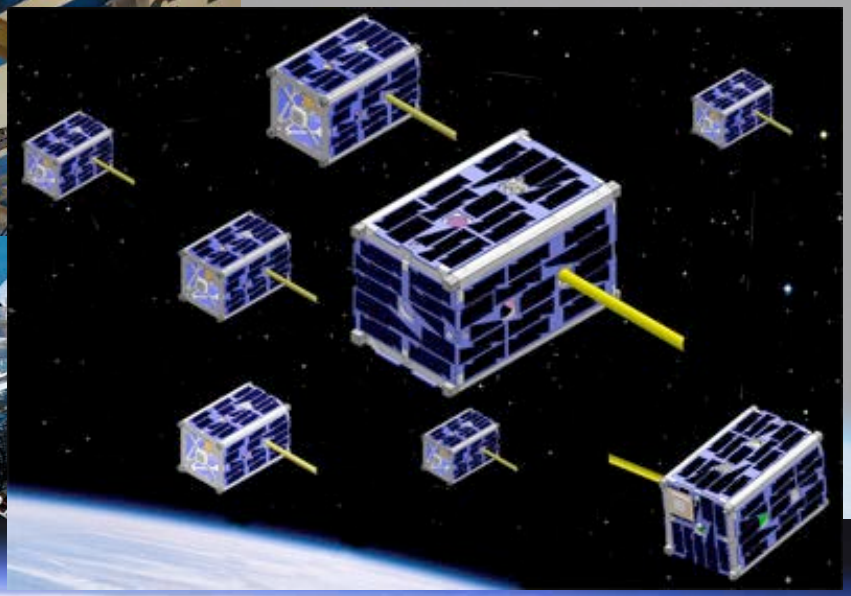


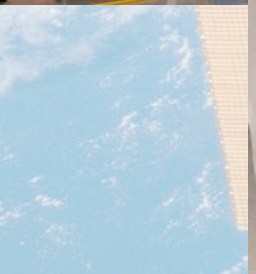


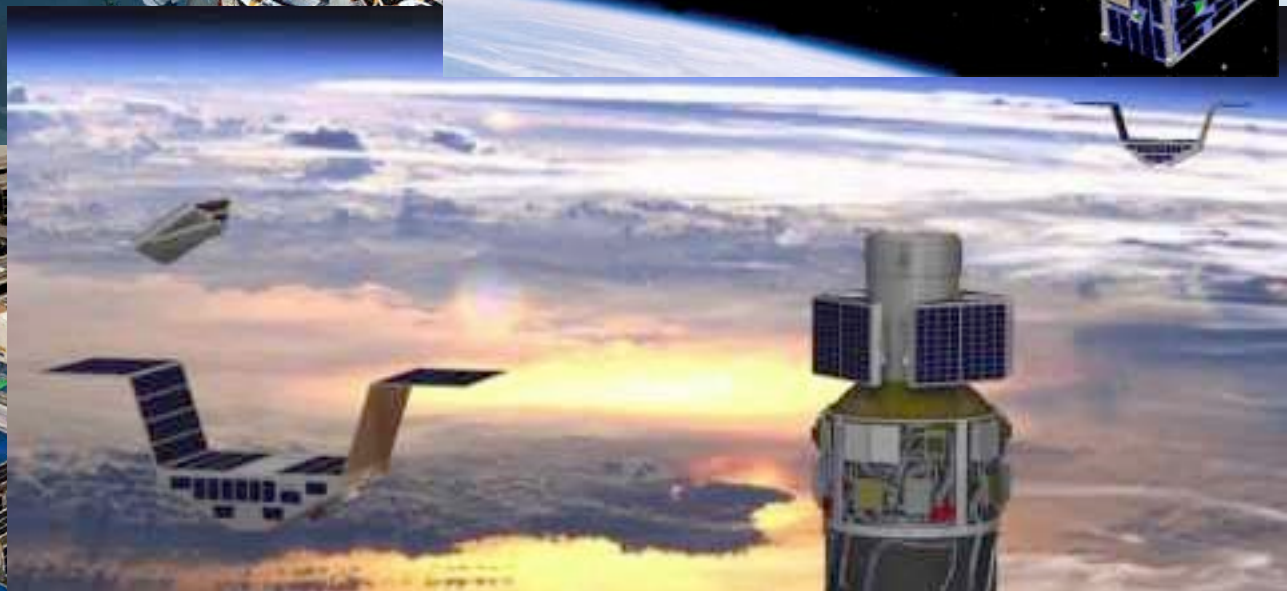
# Satellite Technologies



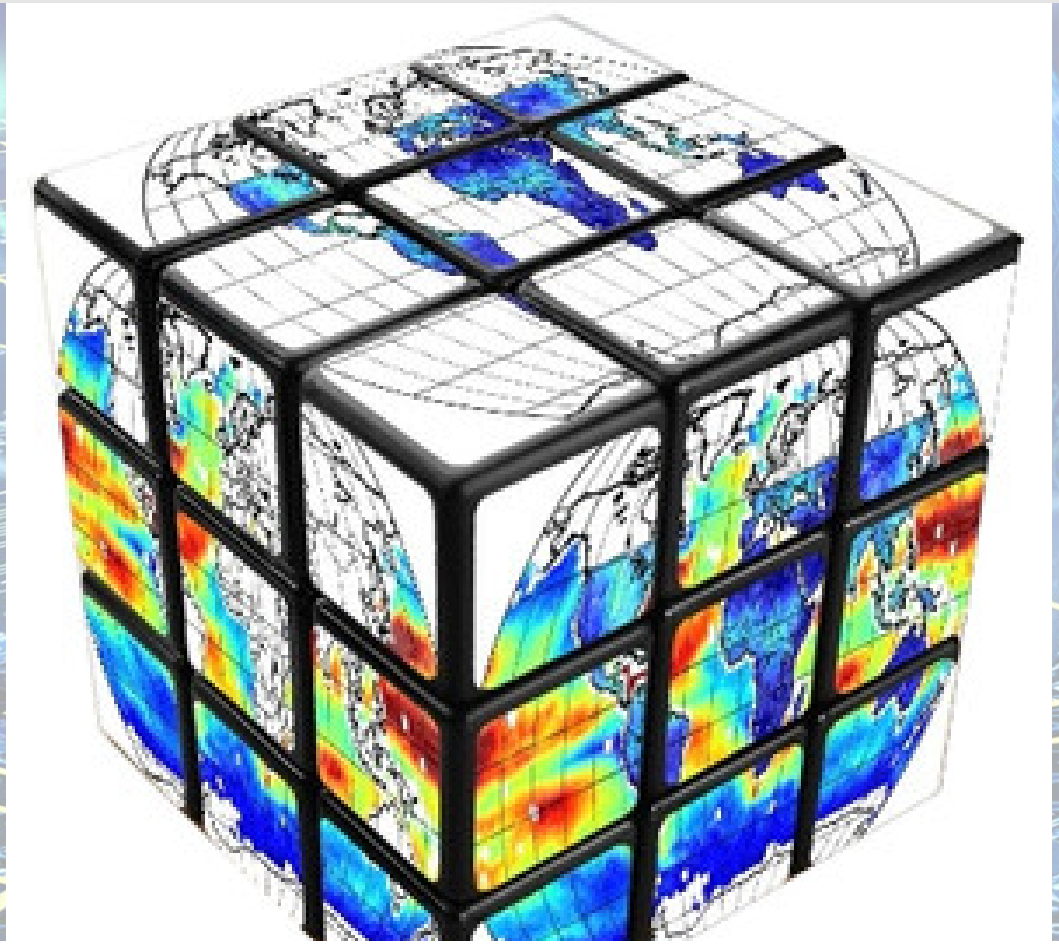








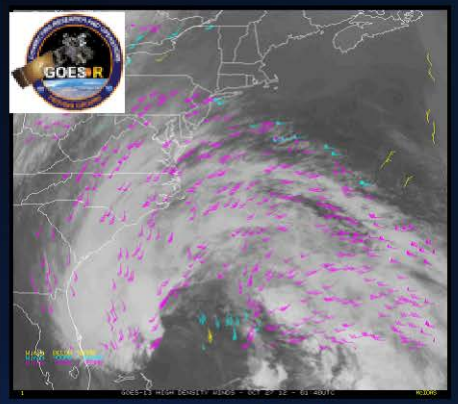
# Data Integration, Quality, Ownership, Continuity



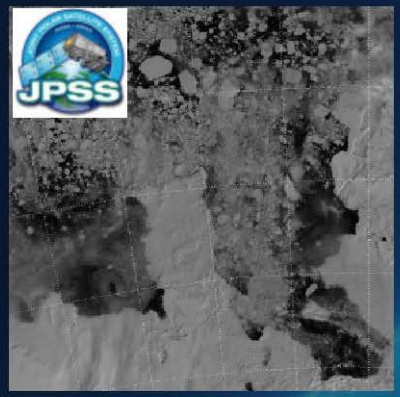
Ultimately most of our products fuse different data sets, so we need to be able to do that fusion efficiently and reflexively, regardless of where the data come from, and with confidence that the fusion will produce reliable information

# Satellite Proving Ground

Supporting demonstration and utilization of new capabilities by the end users
Facilitating the transition of GOES-R and JPSS to operations
Incorporating user feedback for product improvements

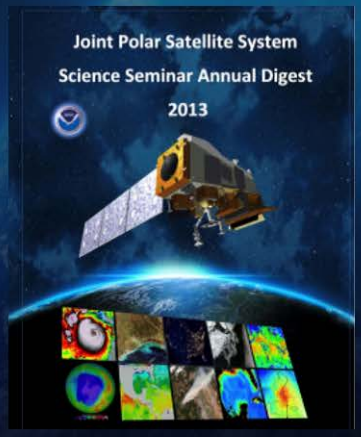


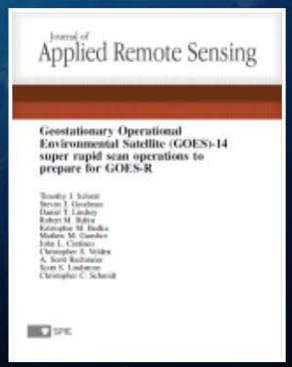
Hurricane Sandy-
GOES High Density
Atmospheric Motion Vectors



S-NPP Day/Night Band
Ice Detection

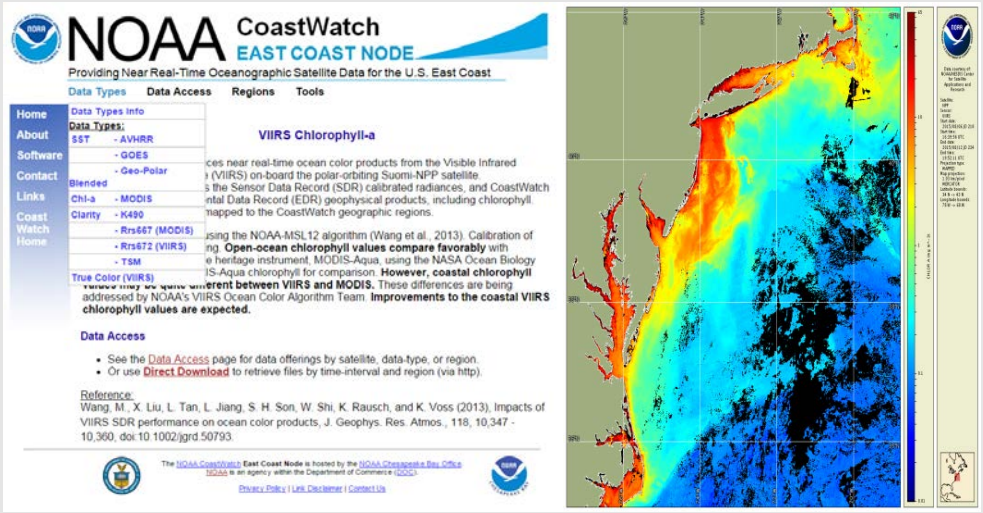
**NOAA Hazardous Weather Testbed (HWT)**



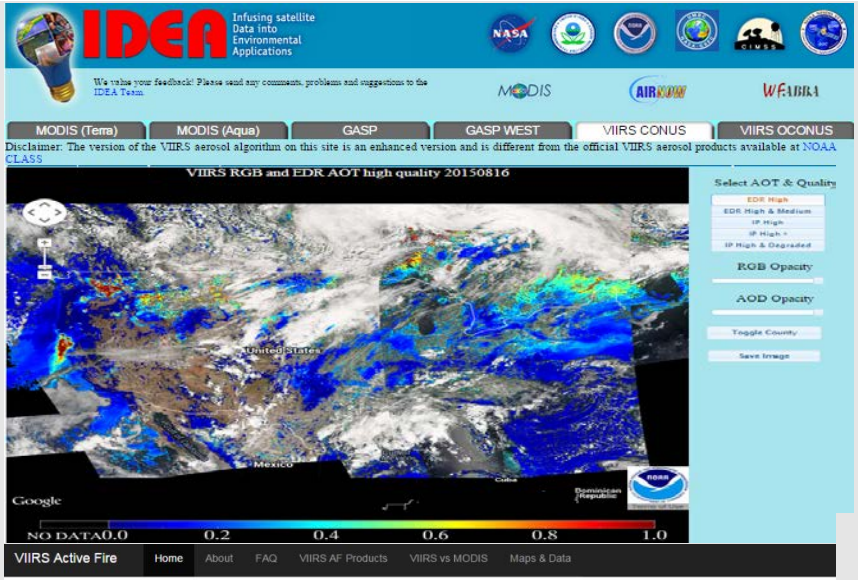



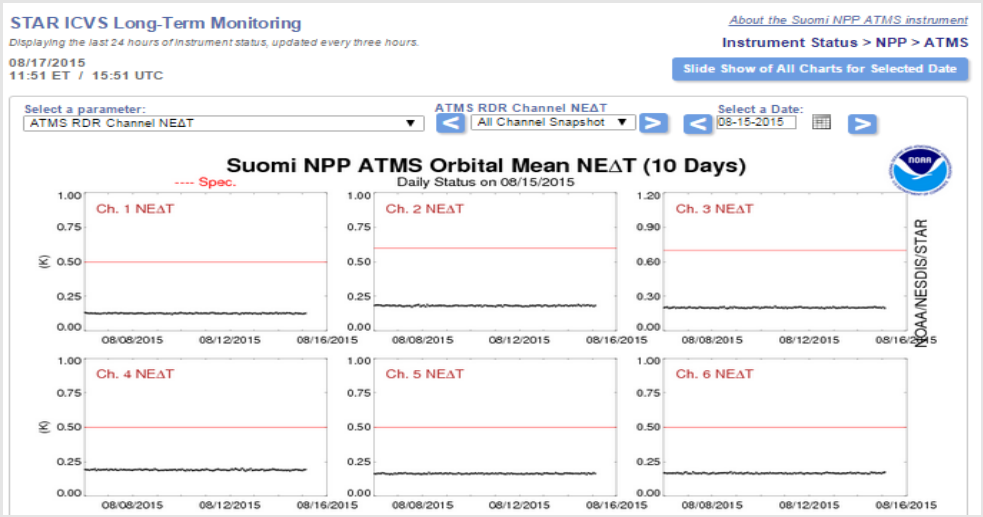
http://www.goes-r.gov/users/proving-ground.html

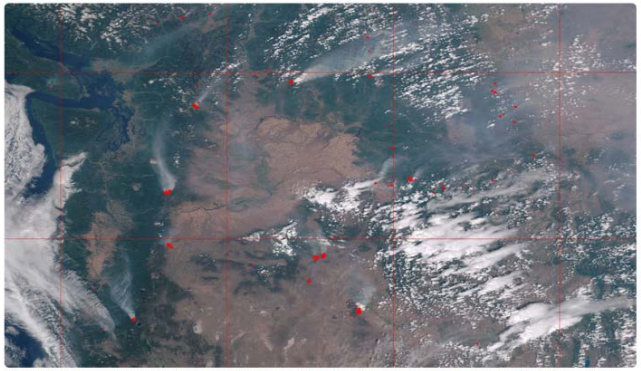
# Visualization and interacting with data is important





Fire activity shows no slowing down in the western states and this is reflected in the true-color image captured by VIIRS yesterday (August 13th) at 1:15pm, local time. In fact, the National Interagency Fire Center (NIFC) in Boise, Idaho, announced yesterday morning that the National Fire Preparedness Level would be increased to 5, the highest level and not seen since 2013. The M-band image (bands 5-4-3) and fire detections shows the many active fires and smoke emissions in the northwest. The most active, currently, include the Cougar (lower-left), Wolverine (center-left), Soda (lower-right), and the North Boulder 2.

Active Fire Team

Ivan Csiszar
Chris Justice
Louis Giglio
Evan Ellicott
Wilfrid Schroeder
Krishna Vadrevu
Antonio Sanchez

Links

JPSS
VIIRS
University of Maryland
NOAA
NOAA-STAR

# NASA-Developed Example: Giovanni

Giovanni (Geospatial Interactive Online Visualization and Analysis Interface) is an interactive data analysis tool, that can provide data visualization and download in minutes upon providing data space, time, and parameter specification

**Exploratory Data Analysis**

- Find
- Download
- Learn format

***WRITE CODE***

- Read
- Subset
- Quality Filter
- Summarize / Analyze
- Visualize

**Main Analysis Phase**

- Select Data
- Analyze
- Derive Conclusions
- Publish

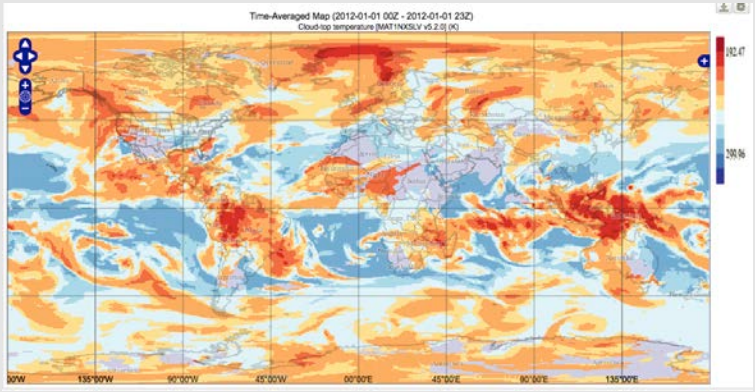
Giovanni provides *Quick-Start Exploratory Data Analysis:*

no coding necessary

***Web-based Services***

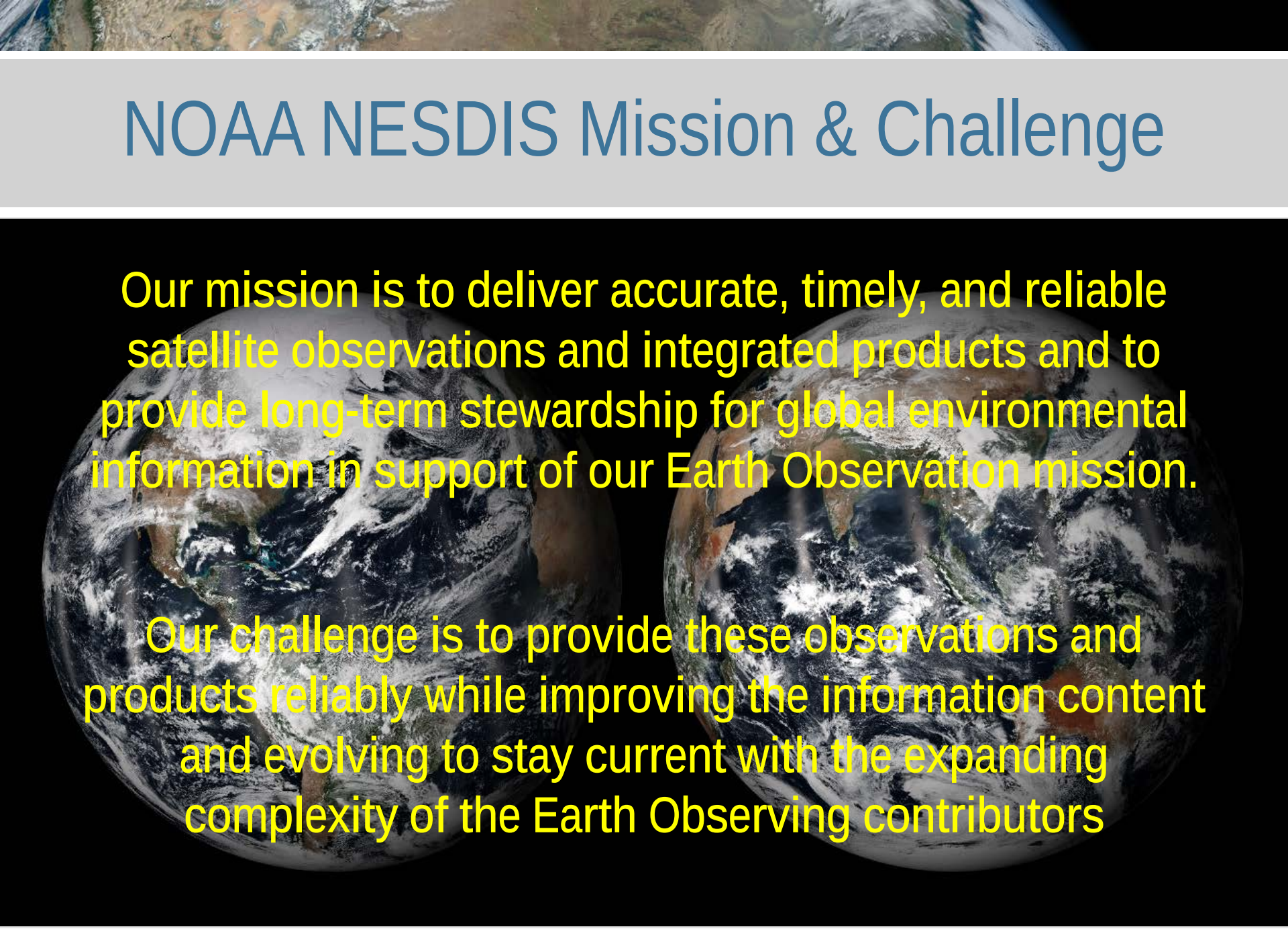
**Giovanni**

- Find
- Fetch
- Reformat
- Filter
- Regrid
- Summarize
- Visualize

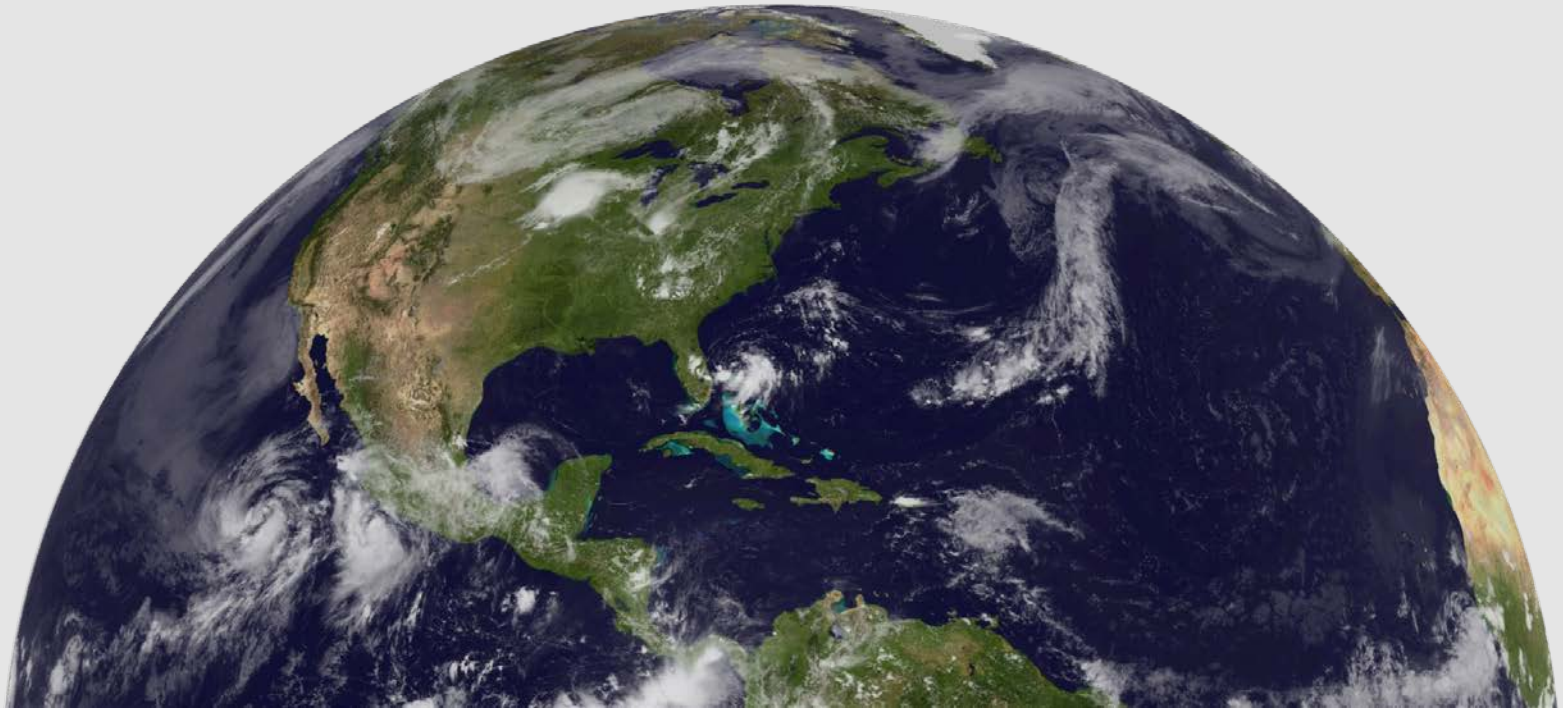



From NASA/GES DISC

# NOAA NESDIS Mission & Challenge



Our mission is to deliver accurate, timely, and reliable satellite observations and integrated products and to provide long-term stewardship for global environmental information in support of our Earth Observation mission.

Our challenge is to provide these observations and products reliably while improving the information content and evolving to stay current with the expanding complexity of the Earth Observing contributors

# Questions?