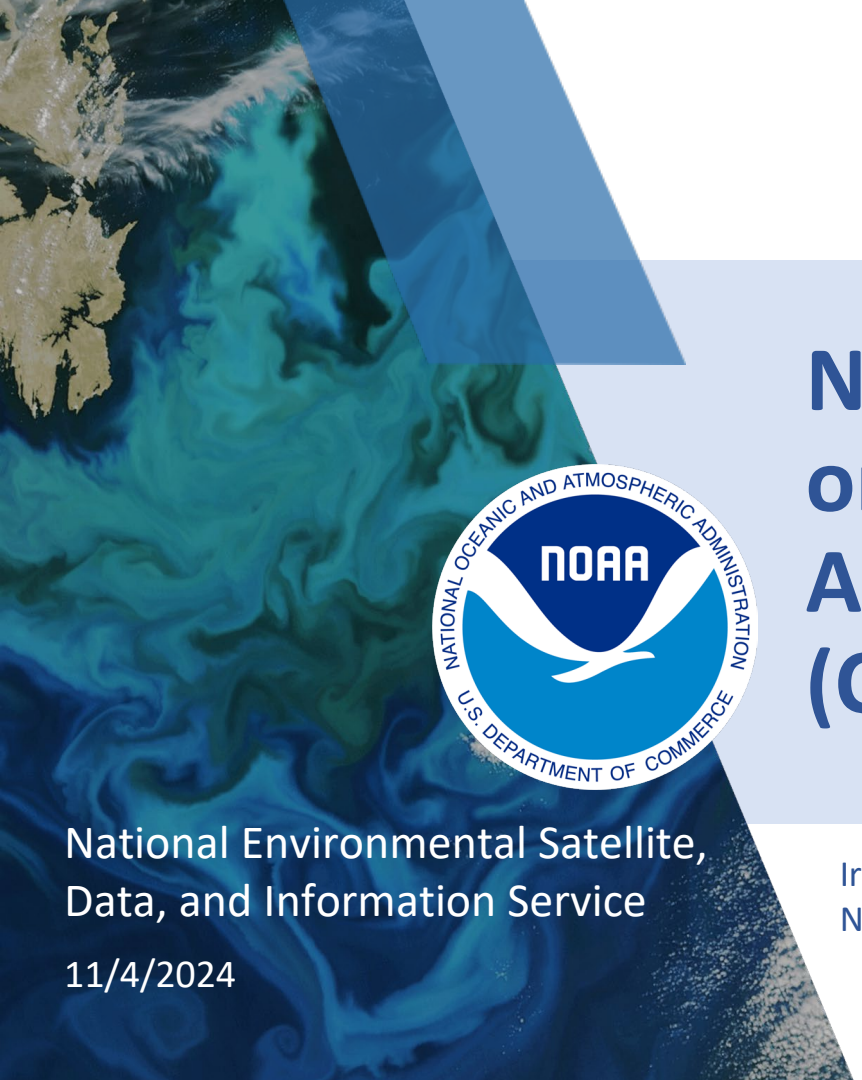


NOAA Update: Committee on Earth Science and Applications from Space (CESAS)

National Environmental Satellite, Data, and Information Service

11/4/2024

Irene Parker
NOAA NESDIS Deputy Assistant Administrator for Systems

Outline

1. NOAA & NESDIS Missions
2. Budget Update
3. NESDIS Satellite Observing System, Present & Future
4. NESDIS Ground, Data, and Information Systems

NOAA and NESDIS Missions


NOAA
SCIENCE. SERVICE. STEWARDSHIP.
NOAA
S 222
On the Web: www.noaa.gov | On Twitter: @NOAA | On Facebook: NOAA

NOAA Priorities

Science, Service, and Stewardship

CLIMATE

Building a Climate Ready Nation by establishing NOAA as the federal authoritative provider of climate information and services in the whole-of-government response to tackling the climate crisis

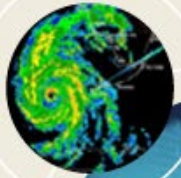
BALANCE

Advance NOAA's complementary work on **environmental stewardship and economic development** with a particular focus on the New Blue Economy.

EQUITY

Exhibit equity in how NOAA builds and provides services. Promote diversity, equity, inclusion, and accessibility in the workforce. Provide **equitable access to NOAA products and services.**

Climate Value Chain: Building a Framework for a Climate Ready Nation



1

SERVICE DELIVERY & DECISION SUPPORT TOOLS

Comprehensive service delivery and decision support tools are necessary to build a Climate Ready Nation to meet the needs of businesses, federal partners and communities most vulnerable to climate and weather hazards.

2

MODELING, PREDICTION & PROJECTION

With state-of-the-science modeling, prediction and projection capabilities, NOAA leverages high-performance computing and the use of artificial intelligence.

3

RESEARCH & DEVELOPMENT

6,000 NOAA scientists and engineers develop cutting-edge applied research and applications to address pressing climate and weather challenges.

4

DATA & INFORMATION STEWARDSHIP

NOAA's world-class data and information stewardship is leveraging cloud infrastructure and working to store and to provide to the public more user friendly and authoritative data sets.

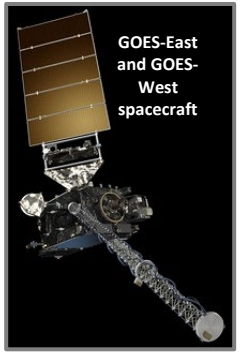
5

OBSERVATIONAL INFRASTRUCTURE

From the ocean floor to on orbit, NOAA's robust next-generation observational infrastructure and data dissemination observes and collects data 24/7.

NESDIS National Security, Safety, and Prosperity Mission

- NESDIS **operates the Nation's weather satellites**, 24/7
- Integrates observations from a **global network** of international satellite partners
- Acquires **next-generation satellites** to observe the Sun and Earth
- Provides **data and imagery** for environmental and atmospheric modeling
- **Assesses the U.S. and global climate**
- Maintains **one of the most significant archives** of environmental data on Earth



90 percent of the data used in numerical weather forecast models comes from satellites.

NESDIS Strives to Provide Integrated, Digital Understanding of Earth

Advance terrestrial observational leadership in geostationary and extended orbits

Advance space weather observational leadership in all applicable orbits to meet mission needs

Evolve LEO architecture to enterprise system of systems that exploits and deploys new observational capabilities

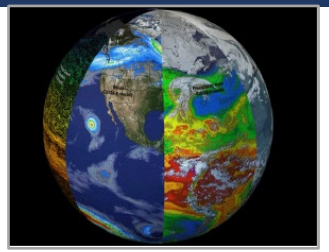
Develop agile, scalable ground capability to improve efficiency of service deliverables and ingest of data from all sources

Provide consistent ongoing enterprise-wide user engagement to ensure timely response to user needs

Deliver the best value integrated suite of products and services responsive to user needs.

End-to-End Responsibility



Requirements & Planning (SAE)

System Acquisition (LEO, GEO, SWO)

Launch (OSPO, LEO, GEO, SWO)

Command & Control (OSPO)

Processing & Distribution (OCS, NCEI)

Data Archive & Access (OCS, NCEI)

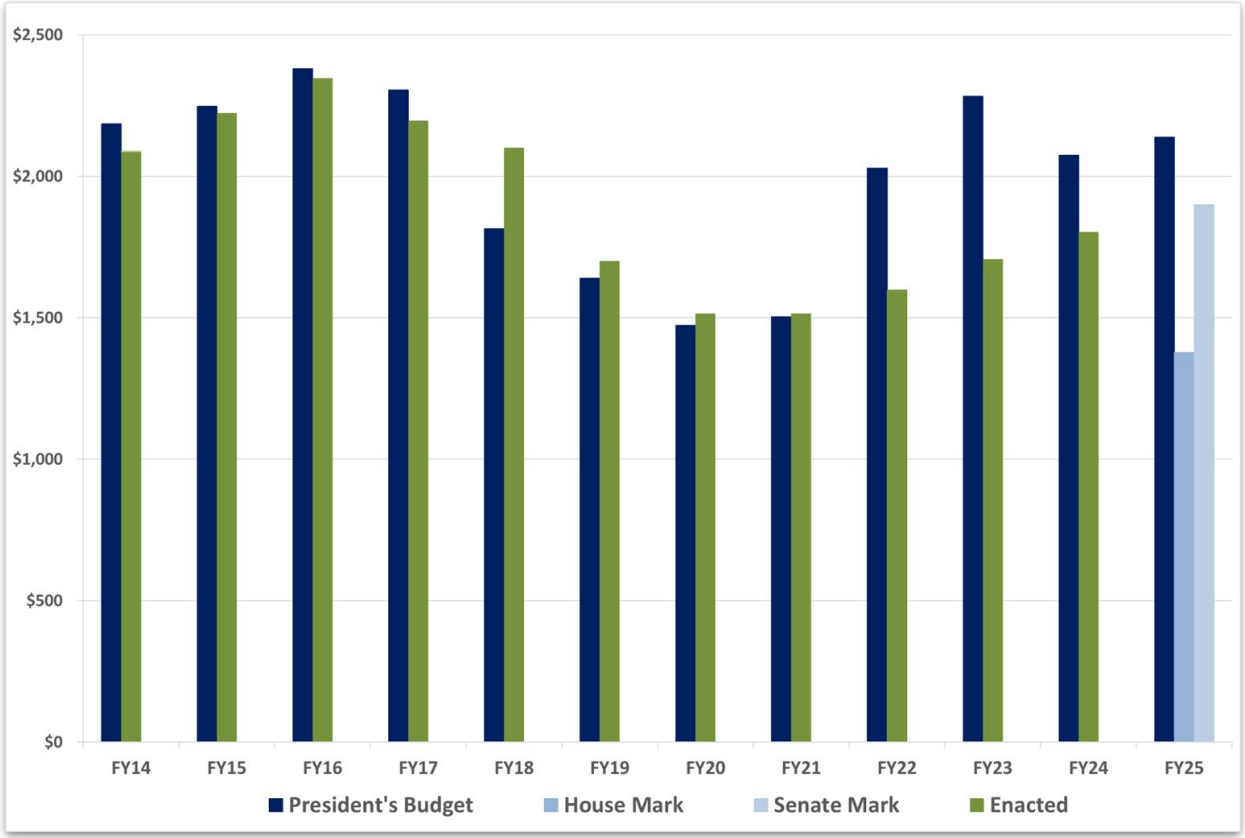
Products & Services (STAR, NCEI)



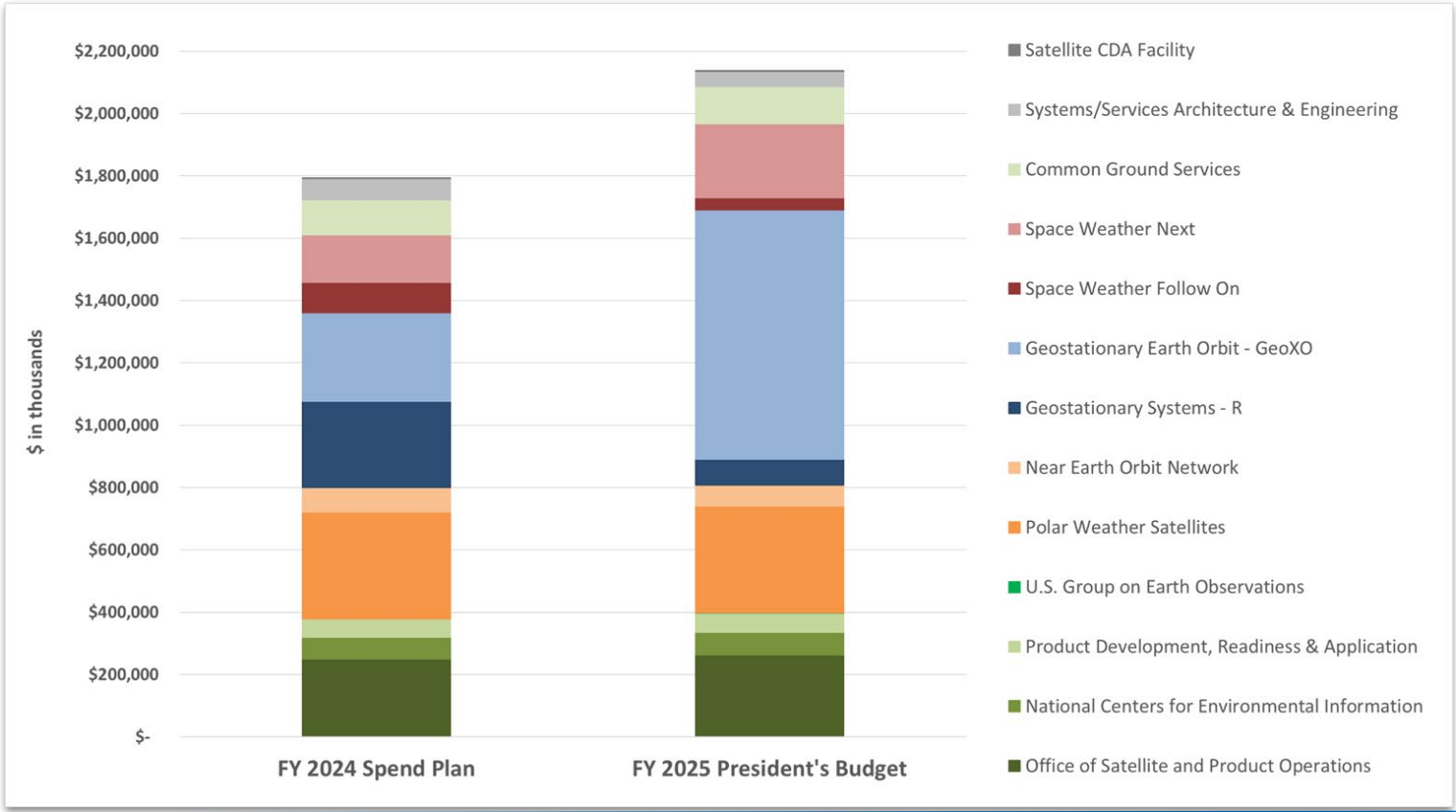
Budget Update

NESDIS Discretionary Budget Trends

President's Budget (PB) vs. Enacted (FY 2014-2025) ($M)



NESDIS Discretionary Budget Trends



NESDIS Satellite Observing Systems
Current and Future


JAPAN
SOUTH KOREA
CANADA
SPAIN
USA
FRANCE
NOAA
EUMETSAT
EUROPEAN COMMISSION
TAIWAN SPACE AGENCY (TASA)
EUROPEAN SPACE AGENCY
NASA
DEPARTMENT OF DEFENSE
COMMERCIAL DATA PURCHASE
STEREO
DSCOVR
SOHO
ACE
GEOKOMPSAT
HIMAWARI-8/9
140.7° E
128.2° E
105° E
90° E
86.5° E
82° E
78° E
74° E
180° W
KOMPSAT-5
PAZ
GPM
NOAA-15/18/19
SENTINEL-6 MICHAEL FREILICH
SENTINEL-1
SENTINEL-2
SENTINEL-5P
SENTINEL-3
JASON-3
41.5° E
EWS-G2
METEOSAT-9
METEOSAT-8
GCOM-C/W
RADARSAT
METOP B/C/SG
NOAA-20/21
A-TRAIN CONSTELLATION
SUOMI NPP
COSMIC 2
DMSP-F14-18
GOES-WEST
137° W
135° W
105° W
89.5° W
75° W
9.5° E
0
3.4° W
METEOSAT-10
METEOSAT-11
SES-14
GOES-14
GOES-17
GOES-19
GOES-EAST
GEOSTATIONARY ORBIT
LOW EARTH ORBIT
DEEP SPACE

NOAA Satellite Missions

DSCOVR
Operational July 27, 2016

SWFO
SWFO-L1 - Launches fiscal year 2025

SW NEXT

COSMIC-2
Operational Feb. 25, 2020

JASON-3
Operational July 1, 2016

GOES-R SERIES
GOES-16 - Operational Dec. 18, 2017
GOES-17 - Operational Feb. 12, 2019
GOES-18 - Operational Jan. 4, 2023
GOES-19 - Operational April, 2025

GeoXO

SENTINEL-6 Michael Freilich
Operational Nov. 22, 2021

JPSS SERIES
NOAA-20 - Operational May 30, 2018
NOAA-21 - Launched Nov. 10, 2022
JPSS-4 - Launches fiscal year 2028
JPSS-3 - Launches fiscal year 2033

NEON

QuickSounder
Launches FY2026

NOAA's Next-Gen Earth Observation Strategy

Integrated, Adaptable, and Affordable: Orbits, Instruments & Systems

LEO

Miniaturized instruments on small, lower cost, and proliferated satellites and partner data improving forecasts through better and additional data. Better precipitation forecasts, wave height predictions, ocean currents, and more.

GEO

Continuous real-time observations supporting warnings and watches of severe weather and hour-by- hour changes. High-inclination orbits to observe northern latitude & polar regions.

Space Weather

Reliably monitoring coronal mass ejections from L1, GEO, and LEO can protect the nation's valuable, vulnerable infrastructure. New capabilities at L5 and high earth orbit can provide additional insight and improve forecasts.

Common Ground Services

Secure ingest of data in different formats from different partners requires a flexible, scalable platform. Common Services approach integrates cloud, AI, and machine-learning capabilities to verify, calibrate, and fuse data into new and better products and services.

Geostationary (GEO) Portfolio

GOES-R Program Overview

The GOES-R Series is a four satellite program which provides advanced imagery and atmospheric measurements of Earth's weather, climate, oceans and environment, real-time mapping of lightning activity, and improved monitoring of solar activity and space weather.

GOES-U Launch on June 25th, 2024. Image Credit: NASA

GEOS-16, 17, 18, 19 On Orbit

GOES-14 & -15 as well

GOES-16:

- ✓ In operational service as GOES East since December 2017

GOES-17:

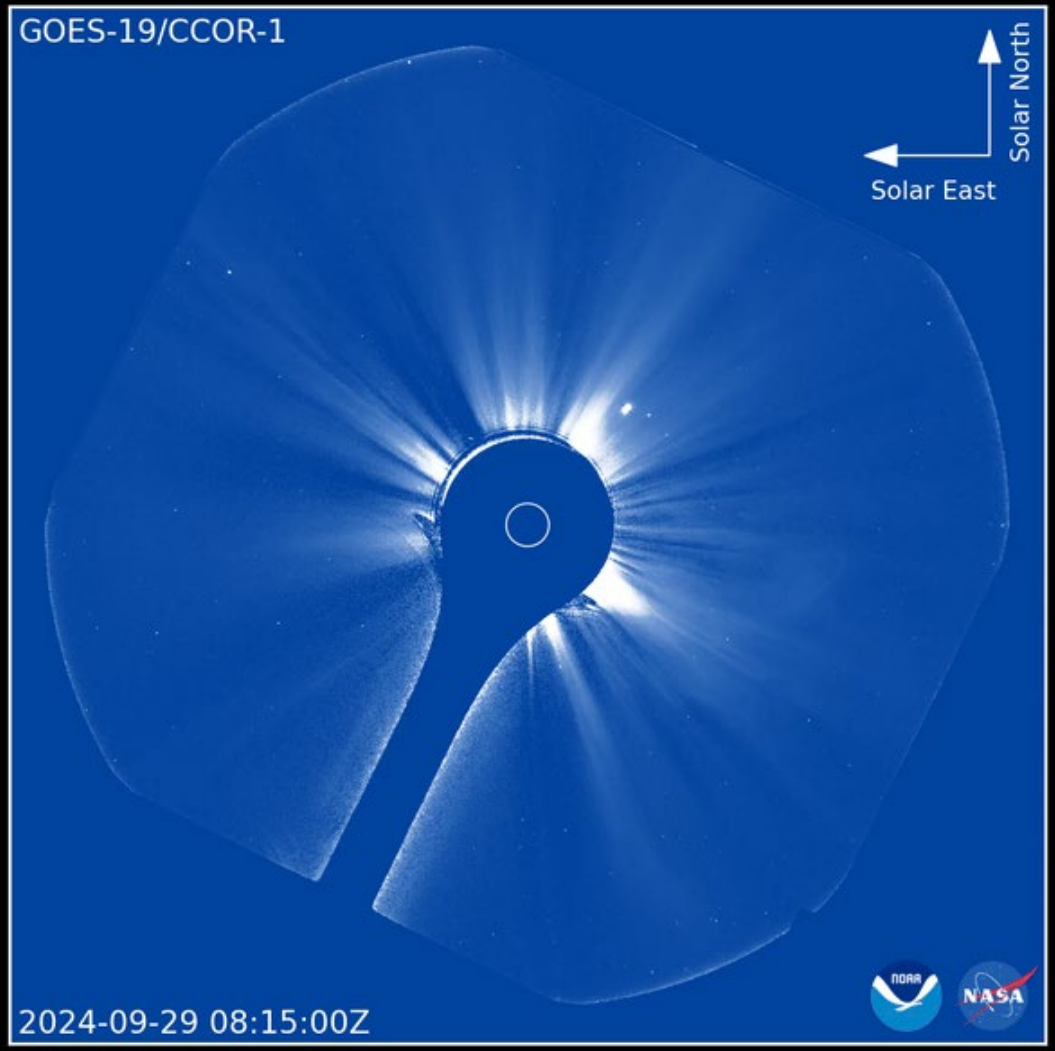
- ✓ Continuing mitigations for ABI Heat Pipe anomaly
- ✓ Placed in storage now that GOES-18 is GOES-West

GOES-18:

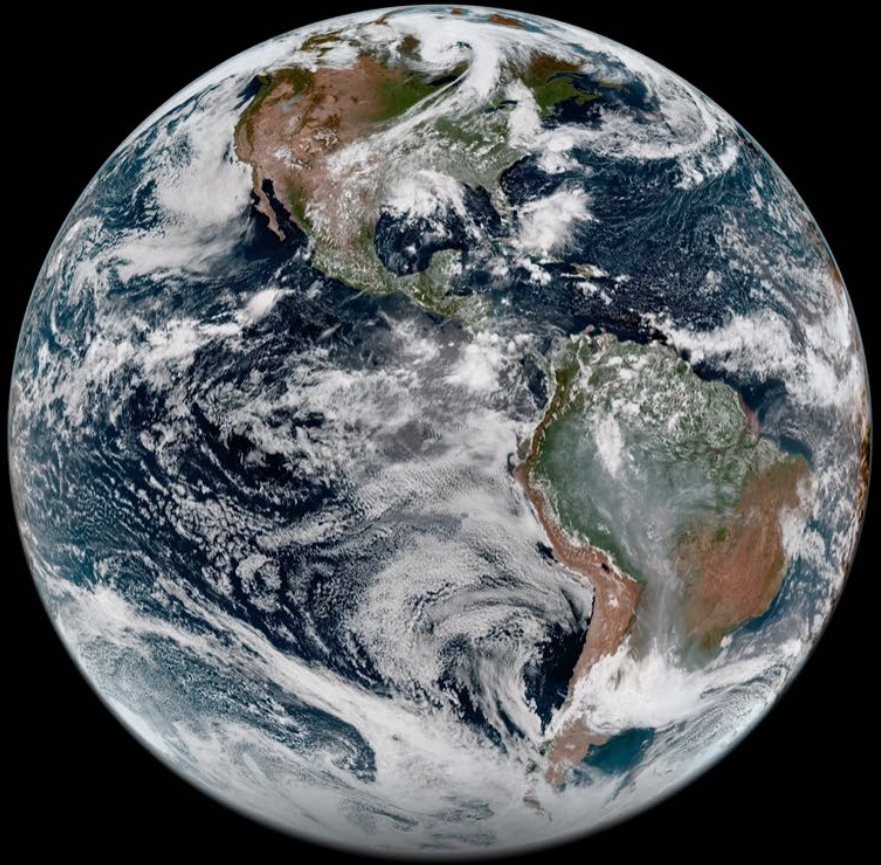
- ✓ Operational as GOES West in January 2023

GOES-19:

Operational in April 2025 and to replace GOES-16 as GOES East.


GOES-19/CCOR-1
Solar North
Solar East
NOAA
NASA
2024-09-29 08:15:00Z

What’s next?



On Sept. 18, 2024, NOAA shared the first images of the Western Hemisphere from its GOES-19 satellite. The satellite’s Advanced Baseline Imager (ABI) instrument recently captured stunning views of Earth.

Geostationary Extended Observations

GXI
Vis/IR Imager

- Hurricane location / track
- Severe storms, rain, wind, hail
- Atmospheric rivers, flooding
- Winter storms, ice cover
- Wildfire, smoke, volcanic ash
- Methane plume monitoring
- Aviation hazards, turbulence

GXS
Hyperspectral IR Sounder

- Numerical weather prediction
- Hurricane track / intensity
- Now-casting
- Warn-on-Forecast
- Air quality monitoring

ACX
Atmospheric Composition Instrument

- Air quality forecasting
- Air quality monitoring
- Airborne hazards
- Emissions monitoring

LMX
Lightning Mapper

- Thunderstorm / tornado warning
- Wildfire ignitions
- Precipitation forecasts
- Tropical storm diagnosis

OCX
Ocean Color Instrument

- Harmful algal blooms
- Water quality
- Oil spill tracking
- Plankton classification
- Refined fisheries yield
- Habitat / species protection
- Naval forecasting

Note:
OCX represented by GLIMR
LMX represented by GLM
ACX represented by TEMPO

GeoXO Constellation

(Preliminary, pending program approval)

GEO-West

Visible/Infrared Imager
Lightning Mapper
Ocean Color

GEO-Central

Hyperspectral Infrared Sounder
Atmospheric Composition
Partner Payload

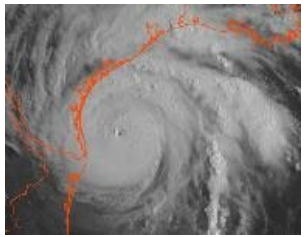
GEO-East

Visible/Infrared Imager
Lightning Mapper
Ocean Color

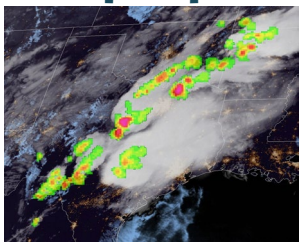
GeoXO Program Overview

- GeoXO will provide mission continuity of the GOES-R program, as well as deliver growing user needs with three new instruments. Improvements include:
  - Improved numerical weather prediction and local nowcasting, delivered by Hyperspectral IR Sounder
  - Monitoring dynamic coastal/ocean features, ecosystem change, water quality, and hazards, delivered by Ocean Color Instrument
  - Monitoring air quality and linkages with weather and climate, delivered by Atmospheric Composition Instrument

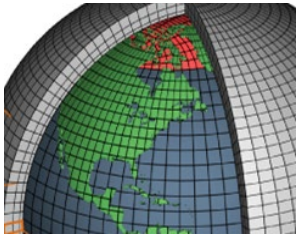
Vis/Near-IR Imagery [Supporting NWS]



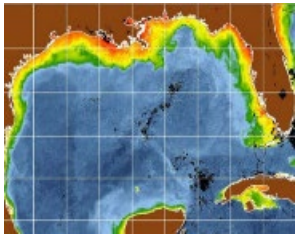
Lightning Mapping [NWS]



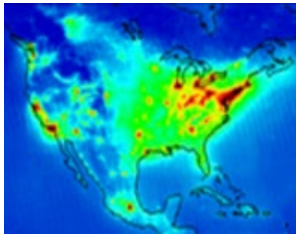
IR Sounding [NWS]



Ocean Color [NOS, NMFS]



Atmo. Composition [OAR]



GeoXO Status

- Officially initiated by the Department of Commerce
- November 2021: DOC Milestone 1 approved
- December 2022: DOC Milestone 2 approved
- March 2023: Imager (GXI) contract awarded to L3Harris
- September 2023: Sounder (GXS) awarded to BAE
- May 2024: Atmospheric Composition (ACX) and Ocean Color (OCX) awarded to BAE
- June 2024: GeoXO Spacecraft awarded to Lockheed Martin
- September 2024: Lightning Mapper (LMX) awarded to Lockheed Martin

Planning towards 1st Launch in 2032


Low Earth Orbit (LEO) Portfolio

JPSS is NOAA's current generation of LEO satellites.

Earth Science Products & Applications for:

- Weather forecasting
- Disaster management, and
- Understanding effects of global climate change.

JPSS is a five-satellite series:

- Suomi NPP: launched October 28, 2011
- NOAA-20/JPSS-1: launched November 18, 2017
- NOAA-21/JPSS-2: launched November 10, 2022
- JPSS-4: launches FY 2028
- JPSS-3: launches FY 2033

Near Earth Orbit Network (NEON)

“Buy or partner where we can. Build what we must.”

NEON Program Overview

- Evolve the LEO architecture to exploit and deploy new observational capabilities that will support:
  - Continuity of the product baseline
  - Partnerships, commercial, or NOAA-developed approaches
  - A disaggregated architecture exploiting commercial “New Space” while accepting greater risk
- Initial focus on:
  - Exploiting commercial investment, expertise, and innovation
  - Developing the next generation microwave and infrared sounders critical to Numerical Weather Prediction (NWP)
  - Maintaining continuity of key partnerships supported by the JPSS Program

Space Weather Observations (SWO) Portfolio

Growing User Needs in Space Weather

Space Operations
- Postpone launch of satellite
- Turn off/safe instruments and/or spacecraft in orbit

Electric Power Grid
- Adjust/reduce system load
- Disconnect components
- Postpone maintenance

Airlines
- Divert polar flights
- Change altitude

GPS/Navigation
- Postpone activities
- Redo survey
- Use backup systems

Communications
- Use backup capabilities
- Alternative frequencies

Rocket Lab launches 2 satellites, returns booster to Earth after delay from surprise solar storm

By Mike Wall | Contributions from Tereza Pultarova last updated 4 days ago

The company's Electron rocket carried two commercial Earth-imaging satellites into orbit Friday (March 24), then splashed down

March 24, 2023

The Washington Post
Democracy Dies in Darkness

CAPITAL WEATHER GANG

How a rather mundane space storm knocked out 40 SpaceX satellites

As the sun enters a more active phase, even minor geomagnetic activity could pose problems for smaller SpaceX satellites.

By Kasha Patel
February 12, 2022 at 9:00 a.m. EST

February 12, 2022

Solar storm bombarding Earth now may reach 'extreme' levels, sparking auroras down to Alabama and straining hurricane-weakened power grids

News By Tariq Malik published October 10, 2024

Supercharged northern lights displays may be visible as far south as California or even Alabama.

October 10, 2024

The New York Times

Solar Storm Crashes GPS Systems Used by Some Farmers, Stalling Planting

The storm interfered with navigational systems used in tractors and other farming equipment, leaving some farmers temporarily unable to plant their crops.

Listen to this article · 3:45 min Learn more

Share full article

May 13, 2024

A tractor at O'Connor Family Farms near Blooming Prairie, Minn. Tiffany Graham

SWO-related **economic losses could be "even more than a trillion dollars" just for the power grid,** without accurate forecasts. FEMA: **Space weather sits alongside pandemic** as the only two natural hazards with the potential for **nationwide and global impacts**.

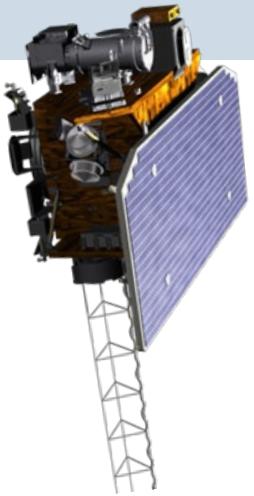
Source: Congressional Budget Office (CBO), 2020: Enhancing the Security of the North American Electric Grid & Federal Emergency Management Agency (FEMA), 2019: 2019 National Threat and Hazard Identification and Risk Assessment

SWFO Program Overview

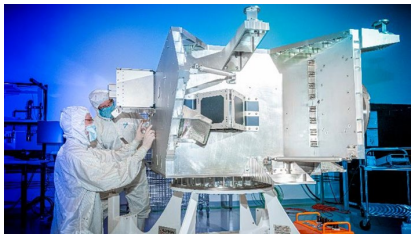
SWFO **sustains** NOAA's foundational set of space-based space weather observations and measurements to ensure continuity of critical data.

- **Development underway for:**
  - SWFO-L1 Observatory (Bus + Instruments)
  - Instruments (CCORs, MAG, SWiPS, STIS)
  - Ground Segment (Command & Control, SWFO Antenna Network, and Product Generation and Distribution)
- **Established agreements** with NASA, NRL, and European Space Agency (L1 & L5 cooperation)
- **Completed SWFO Program & Flight Project Critical Design Reviews** (May 2022)
- **On track for launches** in 2024 (CCOR-1 on GOES-U Mission) and 2025 (SWFO-L1 Mission)

CCOR-1 integration onto GOES-U
Image Credit: Lockheed Martin



SWFO-L1 Spacecraft
Image Credit: Ball Aerospace

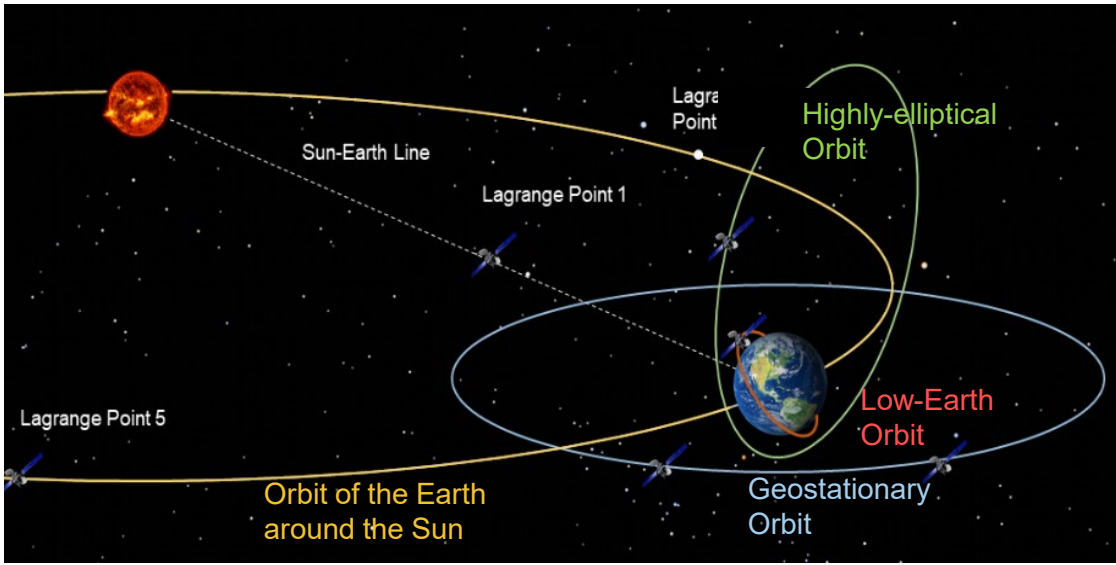


Spacecraft assembly
Image credit: Ball Aerospace

Program Overview

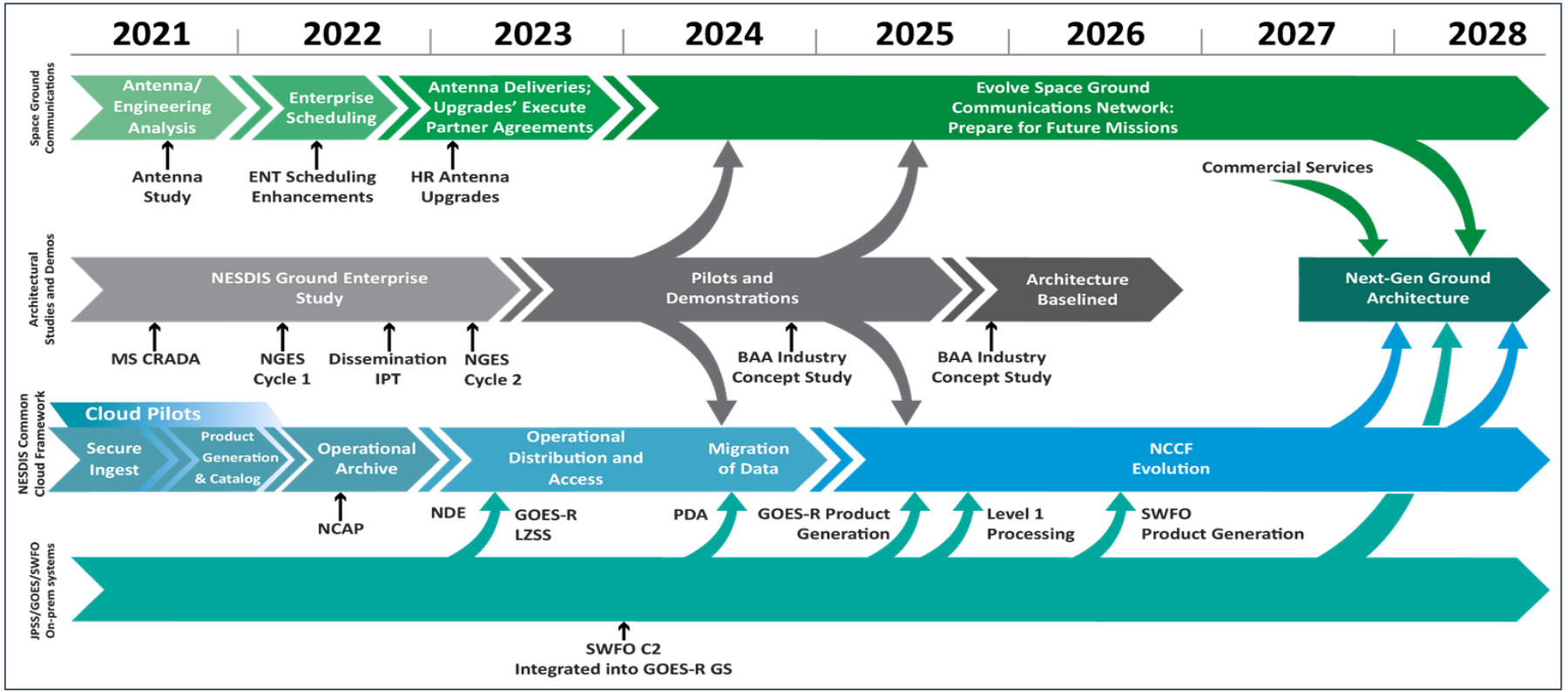
SW Next will **maintain and extend** space weather observations from a range of different observing points, selected to most efficiently provide comprehensive knowledge of the Sun and the near-Earth space environment.

- **Planning for continuity of observations**:
  - L1 and L5 orbits
  - Geostationary and Low-Earth orbit
  - Ground support networks
- **Formulation underway** for L1 Series Project, and L5 Project
- **Engaging stakeholders** via user outreach, partnerships, and market research



NESDIS Ground, Data, and Information Systems

NESDIS Ground Enterprise Strategy



Office of Common Services Mission

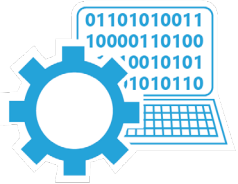
NESDIS Mission: Provide secure and timely access to global environmental data and information from satellites and other sources to promote and protect the nation's security, environment, economy, and quality of life.

OCS Mission: To provide enterprise technologies and solutions for satellite ground systems and data archives that deliver environmental intelligence to make informed decisions and enable innovative science.

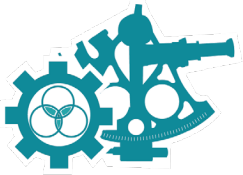
OCS Mission Areas

Emerging Technologies

Systems & Infrastructure



Software Engineering



Product Portfolio Management

National Centers for Environmental Information (NCEI)

NCEI provides environmental data, products, and services covering the depths of the ocean to the surface of the sun to drive resilience, prosperity, and equity for current and future generations.

- NCEI data helps businesses and organizations across sectors operate more efficiently, safely, environmentally, and economically.
- The NCEI archive and backup copy contains more than 60 petabytes of data.
- NCEI data and products help decision makers address specific challenges and use cases in a variety of societal sectors.
- Story maps transform NCEI data and products into a visual narrative by combining custom maps with storytelling.

NCEI has four national locations, as well as regional centers, field sites, and cooperative institutes throughout the country.

Asheville, North Carolina

Boulder, Colorado

John C. Stennis Space Center, Mississippi

Silver Spring, Maryland

NOAA NCEI, headquartered in Asheville, North Carolina, is still recovering from impacts of Hurricane Helene. NCEI has confirmed that all of its employees and staff are safe, and is continuing to support them through the storm recovery. NCEI's data holdings — including its paper and film records — are also safe.

Office of Satellite and Product Operations (OSPO)

24-Hour Operations for GEO, LEO, & Space Weather satellite systems

24-Hour Support for Severe Weather and Environmental Forecasting Near-Real-Time Products For the User

Functions:

- Orbit determination
- Spacecraft navigation
- Data acquisition
- Command and control of 19 satellites
- Mission control for satellite-assisted search and rescue (SARSAT)
- Satellite command and data acquisition stations in Alaska (Fairbanks and Utqiagvik), Virginia (Wallops Island) West Virginia (Fairmont) from Maryland (Suitland).

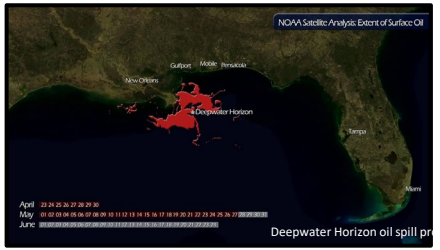
NOAA Satellite Operations Facility, MD

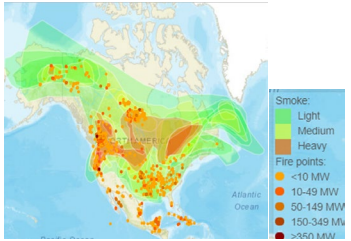
Operational Products:

- Atmospheric temperature and moisture profiles
- Winds
- Wildfire detection
- Gridded images of clouds and moisture
- Vegetation index
- Solar radiation
- Volcanic detection
- Sea surface temperature
- Snow and ice cover

Environmental Monitoring:

- Ozone data and products



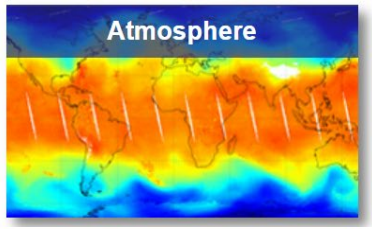


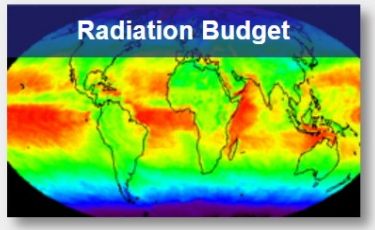
Near real time wildfire and smoke monitoring August 2021

Wildlife tracking using Argos Data Collection System

Center for Satellite Applications & Research (STAR)

- Operations-focused research, development, validation, and maintenance of products and applications based on end user needs
  - **Develops** the science to make raw satellite data useful
  - **Improves** data quality, products, and services
  - **Supports** development of next-generation NOAA satellites and missions
  - **Collaborates** with a wide range of domestic and international partners

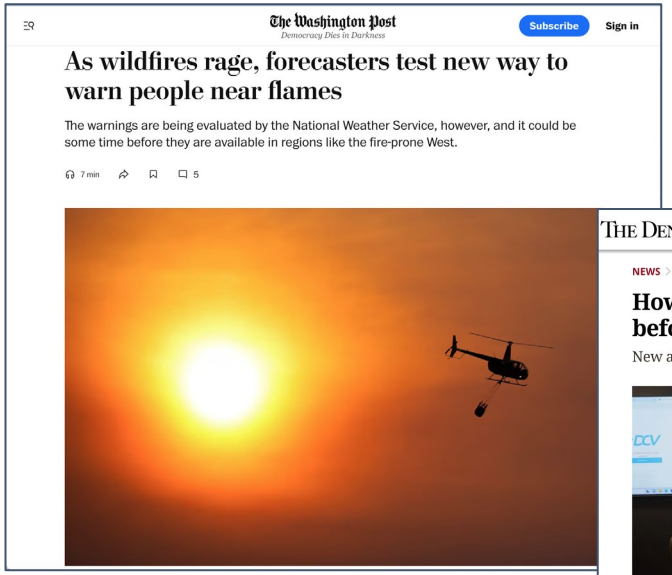




Range of products within STAR portfolio are essential to forecast severe weather, aid in ocean navigation, monitor vegetative health, detect harmful algal blooms and coral bleaching, and assess climate change.

Next Generation Fire System (NGFS)

NOAA tests fire warning service, powered by satellites and NESDIS Next Generation Fire System (NGFS)


The Washington Post
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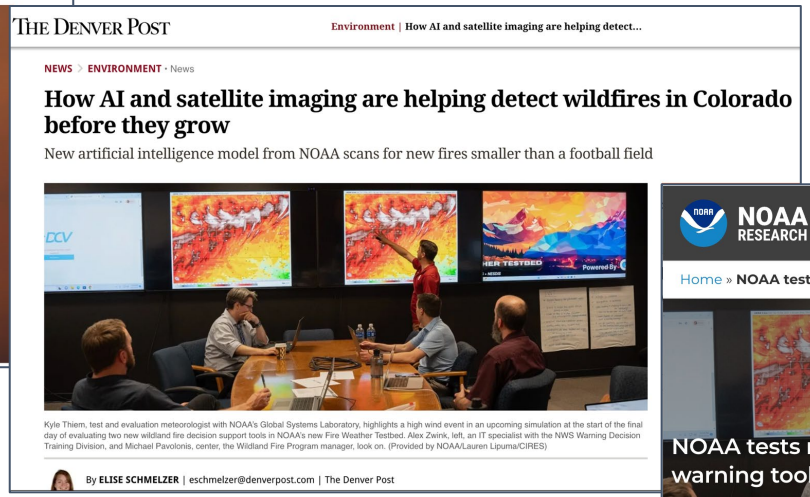
As wildfires rage, forecasters test new way to warn people near flames

The warnings are being evaluated by the National Weather Service, however, and it could be some time before they are available in regions like the fire-prone West.

7 min 5

[Washington Post]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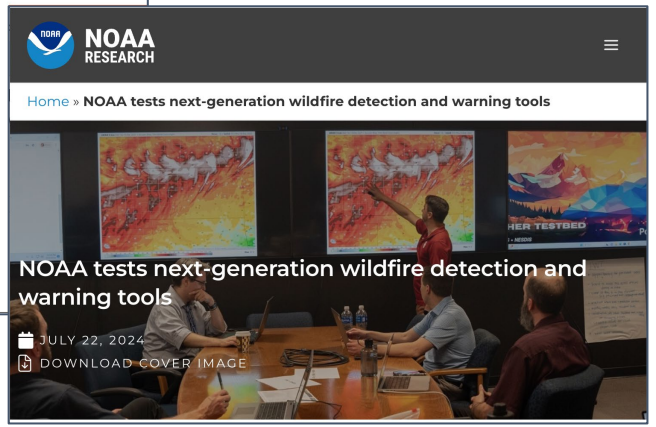
How AI and satellite imaging are helping detect wildfires in Colorado before they grow

New artificial intelligence model from NOAA scans for new fires smaller than a football field

Kyle Thiem, test and evaluation meteorologist with NOAA's Global Systems Laboratory, highlights a high wind event in an upcoming simulation at the start of the final day of evaluating two new wildland fire decision support tools in NOAA's new Fire Weather Testbed. Alex Zwink, left, an IT specialist with the NWS Warning Decision Training Division, and Michael Pavolonis, center, the Wildland Fire Program manager, look on. (Provided by NOAA/Lauren Lipuma/CIRES)

By ELISE SCHMELZER | eschmelzer@denverpost.com | The Denver Post

[Denver Post]


NOAA RESEARCH

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NOAA tests next-generation wildfire detection and warning tools

JULY 22, 2024

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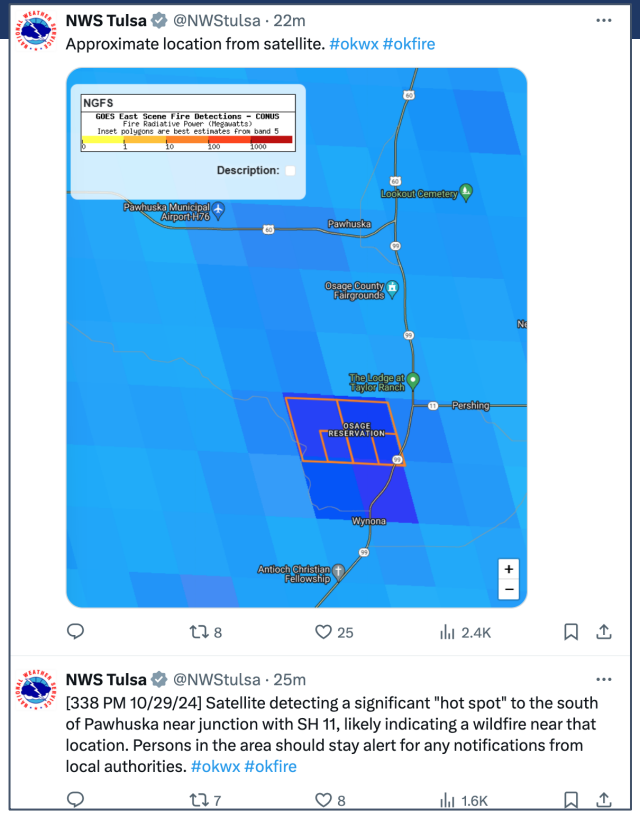
[NOAA Research]

NGFS in Action - to Public Messaging



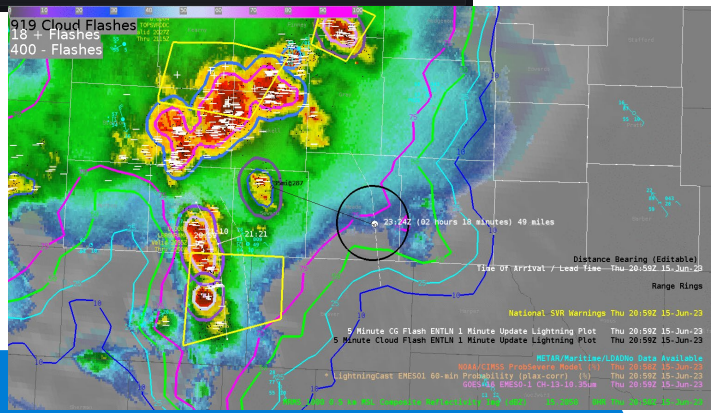
NOAA NGFS product used in public messaging

National Weather Service feedback regarding the Dinosaur fire near the NOAA/NIST campus (7/16/24): "the detection came about 10 minutes after a human saw the smoke, and called the NIST emergency operation team and Boulder Fire to coordinate response. That's exceptionally fast. I am amazed that the pixel within the pixel location of the first detection is SPOT on. The old detection tool we've used is typically a few km from the actual fire."

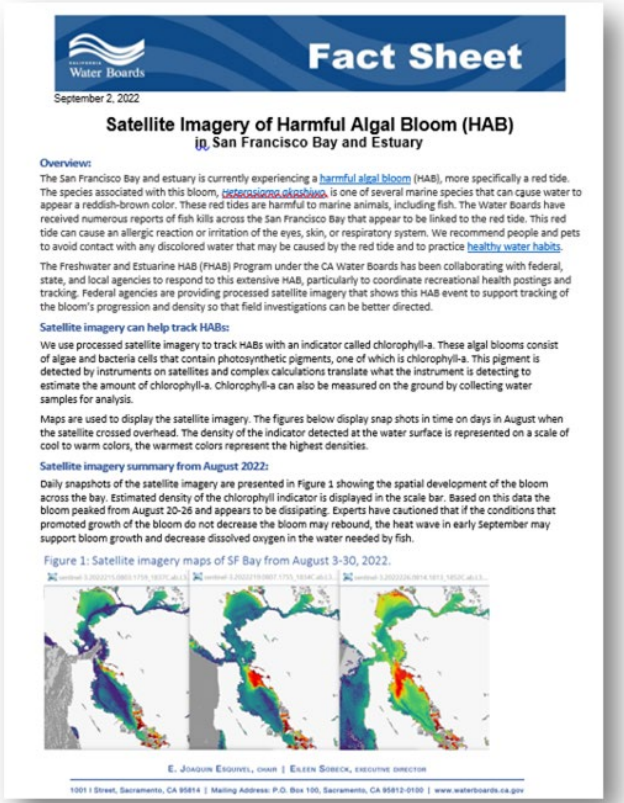
Land manager feedback regarding use in the Northern Rockies region (7/22/24): "The [NGFS] is having a strong track record in the Northern Rockies this year. A few weeks ago, we had the Horse Gulch fire detected at less than 10 acres and almost simultaneous with the smoke report. Last night the Butler Fire was only detected by NGFS and none of our other systems."

LightningCast

- Designed for Decision Support Services (DSS) events, such as a college football game **where a forecaster must warn about impending lightning threats**
- LightningCast is a machine learning model that forecasts the **probability of lightning at a location within the next hour**, using **GOES-R** ABI data only as input
- **Users can enter a custom location** using a google form, and the system will automatically generate a line plot like the one on the top right
- Built with users in the **Hazardous Weather Testbed**
- Developed by **John Cintineo (CIMSS) and Mike Pavolonis (NESDIS/STAR)**



HAB Forecast Example: San Francisco Bay



Water Boards

Fact Sheet

September 2, 2022

Satellite Imagery of Harmful Algal Bloom (HAB) in San Francisco Bay and Estuary

Overview:

The San Francisco Bay and estuary is currently experiencing a harmful algal bloom (HAB), more specifically a red tide. The species associated with this bloom, cochlodinium polykrikoides, is one of several marine species that can cause water to appear a reddish-brown color. These red tides are harmful to marine animals, including fish. The Water Boards have received numerous reports of fish kills across the San Francisco Bay that appear to be linked to the red tide. This red tide can cause an allergic reaction or irritation of the eyes, skin, or respiratory system. We recommend people and pets to avoid contact with any discolored water that may be caused by the red tide and to practice healthy water habits.

The Freshwater and Estuarine HAB (FHAB) Program under the CA Water Boards has been collaborating with federal, state, and local agencies to respond to this extensive HAB, particularly to coordinate recreational health postings and tracking. Federal agencies are providing processed satellite imagery that shows this HAB event to support tracking of the bloom's progression and density so that field investigations can be better directed.

Satellite imagery can help track HABs:

We use processed satellite imagery to track HABs with an indicator called chlorophyll-a. These algal blooms consist of algae and bacteria cells that contain photosynthetic pigments, one of which is chlorophyll-a. This pigment is detected by instruments on satellites and complex calculations translate what the instrument is detecting to estimate the amount of chlorophyll-a. Chlorophyll-a can also be measured on the ground by collecting water samples for analysis.

Maps are used to display the satellite imagery. The figures below display snap shots in time on days in August when the satellite crossed overhead. The density of the indicator detected at the water surface is represented on a scale of cool to warm colors, the warmest colors represent the highest densities.

Satellite imagery summary from August 2022:

Daily snapshots of the satellite imagery are presented in Figure 1 showing the spatial development of the bloom across the bay. Estimated density of the chlorophyll indicator is displayed in the scale bar. Based on this data the bloom peaked from August 20-26 and appears to be dissipating. Experts have cautioned that if the conditions that promoted growth of the bloom do not decrease the bloom may rebound, the heat wave in early September may support bloom growth and decrease dissolved oxygen in the water needed by fish.

Figure 1: Satellite imagery maps of SF Bay from August 3-30, 2022.

E. Joaquin Esquivel, chair | Eileen Sobeck, executive director

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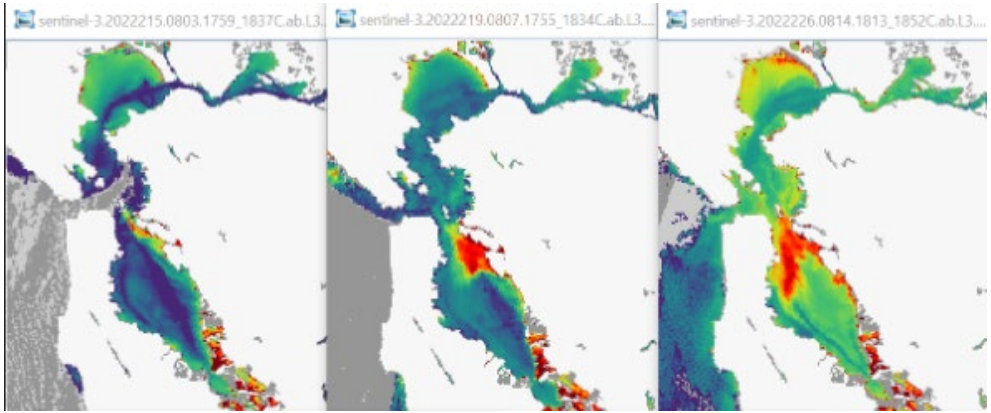
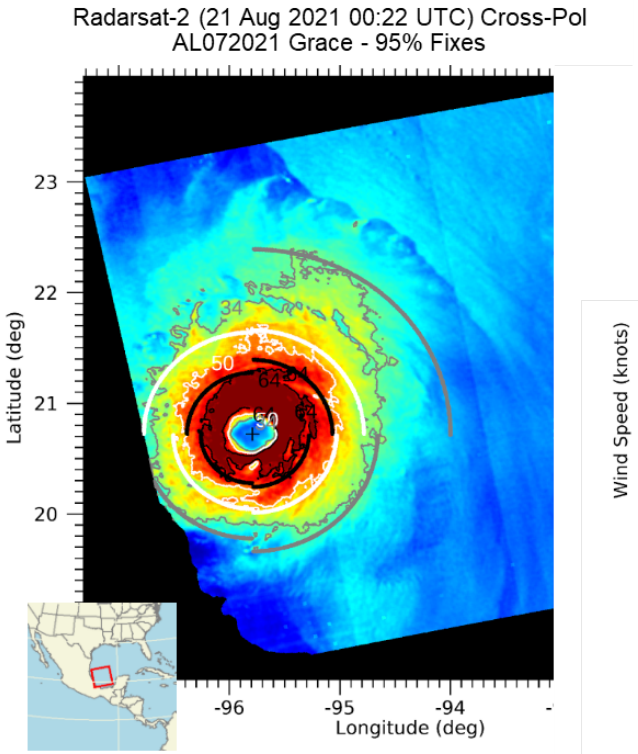


"Had we not had remote sensing imagery, we definitely would not have realized the bloom had expanded after our 8/17 sampling and probably would have missed a key moment in the blooms trajectory"

- Keith Bouma-Gregson, USGS California Water Science Center

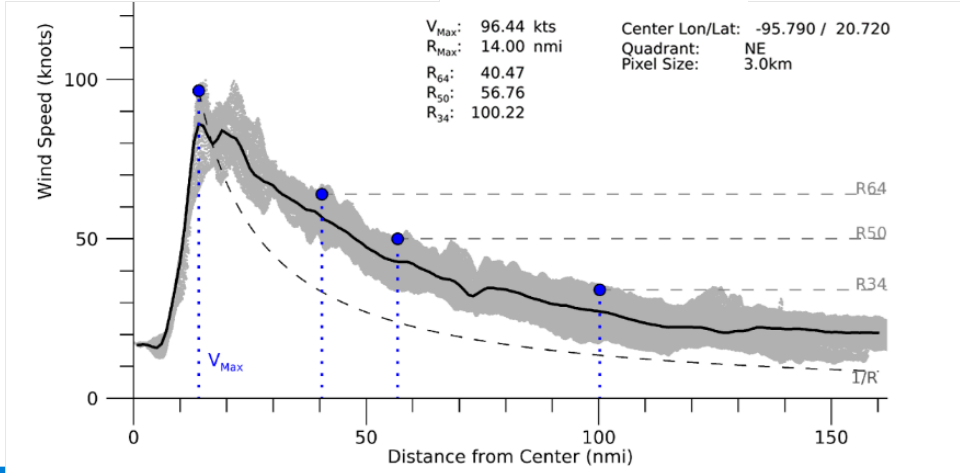
Enhanced Tropical Cyclone Info from SAR

SAR Derived TC Information Location / Profiles / Fixes



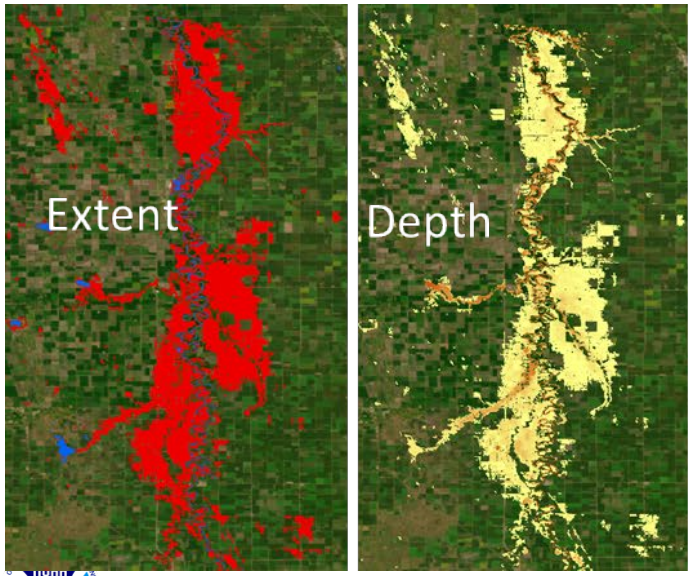
Key TC information from SAR

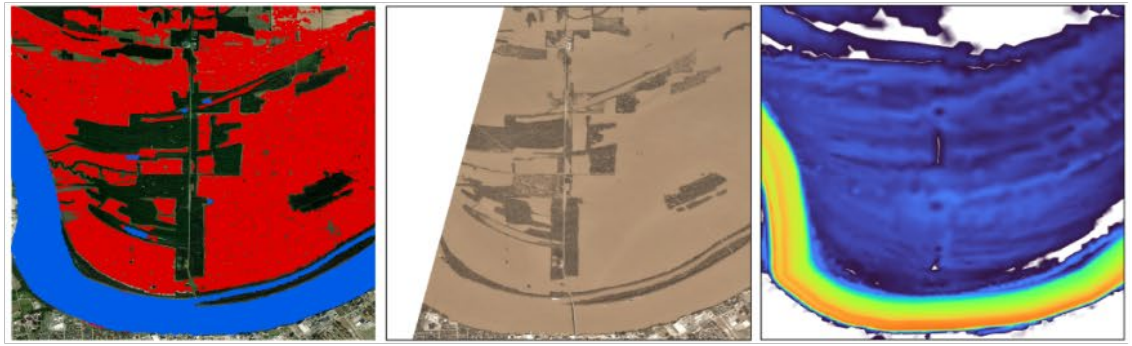
- Identifying the center of circulation (when covered).
- Maximum wind speed and Radius of max winds
- Radial wind profiles (per quadrant 3km sampling)
- 34, 50 and 64 knot quadrant fixes



Blending of Sources for Flood Inundation Mapping

- Providing Flood Mapping Applications
- Blending VIIRS, SAR, Hi-Res, and new models to provide extent and depth of flooding for users





RAPID SAR FIM | PlanetScope image | Hydraulic Modeling

Sean Helfrich, NESDIS STAR

Questions & Discussion