An Update of NOAA Satellite Missions for ITWG

ITSC-25, 12th May 2025

National Environmental Satellite, Data, and Information Service

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NOAA/NESDIS/LEO

Contributions from Satya Kalluri, Ken Yienger, Andy Heidinger, and Rich Ullman are gratefully acknowledged

Executive Summary

● NOAA-21 launched on November 10, 2022 is the primary satellite at 1330 LTAN – Operating Nominally. NOAA-20 launched on November 18, 2017 is the secondary satellite. Operating Nominally.

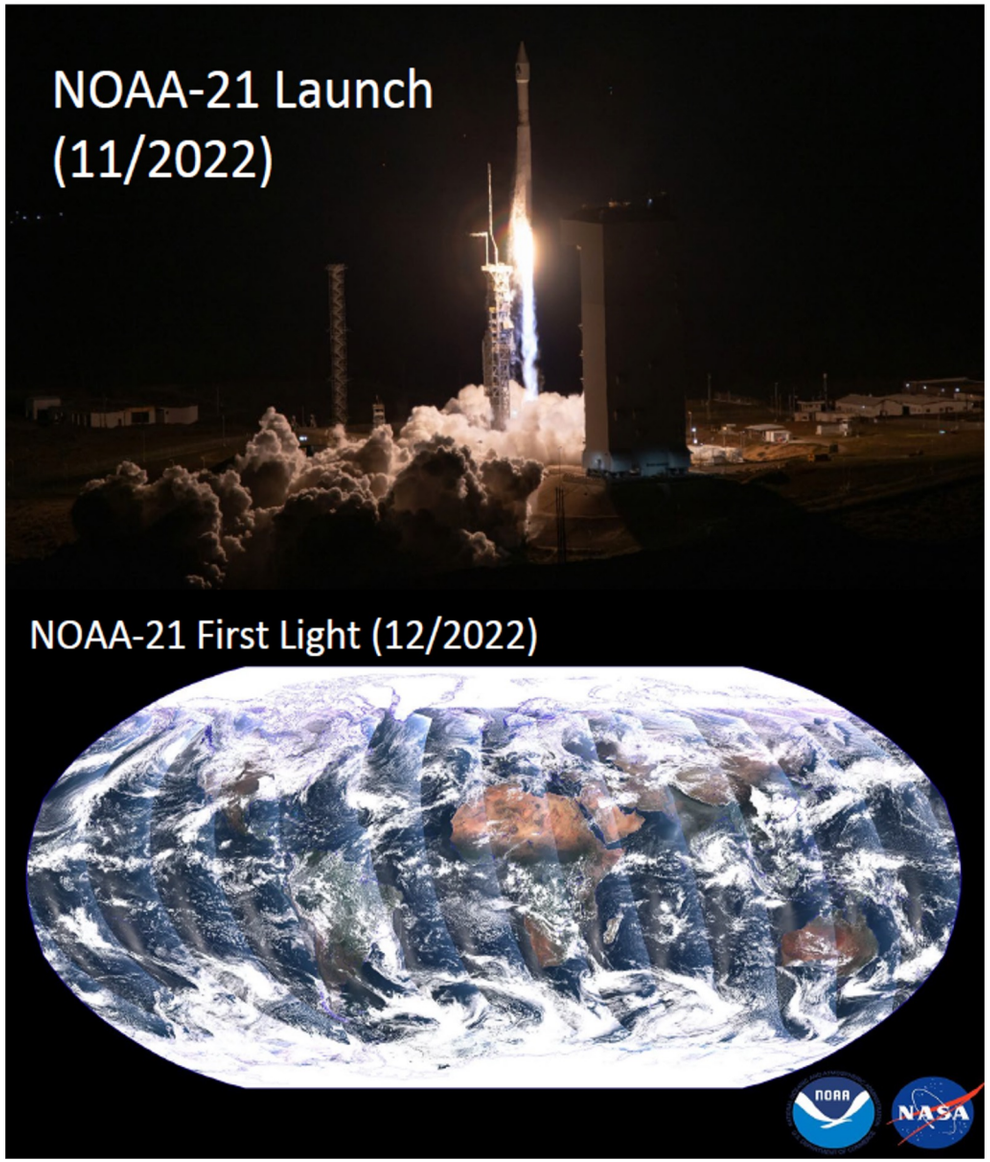
● SNPP launched in October 28, 2021 is a tertiary asset All SNPP users should have migrated to NOAA21 and NOAA20. SNPP is maintained on a best effort basis.

● GOES-19 is operational as GOES-East and all L1 and L2 products are ready for use. GOES-18 is GOES-West and and operating nominally. GOES-16 is now in storage.

● GOES-19 also carries a suite of space weather instruments, including NOAA's first operational compact coronagraph instrument (CCOR-1); and continues other space weather observations of the GOES-R series

LEO Program

- NOAA 21 launched on November 10, 2022, is the primary satellite at 1330 LTAN – *Operating Nominally.*
- NOAA 20 launched on November 18, 2017, is the secondary satellite. *Operating Nominally.*
- SNPP launched in October 28, 2021, is a tertiary asset, maintained on a best effort basis.
- Ozone from NOAA-21/OMPS is now finer resolution and improves volcanic ash monitoring.
- Near Earth Orbit Network (NEON) Program's Sounder for Microwave-Based Applications (SMBA) Implementation Phase Draft RFP released in April 2025.
- QuickSounder (pathfinder for NEON) to launch in May 2026. JPSS-4 to launch in 2027.
- NOAA POES starts decommissioning in June 2025



Low Earth Orbit Observations

MULTIPURPOSE IMAGERY

- Hurricane Location and Track
- Fires
- Air Quality
- Droughts and Floods
- Cloud Cover
- Land and Sea Ice
- Snow Cover
- Land Cover Changes
- Harmful Algal Blooms
- Wind Speed in High Latitudes
- Night Time Imagery
- Water Quality
- Fish Stock Assessments
- Oil Spills

SAR

- Floods
- Oil Slicks
- Ocean Surface Winds
- Sea Ice

UV MEASUREMENTS

- Ozone Hole Monitoring
- Air Quality

SCATTEROMETRY

- Ocean Surface Winds
- Marine Weather
- Tropical Cyclone Intensity

SOUNDINGS

- Numerical Weather Prediction
- Precipitaion
- Routine Weather
- Tropical Cyclone Intensity and Track Forecasts
- Aviation Weather
- Atmospheric Rivers

MICROWAVE IMAGERY

- Precipitation
- Land and Sea Ice
- Ocean Surface Winds
- Tropical Cyclone Location, Track and Intensity
- Marine Weather
- Soil Moisture
- Ocean Salinity

ALTIMETRY

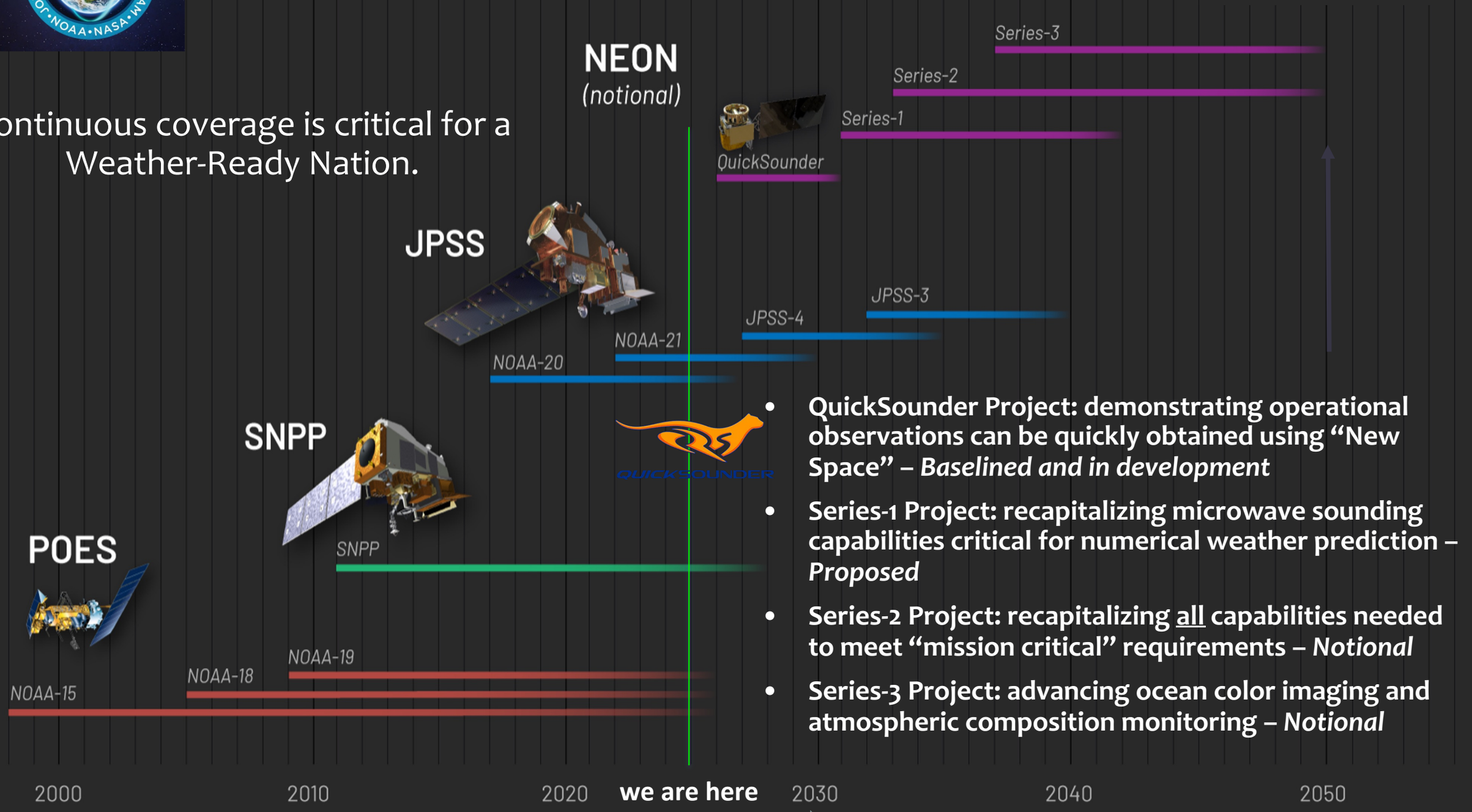
- Sea Surface Height
- Marine Weather
- Coastal Flooding

LIDAR

- Wind Speed
- Aerosols for Air Quality
- Cloud Properties for Precipitation and Climate

NOAA LEO Satellite Programs

Continuous coverage is critical for a Weather-Ready Nation.



- QuickSounder Project: demonstrating operational observations can be quickly obtained using "New Space" – *Baselined and in development*
- Series-1 Project: recapitalizing microwave sounding capabilities critical for numerical weather prediction – *Proposed*
- Series-2 Project: recapitalizing <u>all</u> capabilities needed to meet "mission critical" requirements – *Notional*
- Series-3 Project: advancing ocean color imaging and atmospheric composition monitoring – *Notional*

Present Missions → **Future Missions**

QuickSounder render credit: SwRI/Richard Menchaca

LEO NEON Program Overview

- Evolve the LEO architecture to exploit and deploy new observational capabilities
  - **Continuity** of the product baseline and finding pathways for new observational needs
  - **Partnerships, commercial, and industry**-developed approaches
  - A **disaggregated architecture** exploiting commercial “New Space”; accepting greater risk at the element level while maintaining high operational availability

NEON is a Disaggregated Architecture

	JPSS	NEON
BUS:	Large Spacecraft Bus	SmallSat Spacecraft Bus
INSTRUMENTS:	4-5 Instruments	Single Instrument
LAUNCH CADENCE:	5 Years	3–4 Years

Architecture lends itself to flexibility, agility, resiliency

- Initial focus on
  - Exploiting **commercial** investment, expertise, and innovation
  - Gaining experience with obtaining commercial **flight-related** elements (e.g., spacecraft, mission operations, launch vehicles)
  - Developing the next generation **microwave sounders** critical to Numerical Weather Prediction
  - Maintaining continuity of **key partnerships supported by the JPSS** Program

Leveraging Savings from Commercial Space without Sacrificing Next Generation Performance

LEO NEON Missions: Quicksounder and Series-1

MIRS integrates QuickSounder ATMS EDU data (Updates from NOAA STAR MIRS Team)

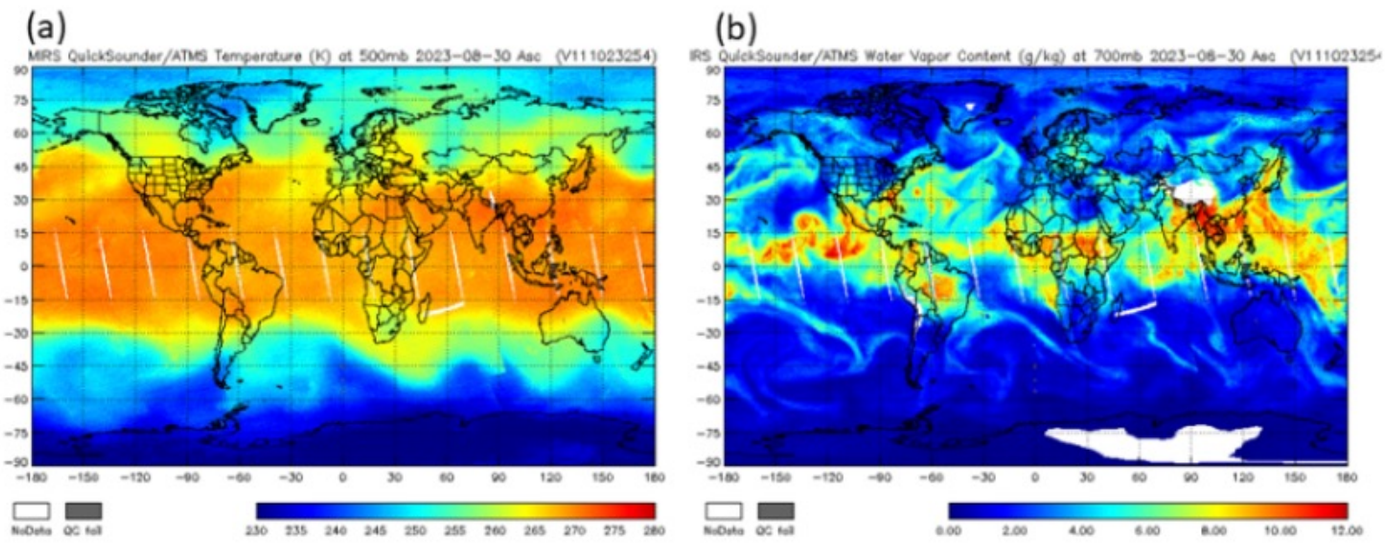


Figure. MiRS results using ATMS EDU proxy data on August 30, 2023. (a) MiRS retrieved temperature (K) at 500 hPa and (b) MiRS retrieved water vapor (g/kg) at 700 hPa.

The MiRS team successfully implemented QuickSounder ATMS Engineering Development Unit (EDU) in MiRS and the package has been shared with the ASSISTT team. The ATMS EDU is a prototype ATMS instrument developed while preparing the launch of the initial ATMS instrument on board the SNPP satellite in 2011. ATMS EDU proxy data also have been generated for 30 August 2023 assuming that ATMS EDU measurements have the same structure as the current JPSS ATMS measurements. Since ATMS EDU was designed and built using older technology, in order to maximize the benefit of the anticipated QuickSounder mission, extensive work is necessary to properly anticipate the instrument characteristics and adapt science algorithms so that the resulting data products are as accurate as possible. The efforts will include MiRS software adjustments, algorithm assessment and ATMS EDU instrument characterization and noise mitigation with real measurements. The current tentative launch date is planned for May 2026. After launch, the MiRS retrieval products from QuickSounder mission will be evaluated to determine performance relative to current environmental data product standards for mission.

Global Refresh of Microwave Sounding

<6-hour global refresh requirement achieved with satellites in 3 polar sun-synchronous orbital planes

2-hour global refresh desire can be achieved with satellites in additional orbits

Operational orbits are usually referred to by their “sunlight node”:

- ❑ 13:30 LTAN – Afternoon
- ❑ 17:30 LTAN – Early-morning
- ❑ 21:30 LTAN – Mid-morning

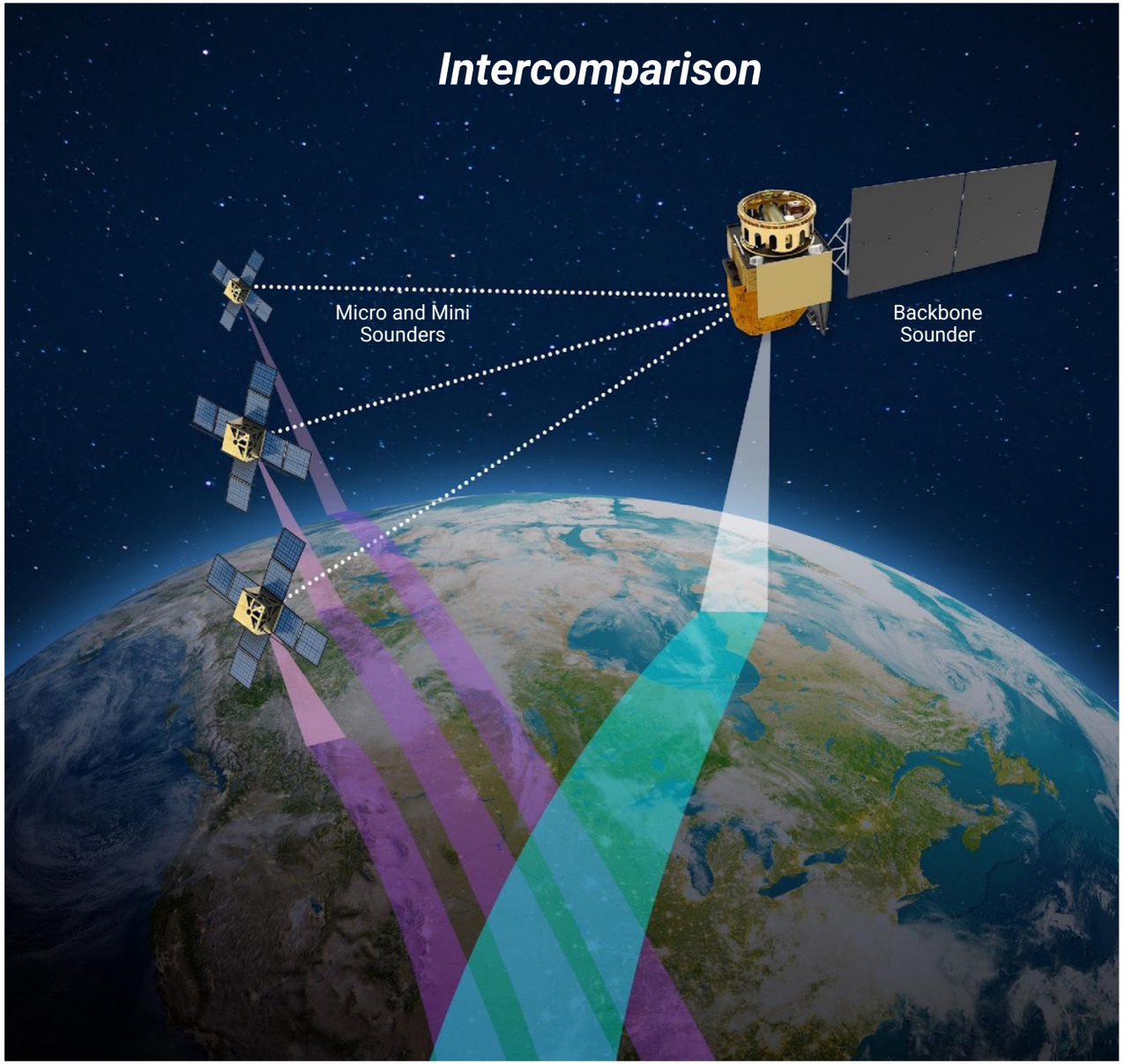
LTAN: Local Time Ascending Node

Calibration, Intercalibration, and Intercomparison

Intercalibration

- Will develop a National Institute of Standards and Technology (NIST) traceable calibration target
- SMBA will be the first microwave sounder to use intercalibration
- Intercalibration made available to industry and partners

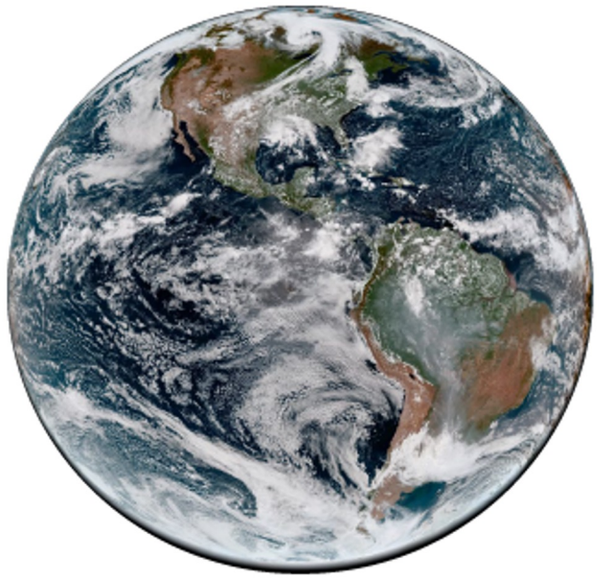
Black Body traceable standard



Calibration, Intercalibration and Intercomparison all build trust in the data

GEO Program

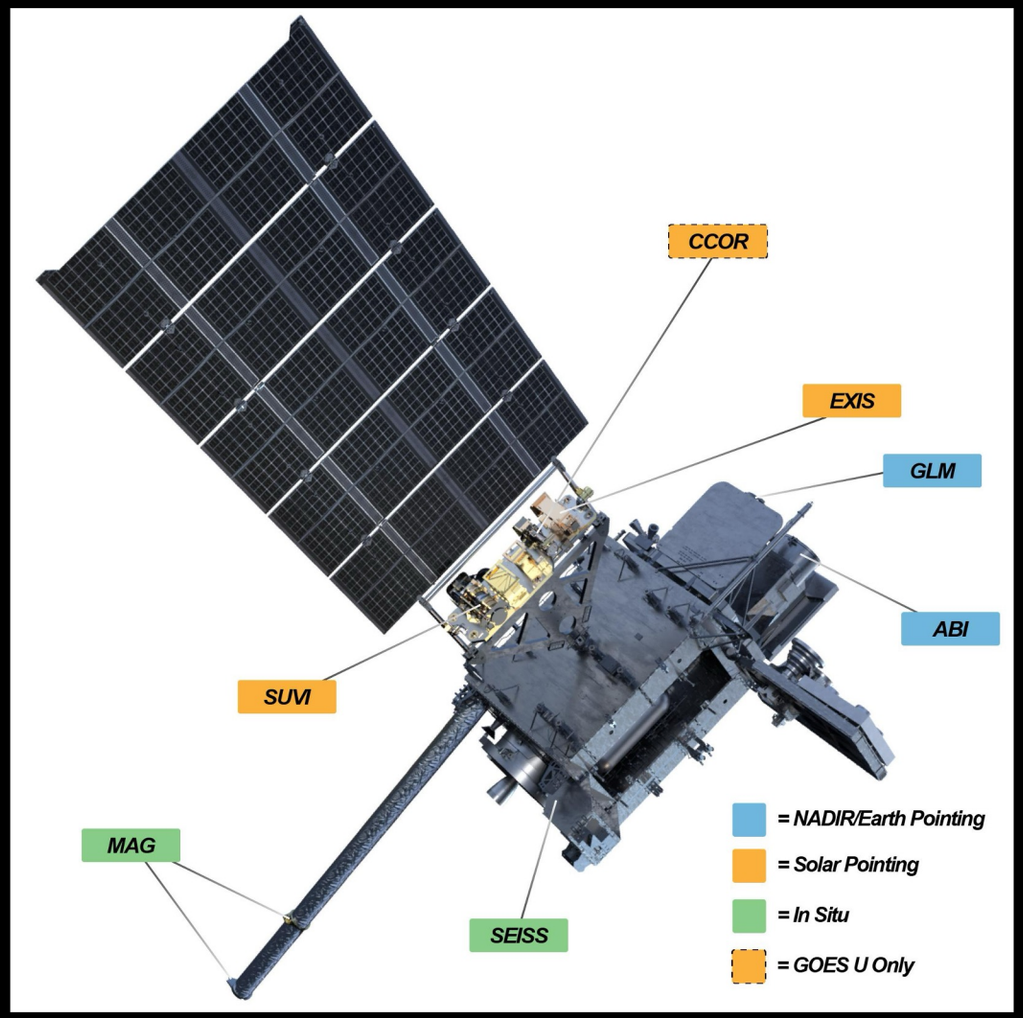
- GOES-19 Launched June 2024 and all GOES-19 L1 and L2 products have been declared provisional maturity and are ready for operational use.
- GOES-19 Declared operational GOES-East on 7 April 2025
- GEO L2 production will transition to NCCF (Cloud) in late Fy26.
- GOES-16 L1b has been reprocessed.
- GeoXO algorithm developers are using MTG/FCI to explore the benefits of 0.91µm and finer spatial resolution IR channels.



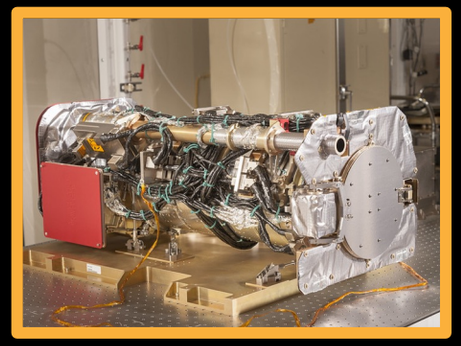
GOES-19 First Light
August 30, 2024

Please go to Andy Heidinger's talk for more detailed updates on GEO

GOES-19 spacecraft hosts NOAA's first operational coronagraph
SWFO-L1 mission scheduled to launch in 2025



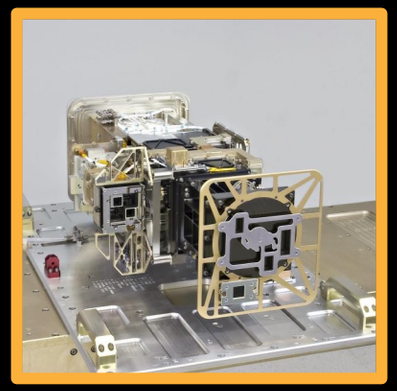
Rendering of the GOES-19 satellite



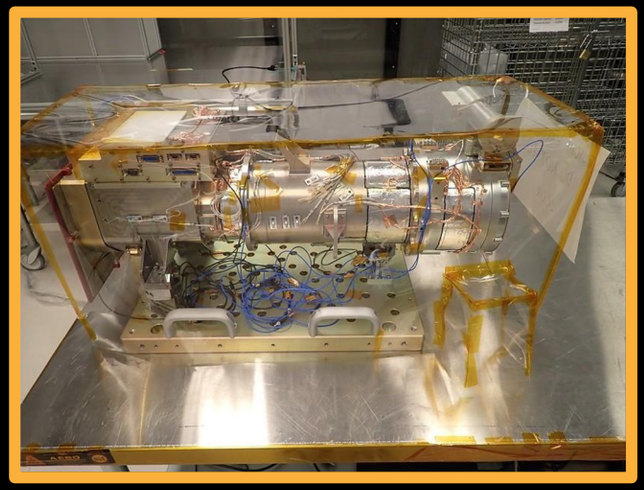
Solar Ultraviolet Imager (SUVI)

Magnetometer (MAG) Sensor

Space Environment In-Situ Suite (SEISS)



Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)

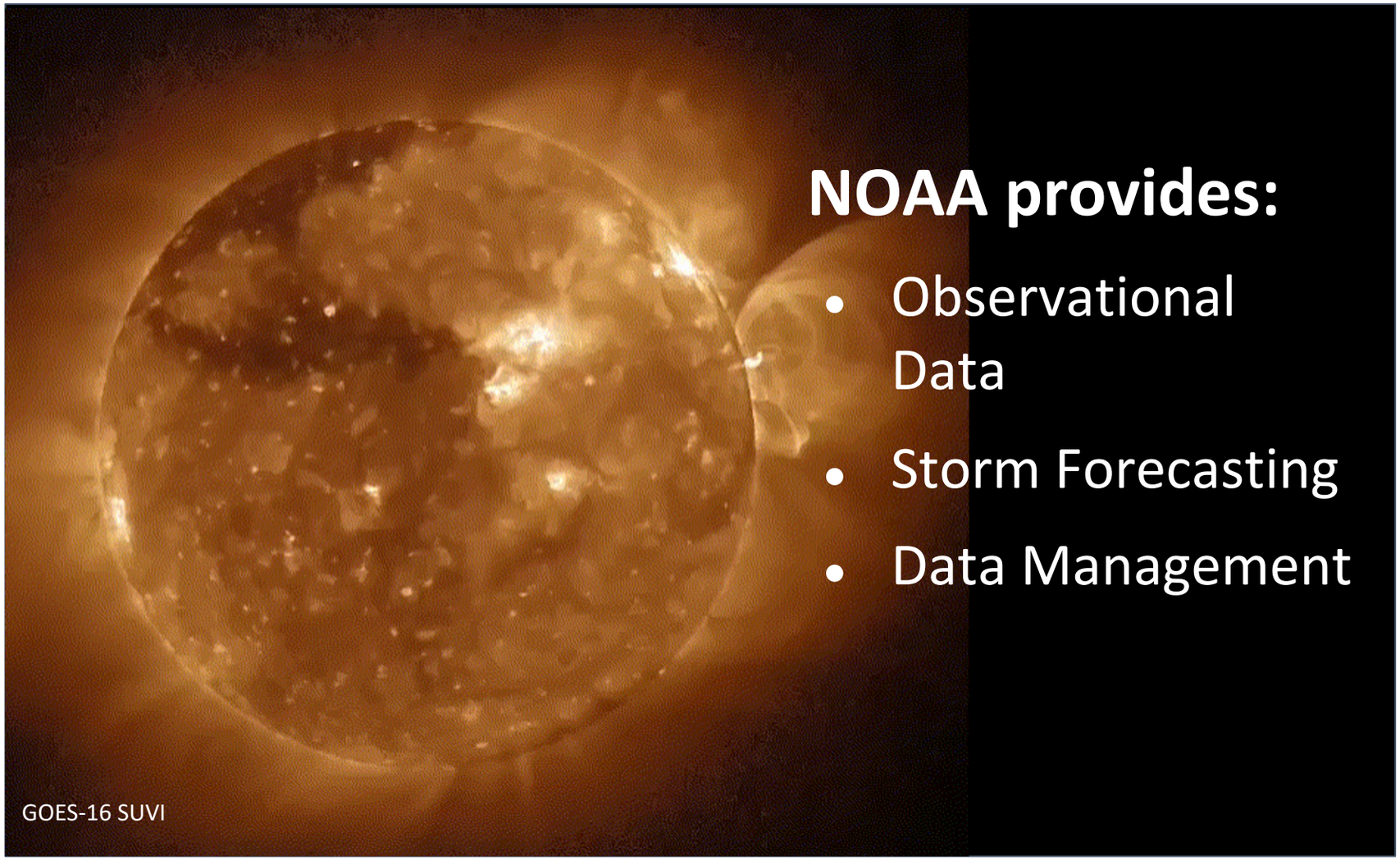


Compact Coronagraph (CCOR)

Space Weather: NOAA provides decision makers and users with actionable information and tools

- Planning for continuity of observations from:
  - L1 (SOL) and L5 (Vigil) orbits
  - Geostationary orbit (SWX GEO)
  - Low Earth orbit
  - Space Weather ground support networks
- Pre-formulation underway
- L5 Project (ESA Vigil CCOR-3) preparing for System Requirement Review
- SOL Flight segment: Spacecraft and Instruments awarded
- Development of Ground Services underway
- SWX GEO Series requirement and concept definition work initiated
- Engaging stakeholders through user outreach, partnerships, and market research

<- Space Weather Next (SW Next) program



Summary and Moving Forward

- **NOAA Operational Missions:**
  - **NOAA-21 is the NOAA Primary LEO Satellite:** NOAA-21 Products are running in operation supporting environment and forecasting applications, along with NOAA-20 (secondary) and SNPP (Tertiary)
  - **NOAA's GOES-19** satellite now operational, providing critical new data to forecasters
- **Readiness for Future Missions:**
  - Plans for the data products of the future LEO/GEO/SWO missions and partnership missions
  - NEON (KDP-1 passed; Series-2 hyperspectral IR and weather imager instrument requirement studies begun), GEOXO, SWFO in formulation
- **Key Next Steps:**
  - Further accelerate the cal/val process and uses of new observations; utilize the AI/ML and cloud computing services
  - Transitioning science dev. to NESDIS Common Cloud Framework (NCCF); and make data available on the NOAA Open Data Dissemination (NODD)
  - Work with user communities, partnerships, commercial, industry, and key stakeholders, and develop the requirements and plans for the next generation satellite measurements

THANK YOU

Questions can be directed to:

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Back Up

Acronyms

- AMSU – Advanced Microwave Sounding Unit
- ATMS – Advanced Technology Microwave Sounder
- AWS – Arctic Weather Satellites
- BAA – Broad Area Announcement
- CRADA – Cooperative Research And Development Agreement
- dRFP – Draft Request for Proposal
- EoY – End of Year
- EUMETSAT - European Organisation for the Exploitation of Meteorological Satellites
- FM – Flight Model
- GEMS – Global Environmental Monitoring System
- GPSRO – Global Positioning System Radio Occultation
- GSFC – Goddard Space Flight Center
- HyMS – Hyperspectral Microwave Sounder
- IOD – In Orbit Demonstrator
- IR - InfraRed
- JPSS – Joint Polar Satellite System
- JV – Joint Venture
- LEMUR – Low Earth Multi-Use Receiver
- LEO – Low Earth Orbit
- LTAN – Local Time of the Ascending Node
- METOP – Meteorological Operational satellite
- METOP-SG – Meteorological Operational satellite - Second Generation
- MHS – Microwave Humidity Sounder
- MIT-LL – Massachusetts Institute of Technology - Lincoln Laboratory
- MS – Microwave Sounder
- MS – Milestone
- MW – Microwave
- MWR – Microwave Radiometer
- MWS – Microwave Sounder
- NEON – Near Earth Orbit Network
- NG – Northrop Grumman
- NIR – Near Infrared
- NIST – National Institute of Standards and Technology
- NMOC – Naval Meteorology and Oceanography Command
- NS1 – NEON Series-1
- NS2 – NEON Series-2
- NWP – Numerical Weather Prediction
- OMS – Orbital Micro Systems
- PFAL – Pre-Formulation Authorization Letter
- PMW – Passive Microwave
- POES – Polar Operational Environmental Satellites
- PSM – Procurement Strategy Meeting
- RAL – Rutherford Appleton Laboratory
- RFI – Radio Frequency Interference
- RFI – Request for Information
- RFP – Request for Proposal
- SMAP – Soil Moisture Active Passive
- SMBA – Sounder for Microwave-Based Applications
- TBD – To Be Determined
- TPW – Total Precipitable Water
- TROPICS – Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats
- UV – Ultra-Violet
- VIIRS – Visible Infrared Imaging Radiometer Suite
- VIS – Visible light