

Enhancing Space Weather Observations: NESDIS's Approach to User Needs and the Decadal Survey

> Richard Ullman Director (Acting), Office of Space Weather Observations, NOAA/NESDIS

NOAA • NASA Space Weather Observations

NOAA's Space Weather Responsibilities

- provide operational space weather monitoring, forecasting, and long-term data management for civil applications
- maintain ground-based and space-based assets for space weather forecasting, prediction, and warnings
- provide research to support operational responsibilities
- develop **requirements** for space weather forecasting technologies and science





Space Weather is a strategic priority for NOAA/NESDIS

The NESDIS Vision:

A truly integrated digital understanding of our earth environment that can evolve quickly to meet changing user expectations by leveraging NOAA's own capabilities and partnerships.

Space Weather Strategic Objective:

Advance Space Weather observational leadership in LEO, GEO, and extended orbits consistent with the agency's responsibilities within the National Space Weather Strategy and Action Plan.



NOAA's Office of Space Weather Observations (SWO) develops, deploys, and sustains NOAA operational satellite systems that study space weather and safeguard society.



Office of Space Weather Observations Safeguarding Society with Actionable Space Weather Information



Space Weather Follow On (SWFO) Program

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

Successful launch for CCOR-1 on GOES-19 in June 2024

SWFO-L1 mission scheduled to launch NET Sept. 2025



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





Spacecraft assembly Image credit: BAE



SWAG User Survey Recommendation 7.3.1

Ensure the continuity of key long-term, historical space-based sensors.

Space Weather Next Program

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

- Project formulation
 - Space weather Observations at Lagrange 1 (SOL)
 - SRR completed Oct. 2024 and KDP-B completed Dec. 2024
 - Contracts awarded for spacecraft and all instruments
 - L5 Project preparing for System Requirement Review
- Pre-formulation underway
 - GEO project preparing for instrument studies and observatory RFI





SWAG User Survey Recommendation 7.3.1

Ensure the continuity of key long-term space-based sensors. **Decadal Survey Recommendation 5-1** *Manage all assets as part of an integrated HelioSystems Laboratory.*

NESDIS Innovation Projects

SWO is supporting a study to develop and test a framework and data processing software for thermosphere neutral density from SpaceX Starlink satellite orbit ephemerides and other relevant information.

Preliminary evaluations of the neutral density data with the High Accuracy Satellite Drag Model (HASDM) model show promising results.



Decadal Survey Recommendation 3-4

Take advantage of new data streams for operational services. SWAG User Survey Recommendation 5.1.2



Develop new observations and paths for acquiring neutral density information from satellite constellations.

A Data-Centric Vision for NESDIS

NESDIS is developing the NESDIS Common Cloud Framework (NCCF) to consolidate operational workloads, enhance data discovery and enable innovative science.

NCEI is developing a cloud-based portal for NOAA's space weather satellite data, the Space Weather Portal (SPOT).





Support effective data sharing and utilization. **SWAG User Survey Recommendation 5.2.1** Maintain and expand archives of space weather information and data.



One-NOAA Space Weather Strategy

Fully mature NOAA's space weather value chain and advance predictive services by integrating Line Office efforts to establish robust space weather research and expedite its transition to operational readiness





Decadal Survey Recommendation 3-4

NOAA should establish a space weather research program.





Thank you!

NOAA • NASA Space Weather Observations

One-NOAA SWx effort working towards seamless collaboration and integration across NOAA

One-NOAA SWx Strategy Establishes the Way to A Space Weather-Ready Nation

- Aligning priorities and connecting:
 - NESDIS Satellite and Data focus
 - NWS Forecast and Operations focus
 - OAR (potential) Research and Modeling focus



SWO is pursuing a variety of data sharing and instrument hosting opportunities



☆ : Instrument Hosting Examples



Introducing Space weather Observations at L1 (SOL)

- The Space Weather Next L1 mission formerly referred to as L1 Series is now **Space weather Observations at L1 (SOL)**
- SOL observational requirements provide continuity with SWFO-L1
 - SOL-A includes ESA-contributed X-ray Flux Monitor plus an instrument of opportunity
 - SOL-B includes an X-ray Irradiance Sensor (XRIS) plus an instrument of opportunity
- SOL consists of two independently launched spacecraft on dedicated launch vehicles
 - Targeting SOL-A launch in 2029
 - Targeting SOL-B launch in 2032
- As with other NOAA satellites, once in orbit the satellite is renamed with a number that continues the pre-existing series.
 - SWFO-L1 will be renamed SOL-1 once in final orbit
 - SOL-A will be renamed SOL-2 once in final orbit
 - SOL-B will be renamed SOL-3 once in final orbit



Instrument	Status
Coronagraph	Contract awarded to SwRI
Solar Wind Plasma Sensor	Contract awarded to UNH
Suprathermal Ion Sensor	Contract awarded to APL
Magnetometer	Contract awarded to SwRI
X-ray Flux Monitor	ESA-contributed, flown on SOL-A only
X-ray Irradiance	Solicitation to be developed for SOL-B



NOAA is providing a Compact Coronagraph (CCOR-3) to ESA'S Vigil Mission to L5



Magnetography: PM

EUV Imaging: JEDI

Solar Wind: PLA

IMF: MAG

Heliospheric Imaging: HI







- Continuous observations of Sun and heliosphere between Earth and the Sun
- Data availability in near real-time => \circ operational applications
- Complementary to Sun-Earth line measurements
- Launch: 2031

SW Next GEO is in Pre-Formulation to provide continuity for critical measurements and transition new capabilities to operations

Pre-formulation activities:

- Instrument studies to assess technology readiness
- Upcoming spacecraft RFI
- Analysis of alternatives to assess requirements and develop mission concept

In situ energetic particles and magnetic fields for characterizing radiation environment



Solar X-ray Irradiance for flare detection



Solar EUV Imagery and Irradiance for 94Amonitoring solar activity and driving models

Capability enhancements under consideration



Office of Space Weather Observations Safeguarding Society with Actionable Space Weather Information

Space Weather Follow On Program



GOES-16 SUVI



CCOR-1 integration onto GOES-U



CCOR-2 on SWFO-L1 Together with: Solar Wind Plasma Ion Sensor Magnetometer



Reaching L1 riding with NASA's IMAP mission

Space Weather Next Program

- Planning for continuity and enhanced capability with observations from:
 - L1 extended continuity
 - L5 Orbits ESA Partner
 - Geostationary Orbit TBD
 - Low Earth Orbit TBD
- Development of Space Weather Ground Support Networks