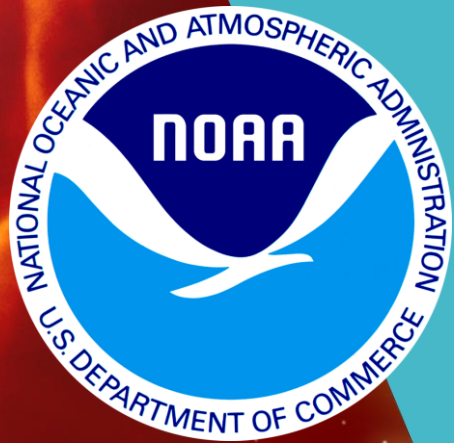


2022 CEDAR Workshop, Austin, TX

# NOAA's Space Weather Observations Program

**Irfan Azeem**

**Research to Operations and Planning Division  
Office of Project Planning and Analysis**



National Environmental Satellite,  
Data, and Information  
Service (NESDIS)

# Outline

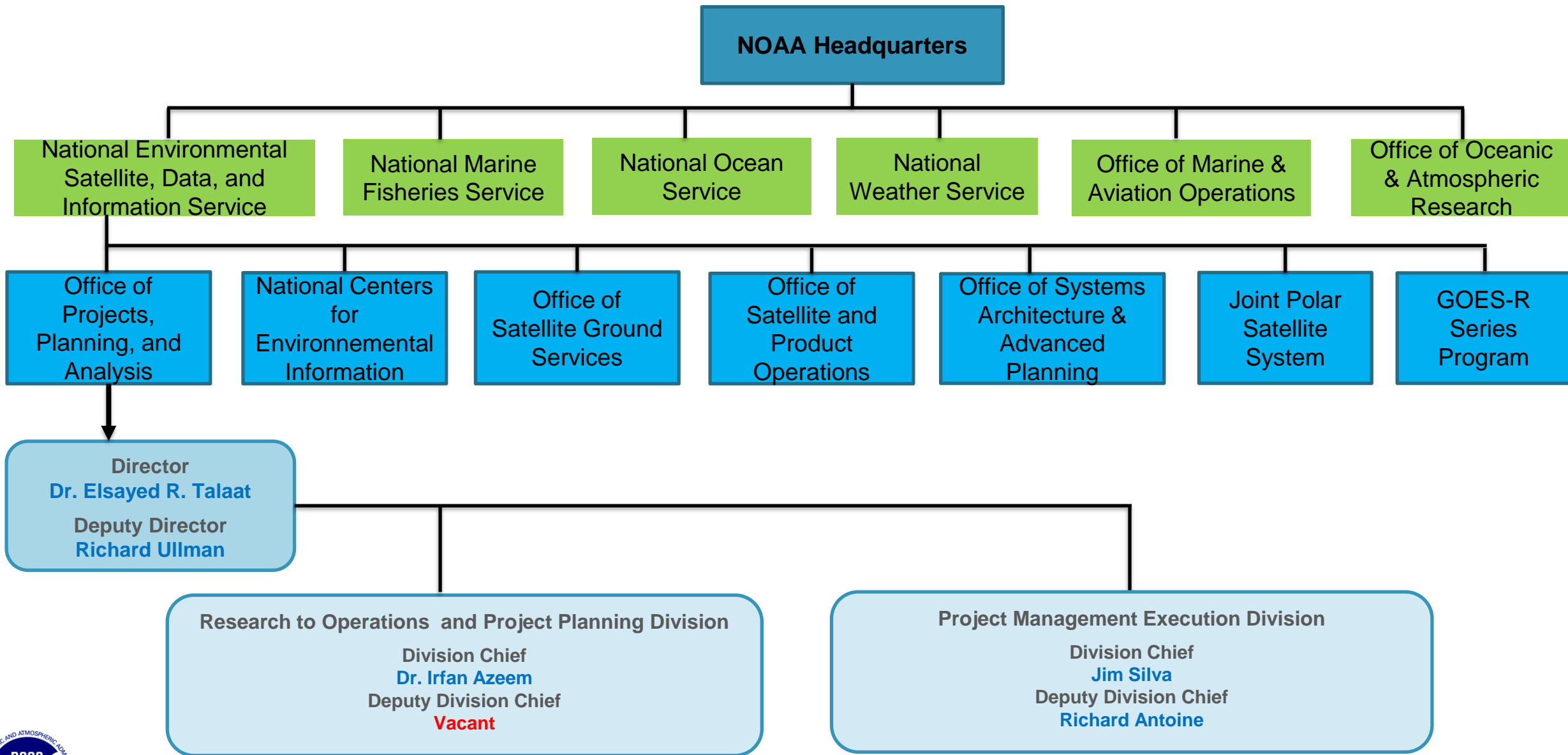
- **Introduction**
- **NOAA's Organizational Structure**
- **NESDIS' Space Weather Planning**
- **Current Space Weather Activities**
- **FY23 President's Budget Request**
- **Space Weather Observations Program**
- **Future State**
- **Summary**



# Introduction

- NOAA/NESDIS mission is to provide secure and timely access to global environmental data and information from satellites and other sources.
- NESDIS' environmental monitoring capabilities include space weather measurements.
- NESDIS is embarking on creating a new space weather program that will provide continuity of space weather monitoring.
  - Support existing, and improved, space weather forecasting and warnings capabilities and the Department's primary mission essential functions
  - Support national priorities for space weather forecasting
  - Continue commitment to the CGMS Baseline
  - Support World Meteorological Organization's strategic vision







# NESDIS's Vision for Space-Based Environmental Monitoring

Space Weather is a strategic priority for NOAA/NESDIS

## NESDIS's 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.*

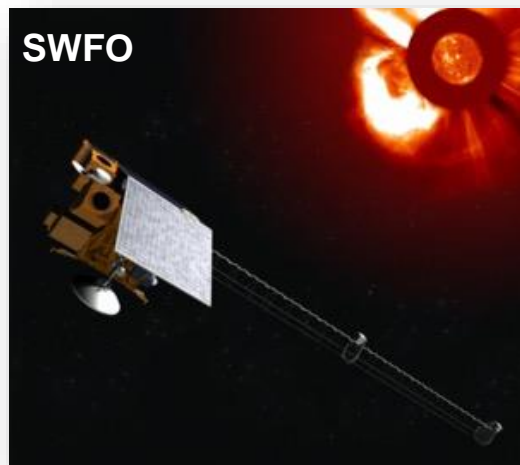
## Space Weather Strategic Objective:

*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.*



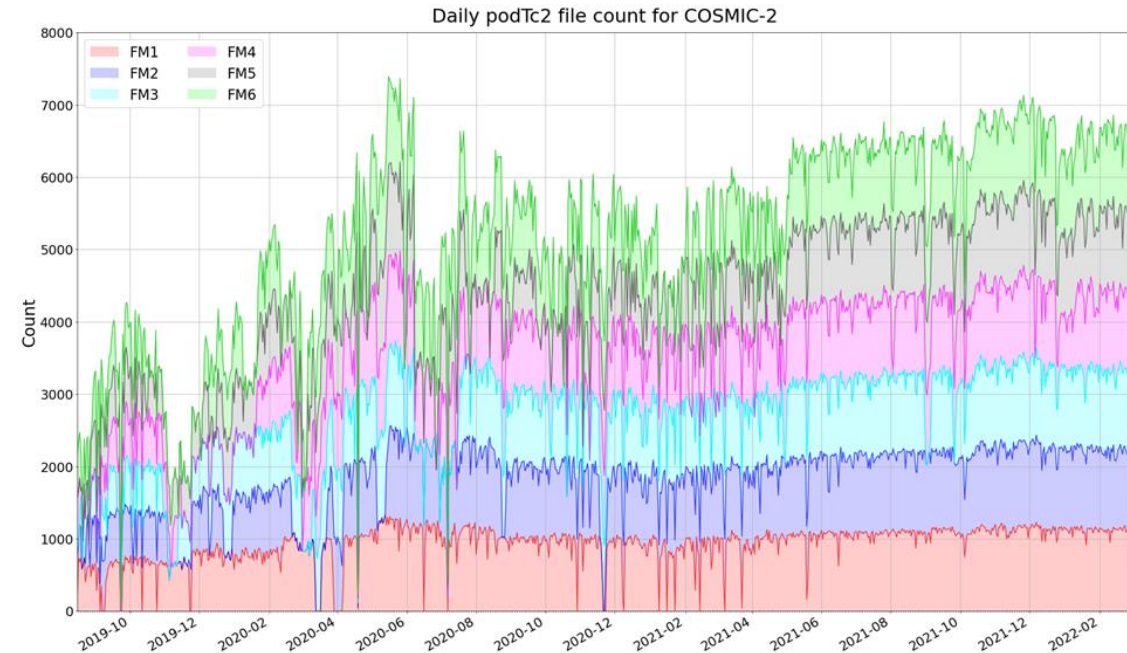
# 2025 Program of Record

- 2025 NOAA Program of Record – Space Weather Elements
  - ❑ SWFO
  - ❑ GOES-R
  - ❑ COSMIC-2
  - ❑ Metop – C, SG A1, SG B1
  - ❑ *ESA Vigil – L5*



# Mission Updates: COSMIC-2

- Six-satellite mission launched in June 2019. Lifetime: 5 years. **Mission status: Nominal**
- Carries the TGRS instrument measuring ionospheric electron density profiles; and the IVM measuring plasma drift speed.
- Daily ionospheric file podTc2 contains all TGRS data
  - Total Electron Content (TEC)
  - Scintillation Phase and Amplitude
- TEC data (February 2022):
  - Daily average Arc+Occ counts: 12,141. Requirement: 12,000 (28/30 days)**
  - Daily Median Latency: 27.4 min. Requirement: 30 min**



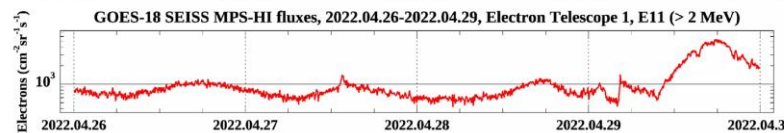
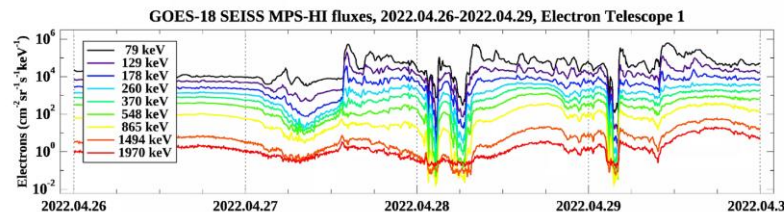
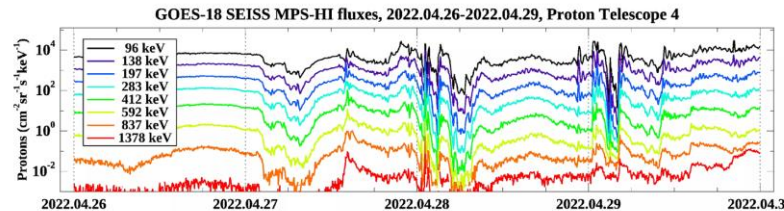
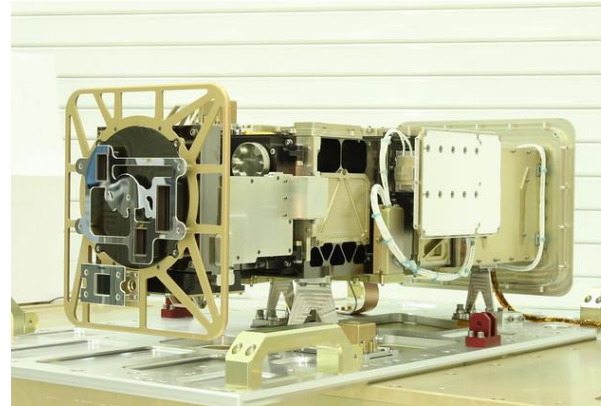
**Achieving over 12,000 TEC arc+occ counts daily on average at a 30-min max latency**



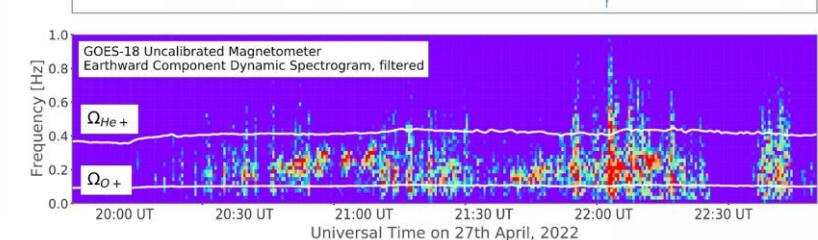
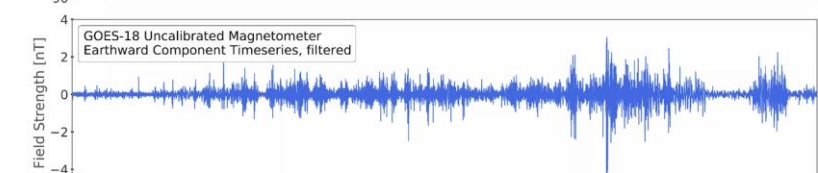
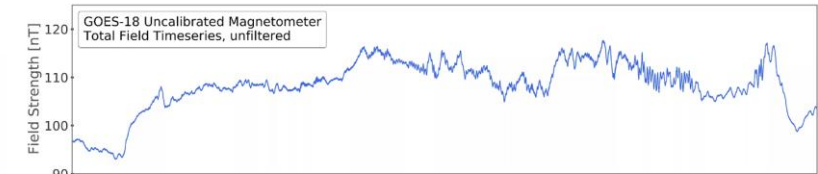
# Mission Updates: GOES-18

- GOES-18 (formerly: GOES-T) was launched on March 1, 2022.
- It is the third satellite in the GOES-R series which started in November 2016.
- Its instrumentation is used to
  - ❑ **Monitor magnetospheric, solar, and galactic particles;** it is a key contributor to NWS watches/warnings for solar radiation storms (S-scale)
  - ❑ **Measures solar X-ray and EUV flux** impacting the ionosphere. Basis for radio blackout watches/warnings (R-scale)
  - ❑ **Measures the magnetospheric B-field**
- **Currently going through checkout.** **Spacecraft subsystems nominal, including SpWx instruments.** Data are being provided to SWPC.
- GOES-18 will become GOES-West in January 2023

EXIS Sensors



First SEISS particle data – April 26, 2022



First GMAG data – April 27, 2022





# Key Space Weather Activities

## Compact Coronagraph Project

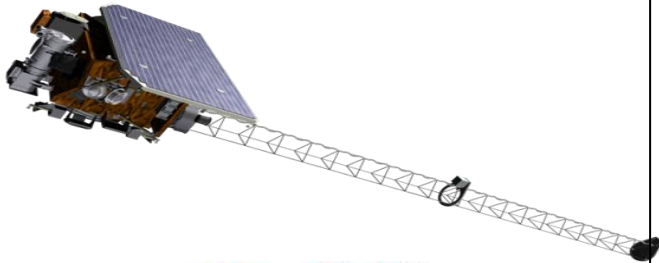
Compact Coronagraph (CCOR)



- Compact Coronagraphs under development by NRL via an IAA
- CCOR for SWFO-L1 Satellite
- CCOR for GOES-U
- Potential CCOR for ESA-L5 Satellite

## SWFO-L1 Mission Overview

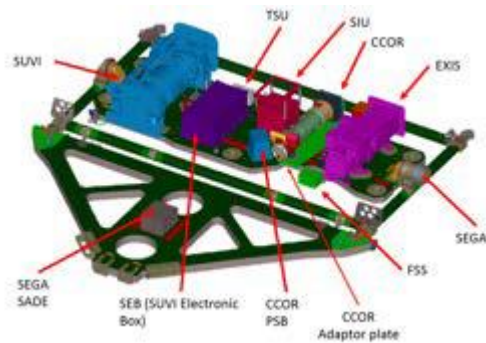
3-Axis Stabilized ESPA Class Spacecraft



- Space Weather Operational Observation at Earth-Sun Lagrange Point 1
- NOAA ground services
- Rideshare with NASA IMAP
- Nominal launch: 2025
- Potential contributed instrument

## CCOR on GOES-U

GOES-U Solar Pointing Platform (SPP)



- CCOR Integrated onto GOES-U SPP
- Commanding and data flow through GOES-R ground services
- Nominal launch: 2024

# Current Activities (1)

- NASA-NOAA Space Weather Research-to-Operations-to-Research (SWR2O2R) program
  - ❑ Whole Atmosphere-Ionosphere Data Assimilation Ensemble Forecast System, PI Tomoko Matsuo (CU Boulder)
  - ❑ Low Elevation Multi-GNSS Signal Processing For Remote Sensing, PI Jade Morton (CU Boulder)
- Space Weather Observing System Simulation Experiments
  - ❑ SW Next program conducting several OSSEs to support AoA studies.
  - ❑ Thermospheric OSSE, PI Eric Sutton (CU Boulder)
  - ❑ Ionospheric OSSE, PI Tomoko Matsuo (CU Boulder)
  - ❑ Radiation Belt OSSE, PI Adam Kellerman (UCLA)
  - ❑ Radiation Belt OSSE, PI Yuri Shprits (SSI)

# Current Activities (2)

- **Space Weather Gap Mitigation**
  - NASA Polarimeter to Unify the Corona and Heliosphere (PUNCH) as gap mitigation
  - Includes a coronagraph broadly similar to SOHO/LASCO.
  - NOAA is supporting PUNCH data processing that could help to mitigate the impact of a gap in DSCOVR, ACE, or SOHO coverage.
- **Space Weather CWDP - Led by OSAAP**
  - Released Solicitation for Commercial Space Weather Data Pilot
  - Currently in review
- **Joint Venture Program – Supported by OSAAP**
  - Leverages development of new technology and new data sources being developed/supported by other federal partners that best meet NESDIS' goals
  - Tiny Remote-sensing Instrument for Thermospheric Oxygen and Nitrogen, PI Andy Nicholas (NRL)



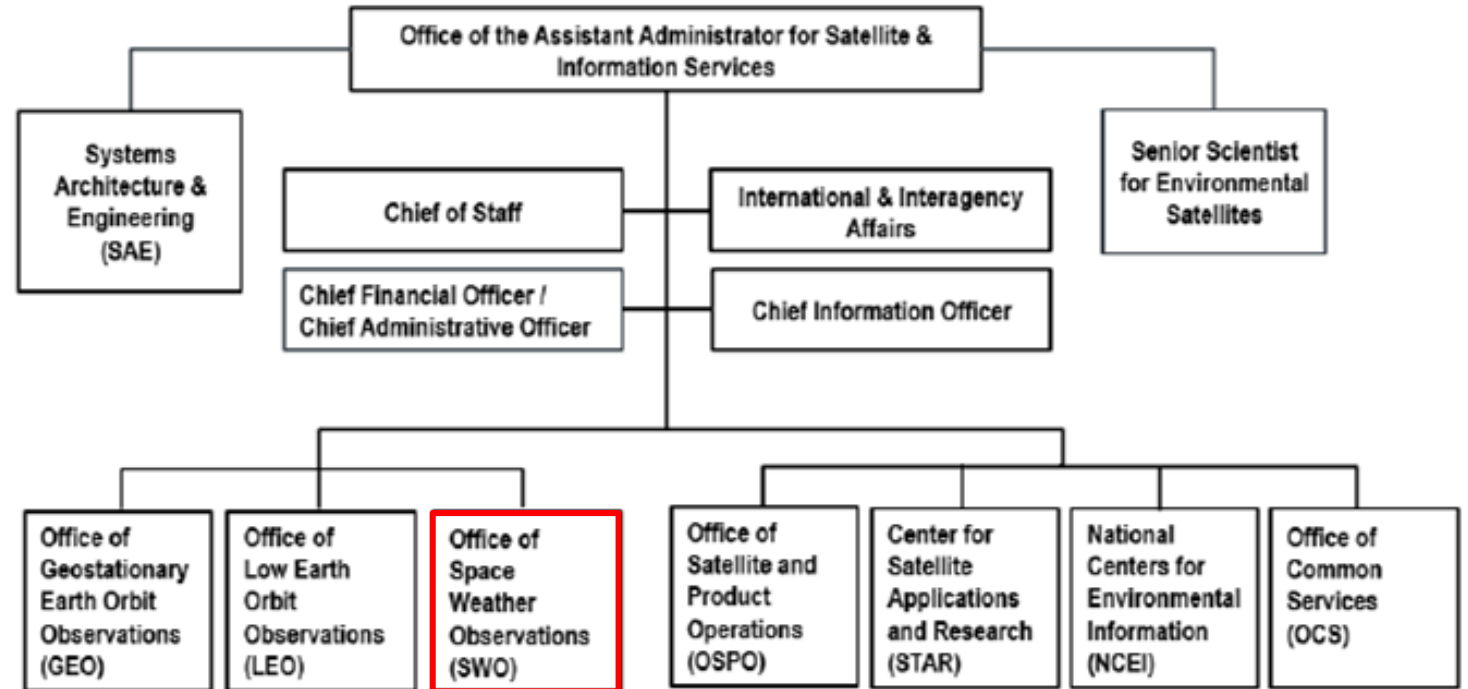
# FY23 President's Budget Request

## Proposed NESDIS organization

### FY 22 Enacted Budget

- COSMIC-2: \$8.1M
- SWFO: \$146.9M
- SW Next: \$55M

In FY 2023, NOAA proposed to establish the Space Weather Observations (SWO) program, which will manage the future space weather observations as loosely coupled programs.



Source: [FY23 NOAA Congressional Justification](#)

# Achieving the Vision

## NESDIS Space Weather Observations (SWO) Program

Organizes NOAA space weather satellite observations under a single NESDIS office.

Includes projects to deploy and sustain NESDIS' flight and ground-based equipment for space-based space weather measurements.

Implemented through a **joint NOAA-NASA Program.**



# Looking Ahead: Space Weather Observations at NESDIS

- SWO will implement Space Weather Next (SW Next) program to establish a comprehensive space weather observational capability for NOAA.
- NESDIS' is responsive to the PROSWIFT Act
  - Fulfilling data continuity requirements.
  - Advancing space weather requirements identified by NSOSA & SWORM.
  - Standing up the SWO Program to define and establish a comprehensive observational capability for several orbital regimes.
  - Developing partnerships and leveraging resources across international, academic, commercial, and Federal agency communities to provide space weather observations to NWS/SWPC, NASA, and DoD and other users.

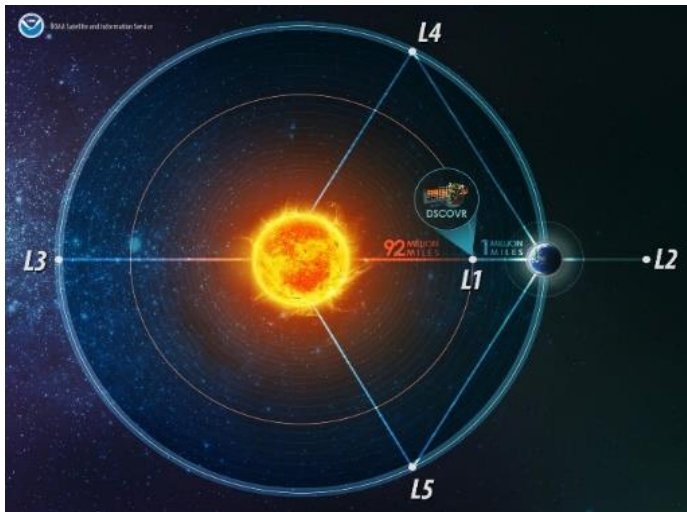




# Space Weather is complex requiring heterogeneity of observations from multiple vantage points.

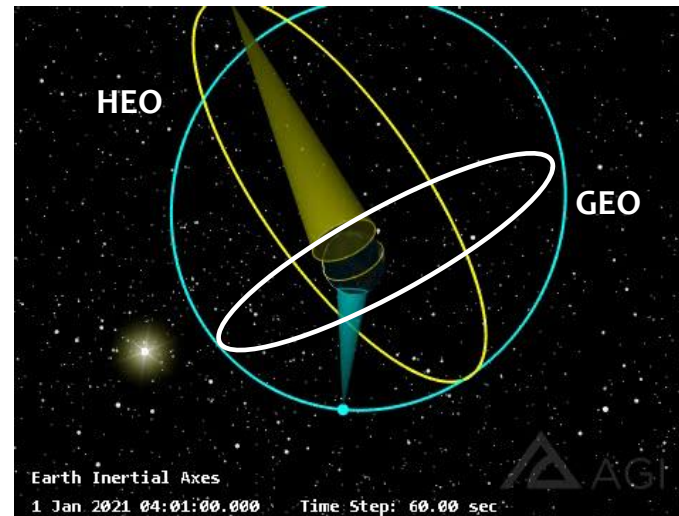
## Sun

Imagery from L1 and L5 for stereoscopic analysis. Up-stream in situ data drive heliospheric models



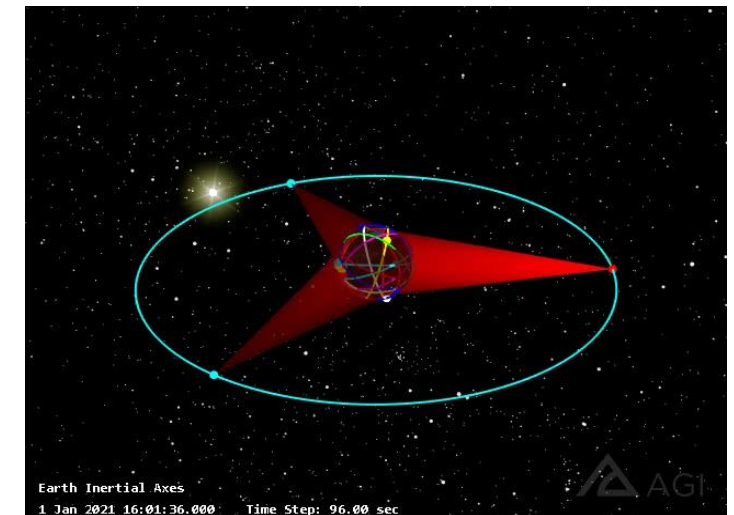
## Magnetosphere

In situ measurements from GEO and HEO



## Thermosphere/ionosphere

In situ and remote sensing from LEO and imaging from GEO



# Career Opportunities

- ROPPD Deputy Division Chief
  - ❑ On or about Jun 21, 2022 NESIDS will advertise a Supervisory General Engineer position at ZP 5 (GS 15) level
- 2-3 positions at ZP 3 (GS 11/12)/ZP 4 (GS 12/13) within PMED and ROPPD
- <https://www.usajobs.gov/>

# Internship at NOAA

- **Ernest F. Hollings Undergraduate Scholarship Program**

- ❑ **Important dates:** Applications are available annually from September through January.
- ❑ <https://www.noaa.gov/office-education/hollings-scholarship/prospective>

- **The NOAA Pathways Internship Program**

- ❑ Provide students, from high school to graduate level, with opportunities to work in Federal agencies and explore
- ❑ Students who successfully complete the program may be eligible for conversion to a permanent job in the civil service.
- ❑ <https://www.usajobs.gov/Help/working-in-government/unique-hiring-paths/students/>





# Summary

## NESDIS's Space Weather Observations Strategic Objective

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



### ***Space Weather Next program:***

- *Sustain and enhance space weather observational capabilities*
- *Improve and expand NOAA's space weather product suite*
- *Collaborate with partners to collect, process, and deliver relevant data to our users*
- *Provide accurate and timely space weather information to users*