NOAA's Space Weather Observations to Provide Continuous Operational Space Weather Capability

Elsayed Talaat
Director, Office of Space Weather Observations

AMS Annual Meeting 2023

NOAA's Space Weather Role

The 2020 PROSWIFT Act establishes **NOAA's responsibility** to:

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

SOURCE: "Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow" (PROSWIFT) Act, 51 U.S.C. § 60601(a)(2).

Space-Based Monitoring at 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.

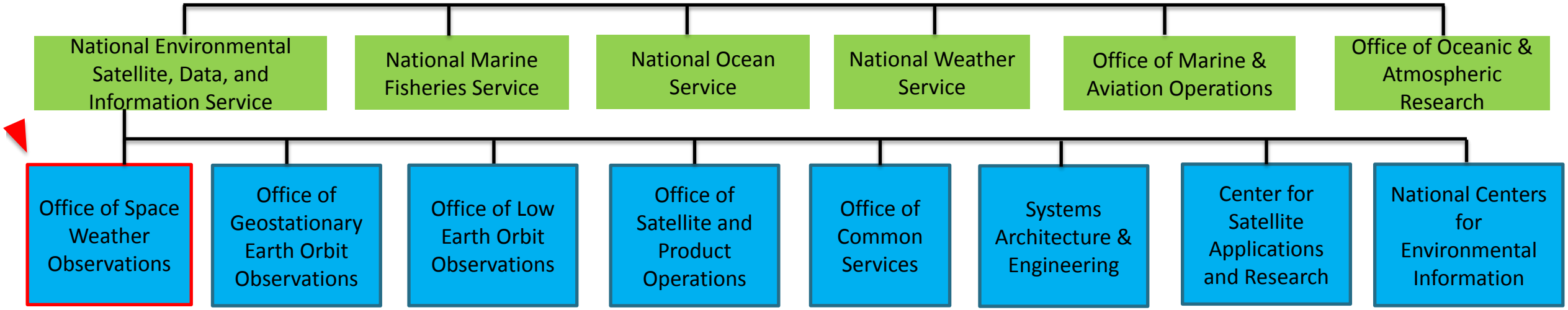
Space Weather Strategic Objective:

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.

Space Weather is a strategic priority for NOAA/NESDIS

Office of Space Weather Observations

- The 2023 Consolidated Appropriations Act establishes the Office of Space Weather Observations (SWO) (formerly, Office of Projects, Planning, and Analysis)
- SWO manages Space Weather Follow-on (SWFO) and Space Weather Next (SW Next)
- Implemented through a joint NOAA-NASA SWO Programs Division (GSFC Code 490)



Sustaining & Advancing Observations

Space Weather Observations (SWO)

Space Weather Follow On (SWFO)

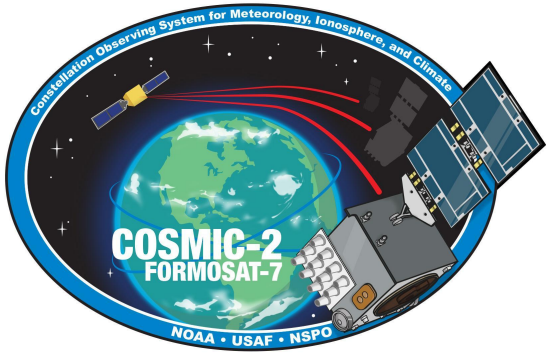
- Achieved Key Decision Point-C (November 2021)
- Instrument, spacecraft, command & control, antenna, and ground system are in development
- Development on schedule to:
  - **CCOR-1** integrated & 2024 launch on GOES-U
  - Deliver **SWFO-L1 observatory** for 2025 ride-share launch on NASA IMAP mission
- NASA & NRL **interagency agreements** in place
- **International agreement** with European Space Agency in place for L1 and L5 cooperation

Space Weather Next (SW Next)

- Achieved Milestone 1 (November 2022)
- Requires observations from diverse vantage points e.g., LEO, GEO, L1, L5, HEO
- Includes recommendations from NSOSA
- Planning for continuity of observations from:
  - L1 and L5 Orbit
  - Geostationary Orbit
  - Low Earth Orbit
  - Space Weather Ground Networks

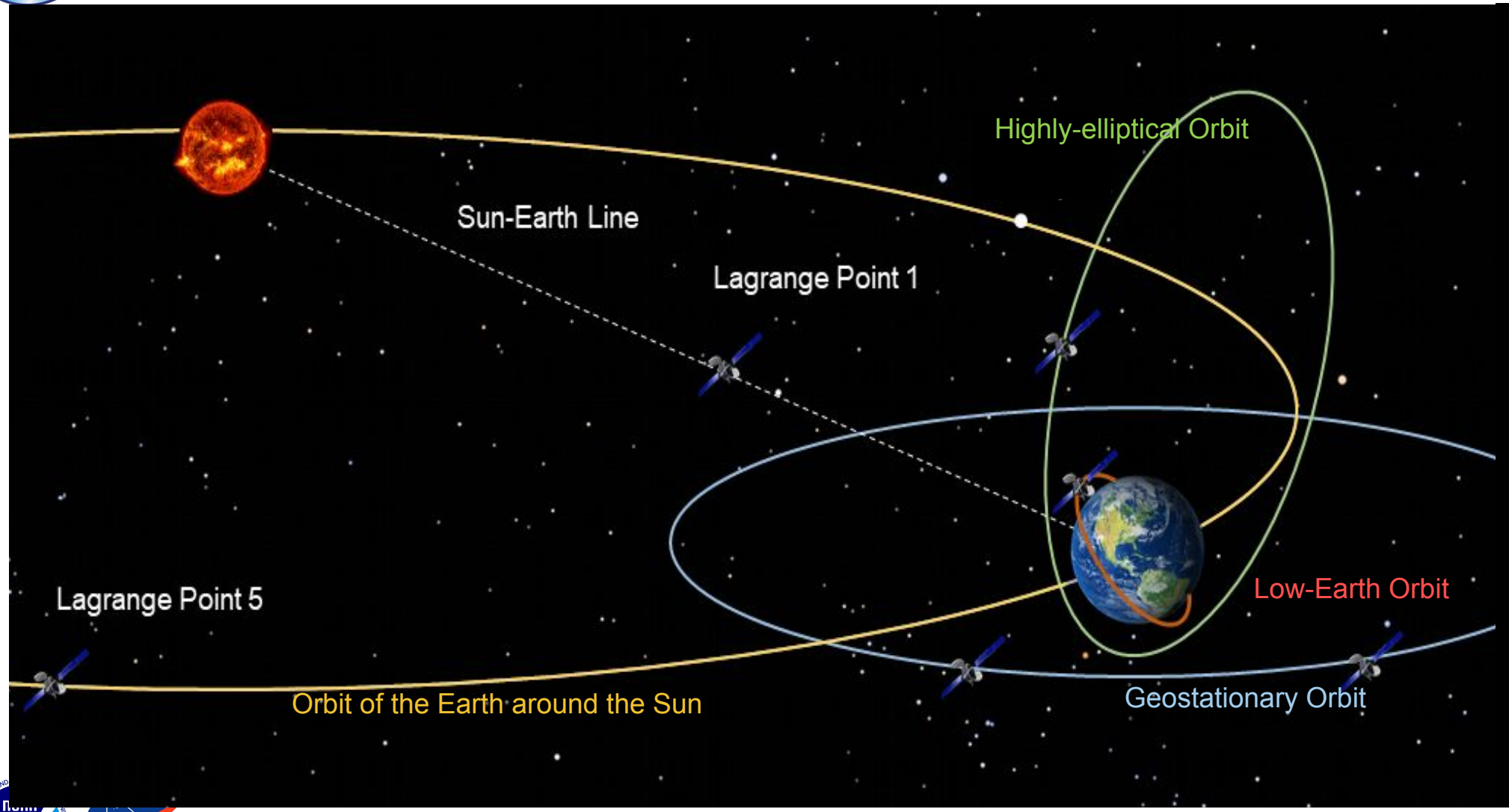
Space-Based Monitoring at NESDIS

- SWFO – L1
  - Solar Wind, Magnetic Field, and Particle Flux
  - Sun-Earth Line (SEL) Coronagraph
  - SEL X-Ray Flux (mission enhancement)
- GOES–R series
  - Magnetic Field and Energetic Particles
  - SEL Solar UV and X-ray Irradiance Imaging
  - SEL Coronagraph on GOES-U
- COSMIC-2 and Commercial RO
- EUMETSAT MetOp-C, -SG
  - Energetic Particles
  - Ionospheric Products via Radio Occultation
- ESA – Vigil (2029) at L5
  - Off SEL Solar Imagery; incl. Coronagraph
  - Magnetic Field and Energetic Particles



EUMETSAT

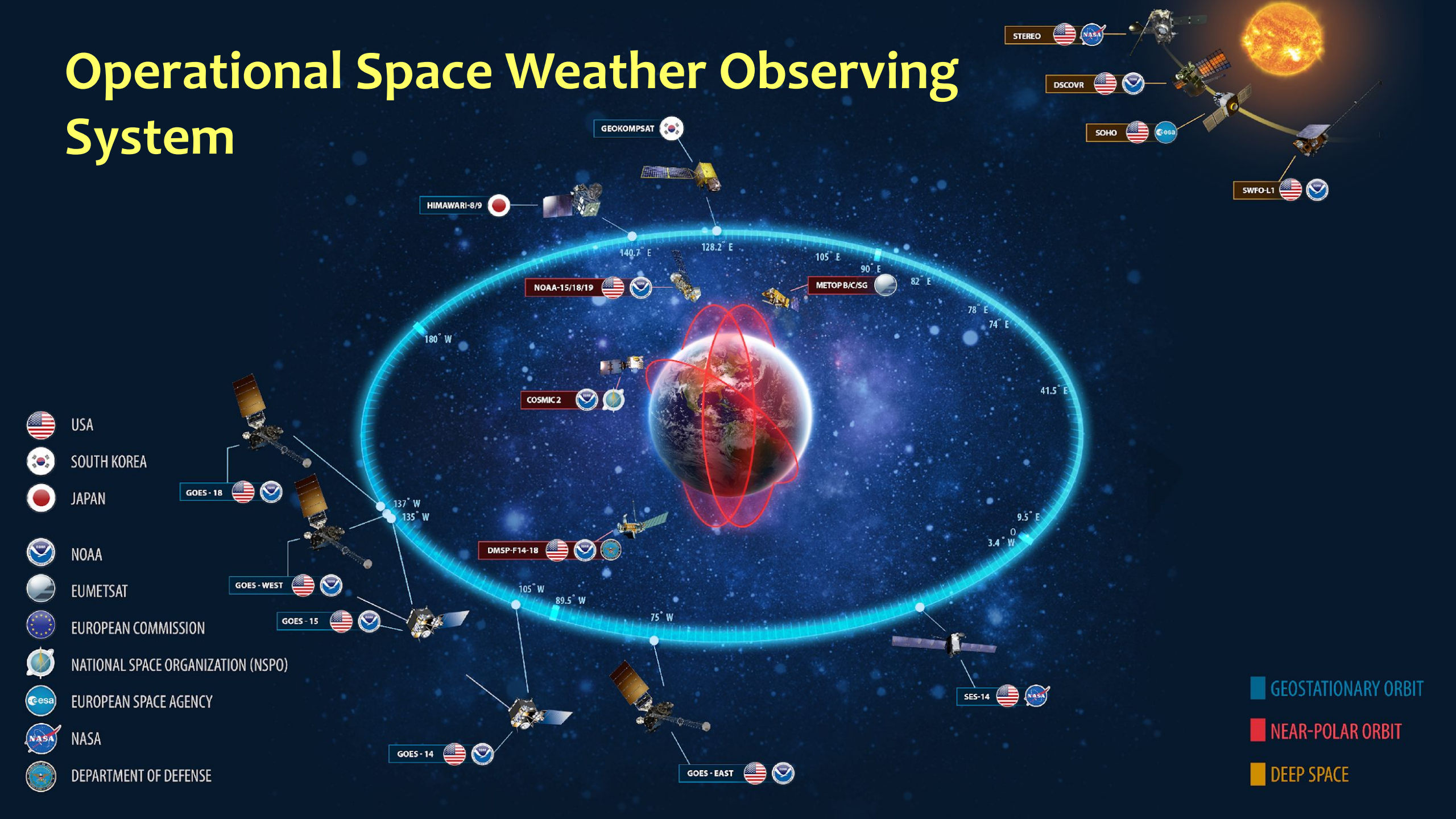
SW Next is a multi-mission program



In order to provide NOAA space weather observational continuity and satisfy program requirements, space weather sensors are required in multiple orbital domains.

SW Next will provide data continuity

Operational Space Weather Observing System



ESA Vigil will provide off-SEL observations

The NOAA-ESA Implementing Arrangement for Space Weather Cooperation includes the ESA *Vigil* mission to Lagrange point 5 (L5), which will launch in late 2028.

1. Vigil will host a NOAA-provided compact coronagraph (CCOR)
2. NESDIS will host an ESA-provided X-ray irradiance instrument at L1
3. NESDIS and ESA will exchange data from science instruments on Vigil

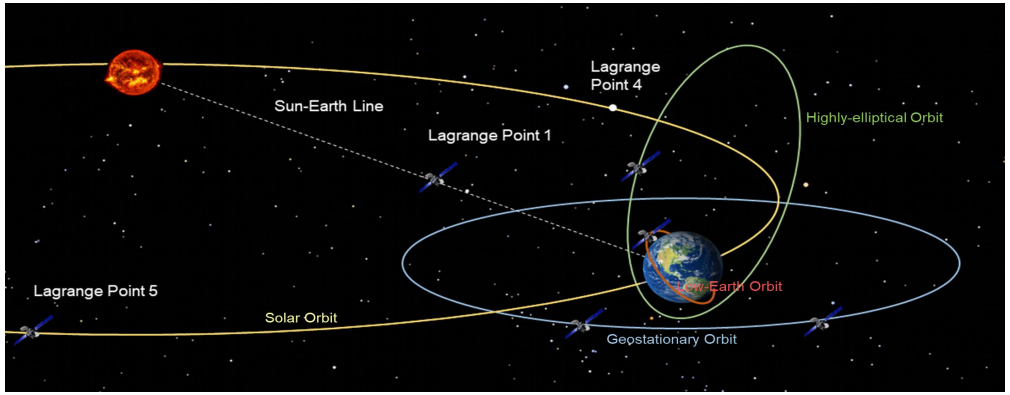
https://www.esa.int/ESA_Multimedia/Videos/2022/02/Introducing_ESA_Vigil_with_embedded_subtitles/(lang)/en

Commercial Data Program (CDP)

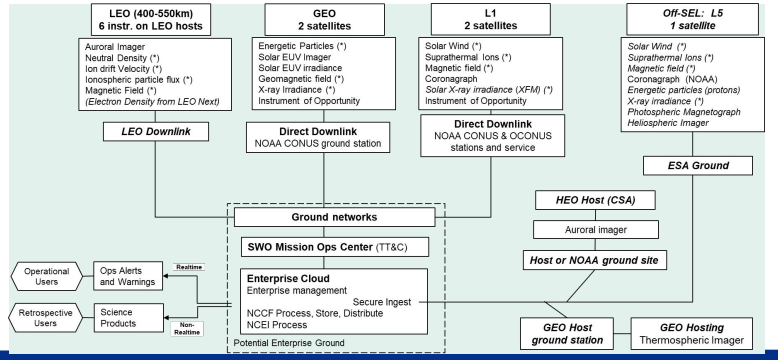
- On November 10, 2021, a Request for Information (RFI) was posted to SAM.gov soliciting information on existing or planned commercial space weather data and related capabilities that will be available in the 2022 through 2028 timeframe
- On May 19, 2022 a Request for Proposal (RFP) to conduct a Commercial Weather Data Pilot (CWDP) Study of commercial space weather data sources and related capabilities that may help NOAA meet its space weather mission objectives
- On July 14, 2022, NOAA awarded three Commercial Weather Data Pilot (CWDP) space weather contracts to GeoOptics Inc. (Pasadena, CA), Space Sciences and Engineering LLC, dba PlanetiQ (Golden, CO), and Spire Global Subsidiary, Inc (San Francisco, CA)
- These contract awards constitute the next round of NOAA's CWDP studies with a particular focus on space weather data.

From Strawman to Program Architecture

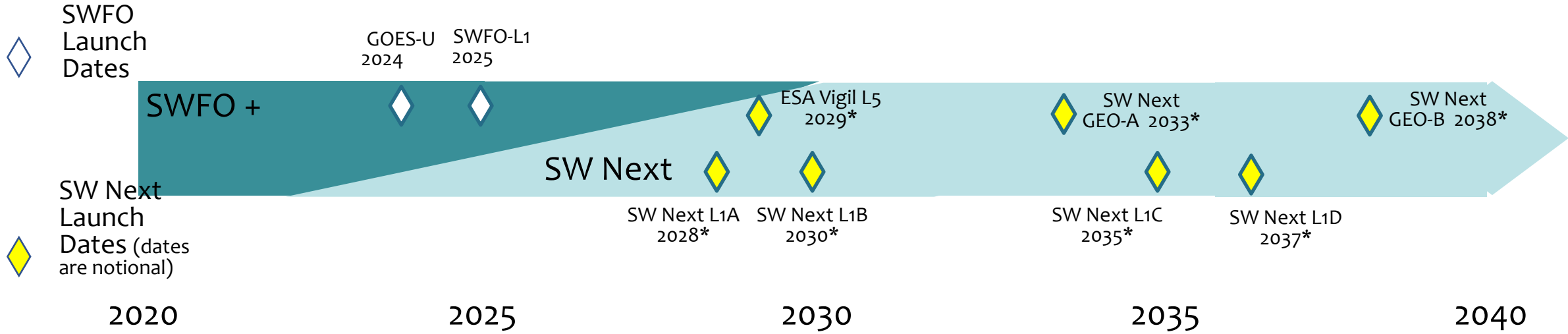
- The SW Next Program “initial” architecture contains assumptions:
  - about the location of some measurements (e.g., either L1 or GEO could satisfy a Sun-Earth Line measurement requirement)
  - about the implementation of space-ground communications and data handling systems



- Analysis of Alternatives (AoA) looked at a variety of instrument allocations and physical implementation options.



Preparing for a Space Weather Ready Nation



- Current notional flyout chart of our planned SWO architecture
- The first SW Next L1 launch is planned to overlap with SWFO for calibration and validation
- Planned architecture supports resiliency of observations at L1 and at GEO for critical observations