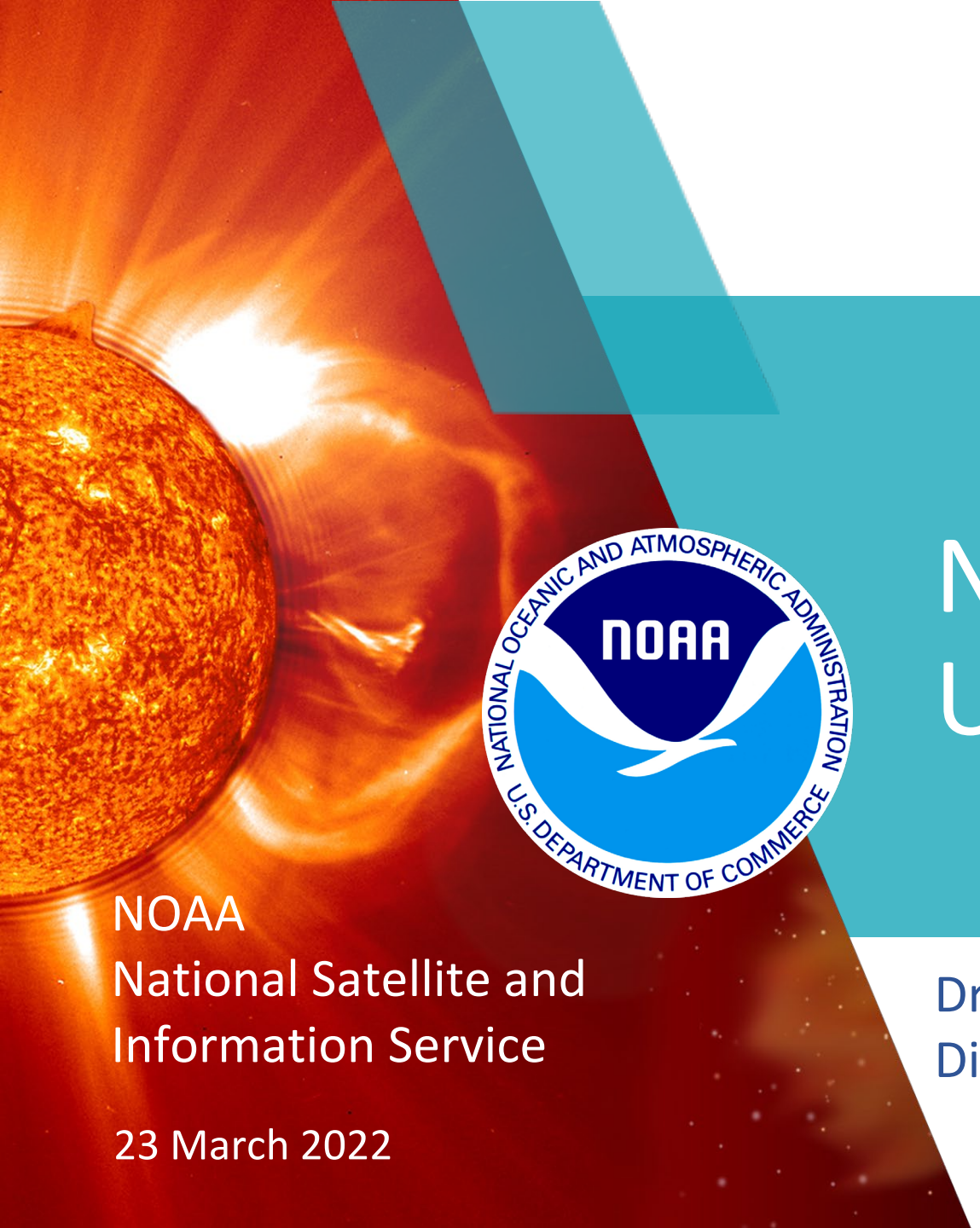


NESDIS Space Weather Update

Dr. Elsayed Talaat
Director, Office of Projects, Planning, and Analysis

NOAA
National Satellite and Information Service

23 March 2022

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 Obs.

Reliably monitoring space weather from all applicable orbits (e.g., L1, GEO, LEO, HEO, L5) to protect the nation's valuable, critical infrastructure. New capabilities at L5 and high earth orbit provide additional insight and improve forecasts.

Common Ground Services

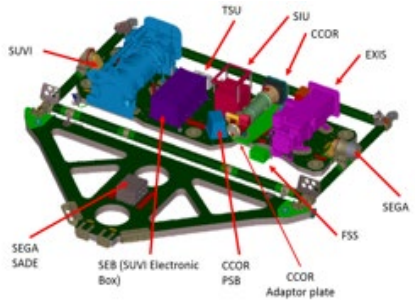
Secure ingest of data in different formats from different partners requires a flexible, scalable platform. Common Services approach integrates cloud, AI, and machine-learning capabilities to verify, calibrate, and fuse data into new and better products and services.

Space Weather Observations

- NESDIS will manage all future space weather observations under a single office, currently the Office of Projects, Planning, and Analysis
  - Includes Space Weather Follow-on program and continuity space weather observations on GOES-R series and on LEO programs such as COSMIC-2, POES.
- Space weather observations continuity and product improvement are the mission goals of the office with two programs:
  - Space Weather Follow-on (SWFO) program executing
    - Coronagraph on GOES-U launch date 2024
    - SWFO – L1 observatory launch date 2025
  - Space Weather Next (SW Next) program in formulation
    - Program formulation: 2023
    - Program of Record 2025
    - SWNext – L1 series first target launch date: 2028
- NOAA co-sponsoring next NASEM Solar and Space Physics Decadal Survey

Space Weather Follow On (SWFO) Program

CCOR +
SUVI +
EXIS



CCOR on GOES-U Mission

Launch: 2024
Orbit: GEO
*Instrumen*t: CCOR on GOES-U solar-pointing platform
Command & Data Flow: GOES-R Ground System

Establish operational capability and continuity of Sun CME imaging observational requirements with multiple platforms; primary operational objectives:

- Observe CME parameters, shape, density and velocity
- Produce CME characteristics for input into operational heliospheric propagation code
- Enable space weather watches, warnings, forecasting and predictions

SWFO-L1 Mission

Launch: 2025 *(ride share with NASA IMAP)*
Orbit: Lagrange Point 1 (L1)
*Instrument*s: CCOR, XFM, Solar Wind Instrument Suite (SWiPS, MAG, STIS)
Command & Data Flow: SWFO Ground System

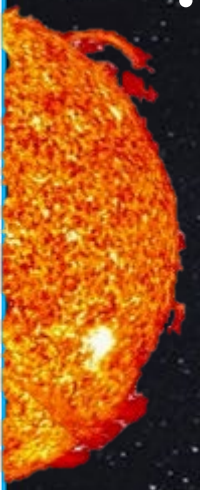
Establish operational capability and continuity of space weather observational requirements with multiple platforms; primary operational objectives:

- Coronal White Light Images for detection of CMEs
- Observe CME parameters, shape, density, velocity
- Produce CME characteristics for input into operational heliospheric propagation code
- In situ solar wind measurements
- Measure solar wind magnetic field, thermal plasma, and energetic particles

SWFO-L1 Mission Architecture

SWFO-L1 will operate in two bands:

- X-band for mission data – real time, 24/7
- S-band for commanding, housekeeping data, and ranging



Sun-Earth Lagrange 1 (L1)

Cruise to L1 from Insertion Orbit

Launch from KSC Feb 2025 IMAP Rideshare

NOAA SWFO Antenna Network (Primary & Backup)

Partner Ground Networks (Receive Only)

NASA (SCaN) Contingency

S-band Hk; X-band Mission & Hk Data

S-band: Cmd, S-band ranging

TLM via S- *or* X-

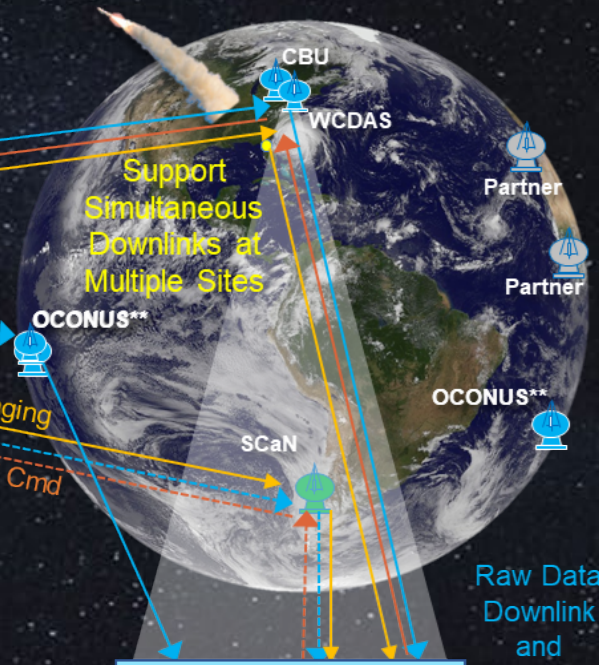
X-band: Hk & Mission Data

S-band Ranging

Contingency

S-band Hk; X-band Mission & Hk Data

S-band Cmd



Raw Data Downlink and Tracking Messages to C2

PGD

SWPC

Boulder, CO

Ashburn, VA (2021)

Products & Data

NCEI

Boulder, CO

Asheville, NC

Real-Time Products to Operational Users

All Products to Retrospective Users

User Community

L0 Msn Data*, Hk Data, Ancillary Data

C2

Primary

NSOF Suitland, MD

WCDAS Wallops, VA

Backup

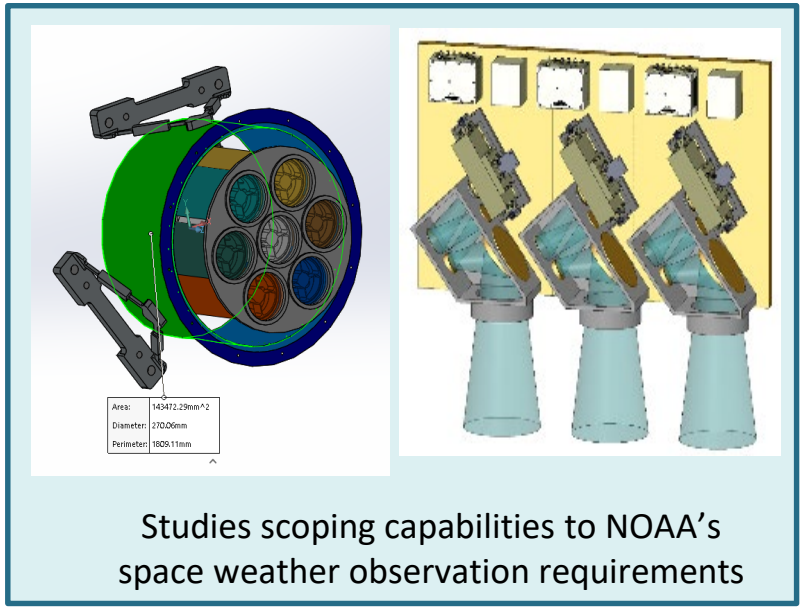
CBU, Fairmont, WV

*GOES-U CCOR-1 data provided to SWPC directly from GOES-R

** OCONUS SAN Stations are implemented as a service

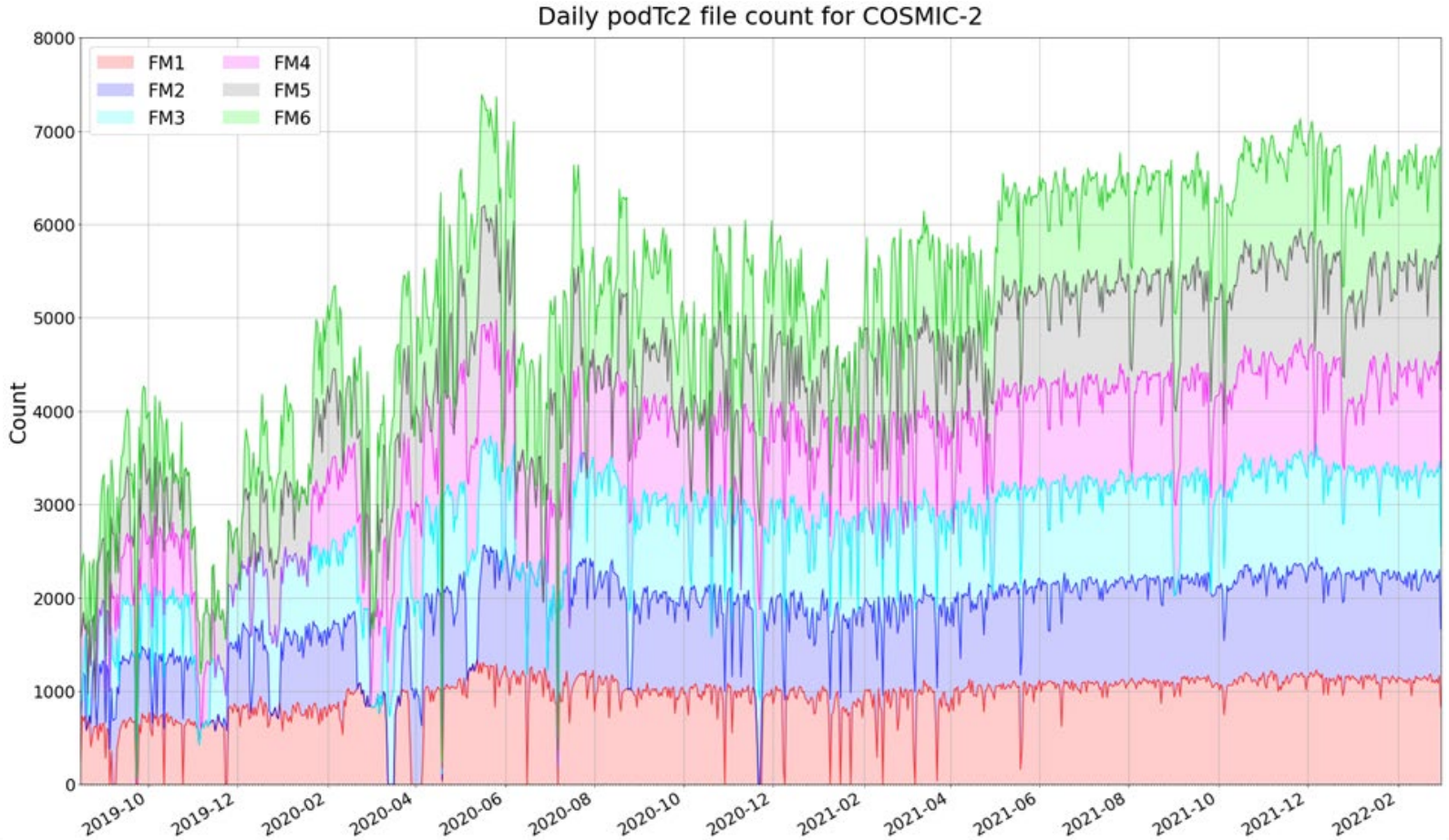
Space Weather Next (SW Next) Status

- NESDIS plans to jointly implement SWFO and SW Next in FY22 through a joint NOAA-NASA effort at Goddard.
- Program Level Requirements (PLR) presented at Space User Needs Working Group (SUNWG)
- Preparing for Program Mission Concept Review (MCR) Q2 FY2022
- Preparing for Analysis of Alternatives, Q3 FY2022 – Q1 FY2023
- Studies in progress and in planning for innovative instruments, modeling and mission concepts
- User Engagements planning in progress to capture user uses of products and services. Focus near term efforts include but not limited to:
  - Engagement with National Weather Service (NWS)/Space Weather Prediction Center (SWPC) in support of the aviation community
  - Engagement with Commercial Satellite service and Office of Space Commerce (OSC), NWS/SWPC, and Department of Defense (DoD), in support of Space Traffic Management (STC) and Space Situational Awareness (SSA)



Studies scoping capabilities to NOAA's space weather observation requirements

COSMIC-2 Daily Ionospheric Files



COSMIC-2 podTc2 file

- Contains all TGRS ionospheric data
  - –Total Electron Content (TEC)
  - –Scintillation Phase and Amplitude
- Total Files: 4,970,876

TEC Data as of Feb, 2022

- Daily Average Arc+Occ Counts: 12,141
  - –Requirement: 12,000 (28/30 days)
- Daily Median Latency: 27.4 min

Requirement: <30 min daily

Achieving over 12,000 TEC arc+occ counts on average daily with under 30-min latency

Commercial Data Program (CDP)

- **Commercial Space Weather (SpWx) Pilot RFI status:**
  - 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 December 8, 2021, eleven SpWx Capability Assessment Statements were received; a SpWx Capabilities Assessment Team (S-CAT) was stood up in January 2022 to evaluate vendor responses and to provide recommendations to the NESDIS AA
  - In March, the NESDIS AA directed the CDP to pursue a SpWx pilot
  - Next steps: Preparations for a potential RFP release under way. Data delivery Period of Performance (POP): 6 months followed by a six-month Data Evaluation period

SW Next Formulation Planning: FY22-FY23

SW Next Formulation Event/Activity	Timeframe	Note
Preliminary Program Level Requirement (PLR)	Feb 22	SUNWG review in January
NESDIS Program MCR / NOAA/NASA SRR	Q3 FY22	Contemporary MCR with SRR
DOC Milestone 1	Q3 FY22	DOC Program Approval, Long-lead project element documentation in prep for next L1 series
NOAA/NASA Program KDP-0	Q4 FY22	
ATP for CCOR-3 for ESA L5	Q3 FY22	ESA L5 launch planned 2027
Program SDR	Q2 FY23	
NOAA/NASA Program KDP-1	Q2 FY23	
NOAA/NASA MCR L1 – series project	Q1 FY23	
NOAA/NASA KDP-A L1-series project	Q1 FY23	

MCR: Mission Concept Review, KDP: Key Decision Point, ESA: European Space Agency, SDR: System Definition Review, SRR: System Requirements Review