



NOAA's Current and Future Space Weather Observational Architecture



NOAA Satellite and
Information Service
www.nesdis.noaa.gov

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2019 Space Weather Enterprise Forum

GO COSMIC-2!





Space Test Program – 2 Falcon Heavy Launch
All six satellites are verified to be in sun-acquisition mode



NOAA's Mandate: Operational Space Weather Watches, Warnings



  **SPACE WEATHER PREDICTION CENTER**
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Wednesday, June 21, 2017 18:17:04 UTC

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SPACE WEATHER CONDITIONS on NOAA Scales ☐

24-Hour Observed Maximums

R none	S none	G none
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Latest Observed

R none	S none	G none
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Predicted 2017-06-21 UTC

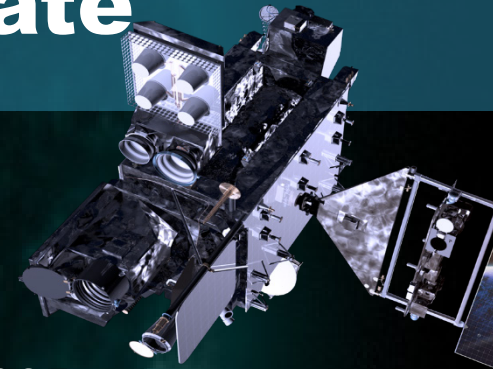
R1-R2	1%	S1 or greater	1%	G none	➔
R3-R5	1%				

Solar Wind Speed: **325** km/sec Solar Wind Magnetic Fields: Bt **6** nT, Bz **-5** nT Noon 10.7cm Radio Flux: **74** sfu

R – radio interference S – solar radiation G – geomagnetic activity



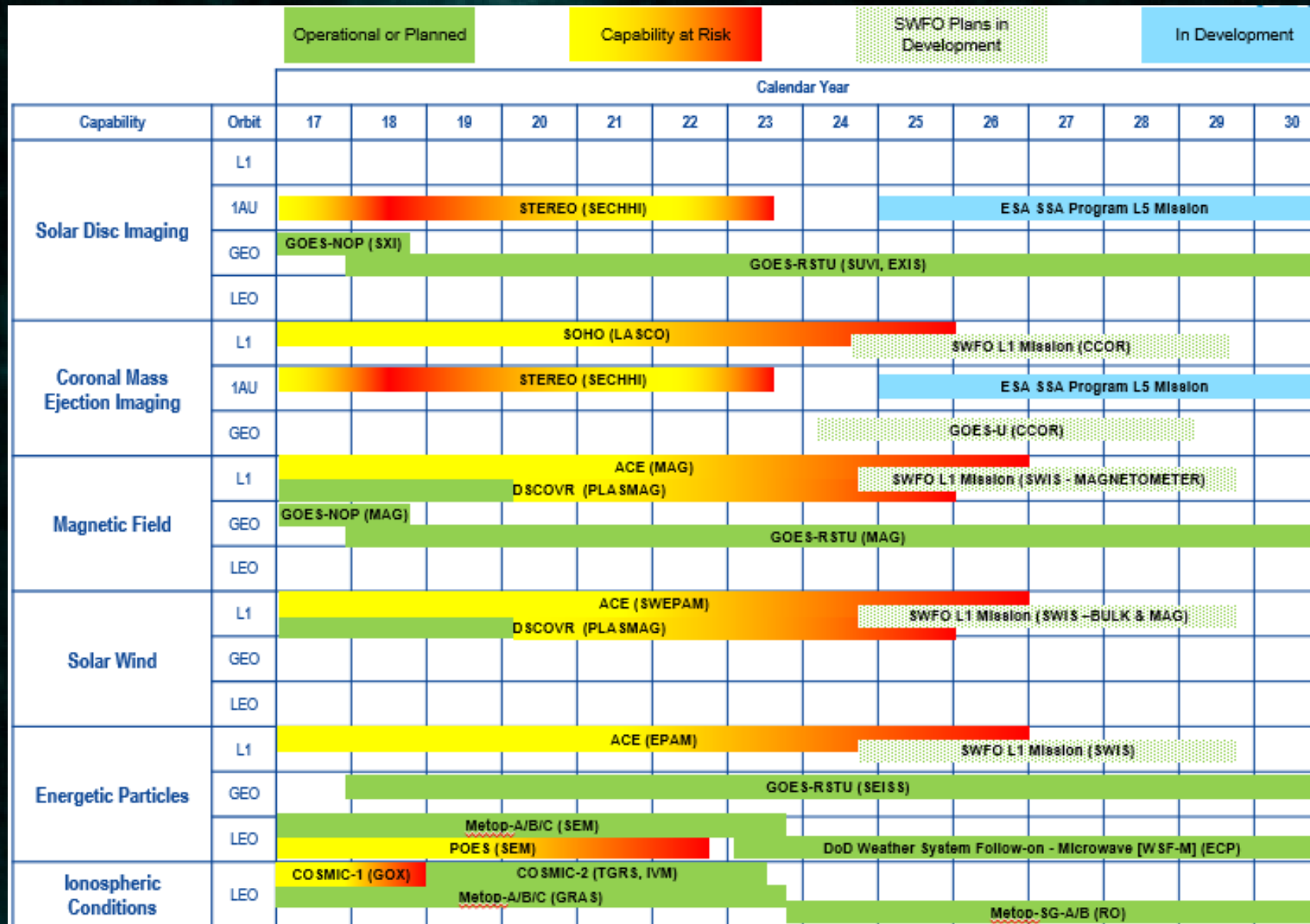
NOAA Space Weather Observations Update



- GOES – Currently Operational with GOES 14&15
 - GOES-16 space weather observations expected in operations by Fall 2019
 - GOES-17 in 2020
- GONG – NOAA continuing to support the Operations and Maintenance of the Observatories
 - SWPC working with NSF/NSO and NOAA/IDP program to operationalize the processing of the GONG data
- DSCOVR – Supporting SWPC operations and models since 2016
 - Software modifications improve data quality
 - Spurious reboots continue – 25 since 2015 – 7 in the last year
- Space Weather Follow On + Operational Coronagraph on GOES-U
 - Working with NESDIS and NASA on a 2024 launch for both
- COSMIC-2 ready for launch June 2019
- NOAA Commercial Weather Data Buy Program
 - SWPC now staffed to evaluate the Radio Occultation data from this pilot program
 - NOAA has awarded Contracts to Spire, PlanetIQ and GeoOptics

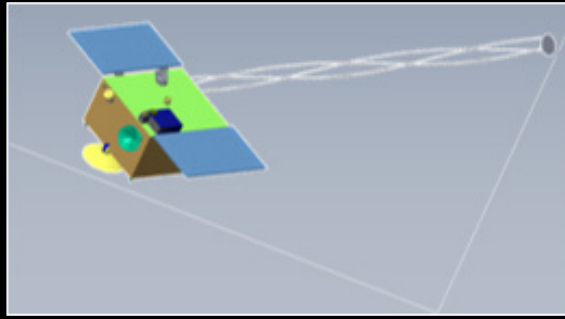


Space Weather Current and Planned Capacity



Space Weather Follow-On (SWFO) Program

3-Axis
Stabilized ESPA
Class
Spacecraft



SWFO-L1 Mission Overview

IAA with NASA to procure a ESPA Grande compatible spacecraft
NOAA ground system
Rideshare with NASA IMAP
Nominal orbit: L1
Nominal launch: 2024

Mission Description

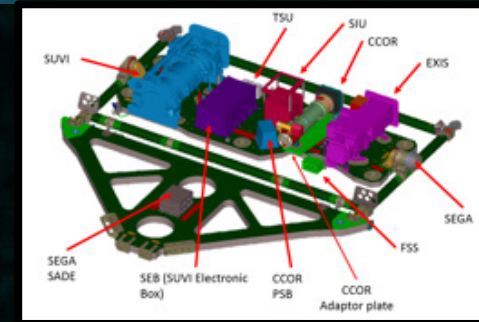
Establish operational capability and continuity of space weather observational requirements with multiple platforms; primary operational objectives:

Observe Coronal Mass Ejection (CME) parameters, shape, density and velocity; for input into operational heliospheric propagation code

Measure solar wind magnetic field, thermal plasma, and energetic particles

Enable space weather watches, warnings, forecasting and predictions

CCOR +
SUVI +
EXIS



CCOR on GOES-U Mission Overview

CCOR Integrated onto GOES-U Solar Pointing Platform (SPP)
Commanding and data flow through GOES-R ground system
Nominal orbit: GEO
Nominal launch: 2024

Mission Description

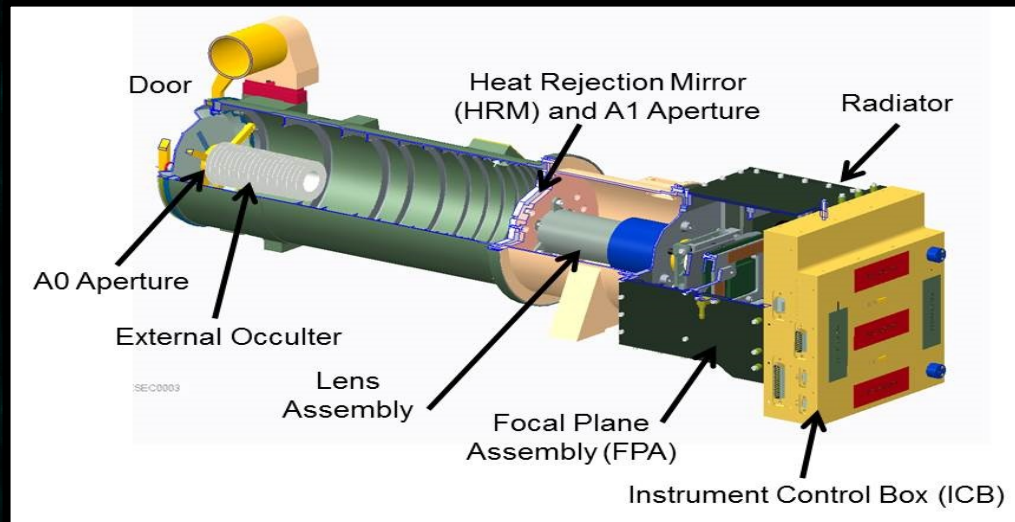
Establish operational capability and continuity of Sun Coronal Mass Ejection (CME) imaging observational requirements with multiple platforms; primary operational objectives:

Observe Coronal Mass Ejection (CME) parameters, shape, density and velocity for input into operational heliospheric propagation code

Enable space weather watches, warnings, forecasting and predictions

A Space Telescope for the Corona: CCOR

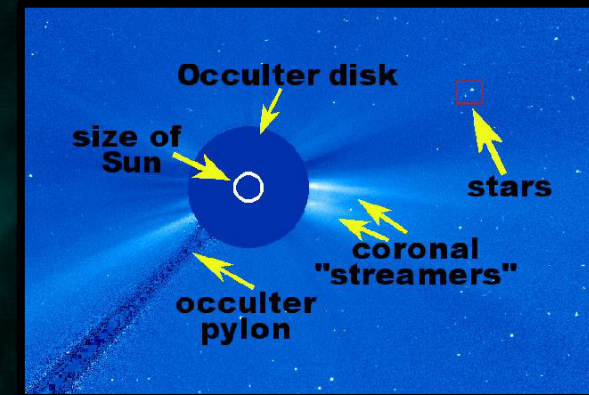
Compact CORonagraph



CCOR Description

- A Research To Operations (R2O) project in close collaboration with the Naval Research Laboratory (NRL)
- Telescope features:
 - Innovative optical and electronic components Planned to replaces SOHO/LASCO
 - High heritage from STEREO/SECCHI, PSP/SoloHi instruments
 - 50% reduction in mass; 2/3 length from earlier designs.
- To operate at a 15-min cadence; shorter if necessary

Coronal Image



Mission Overview

- First CCOR to be placed on board GOES-U
- Second CCOR to be placed on NOAA's SWFO solar wind monitor at L1
- NRL to deliver the units in 2021, 2023

Instrument Requirements

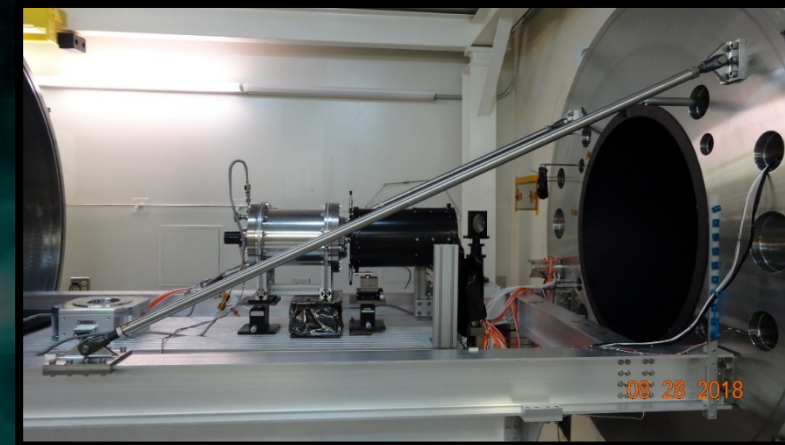
Parameter	Threshold	Goal
Field of View (FOV)	3-17 R_{SUN}	3-22 R_{SUN}
Pointing Knowledge	25 arcsec	12.5 arcsec
Knowledge of Solar North	1 deg	0.5 deg
Spatial Resolution	50 arcsec	
Photometric Accuracy	10%	
Image Cadence	15 min	5 min
Data Latency	15 min	5 min



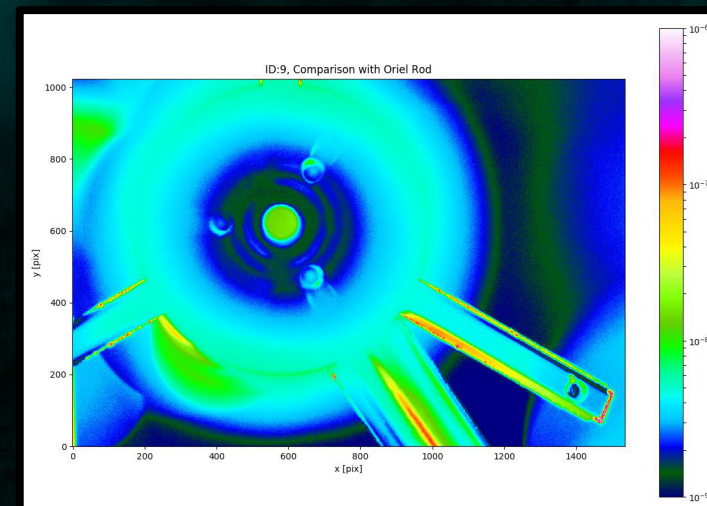
CCOR Instrument Status

- CCOR is developed for NOAA by the Naval Research Laboratory
- The PDR took place in September, 2018. Currently in Phase C (final design and fabrication)
- Subsystem reviews completed in April 2019
- The CDR is planned for June 25-26, 2019
- Unit 1 is on track for delivery in March 2021 for integration onto GOES-U

CCOR Optical Testbed



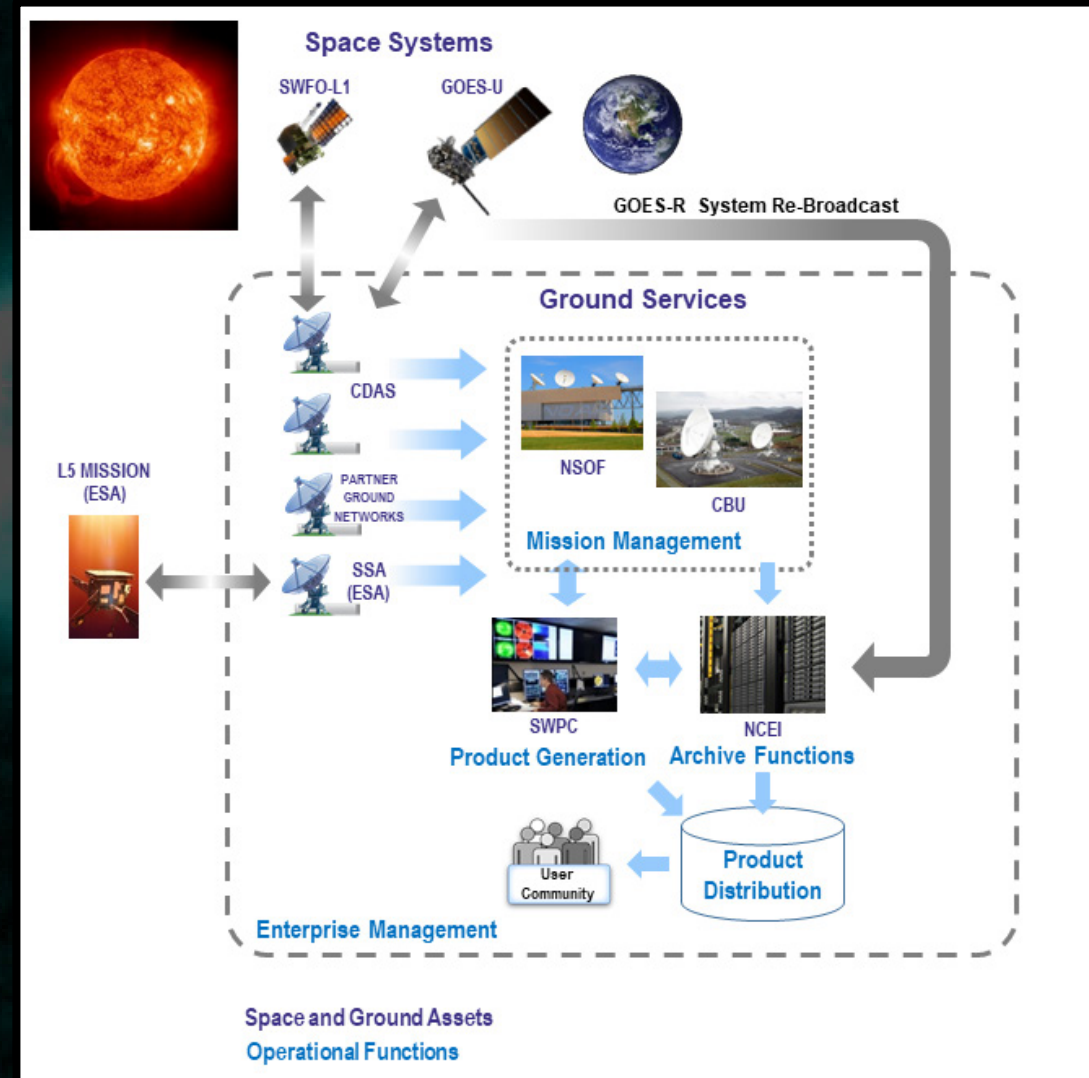
Occulter pylon optimization test



SWFO Program Ground Services

- NOAA will develop and operate the Ground Service in accordance with the existing Ground Enterprise Requirements Structure
- SWFO Ground Services will support all the sensors and the SWFO-L1 spacecraft
- Addition of 13-16m dishes near Madrid and Dongara are being evaluated
- Accommodations to meet IT security requirements are being defined
- S vs. X-band trade to be completed by October 2019
- Commanding by WCDAS, seasonal backup by FCDAS
- NWS/SWPC will continue to produce all level 1, level 2 and higher level space weather data products for the SWFO instruments
- NESDIS/NCEI will archive all space weather data products
- Real-time 24/7 operations so as to accommodate the needs of NWS/SWPC

SWFO System Architecture



COSMIC-2/FORMOSAT-7 Mission

6 Satellite constellation around the equator (24 degree inclination orbit)

Each satellite has 3 instruments:

TriG GNSS-RO receiver (TGRS) – Primary Instrument

Ion Velocity Meter (IVM) – Secondary Instrument

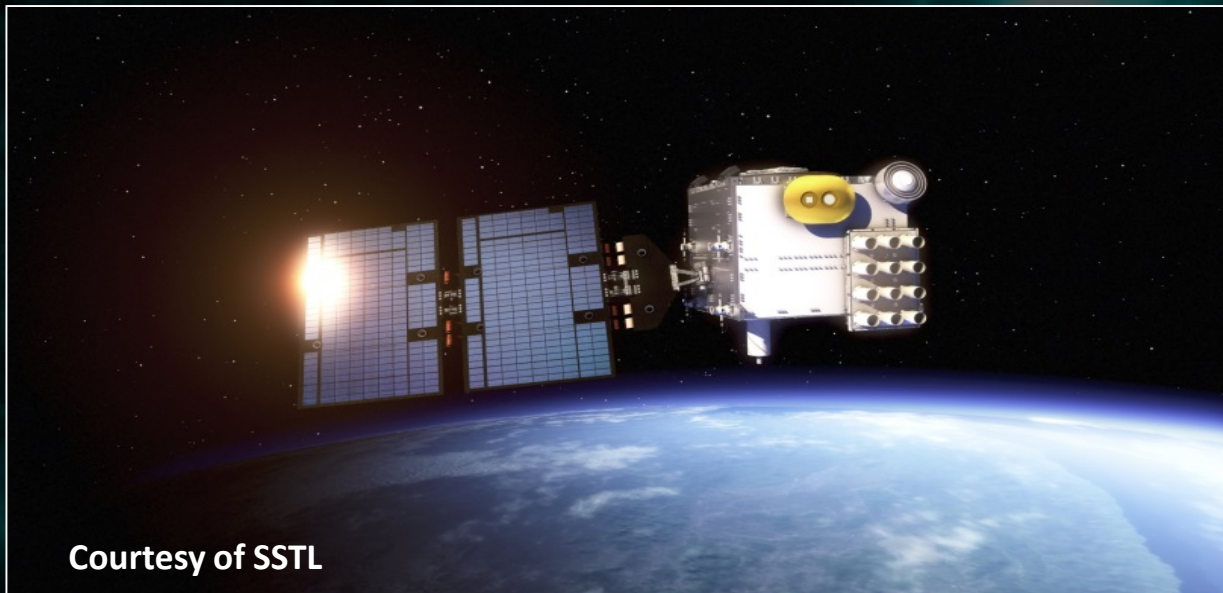
RF Beacon – Secondary Instrument

Mission Design Life: 5 years

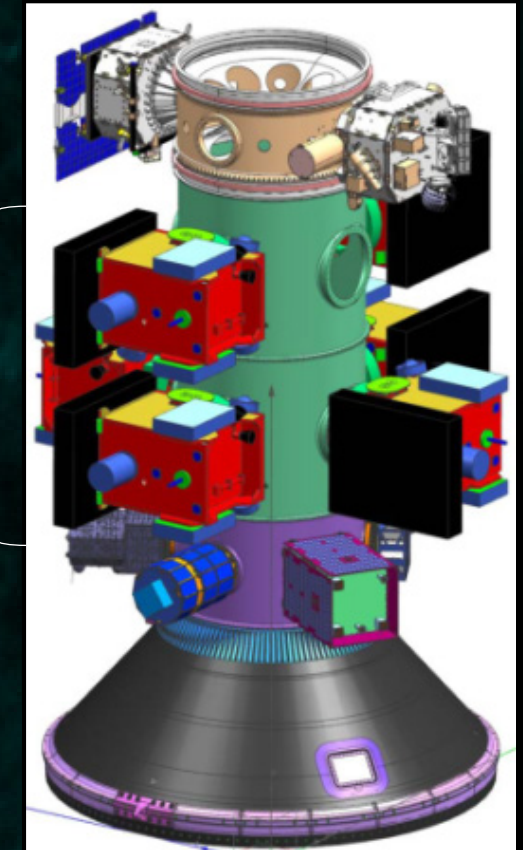
Launch Date: Not Earlier Than June 24, 2019

Launch Vehicle: Falcon Heavy (STP-2 mission stack shown in right figure)

All weather coverage (4,000+ occ/day) with 30 min avg data latency

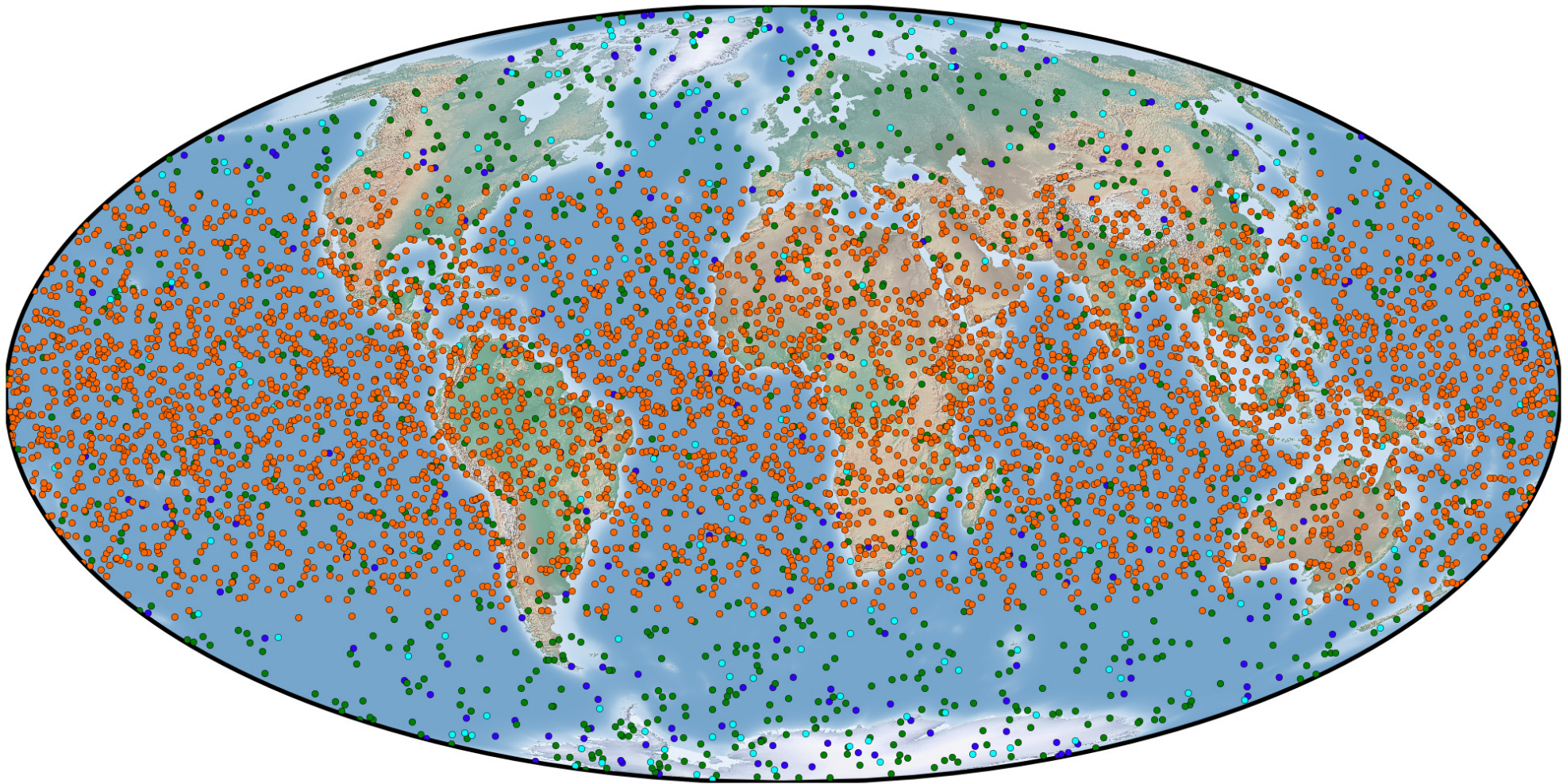


Courtesy of SSTL



COSMIC-2
Spacecraft
in STP-2
Launch
Stack

COSMIC-2 and Partner Data

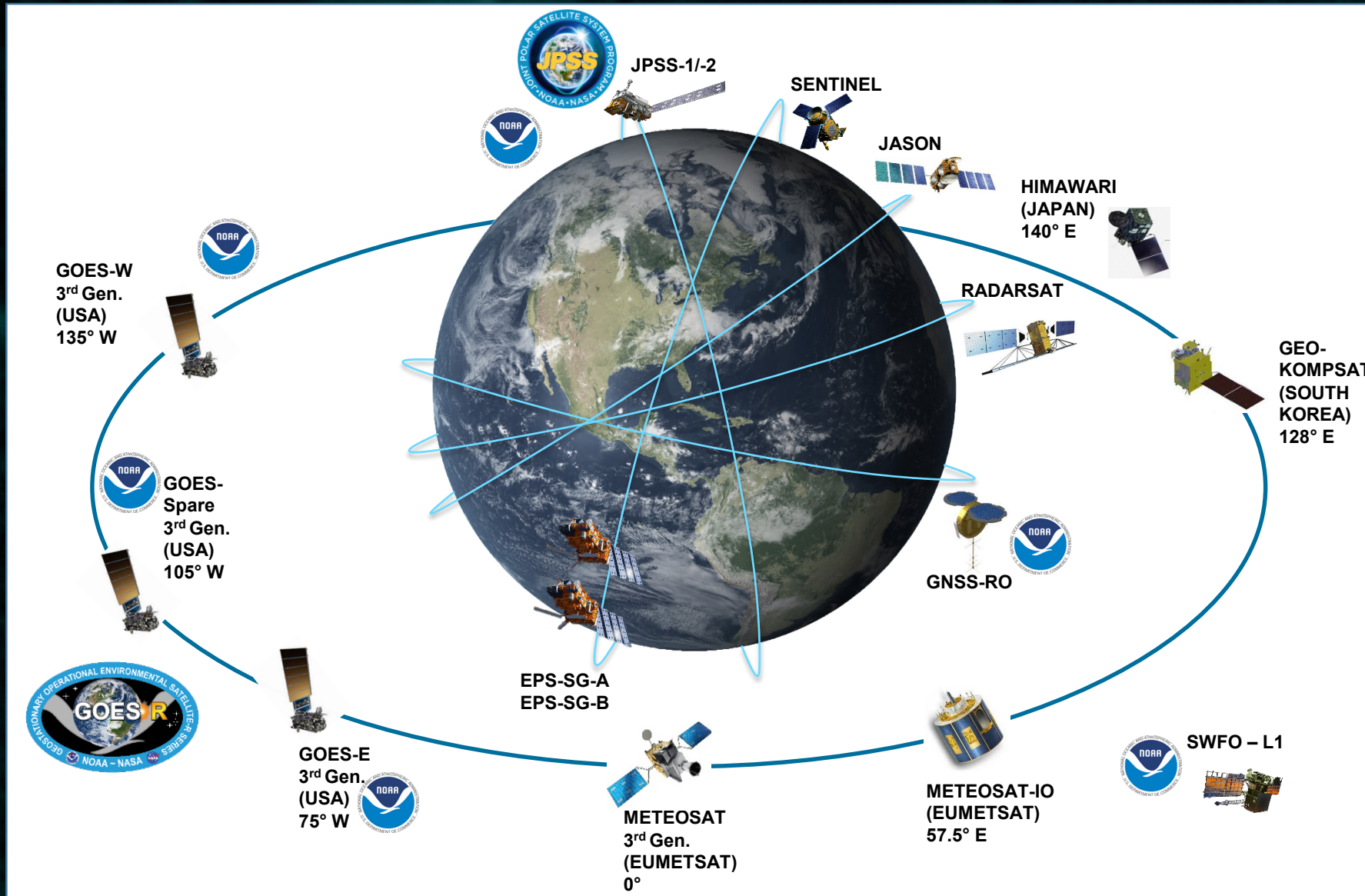


• KOMPSAT-5 • Metop-AB • PAZ • COSMIC-2

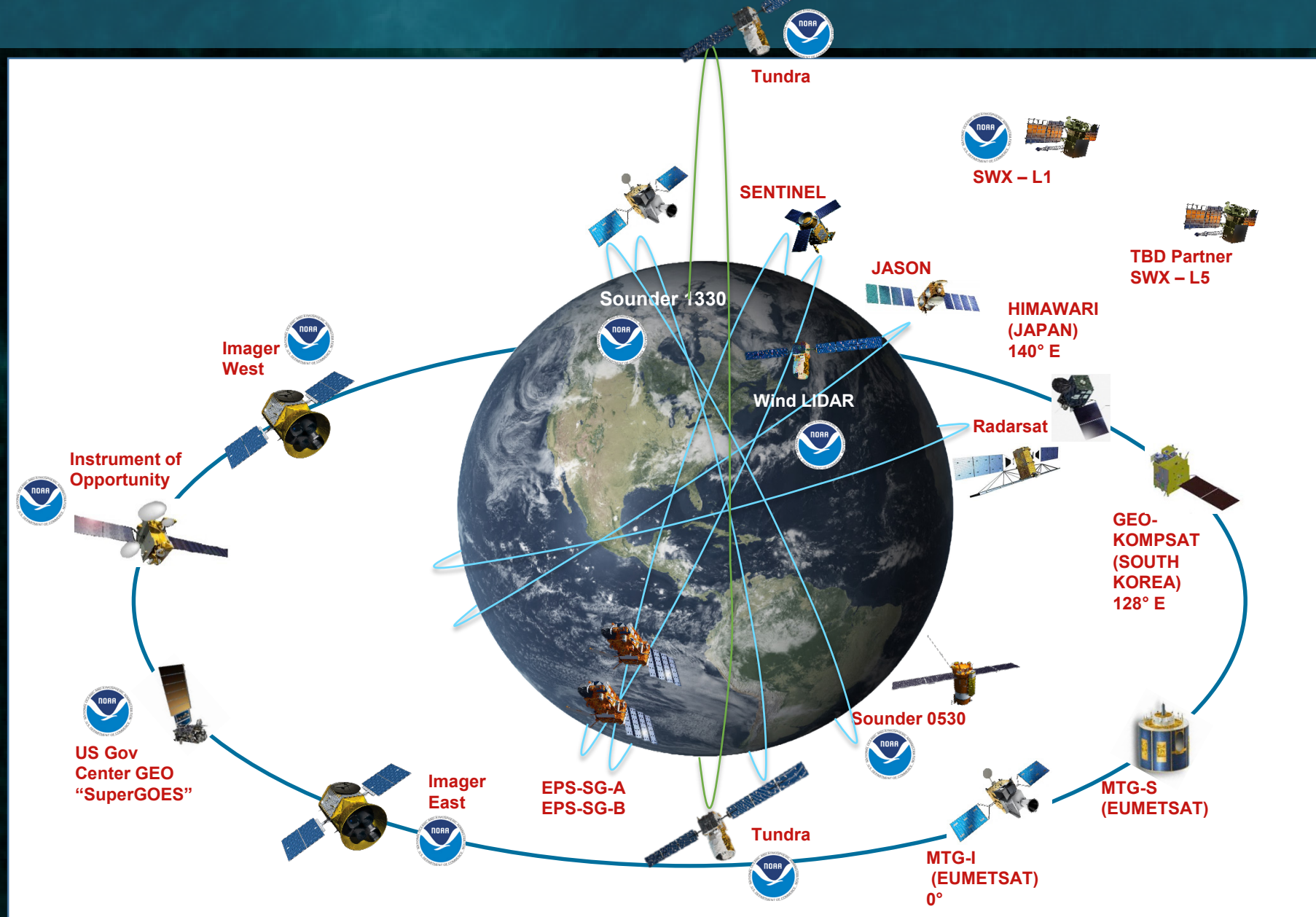
Prepared by UCAR/COSMIC



Near-Term Observational Capability



Evolution of NOAA's Space Architecture



NOAA Commercial Weather Data Pilots

- **CWDP Round 1 – NOAA identified radio occultation (RO) as initial data set for evaluation, concluded in Sep 2017**
 - Round 1 activities addressed processes for contract writing and initial evaluation
 - Did not address: IT security, data rights and distribution, real time data ingest
- **CWDP Round 2 – Released in Apr 2018, awards in Sep 2018**
 - Perform a more comprehensive assessment of the value of commercial RO data
 - Develop NOAA systems readiness for future purchases of operational weather data from commercial sources



- **NESDIS continues to canvass the commercial sector for available data sets that can meet NOAA mission needs**
 - Broad RFI released May 21, 2018 to inform CWDP in 2019 and beyond
- **NOAA Satellite Observing System Architecture Study is informing the NOAA observing architecture 2030-2050**
 - Systematically considering commercial capabilities as a potential part of future architectures, along with NOAA programs of record and international partner missions
 - Future pilots will be guided by the results of this study and ongoing market research



THANK YOU!

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