



# NOAA's Current and Future Space Weather Architecture

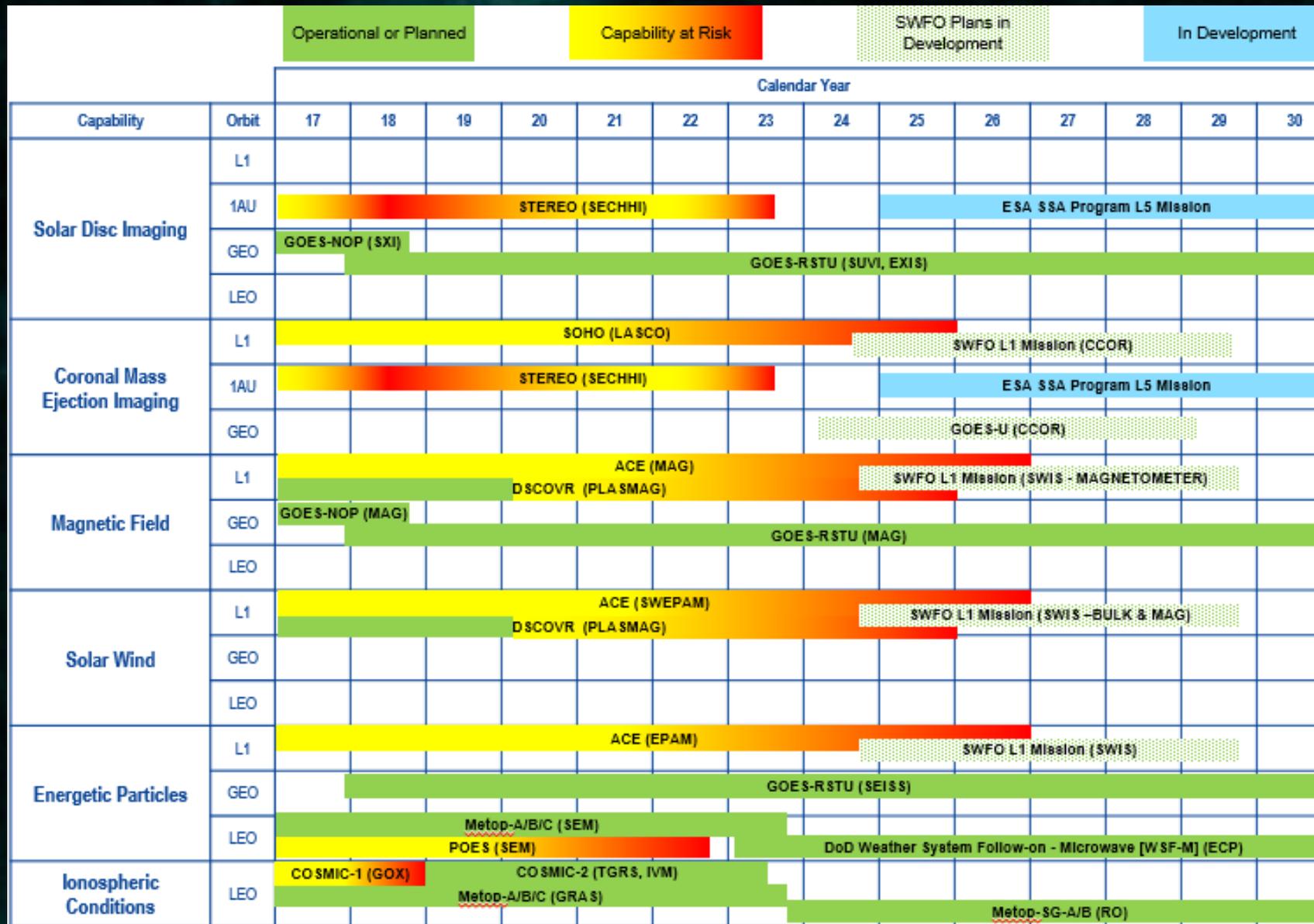


NOAA Satellite and  
Information Service  
[www.nesdis.noaa.gov](http://www.nesdis.noaa.gov)

April 4, 2019

**Dr. Elsayed Talaat**  
**Director, Office of Projects, Planning, and Analysis**  
**2019 Space Weather Workshop**

# Space Weather Current and Planned Capacity



# Space Weather Follow-On (SWFO) Program

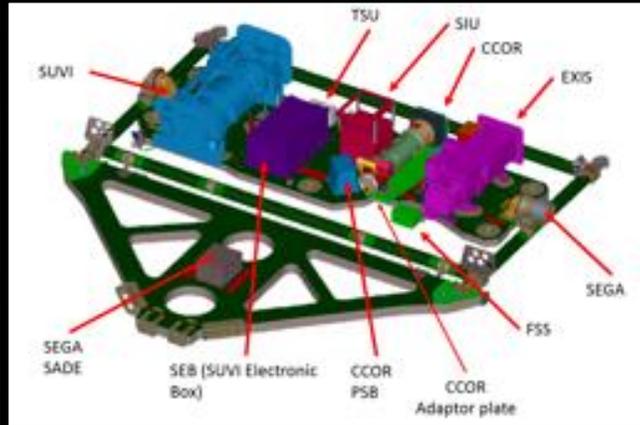
- Sustain a foundational set of space-based observations and measurements (i.e., Coronal Mass Ejection (CME) imaging and solar wind measurements)
- Ensure continuity of critical data:
  - Complete the Compact Coronagraph (CCOR) with the U.S. Naval Research Laboratory (NRL) as a NOAA reimbursed project
    - Transfer ability to manufacture CCOR to private industry for long term data continuity
    - Technology transfer to industry plan in development
  - Develop an L1 satellite mission (SWFO-L1) for launch in late 2024:
    - Include a Solar Wind Instrument Suite (SWIS) to measure essential solar wind, a CCOR for continuous coronal imagery, a possible Instrument of Opportunity (IOO)
    - Work with NASA to launch the SWFO-L1 mission as a rideshare with NASA's Interstellar Mapping and Acceleration Probe (IMAP)
  - Integrate a Coronagraph on the GOES-U spacecraft planned for launch in early 2024
  - Establish a robust ground architecture and service together with interagency and international partners to acquire and process data in support of the space weather mission
  - Archive space weather observations and measurements at the National Centers for Environmental Information (NCEI) to facilitate user access, statistical model development and benchmarking



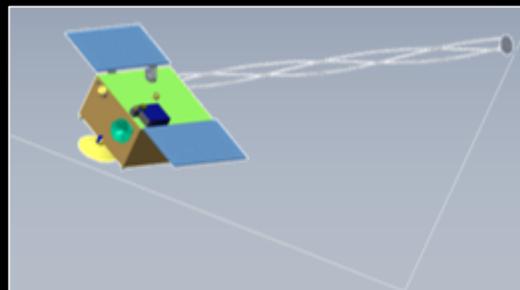
# SWFO Program Key Technical Components

## GOES-U Solar Pointing Platform (SPP)

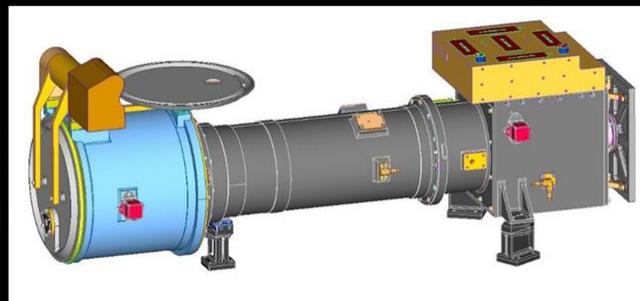
CCOR +  
SUVI +  
EXIS



3-Axis  
Stabilized ESPA  
Class  
Spacecraft



Compact  
Coronagraph  
(CCOR)



## SWFO-L1 Mission Overview

- Space Weather Operational Observation at Earth-Sun Lagrange Point 1
- IAA with NASA to procure an ESPA Grande compatible spacecraft and a SWIS (Solar Wind Instrument Suite)
- NOAA ground services
- Rideshare with NASA IMAP
- Nominal orbit: L1
- Nominal launch: 2024
- SWFO-L1 Instruments: CCOR, SWIS and a potential instrument of opportunity (IOO)
- Potential ESA contributed instrument (X-Ray flux monitor)

## Coronagraph Project

- Compact Coronagraphs under development by NRL via an IAA
- CCOR for SWFO-L1 Satellite, deliver 2022
- CCOR for GOES-U, deliver 2021
- Potential CCOR for ESA-L5 Satellite, deliver 2023

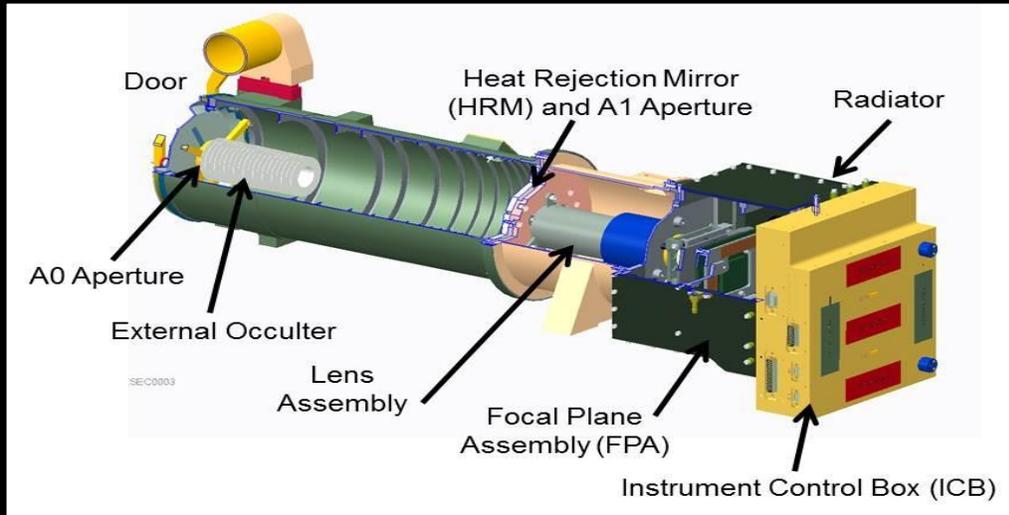
## Coronagraph Accommodation on GOES-U

CME imaging from geostationary orbit  
CCOR Integrated onto GOES-U SPP  
Commanding and data flow through GOES-R ground services  
Nominal launch: 2024



# A Space Telescope for the Corona: CCOR

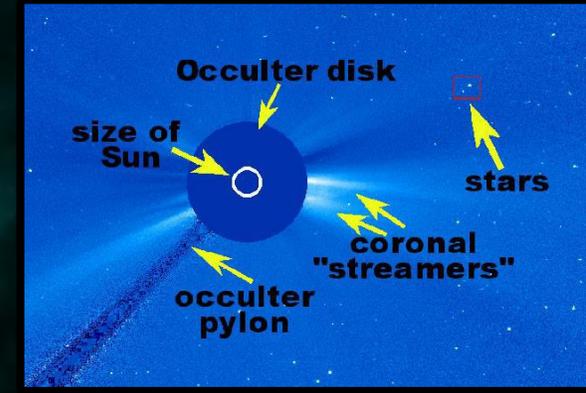
## Compact CORonagraph



## 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

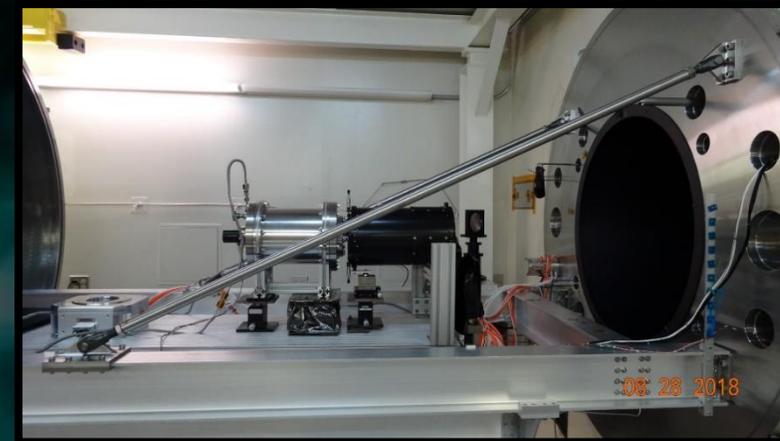
Parameter	Threshold	Goal
Field of View (FOV)	3-17 $R_{SUN}$	3-22 $R_{SUN}$
Pointing Knowledge	25 arcsec	12.5 arcsec
Knowledge of Solar North	1 deg	0.5 deg
Spatial Resolution	50 arcsec	
Photometric Accuracy	10%	
Image Cadence	15 min	5 min
Data Latency	15 min	5 min



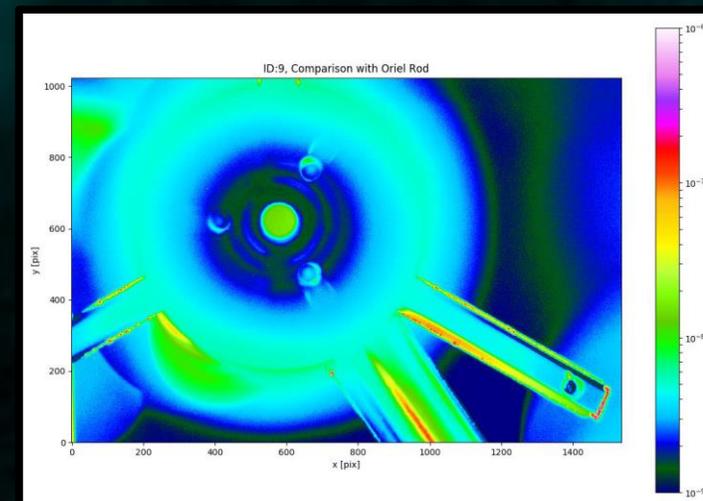
# CCOR Instrument Status

- 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 taking place 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



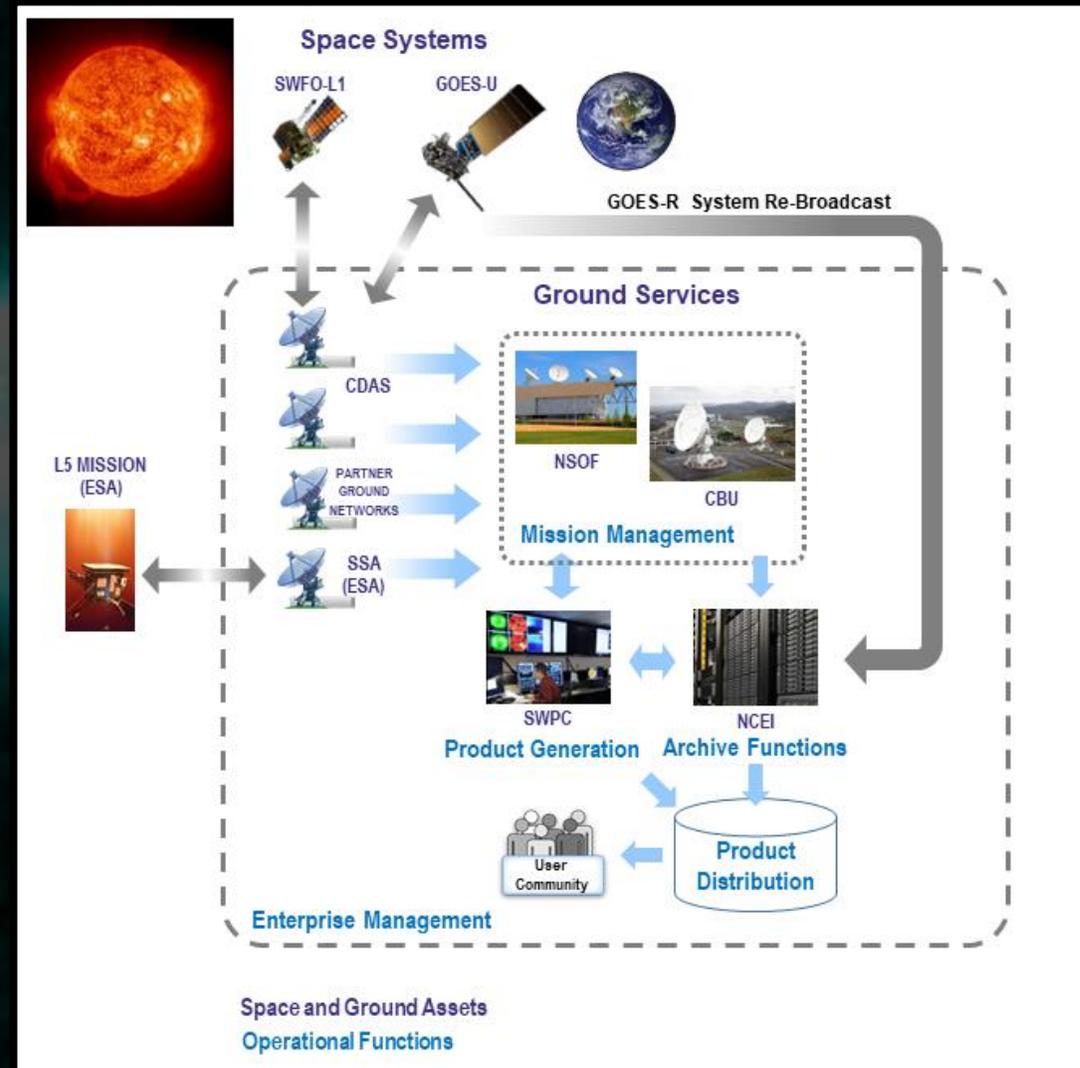
Occulter pylon optimization test



# SWFO Ground Services

- NOAA will develop and operate the Ground Service in accordance with the existing Ground Enterprise Requirements Structure
- The 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

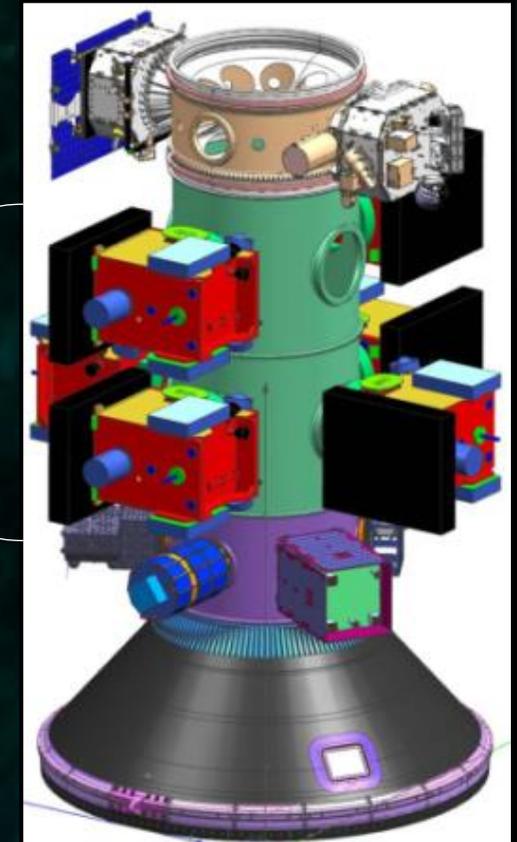
Launch Date: Not Earlier Than June 14, 2019

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

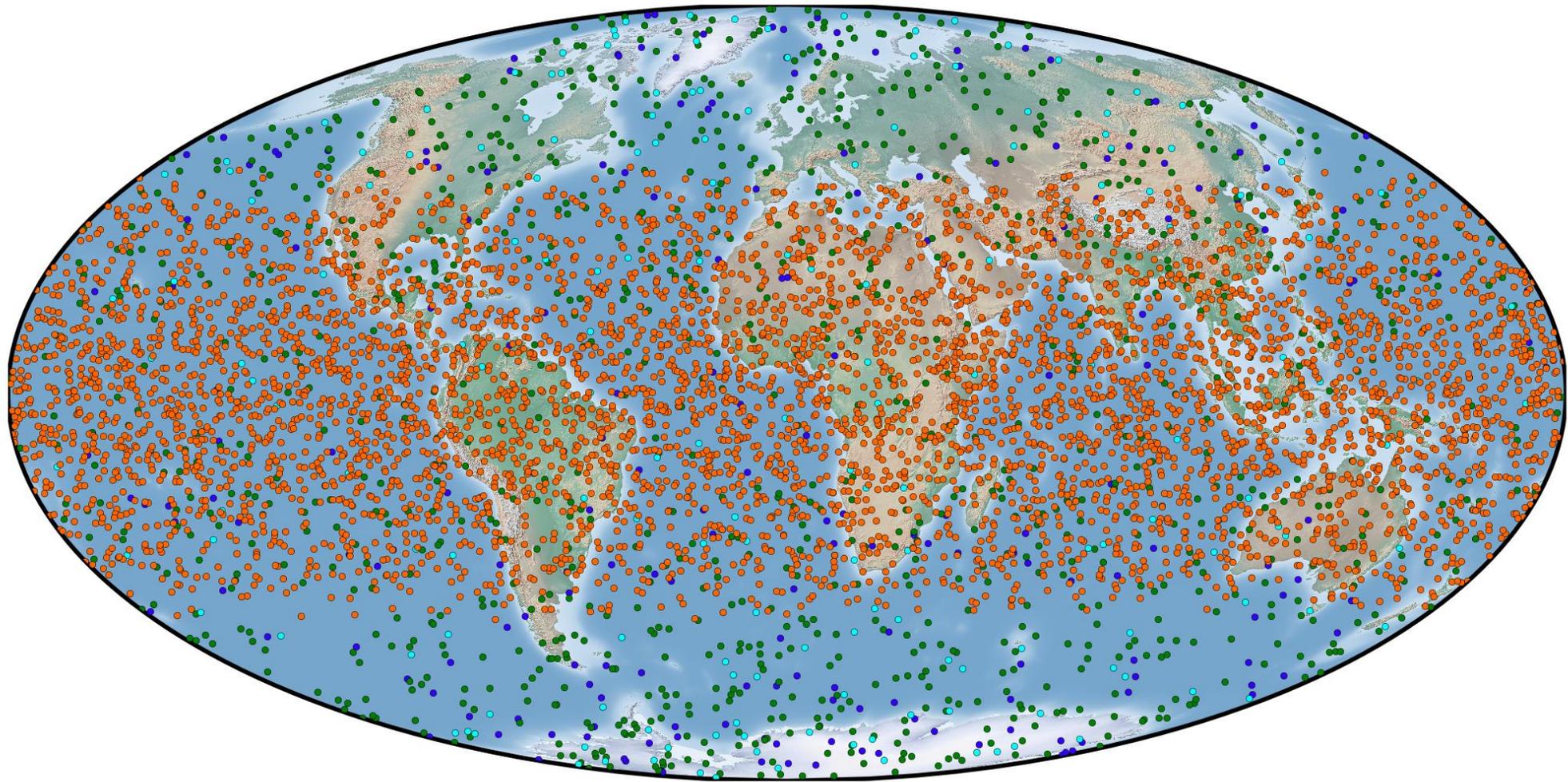


Courtesy of SSTL



COSMIC-2  
Spacecraft  
in STP-2  
Launch  
Stack

# COSMIC-2 and Partner Data

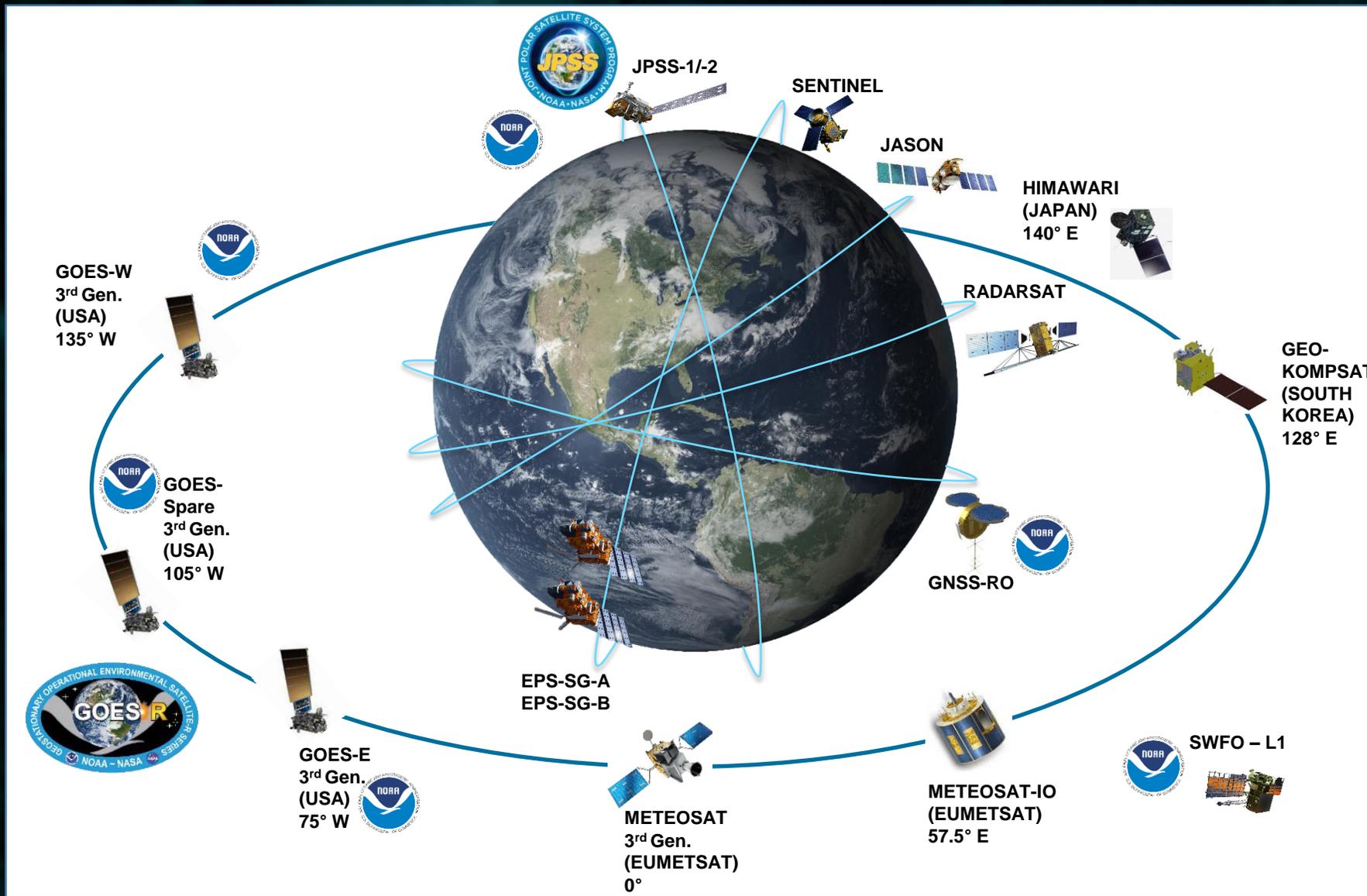


• KOMPSAT-5 • Metop-AB • PAZ • COSMIC-2

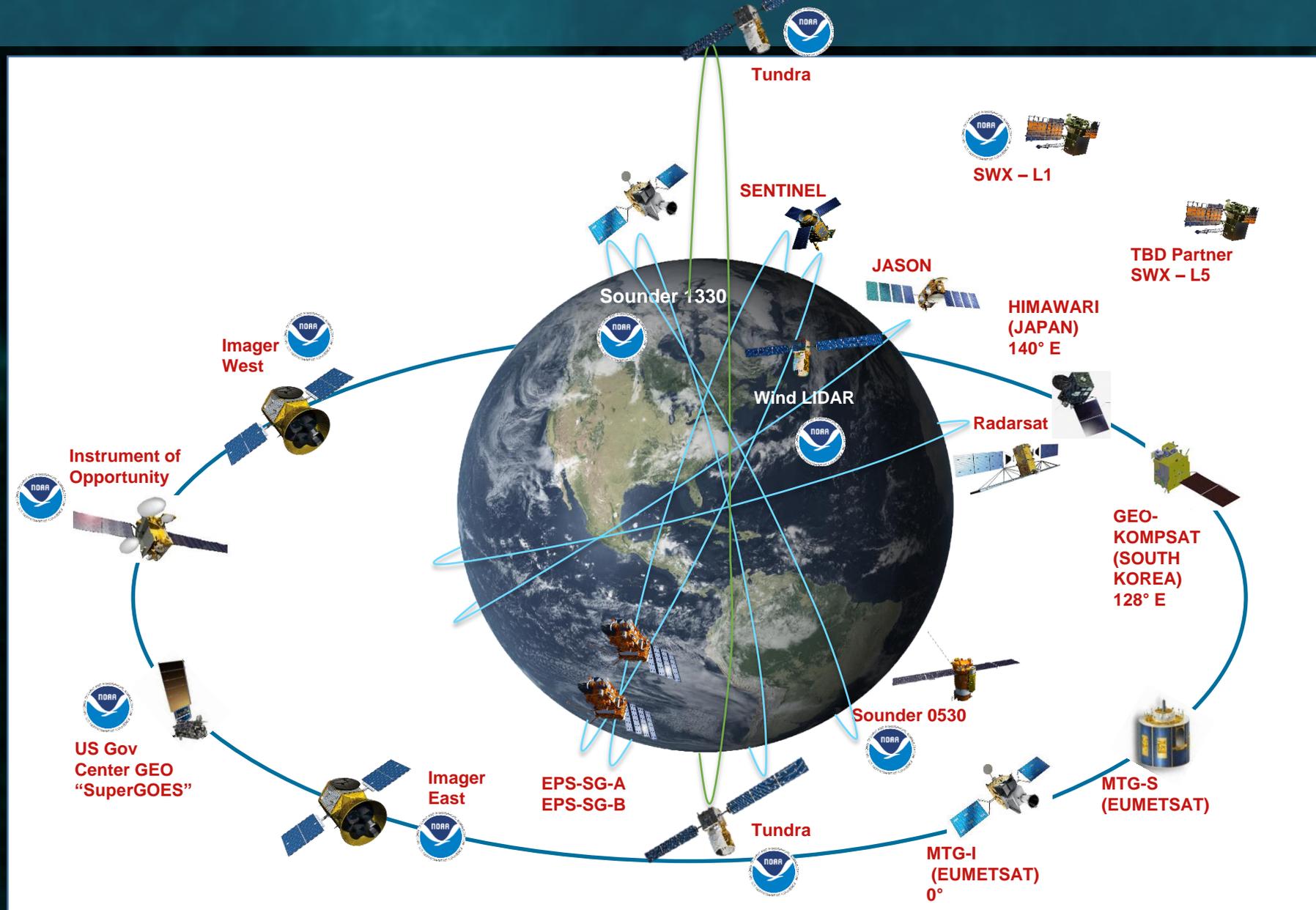
Prepared by UCAR/COSMIC



# 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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