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For Information toPlenary

STATUS OF NOAA CURRENT AND FUTURE SATELLITE PROGRAMS – REPORT TO CGMS-51

1 EXECUTIVE SUMMARY

This document summarizes the status of NOAA current and future LEO and GEO satellite systems. The reporting period for the current satellite operations is June 1, 2022 to June 15, 2023. For future satellites, progress to date at the time of writing is included.

Current satellite programs cover the status of the spacecraft, ground segment, space weather effects, and data transmission.

Future satellite programs cover the mission objectives (spacecraft, payload, instruments, products) and program status (space, system and ground segments).

CGMS is invited to take note.

2 INTRODUCTION

This paper reports on the status of NOAA current and future satellite systems. The reporting period for current satellite operation is 1 June, 2022 to 15 June 2023. For future satellites, progress to date at the time of writing is included.

3 CURRENT SATELLITE SYSTEMS

3.1 GEO Satellites

Sector	Satellites in orbit P= pre-operational Op=operational B=back-up L=limited availability	Location	Launch Date	Details on near real time access to L0- L1 data (links)	Environmental payload and status
GOES-West	GOES-18 (Op)	137.0°W	03/01/2022	https://www.ospo.noaa.gov/Organization/About/access.html	All payloads are operational
GOES-East	GOES-16 (Op)	75.2°W	11/19/2016	https://www.ospo.noaa.gov/Organization/About/access.html	All payloads are operational
Standby	GOES-17	104.7°W	03/01/2018	https://www.ospo.noaa.gov/Organization/About/access.html	Backup for GOES-East and GOES-West
Standby	GOES-14	108.2°W	06/27/2009	https://www.ospo.noaa.gov/Organization/About/access.html	Backup for GOES-East and GOES-West
TBD	GOES-U	TBD	April 2024	https://www.ospo.noaa.gov/Organization/About/access.html	ABI, EXIS, SUVI, SEISS, MAG, GLM, CCOR

3.2 LEO Satellites

Orbit Type ECT=Equator Crossing Time (for sun-synchronous orbits)	**Satellites in orbit** P= pre-operational Op=operational B=back-up L=limited availability	**Equator Crossing Mean Local Time First Ascending Node**	**Mean altitude**	**Launch Date**	**Details on near real time access to L0/L1 data (links)**	**Instrument payload and status**
Polar, non-SSO	JASON-3 (OP)	N/A	1336 km	Jan 17, 2016	https://www.ospo.noaa.gov/Organization/About/access.html	All Green: Poseidon-3B Altimeter, DORIS, AMR-2, GPSP, LRA, CARMEN-3, LPT
Polar, SSO, Afternoon	NOAA-21	13:25	834 km	Nov 10, 2022	https://www.ospo.noaa.gov/Organization/About/access.html	VIIRS, ATMS, CrIS, CERES, OMPS
Polar, SSO, Afternoon	NOAA-20	13:25	834 km	Nov 18, 2017	https://www.ospo.noaa.gov/Organization/About/access.html	VIIRS, ATMS, CrIS, CERES, OMPS
Polar, SSO, Afternoon	Suomi-NPP (Op)	13:25	833 km	Oct 28, 2011	https://www.ospo.noaa.gov/Organization/About/access.html	VIIRS, ATMS, CrIS, CERES, OMPS
Polar, SSO	NOAA-19 (Op)	20:37 as of 6/12/2023	870 km	Feb 6, 2009	https://www.ospo.noaa.gov/Organization/About/access.html	MHS, AVHRR are Yellow, AMSU-A1/2, ADCS, SEM and HIRS, SBUV, APT are Green
Polar, SSO	NOAA-18 (Op)	22:30 as of 6/12/2023	854 km	May 20, 2005	https://www.ospo.noaa.gov/Organization/About/access.html	HIRS, MHS, and SBUV are Red, SEM is yellow, and AVHRR, AMSU-A1/2, APT, DCS are Green
Polar, SSO	NOAA-15 (Op)	19:28 as of 6/12/2023	813 km	May 13, 1998	https://www.ospo.noaa.gov/Organization/About/access.html	AMSU-B are red, HIRS is yellow, AVHRR, AMSU-A1, SARR, SEM are Yellow, and AMSU- A2, and DCS, and APT are Green.
Polar, SSO	JPSS-3 (P)	1330	824	2032	https://www.ospo.noaa.gov/Organization/About/access.html	ATMS, CrIS, VIIRS, OMPS-N, RB

Polar, SSO	JPSS-4 (P)	1330	824	2028	https://www.ospo.noaa.gov/Organization/About/access.html	ATMS, CrIS, VIIRS, OMPS-N, RB

3.3 Other LEO Satellites

Orbit Type	Satellites in orbit P= pre-operational Op=operational B=back-up L=limited availability	Mean altitude	Launch Date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
Low-orbit, 24° inclination, non-SSO	COSMIC-2	520 km	June 25, 2019	https://www.cosmic.ucar.edu/what- we-do/cosmic-2/data	All six TGRS instruments are Green. Neutral atmosphere products assimilated into NWS GFS in May 2020 and other global weather prediction centers

3.4 Space Weather Satellites

Sector	Satellites in orbit P=pre- operational Op=operational B=back-up L=limited availability	Location	Launch date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
L-1	DSCOVR (Op)	L-1 Lagrangian Point	2/11/2015	https://epic.gsfc.nasa.gov/	Operational Space weather instruments - nominal; terrestrial instruments (EPIC and NISTAR) - nominal; DSCOVR attitude control system - nominal and operational

4 STATUS OF CURRENT GEO SATELLITE SYSTEMS

4.1 Mission objectives, payload/instruments, products

The goals of the Geostationary Operational Environmental Satellite (GOES) system program are to:

- Maintain continuous, reliable, operational, environmental, and storm warning systems to protect life and property
- Monitor the earth's surface and space environmental conditions
- Introduce improved atmospheric and oceanic observations as well as data dissemination
- Develop and provide new and improved applications and products for a wide range of federal agencies, state and local governments, and private users

The GOES system functions to accomplish an environmental mission serving the needs of operational meteorological, space environmental, and research users, including:

- Warnings to U.S. public – detect, track, and characterize - hurricanes, severe storms including flash floods, winter cyclones, and forest fires
- Imagery for weather forecasting
- Derived products for analysis and forecasting – surface temperatures, wind for aviation and NWS numerical models, sounding and radiances for NWS models, air quality, and rainfall estimates
- Environmental data collection – platforms including buoys, rain gauges, river levels, and ecosystem monitoring

4.2 Status of spacecraft

GOES-18
GOES-18 launched on March 1, 2022. After completing a successful on-orbit checkout and testing of its instruments and systems, GOES-18 was handed over to the NOAA Office of Satellite and Product Operations in October 2022. The satellite then underwent additional testing of its data products. GOES-18 went into operational service as GOES-West on January 4, 2023, replacing GOES-17.

GOES-17
GOES-17 was launched on March 1, 2018. GOES-17, located at 104.7°W, serves as an on-orbit standby for the operational GOES-East or GOES-West. GOES-17 has ABI performance degradation due to an issue with the instrument's thermal subsystem. A great deal of progress was made optimizing the performance of the GOES-17 data and the instrument is currently delivering over 94% of the data.

GOES-16
GOES-16 was launched on November 19, 2016. It has been located at 75.0°W, as GOES-East since December 18, 2017. All of the GOES-16 payload instruments are nominal.

GOES-15
The U.S. Congress approved the property transfer of GOES-15 to the USSF on June 7, 2023. This satellite will replace EWS-G1 as the operational EWG-G2 to support DoD observations

over the Indian Ocean domain. GOES-15, launched on March 4, 2010, is currently moving westward from 128°W to 61.5°E at approximately 0.35 deg/day. A Yaw-flip maneuver is required at equinox to mitigate a sounder temperature control blanket anomaly. The Star tracker 1 failed in 2014 and star tracker 2 failed in 2015, so GOES-15 is operating with a single star tracker. GOES-15 SXI and XRS are backup instruments for the Space Weather Prediction Center (SWPC).

GOES-14
GOES-14, launched on June 27, 2009, is located at 108.2°W, as a standby spacecraft. GOES-14 is in normal configuration, instead of storage mode configuration, to provide quick services as a backup. All of the GOES-14 payload instruments are nominal.

4.3 Ground segment matters

The availability of the GOES ground systems was nominal in the reporting period. There are three GOES-R antennas at the Wallops Command and Data Acquisition Station (WCDAS) in Wallops, Virginia, and three at the Consolidated Backup Facility (CBU) in Fairmont, West Virginia, which have been tested and certified for GOES NOP operations.

4.4 Data transmission

Data transmission for GOES NOP is handled through the Processed Data Relay (PDR) direct broadcast service in the GOES Variable (GVAR) transmission format. The GOES-R series GOES Rebroadcast (GRB) is the primary relay of full resolution, calibrated, near-real-time direct broadcast space relay of Level 1b data from each instrument and Level 2 data from the Geostationary Lightning Mapper (GLM). The Environmental Satellite Processing Center (ESPC) collocated with the NSOF also provides data directly to users, including the National Weather Service and field users.

4.5 Projects, services

NOAA does not have new projects to list at this time.

4.6 User statistics

None available.

5 STATUS OF CURRENT LEO SATELLITE SYSTEMS

5.1 Mission objectives, payload/instruments, products

NOAA's Joint Polar Satellite System (JPSS) provides global observations that serve as the backbone of both short- and long-term forecasts, including those that help us predict and prepare for severe weather events. NOAA is currently flying three of the five satellites scheduled in the fleet: NOAA/NASA Suomi National Polar-orbiting Partnership (Suomi NPP) satellite, NOAA-20, previously known as JPSS-1, NOAA-21, previously known as JPSS-2. Each satellite carries at least four state-of-the-art instruments, including the Advanced Technology Microwave Sounder (ATMS), the Cross-Track Infrared Sounder (CrIS), the Visible Infrared Imaging Radiometer Suite (VIIRS), the Ozone Mapping and Profiler Suite

(OMPS). Some of the satellites, like NOAA-20 and JPSS-3, carry an instrument to measure the Earth's energy budget.

One of NOAA's previous Polar-orbiting Operational Environmental Satellites (POES) satellites, NOAA-19 (launched in Feb 2009), remains the primary PM satellite only for services such as SARSAT and the Argos Data Collection System (collecting data from small remote environmental transponders worldwide). Two of the residual spacecrafts, NOAA-18 and NOAA-15 provide additional payload data and observational capability. In April 2013, NOAA declared EUMETSAT's Metop-B as NOAA's mid-morning primary operational spacecraft. Metop-C is the successor to Metop-B and Metop-A, and it carries four POES-legacy instruments: The Advanced Very High-Resolution Radiometer (AVHRR), the Advanced Microwave Sounding Units, AMSU-A1 and AMSU-A2, and the Space Environment Monitor, SEM-2. AVHRR captures visible and infrared imagery of clouds, oceans, the atmosphere, ice, and land surfaces. AMSU-A1 and AMSU-A2 measure global atmospheric temperature, humidity, precipitation and snow and ice cover in all weather conditions. And the Space Environment Monitor studies energetic particles in the upper atmosphere.

5.2 Status of spacecraft.

NOAA-21
The Joint Polar Satellite System-2 (JPSS-2) mission launched from the Vandenberg Space Force Base in Lompoc, California on November 10, 2023. NOAA-21 is currently providing provisional data and is expected to be declared operational in July 2023. NOAA-21 is part of the Joint Polar Satellite System (JPSS), NOAA's next generation of weather satellites. It is operating advanced instruments including the Visible Infrared Imaging Radiometer Suite (VIIRS), the Advanced Technology Microwave Sounder (ATMS), the Cross-track Infrared Sounder (CrIS), the Clouds and the Earth's Radiant Energy System (CERES), and the Ozone Mapping and Profiler Suite (OMPS).

NOAA-20
The Joint Polar Satellite System-1 (JPSS-1) launched on November 18, 2017 and re-designated NOAA-20. NOAA-20 has been operated as the Primary PM Weather satellites since February 12, 2019. NOAA-20 is part of the JPPS, NOAA's next generation of weather satellites. NOAA-20 is operating the Visible Infrared Imaging Radiometer Suite (VIIRS), the Advanced Technology Microwave Sounder (ATMS), the Cross-track Infrared Sounder (CrIS), the Clouds and the Earth's Radiant Energy System (CERES), and the Ozone Mapping and Profiler Suite (OMPS) and is contributing to the continuity of observations that are critical for environmental monitoring and prediction. The vehicle and instruments are all operating within specifications.

S-NPP
Suomi National Polar-orbiting Partnership (S-NPP) was launched on Oct 28, 2011, and operated as the Primary PM Weather satellite from May 1, 2014, until February 12, 2019. S-NPP is the precursor of the NOAA's JPSS. It is operating the Visible Infrared Imaging Radiometer Suite (VIIRS), the Advanced Technology Microwave Sounder (ATMS), the Cross-track Infrared Sounder (CrIS), the Clouds and the Earth's Radiant Energy System (CERES), and the Ozone Mapping and Profiler Suite (OMPS). The vehicle and instruments are all operating within specifications except the CrIS instrument is only providing longwave and shortwave IR information due to a digital signal processor issue.

NOAA-19
NOAA-19, launched in February 2009, remains the primary NOAA polar environmental satellite for SARSAT and Argos Data Collection System (NOAA-20 is the primary environmental data satellite in the PM orbit). Along with Metop satellites, it operates the Advanced Very-High- Resolution Radiometer (AVHRR), the High-resolution Infrared Radiation Sounder (HIRS), the Advanced Microwave Sounding Unit (AMSU) A, the Microwave Humidity Sounder (MHS, in place of the AMSU- B), the Solar Backscatter Ultraviolet Instrument (SBUV/2), and the Space Environment Monitor (SEM), as well as SARSAT and the Argos Advanced Data Collection System (ADCS), improved over the version in older satellites. NOAA-19's instruments are fully functional, with the exception of its HIRS and MHS payloads, which are operating in a degraded mode.

NOAA-18
NOAA-18, launched in May 2005, is currently a secondary PM polar environmental satellite. Along with Metop satellites, it is operating the Advanced Very-High-Resolution Radiometer (AVHRR), the High-resolution Infrared Radiation Sounder (HIRS), the Advanced Microwave Sounding Unit (AMSU) A, the Microwave Humidity Sounder (MHS, in place of the AMSU-B), the Solar Backscatter Ultraviolet Instrument (SBUV/2), and the Space Environment Monitor (SEM), as well as SARSAT and the Argos Data Collection System (DCS) payloads. NOAA-18's instruments are mostly fully operational, though the SBUV/2, MHS and HIRS are inoperative. SAR and Argos DCS payloads are both fully functional.

NOAA-15
NOAA-15, launched in May 1998, is currently a secondary AM polar environmental satellite, along with Metop-A/B. Along with the Metop satellites, it is operating the Advanced Very-High-Resolution Radiometer (AVHRR), the High-resolution Infrared Radiation Sounder (HIRS), the Advanced Microwave Sounding Unit (AMSU) A and B, and the Space Environment Monitor (SEM). Most of the instruments are operating in a degraded mode, with the HIRS and AMSU-B non- operational and the SEM and AMSU-A2 units remaining fully operational. At 20+ years old, it is the oldest of the NOAA satellites. NOAA-15 also carries a SARSAT payload, as well as the Argos DCS payload. The SAR unit on NOAA-15 is operating in a degraded mode and the Argos DCS payload is fully operational.

5.3 Ground segment matters

The JPSS Ground System supports Suomi NPP, NOAA-20, NOAA-21 and a diverse set of low-Earth-orbiting satellites used for operational weather forecasting, environmental monitoring and climate research.

The Ground System is a series of antennas, communications networks, and processing facilities that command and control the satellites, bring their data down to Earth, route data to processing facilities, create data products and distribute them.

The JPSS Ground System also provides services to the following missions:

- Japan Aerospace Exploration Agency's Global Climate Observation Mission-Water 1 (GCOM-W1)
- U.S. Department of Defense's Defense Meteorological Satellite Program

- U.S. missions supported by NASA's Space Communications and Navigation networks (such as Terra, Aqua, Aura, Landsat)
- European Organization for the Exploitation of Meteorological Satellites' (EUMETSAT) meteorological operations missions
- National Science Foundation's (NSF) Antarctic research program at McMurdo station

5.4 Data transmission

Data transmission for POES is handled through the Environmental Satellite Processing Center (ESPC) collocated with the NOAA Satellite Operations Facility at Suitland, Maryland. Data is provided to users, including the National Weather Service, through the ESPC, and to field users directly through the High Resolution Picture Transmission (HRPT) direct broadcast service. S- NPP and NOAA-20 utilize the NPP Data Exploitation (NDE) / Product Distribution and Access (PDA) and the Interface Data Processing Segment to ingest and distribute products to users worldwide as well as High Resolution Data (HRD) direct broadcast service.

5.5 Projects, services

NOAA does not have new projects to list at this time.

5.6 User Statistics

NOAA does not maintain user statistics.

6 STATUS OF CURRENT OTHER LEO SATELLITE SYSTEMS

6.1 Mission objectives, payload/instruments, products

FORMOSAT-7/COSMIC-2 is a joint U.S.-Taiwan satellite mission being conducted under an agreement between the American Institute in Taiwan (AIT) and the Taipei Economic and Cultural Representative Office in the United States (TECRO). NOAA is AIT's designated representative, and the National Space Organization (NSPO) is TECRO's designated representative. The objective is to continue collecting data similar to FORMOSAT-3/COSMIC mission (decommissioned in May 2020) with important technology advances. The objective of the FORMOSAT-7/COSMIC-2 mission is to demonstrate an operational constellation for the continuous and uniform collection of atmospheric and ionospheric data as inputs to daily near-real-time weather forecasts, space weather research, and climate change studies. For operational numerical weather prediction and space weather monitoring, the Radio Occultation (RO) data profiles from the reliable global constellation system will number approximately 4,000 profiles on average per day.

The 6 FORMOSAT-7/COSMIC-2A satellites launched into low earth parking orbits with altitude of 720 km and inclination of 24º on June 25, 2019. Each FORMOSAT-7/COSMIC-2 satellite carries one primary mission payload, called the TriG Global Navigation Satellite System (GNSS) Radio Occultation (RO) System (TGRS) which tracks GNSS signals and infers the deviations in each signal's straight-line path caused by temperature, pressure, moisture and electron density gradients.

The six equatorial satellites also each carry two U.S. secondary science payloads. The Ion Velocity Meter (IVM) measures in-situ plasma properties using a series of apertures mounted on the ram-facing side of the low-inclination satellites. The IVM also measures the background ionospheric density, ion composition, and ion temperature for ionospheric modeling research.

The Radio Frequency Beacon (RFB) measures the ionospheric scintillation by transmitting phase coherent signals in UHF, L-Band and S-Band RF which are received by ground-based receivers. The ground receivers also measure the ionospheric total electron content (TEC) along the ground receiver-satellite line of sight during satellite contacts. The RFB ground receivers were established by the USAF and by NSPO at ancillary sites

6.2 Status of spacecraft

The six COSMIC-2 spacecraft completed orbit lowering in February 2021 and are now in their final, evenly spaced mission orbits. The Neutral atmosphere observations are now available through the WMO Global Telecommunications System (GTS) and are used operationally by several Numerical Weather Prediction Centers including at NOAA and ECMWF. The Ionospheric products have been validated and are operational at the USAF 557th Weather Wing, and will be in operational use at NOAA SWPC this fall.

6.3 Ground segment matters

For satellites in the low-inclination orbit, ten (10) receiving stations are strategically placed around the equator in Taiwan, Hawaii, Honduras, Guam, Kuwait, Australia, Brazil, Ghana, Tahiti, and Mauritius Island. The NSPO Satellite Operations Control Center (SOCC) provides command and control of the COSMIC-2 constellation.

The Mark IV-B antennas in Hawaii, Honduras, Guam, and Kuwait are provided by the U.S. Air Force. The Australian Bureau of Meteorology (BoM) provides an antenna in Darwin. The Brazil National Institute of Space Research (INPE) operates an antenna at their facility in Cuiaba, Brazil.

NSPO provides antennas in Taiwan as part of the FORMOSAT-7/COSMIC-2 mission. Mauritius antenna services are provided to NOAA under a Program Implementation Plan with the Norwegian Space Centre, and NOAA has contracted for antenna services in Ghana and Tahiti. The Ghana and Mauritius Island ground sites now provide backup commanding capability.

6.4 Data transmission

The data collected by FORMOSAT-7/COSMIC-2 are downlinked to the tracking stations and then transferred to the U.S. Data Processing Center (USDPC) at UCAR as well as to the Taiwan Data Processing Center (TDPC). The TDPC is the mirror site of the USDPC to serve the users in Taiwan. Several “Day In the Life” (DITL) tests have been completed to demonstrate readiness of the various components of the ground system. These DITL tests have successfully verified the data transmission from the ground antenna sites through the USDPC to the end users at NOAA/NWS.

The main objective of the USDPC is to process all raw mission science data into Environmental Data Record (EDR) products, disseminate the data for operational use by

weather and space weather forecast centers and for research by the broad atmospheric science community. The USDPC processes the mission science data in a near real-time mode for operational applications, within 8 weeks of observation in a post- processing mode, and in a re-processing (re-analysis) mode every 2-3 years with consistent software algorithms. The USDPC serves as a complete mission data analysis center for the FORMOSAT-7/COSMIC- 2 mission.

6.5 Projects, services

COSMIC-2 data is available for operational use through the WMO GTS. UCAR also provides service to the scientific community through UCAR Data Processing Center https://cdaac-www.cosmic.ucar.edu.

6.6 User statistics

NOAA does not maintain user statistics.

7 STATUS OF CURRENT SPACE WEATHER SATELLITE SYSTEMS

7.1 Mission objectives, payload/instruments, products

The DSCOVR mission monitors solar wind activity from L1 in order to provide early warning for Earth orbiting satellites and ground-based systems that are susceptible to disturbances in solar wind. The PlasMag instrument, which includes a Magnetometer, Faraday Cup (FC), and Electrostatic Analyzer (ESA), collects the solar wind data for downlink to SWPC. The data is downlinked 24/7 through NOAA's ground stations (WCDA, FCDA) and Real Time Solar Wind Network (RTSWNet) around the globe.

Additionally, DSCOVR collects Earth observations from a pair of Earth-pointing instruments; the Earth Polychromatic Imaging Camera (EPIC) and U.S. National Institute of Standards and Technology (NIST) Advanced Radiometer (NISTAR).

7.2 Status of spacecraft

DSCOVR spacecraft is operational with all instruments operating as intended. DSCOVR was placed in safe-hold due to life limiting issues associated with Z-axis laser gyro in April 2019 and flight software modifications were deployed in January 2020 to utilize star tracker for attitude determination - in early March 2020 DSCOVR resumed full operations. SWPC switched operations from ACE to DSCOVR on July 27, 2016. ACE is still being utilized as back-up.

7.3 Ground segment matters

NOAA currently does not have any ground segment matters to report.

7.4 Data transmission

DSCOVR Space weather data are collected through NOAA's CDAS (Command and Data Acquisition System) and RTSWNet (Real Time Solar Wind Network) and distributed to U.S. and international users by the NOAA National Weather Service's Space Weather Prediction

Center (SWPC). Terrestrial data and images are distributed by NASA's DSCOVR Science Operations Center (DSOC).

7.5 Projects, services

EPIC images are provided to public through the following web link: http://epic.gsfc.nasa.gov/

7.6 User statistics

NOAA does not maintain user statistics.

8 FUTURE SATELLITE SYSTEMS

8.1 GEO SATELLITES

Sector	Satellites in orbit P= pre-operational Op=operational B=back-up L=limited availability	Location	Launch Date	Details on near real time access to L0- L1 data (links)	Environmental payload and status
TBD	GOES-U	TBD	April 2024	https://www.ospo.noaa.gov/Organization/About/access.html	ABI, EXIS, SUVI, SEISS, MAG, GLM, CCOR

8.2 LEO Satellites

Orbit Type ECT=Equator Crossing Time (for sun-synchronous orbits)	Satellites in orbit P= pre-operational Op=operational B=back-up L=limited availability	Equator Crossing Mean Local Time First Ascending Node	Mean altitude	Launch Date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
Polar, SSO	JPSS-3 (P)	1330	824	2032	https://www.ospo.noaa.gov/Organization/About/access.html	ATMS, CrIS, VIIRS, OMPS-N, RB
Polar, SSO	JPSS-4 (P)	1330	824	2028	https://www.ospo.noaa.gov/Organization/About/access.html	ATMS, CrIS, VIIRS, OMPS-N, RB

8.3 Space Weather Satellites

Sector	Satellites in orbit P=pre- operational Op=operational B=back-up L=limited availability	Location	Launch date	Details on near real time access to L0/L1 data (links)	Instrument payload and status
L-1	Space Weather Follow-On (SWFO) (P)	L-1, Lagrangian Point	2025	https://www.ospo.noaa.gov/Organization/About/access.html	In final design and fabrication phase (Phase C)

9 STATUS OF FUTURE GEO SATELLITE SYSTEMS

9.1 Mission objectives, spacecraft, payload/instruments, products

The Space Segment consists of the spacecraft, instruments, auxiliary communications payloads, and launch vehicle. The primary instrument is the Advanced Baseline Imager (ABI) that will provide hemispheric, synoptic, and mesoscale imagery for global and CONUS forecasting and severe weather warning. Secondary instruments include the Extreme ultraviolet and X-ray Irradiance Sensor (EXIS), Solar Ultraviolet Imager (SUVI), Space Environment In-Situ Suite (SEISS), Magnetometer (MAG), and Geostationary Lightning Mapper (GLM). The GOES-U spacecraft will also include a Compact Coronagraph (CCOR) instrument. Additionally, GOES-R will provide a set of communications services (Unique Payload Services) in support of the Data Collection System (DCS), High-Rate Information Transmission and Emergency Managers Weather Information Network (HRIT/EMWIN) and Search-and-Rescue Satellite Aided Tracking (SARSAT), GOES-R will make available 34 meteorological, solar and space weather products. Additional products will be made available over time. Additional information about the baseline and planned future products is available at: http://www.goes-r.gov/products/overview.html.

The GOES-U, the final satellite in NOAA's GOES-R Series, is nearly integrated and preparing for an environmental test in preparation for its planned launch in April 2024. The GOES-U spacecraft will include the addition of an instrument that is new to the GOES-R series satellite, a Compact Coronagraph (CCOR) instrument that will monitor space weather activity including solar flares and coronal mass ejections.

NOAA has recently initiated formulation for the Geostationary Extended Observations (GeoXO)program, the satellite series that will follow GOES-R. GeoXO previously completed the Mission Concept Review, the Key Decision Point A and the Milestone 1 decision point, during which the program proposed a constellation of three satellites: East and West satellites, at 75W and 137W longitude respectively, will carry an Imager, Lightning Mapper, and Ocean Color instrument. An additional Center satellite at 105W will manifest a Sounder and Atmospheric Composition instrument. There has been a lot of progress with the Phase A Studies for the other instruments (GXS, ACX, LMX and OCX) and the GeoXO spacecraft. These definition- phase studies will help design the instrument and spacecraft concepts, mature necessary technology, and help define potential performance, risks, costs, and development schedule. The results of the studies will be used to set performance requirements for the development contracts. All of the Phase A Studies are now complete (a Space Act agreement non-reimbursable spacecraft Phase A Study vendor final review is scheduled for June 21, 2023 but all of the firm- fixed-price contract Phase A Studies are complete and final reviews have been conducted).

9.2 Ground segment matters

GOES-U will use the GOES-R ground system.

Data transmission

GOES-U will use the data transmission systems for the GOES-R series.

For GEO-XO, the East and West satellites will provide DCS relay capability. Other rebroadcast functions are planned to be accomplished with commercial communications satellites.
To support the large increase in spatial, spectral, and temporal resolution of the ABI and other instruments, the raw data rate has been increased to an equivalent 31 Mbps. GOES-R data volume drives a large increase in processing requirements for product generation and for distribution of the products to users. Product processing accounts for a much greater part of the GOES-R life cycle cost than the legacy system.

10 STATUS OF FUTURE LEO SATELLITE SYSTEMS

10.1 Mission objectives, spacecraft, payload/instruments, products

JPSS-3 and JPSS-4 are scheduled for launch in 2032 and 2028 respectively. They are the final two satellites of NOAA's JPSS.

NOAA's Near-Earth Orbit Network (NEON) Program will develop future low-Earth orbit (LEO) environmental satellites. Low and medium Earth observations are critical for weather forecasting, environmental observation, climate monitoring and public safety. NEON sets the stage for NOAA to manage future polar and other low Earth and medium Earth orbit satellite observations as loosely coupled projects. The NEON Program will supplement and eventually replace NOAA's Joint Polar Satellite System (JPSS). JPSS will continue to operate its series of polar orbiting satellites through the late 2030's. NEON will lay the groundwork for the next generation of LEO satellites long before the final JPSS launch takes place. NEON will continue, improve and extend NESDIS' global observations for weather forecasting, disaster management, and climate monitoring. The Low Earth Orbit (LEO) satellites from NOAA, NASA and international partners contribute to more than a half-century of unbroken climate data records. LEO satellites are the backbone of global long-range weather forecasting models, supplying more than 80 percent of the numerical weather prediction model data used for 3 to 7-day forecasts. These satellites detect and monitor hazards such as fires, droughts, floods, poor air quality, coral bleaching events, unhealthy coastal waters and others. NOAA and its interagency and international partners use LEO data every day to meet ongoing mission needs. The NEON program will usher in a new paradigm for NOAA to continue to provide for these environmental measurements to support a wide variety of atmospheric, terrestrial, marine and polar observations. Data uses include the numerical weather prediction models, fire and flood models, atmospheric chemistry observations and multiple land imagery products that have been crucial pieces of the NOAA strategic goals to build both a "Weather Ready Nation" and a "Climate Ready Nation. NEON is a collaborative mission between NOAA and NASA. NASA will manage the development of the satellites and launch them for NOAA, which will operate them and deliver data to users worldwide. NOAA and NASA will work with commercial partners to design and build the NEON spacecraft and instruments

9.2 Ground segment matters

JPSS-3 and JPSS-4 will use the same ground segment as NOAA-20 and NOAA-21.
Data transmission

JPSS-3 and JPSS-4 will use the same data transmission as NOAA-20 and NOAA-21.

11 STATUS OF FUTURE SPACE WEATHER SATELLITE SYSTEMS

11.1 Mission objectives, spacecraft, payload/instruments, products

NOAA has developed a space weather strategy to ensure continuity of SWPC forecasting capabilities for the space weather effects outlined above. The NESDIS primary space-weather goals include:

- Provide continuous 24/7 CME imagery to maintain SWPC's required operational effectiveness
- Provide continuous 24/7 data of key solar wind variables to SWPC. The variables include plasma density, bulk velocity, and temperature; vector magnetic field; and suprathermal proton flux at several energies.
- Continue to update and operate a robust space and ground architecture.

11.1.1 Space Weather Follow On L1 (SWFO-L1)

In advancing this strategy, NOAA has recently developed the multifaceted SWFO program which aims to:

a) add SWFO-L1 to the monitoring spacecraft; and
b) place a CCOR telescope on GOES-U so as to continue supplying coronal images and solar wind data essential in SWPC's forecasting capabilities.

The spacecraft will also carry a Solar Wind Instrument Suite (SWIS) comprising a plasma instrument to measure the solar wind (Solar Wind Plasma Sensor, or SWiPS), a magnetometer (MAG), and an energetic particle detector (SupraThermal Ion Sensor, or STIS) all of which are specified to be similar to those of DSCOVR. Images of the Sun's corona will be generated at 15- minute intervals while solar wind variables will have a 5-minute cadence.

SWFO-L1 is planned for launch in 2025 as a rideshare to NASA's Interstellar Mapping and Acceleration Probe (IMAP) mission to L1Space Weather Follow On (SWFO) sustains NOAA's foundational set of space-based space weather observations and measurements to ensure continuity of critical data. Development underway for:

- SWFO-L1 Observatory
- Instruments (CCORs, MAG, SWiPS, STIS)
- Ground Segment (Command & Control, SWFO Antenna Network, and Product Generation and Distribution)

NOAA has established agreements with NASA, the Naval Research Lab (NRL), and European Space Agency (L1 & L5 cooperation). NOAA Completed SWFO Program & Flight Project Critical Design Reviews in May 2022 and is on track for launches in 2024 (GOES-U Mission) and 2025 (SWFO L1 Mission).

SWFO-L1 will operate at the L1 point with the objective of providing both coronal imaging and in situ measurements of the solar wind and its magnetic field, all of which are used by SWPC's forecasters and its numerical models. SWFO-L1 will carry the CCOR telescope with a field of view (FOV) of 3-22 Rsun. The CCOR units on GOES-U (section 6) and SWFO-L1 will

complement each other to provide a robust and redundant system to provide continuous 24/7 CME imagery.

11.1.2 Space Weather Next (SW Next)

Space Weather Next (SW Next) will maintain and extend space weather observations from a range of different observing points, selected to most efficiently provide the comprehensive knowledge of the Sun and the near-Earth space environment. Planning for sustainment and augmentation of observations from:

- LaGrange Point 1 (L1)
- LaGrange Point 5 (L5)
- Geostationary Orbit (GEO)
- Low Earth Orbit (LEO)
- Highly Elliptical Orbit (HEO)

Program and L1 Series Project are currently in formulation phase and Space Weather Next (SW Next) is engaging stakeholders through: User outreach targeting civil aviation, electric grid, and satellite operator communities, Partnerships for observational support and exchange of space weather observational data, and RFIs and RFPs for L1 Series Project instruments and observatory.

11.2 Ground segment matters

NOAA will utilize a number of ground station networks for telemetry and data acquisition for SWFO-L1 centered on NOAA's ground station network which includes the Wallops Command and Data Acquisition Station (WCDAS) at Wallops, Virginia, Fairbanks Command and Data Acquisition Station (FCDAS) at Fairbanks, Alaska, and the Consolidated Backup (CBU) facility at Fairmont, West Virginia. NOAA is also investigating the use of ground stations by other agencies (NASA, Air Force) and international partner organizations. In December 2022, NOAA signed an agreement with Japan's National Institute of Information and Communications Technology (NICT) for cooperation to develop and implement an international ground network to support collection and distribution of operational data from space-based space weather missions, including but not limited to the NESDIS Space Weather Follow-on (SWFO) L1 mission

11.3 Data transmission

The coronal images and solar wind data acquired by SWFO-L1 and CCOR on GOES-U will be downlinked to the tracking station of the ground networks and then transferred to OSPO's NSOF. SWPC will process the data and images, generate data products, and distribute them directly to operational users. NCEI will archive data products and make them available to retrospective users.

12 ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION BY CGMS PLENARY SESSION

NOAA has no actions or recommendations for consideration by the CGMS-51 Plenary Session.

13 CONCLUSION

This document summarizes the status of NOAA current and future satellite systems. CGMS is invited to take note.