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NOAA'S FY2019 BUDGET REQUEST FOR SATELLITES

For FY2019, President Trump is requesting $1,399,563,000 for procurement, acquisition and construction (PAC) activities for NOAA's satellite programs, the only portion of the NOAA budget tracked in this report.

Congress has not completed action on NOAA's FY2018 budget request and the agency is operating under a Continuing Resolution (CR) through March 23, 2018. Pursuant to that CR, NOAA's current PAC funding for satellites is $1,965,439,000 because it is based on the FY2017 funding allocation. The FY2018 request, however, was much lower ($1,579,479,000) in part because of the planned ramp down of funding for development of the new geostationary and polar weather satellites.

Introduction

The National Oceanic and Atmospheric Administration (NOAA) manages the nation's civilian weather satellite and other operational environmental satellite programs. NOAA is part of the Department of Commerce and has a broad set of missions that include marine fisheries management, ocean and atmospheric research, and operation of the National Weather Service as well as its satellite programs.

NOAA's satellite programs are part of NOAA's National Environmental Satellite, Data and Information Service (NESDIS). The NESDIS budget is separated into two accounts: Operations, Research and Facilities (ORF) and Procurement, Acquisition and Construction (PAC). The PAC account contains funding for acquisition of new satellite systems *and is the only portion of the NESDIS budget tracked in this fact sheet*. NOAA's FY2019 budget request is available in its "Blue Book," posted on the NOAA website.

Congress appropriates funding to NOAA as part of the Commerce-Justice-Science (CJS) appropriations bill.

NOAA's Satellite Programs

Responsibilities for government weather, land imaging, and earth science satellites are split among several agencies. NOAA manages the nation's civilian weather satellites and, historically, other operational environmental satellite programs. NASA builds and launches earth science satellites for research and technology development purposes. The U.S. Geological

Survey operates the government's Landsat land remote sensing satellites. The Department of Defense (DOD) has its own weather satellite program as well as classified satellites for intelligence gathering.

This fact sheet covers only NOAA's satellite programs and only the Procurement, Acquisition and Construction (PAC) account.

Weather Satellites

NOAA operates two complementary weather satellite systems, one in polar orbit and one in geostationary orbit.

Polar Orbit

Satellites in polar orbit circle Earth's poles, allowing them to view the entire planet. NOAA's polar orbit satellites have been referred to as POES – Polar Orbiting Environmental Satellites – for decades. Once a POES satellite is in orbit, it is given a designation of "NOAA" followed by a number.

The United States began launching polar orbiting weather satellites in 1960 under NASA's aegis. As the program matured from research and development (R&D) to operations, it was transferred to the Environmental Satellite Services Administration (ESSA), which later became NOAA. The first satellite to be designated NOAA was launched in 1983. The last in that POES series, NOAA-19, was launched in 2009.

In 1994, the Clinton-Gore Administration directed NOAA and DOD to merge their separate civil and military polar orbiting weather satellites programs. That became the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program. NASA was part of NPOESS in a technology development role. In 2010, after 16 years of cost overruns and schedule delays, NPOESS was terminated and NOAA and DOD were directed to return to separate systems. Meanwhile, in 2011 NASA launched the technology demonstration satellite it had been building for NPOESS, which is now designated Suomi-NPP.[1]

Following the termination of NPOESS, NOAA initiated the **Joint Polar Satellite System (JPSS)** program. When JPSS began, NOAA was criticized for its high cost -- $12.9 billion for four satellites (a total that included about $4 billion in sunk costs in NPOESS).

NOAA reduced the cost from $12.9 billion to $11.3 billion simply by narrowing the definition of what is included in the estimate – only two satellites (JPSS-1 and JPSS-2) instead of four, plus

[1] Because of the many years that would elapse between the launch of NOAA-19 and JPSS-1, NOAA began using NASA's Suomi-NPP (S-NPP) as an operational weather satellite even though it is a technology demonstrator with a design life of only three years. NOAA officials and others repeatedly expressed concern that NOAA-19 and S-NPP might cease functioning before JPSS-1 was launched and a "gap" in weather satellite coverage might occur. However, that did not occur. NOAA-19, S-NPP and JPSS-1 (NOAA 20) are all currently operational.

the sunk costs in NPOESS. The other two satellites (JPSS-3 and JPSS-4) were put into a separate line item -- **Polar Follow On (PFO)**.[2]

JPSS-1 was launched on November 18, 2017. Now that it is in orbit, it has been redesignated NOAA-20. JPSS-2 is expected to be launched in 2021.

Polar Weather Satellites. In the FY2019 budget request**, JPSS and PFO are merged** into a single budget line item: Polar Weather Satellites. JPSS has been fully funded in recent years, but PFO struggled to win support in part because the satellites will not be launched for many years.

At the end of the Obama Administration, Congress appropriated $328.9 million for PFO in FY2017 and NOAA's FY2017 budget documentation showed the agency planned to request $586 million in FY2018.

Instead, the Trump Administration request for FY2018 was only $180 million and future years were listed as "TBD." NOAA stated in its FY2018 budget book that it would "initiate a re-plan" for the PFO program and "work to improve its constellation strategy considering all the polar satellite assets to ensure polar weather satellite continuity while seeking cost efficiencies, managing and balancing system technical risks and leveraging partnerships."

Congress has not completed action on the FY2018 request (see the FY2018 version of this fact sheet for more information), but the FY2019 budget request reflects the Administration's new plan.

It requests $878 million for the new combined Polar Weather Satellites line item. According to NOAA's budget documentation, that represents a $230.7 million net decrease, but "maintains the original Launch Readiness Dates for JPSS-3 and JPSS-4."

The FY2019 money would support operation of Suomi-NPP and JPSS-1/NOAA-20; continued development of instruments for JPSS-2, -3 and -4; and continued development, operations, maintenance and sustainment of their ground systems.

COSMIC-2 GPS Radio Occultation. NOAA is part of an international/interagency team building and operating a constellation of small satellites, COSMIC-2, to enhance the accuracy of forecasts using data from the polar orbiting satellites.

The Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC)-2 program is a constellation of 12 very small ("micro") satellites built by NOAA in cooperation

[2] In prior years, NOAA included a request of $10 million for an Earth Observing Nanosatellite-Microwave (**EON-MW**) as part of the PFO budget. The EON-MW concept was to build and launch a very small ("nano") satellite carrying a single microwave instrument that could provide vital measurements in case something went awry with JPSS-1. Congress was lukewarm about the idea. In FY2016 it denied the request. In FY2017 it said EON-MW could proceed as long as it did not interfere with PFO and would have to be paid for within available funds. No mention has been made of EON-MW in subsequent budget requests.

with Taiwan and the U.S. Air Force. It is a follow on to COSMIC (also known as Formosat-3), a set of six microsatellites launched in 2006.

The satellites use signals from the Global Positioning Satellite (GPS) system for radio occultation (dubbed GPS-RO or GNSS-RO[3]) to make measurements of temperature and water vapor throughout the lower parts of the atmosphere. When combined with measurements from polar-orbiting weather satellites, better weather forecasts are enabled.

NOAA's goal is to have at least two sets of six microsatellites in low Earth orbit: one in equatorial orbit and the other in polar orbit. NOAA also funds the ground system for reception and processing of the COSMIC data.

NOAA originally planned to fund the construction of the COSMIS-2 satellites, but private sector companies have emerged that want to provide RO data on a commercial basis using their own satellites. See prior year versions of this fact sheet information on the request and appropriations for COSMIC-2 and the debate over obtaining such data from commercial sources instead.

NOAA has stated that as many as 50,000-100,000 RO measurements per day would be useful and COSMIC provides only 2,000-3,000, so there is ample opportunity for other providers of such data if it meets NOAA's criteria that the data are accurate, reliable, timely, and can be validated.

The Trump FY2018 budget request was $6.1 million for COSMIC ground systems, but none for satellites. Congress has not completed action on the FY2018 request.

For FY2019, the COSMIC-2 request is $5.9 million

Geostationary Orbit

NOAA's other weather satellite system is in geostationary orbit 35,800 kilometers (22,300 miles) above the equator where satellites maintain a fixed position relative to a point on Earth. Such weather satellites are especially useful for monitoring tropical regions where hurricanes form.

NOAA keeps one Geostationary Operational Environmental Satellite (GOES) over the eastern region of the United States and adjacent waters and another over the western region. Whatever satellites are in those positions are designated "GOES-East" and "GOES-West." NOAA typically also keeps a spare satellite in between those two positions that can be moved quickly to replace a malfunctioning satellite if necessary (as happened in 2012 and 2013).

[3] GPS is the U.S. satellite system for positioning, navigation and timing (PNT) data. Russia, China and Europe have their own systems (GLONASS, Beidou and Galileo). Collectively they are referred to as Global Navigation Satellite Systems (GNSS). The COSMIC-2 satellites can use any of the signals.

NOAA is procuring[4] four new significantly enhanced GOES satellites – a block buy called the GOES-R series. Initially given letter designations (GOES-R, -S, -T and –U), they will change to numbers once they are in orbit.

The GOES-R satellite itself was successfully launched in November 2016 and is now GOES-16. NOAA recently placed GOES-16 into the GOES-East position, replacing GOES-13, which has been decommissioned. GOES-15 is GOES-West, with GOES-14 as the spare.

The series is still colloquially referred to as "GOES-R." The next one, GOES-S, is scheduled for launch on March 1, 2018.

The FY2018 budget request for the GOES-R series was $519 million, a steep drop from the $753 million appropriated for FY2017, but that is a planned reduction as development ramps down. Congress has not completed action on the FY2018 budget request. See the FY2018 version of this fact sheet for more information.

The request for FY2019 is $408 million.

Space Weather Satellites

Space weather is a term used to refer to ejections from the Sun –Coronal Mass Ejections (CMEs) and solar wind – that can overload systems on Earth and in orbit that are crucial to daily life, such as the electric grid or communications and navigation satellites.

NOAA operates the Space Weather Prediction Center in Boulder, CO that relies on data from many sources, including spacecraft located 1.5 million kilometers (1 million miles) from Earth at the Sun-Earth L1 Lagrange point. The primary satellite for observing CMEs is Europe's Solar Heliospheric Observatory (SOHO), which is quite old. It was launched in 1995. It has a coronagraph that blocks the light from the Sun so it can observe the Sun's corona and detect CMEs. NASA's Advanced Composition Explorer (ACE), launched in 1997, and the NOAA/NASA/Air Force Deep Space Climate Observatory (DSCOVR) detect solar wind.

DSCOVR was launched on February 11, 2015 and is now operational and funded through NOAA's Operations, Research and Facilities (ORF) account, which is not tracked in the fact sheet.[5]

The question now is what spacecraft and instruments are needed to enable space weather predictions in the future. Congressional interest in space weather is growing. On May 2, 2017, the Senate passed the Space Weather Research and Forecasting Act (S. 141) to focus attention on the issue, although its focuses on agency roles and responsibilities, not funding.

[4] NASA serves as the procurement agent for NOAA's satellites. NOAA specifies the requirements and provides the funding while NASA contracts for construction and launch of the satellites.

[5] DSCOVR has two NASA instruments that the Trump Administration wants to turn off. They are discussed in the companion fact sheet on NASA's budget request.

NOAA requested small amounts of money in FY2016 and FY2017 to begin analyzing alternatives for a successor to DSCOVR. In its FY2017 request, NOAA outlined a robust plan to acquire two new satellites, two sets of sensors, and two launches, with the goal of launching the first of the two satellites in FY2022 before the end of DSCOVR's design lifetime.

NOAA requested $2.5 million for FY2017 and Congress doubled it to $5 million. The projected request for FY2018 was $53.7 million, ramping up to $186.1 million in FY2019, $154.5 million in FY2020, and then down to $81.5 million in FY2021.

The Trump FY2018 budget request did not support that plan. The request for Space Weather Follow-on was only $500,000. The request also included $4.9 million for System Architecture and Advanced Planning (SAAP) to complete the NOAA Satellite Observing System Acquisition (NSOSA) study and associated grant work that included assessing future satellites for weather, space weather and environmental remote sensing beyond 2028. Congress has not completed action on the FY2018 budget request.

The FY2019 budget request proposes a different path than was proposed in FY2017 and focuses on a replacement for SOHO's coronagraph rather than a successor to DSCOVR.

Modestly funded at $10 million per year FY2019-2023, the Trump Administration's Space Weather Follow-on would fund the Naval Research Laboratory (NRL) to build a Compact Coronagraph (CCOR) to image CMEs. CCOR would not be launched on its own spacecraft, but integrated into the GOES-U geostationary weather satellite's suite of instruments and launched in 2024.

Whether that is sufficient to ensure the data needed to provide adequate warning of space weather events is likely to be debated during deliberations on the FY2019 request.

Cooperative Data and Rescue Services (CDARS, formerly SIDAR)

In FY2015 and FY2016, NOAA requested funds for a Solar Irradiance, Data and Rescue (SIDAR) program to replace the Polar Free Flyer (PFF) in NOAA's FY2014 budget request, which was zeroed by Congress. The goal was to find a way to launch three instruments – Total Solar Irradiance Sensor (TSIS), Advanced Data Collection System (A-DCS), and Search and Rescue Satellite-Aided Tracking (SARSAT) – that were intended to be launched on the cancelled NPOESS satellites (explained earlier). The JPSS spacecraft that replaced NPOESS are too small to accommodate these instruments. NOAA has been trying to find an alternative way to get them into orbit.

SIDAR was not popular in Congress and the TSIS sensor ultimately was transferred to NASA. By FY2016, what remained in this line item was funding for A-DCS and SARSAT.

For FY2017, the account's name was changed to CDARS, although the House Appropriations Committee still referred to it as SIDAR. The FY2017 request was $500,000 and Congress appropriated that amount.

The Trump FY2018 budget request was $500,000. Congress has not completed action on that request.

For FY2019, the request is $500,000.

Commercial Weather Data Pilot

Congress directed NOAA to initiate a commercial weather data pilot program in the FY2016 appropriations act to determine if weather data from commercial companies can be utilized in NOAA's weather models. Language in the accompanying explanatory report directed NOAA to seek to enter into at least one pilot contract, through a competitive process, to assess the potential viability of commercial weather data in its weather modeling and forecasting. NOAA officials expressed concern about whether commercial data will be accurate, reliable, timely, and can be validated. The pilot program is intended to answer those questions.

NOAA was required to submit an implementation plan for the pilot program. It provided the report to Congress in March 2016 and made it public in April. The pilot program will focus on radio occultation (RO) data, discussed earlier. See prior year versions of this fact sheet for funding in FY2016 and FY2017.

As noted earlier, the FY2018 Trump budget supports acquisition of data from commercial sources although it requests only $3 million, a reduction from the $5 million appropriated for FY2017. Congress has not completed action on the FY2018 request. See the FY2018 version of this fact sheet for more information.

The FY2019 request is $3 million.

Other NESDIS Satellite-Related Activities

The PAC account in NESDIS also funds satellite ground services; systems architecture and advanced planning; and projects, planning and analysis (PPA).

"Satellite CDA" is sometimes listed as part of the NESDIC PAC account. It is a construction project and therefore not tracked in this fact sheet or included in the following table since neither NOAA nor the House Appropriations Committee include in theirs. Only the Senate Appropriations Committee does (see footnote 2 to the table 2).

NOAA's FY2019 Budget Request for Satellite System Acquisition
(in $ thousands; see notes on next page)

Program	FY2017 enacted	FY2018 request	FY2019			
			Request	House	Senate	Final
GOES-R	752,784	518,532	408,380			
Jason-3	4,357	Note 4	N/A			
JPSS	787,246	775,777	N/A			
Polar Follow On (PFO)	328,900	179,956	N/A			
Polar Weather Satellites (merger of JPSS and PFO)	N/A	N/A	877,991			
Coop Data/Rescue Services (CDARS)	500	500	500			
DSCOVR	3,745	Note 5	N/A			
Space Wx FO	5,000	500	10,000			
COSMIC-2 (ground system) (new sats/data)	8,100 (8,100) (0)	6,100	5,892			
Satellite Grnd Services	54,000	53,000	52,332			
Sys Architecture & Adv Planning	3,929	4,929	4,929			
Projects, Planning & Analysis	25,200	37,185	36,539			
Commercial Weather Data Pilot	5,000	3,000	3,000			
TOTAL	1,978,761	1,579,479	1,399,563			

Source: Department of Commerce budget documents.
Note 1: Text and numbers in parentheses are subsets. NA = not applicable.
Note 2: This fact sheet does not track spending for the other NESDIS budget account, Operations, Research and Facilities (ORF), so the totals shown here may not conform to other sources. The Senate Appropriations Committee report usually includes another line – "satellite CDA facility" – that is not tracked in this fact sheet because it is a construction project, not a satellite system. The House Appropriations Committee report separates the satellite CDA facility from the other spending.
Note 3: The Earth Observing Nanosatellite-Microwave (EON-MW) project was variously listed in NOAA budget documents as part of PFO or separately.
Note 4: Beginning with the FY2018 budget request, Jason-3 and DSCOVR are funded in the ORF account that is not tracked in this fact sheet.