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DEFENSE WEATHER SATELLITES

DOD Faces Acquisition Challenges for Addressing Capability Needs

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GAO-16-769T

July 2016

GAO Highlights

Highlights of GAO-16-769T, a testimony before the Subcommittee on Environment, Committee on Science, Space, and Technology, House of Representatives

DEFENSE WEATHER SATELLITES

DOD Faces Acquisition Challenges for Addressing Capability Needs

Why GAO Did This Study

Weather data are instrumental for planning, executing, and sustaining U.S. military operations and for meeting civilian needs, such as weather forecasting and climate research. As existing weather satellite systems age, DOD faces potential gaps in its space-based weather monitoring capabilities. As a result, DOD and other stakeholders, including the military services, the intelligence community, and U.S. civil agencies such as NOAA, are now in a precarious position to fill key capability gaps with immediate and near-term solutions. DOD conducted an AOA to identify and compare the operational effectiveness and life cycle costs of potential solutions.

This testimony is based on a report GAO issued in March 2016 on its assessment of DOD's AOA and focuses on the extent to which it informed DOD's plans for providing weather-related capabilities and addressed input from stakeholders.

GAO reviewed DOD's AOA documents and interviewed DOD officials, including stakeholders within the military services, and NOAA officials.

What GAO Recommends

In the March 2016 report, GAO recommended that DOD establish formal mechanisms for coordination with NOAA, among other things, and DOD concurred.

View GAO-16-769T. For more information, contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov.

What GAO Found

GAO found in March 2016 that the Department of Defense (DOD), in conducting a requirements review and Analysis of Alternatives (AOA) from 2012 to 2014, generally performed a thorough review for identifying capability gaps in meteorological and oceanographic data—also referred to as weather data—that needed to be met and determining the operational benefit of satisfying these gaps.

In doing so, the AOA determined that some capabilities with military utility could be covered by other assets or addressed with modeling development. The AOA also offered analysis that was useful for informing plans for a space-based solution for three capabilities facing near-term needs: ocean surface vector wind, tropical cyclone intensity, and energetic charged particles. GAO found that DOD was developing plans based on this analysis for a Weather System Follow-on program to address these areas.

The AOA was less useful for informing plans for two of the highest-priority capabilities—cloud characterization and theater weather imagery data—now facing near-term gaps over the Indian Ocean. While DOD consulted with a wide range of stakeholders in conducting the AOA, it did not effectively collaborate with the National Oceanic and Atmospheric Administration (NOAA), which, on a case-by-case basis represents DOD's interests with international partners. Specifically, NOAA was not involved in reviews of the AOA or regular discussions with AOA study leadership. The lack of formal coordination and collaboration with NOAA, such as employing a mechanism that identified roles and responsibilities for the two agencies during the AOA, contributed to an incorrect assumption about the continued availability of critical weather data from European satellites. As a result, the AOA did not fully assess solutions for these high priority capabilities.

GAO reported that DOD was exploring options outside of the AOA process for mitigating these pending capability gaps, including continued or increased reliance on data provided by international partners.

Chairman Bridenstine, Ranking Member Bonamici and Members of the Subcommittee:

I am pleased to be here today to discuss the Department of Defense's (DOD) efforts to sustain and improve its space-based weather monitoring capabilities. Meteorological and oceanographic data—also referred to as weather data—are key to providing information for the successful planning, execution, and sustainment of U.S. military operations and for civilian uses, such as weather forecasting and climate research. As DOD's primary existing weather satellite system—the Defense Meteorological Satellite Program (DMSP)—ages and other satellites near their estimated end of life, DOD faces potential gaps in its space-based weather monitoring capabilities which may affect stakeholders that use them, including the military services, the intelligence community, and U.S. civil agencies such as the National Oceanic and Atmospheric Administration (NOAA). Today, I will provide background on DOD efforts to replenish its weather satellites and a brief overview of our recent review of the analysis DOD conducted to assess options for future weather satellites.

DOD has been challenged to replenish its weather satellites. After two unsuccessful attempts to develop follow-on programs from 1997 through fiscal year 2012, DOD and other stakeholders who rely on weather monitoring data are now in a precarious position in which key capabilities require immediate and near-term solutions. From February 2012 through September 2014, DOD conducted a requirements review and its Space-Based Environmental Monitoring (SBEM) Analysis of Alternatives (AOA) to identify and compare the operational effectiveness and life cycle costs of potential solutions for providing SBEM capabilities. An AOA—a key analysis in DOD's acquisition process—is intended to inform a decision on the most cost effective solution for meeting validated capability requirements and identify a wide range of solutions with a reasonable likelihood of providing the needed capabilities.

My statement is based on a report we issued earlier in March 2016 on our assessment of DOD's SBEM AOA and focuses on the extent to which the SBEM AOA addressed input from stakeholders and informed DOD's

plans for providing SBEM capabilities.[1] For that report, we reviewed relevant DOD and GAO documents to develop an understanding of the requirements and guidance for conducting an AOA and reviewed the AOA documents and interviewed DOD officials involved in conducting and reviewing the AOA to understand how it was developed. We also interviewed users and providers of DOD SBEM data (stakeholders), such as military service, intelligence community, and NOAA officials, to gain their perspectives on how stakeholder views were incorporated into the AOA. Additionally, we interviewed industry officials about ways to effectively assess options for providing SBEM capabilities, reviewed documents, and interviewed DOD officials about plans and decision making processes for providing future SBEM capabilities. We also interviewed NOAA officials about activities of the international SBEM community to understand potential effects on DOD's plans. Our work was performed in accordance with generally accepted government auditing standards.

Background

Since the 1960s, the United States has operated meteorological polar-orbiting satellite systems that provide global high-resolution observations—such as cloud cover, winds, precipitation, atmospheric temperature, and sea ice conditions—ideal for tactical weather support and long-range numerical weather prediction. DOD with its DMSP satellites, and NOAA with its Polar-orbiting Operational Environmental Satellite (POES) and Suomi National Polar-orbiting Partnership satellite (the first in the Joint Polar Satellite System), rely on each other's satellite systems to provide the data to meet their respective needs.[2] NOAA established the JPSS program in 2010 to replace aging polar satellites and provide critical environmental data used in forecasting the weather. NOAA, with assistance from the National Aeronautics and Space

[1]GAO, *Defense Weather Satellites: Analysis of Alternatives Is Useful for Certain Capabilities, but Ineffective Coordination Limited Assessment of Two Critical Capabilities*, GAO-16-252R (Washington, D.C.: March 10, 2016).

[2]Polar-orbiting satellites in low Earth orbit constantly circle the earth in an almost north-south orbit over the poles. Each successive orbital pass occurs at the same local time of day, such as early morning, mid-morning, and afternoon. DOD's DMSP satellites cross the equator in the early and mid-morning orbits and NOAA's satellites cross the equator in the afternoon orbit. The United States also relies on a European satellite, the Meteorological Operational satellite, currently crossing the equator in the mid-morning orbit.

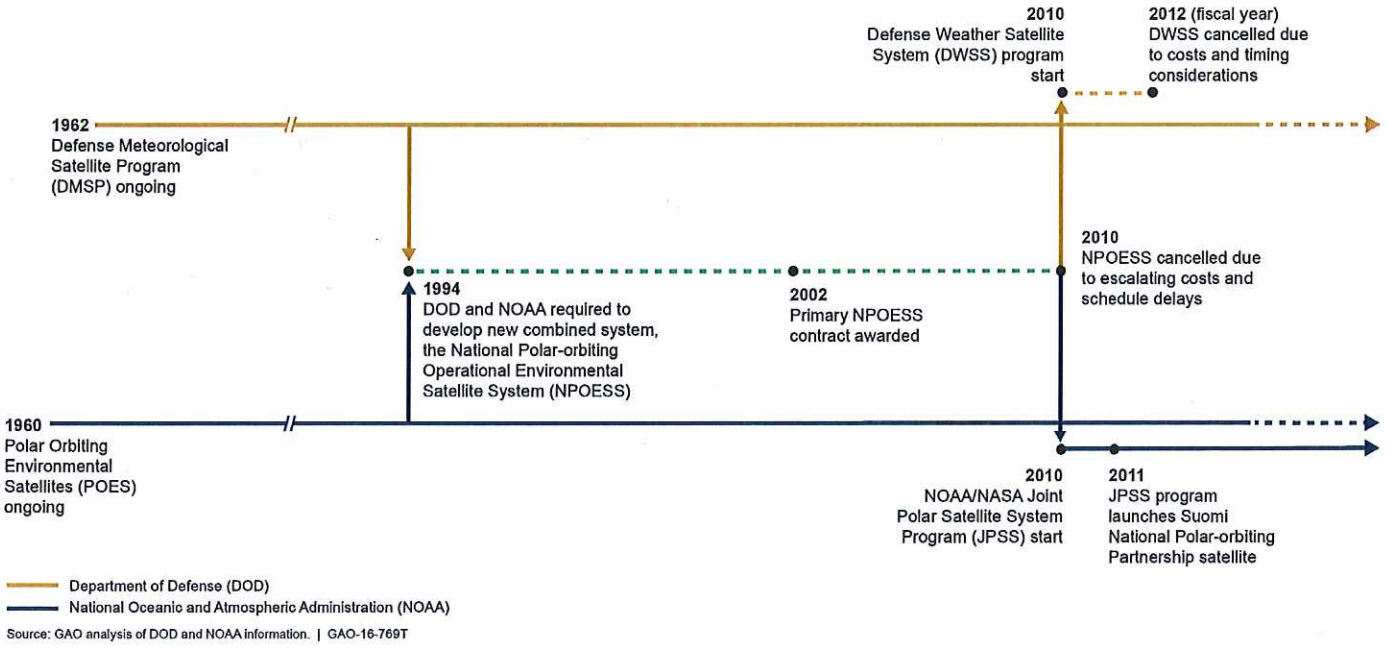
Administration (NASA), has developed the Joint Polar Satellite System to meet the responsibility for coverage in the afternoon orbit. DOD has been involved with two previous efforts to develop a replacement for DMSP, both of which were cancelled:

- National Polar-orbiting Operational Environmental Satellite System (NPOESS)—Tri-agency program between DOD, NOAA, and NASA to replace both DMSP and POES; started in 1997 and cancelled in 2010 due to escalating costs and schedule delays.
- Defense Weather Satellite System—DOD program intended to continue providing weather observations from the morning orbit following NPOESS cancellation; started in 2010 and cancelled in fiscal year 2012 because the program was considered early-to-need with unsustainable costs.[3]

Figure 1 below illustrates the timeline for the past DOD weather satellite acquisitions along with the timeline for NOAA's weather satellite development.

[3] In May 1994, a Presidential Decision Directive required DOD and the Department of Commerce through NOAA to converge their two separate weather satellite programs into a single program capable of satisfying both military and civilian requirements. Presidential Decision Directive NSTC-2, Convergence of U.S. Polar-Orbiting Operational Environmental Satellite Systems (May 5, 1994). DOD was responsible for the NPOESS acquisition, NOAA was responsible for overall program management and satellite operations, and NASA was responsible for facilitating the development and incorporation of new technologies. After NPOESS was cancelled in 2010, DOD was given responsibility for covering the early morning polar orbit and started a separate program, the Defense Weather Satellite System.

Figure 1: Time Line of Efforts to Replace DMSP



Source: GAO analysis of DOD and NOAA information. | GAO-16-769T

The challenges DOD has faced with replenishing its current weather satellite system, especially considering those encountered under the NPOESS program, are not surprising. Our prior work has found that DOD and civil government space programs have long been characterized by large cost overruns and schedule delays.[4] The types of management and oversight problems we commonly found include: optimistic cost estimating, funding gaps, lax oversight, poor contractor performance, parts quality problems, and frequent program manager turnover. Our reviews in recent years have made a number of recommendations aimed at putting DOD on a better footing as it considers and implements

[4]GAO, *Space Acquisitions: Challenges Facing DOD as it Changes Approaches to Space Acquisitions*, GAO-16-471T (Washington, D.C.: Mar. 9, 2016); GAO, *Space Acquisitions: Some Programs Have Overcome Past Problems, but Challenges and Uncertainty Remain for the Future*, GAO-15-492T (Washington, D.C.: Apr. 29, 2015); GAO, *Polar-Orbiting Satellites: With Costs Increasing and Data Continuity at Risk, Improvements Needed in Tri-agency Decision Making*, GAO-09-772T (Washington, D.C.: June 17, 2009).

significant changes for space programs. For example, we recommended that when planning for the next phase of competition for launches, the Air Force use an incremental approach to the next acquisition strategy to ensure that it does not commit itself to a strategy until data is available to make an informed decision, and DOD concurred.[5]

Our prior work has shown that DOD satellites have also tended to be monolithic—attempting to satisfy the needs of many and to get the most capability out of a satellite as possible in light of the high cost of launching them. While this approach met the needs of multiple missions, it further complicated satellite design. Our work on the NPOESS program has shown that without clear lines of authority, conflicts between satellite users hampered decisions, such as for requirements. Cost and schedule growth in DOD's space programs was sometimes driven by inherent technical, design, and engineering risks, but more often than not, our reports found that management and oversight problems were behind cost and schedule growth. Consequently, as DOD moves forward with its efforts to replenish its weather satellites, careful consideration of ways to address or avoid these longstanding challenges may help to deliver needed capabilities within cost and schedule goals.

DOD's SBEM Analysis of Alternatives Is Useful for Certain Capabilities, but Ineffective Coordination Limited Assessment of Two Critical Capabilities

Our March 2016 report found that DOD made an effort to plan for future capabilities with a more cost-effective approach in mind, including consideration of which capabilities DOD needed to provide and which could be provided by leveraging other sources of data. Specifically, we found that DOD generally conducted a thorough review for identifying capability gaps that needed to be met and determining the operational benefit of satisfying these gaps. In doing so, the study determined that some gaps could be better addressed by non-space-based solutions or improvements to modeling. We also found that the AOA offered analysis that was useful for informing plans for a space-based solution for three capabilities with near-term needs—ocean surface vector wind, tropical cyclone intensity, and energetic charged particles—and that other capabilities with military utility could be covered by other assets or addressed with modeling development. In March 2016 we reported that DOD is developing plans based on this analysis for a Weather System

[5]GAO-16-471T.

Follow-on program to provide ocean surface vector wind and tropical cyclone intensity capabilities, though it may not be available in time to avoid short term gaps. For the third capability, energetic charged particles, the Air Force has developed a plan to collect data by hosting sensors on all of its satellites.

However, we found that the AOA was less useful for informing plans for the two highest-priority capabilities—cloud characterization and theater weather imagery data—now facing near-term gaps over the Indian Ocean, because it did not fully assess solutions to provide these capabilities. While DOD consulted with a wide range of DOD stakeholders in conducting the AOA, it did not effectively collaborate with NOAA (on a case-by-case basis, NOAA represents DOD's interests with international partners regarding SBEM data). Specifically, NOAA was not involved in reviews of the AOA or regular discussions with AOA study leadership.[6] The lack of formal coordination and collaboration with NOAA, such as employing a mechanism that identified roles and responsibilities for the two agencies during the AOA, contributed to an incorrect assumption about the continued availability of critical data from European satellites. Specifically, the AOA study determined that the likelihood the gap would not be filled was low, based on historical trends, and as a result DOD did not fully assess solutions for cloud characterization and theater weather imagery data. However, NOAA officials who work closely with international partners had an understanding of the plans for European satellites at the time, and during the AOA study period, publicly available reports from an international coordination group indicated uncertainty about extended European coverage over the Indian Ocean.[7] We found in March 2016 that because of a potential near-term gap for these capabilities, DOD is exploring options outside of the AOA process for

[6]While several NOAA officials were assigned to one of the AOA working groups, according to one NOAA participant, the interaction entailed receiving emails rather than participating in meetings or regular dialogue throughout the AOA.

[7]These reports were published by the Coordination Group for Meteorological Satellites, which has a range of international member organizations, including NOAA and the European agency responsible for the Meteosat system, EUMETSAT. Coordination Group for Meteorological Satellites, *Report of the 41st Meeting of the Coordination Group for Meteorological Satellites*; (Tsukuba, Japan: July 8-12, 2013); *EUMETSAT's Plans for Indian Ocean Coverage Beyond 2013* CGMS-41 EUM-WP-15 v1a (July 2, 2013) ; and *Report of the 40th Meeting of the Coordination Group for Meteorological Satellites* (Lugano, Switzerland: Nov. 5-8, 2012).

mitigating these gaps, including continued or increased reliance on data provided by international partners.

Ideally, DOD could have conducted an SBEM AOA when pursuing new acquisitions in the aftermath of the NPOESS cancellation. But because the analysis was conducted 2 years later, the AOA team faced pressures to complete the study in time to inform decision making for near term needs. However, DOD's effort to analyze options in the SBEM AOA, including consideration of ways to leverage other sources of data, was a positive step toward a more cost-effective approach to providing SBEM capabilities. As a result of the AOA's limitations, though, as well as cancellations of prior efforts to develop a follow-on system to DMSP, DOD is faced with having to quickly initiate efforts to assess potential solutions for near-term capability gaps that were not fully assessed in the AOA.

Because decisions about whether to provide DOD solutions for SBEM capabilities are dependent on the availability of data from U.S. civil government and international partner satellites, sufficient and reliable information to determine the level of risk DOD is willing to take is crucial. Formalizing coordination and collaboration to identify roles and responsibilities in planning for SBEM capabilities could offer DOD and NOAA the opportunity to help ensure effective communication about the availability and reliability of data from U.S. civil government and international partner satellites and better inform decision making in the future. Consequently, to help ensure DOD is sufficiently informed about the availability and reliability of data from U.S. civil government and international partner satellites as it plans for future SBEM capabilities that rely on such satellites, in our 2016 report we recommended that the Secretary of Defense ensure the leads of future SBEM planning efforts establish formal mechanisms for coordination and collaboration with NOAA that specify roles and responsibilities and ensure accountability for both agencies. DOD concurred with our recommendation. In March 2016, we reported that DOD and NOAA officials stated that since the conclusion of the AOA study period, DOD and NOAA have increased their communication by discussing ways to leverage international partner satellite data and the possibility of establishing and employing formal coordination and collaboration arrangements.

These are encouraging actions, but it is too early to tell whether they will be effective or sustainable. We reported in 2012 that past studies and reviews examining the leadership, organization, and management of national security space have found that there is no single authority

responsible below the President for integrating space programs, and responsibilities for acquiring space systems are diffused across various DOD organizations as well as the intelligence community and civil agencies such as NASA and NOAA, who rely on these systems.[8] This fragmentation is problematic not only because of a lack of coordination that has led to delays in fielding systems, but also because no one person or organization is held accountable for balancing government-wide needs against wants, resolving conflicts and ensuring coordination among the many organizations involved with space acquisitions, and ensuring that resources are directed where they are most needed.

Recent events have further heightened DOD's challenge in addressing gaps in weather monitoring data. Because of a lack of funding, in December 2015, the Air Force moved to terminate activities to integrate and launch the last DMSP satellite.[9] Additionally, in February of this year, the latest DMSP satellite to be placed in orbit unexpectedly failed. These events have increased the risk of some capability gaps occurring even sooner. With potential gaps starting as early as this year, it is important for DOD to make decisions in a timely manner, but based on informed analysis that considers stakeholder input.

Chairman Bridenstine, Ranking Member Bonamici and Members of the Subcommittee, this concludes my statement. I would be pleased to respond to any questions you or other Members of the Subcommittee may have.

GAO Contact and Staff Acknowledgments

For further information on this testimony, please contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Individuals making key contributions to this testimony include Emily Bond, Erin Cohen, Brenna Derritt, Juli Digate,

[8]GAO, *2012 Annual Report: Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue,* GAO-12-342SP (Washington, D.C.: February 28, 2012).

[9]DMSP-20 is in "safe keeping" at Lockheed Martin's satellite facility in Sunnyvale, California, where it receives minimal pre-launch preparation and requires less testing than traditional mission-ready storage. The Pentagon has pushed back a deadline to begin dismantling Defense Meteorological Satellite Program Flight 20 until Sept. 1, 2016.

Marie Ahearn, Michael Kaeser, Jay Tallon, Oziel Trevino, and Rich Horiuchi (Assistant Director).

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