

GAO

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POLAR SATELLITES

Agencies Need to Address Potential Gaps in Weather and Climate Data Coverage

Statement of David A. Powner, Director
Information Technology Management Issues

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Highlights of [GAO-11-954T](#), a testimony before the Subcommittees on Oversight and Investigations and Energy and Environment, Committee on Science, Space, and Technology, House of Representatives

Why GAO Did This Study

Environmental satellites provide critical data used in weather forecasting and measuring variations in climate over time. In February 2010, the White House’s Office of Science and Technology Policy disbanded the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—a tri-agency satellite acquisition that had encountered continuing cost, schedule, and management problems—and instructed the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DOD) to undertake separate acquisitions. Both agencies have begun planning their respective programs—the Joint Polar Satellite System (JPSS) and the Defense Weather Satellite System (DWSS)—including creating program offices and transitioning contracts.

GAO was asked to summarize the status of ongoing work assessing (1) NOAA’s and DOD’s plans for their separate acquisitions and (2) the key risks in transitioning from NPOESS to these new programs. In preparing this statement, GAO relied on the work supporting previous reports, attended monthly program management meetings, reviewed documentation on both programs, and interviewed agency officials.

What GAO Recommends

GAO is not making new recommendations in this statement.

View [GAO-11-954T](#) or key components. For more information, contact David A. Powner at (202) 512-9286 or pownerd@gao.gov.

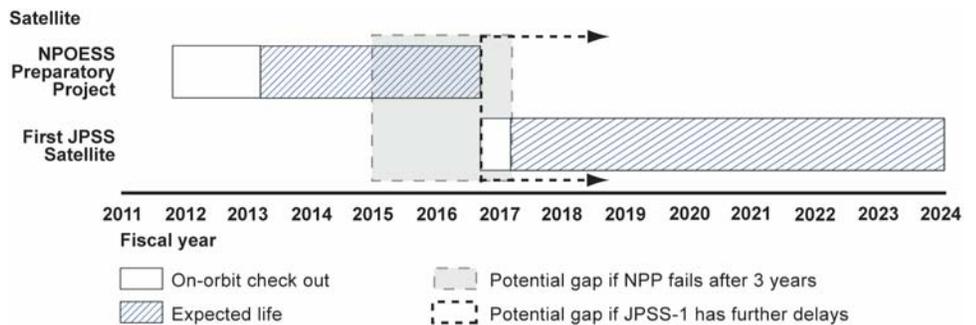
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What GAO Found

In May 2010, GAO reported on the transition from NPOESS to two separate programs, and recommended that both NOAA and DOD expedite decisions on the cost, schedule, and capabilities of their respective programs. Since that time, both agencies have made progress on their programs, but neither has finalized its plans or fully implemented the recommendations. NOAA is currently focusing on the October 2011 launch of the NPOESS Preparatory Project satellite—a demonstration satellite that the agency now plans to use operationally in order to minimize potential gaps in coverage. In addition, NOAA has transferred contracts for satellite sensors from the NPOESS program to the JPSS program. However, NOAA officials stated that the agency slowed down the development of the first JPSS satellite due to budget constraints, causing a delay in the launch date. As a result, NOAA is facing a potential gap in satellite data continuity. Such a delay could significantly impact the nation’s ability to obtain advanced warning of extreme weather events such as hurricanes.

Potential Gaps in Satellite Coverage



Source: GAO analysis of NOAA data.

Meanwhile, DOD began planning for its satellite program. Department officials reported that DWSS is to consist of two satellites with three sensors: an imager, microwave imager/sounder, and a space environment sensor. The first satellite is to be launched no earlier than 2018. The department has not, however, finalized the cost, schedule, and functionality of the program. It expects to do so in early 2012. Until both NOAA and DOD develop and finalize credible plans for their respective programs, it will not be clear what the programs will deliver, when, and at what cost.

In its prior report, GAO also recommended that NOAA and DOD establish plans to mitigate key risks in transitioning from NPOESS to the successor programs, including ensuring effective oversight of JPSS program management, and addressing cost and schedule implications from contract and program changes. Both agencies have taken steps to mitigate these risks, but more remains to be done. For example, NOAA could not provide firm time frames for completing its management control plan or addressing residual contracting issues. Moving forward, it will be important for the agencies to continue efforts to mitigate these risks in order to ensure the success of their respective programs.

Chairman Broun, Chairman Harris, Ranking Member Miller, Ranking Member Edwards, and Members of the Subcommittees:

Thank you for the opportunity to participate in today's hearing on efforts to disband and replace the National Polar-orbiting Operational Environmental Satellite System (NPOESS). NPOESS was planned to be a state-of-the-art, environment-monitoring satellite system that would replace two existing polar-orbiting environmental satellite systems. Managed jointly by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD)/U.S. Air Force, and the National Aeronautics and Space Administration (NASA), the program was considered critical to the nation's weather forecasting and climate monitoring needs through the year 2026. However, to address continuing cost, schedule, management, and technical challenges, the White House's Office of Science and Technology Policy decided in February 2010 to disband the NPOESS acquisition and, instead, to have NOAA and DOD undertake separate acquisitions. As requested, this statement summarizes ongoing work we are doing for your full committee to assess the status of NOAA's and DOD's plans for separate acquisitions and key risks in transitioning from NPOESS to these new programs.

In preparing this testimony, we relied on the work supporting our previous reports¹ and on observations from our ongoing work. To obtain updated information, we attended NOAA's monthly program management council meetings, reviewed briefings for both programs, and interviewed officials from NOAA, NASA, and DOD. All of our work for the prior reports and this testimony was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit

¹GAO, *Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data*, [GAO-10-558](#) (Washington, D.C.: May 27, 2010); *Polar-orbiting Environmental Satellites: With Costs Increasing and Data Continuity at Risk, Improvements Needed in Tri-agency Decision Making*, [GAO-09-564](#) (Washington, D.C.: June 17, 2009); *Environmental Satellites: Polar-orbiting Satellite Acquisition Faces Delays; Decisions Needed on Whether and How to Ensure Climate Data Continuity*, [GAO-08-518](#) (Washington, D.C.: May 16, 2008); and *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain*, [GAO-07-498](#) (Washington, D.C.: Apr. 27, 2007).

objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Since the 1960s, the United States has used satellites to observe the earth and its land, oceans, atmosphere, and space environments. Satellites provide a global perspective of the environment and allow observations in areas that may be otherwise unreachable or unsuitable for measurements. Used in combination with ground, sea, and airborne observing systems, satellites have become an indispensable part of measuring and forecasting weather and climate. For example, satellites provide the graphical images used to identify current weather patterns, as well as the data that go into numerical weather prediction models. These models are used to forecast weather 1 to 2 weeks in advance and to issue warnings about severe weather, including the path and intensity of hurricanes. Satellite data are also used to warn infrastructure owners when increased solar activity is expected to affect key assets, including communication satellites or the electric power grid. When collected over time, satellite data can also be used to observe climate change—the trends and changes in the earth’s climate. These data are used to monitor and project seasonal, annual, and decadal changes in the earth’s temperature, vegetation coverage, and ozone coverage.

The NPOESS Program: Inception, Challenges, and Divergence

Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series, which is managed by NOAA, and the Defense Meteorological Satellite Program (DMSP), which is managed by the Air Force.² Two operational DMSP satellites and one operational POES satellite are currently in orbit and are positioned so that they cross the equator in the early morning, midmorning, and early afternoon. In addition, the government relies on a European satellite, called the Meteorological Operational satellite, for data

²NOAA provides command and control for both the POES and DMSP satellites after they are in orbit.

in the midmorning orbit.³ Together, they ensure that, for any region of the earth, the data provided to users are generally no more than 6 hours old.

With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive required NOAA and DOD to converge the two satellite programs into a single satellite program—NPOESS—capable of satisfying both civilian and military requirements.⁴ To manage this program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office, with NOAA responsible for overall program management for the converged system and for satellite operations, the Air Force responsible for acquisition, and NASA responsible for facilitating the development and incorporation of new technologies into the converged system.

When its primary contract was awarded in August 2002, NPOESS was estimated to cost about \$7 billion through 2026 and was considered critical to the United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring. To reduce the risk involved in developing new technologies and to maintain climate data continuity, the program planned to launch a demonstration satellite, called the NPOESS Preparatory Project (NPP) in May 2006. NPP was to demonstrate selected instruments that would later be included on the NPOESS satellites. The first NPOESS satellite was to be available for launch in March 2008.

However, in the years after the program was initiated, NPOESS encountered significant technical challenges in sensor development, program cost growth, and schedule delays. By November 2005, we estimated that the program's cost had grown to \$10 billion, and the schedule for the first launch was delayed by almost 2 years. These issues led to a 2006 restructuring of the program, which reduced the program's functionality by decreasing the number of planned satellites, orbits, and instruments. The restructuring also led agency executives to decide to

³The European Organisation for the Exploitation of Meteorological Satellites' MetOp program is a series of three polar-orbiting satellites dedicated to operational meteorology. MetOp satellites are planned to be launched sequentially over 14 years. The first of these satellites was launched in 2006 and is currently operational. The next two are expected to launch in 2012 and 2017, respectively.

⁴Presidential Decision Directive NSTC-2, May 5, 1994.

mitigate potential data gaps by using NPP as an operational satellite.⁵ Even after the restructuring, however, the program continued to encounter technical issues in developing two sensors, significant tri-agency management challenges, schedule delays, and further cost increases. To help address these issues, in recent years we have made a series of recommendations to, among other things, improve executive-level oversight and develop realistic time frames for revising cost and schedule baselines.⁶

Faced with costs that were expected to exceed \$14 billion and launch schedules that were delayed by over 5 years, in August 2009, the Executive Office of the President formed a task force, led by the Office of Science and Technology Policy, to investigate the management and acquisition options that would improve the NPOESS program. As a result of this review, the Director of the Office of Science and Technology Policy announced in February 2010 that NOAA and DOD would no longer jointly procure the NPOESS satellite system; instead, each agency would plan and acquire its own satellite system.⁷ Specifically, NOAA is responsible for the afternoon orbit and the observations planned for the first and third NPOESS satellites. DOD is responsible for the early-morning orbit and the observations planned for the second and fourth NPOESS satellites. The partnership with the European satellite agencies for the midmorning orbit is to continue as planned.

⁵Using NPP as an operational satellite means that its data will be used to provide climate and weather products.

⁶[GAO-09-564](#), [GAO-08-518](#), and [GAO-07-498](#).

⁷The announcement accompanied the release of the President's fiscal year 2011 budget request.

Prior GAO Work Evaluated Preliminary Plans for Separate NOAA and DOD Satellite Programs and Recommended Actions to Solidify Plans and Address Risks

In May 2010, we reported on NOAA's and DOD's preliminary plans for initiating new environmental satellite programs and highlighted key transition risks facing the agencies.⁸ At that time, NOAA had developed preliminary plans for its new satellite acquisition program—called the Joint Polar Satellite System (JPSS). Specifically, NOAA planned to acquire two satellites (called JPSS-1 and JPSS-2) for launch in 2015 and 2018.⁹ NOAA also planned technical changes to the satellites, including using a smaller spacecraft than the one planned for NPOESS and removing sensors that were planned for the NPOESS satellites in the afternoon orbit.¹⁰

In addition, NOAA planned to transfer the management of the satellite acquisition from the NPOESS program office to NASA's Goddard Space Flight Center so that it could be co-located at a space system acquisition center, as advocated by an independent review team. NOAA developed a team to lead the transition from NPOESS to JPSS and planned to begin transitioning in July 2010 and complete a transition plan—including cost and schedule estimates—by the end of September 2010. NOAA estimated that the JPSS program would cost approximately \$11.9 billion to complete through 2024.¹¹ It also anticipated funding of about \$1 billion in fiscal year 2011 to set up the new program office and handle the costs associated with transitioning contracts from the Air Force to NASA while continuing to develop NPP and the first JPSS satellite.

⁸GAO-10-558.

⁹NOAA officials noted that these dates could change as transition plans were further developed.

¹⁰NOAA officials planned to exclude (1) the Space Environment Monitor (which collects data to predict the effects of space weather on technological systems) and instead, to obtain this information from DOD's DWSS satellites, and (2) the Microwave Imager/Sounder (which collects microwave images and data needed for measurements such as rain rate and soil moisture) and instead to obtain these data through an agreement with the Japan Aerospace Exploration Agency. Although they plan to launch the Total and Spectral Solar Irradiance Suite, NOAA officials had not made a decision on which satellite will host the sensor.

¹¹This estimate includes approximately \$2.9 billion in NOAA funds spent on NPOESS through fiscal year 2010, but does not include approximately \$2.9 billion that DOD has spent through fiscal year 2010 on NPOESS. NOAA officials also reported that the JPSS cost estimate is at a higher confidence level than the previous NPOESS life-cycle cost estimates.

DOD was at an earlier stage in its planning process at the time of our June 2010 testimony, in part because it had more time before the first satellite in the morning orbit was needed. DOD officials were developing plans—including costs, schedules, and functionality—for their new program, called the Defense Weather Satellite System (DWSS). At that time, DOD expected to make final decisions on the spacecraft, sensors, procurement strategy, and staffing in August 2010, and to begin the program immediately.

In our report, we noted that both agencies faced key risks in transitioning from NPOESS to their separate programs. These risks included the loss of key staff and capabilities, delays in negotiating contract changes and establishing new program offices, the loss of support for the other agency's requirements, and insufficient oversight of new program management. We reported that until these risks were effectively mitigated, it was likely that the satellite programs' costs would continue to grow and launch dates would continue to be delayed. We also noted that further delays could lead to gaps in the continuity of critical satellite data.

We made recommendations to ensure that the transition from NPOESS to its successor programs was efficiently and effectively managed. Among other things, we recommended that the Secretaries of Defense and Commerce direct their respective NPOESS follow-on programs to expedite decisions on the expected cost, schedule, and capabilities of their planned programs and to direct their respective follow-on programs to develop plans to address the key transition risks we identified. As discussed below, the agencies have not yet fully implemented these recommendations.

NOAA and DOD Have Made Progress, but Decisions are Needed to Address Potential Gaps in Weather and Climate Data

Over the last year, NOAA and NASA have worked to establish the JPSS program, to keep the NPP satellite's development on track, and to begin developing plans for the JPSS satellite. However, of the funding made available to NOAA in its fiscal year 2011 appropriations, JPSS was allocated \$471.9 million—far less than the \$1 billion identified in the President's budget to establish a program and stay on track with satellite deliverables. As a result, the JPSS program office decided to focus on developing NPP and the satellite's ground system so that it could remain on track for an October 2011 launch. The program slowed development efforts on the first JPSS satellite and halted work on the second JPSS satellite. Table 1 shows the status of key components of NPP and JPSS-1.

Table 1: Status of NPP and JPSS-1 as of August 2011

Satellite	Status
NPP	<ul style="list-style-type: none">All of the sensors have been integrated onto the NPP spacecraft.Environmental testing and ground compatibility testing have been completed.NASA plans to complete the final operational and mission readiness reviews in early September.The launch date is currently planned for October 25, 2011.
JPSS-1	<ul style="list-style-type: none">Contracts for all sensors have been transferred to NASA.Work on most sensors, including the Clouds' and the Earth's Radiant Energy System, the Visible/Infrared Imager/Radiometer Suite, Total Solar Irradiance Sensor, Cross-Track Infrared Sounder, and Ozone Mapper/Profiler Suite, is under way.Technical issues found on the Cross-Track Infrared Sounder and the Ozone Mapper/Profiler Suite will need to be addressed, but are not expected to affect the JPSS-1 launch date.NOAA has not yet determined how it will accommodate sensors and subsystems that are part of the JPSS program but not included on the JPSS-1 satellite: the Search and Rescue Satellite Aided Tracking, the Advanced Data Collection System, or the Total Solar Irradiance Sensor.

Source: GAO analysis of NOAA and NASA data.

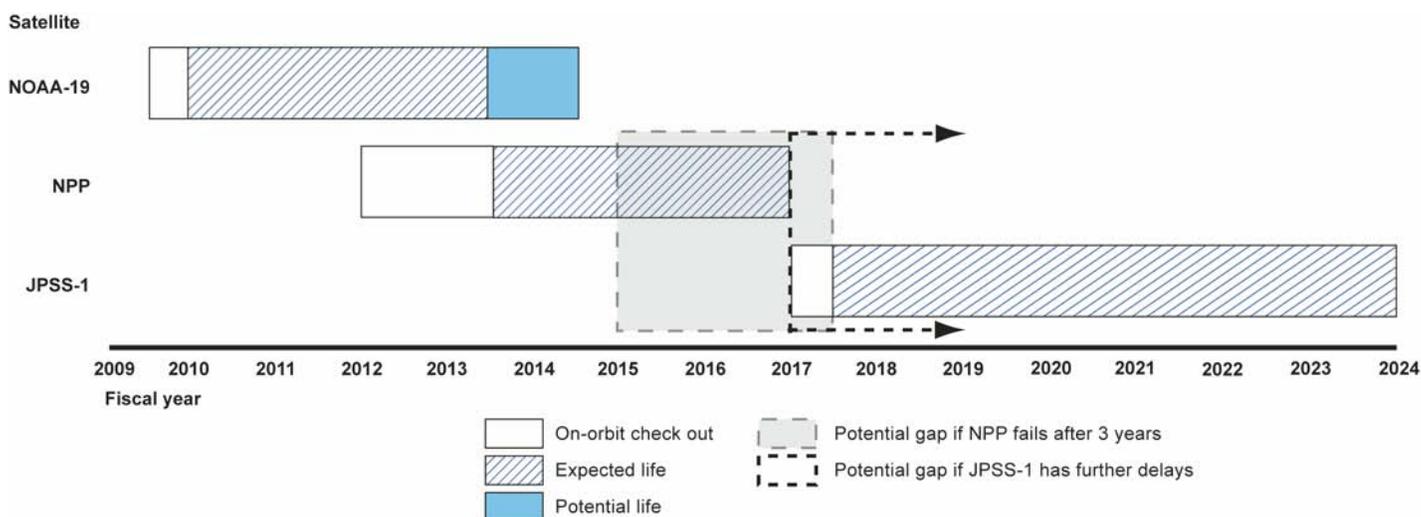
Although we recommended in May 2010 that NOAA expedite decisions on the cost, schedule, and capabilities of JPSS, NOAA has not yet done so. According to NOAA officials, uncertainty surrounding the agency's fiscal year 2011 budget has made it difficult to establish a program baseline. However, NOAA has developed a requirements document and is obtaining an independent cost estimate. The agency expects to have a complete program baseline in place by February 2012. Until this baseline is in place, it is not clear what functionality will be delivered by when and at what cost. Given the critical development activities planned for 2012, it is imperative that NOAA move expeditiously to establish a credible program baseline.

NOAA Faces A Potential Gap in Satellite Data Continuity and Is Considering Options to Minimize That Gap

NOAA is facing a potential gap in satellite data continuity. When NPOESS was first disbanded, program officials anticipated launching the JPSS satellites in 2015 and 2018 (while acknowledging that these dates could change as the program's plans were firmed up). Over the past year, as program officials made critical decisions to defer work on JPSS in order to keep NPP on track, the launch dates for JPSS-1 and JPSS-2 have changed. Program officials currently estimate that the satellites will launch in late 2016 and 2021.

There are two key scenarios that could lead to a gap in satellite data in the afternoon orbit between the end of life of the NPP satellite and the availability of the first JPSS satellite. Under the first scenario, NPP sensors may not last until JPSS-1 is launched. The NASA Inspector General reported that NASA is concerned that selected NPP sensors may last only 3 years because of workmanship issues.¹² The second scenario for a satellite data gap involves further delays in the JPSS-1 launch date. This could occur due to shortfalls in program funding or technical issues in the development of the satellite. Figure 1 depicts possible gaps.

Figure 1: Potential Gaps in Polar Satellite Data in the Afternoon Orbit



Source: GAO analysis of NOAA data.

According to NOAA, a data gap would lead to less accurate and timely weather prediction models used to support weather forecasting, and advanced warning of extreme events—such as hurricanes, storm surges, and floods—would be diminished. The agency reported that this could place lives, property, and critical infrastructure in danger. In addition, NOAA estimated that the time it takes to respond to emergency search and rescue beacons could double.

¹²NASA Office of Inspector General, *NASA's Management of the NPOESS Preparatory Project*, IG-11-018 (Washington, D.C.: June 2, 2011).

Given the potential for a gap in satellite data, NOAA officials are considering whether to remove functionality from JPSS-1 in order to allow it to be developed—and launched—more quickly. For example, program officials are considering increasing the time it takes for data processing centers to receive the data, removing the ground systems' ability to process some data, and removing sensors.

DOD Is Planning for DWSS; Critical Milestones Lie Ahead

DOD has developed draft plans for its DWSS program. The DWSS satellites will take over the morning orbit after the remaining DMSP satellites reach the end of their respective lives.¹³ The DWSS program will be comprised of two satellites—the first expected to be launched no earlier than 2018. Each will have three sensors: a Visible/Infrared Imager/Radiometer Suite, a Space Environment Monitor, and a microwave imager/sounder. DOD plans to formally review system requirements in December 2011 and to conduct a preliminary design review by September 2012. In addition, DOD plans to develop a requirements document and obtain an independent cost estimate during fiscal year 2012.

Although we recommended in May 2010 that DOD expedite decisions on the cost, schedule, and capabilities of DWSS, DOD has not yet finalized the functionality that will be provided by the DWSS program, or developed a cost and schedule baseline. For example, DOD has not yet decided what microwave sounder will be developed for DWSS, and whether it will merely meet legacy requirements or provide the full scope of functionality originally planned for NPOESS. Until DOD defines the scope of its program, including the capabilities each satellite will provide, both military and civilian users will be unable to prepare for DWSS satellite data and any data shortfalls.

NOAA and DOD Continue to Face Key Transition Risks

Over a year ago, we identified key transition risks facing NOAA and DOD, including the need to support the other agency's requirements, ensure effective oversight of new program management, manage cost and schedule implications from contract and other program changes, and ensure the availability of key staff and capabilities, and we recommended

¹³DMSP-17 and 18 are currently in morning orbits. DOD has two more DMSP satellites (called DMSP-19 and 20) and expects to launch them no earlier than 2012 and 2015, respectively.

that the agencies move to mitigate these risks. Today, the agencies continue to face key risks in transitioning from NPOESS to their new programs. These risk areas are discussed below.

- *Supporting the other agency's requirements:* As a joint program, NPOESS was expected to fulfill many military, civilian, and research requirements for environmental data. However, because the requirements of NOAA and DOD are different, the agencies may develop programs that meet their own needs but not the other's. Because both NOAA and DOD have not decided on the final functionality of their respective programs, each could choose to remove functionality that is important to the other agency and its users. This has started to occur. NOAA has already made decisions to remove a transmission capability that is important to the Navy. Other functions that are currently under consideration (such as delaying receipt of the data or removing ground processing functions) could also affect military operations. Agency officials reported that they formed a joint working group in July 2011 to discuss and mitigate these issues, but it is too soon to determine what progress has been made, if any. If the agencies cannot find a way to build an effective partnership that facilitates both efficient and effective decision-making on data continuity needs, the needs of both agencies—and their users—may not be adequately incorporated into the new programs.
- *Oversight of new program management:* Under its new JPSS program, NOAA plans to transfer parts of the NPOESS program to NASA, but it has not yet defined how it will oversee NASA's efforts. We have reported that NASA has consistently underestimated time and cost and has not adequately managed risk factors such as contractor performance.¹⁴ Because of such issues, we listed NASA's acquisition management as a high-risk area in 1990, and it remains a high-risk area today.¹⁵ NOAA officials reported that they are developing a management control plan with NASA and intend to perform an independent review of this plan when it is completed. This plan has now been in development for about 18 months, and neither NOAA nor NASA could provide a firm time frame for its completion. Without strong NOAA oversight of NASA's management of program

¹⁴See, for example, GAO, *NASA: Assessments of Selected Large-Scale Projects*, [GAO-11-239SP](#) (Washington, D.C.: Mar. 3, 2011).

¹⁵GAO, *High-Risk Series: An Update*, [GAO-09-271](#) (Washington, D.C.: January 2009).

components, JPSS may continue to face the same cost, schedule, and contract management challenges as the NPOESS program.

- *Cost and schedule implications resulting from contract and program changes:* NASA has transferred the sensor development and common ground systems contracts from the NPOESS contract. However, NOAA has been in negotiations for at least 6 months with the NPOESS contractor regarding intellectual property rights for components of JPSS. The agency could not provide a time frame for when it expects this issue to be resolved. Until these issues are resolved, the full cost and schedule implications of contract and program changes will be unknown.
- *Ensuring key staff and capabilities:* The NPOESS program office was composed of NOAA, NASA, Air Force, and contractor staff with knowledge and experience in the status, risks, and lessons learned from the NPOESS program. This knowledge would be important to both programs after the transition period. According to NOAA and NASA officials, the JPSS program office is now fully staffed. On the other hand, the DOD program has only staffed approximately 80 out of 155 positions in its program office. In addition, NOAA officials acknowledged that they had estimated that a contractor workforce of approximately 1,600 would work on JPSS activities; however, only 819 are on board due to budget constraints. Unless DOD is proactive in ensuring that its program office is fully staffed and NOAA contractors are able to fill all necessary positions, the new programs may not be able to complete work as scheduled and satellite launches could be delayed.

In summary, the NPOESS program was disbanded in the hope that separate DOD and NOAA programs could prove more successful than the joint program, that costs and schedules might finally begin to stabilize, and that the continuity of satellite data critical to both military and civilian missions would be assured. However, over 18 months later, NOAA and DOD are still scrambling to establish their respective programs and to develop baseline cost and schedule estimates for those programs. As a result, it still is not clear what the programs will deliver, when, and at what cost.

In addition, the agencies continue to face a number of transition risks, including the continued need to support each other's requirements and residual contracting issues. As NOAA makes difficult decisions on whether to remove promised JPSS functionality in order to mitigate a

satellite data gap, it will be important to prioritize the functionality and to work with DOD to ensure that critical requirements are still met. Timely decisions on cost, schedule, and capabilities are needed to allow both acquisitions to move forward and to ensure that painful gaps in satellite data can be minimized. Until both NOAA and DOD can develop and finalize credible plans for their respective programs, and mitigate or minimize the risks, neither agency's users can plan for how to address this gap.

Chairman Broun, Chairman Harris, Ranking Member Miller, Ranking Member Edwards, and Members of the Subcommittees, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you have any questions on matters discussed in this testimony, please contact David A. Powner at (202) 512-9286 or at pownerd@gao.gov. Other key contributors include Colleen Phillips (Assistant Director), Kate Agatone, Franklin Jackson, Fatima Jahan, and Lee McCracken.

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