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ENVIRONMENTAL SATELLITES

Focused Attention Needed to Mitigate Program Risks

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

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

Thank you for the opportunity to participate in today's hearing on two satellite acquisition programs within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). The Joint Polar Satellite System (JPSS) and the Geostationary Operational Environmental Satellite-R (GOES-R) programs are meant to replace current operational satellites, and both are considered critical to the United States' ability to maintain the continuity of data required for weather forecasting.

As requested, this statement summarizes our two reports being released today on (1) the status, plans, and risks for JPSS and (2) the status, schedule management process, and risk management process within the GOES-R program.[1] In preparing this testimony, we relied on the work supporting those reports. They each contain a detailed overview of our scope and methodology, including the steps we took to assess the reliability of cost and schedule data. As noted in those reports, we found that the JPSS cost and GOES-R contractor cost data were sufficiently reliable for our purposes. Further, while we found that the GOES-R schedule and management reserve data were not sufficiently reliable, we reported on the data's shortcomings in our report. All of our work for the reports 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 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 both polar-orbiting and geostationary satellites to observe the earth and its land, oceans, atmosphere, and space environments. Polar-orbiting satellites constantly circle the earth in an almost north-south orbit, providing global coverage

[1]GAO, *Polar-Orbiting Environmental Satellites: Changing Requirements, Technical Issues, and Looming Data Gaps Require Focused Attention*, GAO-12-604 (Washington, D.C.: June 15, 2012), and *Geostationary Weather Satellites: Design Progress Made, but Schedule Uncertainty Needs to be Addressed*, GAO-12-576 (Washington, D.C.: June 26, 2012).

of conditions that affect the weather and climate. As the earth rotates beneath it, each polar-orbiting satellite views the entire earth's surface twice a day. In contrast, geostationary satellites maintain a fixed position relative to the earth from a high orbit of about 22,300 miles in space.

Both types of satellites provide a valuable perspective of the environment and allow observations in areas that may be otherwise unreachable. Used in combination with ground, sea, and airborne observing systems, satellites have become an indispensable part of monitoring and forecasting weather and climate. For example, polar-orbiting satellites provide the data that go into numerical weather prediction models, which are a primary tool for forecasting weather days in advance—including forecasting the path and intensity of hurricanes, and geostationary satellites provide the graphical images used to identify current weather patterns. These weather products and models are used to predict the potential impact of severe weather so that communities and emergency managers can help mitigate its effects. Polar satellites also provide data used to monitor environmental phenomena, such as ozone depletion and drought conditions, as well as long-term data sets that are used by researchers to monitor climate change.

Events Leading to the JPSS Program

For over forty years, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite series, which is managed by NOAA, and the Defense Meteorological Satellite Program, which is managed by the Air Force.[2] Currently, there is one operational Polar-orbiting Operational Environmental Satellite and two operational Defense Meteorological Satellite Program satellites that are positioned so that they cross the equator in the early morning, midmorning, and early afternoon. In addition, the government is also relying on data from a European satellite, called the Meteorological Operational (MetOp) satellite program.[3]

[2] NOAA provides command and control for both the Polar-orbiting Operational Environmental Satellite and Defense Meteorological Satellite Program satellites after they are in orbit.

[3] The European Organisation for the Exploitation of Meteorological Satellites' MetOp program is a series of three polar-orbiting satellites dedicated to operational meteorology. These satellites are planned to be launched sequentially over 14 years. The first of these satellites was launched in 2006 and is currently operational.

With the expectation that combining the Polar-orbiting Operational Environmental Satellite program and the Defense Meteorological Satellite Program would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive[4] required NOAA and DOD to converge the two satellite programs into a single satellite program—the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—capable of satisfying both civilian and military requirements. However, in the years after the program was initiated, NPOESS encountered significant technical challenges in sensor development, program cost growth, and schedule delays. Specifically, within 8 years of the contract's award, program costs grew by over $8 billion, and launch schedules were delayed by over 5 years. In addition, as a result of a 2006 restructuring of the program, the agencies reduced the program's functionality by decreasing the number of originally planned satellites, orbits, and instruments.

Even after this restructuring, however, the program continued to encounter technical issues, management challenges, schedule delays, and further cost increases. Therefore, 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 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 acquire NPOESS; instead, each agency would plan and acquire its own satellite system. Specifically, NOAA and NASA would be responsible for the afternoon orbit, and DOD would be responsible for the early morning orbit. The partnership with the European satellite agencies for the midmorning orbit would continue as planned.

When this decision was announced, NOAA immediately began planning for a new satellite program in the afternoon orbit—called JPSS—and DOD began planning for a new satellite program in the morning orbit—called the Defense Weather Satellite System. NOAA transferred management responsibilities to its new satellite program, defined its requirements, and transferred contracts to the new program. Specifically, NOAA established a program office to guide the development and launch

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

of the NPOESS Preparatory Project (NPP)[5]—a demonstration satellite that was developed under NPOESS and managed by the National Aeronautics and Space Administration (NASA)—as well as the two planned JPSS satellites, known as JPSS-1 and JPSS-2. NOAA also worked with NASA to establish its program office to oversee the acquisition, system engineering, and integration of the satellite program. By 2011, the two agencies had established separate—but co-located—JPSS program offices, each with different roles and responsibilities.

In addition, DOD established its Defense Weather Satellite System program office, started defining its requirements, and modified contracts to reflect the new program. These efforts, however, have been halted. In early 2012, in response to congressional direction, DOD decided to terminate the program because it still has two satellites to launch within its legacy Defense Meteorological Satellite Program. DOD is currently identifying alternative means to fulfill its future environmental satellite requirements.

We have issued a series of reports on the NPOESS program—and the transition to JPSS—highlighting technical issues, cost growth, key management challenges, and key risks of transitioning from NPOESS to JPSS.[6] In these reports, we made multiple recommendations to, among other things, improve executive-level oversight and develop realistic time frames for revising cost and schedule baselines. NOAA has taken steps to address our recommendations, including taking action to improve executive-level oversight, but as we note in our report being released today, the agency is still working to establish cost and schedule baselines.

Overview of the GOES Program

In addition to polar-orbiting satellites, NOAA operates GOES as a two-satellite geostationary satellite system that is primarily focused on the United States. The GOES-R series is the next generation of satellites that

[5]In January 2012, the name of the satellite was changed to the Suomi National Polar-orbiting Partnership satellite. The NPP acronym remained the same.

[6]See, for example, GAO, *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). Our report being released today on polar-orbiting satellites includes a full list of related GAO products.

NOAA is planning; the satellites are planned to replace existing weather satellites that will likely reach the end of their useful lives in about 2015.

NOAA is responsible for overall mission success for the GOES-R program. The NOAA Program Management Council, which is chaired by NOAA's Deputy Undersecretary, is the oversight body for the GOES-R program. However, since it relies on NASA's acquisition experience and technical expertise to help ensure the success of its programs, NOAA implemented an integrated program management structure with NASA for GOES-R. Within the program office, two project offices manage key components of the GOES-R system. NOAA has entered into an agreement with NASA to manage the Flight Project Office, including awarding and managing the spacecraft contract and delivering flight-ready instruments to the spacecraft. The Ground Project Office, managed by NOAA, oversees the Core Ground System contract and satellite data product development and distribution.

NOAA has made a number of changes to the program since 2006, including the removal of certain satellite data products and a critical instrument (the Hyperspectral Environmental Suite), and a reduction in the number of satellites from four to two. NOAA originally decided to reduce the scope and technical complexity of the GOES-R program because of the expectation that total costs, which were estimated to be $6.2 billion, could reach $11.4 billion. Recently, NOAA restored two satellites to the program's baseline, making GOES-R a four-satellite program once again. In February 2011, as part of its fiscal year 2012 budget request, NOAA requested funding to begin development for two additional satellites in the GOES-R series. The program estimates that the development for all four satellites in the GOES-R series is to cost $10.9 billion through 2036. The current anticipated launch date for the first GOES-R satellite is planned to be in October 2015, with the last satellite in the series planned for launch in calendar year 2024.

In September 2010, we reported that as a result of delays to planned launch dates for the first two satellites in the GOES-R series, NOAA might not be able to meet its policy of having a backup satellite in orbit at all times, which could lead to a gap in satellite coverage if an existing satellite failed prematurely. [7] We recommended that NOAA develop and document plans for the operation of geostationary satellites that included the implementation procedures, resources, staff roles, and time tables needed to transition to a single satellite, an international satellite, or other solution.

NOAA has since developed a continuity plan that generally includes the key elements we recommended. As a result, NOAA has improved its ability to fully meet its mission-essential function of providing continuous satellite imagery in support of weather forecasting.

The JPSS Program Has Made Progress, but Faces Changing Requirements, Critical Steps in Sensor Development, and Looming Data Gaps

NOAA and NASA have made progress on the JPSS program since it was first formed in 2010, but are modifying requirements to limit program costs. After establishing a JPSS program office and transferring contracts to NASA, the program successfully launched the NPP satellite on October 28, 2011. After this launch, NASA began the process of activating the satellite and commissioning the instruments, a process that was completed in March 2012. NOAA is receiving data from the five sensors on the NPP satellite, and has begun calibration and validation. NOAA's satellite data users began to use validated products from one sensor in May 2012, and NOAA expects that they will increase the amount and types of data they use in the following months. In addition, NOAA established initial requirements for the JPSS program in September 2011. Key components include acquiring and launching JPSS-1 and JPSS-2, developing and integrating five sensors on the two satellites, finding alternate host satellites for selected instruments that would not be accommodated on the JPSS satellites, and providing ground system support.

NOAA also developed a cost estimate for the JPSS program, which it reconciled with an independent cost estimate. Specifically, from January to December 2011, the agency went through a cost estimating exercise for the JPSS program. At the end of this exercise, NOAA validated that the cost of the full set of JPSS functions from fiscal year 2012 through fiscal year 2028 would be $11.3 billion. After adding the agency's sunk costs of $3.3 billion, the program's life cycle cost estimate totaled $14.6

[7] GAO, *Geostationary Operational Environmental Satellites: Improvements Needed in Continuity Planning and Involvement of Key Users*, GAO-10-799 (Washington, D.C., Sept. 2010).

billion.[8] This amount is $2.7 billion higher than the $11.9 billion estimate for JPSS when NPOESS was disbanded in 2010.[9]

Although NOAA has established initial requirements for the program, these requirements could—and likely will—change in the near future, in order to limit program costs. In working with the Office of Management and Budget to develop the president's fiscal year 2013 budget request, NOAA officials stated that they agreed to fund JPSS at roughly $900 million per year through 2017, to merge funding for two climate sensors into the JPSS budget, and to cap the JPSS life cycle cost at $12.9 billion through 2028. Because this cap is $1.7 billion below the expected $14.6 billion life cycle cost of the full program, our report being released today discusses NOAA's plans to remove selected elements from the satellite program. These included NOAA potentially discontinuing the development of certain sensors, plans for a network of ground-based receptor stations, planned improvements in the time it takes to obtain satellite data from JPSS-2,[10] and plans to install a data processing system at two Navy locations. Recently, NOAA briefed us on updated plans to address this cost cap by changing the way the agency approached operations and sustainment, and restructuring the free-flyers project.

The removal of these elements from the JPSS program will affect both civilian and military satellite data users. The loss of certain sensors could cause a break in the over 30-year history of satellite data and would hinder the efforts of climatologists and meteorologists focusing on understanding changes in the earth's ozone coverage and radiation budget.[11] The loss of ground-based receptor stations means that NOAA may not be able to improve the timeliness of JPSS-2 satellite data from

[8]NOAA's $3.3 billion sunk costs included $2.9 billion through fiscal year 2010 and about $400 million in fiscal year 2011.

[9]According to NOAA officials, this increase is primarily due to a 4-year extension of the program from 2024 to 2028, the addition of previously unbudgeted items such as the free flyers, cost growth associated with transitioning contracts from DOD to NOAA, and the program's decision to slow down work on lower-priority elements because of budget constraints in 2011.

[10]The requirement was to provide data in 30 minutes; instead, the requirement will remain at the JPSS-1 level of 80 minutes.

[11]The radiation budget is the amount of the solar energy entering and leaving the earth's atmosphere.

80 minutes to the current 30 minute requirement, and as a result, weather forecasters will not be able to update their weather models using the most recent satellite observations. Further, the loss of the data processing systems at the two Navy locations means that NOAA and the Navy will need to establish an alternative way to provide data to the Navy.

Development of the First JPSS Satellite Has Begun, but Critical Steps Remain

The major components of the JPSS program are at different stages of development, and important decisions and program milestones lie ahead. NASA's JPSS program office organized its responsibilities into three separate projects: (1) the flight project, which includes sensors, spacecraft, and launch vehicles; (2) the ground project, which includes ground-based data processing and command and control systems, and (3) the free-flyer project, which involves developing and launching the instruments that are not going to be included on the JPSS satellites (including a data collection system used to transmit ground-based observations from remote locations, such as ocean-based buoys; a search and rescue system, and a total solar irradiance sensor).

Within the flight project, development of the sensors for the first JPSS satellite is well under way; however, selected sensors are experiencing technical issues and the impact of these issues has not yet been determined. For example, the program plans to address communication issues that could affect a key sensor's ability to provide data in every orbit, but they have not identified the potential cost and schedule impact of this issue. The ground project is currently in operation supporting NPP, and NOAA is planning to upgrade selected parts of the ground systems to increase security and reliability. The free-flyer project is still in a planning stage because NOAA has not yet decided which satellites will host the instruments or when these satellites will launch. One of these projects has recently completed a major milestone and one project has its next milestone approaching. Specifically, the flight project completed a separate system requirements review in April 2012, while the ground project's system requirements review is scheduled for August 2012.

NOAA Has Not Established Plans to Mitigate the Risk that the Polar Satellite Constellation Is Becoming Increasingly Unreliable

Since its inception, NPOESS was seen as a constellation of satellites providing observations in the early morning, midmorning, and afternoon orbits. Having satellites in each of these orbits ensures that satellite observations covering the entire globe are no more than 6 hours old, thereby allowing for more accurate weather predictions. Even after the program was restructured in 2006 and eventually terminated in 2010, program officials and the administration planned to ensure coverage in the early morning, midmorning, and afternoon orbits by relying on DOD satellites for the early morning orbit, the European satellite program for the midmorning, and NOAA's JPSS program for the afternoon orbit.

However, recent events have made the future of the polar satellite constellation uncertain:

- **Early morning orbit**—As discussed earlier in this statement, in early fiscal year 2012, DOD terminated its Defense Weather Satellite System program. While the agency has two more Defense Meteorological Satellite Program satellites—called DMSP-19 and DMSP-20—to launch and is working to develop alternative plans for a follow-on satellite program, there are considerable challenges in ensuring that a new program is in place and integrated with existing ground systems and data networks in time to avoid a gap in this orbit.

- DOD officials stated that they plan to launch DMSP-19 in 2014 and DMSP-20 when it is needed. If DMSP-19 lasts 6 years, there is a chance that DMSP-20 will not be launched until 2020. Thus, in a best-case scenario, satellites from the follow-on program will not need to be launched until roughly 2026. However, civilian and military satellite experts have expressed concern that the Defense Meteorological Satellite Program satellites are quite old and may not work as intended. If they do not perform well, DOD could be facing a satellite data gap in the early morning orbit as early as 2014.

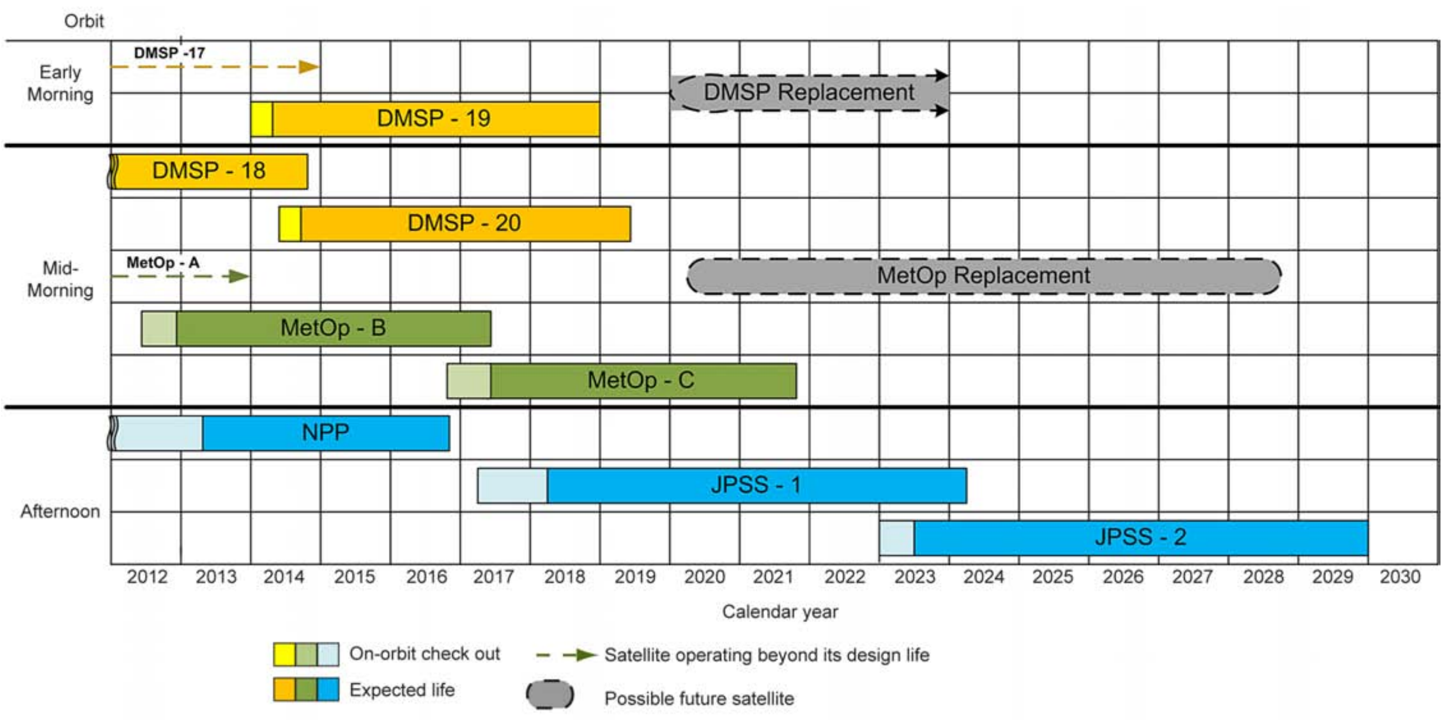
- **Midmorning orbit**—The European satellite organization plans to continue to launch MetOp satellites that will provide observations in the midmorning orbit through October 2021. The organization is also working to define and gain support for the follow-on program, called the Eumetsat Polar System-2nd Generation program. However, in 2011, NOAA alerted European officials that, because of the constrained budgetary environment, they will no longer be able to provide sensors for the follow-on program. Due to the uncertainty surrounding the program, there is a chance that the first European follow-on satellite will not be ready in time to replace the final MetOp satellite at the end of its expected life. In that case, this orbit, too, would be in jeopardy.

- **Afternoon orbit**—There is likely to be a gap in satellite observations in the afternoon orbit that could last well over one year. According to our analysis, this gap could span from 17 months to 3 years or more. In one scenario, NPP would last its full expected 5-year life (to October 2016), and JPSS-1 would launch as soon as possible (in

March 2017) and undergo on-orbit checkout for a year (until March 2018). In that case, the data gap would extend 17 months. In another scenario, NPP would last only 3 years as noted by NASA managers concerned with the workmanship of selected NPP sensors. Assuming that the JPSS-1 launch occurred, as currently scheduled, in March 2017 and the satellite data was certified for official use by March 2018, this gap would extend for 41 months. Of course, any problems with JPSS-1 development could delay the launch date and extend the gap period. Given the history of technical issues and delays in the development of the NPP sensors and the current technical issues on the sensors, it is likely that the launch of JPSS-1 will be delayed. While the scenarios in our analysis demonstrated gaps lasting between 17 and 53 months, NOAA program officials believe that the most likely scenario involves a gap lasting 18 to 24 months.

Figure 1 depicts the polar satellite constellation and the uncertain future coverage in selected orbits.

Figure 1: The Polar Satellite Constellation



Source: GAO analysis of NOAA data.

Note: "On-orbit checkout" refers to the accuracy check that scientists perform after a satellite has been launched. This checkout verifies that sensors accurately report ground and atmospheric conditions and ensure that satellite data products are ready for operational use.

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. To illustrate this, the National Weather Service performed several case studies to demonstrate how its weather forecasts would have been affected if there were no polar satellite data in the afternoon orbit. For example, when the polar satellite data were not used to predict the "Snowmaggedon" winter storm that hit the Mid-Atlantic coast in February 2010, weather forecasts predicted a less intense storm, slightly further east, and producing half of the precipitation at 3, 4, and 5 days before the event. Specifically, weather prediction models under-forecasted the amount of snow by at least 10 inches. The agency noted that this level of degradation in weather forecasts could place lives, property, and critical infrastructure in danger.

The NOAA Administrator and other senior executives acknowledge the risk of a data gap in each of the orbits of the polar satellite constellation and are working with European and DOD counterparts to coordinate their respective requirements and plans; however, they have not established plans for mitigating risks to the polar satellite constellation. NOAA plans to use older polar satellites to provide some of the necessary data for the other orbits. However, it is also possible that other governmental, commercial, or international satellites could supplement the data in each of the three orbits. For example, foreign nations continue to launch polar-orbiting weather satellites to acquire data such as sea surface temperatures, sea surface winds, and water vapor. Also, over the next few years, NASA plans to launch satellites that will collect information on precipitation and soil moisture.[12] If there are viable options from external sources, it could take time to adapt NOAA systems to receive, process, and disseminate the data to its satellite data users. Until NOAA identifies these options and establishes mitigation plans, it may miss opportunities to leverage alternative satellite data sources.

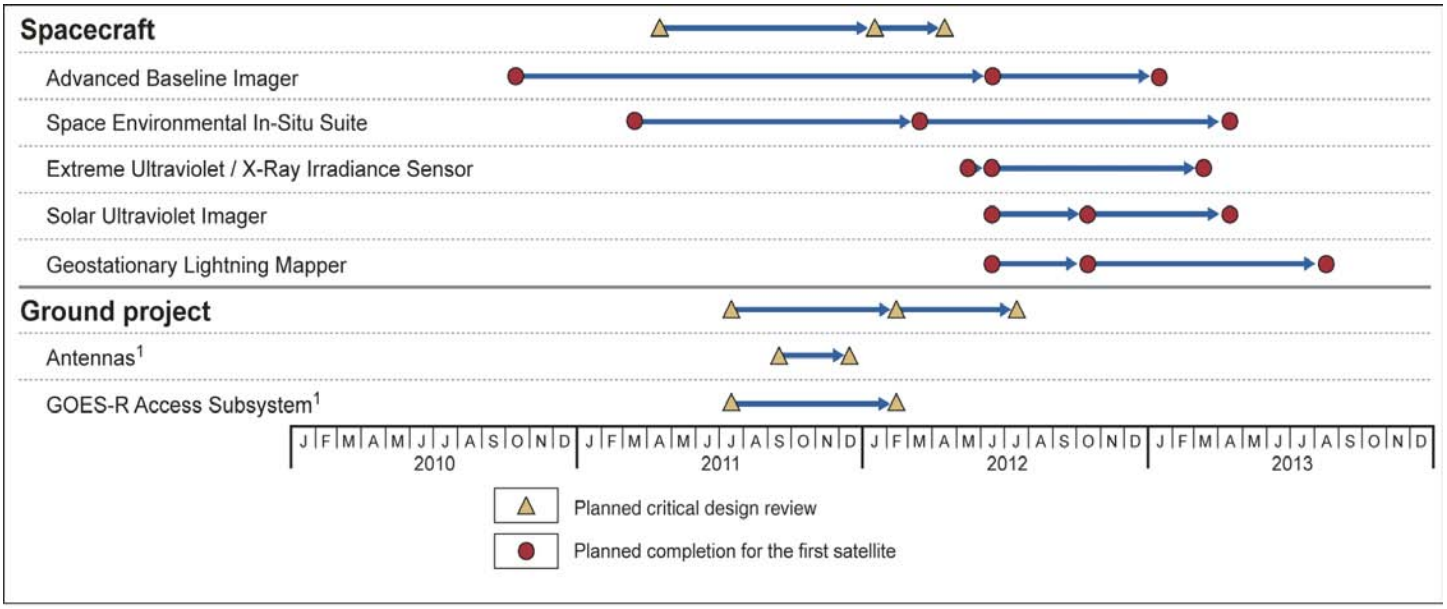
GOES-R Has Completed Early Milestones, but Delays and Schedule Weaknesses Increase Uncertainty for Remaining Development and Launch Date

While the GOES-R program has made progress in completing its design, many key milestones were completed later than planned. The program demonstrated progress towards completing its design in part by completing its set of preliminary design reviews, which indicated readiness to proceed with detailed design activities. The program and its projects are also making progress towards the final design for the entire GOES-R system, which is expected to be completed at the program's critical design review planned for August 2012. However, many key design milestones were completed later than the dates established for them in December 2007 (when the flight and ground project plans were established, prior to entering the program's development phase), and were also later than the dates established following award of the contracts for the instruments, spacecraft, and ground system components. For example, the program's preliminary design review was completed 19 months later than planned, and its critical design review is expected to be completed 13 months later than planned.

[12]NASA plans to launch the Global Precipitation Measurement Mission satellite by June 2014 and the Soil Moisture Active and Passive satellite by January 2015.

The program has also revised planned milestone dates for certain components by at least 3 months—and up to 2 years—since its originally estimated dates. Changes in planned completion dates have occurred for all five flight project instruments, as well as in major components of the ground project. Figure 2 summarizes these changes in planned completion dates.

Figure 2: Changes in Planned Completion Dates for Key Milestones in the GOES-R Flight and Ground Projects



Source: GAO analysis of agency data.

Note: The spacecraft represents the overall schedule for the flight project and includes five flight instruments—the Advanced Baseline Imager, Space Environmental In-Situ Suite, Extreme Ultraviolet/X-Ray Irradiance Sensor, Solar Ultraviolet Imager, and Geostationary Lightning Mapper. The Core Ground System represents the overall schedule for the ground project and includes the Antennas and GOES-R Access Subsystem.

This chart shows estimated timing of GOES-R milestones based on NOAA's initial 2007 estimate and monthly program status reports from 2010 and 2012. Antenna and the GOES-R Access Subsystem dates were not listed in the 2007 estimates.

GOES-R has also encountered a number of technical challenges, some of which remain to be fully addressed. For example, in early 2011 the program discovered that the ground project development schedule included software deliveries from flight project instruments that were not properly integrated—they had not yet been defined or could not be met. To address these problems and avoid potential slippages to GOES-R's launch date, project officials decided to switch to an approach where software capabilities could be delivered incrementally. While the revised plan was to reduce schedule risk with greater schedule flexibility, the plan was also expected to cost an additional $85 million and introduce other risks associated with the incremental development such as additional contractor staff and software development and verification activities that require government oversight and continuous monitoring.

So far, NOAA has been able to address certain delays and technical challenges with an available contingency reserve, in which a portion of the program's budget is allocated to mitigate risks and manage problems as they surface during development, and has not changed its 2007 cost estimates for the development of the first two program satellites. However, contractors' cost estimates for major project components have increased by $757 million, or 32 percent, between January 2010 and January 2012. Given the recent increases in contract costs, the program plans to determine how to cover these increased costs by reducing resources applied to other areas of program development and support, delaying scheduled work, or absorbing additional life cycle costs. Furthermore, as a result of changes in budget reserve allocations and reserve commitments, the program's reserves have declined in recent years from $1.7 billion to $1.2 billion. Between January 2009 and January 2012, the program reported that its reserves fell from 42 percent of remaining development costs to 29 percent.

NOAA's ability to effectively limit milestone delays and component cost increases depends in part on having an integrated and reliable programwide schedule—called an integrated master schedule—that defines, among other things, necessary detailed tasks, when work activities and milestone events will occur, how resources will be applied, how long activities will take, and how activities are related to one another. GOES-R has a programwide integrated master schedule that is created manually once a month directly from at least nine subordinate contractor schedules.[13]

[13]The subordinate schedules used in creating the integrated master schedule each contain detailed activities for discrete segments of the GOES-R program, such as instruments, which are assigned to a specific contractor. We did not analyze the programwide schedule itself due to the limitations inherent in manual creation of this schedule. However, conclusions drawn from analysis of contractors' schedules that feed directly into the programwide schedule can therefore be applied to the program's schedule as well.

We analyzed four of these subordinate contractor schedules and discovered instances where certain best practices had been implemented in the schedules, as well as weaknesses in each schedule when compared to nine scheduling best practices.[14] When viewed in conjunction with manual program-level updates, we concluded that the program-level schedule may not be fully reliable. A full set of analysis results is listed in table 1.

Table 1: Practices Utilized in Selected GOES-R Schedules

Scheduling best practice	Geostationary Lightning Mapper schedule	Advanced Baseline Imager schedule	Spacecraft schedule	Core Ground System schedule
Best practice 1: Capturing all activities	●	◕	◕	◑
Best practice 2: Sequencing all activities	◕	◑	◑	◑
Best practice 3: Assigning resources to all activities	◔	◕	◔	◑
Best practice 4: Establishing the duration of all activities	◕	◑	◕	◕
Best practice 5: Integrating schedule activities horizontally and vertically	◑	◑	◕	◑
Best practice 6: Establishing the critical path for all activities	◕	◑	◕	◔
Best practice 7: Identifying float on activities and paths	◕	◑	◑	◔
Best practice 8: Conducting a schedule risk analysis	◔	◔	◔	◔
Best practice 9: Updating the schedule using logic and durations to determine the dates	●	●	●	◕

Source: GAO analysis of schedules provided by GOES-R, documents and information received from GOES-R officials.

Key

● = The agency/contractor has fully met the criteria for this best practice

◕ = The agency/contractor has substantially met the criteria for this best practice

◑ = The agency/contractor has partially met the criteria for this best practice

◔ = The agency/contractor has minimally met the criteria for this best practice

○ = The agency/contractor has not met the criteria for this best practice

Selected schedule weaknesses existed across each of the four schedules analyzed. For example, each of the contractor schedules either did not include information on allocation of resources or allocated too much work to many of its resources. In addition, none of the contractors had

[14]These practices were based on GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs,* GAO-09-3SP (Washington, D.C.: March 2009).

completed usable schedule risk analyses that included risk simulations. Particularly important is the absence of a valid critical path[15] throughout all the schedules. Establishing a valid program-level critical path depends on the resolution of issues with the respective critical paths for the spacecraft and Core Ground System components. Without a valid critical path, management cannot determine which delayed tasks will have detrimental effects on the project finish date.

The program office has taken specific positive actions that address two of the scheduling weaknesses we identified. First, the program implemented a tool that tracks deliverables between the flight and ground projects. This initiative is intended to address a program-recognized need for better integration among the program components. Second, the program conducted a schedule risk analysis designed to identify the probability of completing a program on its target date. This initiative, while not addressing risk analyses for component schedules, is intended to address a program-recognized need to conduct a schedule risk analysis. In addition, GOES-R officials also stated that they are in the process of creating an automated process for updating their integrated master schedule sometime in 2012 and our analysis did find improvements between July 2011 and December 2011 to weaknesses in each of the four contractors' schedules.

While the program has taken positive steps to improve its scheduling, weaknesses that have the potential to cause delays nonetheless still exist as the instruments, spacecraft, and ground project components complete their design and testing phases. For example, according to program officials, the Geostationary Lightning Mapper shipment date remains at risk of a potential slip due to redesign efforts. The current projected delivery for this instrument is August 2013, leaving only 1 month before it is on the critical path for GOES-R's launch readiness date. As another example, the schedule reserve for the first satellite in the GOES-R series is being counted on to complete activities for the second satellite in the series. As a result, delays to certain program schedule targets for the first satellite could impact milestone commitments for the second satellite.

[15]The critical path represents the chain of dependent activities with the longest total duration in the schedule.

The schedule risk analysis conducted by the program indicated that there is a 48 percent confidence level that the program will meet its current launch readiness date of October 2015. Program officials plan to consult with the NOAA Program Management Council to determine the advisability of moving the launch readiness date to a 70 percent confidence level for February 2016. Even these confidence levels may not be reliable, since the establishment of accurate confidence estimates depends on reliable data that, in turn, results from the implementation of a full set of scheduling best practices not yet in place in the program.

Delays in GOES-R's launch date could impact the continuity of GOES satellite coverage and could produce milestone delays for subsequent satellites in the series. Program documentation indicates that there is a 37 percent chance of a gap in the availability of two operational GOES-series satellites at any one time given the current October 2015 launch readiness date and an orbital testing period, assuming a normal lifespan for the satellites currently on-orbit. Any delays in the launch readiness date for GOES-R, which is already at risk due to increasing development costs and use of program reserves, would further increase the probability of a gap in satellite continuity. This could result in the need for NOAA to rely on older satellites that are not fully functional.

Implementation of Recommendations Should Help Mitigate Risks of the Two Programs

Both the JPSS and GOES-R programs face risks going forward during their development; implementing the recommendations in our accompanying reports should help mitigate those risks. In the JPSS report being released today, we recommend that NOAA establish mitigation plans for risks associated with pending satellite data gaps in the afternoon orbit as well as potential gaps in the morning and midmorning orbits. NOAA agreed with our recommendation and noted that the National Environmental Satellite, Data, and Information Service—a NOAA component agency—has performed analyses on how to mitigate potential gaps in satellite data, but has not yet compiled this information into a report. The agency plans to provide a report to NOAA by August 2012.

To improve NOAA's ability to execute GOES-R's remaining planned development with appropriate reserves, improve the reliability of its schedules, and address identified program risks, we are recommending in our report being released today that NOAA

- Assess and report to the NOAA Program Management Council the reserves needed for completing remaining development for each satellite in the series.
- Assess shortfalls in schedule management practices, including creating a realistic allocation of resources and ensuring an unbroken critical path from the current date to the final satellite launch.
- Execute the program's risk management policies and procedures to provide more timely and adequate evaluations and reviews of newly identified risks, and provide more information, including documented handling strategies, for all ongoing and newly-identified risks in the risk register.
- Add to the program's critical risk list the risk that GOES-S milestones[16] may be affected by GOES-R development, and ensure that this risk and the program-identified funding stability risk are adequately monitored and mitigated.

In commenting on a draft of our GOES-R report, NOAA agreed with three of our four recommendations. It partially concurred with the fourth recommendation to fully further execute the program's risk management policies and procedures and to include timely review and disposition of candidate risks. NOAA stated that it did not consider the "concerns" listed in its risk database to be risks or candidate risks and that the risk management board actively determines whether recorded concerns should be elevated to a risk. However, the GOES-R program is not treating concerns in accordance with its risk management plan, which considers these to be "candidate risks" and requires their timely review and disposition, as evidenced by the many concerns in the database that were more than 3 months old and had not been assessed or dispositioned. Unless NOAA follows its risk management plan by promptly evaluating "concerns," it cannot ensure that it is adequately managing the full set of risks that could impact the program.

In summary, after spending about $3.3 billion on the now-defunct NPOESS program, NOAA officials have established a $12.9-billion JPSS program and made progress in launching NPP, establishing contracts for the first JPSS satellite, and enhancing the ground systems controlling the satellites and processing the satellite data. In the coming months,

[16]GOES-S is the second of four planned satellites in the GOES-R series.

program officials face changing requirements, technical issues on individual sensors, key milestones in developing the JPSS satellite, and important decisions on the spacecraft, launch vehicles, and instruments that are not included on the JPSS satellite. In addition, NOAA has not established plans to mitigate the almost certain satellite data gaps in the afternoon orbit or the potential gaps in the early and mid-morning orbits. These gaps will likely affect the accuracy and timeliness of weather predictions and forecasts and could affect lives, property, military operations, and commerce. Until NOAA identifies its mitigation options, it may miss opportunities to leverage alternative satellite data sources.

Completing many of GOES-R's early design activities is an accomplishment for this complex program, but this accomplishment has been accompanied by milestone delays and increased contractor cost estimates for GOES-R's components. The unreliability of GOES-R's schedules adds further uncertainty as to whether the program will meet its commitments. NOAA has taken steps to improve schedule reliability, but until the program implements and uses a full set of schedule best practices throughout the life of the program, further delays to program milestones may occur. Moreover, until all contractor and subcontractor information is included in the program's integrated master schedule and regular schedule risk assessments are conducted, program management may not have timely and relevant information at its disposal for decision making, undercutting the ability of the program office to manage this high-risk program.

Chairman Broun, Chairman Harris, Ranking Member Tonko, Ranking Member Miller, 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

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