SETTING NEW COURSES FOR POLAR WEATHER SATELLITES AND EARTH OBSERVATIONS

HEARING

BEFORE THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

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June 29, 2010

SETTING NEW COURSES FOR POLAR WEATHER SATELLITES AND EARTH OBSERVATIONS

TUESDAY, JUNE 29, 2010

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:07 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Brad Miller [Chairman of the Subcommittee] presiding.

HEARING CHARTER

U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

Setting New Courses for Polar Weather Satellites and Earth Observations

TUESDAY, JUNE 29, 2010
10:00 A.M.–12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

Since 2003, there have been seven hearings before the Science and Technology Committee or its subcommittees on the subject of the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) program. Established in 1994, the program was intended to design, develop, construct and launch satellites into polar orbits so that the National Oceanic and Atmospheric Administration (NOAA) and Department of Defense (DOD) would continue to receive daily data necessary for civilian and military weather forecasting needs. In the 2003 hearing, the life-cycle cost for NPOESS stated in the March 2003 budget request was **$6.1 billion,** with the first of **six satellites** expected to be **launched in 2009.** In last year's hearing, the life-cycle cost estimate had grown to at least **$14.9 billion,** was intended to purchase only **four satellites** with a first **launch pushed back to 2014.**

The key reasons for this situation include major performance problems and schedule delays for the primary imaging instrument, spawning cost overruns, all tied to a management structure that delayed rather than fostered decisions at critical moments. In 2005, the growth in cost estimates exceeded statutory limits triggering a Nunn-McCurdy [1] recertification, the elimination of two satellites and removal or downgrading of sensor capabilities—decisions driven by the Pentagon. Last year, witnesses testified before this Subcommittee that program leadership had deteriorated to the point that only White House intervention would assure that there would ever be any NPOESS satellites at all.

Rather than trying to satisfy the needs of three agencies with one satellite design, the Office of Science and Technology Policy (OSTP) [2] instructed that the program be cut in two. Satellites flying in orbits to collect early-morning observations would be developed and launched by DOD. NOAA would do the same to collect observations in the afternoon. NOAA would operate all the satellites while in orbit,[3] and would manage the common data system to receive, store and share all data. These changes will be the focus of Administration witness testimony.

From the outset of the Committee's oversight,[4] the Government Accountability Office (GAO) has delivered valuable insight on the status of the polar satellite program. Its reports have documented the steady deterioration in the program's condition. Today's hearing builds off two reports that GAO is testifying to today. The first focuses specifically on the decisions surrounding the NPOESS program and how the program is progressing. The second examines the unfinished attempts to restore important sensor capabilities, many of which were jettisoned in the Nunn-McCurdy program restructuring. Without these sensors, or similar capabilities, our ability to strengthen our Earth observation networks as a whole will be compromised.

Before turning to the issues raised by GAO in their two new reports, it is useful to get a perspective on how the cost and schedule on NPOESS have evolved (table from GAO).

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[1] As set forth in the Memorandum of Agreement governing the NPOESS program, the Air Force managed the acquisition of the satellites. NPOESS was therefore subject to Department of Defense regulations for major defense programs. When such programs exceed approved baseline costs by more than 25 percent, recertification is required by 10 U.S.C. 2433 *et seq*.

[2] In concert with the Office of Management and Budget and the National Security Council.

[3] NOAA took on operating responsibility for Defense Meteorological Satellite Program (DMSP) satellites in 1998.

[4] Mr. Dave Powner, GAO's witness, has testified at five of the seven previous hearings.

Table 4: Changes in NPOESS Life-Cycle Cost Estimates and Estimated Satellite Launch

(Dollars in billions)

As of	Life-cycle cost estimate	NPP launch	C1 launch	C2 launch
August 2002	$7.0	May 2006	April 2009	June 2011
July 2003	7.0	October 2006	November 2009	June 2011
September 2004	8.1	October 2006	November 2009	June 2011
August 2005	8.1	April 2008	December 2010	December 2011
June 2006	12.5	January 2010	January 2013	January 2016
December 2008	13.95	January 2010	January 2013	January 2016
June 2009	14.95[a]	January 2011	March 2014	May 2016

Source: GAO analysis of program office and contractor data.

[a]This is a GAO estimate based on our analysis of contractor data.

GAO's NPOESS Report—Leadership Paralysis

A dominant theme in the Committee's hearings of the last three years, and a bipartisan concern, was the ineffectiveness of the chief leadership arm, the so-called Executive Committee (ExCom).[5] Particularly revealing was the fact that it took more than a year to agree on documents needed to implement the changes from the Nunn-McCurdy process.

By June of last year, this leadership dysfunction was so pronounced that both GAO and an independent review team (IRT) commissioned by the ExCom concluded that the program could not succeed if it was left in place. In the Subcommittee's previous hearing GAO's Mr. Powner testified that the ExCom ". . . has not effectively fulfilled its responsibilities and does not have the membership and leadership it needs to effectively or efficiently oversee and direct the NPOESS program."[6] The Independent Review Team report stated, ***"The IRT believes that this program will not survive if this particular problem is not addressed immediately"*** [emphasis added] and that the problems ". . . can only be resolved at the White House level."[7] The IRT recommended that the program, in its entirety, be assigned to NOAA or DOD; the team felt that NOAA was the better choice given that the agency could not execute its fundamental missions without these satellites.

A task force to devise a solution, chaired by OSTP's Associate Director Shere Abbott, began work last August. In October, Chairman Gordon and Mr. Miller wrote OSTP Director John Holdren to advocate for the IRT's proposed solution assigning program responsibility to NOAA. With decisions relating to NOAA's Fiscal Year (FY) 2011 budget request looming, the letter also urged the task force to expedite its work.

On January 5, the Office of Management and Budget (OMB) provided direction on restructuring to the agencies.[8] The decision became public with the release of a White House fact sheet on February 1 in conjunction with the release of the President's budget. Key points from the fact sheet were:

- **". . . NOAA and NASA** [the National Aeronautics and Space Administration] **will take primary responsibility for the afternoon orbit, and**

[5]The Committee consisted of the NOAA and NASA Administrators, and the Under Secretary of Defense for Acquisition, Technology and Logistics, who normally delegated responsibility for ExCom attendance to the Secretary of the Air Force.

[6]U.S. Congress. House. Committee on Science and Technology. *Continuing Independent Assessment of the National Polar-Orbiting Operational Environmental Satellite System.* Hearing before the Subcommittee on Investigations and Oversight (Washington: Government Printing Office). Serial 111–36. June 17, 2009; p. 19.

[7]*Ibid.;* pp. 120, 125.

[8]Restructure of the NPOESS Program. Memorandum from the Director of OSTP, Director of OMB and the National Security Advisor to the Under Secretary of Defense for Acquisition, Technology and Logistics, the Under Secretary of Commerce for Oceans and Atmosphere and the Administrator of NASA, March 2, 2010.

DOD will take primary responsibility for the morning orbit. The agencies will continue to partner in those areas that have been successful in the past, such as a shared ground system. The restructured programs will also eliminate the NPOESS tri-agency structure that that has made management and oversight difficult, contributing to the poor performance of the program. [emphasis added]

- **"NOAA and the Air Force have already begun to move into a transition period during which the current joint procurement will end. A detailed plan for this transition period will be available in a few weeks.** [emphasis added]
- **"NASA's role in the restructured program will be modeled after the procurement structure of the successful POES and GOES programs, where NASA and NOAA have a long and effective partnership.** Work is proceeding rapidly with NOAA to establish a JPSS program at NASA's Goddard Space Flight Center (GSFC). [emphasis added]
- ". . . NOAA and NASA will strive to ensure that all current NPOESS requirements are met on the most rapid practicable schedule without reducing system capabilities.
- ". . . Cost-estimates will be produced at or close to the 80% confidence level.
- "DOD remains committed to a partnership with NOAA in preserving the Nation's weather and climate sensing capability. **For the morning orbit, the current DOD plan for deploying DMSP satellites ensures continued weather observation capability. The availability of DMSP satellites supports a short analysis (in cooperation with the partner agencies) of DOD requirements for the morning orbit and solutions with the start of a restructured program in the 4th quarter of fiscal year 2011. While this study is being conducted, DOD will fully support NOAA's needs to ensure continuity of data in the afternoon orbit by transitioning appropriate and relevant activities from the current NPOESS effort.** [emphasis added]
- "We expect much of the work being conducted by Northrop-Grumman and their subcontracts will be critical to ensuring continuity of weather observation in the afternoon orbit. DOD will work closely with the civil partners to ensure the relevant efforts continue productively and efficiently, and ensure the requirements of the national weather and climate communities are taken into consideration in building the resultant program for the morning orbit."

OSTP, on March 12, described the implementation plan for the new program. The requirements for data to be collected did not change. NASA and NOAA were to continue preparing the NPOESS Preparatory Program (NPP) satellite for launch in 2011 to avoid losing data coverage in the afternoon. NOAA will reimburse NASA to manage the JPSS program at the Goddard Space Flight Center, as recommended by the IRT report discussed earlier. The Air Force will assume the responsibility for managing its program with the management office at Space and Missile Systems Center at the Los Angeles Air Force Base. In an Acquisition Decision Memorandum issued on March 17, the NPOESS Integrated Program Office (IPO) was ordered to facilitate the necessary actions.

GAO's NPOESS Report—Early Transition issues

A. NPP Satellite Status

Preparation and launch of the NPP satellite is the immediate critical item in the polar satellite program. GAO notes the delivery of the long-awaited VIIRS instrument and its integration on the satellite. The report also notes that the Cross-Track Infrared Sounder (CrIS) suffered its own technical problems late in development, involving damage to the instruments structure during vibration testing and questionable circuit card manufacturing. Resolving the issues and additional testing had the effect of delaying the NPP launch yet again, to September 2011. NOAA will testify, however, that CrIS has met its revised delivery date.

NPP was never intended to be an operational satellite. Rather it was more of a "proof of concept" satellite that would allow NOAA time to practice incorporating data collected by the new sensors into its operational activities and to cross-compare sensor performance against those on board existing satellites. However, last year, when the continuing sensor trouble led to another delay in the predicted launch date for the first NPOESS satellite, the program decided to compensate by using the NPP as a quasi-operational stopgap. As GAO notes, NPP was not designed to use the full NPOESS ground system and so will not approach the improvements in

data delivery time that were expected from the next-generation satellites. Further, only NOAA and the Air Force weather center will have direct NPP data readouts; the two Navy centers without such capability will find that NPP data may not arrive in time to be used in their operations. Both DOD and NOAA are seeking fixes for this issue.

B. Initial Planning

As GAO notes, the transition is moving at different rates within DOD and NASA. NOAA indicated to GAO that **transition activities would begin in July and be complete by September.** NOAA received approval from the Committee on Appropriations for an April request to reprogram $73.8 million in NPOESS funds to fund establishment of the Goddard office and other transition activities. GAO reported that the DOD was expecting to complete a requirements review and determine whether to employ the NPOESS spacecraft by the end of June 2010, then make instrument selections by October 2010. The target for starting the program was FY 2013.

GAO included the following table to compare the new program with NPOESS:

Table 6: Comparison of NPOESS to the New NOAA and DOD Acquisitions

Key area	NPOESS program after the Nunn-McCurdy decision (as of June 2006)	NPOESS program (as of February 2010)	NOAA and DOD acquisition plans (as of February 2010)
Life-cycle range	1995-2026	1995-2026	*JPSS*: 1995-2024 *DOD program*: unknown
Estimated life-cycle cost[a]	$12.5 billion	$13.95+ billion[b]	*JPSS*: $11.9 billion (which includes about $2.9 billion in NOAA funds spent through fiscal year 2010 on NPOESS) *DOD program*: unknown; DOD s initial estimates include costs of about $5 billion through fiscal year 2015 (which includes about $2.9 billion in DOD funds spent through fiscal year 2010 on NPOESS)
Launch schedule	NPP by January 2010 C1 by January 2013 C2 by January 2016 C3 by January 2018 C4 by January 2020	NPP no earlier than September 2011 C1 by March 2014[c] C2 by May 2016 C3 by January 2018 C4 by January 2020	NPP no earlier than September 2011 JPSS-1 (C1 equivalent) available in 2015 JPSS-2 (C3 equivalent) available in 2018 *DOD program*: unknown
Number of sensors	NPP: 4 sensors C1: 6 sensors C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors C1: 7 sensors[d] C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors JPSS-1 and 2: Although NOAA has not determined the exact complement of sensors, it will have at least 5 of the original NPOESS sensors[e] *DOD program*: unknown

Source: GAO analysis of NOAA, DOD, and task force data.

[a]Although the life-cycle ranges for NPOESS are through 2026, the cost estimates for both NPOESS and JPSS are only through 2024.

[b]Although the program baseline is currently $13.95 billion, we estimated in June 2009 that this cost could grow by about $1 billion. In addition, officials from the Executive Office of the President stated that they reviewed life-cycle cost estimates from DOD and the NPOESS program office of $15.1 billion and $16.45 billion, respectively.

[c]Officials from the Executive Office of the President noted that the expected launch date of C1 had slipped to late 2014 by the time of their decision.

[d]In May 2008, the NPOESS Executive Committee approved an additional sensor the Total and Spectral Solar Irradiance Sensor for the C1 satellite.

[e]These five sensors are: VIIRS, CrIS, OMPS-nadir, the Advanced Technology Microwave Sounder, and the Clouds and the Earth s Radiant Energy System/Earth Radiation Budget Sensor.

Based on this information, GAO projects that the final life-cycle cost for the new polar satellite constellation will be more than the current approved spending baseline for the NPOESS program. Based on previous experience, launch delays can be expected. Decisions are still lacking on which sensors will fly and the platform they will be carried on in orbit. GAO recommends that the Departments of Commerce and Defense seek expedited decisions on these issues.

Some of the unknown items have been addressed by decisions made last week by DOD and NOAA. Mr. Klinger should testify about the Acquisition Decision Memorandum (ADM) subsequently issued on June 22. In it, DOD indicates it expects the newly-christened Defense Weather Satellite System (DWSS) to launch its first satellite in 2018. DOD intends to also use the VIIRS sensor as its imager, and the satellite will carry the Space Environment Monitor originally intended for NPOESS.

However, more information was requested on the anticipated microwave sounding instrument and its selection was postponed until August 2010.

The other major decision that was deferred until August concerned the spacecraft "bus" to fly in the morning orbit. The ADM states, "Implement the above actions to maximize use of the Government's investment in NPOESS, and in a manner that offers maximum opportunities for collaboration with the NOAA JPSS program."[9] A major debate between DOD and NOAA at this point is whether both agencies should use the spacecraft design originally intended for NPOESS. DOD's platform choice is likely affected by the final configuration of the microwave sounder it will choose.[10] For NOAA, on the other hand, the issue was time. Having no spare satellites in ground storage,[11] NOAA is focusing on avoiding schedule delays.

This time pressure can be seen in NOAA's decision on June 23 to obtain a "clone" of the NPP satellite to serve as JPSS–1. Ms. Glackin should testify that this satellite will be purchased from Ball Corporation, NASA's contractor on the NPP satellite, on a sole-source basis. The instruments will be supplied by NASA, and will be much the same as those aboard NPP. However, NOAA's decision has the effect of reopening the debate about how to maintain continuity in the records of solar energy incidence, a critical climate variable, because the new satellite will not have space for the Total Solar Irradiance Sensor (see the discussion below in the discussion of GAO's second report). International obligations to maintain search-and-rescue communication transponders may also be affected.

With this decision, NOAA hopes to be able to maintain an opportunity to launch JPSS–1 in 2014. As GAO notes, NPP only has a five-year design life, and NOAA's current plan envisions a 2015 launch for JPSS–1. Assuming that timeline, adding in the time needed to bring the new satellite into service, NPP might well fail before JPSS–1 is fully operational.

C. The Funding Squeeze

The March 12 implementation plan lays out an anticipated funding profile. It is consistent with cost numbers GAO quotes: $11.929 billion for NOAA through the end of 2024; $5 billion for DOD through the end of FY 2015:

Table 1: Outyear Funding Estimates for the Restructured NPOESS Program (Budget Authority in millions of dollars)*

($M)	FY 2009 & prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost to Complete	Total
PM orbit: Joint Polar Satellite System (NOAA and NASA costs)	2,526	382	1,061	1,160	960	740	610	4,490	11,929
AM Orbit DoD portion of the restructured NPOESS Program (DoD budget)	2,512	391	352	491	439	338	456	TBD	TBD
Total	**5,038**	**773**	**1,413**	**1,651**	**1,399**	**1,078**	**1,066**	**TBD**	**TBD**

According to the plan, the FY 2010 funds are intended to maintain progress toward an NPP launch, to fund the transition and to initiate the purchase of the JPSS spacecraft bus. As noted earlier, NOAA has reprogrammed $74 million into a new JPSS appropriation account. DOD will not change its requests for FY 2010 and FY 2011 funds to minimize problems in the transition; changes in the later years await final DWSS definition.

GAO notes that DOD is operating under Congressional restrictions in the use of its funding, which limited FY 2010 funds available to the Air Force until the submission of a strategy and implementation plan.[12] The March submission fulfilled

[9] Ashton B. Carter. Acquisition Decision Memorandum (ADM) for Department of Defense responsibilities under the restructure of the National Polar-Orbiting Operational Environmental Satellite System (NPOESS). June 22, 2010; p. 1.

[10] The original NPOESS spacecraft had to be increased in size in order to accommodate growth in the Conical Microwave Imaging Sounder, an instrument that was later removed from the spacecraft during the Nunn-McCurdy restructuring due to design challenges.

[11] The last current model, NOAA–19, has been in on-orbit storage since its launch February 6, 2009.

[12] Sec. 913, Public Law 111–884; October 28, 2009.

those conditions, although GAO expresses concern that funding recessions might still force termination of the NPOESS contract by the end of September. So far the funds remain available. However, the House Armed Services Committee, dissatisfied with DOD's somewhat vague transition plan, proposes only $25.5 million for FY 2011.[13] According to the June 22 ADM, the August meeting is to consider the "schedule, estimated costs, and risks to a successful launch and deployment of the capability in FY 2018," and develop a rough-order-of-magnitude" cost estimate.

With the program changes, the agencies will submit separate funding requests in the future. NPOESS operated under a directive from the Appropriations Committee that both agencies contribute equally to the program. With the new JPSS/DWSS, NOAA will likely submit requests higher than those of DOD, reflecting the fact that NOAA is responsible for the ground system. NOAA's decision to prepare its requests with more conservative assumptions, thus leading to higher confidence that it will more closely approximate actual spending, will also play a role. This is likely to be small comfort to appropriators already pressed to reduce spending.

D. The Northrop Grumman Contract

Central to the funding squeeze, GAO says, is a requirement in the NPOESS prime contract awarded to the Northrop Grumman Corporation in 2002. According to the report, the contract requires full funding of termination liability (i.e., the penalty to be paid by the government if it decides to end the contract) in the current year budget. NOAA and DOD are carefully watching expenditures to assure that FY 2010 funds would be sufficient to pay an estimated $84 million in such costs (the agencies have agreed they share the liability equally).

At the rate of spending in the NPOESS program, the agencies would have been forced to bring the program to a halt in August to have $84 million available, according to GAO. In April, steps began to "slow down work on all development activities so that work could continue through the end of the fiscal year." The risk therefore remains that, if the agencies misjudge fund management, there could be an immediate impact on NPP preparations or the transition might come to a halt.

Northrop also has keen interest in the outcome of the agency debate on bus options for their satellites. Despite NOAA's decision to develop JPSS–1 using the NPP bus, there is still the possibility that the DOD satellites and NOAA's JPSS–2 could be using Northrop's NPOESS bus or a variant thereof. The government's decision on what buses it will buy will do much to determine its answer to Northrop's basic question: how much we will participate in the new program?

GAO's NPOESS Report—Maintaining Direction

Looking at the history of NPOESS and similar program, GAO cites other issues that may prove problematic as the agencies proceed to organize their respective programs.

A. Negotiating Change

Northrop Grumman's contract includes the responsibility for managing the subcontractors producing the various instruments. In the new program, each of these subcontracts will be transferred to NASA. There will also be changes resulting from the final choices on the satellite buses. Program restructuring also entails reworking budget and schedule plans, a process which took months to complete after the Nunn-McCurdy decisions in 2006. GAO warns that there may be similar problems in this transition. Indeed, some of these negotiations cannot even begin until the new program offices are in place or until decisions like those on the microwave sounder are finalized.

B. NASA's Increased Responsibilities

In the NPOESS program, NASA was distinctly a junior partner. For JPSS, it will return to its more traditional role as NOAA's technical support arm. Ms. Glackin and Mr. Scolese will refer to the long history the two agencies share, from the original Television Infrared Observation Satellite of 1960 to the current Geostationary Operational Environmental Satellite (GOES) program now underway.

GAO points out, however, that NASA procurement remains on its list of high-risk concerns. It warns that unless NOAA establishes a strong system for obtaining information from and providing direction to NASA, there is a possibility for replaying

[13] U.S. Congress. House. Committee on Armed Services. Report to Accompany H.R. 5136, the National Defense Authorization Act for Fiscal Year 2011 (Washington: Government Printing Office). H. Rpt. 111–491. May 21, 2010; p. 179.

the unhappy example of the GOES I–M program.[14] Simply shifting program elements to NASA, GAO warns, is not a guarantee problems will no longer occur.

C. Avoiding the Brain Drain

Finding qualified people capable of managing complex technical development programs is difficult for NOAA, NASA and DOD. Having to staff the management offices needed to winnow the valuable elements of the NPOESS program while gearing up its successors will pose challenges to the agencies' human resource personnel. GAO states that the existing Integrated Program Office staff, beset with turmoil and uncertainty, has been leaving or preparing to do so. Steps should be underway to prevent hard-earned experience from slipping out the door.

D. Preserving Cooperation

Even with the divergence of procurement responsibility, there are still areas where the JPSS and DWSS staffs will continue to cooperate, says GAO. In managing the data system, DOD and NOAA will have to assure that cooperation on transmission protocols and formatting is preserved. Instrument selection must consider the full spectrum of agency needs. Preserving the process for requirements development would be beneficial.

GAO's Earth Observation Strategy Report

A. Preserving Climate and Space Weather Continuity

When the NPOESS program underwent restructuring in 2006 after its Nunn-McCurdy recertification, the decision was made to support only those components that contributed to weather observations. Accordingly, a set of sensors intended for monitoring climate parameters was removed. Additionally, improved versions of instruments designed to expand the ability to monitor emissions from solar activity were canceled in favor of flying copies of the existing instruments.

At a time where concern about climate change had real political and economic consequences, the loss of the climate sensors threatened to disrupt the ability to answer a pressing issue—which changes were the result of human actions, and which were caused naturally? Doing so requires technology that can discriminate between small differences in temperature and other conditions. Such data must be collected for decades or longer. Without the NPOESS sensors, the interruptions in the data records would make it difficult if not impossible to properly identify climate trends.

Dr. John Marburger, Dr. Holdren's predecessor at OSTP, asked NASA and NOAA in June 2006 to find alternatives for putting the climate instruments into service.[15] As a result of that effort, the Total Solar Irradiance Sensor (TSIS) was identified as top priority, which measured the amount of energy the Sun was providing to the Earth. As this represents the major source of energy powering the Earth's physical, chemical and biological systems, precise knowledge of the amounts arriving and the changes in that amount over time is fundamental to climate science. Second priority went to the Earth Radiation Budget Sensor (ERBS) which tracked the amount of energy the Earth returned to space.

Based on this analysis, NOAA has obtained appropriations to build one of each sensor. The TSIS sensor was intended to fly on the first NPOESS satellite. The NPP "clone" NOAA now intends to buy, however, does not have sufficient space to accommodate TSIS and so the question of maintaining continuity of this data is again open. Earth radiation budget data will be collected using a copy of the existing Clouds and the Earth's Radiant Energy System (CERES) sensor on both NPP and JPSS–1. The ERBS upgrade will likely fly on JPSS–2. NOAA has also decided to restore the full capability of the Ozone Monitoring and Profiler Suite on NPP, but whether it will also fly the Limb component aboard the follow-on satellites has not been finally determined.

GAO was asked to evaluate the efforts NOAA and NASA expended in restoring the full complement of climate sensors, leading to this second report. GAO had recommended in 2008 that a long-term strategy for a climate observation network was needed. GAO states that recommendation has not been satisfied:

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[14] Government Accountability Office. *WEATHER SATELLITES: Action Needed to Resolve Status of the U.S. Geostationary Satellite Program.* NSIAD–91–252. July 24, 1991.

[15] Dr. Marburger testified before the Energy and Environment Subcommittee about this process on June 7, 2007. See U.S. Congress. House. Committee on Science and Technology. *The Status Report on the NPOESS Weather Satellite Program:* Hearing before the Subcommittee on Energy and Environment (Washington: Government Printing Office). Serial 110–36. June 7, 2007.

> Since June 2006, the agencies have taken steps to restore selected capabilities that were removed from NPOESS in the near-term; however, they do not yet have plans to restore capabilities for the full length of time covered by the NPOESS program . . . . Both DOD and NOAA officials reiterated their commitment to look for opportunities to restore the capabilities that were removed from NPOESS and GOES–R. However, agency officials acknowledge that they do not have plans to restore the full set of capabilities because of the complexity and cost of developing new satellite programs.

The report tells a very similar story for the instruments devoted to so-called "space weather," a colloquial term referring to the effects generated in Earth's atmosphere and magnetic field by events on the Sun. The power of such events was demonstrated in 1998 when a solar geomagnetic storm affected the power grid of Quebec and caused a regional blackout. Similar storms today, in an era where Global Positioning Satellites keep offshore oil rigs from drifting out of position, pipelines may be damaged by currents induced as magnetic fields shift, and airlines shorten international flights by flying in the polar region (exposing passengers to charged particles from the "solar wind"), make it important to know what is happening on our nearby star. Again, however, there is no long-term strategy to provide for these observations.

GAO recommends that the Office of Science and Technology Policy direct the completion and release of three reports, one prepared by the United States Group on Earth Observations and two by the Office of the Federal Coordinator for Meteorology. With those reports in hand, these interagency groups can move forward with the process of developing the strategies called for by GAO two years ago. Ms. Abbott's testimony does not indicate completion dates for the reports.

B. Pieces of a Global Puzzle

During the 2008 Presidential campaign, President Obama issued a position paper entitled "Advancing the Frontiers of Space Exploration." It stated, in part:

> "Understanding how Earth supports life and how human activities affect its ability to do so is one of the greatest challenges facing humanity . . . . Given the urgency of climate-related monitoring, and considering the time required to design, develop, and deploy Earth observation satellite systems, the Obama administration will lean forward to deploy a global climate change research and monitoring system that will work for decades to come." [16]

Across the globe and in space, the United States has for decades deployed increasingly sophisticated instruments capable of following environmental change and collecting data to assist in predicting such changes. Satellites such as NOAA and DOD's weather satellites and the three NASA Earth observation platforms *Terra, Aura* and *Aqua* are daily watching the evolution of weather, land use changes and shifting currents in the ocean. In 1900, thousands in Galveston, Texas died because there was no way to know a massive hurricane was bearing down on the city. In contrast, when Hurricane Ike struck Galveston in September 2008, authorities were able to order evacuation of the island two days before. Loss of lives was limited to fewer than 200. The difference was the ability to follow Ike almost from birth to death with the GOES satellites, and to predict where it was likely to go using data supplied by data from buoys, ships and planes.

The strategies discussed in GAO's report are smaller pieces of the effort that will be needed to accomplish the President's broader goal. Such a network must extend across four major environments: the interplanetary medium (the region between the Sun and the Earth affected by the "solar wind" and other emissions), the atmosphere, the oceans and the land surface. Among the questions that need answers: What information should be collected in each environment? What instrument is needed to collect that information? Should that information be collected in space or on the ground?

Satellites make their primary contributions collecting data at a global scale, but equally vital are sensor webs such as the 3000 free-drifting floats of the Argo network, moving through the oceans where winds and currents drive them. The hurricane forecasters of NOAA's Tropical Prediction Center fiercely object if cutbacks are proposed for "hurricane hunter" aircraft or their specialized ocean buoys. Since 1996, the Department of Energy has supported the AmeriFlux network studying the flow of carbon dioxide, water and energy through ecological systems during various time scales. Satellite operators compare their data to those from these ground-based

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[16] Advancing the Frontiers of Space Exploration, Barack Obama 2008, August 16, 2008. Accessed at *http://www.spaceref.com/news/viewsr.htmi?cid=28880* (June 24, 2010).

counterparts in order to be sure they understand exactly what they are seeing. It may sometimes produce better scientific outcomes and be a better use of resources to collect data on the ground instead of from orbit.

Many agencies have invested in or are contemplating projects that might serve well as parts of a global observing system. GAO's report indicates that the coordination of the disparate efforts may not be occurring within OSTP, OMB or the Council on Environmental Quality. There are important questions which cannot be answered by one agency: Is a proposal duplicating observational activities or can it close a gap for another agency? How are these deployments coordinated? In an era of fiscal austerity, which networks collect information that we cannot afford to lose? Who assures that data from different sources is compatible so that hidden connections can be identified by comparing, for example, river flow records to estuarine production? Where do we store the data so that it can be found later and used to answer questions not even considered when it was originally collected?

As a specific issue, consider the so-called "research-to-operations" gap that regularly opens up between NASA and NOAA. Part of the benefit from NASA's application of its technology to looking at Earth is that it may open a new window on what is happening on land or in the air or water. In the specific case of NPOESS, the VIIRS sensor is an advanced version of the Moderate Resolution Imaging Spectroradiometer flying on NASA's *Terra* and *Aqua* satellites. Too often, however, technological improvement languishes because NOAA's satellite operators and NASA's scientists fail to communicate about the value in applying new techniques. This disconnection showed itself in examples such as NASA's decision to shut down the *Tropical Rainfall Measuring Mission* (TRMM) because it had succeeded in accomplishing its goal of demonstrating the technology. NASA's announcement came at the outset of the 2004 hurricane season, which left NOAA disconcerted when it turned out that TRMM data was being used in some forecasting models. TRMM is still operating as a result. This year has seen the scatterometer instrument die on NASA's *QuikSCAT* satellite before NOAA could arrange for new versions to continue collecting the wind data that made it possible to issue alerts to shipping about high-wind threats. NASA's *Advanced Composition Explorer* (ACE) is well past its design life at its position between the Sun and Earth. From where it sits, ACE can detect solar emissions that are heading for Earth and offer enough warning to protect critical systems from damage. Yet this "fire alarm" may soon fail just as the Sun may be emerging from the "quiet period" in its 11-year cycle and there is no replacement ready. One of the reports GAO recommends releasing, prepared by the National Space Weather Program, discussed options for replacing ACE. NOAA now intends to retrieve the *Deep Space Climate Observatory* (DSCOVR) from storage and outfit it to serve as ACE's successor.

In 2005, the National Academies issued an interim report relating to their decadal survey of the Earth sciences. It noted that, following the Vision for Space Exploration articulated by President George W. Bush in 2004, NASA's budget request had included a guiding national objective "to study the Earth system from space and develop new space-based and related capabilities for this purpose." Yet the Academy panel went on to note that ". . . the priority for Earth observations, which have direct and immediate relevance to society, appears greatly diminished in terms of the projected declining budgets that are proposed for FY 2006." When this Committee met for hearings on the NASA Earth science program, Chairman Gordon (at the time Ranking Member on the Committee), made a direct connection between the concerns expressed by the Academy panel and the lack of an agency strategy:

> . . . [T]he fact is that when the President cut $2.5 billion from NASA's funding plan for fiscal year 2006 through 2009 relative to what he had promised just a year earlier, NASA imposed 75 percent of the cut on NASA's Science and Aeronautics program and only ten percent on NASA's Exploration Systems program . . . .
>
> It is no wonder that the Earth science program is canceling and delaying missions. And the problem has been compounded by NASA's apparent unwillingness or inability to date to develop a long-term vision for Earth science and application programs.
>
> So where does all of this leave us?
>
> Let me quote the National Research Council once again: "Today the Nation's Earth Observatory program is at risk." [17]

[17] U.S. Congress. House. Committee on Science. NASA Earth Science. Hearing before the Committee on Science (Washington: Government Printing Office). Serial 109–12. April 28, 2005; p. 30.

In its final report, the Academy panel made a recommendation particular to OSTP:

> The committee is concerned that the nation's institutions involved in civil space (including NASA, NOAA, and USGS) are not adequately prepared to meet society's rapidly evolving Earth information needs. These institutions have responsibilities that are in many cases mismatched with their authorities and resources: institutional mandates are inconsistent with agency charters, budgets are not well-matched to emerging needs, and shared responsibilities are supported inconsistently by mechanisms for cooperation. These are issues whose solutions will require action at high-levels of the government. Thus, the committee makes the following recommendation: **Recommendation: The Office of Science and Technology Policy, in collaboration with the relevant agencies, and in consultation with the scientific community, should develop and implement a plan for achieving and sustaining global Earth observations. This plan should recognize the complexity of differing agency roles, responsibilities, and capabilities as well as the lessons from implementation of the Landsat, EOS, and NPOESS programs.** [emphasis in original]

GAO concludes with similar recommendations, calling on OSTP to direct the Group on Earth Observations and the National Space Weather Program to produce long-term strategies for observations in their particular disciplines.

Witnesses

Hon. Shere Abbott
Associate Director, Energy and Environment Division
Office of Science and Technology Policy

Ms. Abbott directed the task force established by Dr. John Holdren, Director of OSTP, to evaluate changes in the management of the NPOESS program. She will testify on the task force's recommendation to divide responsibility for polar weather satellite coverage so that agencies will meet their own requirements. Ms. Abbott will also address the recommendations in a second Government Accountability Office (GAO) report that Dr. Holdren should expedite the completion of planning reports for climate and space weather observations in order to advance the development of a national earth observation strategy.

Ms. Mary Glackin
Deputy Under Secretary for Oceans and Atmosphere
National Oceanic and Atmospheric Administration

Polar-orbiting satellites supply vital data for the computer models used for weather forecasting. Success in completing and launching the NPOESS satellites was therefore of paramount importance to NOAA. NOAA has launched the last of its existing series of polar satellites and would therefore be the principal beneficiary of a solution to the persistent deadlock in the NPOESS program. Ms. Glackin is now supervising NOAA's transition to the follow-on Joint Polar Satellite System and the expanded cooperation with the National Aeronautics and Space Administration in developing afternoon-orbit satellite coverage.

Mr. Christopher Scolese
Associate Administrator
National Aeronautics and Space Administration

Originally, NASA had a secondary role in the NPOESS program. With the changes now underway, it will adopt its more traditional role as technical support arm and program manager for NOAA in the new JPSS effort. NASA will assume management of the instrument contracts from the prime contractor, Northrop Grumman. The NPOESS Preparatory Program (NPP) satellite, which NASA funded and has managed as a testbed to allow early experience in operating the new NPOESS satellites, will instead serve as an interim operational satellite to avoid loss of data between NOAA's existing polar-orbiting satellites and launch of the first JPSS satellite. Mr. Scolese will testify regarding NASA's new responsibilities in the JPSS effort.

Mr. Gil Klinger, Director, Space and Intelligence Office
Assistant Secretary of Defense for Acquisition
Department of Defense

Mr. Klinger provides oversight for all Department of Defense space and intelligence programs within the Office of the Under Secretary of Defense for Acquisi-

tion, Technology and Logistics. As the Air Force was responsible for managing the NPOESS acquisition, Mr. Klinger's office had the responsibility to approve major program decisions under the terms of DOD acquisition management regulations (one of the major aspects of the ExCom's ineffectiveness). Mr. Klinger is currently elaborating what changes—if any—DOD will make to its plans for polar weather satellite coverage in the wake of the decision to transfer responsibility for acquiring morning orbit satellites to DOD.

Mr. David Powner
Director, Information Technology Management Issues
Government Accountability Office

Mr. Powner has directed GAO's team monitoring the NPOESS program for the Committee since 2001. GAO's report last year and Powner's testimony at the Subcommittee's previous hearing was central to the convening of the Administration's task force. Powner will testify on two reports completed at the request of the Committee:

- *POLAR–ORBITING ENVIRONMENTAL SATELLITES: Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data*
- *ENVIRONMENTAL SATELLITES: Strategy Needed to Sustain Critical Climate and Space Weather Measurements*

Chairman MILLER. Good morning. This hearing will now come to order. Welcome to today's hearing entitled *Setting New Courses for Polar Weather Satellites and Earth Observations.* This is a familiar topic to this committee and subcommittee. Since 2003, there have been seven hearings before the Science and Technology Committee or various subcommittees on the subject of the National Polar Orbiting Operational Environmental Satellite System. Mercifully there is an acronym, NPOESS.

Established in 1994, the program was intended to design, develop, construct, and launch satellites into polar orbits so that the National Oceanic and Atmospheric Administration, NOAA, and the Department of Defense, DOD, would continue to receive daily data necessary for civilian and military weather forecasting needs.

In the 2003 hearing the life cycle costs for NPOESS in March, 2003 budget was $6.1 billion, with the first of six satellites expected to be launched in 2009. In last year's hearing the life cycle cost estimate had grown to at least 14.9 billion, was intended to purchase only four satellites with a first NPOESS satellite launch pushed back to 2014.

NPOESS has continued to suffer from major performance problems and schedule delays for the primary imaging instrument and those spawned cost overruns. The program has undoubtedly been snake bit, but at least we thought we knew the snake that bit it. The real problem appeared to be that the program was crippled by management structure that delayed decisions at critical moments. The tri-agency management board proved incapable of making decisions and taking action when most needed.

Last year's witnesses testified before the subcommittee that program leadership had deteriorated to the point that only White House intervention would assure that there would ever be any NPOESS satellite at all. At that hearing we were told that one agency should be put in charge of managing the program, either DOD or NOAA.

OSTP did take responsibility for intervening to rescue the drifting program, but instead of putting one of those two agencies in charge, OSTP adopted the Solomonic solution of cutting the program in two. Satellites flying in orbits to collect early-morning observations were developed and launched by DOD with their newly-christened Defense Weather Satellite System. NOAA would do the same thing with their renamed Joint Polar Satellite System to collect observations in the afternoon. NOAA would operate all the satellites while in orbit and would manage the common data to receive, store, and share the data.

With this decision OSTP has removed the block over which we had been stumbling in the last few years—the snake that appears to have bitten this program repeatedly—but that is not all that will be required to guarantee success. There was a reason for having a single program in the first place, and splitting the program in two may simply create two programs with the same old problems.

There are plenty of reasons to keep attention fixed on these new programs. For example, even though we now have clarity about what agency is responsible for which mission, this clarity apparently comes at the cost of delay and confusion about which instru-

ments will be flown on which satellite and when will the satellite launch.

There is a contractor that still has continuing work for the old NPOESS program and subcontractors with instruments in various states of development. What is to be the fate of those work efforts, and when will those decisions be made?

Our other discussion today grows out of the experience, our experience with NPOESS. Back in 2006, all the climate sensors being prepared to fly on NPOESS were removed. If we anticipate having to deal with climate change or—I am sure Dr. Broun will say the possibility of climate change—for decades to come, how can we eliminate a means for knowing how well we are doing. It has been clear that this decision was ill-thought through and would have to be reversed.

Without these sensors or similar capabilities our ability to strengthen our earth observation networks as a whole will be compromised. We asked GAO to examine the current state of the strategy for gathering necessary climate data. GAO's answer is that we don't have one, at least not a comprehensive strategy. That is a subject that we hope the Administration witnesses can discuss today.

We have spent almost $6 billion already on the NPOESS program, the original projected cost of the whole program. There is not a single completed satellite to show for that time and money. We do have, however, two signs that read, "now under new management." I know it is the hope of everyone here that the new management for the now two agencies, two programs will be the solution to what has ailed NPOESS.

I now recognize Dr. Broun from Georgia, the Ranking Member of the Investigation—of this subcommittee for his opening statement.

[The prepared statement of Chairman Miller follows:]

PREPARED STATEMENT OF CHAIRMAN BRAD MILLER

Since 2003, there have been seven hearings before the Science and Technology Committee or its subcommittees on the subject of the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) program. Established in 1994, the program was intended to design, develop, construct and launch satellites into polar orbits so that the National Oceanic and Atmospheric Administration (NOAA) and Department of Defense (DOD) would continue to receive daily data necessary for civilian and military weather forecasting needs.

In the 2003 hearing, the life-cycle cost for NPOESS in the March 2003 budget request was $6.1 billion, with the first of six satellites expected to be launched in 2009. In last year's hearing, the life-cycle cost estimate had grown to at least $14.9 billion, was intended to purchase only four satellites with a first NPOESS satellite launch pushed back to 2014.

NPOESS suffered from major performance problems and schedule delays for the primary imaging instrument and these spawned cost overruns. However, the real problem with the program was that it was crippled by a management structure that delayed decisions at critical moments. The tri-agency management board proved incapable of making decisions and taking action when most needed. Last year, witnesses testified before this Subcommittee that program leadership had deteriorated to the point that only White House intervention would assure that there would ever be any NPOESS satellites at all. At that hearing, we were told that one agency should be put in charge of managing the program-either DOD or NOAA.

OSTP did take responsibility for intervening to rescue this drifting program. However, instead of putting just one agency in charge, OSTP adopted the Solomanic solution of cutting the program in two. Satellites flying in orbits to collect early-morning observations would be developed and launched by DOD with their newly-chris-

tened Defense Weather Satellite System. NOAA would do the same with their renamed Joint Polar Satellite System to collect observations in the afternoon. NOAA would operate all the satellites while in orbit, and would manage the common data system to receive, store and share all data.

With its decision, OSTP has removed the block over which we've been stumbling for the past few years. This does not guarantee success. There was a reason for having a single program in the first place, and splitting the program in two may simply create two new programs with the same problems. There are plenty of reasons to keep attention fixed on these new programs. For example, even though we now have clarity about what agency is responsible for which mission, this clarity comes at the cost of delay and confusion about which instruments will be flown on what satellite and when will the satellite launch? There is a contractor that still has continuing work for the old NPOESS program, and subcontractors with instruments in various states of development-what is to be the fate of those work efforts and when will those decisions be made?

Our other discussion today grows out of our experience with NPOESS. Back in 2006, all of the climate sensors being prepared to fly on NPOESS were removed. If we anticipate having to deal with climate change for decades to come, how can we eliminate a means of knowing how well we are doing? It has been clear that this decision was ill-thought through and would have to be reversed. Without these sensors, or similar capabilities, our ability to strengthen our Earth observation networks as a whole will be compromised. We asked GAO to examine the current state of the strategy for gathering necessary climate data. GAO's answer is that we don't have one, at least not a comprehensive strategy. This will be a subject that we hope the administration witnesses can shed some light upon.

We have spent almost $6 billion already on the NPOESS program. There is not a single completed satellite to show for the time and money. We do however have two signs that read, "now under new management". I know it is the hope of everyone here, that this new management will be the solution to what has ailed the NPOESS program.

Mr. BROUN. Thank you, Mr. Chairman. Just for your record, what I questioned is that of human-induced global warming.

Chairman MILLER. Okay.

Mr. BROUN. So, anyway, thank you, Mr. Chairman. I want to welcome our witnesses here today at this important hearing, and thank you for your participation. This is the Committee's first hearing on the Joint Polar Satellite System but the seventh time we have looked into the previous program, the NPOESS program, National Polar Orbiting Operational and Environmental Satellite System.

NPOESS was originally planned to create synergies and cost savings by combining the Defense Meteorological Satellite Program within the Department of Defense and the Polar Orbiting Environmental Satellite System at NOAA. Instead, the program doubled in cost, shrunk from six to four satellites, degraded its sensor capabilities, and its schedule slipped six years. Now, 15 years later we are back where we started.

At last year's hearing I asked questions. How did we get here, and where do we go from here? My question today is where are we going? The Administration announced plans to restructure the program last winter, but as Mr. Powner points out in his testimony, "Because neither agency has finalized plans for its acquisition, the full impact of OSTP's decision on the expected cost schedule and capabilities is unknown."

Until we receive this information we can't fully review this new program. While it is understandable that it will take time to restructure, I hope the Administration consults with Congress and with this Committee in particular given its history with the program.

I look forward to working with the Administration and with the Chairman as we move forward. As I said at last year's hearing, every American is impacted by this program whether they know it or not. It is our responsibility to ensure that the farmers, fisherman, warfighters, and everyday commuters continue to receive weather and climate information, but we must not forget to be good stewards of the taxpayers' money and route out waste, inefficiency, and duplication where we can.

Thank you, Mr. Chairman. I yield back the balance of my time.

[The prepared statement of Mr. Broun follows:]

PREPARED STATEMENT OF REPRESENTATIVE PAUL C. BROUN

Thank you, Mr. Chairman. I want to welcome our witnesses here today and thank them for participating in this important hearing. This is the Committee's first hearing on the Joint Polar Satellite System (JPSS), but the seventh time we have looked into the previous program, the National Polar-Orbiting Operational Environmental Satellite System (NPOESS).

NPOESS was originally planned to create synergies and cost-savings by combining the Defense Meteorological Satellite Program (DMSP) within the Department of Defense (DoD) and the Polar-Orbiting Environmental Satellite (POES) System at the National Oceanic and Atmospheric Administration (NOAA). Instead, the program doubled in cost, shrunk from six to four satellites, degraded its sensor capabilities, and its schedule slipped six years. Now, 15 years later, we are back where we started.

At last year's hearing I asked the questions, 'how did we get here?' and 'where do we go from here?' My question today is 'where are we going?' The Administration announced plans to restructure the program last winter, but as Mr. Powner points out in his testimony "[b]ecause neither agency has finalized plans for its acquisition, the full impact of OSTP's decision on the expected cost, schedule, and capabilities is unknown." Until we receive this information, we can't fully review this new program. While it is understandable that it will take time to restructure, I hope the Administration consults with Congress, and this Committee in particular given its history with the program.

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Thank you Mr. Chairman, I yield back my time.

Chairman MILLER. Thank you, Dr. Broun. I now ask unanimous consent with all additional opening statements submitted by members be included in the record.

Without objection, so ordered.

It is now my pleasure to introduce our witnesses. Dr. Shere Abbott is the Associate Director of the Energy and Environment Division in the Office of Science and Technology Policy. Ms. Abbott directed the taskforce established by Dr. John Holdren, Director of OSTP, to evaluate changes in the management of the NPOESS program.

Ms. Mary Glackin is the Deputy Director Under Secretary for the National Oceanic and Atmospheric Administration, NOAA. Ms. Glackin supervises NOAA's transition to the follow-on Joint Polar Satellite System and the expanding cooperation with the National Aeronautics and Space Administration to develop afternoon orbit satellite coverage.

Mr. Christopher Scolese is the Associate Administrator for the National Aeronautics and Space Administration, NASA. NASA will resume its traditional role of supporting NOAA in developing the

JPSS weather satellites, and Mr. Scolese will testify today about the changes that will be needed to bring NASA into the program.

Mr. Gil Klinger is the Director of the Space and Intelligence Office providing oversight for all Department of Defense space and intelligence programs within the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics. Mr. Klinger is currently elaborating what changes, if any, DOD plans to make for polar weather satellite coverage in the wake of the decision to transfer responsibility for acquiring morning orbit satellites to DOD.

And then, finally, Mr. David Powner is the Director of Information Technology Management System Issues at the Government Accountability Office, GAO. Mr. Powner has directed GAO's team monitoring of the NPOESS program for this committee since 2001. GAO's report last year and Mr. Powner's testimony at the subcommittee's previous hearing was central to the convening of the Administration's task force, and he has two reports to share with our subcommittee today.

As our witnesses should know, you will have—each have five minutes for your spoken testimony. Your written testimony will be included in the record for the hearing. When you have all completed your spoken testimony, we'll begin—we will begin with questions, and each member will have five minutes to question the panel.

It is the practice of the subcommittee to—because we are an investigations and oversight subcommittee—to receive our testimony under oath. Do any of you have any objection to taking an oath? The record should reflect that all the witnesses said that they had no objection to taking an oath.

You also have the right to be represented by counsel. Do any of you have counsel here? The record should reflect that all of the witnesses indicated that they did not have counsel here.

Please now stand and raise your right hand. Do you swear to tell the truth and nothing but the truth?

Okay. The record should reflect that all of the witnesses took the oath.

I should say for purposes of understanding the flow, there is a likelihood that we will be called for votes at an awkward time, probably in the middle of the opening statements, but we will go as far as we can, and we will break and come back after our votes.

So let us now begin with Ms. Abbott. You are recognized for five minutes.

STATEMENT OF HON. SHERBURNE B. "SHERE" ABBOTT, ASSOCIATE DIRECTOR, ENERGY AND ENVIRONMENT DIVISION, OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Ms. ABBOTT. Thank you, Mr. Chairman and members of the subcommittee. I appreciate the opportunity to appear today to discuss the decision to restructure the NPOESS program and the Administration's efforts to improve capabilities for earth observations.

As you, Mr. Chairman, noted, the NPOESS program was created 16 years ago to combine civil and military operational weather satellite capabilities that would provide global weather coverage, storm tracking, and climate monitoring requirements.

The tri-agency construct of the NPOESS program was intended to integrate the talent, technology, and resources of the agencies into a single, converged, operational system. DOD was responsible for major program acquisitions and contract administration, NOAA was responsible for satellite operations, and NASA was responsible for developing new technologies.

In spite of this vision of coordination and efficiency and in spite of multiple attempts to improve its execution, the program has consistently been behind schedule, over budget, and underperforming. At the request of Dr. Holdren, Assistant to the President for Science and Technology, I convened an Executive Office of the President taskforce on this matter starting in August, 2009, with participation from the Office of Management and Budget and the National Security Council.

Working closely with the three agencies, the taskforce performed a thorough analysis of the program, its content, cost projections, budgeting, acquisition issues, and related management options. The taskforce found that the major challenge of NPOESS was its structure, jointly funding and executing common ground on a single program with a single, common platform and a uniform set of instruments.

This is because the three agencies of different technical objectives, acquisition procedures, engineering and management philosophies, risk tolerance, and approaches to managing budget adjustments. These differences led to continued developmental challenges, escalating costs, and increasing risks.

In consultation with the agencies the EOP leadership decided to disaggregate management of the satellite programs by proceeding with separately managed acquisitions. The key elements of the restructured program will retain the observational requirements of the NPOESS program; however, NOAA and DOD will be responsible for meeting these requirements through their assigned orbits.

NOAA, with NASA acting as the acquisition agent, will be responsible for the afternoon orbit. DOD will be responsible for the early morning orbit. The European Organization for Exploitation of Meteorological Satellites will continue to provide observations in the mid-morning orbit. The agencies will continue to partner in those areas that have been successful in the past, such as the shared ground system.

The NOAA portion of the restructured program is called the Joint Polar Satellite System. The DOD portion will be called the Defense Weather Satellite System. This structure is codified in the sector guidelines in the National Space Policy released yesterday.

The program restructure accomplishes the following goals. First, it reduces the risk of schedule slips and cost increases by clarifying acquisition authorities. Second, it allows each agency to manage its program within its own agency culture and environment. Third, it provides clear accountability, responsibility, and authority for each orbit. Fourth, it allows for greater government control over the development process. Fifth, it retains strategic coordination across the civil and defense programs, and sixth, it aligns with proven acquisition centers.

I want to be clear. We are not canceling the program but merely restructuring the procurements to put the program on the pathway

to success, taking maximum advantage of government expertise. We will be using all of the taxpayer-funded investments for the future satellite programs. The decision is supported by the long history of reviews called for by the Congress and the agencies as well as independent reviews of the program.

Plans for continuity of a number of earth observations from space have been tied to NPOESS at one point or another in the program's history. With the NPOESS decision behind us, the Administration is focusing on the broader issue of the development of a comprehensive strategy for earth observations. We are working internationally through the Group On Earth Observations toward the development of an integrated earth observing system with leadership from the U.S. provided by the agencies through the U.S. Group on Earth Observations.

In addition, the substantial increases in funding as part of the President's proposed FY 11 budget for NASA's Earth Sciences Program will be used to address the pressing issues related to the Nation's climate research and monitoring capabilities and climate data continuity.

And the Administration will be drawing on the analysis of the USGEO as a first but very significant step in the development of a comprehensive strategy for earth observations.

In conclusion, OSTP will continue to play an important role in coordinating interagency satellite observation policy, successfully restructuring the NPOESS program and ensuring continuity of weather and climate data has been a high priority for the Administration's leadership team. We will continue to meet regularly with NOAA, NASA, and DOD to ensure a smooth transition of the program to meet the nation's need for weather forecasting, storm tracking, and climate monitoring.

I look forward to working with the committee as we move the NPOESS program down the pathway to success and as we move forward with a broader national strategy for earth observations. I will be pleased to try to answer any questions that you may have.

[The prepared statement of Ms. Abbott follows:]

PREPARED STATEMENT OF SHERBURNE B. "SHERE" ABBOTT

Chairman Miller, Ranking Member Broun, Members of the Committee: I appreciate the opportunity to testify today at this important hearing. In what follows I will address the questions posed in the Chairman's letter of invitation regarding both the process and the findings that led to the decision to restructure the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program, as well as the efforts within the Administration to improve capabilities for Earth observations to examine, monitor, and model our planet.

Brief History of NPOESS

The tri-agency [National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD)] NPOESS program was created sixteen years ago by Presidential Decision Directive (PDD) to deliver operational weather satellites that would provide global weather coverage, storm tracking, and climate-monitoring requirements. All weather forecasts, including detection and forecasting of tropical storms in the Atlantic and Pacific oceans, depend on data from these observations. The program had been slated to operate from 2009 through 2020, but was extended to 2024 (and then again to 2026) due to delays. The tri-agency construct of NPOESS was intended to integrate the talent, technology, and resources of the agencies, thereby ". . . establishing a single, converged, operational system (that) can reduce duplication of efforts (and competition for resources) in meeting common requirements while satis-

fying the unique requirements of the civil and national security communities." DOD was responsible for major program acquisitions and contract administration (implemented through the Air Force); NOAA was responsible for satellite operations; and NASA was responsible for developing new technologies. To facilitate the convergence of civil and defense weather observational capabilities, DOD, NOAA, and NASA created an NPOESS Executive Committee (EXCOM), which included senior officials from the three agencies, in order to provide oversight for the joint effort and to help ensure that the program as a whole met the needs of the three agencies. An NPOESS Integrated Program Office (IPO) was also established to manage hardware development and related activities.

In spite of this vision of coordination and efficiency, and in spite of multiple attempts to improve its execution, the program has consistently been behind schedule, over budget, and underperforming. The most serious of cost increases and scheduling delays occurred in late 2005, when projected cost overruns triggered a breach of the Nunn-McCurdy statute, requiring DOD to recertify the program (otherwise the program would have been terminated). As part of this process, DOD worked with NOAA and NASA to restructure NPOESS in order to decrease costs and reduce program risk. Concluded in June 2006, this effort assigned highest priority to preserving continuity of operational weather measurements, which ultimately led to a decision to remove several key climate and space weather capabilities from the NPOESS satellites. In addition, the number of planned satellites was reduced from a total of six satellites (flying in three orbits) to four satellites (in two orbits), while relying on European weather satellite systems for data in the third orbit. Despite this restructuring, development and acquisition costs (i.e., life cycle costs) for the program nonetheless rose from $7B (in 2002) to approximately $12B in 2006.

By 2009 the official cost estimate had risen to $13.9B. Faced with these additional cost increases and further delays, the three agencies requested that a high-level Independent Review Team (IRT) examine the program. The team was led by A. Thomas Young, former President and Chief Operating Officer of Martin Marietta, and included aerospace experts from industry, academia, and government. The IRT concluded that the NPOESS program ". . . as constructed had an extraordinarily low probability of success." (A. Thomas Young testimony to House Science and Technology Committee, June 17, 2009) In addition, the Government Accounting Office (GAO) has conducted eight reviews of the program, including one reported on today, all showing serious lapses in capabilities that, in turn, threaten the continuity of weather and climate data.

The EOP Analysis of the NPOESS Program and Findings

Supporting the Nation's weather-forecasting and climate-monitoring capabilities is of great importance to the Administration, and we recognize the critical role that NPOESS was intended to play in providing these vital capabilities. Because of the extensive difficulties that this program has experienced in recent years, Dr. John Holdren, Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy (OSTP), began to meet with the heads of agencies soon after his confirmation last year in order to assess what potential changes needed to be made.

At his request, I convened an Executive Office of the President (EOP) Task Force on this matter starting in August 2009, with participation from the Office of Management and Budget (OMB) and the National Security Council (NSC), as well as from the three lead agencies: NOAA, NASA and DOD. The goal of the Task Force was to determine suitable options for structuring the program for success in order to ensure continuity of the Nation's weather and climate observational needs. With close agency cooperation, the Task Force performed a thorough and careful analysis of a number of aspects of the program, including content, cost projection and budgeting, and acquisition issues. The Task Force also examined options for changing the management and governance, taking into account the recommendations of the IRT noted above, as well as the concerns raised by numerous Members of Congress.

The EOP Task Force met regularly over a period of two months and assembled working groups with senior staff from the lead agencies who met weekly to assess the current difficulties with the program and to provide guidance on options for structuring the program for the greatest benefit for the Nation. The goals of the Task Force were to resolve issues in the following areas:

1) *Aligning Priorities and Requirements.* The Task Force identified significant commonality among agency interests and priorities, but found important differences as well (e.g., in defining acceptable risk levels for data continuity and in determining whether program schedules could be slipped further to accommodate cost/budget constraints).

2) *Determining the Available Options for Reducing Risk.* The Task Force conducted analysis of options for mitigating program risks, improving the probability of success, and enhancing constellation robustness in terms of both program content and schedule).
3) *Budget and Costing Methodologies.* The Task Force analyzed the costing methodologies and budgeting philosophies of the agencies in an attempt to reach a common understanding of the financial state of the program, the projected costs of options under consideration, and the necessary funding reserves.
4) *Program Management and Acquisition Issues.* The Task Force looked at possible improvements in program oversight and governance, such as the functioning of the EXCOM, the alignment of the IPO with a space acquisition center, and contractual issues.

The details of the Task Force analysis, deliberations, and findings are discussed below.

Cost-estimates

The most apparent challenge of the program was the rising cost-estimates and astounding life-cycle cost growth. The Task Force found disagreement among the agencies on both cost-estimating methodology and levels of risk tolerance, which resulted in differing agency conclusions on costs of the program at any given point in time. In addition to developing an understanding of the assumptions and outputs of these costing methodologies, the Task Force analyzed cost-estimates for various changes in management options. These options included possible continuation of the program under the current IPO structure, as well as alternatives such as moving the management function for the program to a single acquisition centereither the Air Force Space and Missile Systems Center (SMC) or the NASA Goddard Space Flight Center (GSFC).

During the analysis in the fall of 2009, the Task Force concluded that the life-cycle cost of the program would exceed the official 2009 estimate of $13.9B regardless of cost methodology or changes in management. Recent analyses conducted by external groups supported this finding—for example, in 2009, both the IRT and the GAO concurred with the agencies' assessment of cost growth and estimated that this figure would increase by at least $1B to $2B. The DOD estimates presented in October 2009 for the NPOESS program of record showed an increase of approximately $1B, and in November 2009, the IPO provided a revised cost-estimate showing an increase of approximately $2.5B over the official estimate. NASA had also previously performed various cost-estimates for the NPOESS program of record, but these estimates assumed that the program had been conducted within NASA from the beginning, and thus were not directly comparable to the official cost estimates.

The increasing cost estimates and the absence of consensus among the agencies on the appropriate estimate to use reflected a fundamental problem with the program—namely, that there were significantly divergent views among the agencies as to the overall requirements of the program. The inability of the agencies to compromise on this basic matter highlighted a further conclusion of the Task Force—that over time, the goals of the agencies associated with the program had drifted apart significantly. The risk of further escalating cost, on a program with approximately $5B invested through FY 2009 (and which had a life cycle cost originally estimated as $7B in 2002), was notable and concerning.

Qualitative Analysis

The Task Force's examination of the management structure and challenges revealed that the current governance structure was the major impediment to program success. As described in the IRT report, and affirmed in other analyses (including that of the Task Force), the Tri-agency EXCOM had not proven effective for making timely decisions and resolving technical challenges on this extremely complicated and dynamic program. Despite attempts at improved management and oversight, such as more frequent EXCOM meetings, deputies-level commitments and meetings, and reviews with the IPO, the EOP leadership did not see adequate gains in effectiveness resulting from this governance arrangement, nor did it see any possible substantial gains from improvement of the IPO that would move the program toward success. In large part, this was a failure of governance architecture. When presented with decisions affecting rising costs, schedule delays due to failed tests, required redesigns or inconclusive failure analyses, the EXCOM principals provided perspectives for guidance that were not in alignment.

These differences in desires and expectations meant, in effect, that the Program Executive Officer (PEO), a NOAA employee, answered to three decision bodies-the EXCOM, NOAA management, and DOD—each with their own visions of program imperatives. Senior program leaders were presented with challenges, often developed exhaustively by their deputies and staff, reflecting different perspectives on how NPOESS progress was or was not satisfying agency-unique goals. The processes associated with making major decisions across three agencies were onerous and inadequate to provide timely resolution of curative measures, even after more than eight years of these agencies trying their level-best at compromise (and 16 years since the inception of the program). In addition, the IPO team, although dedicated to the mission, highly motivated, and led by a capable leadership team, was not structured with the right numbers of highly experienced acquisition and engineering personnel, despite some improvements following the 2005–06 restructure.

Furthermore, the Task Force found chronic problems in the contract management structure with few obvious solutions. For example, the prime contractor had continuing difficulties managing individual sensor projects, especially the Visible/Infrared Imager/Radiometer Suite (VIIRS). These sensors are among the most exquisite in the field of remote sensing and are challenging to develop. Although the prime contractor's senior leadership applied seasoned manpower to better manage the activities, there was no probable path to building adequate and timely capacity within the contractor workforce of the magnitude needed to effectively manage the technical challenges of the program.

One fundamental qualitative question the Task Force addressed was whether merging civilian and defense weather observation requirements, while also adding requirements of continuity of certain climate data records, all onto one common platform, was the optimal or a sustainable approach for the long term. (Note that the original 1994 PDD did not specify converging to one common platform, just to one "system.") The IRT recognized that the major challenge of NPOESS was joint execution of the program by three agencies with different technical objectives, acquisition procedures, engineering and management philosophies, risk tolerance, and approaches to managing budget adjustments. Trying to find common ground on a single program (with a single common platform and a uniform set of instruments) proved to be an extraordinarily difficult task. The NPOESS program was initiated under the pretext that cost savings and efficiencies could be achieved through consolidation of military and civilian weather observation requirements; however, these cost savings and efficiencies have not been realized to date. The possibility of continued developmental challenges, escalating costs, and increasing risk, led the Task Force to conclude that the program would not be able to succeed as currently structured, and that it would be better to shift the NPOESS program away from the existing management paradigm sooner rather than later.

Thus, the decision to restructure the program to split the responsibility of procurement was rooted in a success-based, simplified management scheme that addressed the systemic problems identified by the IRT, and subsequently confirmed by the Task Force's own analysis. in addition, separate procurements allowed for the civilian and military entities (NOAA/NASA and DOD) to develop and fly satellites more ideally focused for their needs, while still reducing redundancy, and maintaining a converged "system" of satellite data through a shared ground and data system operated by NOAA, an area of proven success.

External Views in Support of the Task Force's Conclusions

The EOP Task Force's conclusion that significant changes needed to be made to the management structure matched the conclusions of external reviewers. The IRT report stated that "the NPOESS EXCOM process is ineffective and must be fixed," and that "the IPO [does] not have sufficient space systems acquisition expertise and process" necessary for a program of this size. The IRT report stated that the program "is being managed with cost as the most important parameter and not mission success." The IRT suggested that "an established space acquisition center, such as [SMC or GSFC]" would provide "the institutional knowledge, robust infrastructure support, and a cadre of seasoned space system acquisition experts" to ensure success of the program. The report recommended that the parties agree to a cost-estimating approach that is based on an 80% confidence level. (DOD currently estimates cost to a 50% level based on schedule that is more conservative than the IPO.) Finding the then-current ($13.9B) cost estimate of the program unrealistic, the IRT noted that while a significantly more conservative (e.g. 80% confidence) cost estimate would be judged by the DOD to be unaffordable, a program which would fit within the then-current budget would perform at such a reduced level that it would be unacceptable for NOAA and NASA. Believing that the EXCOM would be unable to re-

solve this difference, the IRT report stated that "this will require the White House to define the NPOESS program that is in the national interest."

These views were not just held by the IRT. The final conference report for the FY 2010 Commerce Justice and Science (CJS) Appropriations bill (House Report 111–366, to accompany H.R. 3288 or Public Law 111–117) stated that "the budget request does not reflect the true need and the program's long-term projections for success remain in doubt. In fact, to date this experiment in combining disparate elements has been a horrendous and costly failure." Noting that "this situation has been developing for some time and is the result of a dysfunctional tri-agency management approach," the conferees went on to state that "nothing short of an immediate and out-of-the-box solution will do." The conferees stated that "the program needs a cooperative solution that will take advantage of the strengths of the three agencies involved, sustain the integrated operations of the various satellites, and should not be based on financial projections that have proven to be consistently and abysmally unreliable." The Task Force took this and other direction of CJS appropriators into account when determining the best path forward.

Restructuring the NPOESS Program for Success

EOP leadership reviewed the Task Force's analysis and, in consultation with the agencies, decided to restructure the process through which the three agencies collaborate to implement the Nation's polar-orbiting environmental satellite program—specifically, by proceeding with separately managed acquisitions. The Task Force had reviewed the full range of ramifications and risk mitigation to ensure the decision was indeed prudent. The February 1, 2010 restructuring decision was made by the leaders of the relevant offices in the EOP, specifically by the OSTP Director, the OMB Director, and the National Security Advisor, after an intensive interagency process involving the EOP Task Force and top officials and supporting staff from NASA, NOAA, and DOD.

The agencies will rely upon the civil and defense establishments to construct, manage, and operate their respective tailored systems with proactive approaches to controlling cost, meeting schedule needs, and achieving performance goals. The key elements of the restructured program will retain the observational requirements of the NPOESS program; however, NOAA and DOD will be responsible for meeting these requirements through their assigned orbits:

- NOAA, with NASA acting as the acquisition agent, will be responsible for the afternoon orbit.
- DOD will be responsible for the early-morning orbit.
- The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) will continue to provide observations in the mid-morning orbit.
- The agencies will continue to partner in those areas that have been successful in the past, such as a shared ground system and operation of both the early-morning and afternoon orbit platforms by NOAA.

The NOAA portion of the restructured NPOESS program is called the Joint Polar Satellite System (JPSS). EUMETSAT retains the name Meteorological Operational satellite (MetOp) for its polar-orbiting assets in the mid-morning orbit. The DOD program development will flow from established processes. Remaining DOD Defense Meteorological Satellite Program (DMSP) satellite capabilities provide enough time for DOD to study priorities and alternatives for the early-morning orbit program. All three agencies are still closely collaborating on aspects of developing a next generation polar-orbiting environmental satellite system.

In summary, the restructure was driven largely by the Task Force's recognition of the inability of the current tri-agency governance structure to effectively manage the acquisition process, which contributed to cost growth and schedule delays. Maintaining this structure would likely have continued the history of schedule slips and cost increases, jeopardizing the availability of critical weather and climate data.

The program restructure, therefore, accomplishes the following goals:

(1) It reduces the risk of schedule slips and cost increases by clarifying acquisition authorities through splitting the procurements and making a single agency responsible for each orbit.

(2) It allows each agency to manage its program within its own agency culture and environment. The platforms for the respective orbits will be developed and procured so as to leverage the strengths of each agency, and also to best harness the experience each agency has in continuing and improving on legacy measurements.

(3) It provides clear accountability, responsibility, and authority for each orbit, and simplifies the complicated tri-agency decision processes that made management and oversight difficult and contributed to the prior poor performance of the program. The agencies will continue to partner in those areas that have been successful in the past, such as a shared ground system and operation of both early-morning and afternoon platforms by NOAA.

(4) It allows for greater government control over the development process. This will enable NOAA (with NASA as its acquisition agent) to have greater control over setting the pace of work that is required to develop the instruments and space and ground segments for the afternoon orbit.

(5) It retains strategic coordination across the civil and defense programs. The civil and defense weather and climate communities are critically dependent upon data from all the orbits.

(6) It aligns with proven acquisition centers. As noted by the IRT the program lacked timely access to technical expertise, broad mentoring and development opportunities for staff, and rigorous checks and balances of engineering and program processes. The Administration followed the recommendation of the IRT concerning alignment of the program with an established acquisition center—in this case, NASA's GSFC will be NOAA's acquisition agent for the afternoon orbit, and the Air Force SMC will be DOD's acquisition agent for the early morning orbit.

While the NPOESS program restructure has the potential for adding some near-term risk to NOAA and DOD associated with a transition, the improved management structure of the follow-on programs will enable the agencies to proceed in a more effective and efficient manner in the mid to long term. The ability to recover lost schedule and rebuild critical spares will not occur overnight, and it will take some time to recover the robustness of the past national polar satellite missions. However, the ability to use different spacecraft as well as international and commercial platforms will provide more flexibility to achieve improved continuity of observation in the near term.

I want to be clear that we are not "cancelling" the program, but merely restructuring the procurements. We will be taking maximum advantage of the investments made to date, by maintaining almost all of the hardware that has been developed for use on future platforms. The Administration believes it was in the best interest of U.S. taxpayers to restructure the NPOESS program. The decision is supported by the long history of reviews called for by House and Senate authorizers and appropriators and completed by GAO, by other reviews completed by the Department of Commerce Inspector General as well as senior-level independent reviews of the program.

A Strategy for Improving Earth Observation Capabilities

With the NPOESS decision behind us, I believe it is essential to focus on the broader issue of the development of a comprehensive strategy for Earth observations, both from space and *in situ.* We live in an era of unprecedented stress on our planet. The combination of population growth, climate change, resource demand, and the continuing development of coastal and built areas creates unparalleled challenges for our health, economic, and natural resource management and maintaining our National security. A robust infrastructure of Earth observations about the Earth/ocean system and how it is changing over time will best support our Nation's need to inform decisions and policy. Additionally, in this ever-more global society, information and understanding derived from Earth observations are important in sustaining the U.S. role in global leadership.

The myriad of Earth observations from space taken today vary widely in purpose and scope and are appropriately distributed among numerous programs under the purview of Federal agencies and other institutions and individuals. To a large degree, these observations have been only loosely coupled, coordinated, and integrated. The critical leap forward can only be achieved with a synergy between remotely sensed and *in situ* observations supported by robust data systems. The Administration recognizes that a coordinated approach is needed to sustain and build on the current set of Earth observations.

System of Systems Approach to Earth Observations

Increasingly the promise of a coordinated approach to Earth observations is being realized, and seemingly disparate observations are being combined in new ways to produce benefits across multiple societal areas. The concept of an integrated Earth observing system is being articulated internationally by the Group on Earth Obser-

vations (GEO), with leadership from the United States provided by the agencies through the U.S. Group on Earth Observations (USGEO), which is a standing subcommittee of the National Science and Technology Council (NSTC), and by the EOP through OSTP. In 2005, GEO initiated a ten-year plan to implement a Global Earth Observation System of Systems (GEOSS) to coordinate observations at the international level. Eighty-one countries, the European Commission and over 50 international organizations are currently engage in this effort. As U.S. co-chair of GEO, I chaired the Sixth Plenary Session of GEO hosted by the United States here in Washington last November. I continue to work with the other co-chairs from the European Commission, China, and South Africa and the GEO Secretariat to realize the vision of the "system of systems" approach to Earth observations.

The U.S. contribution to GEOSS is the Integrated Earth Observation System (IEOS). GEOSS and IEOS will facilitate the sharing and applied usage of global, regional, and local data from satellites, ocean buoys, weather stations, and other surface and airborne Earth observing instruments. The end result will be access to an unprecedented amount of environmental information, integrated into new data products benefiting societies and economies worldwide. USGEO is continuing to help ensure the coordination between our national assets and the emerging international architecture for Earth observations.

Status of Earth Observations in the United States

The state of the U.S. space-based observational system in 2009 was largely unchanged from that of 2005, when an interim report of the National Research Council's committee that produced the Earth Science and Applications from Space "Decadal Survey" Report described the national system of environmental satellites as "at risk of collapse." Later, in 2007, the Decadal Survey Report concluded the outlook had significantly worsened. The likelihood of a degradation in land imagery capability, affecting multiple societal needs (e.g., agriculture, biodiversity, climate, ecosystems, water, etc.), was almost a certainty. In addition, no plans had been developed to continue some of the valuable observations demonstrated by the NASA Earth Observing System (EOS) program that benefit the disaster preparedness, human health, climate, and water areas. Continuity of the weather observing system was also threatened by reductions and delays in the NPOESS program, and plans for climate measurements on NPOESS had been scaled back.

In an overall sense, deployments of new and replacement satellites were not keeping pace with the termination of older systems, even though many existing satellites are operating well past their nominal lifetimes. A number of satellites built as research missions were seen to have ongoing societal benefit, but there were no plans for continuity of many of these. Given the long development times associated with fielding new systems, particularly satellite systems a sustained commitment to sensor system development is necessary to avoid a loss of observing capability in the next decade.

In addition to global observations made from space, *in situ* measurements provide critical data at fine spatial and temporal scales and of parameters and in places not achievable from space. Our observational infrastructure for some in-situ measurements has been aging and investment in monitoring programs has declined despite growing demand. And, there still remains the grand challenge and promise of using geospatial information to link the broad coverage and context of our top-down remote-sensing view with the comprehensive and detailed measurements made *in situ* in order to best characterize and understand environmental resources.

These realities reinforce the need to address the challenges and recommendations in the NRC's Decadal Survey. The Administration has taken decisive steps to begin reversing the trend of declining observational capabilities. The longer term need is the development of an overall national strategy for Earth observations.

The initial step was to put the Nation's system of polar-orbiting operational environmental satellites on a path to success, as plans for continuity of a number of Earth observations from space had been tied to NPOESS at one point or another in the program's history. There was first a need to "bound" the capabilities of the polar-orbiting operational environmental satellites in order to avoid the problem of having large, monolithic platforms responsible for obtaining an overly broad set of measurements, which contributed to the fragility of the constellation of Earth observing satellites by having a "single string" failure mode. Once the "bounds" of the future platforms were determined, only then could the Administration focus on where the agencies needed "to fill in the gaps" in terms of continuity of key climate observations.

For the near-term, the Administration has recently made a significant step in regards to continuity of key climate data from space with the substantial increases

in funding as part of the FY 2011 budget for NASA's Earth Sciences program. NASA will be using this augmentation to address pressing scientific and national issues associated with climate change and the Nation's climate research and monitoring capabilities. As recommended by the NRC's Decadal Survey, this budget returns NASA Earth Science funding to the approximate level that it had in FY 2000, an increase of more than 30% from recent levels. This funding allows for the acceleration and expansion of activities across the entire, coordinated Earth Science program-in the areas of flight missions, research, applications, and Earth Science mission technology development-thus advancing the balance and scope that have been hallmarks of NASA Earth System Science. In addition to building the Orbiting Carbon Observatory-2 mission for launch in 2013, NASA will: accelerate development of the four NRC Decadal Survey Tier 1 missions so that they are all launched by 2017; accelerate and expand the Venture-class line of competed, innovative small missions; initiate new space missions to address continuity of high-priority climate observations; and bring two Decadal Survey Tier 2 missions forward to allow launch by 2020. Complementing the flight portfolio expansion, NASA will advance climate research, multiply applications using the full set of available (NASA and non-NASA) satellite measurements for direct societal benefit, and develop/mature technologies required for the next generation of Earth observing missions.

As part of the U.S. Global Change Research Program's (USGCRP) role in coordination of the Federal climate change research portfolio across all the relevant agencies, the principal agency representatives to USGCRP reviewed NASA's draft plan for the FY 2011 augmentation, and these reviews will be taken into account as NASA moves forward in implementing the plan. I anticipate that the details relating to NASA's implementation of the augmentation for FY 2011 will be available in the coming weeks. We intend to utilize USGCRP in a similar manner in the future as a mechanism for ensuring broad Federal coordination on climate observations.

Progress Toward a National Strategy

The Administration will be drawing on the analysis of USGEO to assist in the development of a comprehensive strategy for Earth observations, as called for in the recent GAO report *Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements.* OSTP is utilizing analysis from USGEO as input for reporting requirements to Congress (specifically the FY 2010 CIS Appropriations Conference Report language) which directed OSTP to develop a strategy on Earth observations. This report will be a first (but very significant) step in developing a larger strategy for Earth observations.

Working toward a national strategy will be a priority for the Administration in the coming year, including the coordination of multi-agency initiatives and budget submissions from individual Federal agencies. Other elements of that strategy are already in development, and they include articulating high-priority environmental policy priorities that can be directly advanced through improved Earth observations, identifying Earth observation-derived information requirements held in common across Federal agencies, evaluating existing and imminent gaps, preserving the continuity of existing critical observing systems, and recommending new systems as appropriate.

Concluding Remarks

OSTP will continue to play an important role in coordinating interagency satellite observation policy. We must increase government oversight and improve the interagency partnerships central to the management of civilian satellite programs, which among other things are critical to the Nation's climate and weather forecasting. We need to proactively manage our programs to avert future cost and schedule overruns. Agencies must work together to manage the contractors building these satellites and demand cost and schedule accountability. Successfully restructuring the NPOESS program and ensuring continuity of weather and climate data has been a high priority for the Administration's leadership team. We will continue to meet regularly with NOAA, NASA, and DOD to ensure a smooth transition of the program to meet the Nation's need for weather forecasting, storm-tracking, and climate monitoring.

As Associate Director for Environment for OSTP, I regard one of the primary functions and principle challenges of OSTP to be providing the leadership and needed coordination of Earth observations to ensure that our decision makers, our businesses, our farmers, our health care workers, and all our citizens have the information they need to take actions to improve human well-being and environmental management, particularly as the climate changes. Working in partnership with the

OMB and the Congress, we aim to pull together the expertise across the government, drawing from each agency's distinctive capacity, to construct the relationships and interactions among the agencies that will result in a program for Earth observations that contributes to both our national prosperity and our national security.

The Administration obviously will need the support of the Congress in moving forward with a broader strategy for Earth observations. I look forward to working with the Committee in this effort. I will be pleased to try to answer any questions the Committee may have.

BIOGRAPHY FOR SHERBURNE B. "SHERE" ABBOTT

Sherburne "Shere" Abbott serves as the Associate Director for Environment of the Office of Science and Technology Policy in the Executive Office of the President. She manages a portfolio of S&T policy that ranges from energy and climate change to environmental quality and sustainability.

Prior to her confirmation for this position by the Senate on April 30, 2009, Ms. Abbott was a faculty member of the College of Liberal Arts at the University of Texas at Austin and served as the Director of the Center for Science and Practice of Sustainability in the Office of the Executive Vice President and Provost. Previously, Ms Abbott served as Chief International Officer of the American Association for the Advancement of Science. Prior to that appointment, over a 17 year period at the National Academies' National Research Council she served as Executive Director of the Board on Sustainable Development, the Director of International Organization Programs for the Office of International Affairs, and the Director of the Polar Research Board of the National Academies' National Research Council. Ms. Abbott also served as Assistant Scientific Program Director of the U.S. Marine Mammal Commission.

Ms. Abbott earned her A.B. from Goucher College and her M.F.S. from Yale University's School of Forestry and Environmental Studies.

Chairman MILLER. Thank you.

Ms. Glackin for five minutes.

STATEMENT OF MS. MARY M. GLACKIN, DEPUTY UNDER SECRETARY FOR OCEANS AND ATMOSPHERE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Ms. GLACKIN. Chairman Miller, Ranking Member Broun, and distinguished members and committee of the—members and staff of the committee, I, too, appreciate the opportunity to testify in front of you today. I have been working closely with Secretary Locke and Under Secretary Lubchenco to ensure the continuity of the critical weather and satellite data that this nation needs.

As has been highlighted here by the opening statements, it was imperative that a decision be made to address the acquisition chal-

lenges facing the NPOESS program. NOAA's follow-on program to NPOESS, the Joint Polar Satellite System, or JPSS, will address our requirements to provide global environmental data and support our mission.

Since the Administration's decision to restructure the program, NOAA has taken several steps to ensure that there is uninterrupted, reliable weather and climate data. We have established a transition team, including members from the Department of Commerce, NOAA, and NASA with participation of the Department of Defense. We have made significant progress moving forward, including defining the organizational structure and beginning the process of locating and staffing the JPSS office.

NOAA and NASA are assuring that we have high-performing teams working on the program and, in particular, leveraging and the placement of the civil workforce that we have at the Integrated Program Office today.

Concurrent with these activities we have already—we have also moved forward to ensure that the NPOESS requirements for the afternoon orbit are appropriately translated into program-level requirements for JPSS.

The Integrated Program Office oversight has been reassigned to the Air Force Space and Missile Systems Center. We have a NOAA senior engineer with significant experience that's been assigned to work with the Center for close coordination. The IPO has issued guidance outlining priorities for work stoppage and, in particular, ensuring that we maintain the NPOESS Preparatory Project, NPP, cost and schedule as a top priority.

Due to the delays in the NPOESS program, it has been necessary to repurpose the NPP satellite from a research mission to an operational satellite. All the instruments have been delivered for integration onto the NPP satellite, and NOAA is supporting NASA's efforts for launch of this satellite.

The JPSS afternoon orbit will maintain observations that were planned for NPOESS in the afternoon orbit. We anticipate that NASA will assume management control of these sensor acquisitions in early fiscal year 2011. NOAA will continue the development and fielding of the ground system network that was to support NPOESS and its users. The President's budget provides adequate resources to support NOAA's efforts for completing the development of the ground system which will be used by both DOD and NOAA for both the morning and the afternoon orbits.

As I have mentioned, continuity of data is a top priority and a basis for all of our considerations. After careful analysis of technical costs, schedule, and programmatic risks, with input and advice from NASA, NOAA has decided to procure a clone of the NPP spacecraft bus to support the JPSS–1 launch readiness date of 2014. We believe an NPP clone will carry the same suite of instruments and collect the same data as NPP, provides a proven solution for placing these sensors in orbit.

This will allow us to meet our launch readiness date in 2014, and minimize the potential of an observation gap. We are still working with NASA and DOD regarding the spacecraft decisions for the second spacecraft that will support a 2017 launch readiness date.

During this transition phase our ability to make final decisions are still coupled with the Department of Defense. Due to DOD's decision making timeline on the spacecraft bus, a level of uncertainty still exists regarding the resolution of the Northrop contract. Until the contract is resolved, NOAA will continue to be exposed to additional procurement, schedule and cost risks.

I would like to briefly address the two GAO reports that are subject of this hearing. NOAA agrees with the recommendations in both reports, and I would be remiss if I didn't acknowledge the tremendous effort OSTP has undertaken over the years to address the importance of continuing critical space-braced climate observations.

With respect to the GAO report released at this hearing addressing risks that jeopardize continuity of weather and climate data, we appreciate the perspectives of the GAO professionals in their regular reviews of the NPOESS program. The report provides recommendations to both the Secretaries of Defense and Commerce, and NOAA agrees with all recommendations in this report.

In conclusion, NOAA appreciates the committee's continued interest in the success of the agency's satellite programs. It is widely acknowledged that satellites are very complicated and difficult systems to design, build, and operate. However, NOAA is acting quickly to support the February 1, 2010, decision to restructure this program, and I, too, would be happy to answer any questions you may have.

[The prepared statement of Ms. Glackin follows:]

PREPARED STATEMENT OF MARY M. GLACKIN

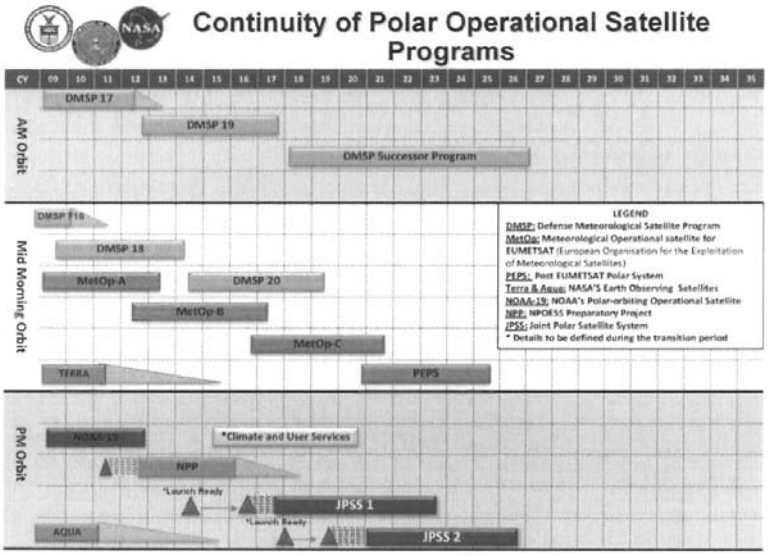
Introduction

Mr. Chairman and members of the Subcommittee, I am Mary Glackin, the Deputy Under Secretary for Oceans and Atmosphere of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce (DOC). NOAA's mission is to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs. NOAA's satellite systems are tremendously important for global monitoring of environmental conditions in direct support of the agency's mission.

Data provided by NOAA's satellites are used in its numerical weather prediction models, which are in turn used by National Weather Service forecasters to inform severe weather warnings, such as tornadoes and flooding, and to support the detection and spread of wild fires, as well as the monitoring and forecasts of hurricanes. NOAA's satellites are also critical to providing uninterrupted climate data and information to support scientific assessments and climate change predictions. In the Gulf of Mexico, NOAA's satellites continue to provide important data to support weather and oceanographic forecasts and oil spill response efforts. Given the importance of these satellite systems to NOAA's mission, it was imperative that a decision be made to address the acquisition challenges within the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program. I appreciate the opportunity to testify about the steps NOAA has taken to implement its responsibilities as outlined in the decision to restructure the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program.

Decision to Restructure the NPOESS Program

On February 1, 2010, after an exhaustive review and assessment process, the Administration announced its decision to restructure the NPOESS program. This decision reaffirmed the importance of meeting the Nation's space-based environmental needs and revised agency responsibilities for implementation of observational assets and the sustainment of weather and climate observations from polar-orbiting satellites.



NOAA was assigned responsibility for the afternoon orbit and for fielding of the shared ground system. The NOAA Joint Polar Satellite System (JPSS) will support this effort by delivering observations in the afternoon orbit. The Department of Defense (DOD) was assigned responsibility for the early morning orbit. Responsibility for the mid-morning observations remains unchanged, and will be provided by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) which operates the MetOp polar-orbiting satellites. NOAA is also responsible for cooperative activities with international partners who will assist with implementation of the NPOESS restructure. This coordination involves close contact with EUMETSAT, the Japan Aerospace Exploration Agency, the Centre National d'Etudes Spatiales, and the Department of National Defence-Canada.

The February 1 decision addresses three major recommendations of an independent review of expert satellite executives that are required for the program to be successful:

- **Alignment with a proven acquisition center**
  NOAA will work with its long standing partner, the National Aeronautics and Space Administration (NASA), as its acquisition agent for JPSS. NOAA and NASA have aligned the JPSS program with the Goddard Space Flight Center, which has very successfully implemented NOAA's Geostationary Operational Environmental Satellite and Polar-orbiting Operational Environmental Satellite programs. JPSS will benefit from the technical and programmatic resources of NASA, as well as its rigorous acquisition processes.
- **Realistic cost confidence at the 80 percent level**
  The NPOESS Integrated Program Office was often forced by near term funding limitations into decisions that were not cost efficient. A budget that realistically reflects the complexity of the program affords NOAA with sufficient resources to address issues that may arise during the development of JPSS without adding risk to overall life cycle cost or delays to launch readiness dates. A higher confidence cost estimate benefits JPSS by improving NOAA's ability to manage the program more effectively. The President's FY 2011 Budget requests $1.060 billion to implement the JPSS program within a life cycle cost of $11.9 billion.
- **Clear lines of authority and responsibility**
  The division of orbits and observations provides clear accountability to a single agency responsible for each acquisition. Decision authority for JPSS lies within the Department of Commerce/NOAA, rather than multiple agencies (DOD, DOC/NOAA, and NASA). The NOAA Program Management Council, which I chair, is NOAA's management oversight mechanism for the JPSS Program. Membership is comprised of Senior Executives at NOAA and NASA.

Similarly, decision authority for DOD acquisitions will be handled within DOD.

Status of NOAA's Implementation of the February 1, 2010 Decision

Notwithstanding the acquisition challenges that the NPOESS program faced, we appreciate the hard work of the many persons who have worked on the NPOESS program since its inception in 1994. All the agencies recognize that transition is a very difficult period. We believe that the transition process related to the February 1, 2010 decision to restructure the NPOESS program may take many months to be fully implemented, but in the long run, the decision to transition to JPSS will be the right one for the United States and its need for uninterrupted, reliable weather and climate data from space.

Transition Team

NOAA has established a Transition Team which includes members from DC. NOAA, and NASA, with participation from DOD. The three agencies have made significant progress and are moving forward in implementing the transition. Concurrent with the Transition Team's activities, NOAA has asked the Office of the Federal Coordinator for Meteorology to ensure that NPOESS requirements for the afternoon orbit are appropriately translated into program level requirements for JPSS. This requirements review team also maintains membership from all three agencies.

NPOESS Components being Transitioned to JPSS

Space Segment—Instruments

NOAA's JPSS afternoon orbit will maintain the observations that were planned for NPOESS in the afternoon orbit. The JPSS Program will consist of:

- Visible/Infrared Imager/Radiometer Suite
- Cross-track Infrared Sounder
- Advanced Technology Microwave Sounder (ATMS)
- Ozone Mapping and Profiler Suite (OMPS) Nadir
- Advanced Data Collection System (A–DCS)
- Satellite-assisted Search and Rescue (SARSAT)

We anticipate that NASA will assume management control of these sensor acquisitions in early FY 2011. NOAA and NASA continue to coordinate with DOD and the NPOESS prime contractor, Northrop Grumman Aerospace System (NGAS) to transition the management of these instrument contracts from NGAS to NASA management control.

With respect to the other measurements that had been part of the NPOESS Program:

- DOD responsibilities under the restructure of the NPOESS program defines the Defense Meteorological Satellite Program (DMSP) successor sensor suite to include a Space Environment Monitor package.
- Observations for microwave imaging and sounding are planned to be provided by international partnership. NOAA has initiated discussions with the Japan Aerospace Exploration Agency to collaborate in its Global Change Observation Mission (GCOM) missions. The GCOM's Advanced Microwave Scanning Radiometer (AMSR) instrument will satisfy the Key Performance Parameters that the Microwave Imager Sounder instrument would have supported and, along with the JPSS ATMS, will continue the legacy microwave capability in the afternoon orbit established by the Polar-orbiting Operational Environmental Satellite sounders and the AMSR on the NASA Earth Observing System (EOS) Aqua mission. DOD's June 22, 2010 Acquisition Decision Memorandum also provides for a to-be-determined microwave sensing capability for the DMSP successor.

The JPSS Program will also fly instruments that are being procured with funds from the NOAA Climate Sensor Program:

- Cloud and Earth Radiant Energy System and the follow-on Earth's Radiation Budget Sensor
- Total Solar and Spectral Irradiance Sensor (TSIS)
- OMPS–Limb

Space Segment—Spacecraft

In order to ensure the lowest risk of an observational gap, NASA, at the request of NOAA, will procure a clone of the NPOESS Preparatory Project (NPP) spacecraft bus to support the JPSS–1 launch readiness date of 2014. NOAA believes an NPP-clone that will carry the same suite of instruments and collect the same data as NPP provides a proven solution for placing core weather and climate sensors on-orbit in the afternoon. This will allow us to meet a launch readiness date in 2014 that minimizes the potential of a data gap. This decision was made after careful analysis and consideration of technical, cost, schedule, and programmatic risks, which included input and advice from NASA. NOAA is seeking an alternate platform to carry the TSIS instruments, and international partnerships to provide SARSAT, and A–DCS data since they will not fit on the NPP-clone. NOAA is still working with NASA and DOD regarding the spacecraft decision for the JPSS–2 spacecraft bus which will support a 2017 launch readiness date.

Ground segment

NOAA, via the JPSS program, will continue the development and fielding of the ground system network that was to support NPOESS and its users. The JPSS ground system allows us to implement an enterprise solution rather than the current stovepiped ground systems.

The President's FY 2011 budget for JPSS provides adequate resources to support NOAA's efforts for complete development of the ground system which will be used by DOD and NOAA for both the morning and afternoon orbits. NOAA believes the challenges that remain to field and deploy the ground system are manageable. There will be a period of time when NOAA and DOD will operate legacy satellites that are ending their useful life, while at the same time operating the JPSS satellites. NOAA's ground system network will support these legacy systems and JPSS satellites, and will be able to ingest and utilize all sources of data. Having access to data from legacy and JPSS systems at the same time will allow for calibration and validation activities of the new data to occur in a measured and deliberate manner and will support enhancement of numerical weather prediction models and climate models.

The advanced observational capabilities planned for the JPSS satellites will provide significantly improved data that will benefit all users. The more accurate JPSS data will support improved weather forecasts and alerts, and will further our understanding of climate to enable informed decisions to mitigate or adapt to climate change.

Risk of Data Gaps In the Afternoon Orbit Remains

NOAA recognizes that the risk of data gap in the afternoon orbit still exists and will likely continue until we have recovered lost schedule and rebuilt critical spares for the afternoon constellation. NOAA's final satellite in its Polar Operational Environmental Satellite series, NOAA–19, was launched in February 2009 and is the primary operational satellite in the afternoon orbit. NOAA also operates, at the request of DOD, the Air Force's Defense Meteorological Satellite Program satellites. By the end of the year, NOAA will have delivered to EUMETSAT all the NOAA instruments that will fly on the MetOp A, B, and C satellites. The NPP satellite, which NASA expects to launch in 2011, had originally been planned as a demonstration of the key NPOESS instruments. NOAA has included funds in the JPSS budget to support use of the NPP data for operational purposes and as a mitigation measure for a data gap in the afternoon orbit.

I would like to now address the Government Accountability Office (GAO) recommendations.

GAO Recommendations for Executive Action

There are two GAO reports that are the subject of this hearing. The report entitled *"Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements"* contains a number of recommendations directed at the Executive Office of the President's Office of Science Technology Policy (OSTP) to initiate high-level coordination of earth and space weather observations across the Executive Branch. NOAA agrees with the recommendations and its general comments were included in the report's Appendix. I would be remiss if I did not acknowledge the tremendous effort that OSTP has undertaken over the years to address the importance of continuing critical space-based climate observations in 2006 after the Nunn-McCurdy certification of the NPOESS program. Again in 2009, OSTP was a major driver of the review and decision-making that supported the Feb-

ruary 1, 2010 announcement to restructure the NPOESS program. Balancing these critical space-based observations is complex, and NOAA is ready to support OSTP in its task.

With respect to the report that GAO is releasing at this hearing, *"Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks that Jeopardize the Continuity of Weather and Climate Data,"* NOAA appreciates the perspective GAO professionals have provided during its regular reviews of the NPOESS program. NOAA has met with GAO and provided information and feedback on its most recent report.

The draft GAO report states, "In order to ensure that the transition from [the National Polar-orbiting Operational Environmental Satellite System (NPOESS)] to its successor programs is efficiently and effectively managed, we recommend that the Secretaries of Defense and Commerce take the following four actions:"

Recommendation 1: *Direct their respective NPOESS follow-on programs to expedite decisions on the expected cost, schedule, and capabilities of their planned programs.*

NOAA agrees with this recommendation. A transition team has been formed to manage the activities of transitioning the NPOESS activities to the Joint Polar Satellite System (JPSS) program. This team includes representatives from NOAA, NASA, and DOD, who are working together to transition the NPOESS activities to JPSS and DOD (U.S. Air Force) no later than December 31, 2010. NOAA and NASA have signed a memorandum of understanding (MOU) to begin transition activities, which will focus on the cost, schedule and performance capabilities of the JPSS program. As I mentioned earlier, our ability to make final decisions are still coupled with DOD during this transition phase. Pending the adjudication of all the NPOESS elements into the successor programs, a level of uncertainty will remain regarding resolution of the NGAS contract. Until the NGAS contract is resolved, NOAA will continue to be exposed to additional procurement, schedule and cost risk.

Recommendation 2: *Direct their respective NPOESS follow-on programs to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up new program offices, loss of support for the other agency's requirements, and oversight of new program management.*

NOAA agrees with this recommendation. Under the NOAA NASA Transition MOU, the agencies will define the system concept for JPSS, set the level-1 requirements, establish the acquisition plans, determine the organization and staffing needed to run the program and establish a schedule and cost baseline. These will all be subject to internal program management councils and to external independent review teams. NOAA and NASA are working to ensure that the high performing teams that worked on the NPOESS program are provided an opportunity to continue with the JPSS program. Placement of the civil workforce among the three agencies is being finalized. The transition team is still carefully assessing the skill mix and capabilities that the contractor task support must possess to support the government in its efforts to make JPSS program a success.

Recommendation 3: *Direct the NPOESS program office to develop priorities for work stoppage to allow the activities that are most important to maintaining launch schedules to continue.*

NOAA agrees with this recommendation. On March 17, 2010, DOD signed the ADM, "National Polar-orbiting Operational Satellite System (NPOESS) Program Restructure" with a revised ADM which was signed on June 22, 2010 that directs the Air Force to "maximize use of the Government's investment in NPOESS, and (to do so) in a manner that offers maximum opportunities for collaboration with the NOAA JPSS program." In turn, the NPOESS Program Executive Officer (PEO) provided ADM implementation guidance to the NPOESS System Program Director (SPD) on March 26, 2010. This guidance outlines priorities for work stoppage and provides transition guidance for those activities most important to maintaining launch schedules. Subsequently, the PEO and SPD have worked to refine the specifics of implementing the ADM. The Integrated Program Office oversight has been assigned to the Air Force Space and Missile Systems Center (SMC) at Los Angeles AFB, California. A NOAA senior engineer with significant experience in satellite acquisition has been assigned to liaise with SMC to ensure close coordination. This coordination complements ongoing coordination among NOAA, NASA, and DOD.

Recommendation 4: *Direct NOAA and DOD officials to develop timeframes for making key decisions on-or accepting the risks related to-the timeliness of [NPOESS Preparatory Project's (NPP's)] data.*

NOAA agrees with this recommendation. The NPP data will be collected once per orbit and provided to users with timeliness comparable to the data from the current Polar-orbiting Operational Environmental Satellites and MetOp satellites. NOAA continues its preparation to use NPP data on an operational basis. NOAA is also working to increase the number of products, from 19 to 54, that will be available to users within the first 18 months from launch. Notwithstanding the NPOESS restructure, all the instruments have been delivered for integration onto the NPP satellite and NOAA is supporting NASA's efforts for the launch of NPP.

Conclusion

NOAA appreciates the Committee's continued interest in the success of the agency's satellite programs. It is widely acknowledged that satellites are very complicated and difficult systems to design, build, and operate. However, their capabilities play a key role in NOAA's mission to observe and predict the Earth's environment and to provide critical information used in protecting life and property. NOAA is acting quickly to support the February 1, 2010 decision to restructure the NPOESS program. While significant risk exists, NOAA is confident that the restructured program offers greater chances for success than the NPOESS program provided. DOC and NOAA remain committed to pursuing a program that will provide continuity of data for the Nation's weather and climate prediction needs. I would be happy to answer any questions you may have.

BIOGRAPHY FOR MARY M. GLACKIN

Mary M. Glackin has been the Deputy Under Secretary for Oceans and Atmosphere since December 2007. In this role she is responsible for the day-to-day management of NOAA's national and international operations for oceanic and atmospheric services, research, and coastal and marine stewardship.

Mary has worked at NOAA 33 years with nearly 20 years of senior executive level experience working in numerous NOAA line offices. She served as the acting Assistant Administrator for Weather Services and Director, National Weather Service in 2007. Before that, she was the Assistant Administrator for the National Oceanic and Atmospheric Administration's (NOAA) Office of Program Planning and Integration. From 1999 until 2002, she served as the Deputy Assistant Administrator for the National Environmental Satellite, Data, and Information Service of NOAA.

From 1993 to 1999, she worked as the Program Manager for the Advanced Weather Interactive Processing System (AWIPS) with the National Weather Service (NWS), NOAA. Prior to this, Ms. Glackin was both a meteorologist and computer specialist in various positions within NOAA where she was responsible for introducing improvements into NWS operations by capitalizing on new technology systems and scientific models.

She has twice received the Presidential Rank Award (2001 and 2009). She is also the receipient of the Charles Brooks Award for Outstanding Services to the American Meteorological Society, the NOAA Bronze Medal (2001), the Federal 100 Information Technology Manager Award (1999), the NOAA Administrator's Award (1993), and the Department of Commerce Silver Medal Award (1991). She is a Fellow of the American Meteorological Society and a member of the National Weather Association and the American Geophysical Union.

Ms. Glackin has a B.S. degree from the University of Maryland.

Chairman MILLER. Thank you, Ms. Glackin.

Mr. Scolese for five minutes.

STATEMENT OF MR. CHRISTOPHER J. SCOLESE, ASSOCIATE ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. SCOLESE. Mr. Chairman and Members of the Committee, thank you for the opportunity to appear today to discuss NASA's role in and commitment to the JPSS program. This program is crucial to the Nation's ability to make important weather and climate measurements.

NASA's role will be to manage the acquisition and integration of the JPSS program elements on behalf of NOAA. As the nation's civil space agency, NASA is fully prepared to support JPSS.

NASA, and more specifically NASA's Goddard Space Flight Center, has over 40 years of experience developing large-scale operational space systems for NOAA. NASA Goddard developed the first operational weather satellite, TIROS–1, launched in 1961, and has continued to support NOAA through development and deployment of the Geostationary Operational Environmental Satellites and the Polar Orbiting Environmental Satellites.

Further, NASA has decades of experience developing and supporting earth observation system research satellites. Many of these capabilities serve as prototypes for operational missions such as the *Aqua* satellite, launched in 2002, that demonstrated the capabilities intended for JPSS.

At present NASA is developing the NPOESS Preparatory Project-NPP-to serve as a gap filler for the afternoon orbiting weather satellites. I must emphasize that NPP was originally intended to be a risk-reduction mission for the NPOESS-provided instruments, so the lifetime and data—excuse me. So the lifetime and data delivery requirements are not the same as for JPSS.

However, the experience that NASA and Goddard have obtained working with the NPOESS program and its contractors on NPP have provided considerable knowledge of the critical systems required for JPSS. Therefore, the acquisition of JPSS, while a large task, is extremely well aligned with the existing capabilities and experience of Goddard.

The JPSS program at Goddard will lead integration across all of the elements of JPSS to ensure delivery of the required data products for weather and climate. This activity includes spacecraft, ground systems, and instruments, including the critical Visible Infrared Imaging Radiometer, Cross-Track Infrared Sounder, Advanced Technology Microwave Sounder, and Ozone Mapping and Profiling Suite of instruments.

All three agencies remain committed to a partnership that preserves and enhances the nation's weather and climate measure-

ment capabilities. The three agencies have established a joint team to transition the NPOESS contracts and activities to the responsible agencies with as little disruption as possible, and we expect to have contracts or contract modifications in place by early fiscal year 2011.

NASA is working with NOAA to establish a high-caliber team of experienced personnel to implement JPSS. The team will be a combination of NASA and NOAA employees with significant experience in acquisition, spaceflight development, and earth remote sensing. For NASA in particular, the JPSS program team will be composed of personnel from NPP as well as members from the successful *Hubble* Space Telescope Servicing Mission-4, the *Lunar Reconnaissance Orbiter, Solar Dynamics Orbiter,* and the recently-launched GOES–N series of geostationary satellites and missions.

Last, I would like to report that all of the instruments for NPP have been delivered for integration with the spacecraft, including the NPOESS-provided VIIRS and CrIS instruments. With now a full complement of instruments we are beginning testing with the ground system and anticipate a launch date of late 2011.

In summary, NASA is committed to a successful JPSS program. NASA will build on its long relationship supporting NOAA, and our experience with operational and research earth observation satellites, to minimize data gaps and provide the nation with the critical operational observations—observation capability it needs.

Once again, thank you for the opportunity to testify today. I appreciate the support of Congress and this committee and would be pleased to answer any questions.

[The prepared statement of Mr. Scolese follows:]

PREPARED STATEMENT OF CHRISTOPHER J. SCOLESE

Mr. Chairman and Members of the Subcommittee, thank you for this opportunity to appear today to share with the Subcommittee information regarding NASA's role in and commitment to NAAA's Joint Polar Satellite System (JPSS) Program. JPSS is crucial to the Nation's ability to make important weather measurements and is critical to the Nation's climate monitoring and climate research activities. As the Nation's Civil Space Agency, NASA is fully prepared to support JPSS.

Background

On February 1, 2010, the Executive Office of the President (EOP) released the FY 2011 budget request, which contained a major restructuring of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) in order to put this critical program on a more sustainable pathway toward success. This satellite system is essential to meeting both civil and military weather forecasting and climate-monitoring requirements.

The EOP recommended a restructured program with the agencies sharing common elements where that has proven successful in the past, and developing separate elements where conflicting perspectives and priorities made the tri-agency managed program unsuccessful.

As you know, the Independent Review Team led by Tom Young made a number of recommendations to improve the viability of the NPOESS program. Specifically, Mr. Young recommended that the acquisition of the NPOESS system be done by an experienced spaceflight hardware acquisition center, such as the Department of Defense (DOD) Space and Missile Command or NASA's Goddard Space Flight Center (GSFC). NASA, and more specifically NASA's GSFC, has over 40 years of experience developing large-scale operational space systems for NOAA. NASA GSFC has developed a series of Geostationary Operational Environmental Satellites (GOES) and Polar Orbiting Environmental Satellites (POES) for weather forecasting and climate monitoring. GSFC also developed the Landsat series of satellites for the U.S. Geological Survey (USGS). In addition, NASA has extensive experience developing Earth Science research missions, such as those that are part of NASA's Earth Ob-

serving System (EOS). JPSS is very similar to EOS satellites, which GSFC developed and has been supporting for years. Hence, adding the acquisition of JPSS to the GSFC portfolio, while a large task, is extremely well aligned with GSFC's existing capabilities and experience.

GSFC will manage the acquisition and integration of the JPSS program elements and has the necessary depth and technical expertise to do the job. GSFC has developed many successful missions for NOAA with a demonstrated track record of success. The Program Manager and senior leadership team will be a combination of GSFC and NOAA employees with significant spaceflight and Earth remote sensing experience. The JPSS program at GSFC will develop the flight mission elements for the afternoon orbit which includes multiple spacecraft and the Visible-Infrared Imaging Radiometer (VIIRS), Cross-track Infrared Sounder (CrIS), Advanced Technology Microwave Sounder (ATMS), and Ozone Mapping and Profiling Suite (OMPS) instruments. NASA will also develop the ground system for both the NOAA and DOD systems prior to handover to NOAA for operations. The JPSS program will also lead integration across all of the elements to ensure delivery of the data products.

Steps Taken to Date to Accomplish the Transition

All three agencies remain committed to a partnership that preserves and enhances the Nation's weather and climate measurement capabilities. NASA is working closely with DOD and NOAA to allow for a smooth transition. NASA's role in the restructured program will follow the model of the successful POES and GOES programs, where NOAA and NASA have a long and effective partnership. NASA program and project management practices have been refined over decades of experience developing and acquiring space systems and these practices will be applied to JPSS. NOAA and NASA will strive to ensure that weather and environmental monitoring requirements are met on the most rapid practicable schedule without reducing system capabilities or further increasing risk.

The three agencies have established a joint team to transition the NPOESS contracts and activities to the responsible agencies with as little disruption as possible, and we expect to have contracts or contract modifications in place by early FY 2011.

NASA is working with NOAA to establish a high caliber team of experienced personnel to implement JPSS. This team will be composed of personnel from the NPOESS Preparatory Project (NPP) mission, as well as members from the following successfully completed missions: Hubble Space Telescope Servicing Mission-4; Lunar Reconnaissance Orbiter; Solar Dynamics Orbiter; and the NOAA GOES-N-series (N–P) geostationary satellites. NOAA personnel from the NPOESS IPO will also fill key positions in the JPSS program. GSFC is also hiring additional staff to directly support JPSS or backfill others who assume that role. Staffing and supporting projects at GSFC is a continual process as missions are completed and new projects are initiated. As such, JPSS is in line with GSFC's normal operating practices. All projects at GSFC are being supported appropriately, and none will be deleteriously impacted by JPSS.

Current cost estimates provided for JPSS are consistent with similar missions developed by NASA. As NASA continues to negotiate contracts with the instrument, ground system, and spacecraft suppliers, the cost confidence will mature as the contracts are put in place. The program cost estimates will be produced at or close to the 80 percent confidence level.

NPP Instruments Are Complete/Some Risk Remains

The NPOESS Preparatory Project (NPP) was originally designed to provide continuity between the EOS Terra mission and the first NPOESS satellite in the morning orbit. The NPP mission was intended to provide risk reduction for the key sensors and the ground system prior to the first NPOESS launch and was not intended to be an operational asset. However, the delays in the delivery of the NPOESS system have required that NPP be shifted from the morning orbit to the afternoon orbit to minimize the potential for a data gap in the operational weather forecasting and environmental monitoring requirements.

The concern about operational data gaps in weather forecasting drove the need for the Administration to establish the EOP task force on the restructuring of NPOESS. The concerns about availability of weather forecasting data in the afternoon orbit and for continuity of climate records are driving the launch of NPP as soon as practicable, and will drive the JPSS program to deliver JPSS–1 as soon as possible.

The final instrument delivery for NPP occurred June 15, 2010, and the NPP spacecraft is on track for launch in 2011. The ground system development to sup-

port the NPP launch remains a major challenge, and NOAA and NASA are working to address this in time to support the NPP launch.

Although the first flight models of these instruments will be flown on NPP, the remaining development of these sensors is not considered low risk. These are highly complex Earth remote sensing instruments that require a significant amount of oversight and careful testing to ensure success. NASA has a great deal of experience in developing these types of instruments on EOS, NOAA POES and GOES missions. NASA is adept at managing the risk and providing the needed oversight to successfully deliver these instruments. The lessons learned from the development, test, and flight of NPP will be incorporated into later flight models for the JPSS program.

Conclusion

NASA and NOAA are committed to a successful JPSS program. NASA will work closely with NOAA in establishing the path forward for JPSS and to identify the right leaders. In addition, we will work closely with DOD to ensure that the civil and defense programs take advantage of the respective skills of each agency and to ensure that the common elements of the program meet the needs for all three agencies.

The existence of NPOESS (now JPSS) was assumed when the National Academy of Sciences (NAS) developed the priorities specified in the recent Earth Science Decadal Survey. NASA is ready to support JPSS as a partner with NOAA and as a part of fulfilling the scientific goals set forth by the NAS. Ensuring the success of JPSS is of the highest importance to NASA and the Agency has the requisite expertise and experience to take on this task.

Once again, thank you for the opportunity to testify today. I appreciate the support of this Committee and the Congress for NASA's programs and would be pleased to answer any questions.

BIOGRAPHY FOR CHRISTOPHER J. SCOLESE

Christopher Scolese is the Associate Administrator of the National Aeronautics and Space Administration, and oversees the planning, directing, organization and control of the day-to-day Agency technical and programmatic operations. He has direct oversight of the Agency's mission directorates, field centers, and technical mission support offices, and is responsible for integrating the technical and programmatic elements of the Agency.

Scolese was formerly the NASA Chief Engineer. In that position he was responsible for the overall review and technical readiness of all NASA programs. NASA's Office of the Chief Engineer assures that the development efforts and missions operations are being planned and conducted on a sound engineering basis with proper controls and management.

Formerly, Scolese was the Deputy Director of the Goddard Space Flight Center where he assisted the Director, Dr. Edward Weiler, in overseeing all activities. He also served as the Deputy Associate Administrator in the Office of Space Science at NASA Headquarters. In this position, he was responsible for the management, direction and oversight of NASA's space science flight program, mission studies, technology development and overall contract management of the Jet Propulsion Laboratory.

Scolese also served as the EOS Program Manager and the Deputy Director of Flight Programs and Projects for Earth Science at the Goddard Space Flight Center. In this position he was responsible for the operation and development of all Earth Science missions assigned to the Goddard Space Flight Center. At Goddard, he also served as the EOS Terra Project Manager responsible for the development of all EOS–AM instruments, the CERES instrument for TRMM, the EOS–AM spacecraft, the interface with the Earth Science Data and Information System and the integration and launch of these elements. In addition, Scolese was the EOS Systems Manager responsible for the EOS system architecture and the integration of all facets of the project. During his tenure at Goddard, which began in 1987, he chaired the EOS Blue Team that re-scoped the EOS Program; he supported the EOS investigators in the development of the EOS payloads in the restructured EOS; and he has been responsible for the adoption of common data system architecture on EOS and some other earth orbiting spacecraft.

Prior to his 1987 appointment at Goddard, Scolese's experience included work in industry and government. While a senior analyst at the General Research Corporation of McLean, Va., he participated in several SDIO programs. He was selected by Admiral Hyman Rickover to serve at Naval Reactors where he was associated with

the development of instrumentation, instrument systems and multi-processor systems for the U.S. Navy and the DOE while working for NAVSEA.

Scolese is the recipient of several honors including the Presidential Rank Award of Meritorious Executive, Goddard Outstanding Leadership, two NASA Outstanding Leadership Medals and the American Institute of Aeronautics and Astronautics (AIAA) National Capital Section Young Engineer/Scientist of the Year award. He was recognized as one of the outstanding young men in America in 1986, was a member of college honor societies including Eta Kappa Nu and Tau Beta Pi, and was recipient of the 1973 Calspan Aeronautics award. He is an Associate Fellow of the AIAA and a member of the Institute of Electrical and Electronics Engineers. He also served as a member of the AIAA Astrodynamics Technical Committee and chaired the National Capitol Section Guidance Navigation and Control Technical Committee.

Chairman MILLER. Thank you. I believe we can get the opening testimony in. We will be called to vote during it, but we have 15 minutes, which really turns out to be 25 minutes. So at least—so we can complete the testimony. Then I suspect we will break. You will be at ease, and we will return to ask for our questions.

Mr. Klinger for five minutes.

STATEMENT OF MR. GIL KLINGER, DIRECTOR, SPACE AND INTELLIGENCE OFFICE, UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY, AND LOGISTICS, DEPARTMENT OF DEFENSE

Mr. KLINGER. Mr. Chairman, Dr. Broun, members of the subcommittee, I am honored to appear before you today to discuss the Department of Defense's role in assuring continuity of the nation's environmental monitoring mission in light of the restructuring of National Polar Orbiting Operational Environmental Satellite System program.

As the director of the Space and Intelligence Office for the Under Secretary of Defense for Acquisition, Technology, and Logistics, I am pleased to join my colleagues here at the table today.

I think our presence here today reflects our collective commitment to continue to work together to meet our nation's weather needs and that is certainly the Defense Department's position.

The environmental monitoring mission serves a critical role in day-to-day weather forecasting and provides critical support for nearly all defense and national security users. So I share your concerns about preserving continuity of environmental data for all users.

In this regard I am pleased to report that the Department of Defense, in close coordination with our interagency partners, has made considerable progress in executing the Administration's direction to restructure NPOESS and to continue to pursue capabilities needed to meet the nation's environmental monitoring needs.

Since receiving the EOP direction the Under Secretary of Defense for Acquisition, Technology, and Logistics has chaired three Defense Acquisition Board reviews to assess follow-on options and acquisition approaches to address DOD responsibilities under the restructure and ensure transition of former NPOESS elements to the appropriate acquisition agencies.

At a minimum, the DOD program designated the Defense Weather Satellite System, or DWSS, will be available for launch in 2018, and will meet or exceed Defense Meteorological Satellite Program, or DMSP, legacy performance while ensuring mission continuity in

the early morning orbit. The DOD is deliberately studying available options to ensure that we strike the right balance of cost, performance, and technical risks while staying within current budgetary constraints.

To meet the on-orbit timeline required, the DOD will leverage technology and previous investments in the NPOESS program. The DWSS and JPSS programs will share a common ground system based on that design for NPOESS. Under the restructure, ground system development is a NOAA/NASA responsibility. NOAA will operate DOD satellites on a reimbursable basis as it does today for the Defense Department with respect to DMSP.

Additionally, the Visible Infrared Imager Radiometer Suite, or VIIRS, and Space Environmental Monitor-NPOESS, SEM–N, are prominent in our plans for use on the DWSS program. The Air Force is also developing an implementation plan addressing the most appropriate microwave sensor and satellite bus to meet DOD requirements and the attendant procurement strategy.

Further, the procurement strategy will seek to maximize the government's investment in NPOESS. It will focus on the best mix of costs, technical risks, and capability and, where applicable, support NOAA's JPSS program. We plan to finalize our procurement strategy not later than August 10 of this year.

Weather observation and forecasting is greatly improved over the last four decades due in large part to space-based environmental sensing. Global, high-resolution measurements of atmospheric temperature, density, and humidity populate mathematical models for weather prediction. Our warfighters need accurate, time-sensitive weather data as a key enabler for maneuver planning, weapons employment, and intelligence collection. DWSS will continue to provide critical global environmental information to effectively employ military capabilities and aid in the protection of national resources.

Thank you for your time today, and I look forward to answering any questions that you may have.

[The prepared statement of Mr. Klinger follows:]

PREPARED STATEMENT OF GIL KLINGER

INTRODUCTION

I am honored to appear before you today to address this Committee. I am also pleased to be joined today by my colleagues from the Executive Office of the President, Ms. Shere Abbott, the National Oceanic and Atmospheric Administration (NOAA), Ms. Mary Glackin, and the National Aeronautics and Space Administration (NASA), Mr. Chris Scolese.

On February 1, 2010, the Executive Office of the President (EOP) directed the restructuring of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program, assigning each agency responsibility for their highest priority orbit. Accordingly, the Department of Commerce (DOC) will populate the afternoon orbit through the Joint Polar Satellite System (JPSS); the Department of Defense (DOD) will populate the early morning orbit. We will rely on capabilities from our European partners for the mid-morning orbit, upon the conclusion of the Defense Meteorological Satellite Program (DMSP) operations in that orbit.

For the morning orbit, DMSP continues to provide key terrestrial forecasting and space environmental sensing for defense and civil uses. DMSP Flight 17 was launched into the early morning orbit on November 2006 and continues to perform very well. There are two DMSP satellites remaining with Flight 19 and 20, and they are currently undergoing a Service Life Extension Program (SLEP) to refurbish, replace, and test components that have exceeded their shelf life and upgrade components which are known life-limiters. Flight 19 is scheduled to launch in October 2012 with Flight 20 serving as a back-up.

Mission data requirements for environmental monitoring remain unchanged. Additionally, the agencies will continue to share data and work together where possible. The DOD, in cooperation with NOAA/NASA, is completing an analysis for fulfilling the morning orbit requirements, and the outcome will serve as the basis for the restructured program. While progressing on this effort, we have continued to work closely with the civil agency partners to ensure our plans will support and enable continuity of the JPSS afternoon orbit.

CURRENT STATUS

Since receiving EOP direction, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD/AT&L) has chaired three Defense Acquisition Board (DAB) reviews to assess follow-on options and acquisition approaches to address DOD responsibilities under the restructure and ensure transition of former NPOESS elements to the appropriate acquisition agencies. At a minimum, the DOD program, designated the Defense Weather Satellite System (DWSS), will be available for launch in 2018, and meet or exceed DMSP legacy performance while ensuring mission continuity in the early morning orbit. The DOD is deliberately studying available options to ensure the DOD strikes the right balance of cost, performance, and technical risk while staying within current budgetary constraints (the PB 11 DOD NPOESS budget).

To meet the on-orbit timeline required, the DOD will leverage technology and previous investments in the NPOESS program. The DWSS and JPSS programs will share a common ground system based on that designed for NPOESS. Under the restructure, ground system development is a NOAA/NASA responsibility. NOAA will operate DOD satellites on a reimbursable basis, as it does today for the DMSP. Additionally, the Visible Infrared Imager Radiometer Suite (VIIRS) and Space Environmental Monitor-NPOESS (SEM–N) are prominent in our plans for use on the DWSS program. The Air Force is also developing an implementation plan addressing the most appropriate microwave sensor and satellite bus to meet DOD requirements, and procurement strategy. Further, the procurement strategy will seek to maximize the Government's investment in NPOESS; it will focus on the best mix of cost, technical risk, and capability, and where applicable, support NOAA's JPSS program. DOD plans to finalize its procurement strategy not later than August 10, 2010.

The DWSS program office will be established under the Program Executive Officer/Space (PEO/SP) at the Space and Missile Systems Center (SMC), Los Angeles Air Force Base. This location will afford the DOD the best opportunity to leverage our procurement expertise, resources and location to maximize success on this program. We have begun the process of staffing the program office with the requisite skills (program management, systems engineering, contracting, etc) to enable program execution. SMC is also working with NOAA/NASA management to transition key sensors from the NPOESS contract to support the JPSS in meeting its afternoon mission requirements. Our firm goal for completing the transition is the end of calendar year 2010.

GAO REPORTS

I would now like to address the recent GAO reports. Regarding GAO report 10–456 *"Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements",* the GAO had no specific actions for the DOD. However, I want to ensure you that the DOD team will fully support OSTP efforts to consider Earth and Space Weather monitoring from an enterprise and systems-of-systems standpoint. This support includes both full sharing of environmental monitoring data with our civil agency partners as well as exploration of opportunities to have this data supplied by commercial and foreign sources. We look forward to continued participation in OSTP-sponsored activities and initiatives to ensure we, the agencies, act to satisfy our collective needs in a reasonable and cost-effective manner, and that we coordinate our investments to the benefit of the users of this information and the taxpayers.

Regarding draft GAO report 10–558 *"Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks that Jeopardize the Continuity of Weather and Climate Data,"* the DOD thanks the GAO for their informed and expert insights and recommendations. The draft GAO report states, "In order to ensure that the transition from [the National Polar-orbiting Operational Environmental Satellite System (NPOESS)] to its successor programs is efficiently and effectively managed, we recommend that the Secretaries of Defense and Commerce take the following four actions:" We concurred with the four recommendations, as follows:

RECOMMENDATION 1: *The GAO recommends that the Secretary of Defense direct the DOD National Polar-orbiting Operational Environmental Satellite System (NPOESS) follow-on program expedite decisions on the expected cost, schedule, and capabilities of their planned programs (p. 38/GAO Draft Report)*

We concur. The DOD agrees that expedited decisions are necessary to ensure FY 10 funds are applied where most needed. Decisions on the DOD early morning orbit program will be executed per established acquisition guidelines. USD(AT&L) issued Acquisition Decision Memorandums on March 17th, May 10th, and June 22nd 2010. The most recent ADM directs the Secretary of the Air Force to immediately begin acquisition efforts to support a 2018 launch for a DMSP successor program and to consider maximum use of the Government's investment in NPOESS, and in a manner that offers maximum opportunities for collaboration with the NOAA JPSS program.

RECOMMENDATION 2: *The GAO recommends that the Secretary of Defense direct the DOD NPOESS follow-on program to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up a new program office, loss of support for the other agency's requirements, and oversight of new program management. (p. 38/GAO Draft Report)*

We also concur with this recommendation. The DOD is assessing numerous risks associated with the transition. We will ensure personnel for this effort have the requisite experience and skills (e.g. contracting, program management, systems engineering) to effectively manage the program. The DOD will continue to work with NOAA to ensure that common areas (such as the satellite control, data processing and dissemination capabilities) are arranged as necessary to support other agency needs.

RECOMMENDATION 3: *The GAO recommends that the Secretary of Defense direct the NPOESS program office to develop priorities for work stoppage to allow the activities that are most important to maintaining launch schedules to continue. (p. 38/GAO Draft Report)*

We concur. On 17 March, the Under Secretary of Defense for Acquisition, Technology and Logistics signed the "Acquisition Decision Memorandum (ADM), National Polar-orbiting Operational Satellite System (NPOESS) Program Restructure." In turn, the Acting Program Executive Officer for Environmental Satellites (PEO/ES) provided ADM implementation guidance to the NPOESS System Program Director (SPD) on March 26, 2010. This guidance outlines priorities for work stoppage and provides transition guidance for those activities most important to maintaining launch schedules. Subsequently, the PEO and SPD have worked to refine the specifics of implementing the ADM. The June 22nd ADM extended the transition deadline to the end of calendar year 2010 and plans for a decision by the Under Secretary of Defense for Acquisition, Technology and Logistics not later than August 10, 2010 on a) microwave sensing capability and performance, b) optimal bus configuration to host selected DOD payloads, c) recommended procurement strategy to provide capabilities, and where appropriate, support NOAA's need in filling an afternoon orbit, d) rough-order-magnitude cost estimate, and e) necessary staffing and organization.

RECOMMENDATION 4: *The GAO recommends that the Secretary of Defense direct DOD officials to develop timeframes for making key decisions on—or accepting the risks related to—the timeliness of NPP's data (p. 38/GAO Draft Report)*

We concur and we have accepted the current limitations on the timeliness of NPP data. Further, we will continue to work with our agency partners to make sure all NPOESS follow-on data is made available in a timely a manner to support warfighter missions.

CONCLUSION

Weather observation and forecasting has greatly improved over the last four decades primarily due to space-based environmental sensing. Global, high resolution measurements of atmospheric temperature, density, and humidity populate mathematic models for weather prediction. Our warfighters need accurate, time-sensitive weather data as a key enabler for maneuver planning, weapons employment, and intelligence collection. DWSS will continue to provide critical global environmental information to effectively employ military capabilities and aid in the protection of national resources. Thank you for your time today.

BIOGRAPHY FOR GIL KLINGER

Mr. Gil Klinger is the Director of the Space and Intelligence Office for the Undersecretary of Defense for Acquisition, Technology, and Logistics where he is responsible for acquisition oversight of all space and intelligence programs executed by the Department of Defense.

Immediately prior to assuming leadership of SIO, Mr. Klinger was the Assistant Deputy Director of National Intelligence for Architecture Engineering and Integration where he led intelligence community activities assessing the adequacy of the Intelligence Collection enterprise, identified shortfalls and solutions, managed teams focused on specific short- and long-term issues in response to Director of National Intelligence taskings, and provided domain and subject matter expertise to the Office of the Director of National Intelligence across a broad range of disciplines and collection areas.

Immediately prior to his role as Assistant Deputy Director, Mr. Klinger was the Director of Space Policy, National Security Council Staff, where he was the lead member of the Executive Office of the President on all space issues and the principal author of five new national space polices, including the first new U.S. space exploration vision in more than a generation.

His previous assignments included serving as Director of Policy, National Reconnaissance Office; Acting Deputy Under Secretary of Defense (DUSD) for Space, and the position of Principal Assistant (DUSD/Space), within the Office of the Deputy Under Secretary of Defense for Acquisition and Technology, where he received the 1997 Presidential Rank Meritorious Executive Award, one of the two highest awards given to civil servants within the U.S. government; Director, Space and Advanced Technology Strategy, also within the Office of the Under Secretary of Defense for Policy; and Staff Assistant Deputy Director for Strategic Forces Policy, Office of the Under Secretary of Defense for Policy, where he was awarded the Distinguished Civilian Service Medal, the highest award given to civil servants within the Department of Defense.

Mr. Klinger began his career in government service with his competitive selection to the Presidential Management Internship Program with the Office of the Secretary of Defense.

Mr. Klinger graduated Phi Beta Kappa and summa cum laude from the State University of New York at Albany with an undergraduate degree in European History and Political Science. He received his master's degree in Public Policy from the John F. Kennedy School of Government at Harvard University.

Mr. Klinger has been a member of the Senior Executive Service since 1992 and a member of the Senior Intelligence Service since 1999.

Chairman MILLER. Mr. Klinger did not use all of his time. Outstanding.

Mr. Powner for five minutes.

STATEMENT OF MR. DAVID A. POWNER, DIRECTOR, INFORMATION TECHNOLOGY MANAGEMENT ISSUES, GOVERNMENT ACCOUNTABILITY OFFICE

Mr. POWNER. Chairman Miller, Ranking Member Broun, and members of the subcommittee, we appreciate the opportunity to testify on the disbanding of the NPOESS program and our broader report on the need for long-term strategy for climate and space weather observations.

First, NPOESS. When the taskforce led by the White House's Office of Science and Technology Policy decided in February of this year to disband the NPOESS program and go back to separate satellite acquisitions for NOAA and DOD, many viewed this as fixing the problem. As our report being released today points out, we are far from fixing the problem.

First, both NOAA and DOD's programs are not completely defined, nor are the detailed costs and launch schedules. Although, to their credit, last week both NOAA and DOD announced the key sensors they plan to pursue in their separate acquisitions.

Transition risks are significant. These include loss of key staff, supporting the other agency's requirements, and litigation costs. Near-term budgetary challenges are also a major issue as the agencies are continuing work on NPOESS while starting their new programs.

In addition, they are slowing work because contractor termination liability payments and other litigation costs are still unknown. Because of this we are recommending that NOAA and DOD expedite decisions on the capabilities of the separate satellite acquisitions and the associated costs and launch schedules, and to effectively manage the transition risks.

In addition to the major issues—in addition, the major issues that led to NPOESS's failures are still relevant to the new programs, and neither NOAA, NASA, or DOD should lose sight of these. These include technical complexity. Specifically, the VIIRS instrument plan for the first JPSS satellite is high risk. Contractor and subcontractor oversight and performance should be a major focus area, as should rigorous program management.

In addition, an executive-level oversight structure still needs to be defined for the new programs. Finally, the agencies can't repeat the past poor interagency coordination that plagued NPOESS. NOAA and NASA will need to work together effectively on the new civilian satellite acquisition.

Failing to effectively manage these transition risks in the separate satellite acquisitions could result in the combined programs costing more than NPOESS. In addition, further launch delays are likely to jeopardize the continuity of weather and climate data. Of particular concern is keeping the demonstration satellite known as NPP on schedule as it is to replace the final operational POES that is expected to reach the end of its lifespan at the end of 2012. All indications are that NPP will slip further than the nine months indicated in our report.

Turning to the larger data continuity issue. In 2006, when the NPOESS program was restructured, several climate and space weather instruments were removed to save costs, knowing that these could be addressed later or on other satellites. This com-

plicated an already chaotic approach to our nation's long-term environmental satellite observations. There is no overall strategy to ensure continuity of climate and space weather observations, despite the fact that for over a decade Federal agencies and the climate community at large have clamored for one.

Interestingly a White House-sponsored interagency working group has worked on a short-term strategy and has even drafted a report that identifies and prioritizes these climate observations. This could form the basis for a long-term strategy that ensures our nation adequately monitors the Earth's atmosphere, oceans, land, and space environments. As we heard this morning from Ms. Abbott, OSTP plans to work on this strategy.

In summary, Mr. Chairman, NOAA and DOD need to define and effective manage their separate satellite acquisitions now that NPOESS has been disbanded. But in the near term the transition risks need to be effectively managed. Once the scope of the respected programs are agreed to, any additional gaps in environmental observations will need to be addressed in the strategic planning efforts currently being led by OSTP.

Mr. Chairman, this concludes my statement.

[The prepared statement of Mr. Powner follows:]

PREPARED STATEMENT OF DAVID A. POWNER

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to participate in today's hearing on efforts to disband the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and federal planning to ensure long-term environmental monitoring from satellites. 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 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 (OSTP) decided in February 2010 to disband the NPOESS acquisition and, instead, to have NOAA and DOD undertake separate acquisitions. As requested, this statement summarizes our report being released today on plans for NOAA's and DOD's separate acquisitions and the key risks of transitioning from NPOESS to these new programs, as well as our recent work on federal efforts to establish long-term strategies for satellite-provided climate and space weather data.[1]

In preparing this testimony, we relied on the work supporting the corresponding reports. Those reports contain detailed overviews of our scope and methodology. 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.

[1]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), and *Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements*, GAO-10-456 (Washington, D.C.: Apr. 27, 2010).

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. For example, these data are used to monitor and project seasonal, annual, and decadal changes in the earth's temperature, vegetation coverage, and ozone coverage.

Satellite-provided Environmental Data for Climate and Space Weather

One key subset of satellite-provided data is climate data. These data are used in combination with ground and ocean observing systems to understand seasonal, annual, and decadal variations in the climate. Satellites provide land observations such as measurements of soil moisture, changes in how land is used, and vegetation growth; ocean observations such as sea levels, sea surface temperature, and ocean color; and atmospheric observations such as greenhouse gas levels (e.g., carbon dioxide), aerosol and dust particles, and moisture concentration. When these data are obtained over long periods of time, scientists are able to use them to determine short- and long-term trends in how the earth's systems work and how they work together. For example, climate measurements have allowed scientists to better understand the effect of deforestation on how the earth absorbs heat, retains rainwater, and absorbs greenhouse gases. Scientists also use climate

data to help predict climate cycles that affect the weather, such as El Niño, and to develop global estimates of food crop production for a particular year or season.

Another subset of satellite-provided environmental information is space weather data. Satellite-provided observations of space weather generally describe changes in solar activity in the space environment. Just as scientists use observations of weather that occurs on the earth's surface and in its atmosphere to develop forecasts, scientists and researchers use space weather observations to detect and forecast solar storms that may be potentially harmful to society.

Coordination and Oversight of Satellite-Provided Environmental Observations

NASA, NOAA, and DOD all have responsibilities for acquiring, processing, and disseminating environmental data and information from research or operational satellites. In addition to these agencies, there are two interagency organizations—the U.S. Group on Earth Observations (USGEO) and the U.S. Global Change Research Program (USGCRP)—that are primarily responsible for coordinating federal efforts with respect to observations of the earth's environment. The National Space Weather Program serves as the coordinating body for space weather. USGEO and USGCRP report to the Executive Office of the President through the National Science and Technology Council's Committee on Environment and Natural Resources, while the National Space Weather Program coordinates its activities through NOAA's Office of the Federal Coordinator for Meteorology.

The Executive Office of the President provides oversight for federal space-based environmental observation. Within the Executive Office of the President, the Office of Science and Technology Policy (OSTP), the Office of Management and Budget (OMB), and the Council on Environmental Quality carry out these governance responsibilities. In addition, the National Science and Technology Council and its Committee on Environment and Natural Resources

provide the Executive Office of the President with executive-level coordination and advice.[2]

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.[3] Currently, there is one operational POES satellite and two operational DMSP 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 a European satellite, called the Meteorological Operational (MetOp) satellite.[4] 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.[5] 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

[2]The Council on Environmental Quality coordinates federal environmental efforts; the National Science and Technology Council coordinates science and technological policies and sets national goals for investments in those areas, and the Committee on Environment and Natural Resources provides advice on federal research and development efforts in the area of environment and natural resources.

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

[4]The 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.

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

acquisition; and NASA responsible for facilitating the development and incorporation of new technologies into the converged system.

Since the program's inception, NPOESS costs have grown by over $8 billion, and launch schedules have been 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. The restructuring also led agency executives to mitigate potential data gaps by deciding to use a planned demonstration satellite, called the NPOESS Preparatory Project (NPP) satellite, as an operational satellite providing climate and weather data. Even after this restructuring, however, the program continued to encounter technical issues, management challenges, schedule delays, and further cost increases. To 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]

In August 2009, the Executive Office of the President formed a task force, led by OSTP, to investigate the management and acquisition options that would improve the NPOESS program. As a result of this review, the Director of OSTP announced in February 2010 that NOAA and DOD will no longer jointly procure the NPOESS satellite system; instead, each agency would plan and acquire its own satellite system. Specifically, NOAA is to be responsible for the afternoon orbit and the observations planned for the first and third NPOESS satellites. DOD is to be 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.

[6]GAO, *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).

Agencies Have Started Planning Separate Acquisitions, but the Impact of This Approach Is Not Known and Key Risks and Challenges Remain

NOAA has developed preliminary plans for its new satellite acquisition program—called the Joint Polar Satellite System (JPSS)—to meet the requirements of the afternoon NPOESS orbit. Specifically, NOAA plans to acquire two satellites; the plans call for the first JPSS satellite to be available for launch in 2014, and the second JPSS satellite to be available for launch in 2018.[7] NOAA will also provide the ground systems for both the JPSS and DOD programs. NOAA is also planning 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.[8] In addition, NOAA plans to transfer the management of acquisition from the NPOESS program office to NASA's Goddard Space Flight Center, so that it can be co-located at a space system acquisition center as advocated by an independent review team. NOAA has developed a team to lead the transition from NPOESS to JPSS, and plans to begin transitioning in July and complete the transition plan—including cost and schedule estimates—by the end of September.

DOD is at an earlier stage in its planning process, in part because it has more time before the first satellite in the morning orbit is needed. DOD officials are currently developing plans—including costs, schedules, and risks—for their new program, called the Defense Weather Satellite System. DOD expects to make final

[7]NOAA officials noted that these dates could change as transition plans are developed.

[8]NOAA officials are currently revisiting plans for the Space Environment Monitor, which collects data to predict the effects of space weather on technological systems, and the Microwave Imager/Sounder, which collects microwave images and data needed for measurements such as rain rate and soil moisture. Although they plan to launch the Total and Spectral Solar Irradiance Suite, NOAA officials have not yet made a decision on which satellite will host the sensor.

decisions on the spacecraft, sensors, procurement strategy, and staffing in August 2010, and begin the program immediately.[9]

Because neither agency has finalized plans for its acquisition, the full impact of OSTP's decision on the expected cost, schedule, and capabilities is unknown.

- Cost: NOAA anticipates that the JPSS program will cost approximately $11.9 billion to complete through 2024.[10] Although this estimated cost is less than the current baseline and recent estimates for the NPOESS program, DOD will still need to fund and develop satellites to meet the requirements for the early morning orbit.[11] DOD's initial estimates are for its new program to cost almost $5 billion through fiscal year 2015.[12] Thus, the cost of the two acquisitions will likely exceed the baselined life-cycle cost of the NPOESS program.
- Schedule: Neither NOAA nor DOD has finalized plans that show the full impact of the restructuring on the schedule for satellite development. We have previously reported that restructuring a program like NPOESS could take significant time to accomplish, due in part to the time taken revising, renegotiating, or developing important acquisition documents, including contracts and interagency agreements.[13] With important decisions and negotiations

[9]DOD had originally planned to make decisions on the spacecraft and sensors in June and October 2010, respectively, but revised the dates for these decisions in late June 2010.

[10]This 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.

[11]Although the program baseline is currently $13.95 billion, we estimated in June 2009 that this cost could grow by about $1 billion. In addition, officials from the Executive Office of the President stated that they reviewed life-cycle cost estimates from DOD and the NPOESS program office of $15.1 billion and $16.45 billion, respectively.

[12]This estimate includes approximately $2.9 billion in DOD funds spent on NPOESS through fiscal year 2010. It is not a life-cycle cost estimate and could change as DOD completes its requirements review and analysis of alternatives for its new program. DOD has not yet developed a life-cycle cost estimate.

[13]GAO, *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold*, GAO-06-573T (Washington, D.C.: Mar. 30, 2006).

still pending, it is likely that the expected launch date of the first JPSS satellite will be delayed.

- Capabilities: Neither agency has made final decisions on the full set of sensors—or which satellites will accommodate them—for their respective satellite programs. Until those decisions are made, it will not be possible to determine the capabilities that these satellites will provide and their associated costs.

Timely decisions on cost, schedule, and capabilities would allow both acquisitions to move forward and satellite data users to start planning for any data shortfalls they may experience. Until DOD and NOAA finalize their plans, it is not clear whether the new acquisitions will meet the requirements of both civilian and military users.

Key Transition Risks and Continuing Development Challenges Threaten Satellite Data Continuity

Moving forward, the agencies face key risks in transitioning from NPOESS to their new programs, including loss of key staff and capabilities, delays in negotiating contract changes and establishing new program offices, failure to support the other agency's requirements, insufficient oversight of new program management, and potential cost growth from contract terminations and other program changes.

- *Loss of key staff and capabilities*: The NPOESS program office is 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 will be critical to moving the program forward both during and after the transition period. However, within the past year, the program office has lost its Program Executive Officer, Deputy Program Executive Officer, and System Program Director—the top three individuals who oversee day-to-day operations. Thus, final critical decisions on work slow downs and priorities will be made by a new Program Executive Officer, who has only overseen the program for a few weeks. In addition, program office staff have already begun leaving—or looking for other employment—due to the uncertainties about the

future of the program office. Unless NOAA and DOD are proactive in retaining these staff, the new program may waste valuable time if staff must relearn program details and may repeat mistakes made and lose lessons learned by prior program staff.

- *Delays in negotiating contract changes and establishing new programs*: According to NOAA officials, the plan for JPSS may require negotiations with contractors and between contractors and their subcontractors. In addition, both NOAA and DOD will need to establish and fully staff program offices to facilitate and manage the transition and new programs. Until decisions are made on how the program is to proceed with contract changes and terminations, the contractors and program office cannot implement the chosen solution, and some decisions, such as how to hold schedule slips to a minimum, could become much more difficult.

- *Failure to support 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. If the agencies cannot find a way to build a partnership that facilitates both efficient and effective decision-making on data continuity needs, the needs of both agencies may not be adequately incorporated into the new programs.

- *Insufficient 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. Because of these issues, we listed NASA's acquisition management as a high-risk area in 1990, and it remains a high-risk area today.[14] 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. They could not provide a time frame for its completion.

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

Without strong NOAA oversight of NASA's management of program components, JPSS may continue to face the same cost, schedule, and contract management challenges as the NPOESS program.

- *Cost growth resulting from contract and program changes*: Because neither acquisition has fully developed plans for their respective programs, it is unclear whether contracts will need to be fully or partially terminated, and what the terminations and other program changes could ultimately cost. We have previously reported that if the government decides to terminate a contract for convenience, it must compensate the contractor—in the form of a termination settlement—for the work it has performed.[15] However, a settlement only addresses the government's obligation under a terminated contract, and there may be additional costs. For example, additional costs could result from awarding a new contract to replace a terminated contract. Until NOAA and DOD make decisions and plans for their programs, the full cost of contract and program changes will be unknown.

NOAA, NASA, and DOD acknowledge that there are risks associated with the transition to new programs, but they have not yet established plans to mitigate these risks.

While NOAA and DOD are developing plans for their new programs, the development of key NPOESS components is continuing. In recent months, the program completed the development of the critical imaging sensor, called the Visible/Infrared Imager/Radiometer Suite (VIIRS), and delivered it to NASA for integration onto the NPP satellite. Four of the five sensors intended for NPP are now on the spacecraft. In addition, the program continues to work on components of the first and second NPOESS satellites, which are to be transferred to NOAA and DOD to become part of their respective follow-on programs. However, the expected launch date of the NPP satellite has been delayed by 9 months (moving the launch date to September 2011 or later), due to technical issues in the development of the NPP sensor

[15]GAO, *Defense Acquisitions: Termination Costs Are Generally Not a Compelling Reason to Continue Programs or Contracts That Otherwise Warrant Ending*, GAO-08-379 (Washington, D.C.: Mar. 14, 2008).

that has not yet been integrated. In addition, the development of the VIIRS sensor for the first NPOESS or JPSS satellite is experiencing significant cost overruns. Further, the program is slowing down and may need to stop work on key components because of potential contract liabilities and funding constraints, but it has not developed a prioritized list on what to stop first.

Until the transition risks are effectively mitigated, and unless selected components are able to continue scheduled development, the launches of NPP and the first NOAA and DOD satellites could be further delayed. Further launch delays are likely to jeopardize the availability and continuity of weather and climate data. For example, the POES satellite currently in the afternoon orbit is expected to reach the end of its lifespan at the end of 2012. If NPP is delayed, there could be a gap in polar satellite observations in the afternoon orbit. Similarly, a delay in the launch of the first JPSS satellite may lead to a gap in satellite data after NPP reaches the end of its lifespan.

Federal Efforts to Ensure the Long-term Provision of Environmental Data from Satellites Are Lacking

For over a decade, the climate community has clamored for an interagency strategy to coordinate agency priorities, budgets, and schedules for environmental satellites over the long term—and the governance structure to implement that strategy. Specifically, in 1999, the National Research Council reported on the need for a comprehensive long-term earth observation strategy and, in 2000, for an effective governance structure that would balance interagency issues and provide authority and accountability for implementing the strategy.[16] The National Research Council and others have repeated these concerns in multiple reports since then, including after the agencies responsible for NPOESS canceled key

[16]National Research Council, Climate Research Committee, *Adequacy of Climate Observing Systems* (Washington, D.C.: 1999); National Research Council, Space Studies Board: Committee on Earth Studies, *Issues in the Integration of Research and Operational Satellite Systems for Climate Research: Part I. Science and Design* (Washington, D.C.: 2000).

climate and space weather sensors from the program in 2006.[17] Similarly, in 1999, the Administrators of NOAA and NASA wrote letters to OSTP noting the need for an interagency strategy and the means to implement it.

While progress has been made in developing near-term interagency plans, this initiative is languishing without a firm completion date, and federal efforts to establish and implement a strategy for the long-term provision of satellite data are insufficient. Specifically, in 2005, the National Science and Technology Council's Committee on Environment and Natural Resources established USGEO to develop an earth observation strategy and coordinate its implementation. Since that time, USGEO assessed current and evolving requirements, evaluated them to determine investment priorities, and drafted the Strategic Assessment Report—a report delineating near-term opportunities and priorities for earth observation from both space and ground. According to agency officials, this report is the first in a planned series, and it was approved by OSTP and multiple federal agencies in May 2009. However, OSTP has not yet forwarded the draft to the Committee on Environment and Natural Resources and the President's National Science and Technology Council because it is reconsidering whether to revise or move forward with the plan. USGEO officials could not provide a schedule for completing this near-term interagency plan.

This draft report is an important first step in developing a national strategy for earth observations, but it is not sufficient to ensure the long-term provision of data vital to understanding the climate. The draft report integrates different agencies' requirements and proposes continuing or improving earth observations in 17 separate

[17]For example, see: National Research Council, Committee on a Strategy to Mitigate the Impact of Sensor Descopes and Demanifests on the NPOESS and GOES-R Spacecraft, *Ensuring the Climate Record from the NPOESS and GOES-R Spacecraft: Elements of a Strategy to Recover Measurement Capabilities Lost in Program Restructuring*, (Washington, D.C.: 2008); National Research Council, Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (Washington, D.C.: 2007); Center for Strategic and International Studies (Wigbels, Lyn et.al.), *Earth Observations and Global Change: Why? Where Are We? What Next?: A Report of CSIS Space Initiatives* (Washington, D.C.: July 2008).

areas, using both satellite and land-based measuring systems. However, the report does not include costs, schedules, or plans for the long-term provision of satellite data. While the report does note the importance of continuing certain near-term plans for sensors, it does not make recommendations for what to do over the long term.

In addition, the federal government lacks a clear process for implementing an interagency strategy. Key offices within the Executive Office of the President with responsibilities for environmental observations, including OSTP and the Council for Environmental Quality, have not established processes or time frames for implementing an interagency strategy—including steps for working with OMB to ensure that agencies' annual budgets are aligned with the interagency strategy. As a result, even if an interagency strategy was finalized, it is not clear how OSTP and OMB would ensure that the responsibilities identified in the interagency strategy are consistent with agency plans and are funded within agency budgets.

Until an interagency strategy for earth observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and the continuity of key measurements may be jeopardized. This will hinder our nation's ability to understand long-term climate changes.

Federal Agencies Lack a Strategy for the Long-term Provision of Space Weather Data

While key federal agencies have taken steps to plan for continued space weather observations in the near term, they lack a strategy for the long-term provision of space weather data. Similar to maintaining satellite-provided climate observations, maintaining space weather observations over the long term is important. The National Space Weather Program, the interagency coordinating body for the United States space weather community, has repeatedly recommended taking action to sustain the space weather observation infrastructure on a long-term basis.

Agencies participating in the National Space Weather Program have taken short-term actions that may help alleviate near-term gaps in

space weather observations, but OSTP has not approved or released two reports that are expected to establish plans for obtaining space weather observations over the long term. Specifically, NOAA and DOD are seeking to replace key experimental space-observing satellites.[18] Further, the National Space Weather Program recently developed two reports at the request of OSTP documenting specific recommendations for the future of space weather, one on what to do about a critical NASA space weather satellite, called the Advanced Composition Explorer, and the other on the replacement of the space weather capabilities removed from the NPOESS program. The program submitted the reports in October and November of 2009, respectively. However, OSTP officials do not have a schedule for approving or releasing the reports.

While the agencies' short-term actions and the pending reports hold promise, federal agencies do not currently have a comprehensive interagency strategy for the long-term provision of space weather data. Until OSTP releases the reports, it will not be clear whether they provide a clear strategy to ensure the long-term provision of space weather data—or whether the current efforts are simply ad hoc attempts to ensure short-term data continuity. Without a comprehensive long-term strategy for the provision of space weather data, agencies may make ad hoc decisions to ensure continuity in the near term and risk making inefficient decisions on key investments.

Implementation of Recommendations Could Help Ensure Near- and Long-Term Satellite Continuity

In the report being released today, we are making recommendations to ensure that the transition from NPOESS to its successor

[18]NOAA has requested funding in fiscal year 2011 to refurbish NASA's Deep Space Climate Observatory spacecraft to replace the experimental Advanced Composition Explorer spacecraft and has requested funding to replace its Constellation Observing System for Meteorology, Ionosphere, and Climate. DOD has begun efforts to develop a replacement for its experimental Communication/Navigation Outage Forecasting System satellite, which is designed to sense space weather that affects how the Global Positioning System, high frequency radio, and other communications devices work in low latitude areas.

programs is efficiently and effectively managed.[19] Among other things, we are recommending 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; direct their respective NPOESS follow-on programs to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up new program offices, loss of support for the other agency's requirements, and oversight of new program management; and direct the NPOESS program office to develop priorities for work slowdown and stoppage to allow the activities that are most important to maintaining launch schedules to continue.

In written comments on the NPOESS report, both NOAA and DOD agreed with our recommendations and identified plans to implement them. In addition, NASA made comments on two of our findings. For example, NASA commented on our finding that NOAA would need to provide enhanced oversight of NASA's management of the JPSS program. NASA officials asserted that the proper basis for comparison should not be their leading-edge research missions, but, instead, should be their operational environmental satellite programs. However, the JPSS program does include leading-edge sensor technologies, and the complexity of these sensor technologies has been a key reason for the cost growth and schedule delays experienced to date on the NPOESS program. Thus, it will be important for both NOAA and NASA to ensure that the subcontractors are adequately managed so that technical, cost, and schedule issues are minimized or mitigated. The full text of the three agencies' comments and our evaluation of those comments are provided in the accompanying report.

In the report issued in April, we made recommendations to improve long-term planning for environmental satellites.[20] Specifically, we recommended that the Assistant to the President for Science and Technology, in collaboration with key Executive Office of the

[19]GAO-10-558.

[20]GAO-10-456.

President entities (including the Office of Science and Technology Policy, the Office of Management and Budget, the Council on Environmental Quality, and the National Science and Technology Council) establish a deadline to complete and release three key reports on environmental observations. We also recommended that the Assistant to the President direct USGEO to establish an interagency strategy to address the long-term provision of environmental observations from satellites that includes costs and schedules for the satellites, as well as a plan for the relevant agencies' future budgets, and establish an ongoing process, with timelines, for obtaining approval of the interagency strategy and aligning it with agency plans and annual budgets.

When asked to comment on our report, the Executive Office of the President did not agree or disagree with our recommendations; however, officials noted that OSTP is currently revising USGEO's Strategic Assessment Report to update information on launch schedules and on the availability of certain measurements that have changed since completion of the report a year ago. In crafting this strategy, it will be important for OSTP to address long-term interagency needs and to work with OMB to ensure that the long-term plans are aligned with individual agencies' plans and budgets. If the plan does not include these elements, individual agencies will continue to address only their most pressing priorities, other agencies' needs may be ignored, and the government may lose the ability to effectively and efficiently address its earth observation needs.

In summary, at the end of this fiscal year, the federal government will have spent 16 years and almost $6 billion to combine two legacy satellite programs into one, yet will not have launched a single satellite. Faced with expected cost growth exceeding $8 billion, schedule delays of over 5 years, and continuing tri-agency management challenges, a task force led by the President's Office of Science and Technology Policy decided to disband NPOESS so that NOAA and DOD could pursue separate satellite acquisitions. While

the two agencies are scrambling to develop plans for their respective programs, it is not yet clear what the programs will deliver, when, and at what cost, but it is very likely that they will cost more than the existing NPOESS baseline and recent program office estimates. Timely decisions on cost, schedule, and capabilities are needed to allow both acquisitions to move forward. In addition, the agencies face a number of transition risks, but neither agency has developed plans to mitigate these risks. Meanwhile, the NPOESS program is continuing to develop components of the NPP satellite and components of the first two satellites. However, program officials reported that they have slowed all development work, and may need to stop work on these deliverables. Slowing or stopping work could further delay the satellites' launches, but the program has not developed a prioritized list of what to stop first to mitigate impacts on satellite launches. Until it does so, there may be an increased risk of gaps in satellite data.

Although initial steps have been taken to ensure the short-term continuity of key climate and space weather measurements from satellites, the federal government has not taken the necessary steps to ensure the long-term sustainment of these critical measurements. For example, NOAA recently removed sensors from JPSS that were originally planned for the NPOESS satellites in the afternoon orbit, but it is unclear how this will affect other agencies and programs. Until an interagency strategy for earth observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and the continuity of key measurements may be lost. This will hinder our nation's ability to understand long-term climate changes and risk our ability to measure, predict, and mitigate the effects of space weather.

GAO Contact and Staff Acknowledgments

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BIOGRAPHY FOR DAVID A. POWNER

David A. Powner

Experience
Twenty years' experience in information technology issues in both public and private sectors.

Education
Business Administration
University of Denver

Senior Executive Fellows Program
Harvard University
John F. Kennedy School of Government

Director, IT Management Issues
U.S. Government Accountability Office

Dave is currently responsible for a large segment of GAO's information technology (IT) work, including systems development, IT investment management, and cyber critical infrastructure protection reviews.

In the private sector, Dave has held several executive-level positions in the telecommunications industry, including overseeing IT and financial internal audits, and software development associated with digital subscriber lines (DSL).

At GAO, Dave has led teams reviewing major IT modernization efforts at Cheyenne Mountain Air Force Station, the National Weather Service, the Federal Aviation Administration, and the Internal Revenue Service. These reviews covered many information technology areas including software development maturity information security, and enterprise architecture.

Chairman MILLER. Thank you, Mr. Powner.

Mr. Broun is recognized for a unanimous consent request.

Mr. BROUN. Thank you, Chairman. I ask unanimous consent that Mr. Rohrabacher, who is a member of the full committee but not this subcommittee, be allowed to participate as if he is a member.

Chairman MILLER. I will wait longer than I usually would for an objection to that.

All right. Without objection, that is so granted.

Mr. BROUN. Mr. Chairman, if I could yield for 30 seconds, I would like to thank Mr. Powner for y'all's hard work, and I particularly want to thank you for your yearly reports and all that you have done for this committee. Without your hard work and participation it would be very difficult for us to do our job. So thank you very much.

I yield back, Mr. Chairman.

Chairman MILLER. All right. We now need to go vote. You all are at ease. We will be back.

[Recess.]

Chairman MILLER. I will recognize myself now for five minutes of questions.

I know this isn't fair, and it is a lot more complicated than this, that DOD had different needs from NOAA, but the solution of having NOAA have one satellite with the afternoon orbit and DOD having its own satellite for the morning orbit felt a little like a kindergarten teacher sending one child to—two children to different corners because they can't stop arguing.

And we do need you all to get along. The DOD needs to get data from NOAA, NOAA needs to get the data from DOD, and we need to make sure that you all play nice in the future.

Mr. Klinger, what plans does DOD have to work with NOAA to make sure they get the data that they need and to make sure that you get the data from NOAA that they have that you need?

Mr. KLINGER. Mr. Chairman, I think it's not just the plans that we have. We actually have ongoing interaction right now with both NOAA and NASA. Start with one point. We are going to continue the relationship we have had that I mentioned in my opening statement with respect to ground operations. The ground system and the on-orbit operations, the Defense Department will be dependent, just as it has been, on NOAA for the ground system and for the operations, day-to-day operations as we are with our current generation, the Defense Meteorological Satellite Program.

But, looking forward, one of the reasons we are moving very deliberately within the Defense Department is to ensure that we do not take an action unilaterally that inadvertently places any of NOAA or NASA's equities, and specifically the NPP program, in a disadvantaged position. So everything that we are doing with respect to the Defense Weather Satellite System is measured and assessed not just through the lenses that we would normally use on a DOD-only satellite system, which would be defense and/or intelligence equities—but, in fact, we thoroughly ensure first within the Department that we are not going to do something that has — disadvantages one of our civil partners, whether that's in terms of thinking through what we want to do in the morning orbit—but absolutely with respect to what changes we end up making, if any, to the existing contract.

So, we—and NOAA and NASA, in my view—are inextricably tied together in terms of how we move forward, though—as you pointed out—there will be separate spacecraft programs provisioning the morning and afternoon orbits.

Chairman MILLER. Okay. Ms. Glackin, how about NOAA's plans to play nice?

Ms. GLACKIN. We are very comfortable with the arrangement we are moving into. We have literally, again, decades worth of history in cooperating with the Department of Defense and sharing meteorological data. We work closely with the Air Force. I personally established a working relationship with General Sheridan, who is the director of satellite and missile command out in California that will have oversight of Defense Weather Satellite System, and we have been talking back and forth, as has Mary Kicza, my director of our satellite line office.

So I think that we have this experience doing this, we have a lot of commonality among our users for sharing of data there. We work

closely through the Office of Federal Coordinator for Meteorology as a central focus for coordinating requirements and things like this.

So I am quite comfortable moving forward.

Chairman MILLER. Dr. Abbott, does OSTP plan to play a continuing role in assuring the necessary cooperation, information sharing, *et cetera*, between DOD and NOAA?

Ms. ABBOTT. Yes, we do, because it is of great interest to Dr. Holdren and myself to see this decision through to an end point.

And I would add that, all along, from the beginning of the taskforce's operations until reaching a decision, the communication and coordination across the agencies has been extraordinarily good. We've had a lot of difficult moments in which we have had to deal with some issues that were hard to decide, but in fact, the cooperation has been quite good, and we have been able to negotiate through a lot of challenging moments. And I think, at the end of the day, we've got a program going forward that is consistent with the visions of the agencies and their particular programs, and it makes some sense for the nation.

Chairman MILLER. My time has expired. I now recognize myself for a second round of questions.

Mr. Powner, you—in your testimony in the GAO reports you said that there are still challenges and uncertainties in a polar satellite program. What is your take on the importance of agency cooperation and what must be done to address any issues there effectively?

Mr. POWNER. Well, just to reiterate, touching base on some of the points that were made, I agree with Ms. Glackin that there is decades of experience, but if you look at the NPOESS program, that was not a model for interagency coordination. So it's great that we are—Mr. Klinger is making comments that we are going to work together. I think the key thing moving forward is, if you look at the first satellites that are planned, the NOAA satellite, JPSS, is almost identical to NPP. I mean, that is the plan, and when you look at the initial plan for DOD, you clearly see their requirements when you look at the microwave sensing capabilities, the SEM instrument that Mr. Klinger mentioned.

I think it will be very important as they go forward with the four satellites that there's a sharing of the sensors that will be included so that the different agencies' requirements are considered. That was clearly one of the transition risks that we mentioned in our report, that taking into consideration the other agencies' requirements is still vital moving forward.

Chairman MILLER. Okay. Mr. Powner, you testified that we still do not have a comprehensive plan, strategy for climate observation. What is—who is your—who is it that you think should be in charge of developing that comprehensive policy, that comprehensive plan? How should we go forward and make sure that we correct that deficiency?

Mr. POWNER. Well, I think there's been some initial steps through the Office of Science and Technology Policy. There is an interagency working group, and they've put together some initial plans that lay out the climate observations that we need to ensure that there is continuity. I think there is 17 key observations that they are focused on, and the key going forward is that OSTP con-

tinues to exercise that leadership role so that we have the appropriate interagency coordination for continuity of all those key climate observations.

Chairman MILLER. Okay. Ms. Abbott, you, of course, heard the testimony earlier and know the GAO's view on this. What role does OSTP plan to play in making sure there is a comprehensive plan for climate observation?

Ms. ABBOTT. So, as I said in my testimony, what—now that the NPOESS decision is behind us, we actually are going to focus attention on the follow-on to that U.S. Group on Earth Observations report, and to try to turn some of those considerations of the 17 priority areas into real priorities, aligned with budgets, aligned with agency cooperation and coordination and developing a strategy from that.

Chairman MILLER. We will take just a two-minute recess. I think there are members who are planning to come back—or there were, and I think we are going to—we need to check on their status. If not, we will be done, but we will be in recess for a couple minutes. And you all can talk among yourselves.

[Recess.]

Chairman MILLER. I understand Mr. Bilbray is on his way, but I will now recognize myself for a third round of questions until he gets here.

And these are questions, I think, that Mrs. Dahlkemper had intended to pursue had the hearing today not been disrupted.

Undoubtedly the reason that there are so many well-behaved people in the room today is that there are still a lot of unresolved questions about contractors, and certainly Northrop Grumman has been waiting with bated breath for the resolution of some of these issues and perhaps others as well.

GAO has criticized the program as not having made the transition decisions necessary. What is now—what role do you see for Northrop Grumman in the now two new programs, now two programs, and what can be done to expedite any decisions made with respect to Grumman?

Ms. Glackin.

Ms. GLACKIN. Well, I think that what I would comment on is NOAA and Department of Defense, I believe, are both very interested in leveraging the expertise and experience and investments that the government has with Northrop Grumman; however, we have made no final decisions in going forward at this point.

Chairman MILLER. Mr. Klinger.

Mr. KLINGER. I would echo what Ms. Glackin said. As I mentioned in my opening statement one of the things that is a priority to us within the Department and also to our civil—our agency counterparts and partners is to maximize the degree to which we can take advantage of the investment that we made in NPOESS, and that at the first order includes the expertise that Northrop Grumman as the prime has gained.

In general at the moment I would just offer the following that the contract right now is under the purview of the Air Force and its contracting officer. We're still working through what the specific changes that will attend the restructuring will have and that may or may not require some renegotiation and changes to the contract.

I don't think, as a result, it is appropriate for me, nor are we really ready at this point to provide those details.

There is no question that, as the Air Force sorts through that in the run-up to the deadline of August 10, the Air Force will prepare and update the acquisition strategy, including the specific contract issues, and those will be submitted through our office to the Under Secretary, Dr. Carter, and then that will become clear.

Chairman MILLER. Okay. Mr. Powner, any observations on the need to—or how to expedite issues with contractors? To resolve those.

Mr. POWNER. Well, clearly, I think a key decision moving forward will be the size of the bus and the, you know, clearly with JPSS–1 they decided to go with an NPP-like bus, but the size of the bus will drive decisions. That will be a key driver going forward in terms of the amount of contract leverage Ms. Glackin mentioned.

Chairman MILLER. Okay. Despite the fact I have two minutes left on my questioning, I will now yield back to myself the balance of my time and now recognize Mr. Bilbray for five minutes.

Mr. BILBRAY. Thank you, Mr. Chairman.

Let me sort of follow up and ask for sort of a clarification on something that is near and dear to a lot of us that spend a lot of time out in the water. You know, thousands of Americans both in the military and civilian depend on the EPIRB locating devices, the Emergency Satellite Communication Systems. And there is an assumption out there that if a mariner, if an aircraft goes down and that EPIRB goes off, that the authorities will be there in a very short period. We will know you are in trouble, know where you are, or whatever.

What has happened with the search and rescue satellite-aided tracking system, and what is going to be the impact to the consumer on this?

Ms. GLACKIN. I would be happy to take that one. I certainly agree with you, sir. Search and rescue capabilities that our satellites provide are really a tremendous benefit to society and in particular to mariners and aviators.

This type of instrument we have flown or some period of time. It turns out to be a highly reliable instrument, and for the most part lasts long after the life of other instruments on a spacecraft. So today, for example, in the afternoon orbit we have three of these that are currently running and operational.

With our decision to go with an NPP-like clone for the JPSS–1, that particular instrument won't fit on that bus. However, we are still searching, and we will be looking at whether we, in fact, need to fly it because of the redundancy up there and on what platform we will fly that in that timeframe.

So that remains an open question now, but you should not doubt our commitment to ensuring the continuity of that capability.

Mr. BILBRAY. Well, you know, I really worry about seeing that get bumped on this technology because, you know, we have got an F–18 go down, the system is being depended on for pilots, we require it on American Flag votes, we really encourage civilian mariners to carry this, and this assumption that somehow the United States will keep this umbrella protection, I have the experience just last year of losing, being dismasted off of Nicaragua with my

family. There was the assumption there that if we really, really needed something, we could flip that switch and within a matter of hours people would know where we were and we were in trouble.

My biggest concern is what is the lag time now and should we be telling our consumers now that, look, maybe you want to go to the spot system, maybe you want to invest in a private alternative because the Federal Government's facility is not going to have the coverage or the capability that we said it was going to have within the next couple of years.

Ms. GLACKIN. Congressman Bilbray, I would like to assure you we will have that capability there. We are committed to providing that, it was part of the JPSS suite, so as we make decisions going forward on exactly what—how we will fly that instrument, we will certainly keep this committee and you informed about that.

Mr. BILBRAY. Now, by the—without the polar sensors which are really the locators, I mean, our stationaries can tell us that somebody is in trouble, but trying to figure out where they are precisely is absolutely essential on this. How do we make that assurance if we are not going to have that as part of our polar system?

Ms. GLACKIN. It will be included in the JPSS system. It is just not going to fly on the first bus that we have announced. So we have more decisions to make, and we will be making them in the months ahead about how to fly the one climate instrument that isn't flying called TSIS, the Total Solar Irradiance, as well as search and rescue, and there is a third set of instruments known as user services, data collection capability.

So all three of those announcements are yet to come.

Mr. BILBRAY. That is based on the assumption that there is a budget for this?

Ms. GLACKIN. That is correct, and there is. The President's fiscal year '11 budget includes all of the resources for that.

Mr. BILBRAY. Do we have—that is a proposed budget?

Ms. GLACKIN. It is a proposed budget. Yes.

Mr. BILBRAY. So, you know, we are still in this thing, and I hope that we all remember we are still operating with a proposed budget from the Executive Branch, so all of this is still up in the air.

Ms. GLACKIN. Absolutely.

Mr. BILBRAY. And so we have got to make sure we condition that if we can get this thing approved, if we can go down there, you are showing us.

Let me go back to this total solar, you know, sensor issue. It almost appears to somebody who would be a skeptic that why would the Federal Government be backing off on this sensor when we are talking about the potential climate change, whatever, because I think we all agree the greatest skepticism is coming from those who are saying that the impact of the solar flares and the solar impact on the temperatures is grossly underestimated by models or operating off that.

To retreat from having those sensors would almost leave some of my colleagues, including my surfing buddy to the right here, to claim that there might be some cynical or conspiracy to make sure those—that data is not collected because it may show that the modeling have grossly underestimated the effect of solar radiation. What would you say to my colleague about that kind of perception?

Ms. GLACKIN. I would like to assure you and the committee that we have not backed off from flying the sensor. We will fly the sensor in this timeframe. The announcement that we made to fly an NPP-like bus, which is a smaller bus, is driven by our need to avoid a gap in this afternoon orbit. It represents the lowest technical and schedule solution for us.

So we are still working on our exact plans for flying these three sensors that do not fit on that bus, but you should not doubt our commitment to ensuring those will be flown.

Mr. BILBRAY. Now, look. I am going to be very frank with you. The American people watch what is going on in Washington and what is going on with the Federal Government. There are a lot of people making a lot for promises that affect average Americans' personal lives; their health, their lifestyle, their prosperity, and a lot people in this city are telling the American people trust us. We can get this done. Trust us. We can do the job properly.

When we see, when the American people see the handling of this proposal where you have got, you know, multiple jurisdictions and what looks like an absolute shamble of a strategy and implementation, I mean, you understand why people really do get concerned when Washington extends its footprint, say we are going to manage personal lives of people better, and don't worry about it, and they sit there and say, look, you know. You have got groups like the Federal Government who for a decade has been trying to do electronic medical records and are no closer now than they were ten years ago. Or the fact that we are talking about our satellites, and look what you guys did with that. You expect me to trust you with my family's future?

How do we tell the American people that, look, we can learn from our mistakes, and we can move forward? How can we say that—don't use this as an example of how the Federal Government screws up. What can I tell my constituents out of this experience?

Ms. GLACKIN. Yeah. I think the restructure of the NPOESS program does three things for us. One is it really clarifies the acquisition responsibilities. Number two, it allowed us to propose a budget to the Congress that we think is adequate to cover what is here, and the third is it allows us to align with a proven acquisition center that can bring the government expertise to bear for the oversight of this.

As part of that last part of it, I would like to highlight to this committee that NOAA and NASA will use independent review teams, so over and above what GAO might do on this program, we will use independent review teams to review our plans, assess our progress. We have been doing that with the GOES–R program, we will be doing that with the JPSS as we move forward.

So we are not just allowing it to ourselves and our own oversight, but we are seeking independent review as well.

Mr. BILBRAY. Thank you.

Chairman MILLER. Mr. Rohrabacher is recognized for five minutes.

Mr. ROHRABACHER. I would like to thank my colleague for asking the questions in my name, of course. First of all, Mr. Chairman, thank you very much for holding this very significant hearing, and

I think the witnesses have given us a lot to think about, and I appreciate the high caliber of witnesses that we have.

I notice it said that we have gone from—NPOESS has gone from $7 billion in 2002, to $15 billion. Think what could we have done with all of that extra money that Brian was talking about, and I guess we could have given it to Goldman Sachs coalitions and things like that.

So there has been a lot of money wasted here in Washington, DC. A lot of money over the last couple years, and I would hope that this was—let me put it this way. This was a try. They were trying to accomplish something, and they did not succeed in accomplishing what they set out to do. And I think that is less of a waste than some of the money that we spent in the last 18 months in the name of stimulus that has gone into the pockets of wheeler dealers on Wall Street, et cetera, et cetera.

But back to this. Of—when we are talking about why this failed or how we couldn't reach the goal that we had in mind, one of those things—is one of those goals the technology we needed to make the climate determinations? There is a difference between climate and weather, and the technology for this project between determining what weather is going to be and the whole idea of climate research, was the technology needed for this climate research, which I consider to be a very, very questionable, goal in the first place, was that part of the failure that we have here?

Mr. SCOLESE. No, sir. I don't think it was because there is a mission flying today that we launched several years ago called *Aqua* that is flying sensors that are—that were, if you will, the predecessors of the sensors that were selected for NPOESS, and they are doing climate and weather measurements, although it is a research mission, so it is not tied into the operational stream.

So the technology and the—for accomplishing what NPOESS was going to do has been demonstrated. It is flying. One of those centers has been flying for over ten years now.

Mr. ROHRABACHER. But it was—so we—it would not be accurate to say that climate change, which some of us believe is not manmade and thus we believe frankly it is a phony issue, but that commitment to studying that and the technology needed to do that study was not part of the reason why we went from 7 to 15 billion and have not been able to accomplish the mission?

Mr. SCOLESE. I would not say that the technology was. No.

Mr. ROHRABACHER. Okay. Does anyone else have a comment on that? Okay.

And what—how much was this? Okay. So what do we say is the cause that—of this debacle? Do we say it was—was there, in fact, technology that we couldn't develop? Did we have a problem with procurement problems here? Was it the launch systems that we know there was some problem here with which launch systems were going to be able to do this. Or is this just a lack of—in the beginning it sounds like we just—we had too much confidence that various bureaucracies could work together.

So what was the main driver of this debacle?

Ms. GLACKIN. I will take a cut at that and invite my colleagues to chime in here, but I think as this Committee heard last year

when they did a hearing on this and heard from Tom Young, the independent review team chair, he highlighted several things.

One is the overall management structure and the—because of the agencies' missions, responsibilities, their postures and all, the difficulty in being able to provide adequate oversight. He also highlighted to this committee that we were developing this satellite system in a way that neither NOAA, NASA, or DOD would develop one on their own, and that, in fact, meant that we weren't using a proven government acquisition center. So we weren't availing ourselves of talent that we had within the Federal Government to provide——

Mr. ROHRABACHER. But the bureaucracy wasn't right. I mean, it wasn't because it hadn't done this type of thing before, and it wasn't—but it wasn't the technology.

But we have—didn't I hear Mr. Powner suggest that we are still—there is still some technological risk at play right now?

Mr. POWNER. Yeah. Mr. Rohrabacher, there is one sensor—that is, VIIRS—which has caused some problems with some of the overruns that you mentioned and with JPSS–1, the first NOAA satellite. That's still not out of the woods.

But I would directly answer your question and say that every level was at fault with NPOESS. There was issues with executive level oversight, with the tri-agency overseeing it. There were issues with program management, managing the program, and there were issues with contractor and subcontractor oversight and performance.

So there was—almost every layer you look at there were issues when you looked back over the years with what went wrong.

Mr. ROHRABACHER. We wish all of you success in trying to put this back together again so that that $15 billion that has been invested by the taxpayers aren't just—doesn't just go to waste. So if we can—so thank you very much for focusing on this and being very frank with us today, and we will be following this project and hopefully get it done so that we can get—we can salvage something out of this effort that is of value to the American people.

Thank you very much, Mr. Chairman.

Chairman MILLER. I understand Mrs. Dahlkemper is on her way, but—no, she is not. Okay. My new information, she will not be here.

I now recognize myself for one more round of questions.

Mr. Powner, you mentioned the VIIRS sensor as being the one that was most difficult. Is that for climate research, or is that for weather forecasting?

Mr. POWNER. I think when you look at VIIRS, it is probably a combination of a number of things, and clearly VIIRS is on NPP, the demonstration satellite that is going up, but it is also being built for the first NOAA satellite, and in our report being released today, we do mention that that satellite right now is viewed as high risk for that first NOAA satellite.

Chairman MILLER. Ms. Glackin, what will be the effect of a continuing resolution on funding for the 2011 budget year, and will that affect a launch date for the two new programs?

Ms. GLACKIN. The President's fiscal year 2011 budget is critical for us being able to move forward with the JPSS program. So in

the event of a continuing resolution I believe we would work through the Administration with Congress to see what our options are, to be able to move forward here. We are quite sensitive to the fact that this is proposed as a new program in the 2011 budget, and Congress hasn't made a determination on that yet. So we have been working with both this committee and our appropriations staffs as well in that regard.

Chairman MILLER. Okay. Mr. Klinger, same questions.

Mr. KLINGER. I would just echo what Ms. Glackin said, which is that it is imperative that we get those funds to begin the DWSS program so we will be doing essentially mirroring what NOAA does in the event of a continuing resolution, which is to work through the Administration and secure the release and funds that are appropriate.

Chairman MILLER. I like the two of you agreeing with each other. That is—all right.

Ms. Abbott, do we have a comprehensive catalog of our existing assets for earth observations, and do you have an understanding of the set of observations that need still be obtained?

Ms. ABBOTT. The USGEO report that I mentioned before that Mr. Powner spoke of in their report noted is the first step in developing such a catalog. The agencies got together and identified the seven—through looking through the lens of environmental policy requirements, what are the major observations that are needed to address those policy issues?

And so we have what is close to a catalog of needs. What we don't have is the articulation of that catalog against a set of priorities and budgets. And that is the next step.

Chairman MILLER. Mr. Scolese, I understand that the new JPSS program will be run out of the Goddard Space Flight Center. How many positions, both NASA and contractor staff, do you expect to manage this acquisition, this new program, and how will those staffing levels compare to the NPOESS integrated program office, which was projected to have about 170 staff?

Mr. SCOLESE. Well, let me take it backwards if you might. One of the reasons that Tom Young suggested that the program be put at an acquisition center isn't because of the number of people that are on the project but because of the number of people that can support the project. At Goddard or at the Air Force's SMC, we are procuring or building lots of satellites and lots of sensors and all of that technical capability with our engineering directorates and safety and mission assurance directorates and science organizations (in the case of Goddard) come to bear, to help that organization go off and achieve its goals. By having the ability to look across many projects that are—some ahead of where you are at, some behind where you are at, some using the same contractors—you can identify issues that an individual project that is isolated—as the IPO was—wouldn't see.

So the fact that it is at the Goddard Space Flight Center is probably the most critical element of the program because you bring all those resources to bear, to help the project succeed.

As far as the size of the project, it would be about the size of the IPO, about 100 or so, civil servants and contractors working it, and the staffing is going to come from very experienced people as I

mentioned in my opening statement. We are bringing some of the best people from our projects. The lead of it will be the very successful leader of the *Hubble* servicing missions. We are bringing in as their deputy the person who did the *Solar Dynamics Observatory,* who has built a number of satellites, and we will be bringing in people of that caliber—or have already brought people of that caliber—from NASA and NOAA and the IPO in to go off and manage this program and oversee it.

Chairman MILLER. I now recognize Dr. Broun for five minutes of questions.

Mr. BROUN. Thank you, Mr. Chairman. I think Mr. Bilbray had a question. Is that correct? I would yield to him. Mr. Bilbray.

Mr. BILBRAY. With the Chairman's permission.

Question about the sensors. Are we including maintaining capability to be able to detect ozone and suspended particulates?

Ms. GLACKIN. Yes, we are. We have the OMPS sensor, both the Nadir and the Limb, as part of JPSS–1.

Mr. BILBRAY. Okay. Mr. Chairman, just for the record, I know people on this Committee have chuckled about the whole concept, but I think that we really got to understand how important this aspect is of the suspended particulates and its affects and the ozone issue, because there have been legitimate concerns raised about people considering is global warming a factor we need to consider or not, and the argument has gone back and forth.

But just to articulate how important this could be, if global warming is a significant issue as some have said, we have to totally reverse our policies on implementation of climate change legislation because rather than looking at things like coal, which should be the first operations, I know that makes—first operation shut down. There may be a whole argument to reverse that decision and have it as the last CO emissions shut down because there may be major short-term benefits there that helps, would help to mitigate.

I just want to make sure the good science on this is out there, and this sensing could be a critical component. I just hope we keep our minds open as we develop these strategies. My biggest concern I seen as too many people are making assumptions based on 1970, concepts when there is a whole lot of new data and technology out there, and this data may be critical at getting those of us in Washington to rethink our entire implementation strategy and actually reversing our implementation strategies based on new data.

So I am glad to hear that. I think it is critical. It will at least answer some questions and make sure, reassure us that our assumptions may be, may continue to be followed up rather than have them be reversed, and I will yield back to the gentleman.

Mr. BROUN. I thank the gentleman.

Mr. Chairman, I have got some written questions that I will submit for written responses if I could get you all to do that, and so I will just ask one question orally today, and it is of Ms. Abbott.

OSTP has stated that this is a restructuring and not a cancellation. How do you believe this affects the Nunn-McCurdy law which says that 15 percent over budget Congress has to be notified, 25 percent it has to be reauthorized. So how do you think this affects the Nunn-McCurdy law?

Ms. ABBOTT. I am not an expert on the Nunn-McCurdy law, but I think that the restructuring that we have proposed is not over those limits, and I think that the—as we move forward with the DOD portion of this program we'll have a better sense of how—what the costs are going forward.

Mr. BROUN. If it does go over, is Congress going to be informed about this——

Ms. ABBOTT. Yes.

Mr. BROUN. —and will you divide the programs or what is your plan regarding that?

Mr. KLINGER. Dr. Broun, if I may, since Nunn-McCurdy is focused mainly on DOD acquisition, perhaps I can elaborate a little bit on this.

Mr. BROUN. Mr. Klinger.

Mr. KLINGER. Yes. Yes, sir. From our calculus right now, the restructuring does not constitute a breach under the Nunn-McCurdy statute, nor would, although our estimates are not final with respect to the funding profile associated with the Defense Weather Satellite System, we are working within the funds that we had previously planned to use for our share of NPOESS. So we believe that the DWSS as it moves forward would not cross any of the Nunn-McCurdy breach thresholds. But if for some reason there were a breach, by definition we would do the necessary reporting and subsequent work for recertification.

Mr. BROUN. Does this mark a rebaseline?

Mr. KLINGER. There will be a new acquisition strategy for the DWSS, and there will be a new acquisition program baseline that the Air Force will bring forward to OSD as we—as part of the definition of the new program. Or of the restructured DWSS.

Mr. BROUN. I look forward to hearing back from you guys what is going to go on with that, too.

Mr. KLINGER. Yes, sir. We will be happy to do that.

Mr. BROUN. Mr. Chairman, I yield back.

Chairman MILLER. Thank you, Dr. Broun. That ends the questioning of the hearing. Dr. Broun has already said that he has questions he will submit in writing. I may as well. Other members may.

Before we bring this hearing to a close, I want to thank our witnesses for testifying before our subcommittee today. Under the rules of the committee, the record will remain open for two weeks for additional statements from members and for answers to any follow-up questions the subcommittee may have for the witnesses.

The witnesses are excused, and the hearing is now adjourned.

[Whereupon, at 12:10 p.m., the Subcommittee was adjourned.]

Appendix:

Additional Material for the Record

United States Government Accountability Office

GAO

Report to Congressional Committees

May 2010

POLAR-ORBITING ENVIRONMENTAL SATELLITES

Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data

GAO-10-558

GAO
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Highlights

Highlights of GAO-10-558, a report to congressional committees

May 2010

POLAR-ORBITING ENVIRONMENTAL SATELLITES

Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data

Why GAO Did This Study

In the 8 years since a contract was awarded, the National Polar-orbiting Operational Environmental Satellite System (NPOESS)—a tri-agency program managed by the National Oceanic and Atmospheric Administration (NOAA), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA)—has experienced escalating costs, schedule delays, and ineffective interagency management. The launch date for a demonstration satellite has been delayed by over 5 years and the cost estimate for the program has more than doubled—to about $15 billion. In February 2010, a Presidential task force decided to disband NPOESS and, instead, have the agencies undertake separate acquisitions.

GAO was asked to (1) assess efforts to establish separate satellite programs; (2) evaluate the status and risks of the NPOESS components still under development; and (3) evaluate the implications of using the demonstration satellite's data operationally. To do so, GAO analyzed program management and cost data, attended program reviews, and interviewed agency officials.

What GAO Recommends

GAO is making recommendations to NOAA and DOD to address key risks in transitioning to their respective new programs. Both agencies agreed with GAO's recommendations and identified plans for addressing them.

View GAO-10-558 or key components. For more information, contact David A. Powner at (202) 512-9286 or pownerd@gao.gov.

What GAO Found

NOAA and DOD have begun planning to transition the NPOESS program to separate acquisitions, but neither has finalized its plans. NOAA has developed preliminary plans for its new program—called the Joint Polar Satellite Program—to meet the requirements of the afternoon NPOESS orbit. DOD expects to make decisions on the spacecraft and sensors by June and October 2010, respectively. Because neither agency has completed its plans, the impact of the decision to disband the program on expected costs, schedules, and promised capabilities has not been fully determined. Moving forward, the agencies face key risks in transitioning from NPOESS to their separate programs. These risks include 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. Until these risks are effectively mitigated, it is likely that the satellite programs' costs will continue to grow and launch dates will continue to be delayed, which could lead to gaps in the continuity of critical satellite data.

While NOAA and DOD are establishing plans for their separate acquisitions, the development of key components of the NPOESS program is continuing. In recent months, a critical imaging sensor has been completed and integrated onto the spacecraft of a demonstration satellite, called the NPOESS Preparatory Project (NPP). In addition, the program continues to work on components of the first and second NPOESS satellites, which are to be transferred to NOAA and DOD to become part of their respective follow-on programs. However, the expected launch date of the NPP satellite has been delayed by 9 months due to technical issues in the development of a key sensor. Further, the program is slowing down and may need to stop work on key components because of potential contract liabilities and funding constraints, but has not developed a prioritized list on what to stop first. This may further delay NPP and the components of the first NOAA and DOD satellites under their new programs.

Because the NPP demonstration satellite was designed as a risk-reduction mission, not as an operational asset, it has several limitations. These limitations include fewer ground-based data processing systems, fewer security controls, and a shorter satellite lifespan than exist for current or planned operational satellites. These design limitations mean that, in some cases, NPP's data will not be as timely, useful, and secure as other polar satellites and that there is a risk of a gap in the nation's climate and weather services should NPP fail before the next satellite is launched. Agency officials acknowledge these limitations and are assessing options to make NPP data more timely and secure.

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Figures

Abbreviations

CrIS	Cross-track Infrared Sounder
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
JPSS	Joint Polar Satellite System
MetOp	Meteorological Operational (satellite)
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
OMPS	Ozone Mapping and Profiler Suite
OSTP	Office of Science and Technology Policy
POES	Polar-orbiting Operational Environmental Satellites
VIIRS	Visible/Infrared Imager/Radiometer Suite

GAO
Accountability * Integrity * Reliability
United States Government Accountability Office
Washington, DC 20548

May 27, 2010

The Honorable Bart Gordon
Chairman
The Honorable Ralph Hall
Ranking Member
Committee on Science and Technology
House of Representatives

The Honorable Brad Miller
Chairman
The Honorable Paul Broun, Jr.
Ranking Member
Subcommittee on Investigations and Oversight
Committee on Science and Technology
House of Representatives

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) program 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 ability to maintain the continuity of data required for weather forecasting (including severe weather events such as hurricanes) and global climate monitoring through the year 2026.

However, in the 8 years since the NPOESS contract was awarded, the cost estimate has more than doubled—to about $15 billion, launch dates have been delayed by over 5 years, significant functionality has been removed from the program, and the program's tri-agency management structure has been ineffective. Importantly, delays in launching the satellites put the program's mission at risk. To address these challenges, a task force led by the White House's Office of Science and Technology Policy (OSTP) reviewed the management and governance of the NPOESS program. In February 2010, the OSTP Director announced his decision to disband the NPOESS acquisition and, instead, to have NOAA and DOD undertake separate acquisitions, with NOAA responsible for satellites in the afternoon orbit and DOD responsible for satellites in the early-morning orbit. While NOAA and DOD begin the transition to separate acquisitions, the development of key components of the NPOESS program is

continuing—including the development of sensors and ground systems supporting a demonstration satellite called the NPOESS Preparatory Project (NPP).

This report responds to your request that we (1) assess efforts to plan for separate satellite acquisitions, (2) evaluate the status and risks of the key NPOESS components still under development, and (3) evaluate the implications of using the demonstration satellite's data operationally. To assess efforts to plan for separate satellite acquisitions, we reviewed the task force's decision to disband the NPOESS program and NOAA's preliminary plans for a replacement satellite program, and we interviewed OSTP, NOAA, and DOD officials. To evaluate the status and risks of key program components, we reviewed program documentation including status briefings, monthly program management documents, and cost reports. To evaluate plans for and implications of using the demonstration satellite's data operationally, we compared the agencies' plans for using NPP data to the plans for using NPOESS data and interviewed relevant NOAA, NASA, and DOD officials. In addition, this report builds on work we have done on environmental satellites over the last several years.[1]

[1]GAO, *Polar-Orbiting Environmental 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); *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-08-899T (Washington, D.C.: June 19, 2008); *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); *Environmental Satellite Acquisitions: Progress and Challenges*, GAO-07-1099T (Washington, D.C.: July 11, 2007); *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Challenges and Risks Remain*, GAO-07-910T (Washington, D.C.: June 7, 2007); *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain*, GAO-07-498 (Washington, D.C.: Apr. 27, 2007); *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold*, GAO-06-573T (Washington, D.C.: Mar. 30, 2006); *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions*, GAO-06-249T (Washington, D.C.: Nov. 16, 2005); *Polar-orbiting Environmental Satellites: Information on Program Cost and Schedule Changes*, GAO-04-1054 (Washington, D.C.: Sept. 30, 2004); *Polar-orbiting Environmental Satellites: Project Risks Could Affect Weather Data Needed by Civilian and Military Users*, GAO-03-987T (Washington, D.C.: July 15, 2003); and *Polar-orbiting Environmental Satellites: Status, Plans, and Future Data Management Challenges*, GAO-02-684T (Washington, D.C.: July 24, 2002).

We conducted this performance audit from August 2009 to May 2010 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. Additional details on our objectives, scope, and methodology are provided in appendix I.

Background

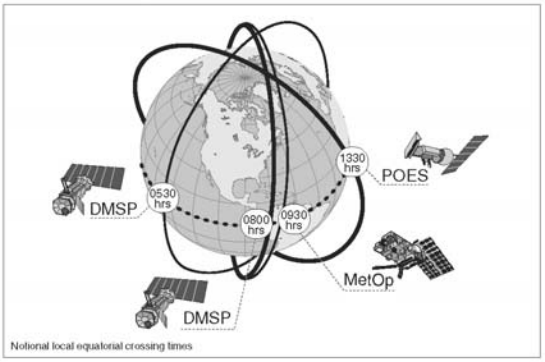
Since the 1960s, the United States has operated two separate operational polar-orbiting meteorological satellite systems: the Polar-orbiting Operational Environmental Satellite (POES) series, which is managed by NOAA, and the Defense Meteorological Satellite Program (DMSP), which is managed by the Air Force.[2] These satellites obtain environmental data that are processed to provide graphical weather images and specialized weather products. These satellite data are also the predominant input to numerical weather prediction models, which are a primary tool for forecasting weather days in advance—including forecasting the path and intensity of hurricanes. The weather products and models are used to predict the potential impact of severe weather so that communities and emergency managers can help prevent and mitigate its effects. Polar satellites also provide data used to monitor environmental phenomena, such as ozone depletion and drought conditions, as well as data sets that are used by researchers for a variety of studies such as climate monitoring.

Unlike geostationary satellites, which maintain a fixed position relative to the earth, polar-orbiting satellites constantly circle the earth in an almost north-south orbit, providing global coverage of conditions that affect the weather and climate. Each satellite makes about 14 orbits a day. As the earth rotates beneath it, each satellite views the entire earth's surface twice a day. Currently, there is one operational POES satellite and two operational DMSP 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 a European satellite, called the

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

Meteorological Operational (MetOp) satellite.[5] Together, they ensure that, for any region of the earth, the data provided to users are generally no more than 6 hours old. Besides the four operational satellites, six older satellites are in orbit that still collect some data and are available to provide limited backup to the operational satellites should they degrade or fail. The last POES satellite was launched in February 2009 and declared operational in early June 2009. The Air Force plans to launch its two remaining DMSP satellites as needed. Figure 1 illustrates the current operational polar satellite configuration.

Figure 1: Configuration of Operational Polar Satellites



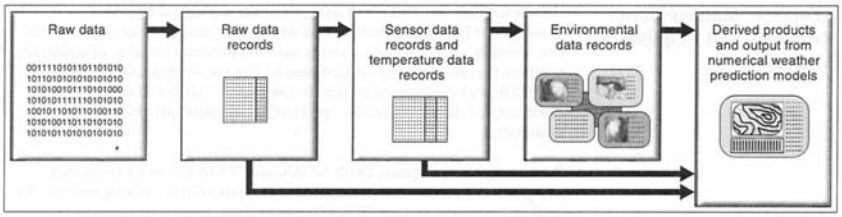
Sources: GAO, based on NPOESS Integrated Program Office and DOD data, MapArt (globe).

[5]The European Organisation for the Exploitation of Meteorological Satellite's 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.

Polar Satellite Data and Products

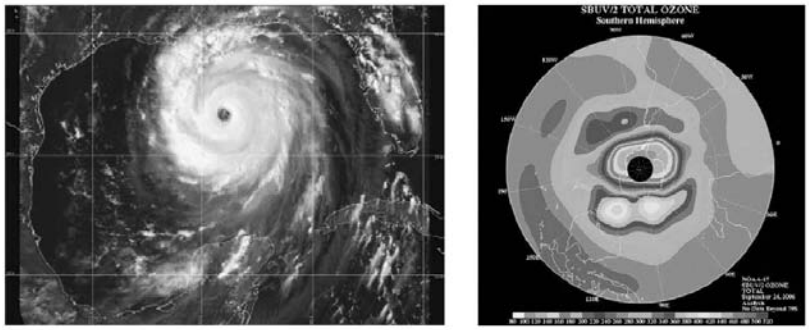
Polar satellites gather a broad range of data that are transformed into a variety of products. Satellite sensors observe different bands of radiation wavelengths, called channels, which are used for remotely determining information about the earth's atmosphere, land surface, oceans, and the space environment. When first received, satellite data are considered raw data. To make them usable, processing centers format the data so that they are time-sequenced and include earth location and calibration information. After formatting, these data are called raw data records. The centers further process these raw data records into channel-specific data sets, called sensor data records and temperature data records. These data records are then used to derive weather and climate products called environmental data records. These environmental data records include a wide range of atmospheric products detailing cloud coverage, temperature, humidity, and ozone distribution; land surface products showing snow cover, vegetation, and land use; ocean products depicting sea surface temperatures, sea ice, and wave height; and characterizations of the space environment. Combinations of these data records (raw, sensor, temperature, and environmental data records) are also used to derive more sophisticated products, including outputs from numerical weather models and assessments of climate trends. Figure 2 is a simplified depiction of the various stages of satellite data processing, and figure 3 depicts examples of two different weather products.

Figure 2: Stages of Satellite Data Processing



Source: GAO analysis of NOAA information.

Figure 3: Examples of Weather Products



Source: NOAA's National Environmental Satellite Data and Information Service.

Note: The figure on the left is a POES image of Hurricane Katrina in 2005; the figure on the right is an analysis of ozone concentration produced from POES satellite data.

NPOESS Overview: Inception, Management Structure, and Acquisition Strategy

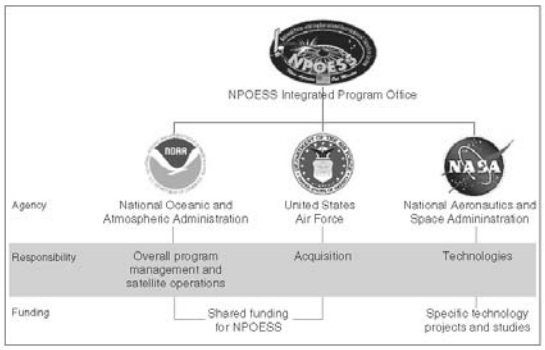
With the expectation that combining the POES and DMSP programs would reduce duplication and result in sizable cost savings, a May 1994 Presidential Decision Directive required NOAA and DOD to converge the two satellite programs into a single satellite program capable of satisfying both civilian and military requirements.[4] The converged program, NPOESS, was considered critical to the nation's ability to maintain the continuity of data required for weather forecasting and global climate monitoring.

To manage this program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office. Within the program office, each agency has the lead on certain activities: NOAA has overall program management responsibility for the converged system and for satellite operations; the Air Force has the lead on the acquisition; and NASA has primary responsibility for facilitating the development and incorporation of new technologies

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

into the converged system. NOAA and DOD share the cost of funding NPOESS, while NASA funds specific technology projects and studies. In addition, an Executive Committee—made up of the administrators of NOAA and NASA and the Under Secretary of Defense for Acquisition, Technology, and Logistics—is responsible for providing policy guidance, ensuring agency support and funding, and exercising oversight authority. Figure 4 depicts the organizations that make up the NPOESS program office and lists their responsibilities.

Figure 4: NPOESS Program Roles and Responsibilities



Source: GAO analysis of NPOESS program office data.

NPOESS is a major system acquisition that was originally estimated to cost about $6.5 billion over the 24-year life of the program from its inception in 1995 through 2018. The program includes satellite development, satellite launch and operation, and ground-based satellite data processing. When the NPOESS engineering, manufacturing, and development contract was awarded in August 2002, the cost estimate was adjusted to $7 billion.

Acquisition plans called for the procurement and launch of six satellites over the life of the program, as well as the integration of 13 instruments—consisting of 10 environmental sensors and 3 subsystems. Together, the sensors were to receive and transmit data on atmospheric, cloud cover,

environmental, climatic, oceanographic, and solar-geophysical observations. The subsystems were to support non-environmental search and rescue efforts, system survivability, and environmental data collection activities.

In addition, a demonstration satellite, called the NPOESS Preparatory Project (NPP), was planned to be launched several years before the first NPOESS satellite in order to reduce the risk associated with launching new sensor technologies and ensure continuity of climate data with NASA's Earth Observing System satellites. NPP is a joint mission between the NPOESS program office and NASA. NPP was to host four NPOESS sensors and provide the program office and the processing centers an early opportunity to work with the sensors, ground control, and data processing systems.[5]

When the NPOESS development contract was awarded in 2002, the schedule for launching the satellites was driven by a requirement that the NPOESS satellites be available to back up the final POES and DMSP satellites should anything go wrong during the planned launches of these satellites.[6] Early program milestones included (1) launching NPP by May 2006, (2) having the first NPOESS satellite available to back up the final POES satellite launch then planned for March 2008, and (3) having the second NPOESS satellite available to back up the final DMSP satellite launch then planned for October 2009. If the NPOESS satellites were not needed to back up the final predecessor satellites, their anticipated launch dates would have been April 2009 and June 2011, respectively.

[5]The four original sensors on NPP were the Visible/Infrared Imager/Radiometer Suite, the Cross-track Infrared Sounder, the Advanced Technology Microwave Sounder, and the Ozone Mapping and Profiler Suite. In January 2008, the NPOESS Executive Committee agreed to add the Clouds and the Earth's Radiant Energy System sensor to NPP.

[6]The contract was awarded to TRW in August 2002. Shortly after the contract was awarded, Northrop Grumman Space Technology purchased TRW and became the prime contractor on the NPOESS project.

Cost Increases, Schedule Delays, and Technical Problems Led to a Decision to Restructure NPOESS in 2006

Over several years, we reported that NPOESS had experienced continued cost increases, schedule delays, and serious technical problems.[7] By November 2005, we estimated that the cost of the program had grown from $7 billion to over $10 billion. In addition, the program was experiencing major technical problems with a critical imaging sensor that were expected to delay the launch date of the first satellite by almost 2 years. These issues ultimately required difficult decisions to be made about the program's direction and capabilities.

The Nunn-McCurdy law requires DOD to take specific actions when a major defense acquisition program's cost growth exceeds certain thresholds.[8] Where applicable, the law requires the Secretary of Defense to certify the program to Congress when it is expected to overrun its current baseline by 25 percent or more. In November 2005, NPOESS breached the 25 percent threshold, and DOD was required to certify the program for it to continue. The requirements for certifying a program, as relevant here, involved a determination that (1) the program is essential to national security, (2) there are no alternatives to the program that will provide equal or greater military capability at less cost, (3) the new estimates of the program's cost are reasonable, and (4) the management structure for the program is adequate to manage and control costs. DOD established tri-agency teams—made up of DOD, NOAA, and NASA experts—to work on each of the four elements of the certification process.

In June 2006, DOD (with the agreement of both of its partner agencies) certified a restructured NPOESS program, estimated to cost $12.5 billion through 2024—an increase of $4 billion more than the prior life-cycle cost estimate.[9] This restructuring decision delayed the launch of NPP and the first two satellites (called C1 and C2) by roughly 3 to 5 years—a deviation from the requirement to have NPOESS satellites available to back up the final POES and DMSP satellites should anything go wrong during those launches. The restructured program also reduced the number of satellites

[7]GAO-06-573T, GAO-06-249T, GAO-04-1054, GAO-03-987T, and GAO-02-684T.

[8]10 U.S.C. § 2433 (Supp. V 2005). For the current provisions of Nunn-McCurdy that are reflected herein see 10 U.S.C. §§ 2433 and 2433a (Supp. III 2009).

[9]DOD estimated that the acquisition portion of the certified program would cost $11.5 billion. The acquisition portion includes satellite development, production, and launch, but not operations and support costs after launch. When combined with an estimated $1 billion for operations and support after launch, this brings the program life-cycle cost to $12.5 billion.

to be produced by relying on European satellites for the midmorning orbit and planning to use NPOESS satellites in the early-morning and afternoon orbits. In addition, in order to reduce program complexity, the Nunn-McCurdy certification decision decreased the number of NPOESS instruments from 13 to 9 and reduced the functionality of 4 sensors. Table 1 summarizes the major program changes made by the Nunn-McCurdy certification decision and table 2 describes the sensors that were planned for NPP and NPOESS after the Nunn-McCurdy certification.

Table 1: Major Changes to the NPOESS Program by the Nunn-McCurdy Certification Decision

Key area	Program before the Nunn-McCurdy decision	Program after the Nunn-McCurdy decision (as of June 2006)
Life-cycle range	1995 through 2020	1995 through 2026
Estimated life-cycle cost	$8.4 billion	$12.5 billion*
Launch schedule	NPP by October 2006	NPP by January 2010
	First NPOESS (C1) by November 2009	C1 by January 2013
	Second NPOESS (C2) by June 2011	C2 by January 2016
Management structure	System Program Director reports to a tri-agency steering committee and the tri-agency Executive Committee	System Program Director is responsible for day-to-day program management and reports to the Program Executive Officer
	Independent program reviews noted insufficient system engineering and cost analysis staff	Program Executive Officer oversees program and reports to the tri-agency Executive Committee
Number of satellites	6 (in addition to NPP)	4 (in addition to NPP)
Number of orbits	3 (early morning, midmorning, and afternoon)	2 (early morning and afternoon; will rely on European satellites for midmorning orbit data)
Number and complement of instruments	13 instruments (10 sensors and 3 subsystems)	9 instruments (7 sensors and 2 subsystems); 4 of the sensors are to provide fewer capabilities
Number of environmental data records	55	39 (6 are to be degraded products)

Source: GAO analysis of NPOESS program office data.

*Although the program's life cycle was through 2026, the cost estimate was only through 2024.

Table 2: Description of Expected NPP and NPOESS Sensors, as of May 2008

Sensor	Description
Advanced Technology Microwave Sounder	Measures microwave energy released and scattered by the atmosphere and is to be used with infrared sounding data from the Cross-track Infrared Sounder to produce daily global atmospheric temperature, humidity, and pressure profiles.
Microwave Imager/Sounder	Collects microwave images and data needed to determine sea ice characterization and measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, and soil moisture, as well as temperature and humidity at different atmospheric levels.
Cross-track Infrared Sounder (CrIS)	Collects measurements of the earth's radiation to determine the vertical distribution of temperature, moisture, and pressure in the atmosphere.
Clouds and the Earth's Radiant Energy System sensor	Measures solar short-wave radiation and long-wave radiation released by the earth back into space on a worldwide scale to enhance long-term climate studies.
Ozone Mapping and Profiler Suite (OMPS)	Collects data needed to measure the amount and distribution of ozone in the earth's atmosphere. Consists of two components (limb and nadir) that can be provided separately.
Space Environment Monitor	Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.
Total and Spectral Solar Irradiance Sensor	Monitors and captures total and spectral solar irradiance data.
Visible/Infrared Imager/Radiometer Suite (VIIRS)	Collects images and radiometric data used to provide information on the earth's clouds, atmosphere, ocean, and land surfaces.

Source: GAO analysis of NPOESS program office data

The changes in NPOESS sensors affected the number and quality of the resulting weather and environmental products. In selecting sensors for the restructured program during the Nunn-McCurdy process, decision makers placed the highest priority on continuing current operational weather capabilities and a lower priority on obtaining selected environmental and climate measuring capabilities. As a result, the revised NPOESS system had significantly less capability for providing global climate, ocean, and space environment measures than was originally planned. Specifically, the number of environmental data records was decreased from 55 to 39, of which 6 were of a reduced quality. The 39 data records that remain include cloud base height, land surface temperature, precipitation type and rate, and sea surface winds. The 16 data records that were removed include cloud particle size and distribution, sea surface height, net solar radiation at the top of the atmosphere, and products to depict the electric fields in the space environment. The six data records that are of a reduced quality include ozone profile, soil moisture, and multiple products depicting energy in the space environment.

After the 2006 Nunn-McCurdy decision, the NPOESS Executive Committee decided to add selected sensors back to individual satellites in order to

address concerns from the climate community about the loss of key climate data. In January 2008, the Committee approved plans to include the Clouds and the Earth's Radiant Energy System sensor on the NPP satellite. In addition, in May 2008, the Committee approved plans to include a Total and Spectral Solar Irradiance Sensor on the C1 satellite. Table 3 shows which sensors were planned for NPP and the four satellites of the NPOESS program, called C1, C2, C3, and C4, as of May 2008. Program officials acknowledged that these configurations could change if other parties decide to develop the sensors that were canceled.

Table 3: Configuration of Sensors Planned for NPP and NPOESS Satellites, as of May 2008

Sensor	NPP	NPOESS C1 (PM)	NPOESS C2 (AM)	NPOESS C3 (PM)	NPOESS C4 (AM)
Advanced Technology Microwave Sounder	X	X	O	X	O
Microwave Imager/Sounder	—	—	X	X	X
Cross-track Infrared Sounder (CrIS)	X	X	O	X	O
Clouds and the Earth's Radiant Energy System sensor	X	X	—	—	—
Ozone Mapping and Profiler Suite (OMPS) Nadir / Limb components[a]	X/X	X/O	—	X/O	—
Space Environment Monitor	—	X	—	X	—
Total and Spectral Solar Irradiance Sensor	—	X	O	—	O
Visible/Infrared Imager/Radiometer Suite (VIIRS)	X	X	X	X	X

Key:

X = Sensor is currently planned for this satellite

O = Canceled during the Nunn-McCurdy certification, but could be restored to this satellite

— = Not applicable—sensor was never planned for this satellite

Source: GAO analysis of NPOESS program office data

[a]The OMPS sensor consists of two components, called the nadir and limb. During the 2006 restructuring, a decision was made to remove the limb component from both C1 and C3 satellites.

NPOESS Continued to Experience Management Challenges, Cost Overruns, and Schedule Delays after the 2006 Restructuring

After the program was restructured, the NPOESS program continued to experience cost growth, schedule delays, and management challenges. In April 2007, we reported that DOD's plans to reassign the Program Executive Officer would unnecessarily increase risks to an already risky program.[10] We also reported that, while the program office had made progress in restructuring NPOESS after the June 2006 Nunn-McCurdy certification decision, important tasks leading up to finalizing contract

[10]GAO-07-498.

changes remained to be completed. Specifically, executive approval of key acquisition documents was about 6 months late at that time—due in part to the complexity of navigating three agencies' approval processes. To address these issues, we recommended that DOD delay the reassignment of the Program Executive Officer until all sensors were delivered to NPP, and that the appropriate agency executives finalize key acquisition documents by the end of April 2007.

In May 2008, we reported that DOD had reassigned the Program Executive Officer and that key acquisition documents were more than a year late. We reiterated our prior recommendation that the agencies immediately complete the acquisition documents.[11] In addition, we reported that poor workmanship and testing delays caused an 8-month slip to the expected delivery date of the Visible/Infrared Imager/Radiometer Suite (VIIRS) sensor. This late delivery caused a corresponding delay in the expected launch date of the NPP demonstration satellite, moving it to June 2010.

In June 2008, we also reported that the program's life-cycle costs, estimated at $12.5 billion, were expected to rise by approximately $1 billion because of problems experienced in the development of the VIIRS and Cross-track Infrared Sounder (CrIS) sensors, the need to revise outdated operations and support cost estimates, and the need to modify information security requirements on ground systems.[12] Program officials subsequently modified their life-cycle cost estimate in December 2008 to $13.95 billion, which included about $1.15 billion for revised pre- and post-launch operations and support costs and about $300 million to address development issues. The revised cost estimate did not include funds to modify information security requirements.

In June 2009, we added to our previous concerns about the tri-agency oversight of the NPOESS program.[13] Specifically, we reported that the Executive Committee was ineffective because the DOD acquisition executive did not attend committee meetings; the committee did not track its action items to closure; and many of the committee's decisions did not achieve desired outcomes. We also reported that the life-cycle cost estimate of $13.95 billion was expected to rise by another $1 billion, and the schedules for NPP

[11] GAO-08-518.

[12] GAO-08-899T.

[13] GAO-09-564.

and the first two NPOESS satellites were expected to be delayed by 7, 14, and 5 months, respectively. (See table 4 for the history of cost and schedule estimates for the program.) We recommended that the DOD Executive Committee member attend and participate in Executive Committee meetings, and that the Executive Committee better track and manage risk and action items. Additionally, we recommended that the program develop plans to mitigate the risk of gaps in satellite continuity and establish a realistic time frame for revising the program's cost and schedule baselines.

Table 4: Changes in NPOESS Life-Cycle Cost Estimates and Estimated Satellite Launch

(Dollars in billions)

As of	Life-cycle cost estimate	NPP launch	C1 launch	C2 launch
August 2002	$7.0	May 2006	April 2009	June 2011
July 2003	7.0	October 2006	November 2009	June 2011
September 2004	8.1	October 2006	November 2009	June 2011
August 2005	8.1	April 2008	December 2010	December 2011
June 2006	12.5	January 2010	January 2013	January 2016
December 2008	13.95	January 2010	January 2013	January 2016
June 2009	14.95*	January 2011	March 2014	May 2016

Source: GAO analysis of program office and contractor data.

*This is a GAO estimate based on our analysis of contractor data.

To address risks and challenges, the NPOESS Executive Committee sponsored a series of reviews of the program. Two of the reviews, conducted in 2007 and 2008, examined the feasibility of alternative management strategies. Both of these reviews recommended against changing the prime contractor and made recommendations to improve other aspects of program management—including the government's executive and program management and the contractor's management. In the fall of 2008, an independent review team assessed the program and delivered its final report in June 2009. Among other things, the independent review team found that the program had a low probability of success, the continuity of data was at risk, and the priorities of DOD and NOAA were not aligned. The team recommended using NPP data operationally to mitigate potential gaps in coverage, co-locating the program at an acquisition center, and involving the White House to resolve priority differences. In March 2009, in response to a draft of the review team's report, the NPOESS Executive Committee decided to use NPP data operationally.

Executive Office Review Led to a Decision to Disband the NPOESS Program

In August 2009, the Executive Office of the President formed a task force, led by the Office of Science and Technology Policy (OSTP), to investigate the management and acquisition options that would improve the NPOESS program.[14] Specifically, the task force sought to identify a governance structure that would address the problems in schedule and budget, and the risk of a loss of satellite data due to delays in launching the satellites. In performing its review, the task force worked with NOAA, DOD, and NASA representatives and attended Executive Committee meetings.

In February 2010, the Director of OSTP announced that NOAA and DOD will no longer jointly procure the NPOESS satellite system; instead, each agency would plan and acquire its own satellite system. Specifically, NOAA is to be responsible for the afternoon orbit and the observations planned for the first and third NPOESS satellites. DOD is to be responsible for the 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. In addition, the task force explained that partnerships between DOD, NOAA, and NASA should continue and encouraged the agencies to continue joint efforts in the areas that have been successful in the past, such as the command and control of the satellites. Moving forward, while NOAA and DOD develop plans for separate acquisitions, the development of key components of the NPOESS program is continuing. Specifically, the program is continuing to develop the instruments and ground systems supporting NPP and selected components of the first two NPOESS satellites, which will likely be needed by the NOAA and DOD follow-on programs.

[14]The NPOESS task force consisted of participants from OSTP, the Office of Management and Budget, and the National Security Council.

Agencies Have Begun Planning for Separate Acquisitions, but the Impact of This New Approach Is Not Fully Known and Key Transition Risks Exist

NOAA and DOD have begun planning to transition the NPOESS program to separate acquisitions, but the agencies are at different stages in planning and neither has finalized its plans. NOAA has developed preliminary plans for a new program to fulfill the requirements of the afternoon NPOESS orbit. DOD has just begun planning how it will meet the requirements of the morning orbit, and expects to have initial decisions on how it will proceed in acquiring the spacecraft and sensors by June 2010 and October 2010, respectively. Because neither agency has completed its plans, the impact of the decision to disband the program on expected costs, schedules, and promised capabilities has not yet been fully determined. However, it is likely that the decision will further delay the first satellite's launch schedule, add to the overall cost, and remove selected capabilities. Moving forward, the agencies face key risks in transitioning from NPOESS to two separate programs. These risks include the loss of key staff and capabilities, added 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. Until these risks are effectively mitigated, it is likely that the satellite programs' costs will continue to grow and launch dates will continue to be delayed. Further delays are likely to jeopardize the availability and continuity of weather and climate data.

NOAA and DOD Have Begun Planning for Their Separate Acquisitions, but the Impact on Cost, Schedule, and Capabilities Is Not Fully Known

NOAA and DOD have begun planning to transition the NPOESS program to separate acquisitions, but the two agencies are at different stages in planning. NOAA has developed preliminary plans for its new satellite acquisition program—called the Joint Polar Satellite System (JPSS). Specifically, NOAA developed plans for two satellites to fly in the afternoon orbit. NOAA plans to have the first JPSS satellite, formerly NPOESS C1, available for launch in 2015, and the second JPSS satellite, formerly NPOESS C3, available for launch in 2018.[15] NOAA will also provide the ground systems for both the JPSS and DOD programs. Current plans estimate that the life-cycle cost of the JPSS program will be approximately $11.9 billion, which includes $2.9 billion in NOAA funds spent on NPOESS through fiscal year 2010.[16]

[15]NOAA officials noted that these dates could change as transition plans are developed.

[16]This estimate does not include approximately $2.9 billion that DOD has spent through fiscal year 2010 on NPOESS.

NOAA is also considering technical changes to the program that involve the size of the spacecraft and the sensors to be included on each of the satellites. Specifically, NOAA is considering using a smaller spacecraft than the one planned for NPOESS. NOAA is also considering removing sensors that were planned for the NPOESS C1 and C3 satellites and obtaining those data from other sources, including international satellites.[17] Table 5 includes preliminary plans for which sensors will be accommodated on the JPSS satellites.

Table 5: Configuration of Sensors Planned for NPP and JPSS Satellites, as of March 2010

Sensor	NPP	JPSS-1 (C1 equivalent)	JPSS-2 (C3 equivalent)
Advanced Technology Microwave Sounder	X	X	X
Microwave Imager/Sounder	—	—	0
Cross-track Infrared Sounder (CrIS)	X	X	X
Clouds and the Earth's Radiant Energy System/Earth Radiation Budget Sensor[a]	X	X	X
Ozone Mapping and Profiler Suite (OMPS) Nadir/Limb components[b]	X/X	X/?	X/X
Space Environment Monitor	—	0	0
Total and Spectral Solar Irradiance Sensor[c]	—	?	?
Visible/Infrared Imager/Radiometer Suite (VIIRS)	X	X	X

Key:

X = Sensor is currently planned for this satellite

? = A decision has not been made as to whether it will be on this satellite

0 = Sensor was planned for the NPOESS satellite, but NOAA currently does not plan to include it on the JPSS satellite

— = Not applicable—sensor was never planned for this satellite

Source: GAO analysis of NPOESS program office data.

[a]The Clouds and the Earth's Radiant Energy System sensor is to be included on NPP and JPSS-1. The Earth Radiation Budget Sensor—a follow-on sensor—is to be included on JPSS-2.

[b]The OMPS sensor consists of two components, called the nadir and limb. During the 2006 restructuring, a decision was made to remove the limb component from both C1 and C3 satellites. NOAA plans for OMPS limb to be included on JPSS-2, but may move it to JPSS-1 if the schedule allows.

[c]Although NOAA plans to develop the Total and Spectral Solar Irradiance Sensor, it has not determined whether the sensor will be included on JPSS-1, JPSS-2, or a different accommodation.

[17]NOAA officials are currently revisiting plans for the Space Environment Monitor and the Microwave Imager/Sounder. Although they plan to launch the Total and Spectral Solar Irradiance Suite, NOAA officials have not yet made a decision on which satellite will host the sensor.

The management of the JPSS satellites will also change from that of the NPOESS satellites. NOAA plans to transfer the management of acquisition from the NPOESS program office to NASA's Goddard Space Flight Center, so that it can be co-located at a space system acquisition center as advocated by the NPOESS independent review team. According to NOAA officials, the agency will provide direction, requirements, and budget to NASA. NOAA will also provide staff, including a program director and program scientist. A NASA employee will function as program manager. In addition, NOAA has developed a team to lead the transition from NPOESS to JPSS and has included representatives from NOAA, NASA, and DOD. Because this team has just been formed, they have not yet fully developed plans to guide the transition. NOAA officials plan to begin transitioning in July, and complete the transition plan—including cost and schedule estimates—by the end of September.

DOD is at an earlier stage in its planning process, in part because it has more time before the first satellite in the morning orbit is needed. DOD officials are currently reviewing requirements for the morning orbit and plan to define how to proceed by the end of June 2010. After this review is completed, DOD plans to analyze alternatives for meeting the requirements and to develop a plan for the chosen alternative. DOD anticipates making a decision on whether to use the NPOESS spacecraft by June 2010 and to make a decision on which sensors it will include—including the Space Environment Monitor and the Microwave Imager/Sounder—by October 2010. DOD acquisition officials expect to begin the program in fiscal year 2013.

Table 6 compares key attributes of the NPOESS program when it was restructured in 2006 to the NPOESS program at the time of the task force decision in 2010 and to preliminary plans for the separate NOAA and DOD acquisitions.

Table 6: Comparison of NPOESS to the New NOAA and DOD Acquisitions

Key area	NPOESS program after the Nunn-McCurdy decision (as of June 2006)	NPOESS program (as of February 2010)	NOAA and DOD acquisition plans (as of February 2010)
Life-cycle range	1995-2026	1995-2026	*JPSS*: 1995-2024 *DOD program*: unknown
Estimated life-cycle cost[a]	$12.5 billion	$13.95+ billion[b]	*JPSS*: $11.9 billion (which includes about $2.9 billion in NOAA funds spent through fiscal year 2010 on NPOESS) *DOD program*: unknown; DOD's initial estimates include costs of about $5 billion through fiscal year 2015 (which includes about $2.9 billion in DOD funds spent through fiscal year 2010 on NPOESS)
Launch schedule	NPP by January 2010 C1 by January 2013 C2 by January 2016 C3 by January 2018 C4 by January 2020	NPP no earlier than September 2011 C1 by March 2014[c] C2 by May 2016 C3 by January 2018 C4 by January 2020	NPP no earlier than September 2011 JPSS-1 (C1 equivalent) available in 2015 JPSS-2 (C3 equivalent) available in 2018 *DOD program*: unknown
Number of sensors	NPP: 4 sensors C1: 6 sensors C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors C1: 7 sensors[d] C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors JPSS-1 and 2: Although NOAA has not determined the exact complement of sensors, it will have at least 5 of the original NPOESS sensors[e] *DOD program*: unknown

Source: GAO analysis of NOAA, DOD, and task force data.

[a]Although the life-cycle ranges for NPOESS are through 2026, the cost estimates for both NPOESS and JPSS are only through 2024.

[b]Although the program baseline is currently $13.95 billion, we estimated in June 2009 that this cost could grow by about $1 billion. In addition, officials from the Executive Office of the President stated that they reviewed life-cycle cost estimates from DOD and the NPOESS program office of $15.1 billion and $16.45 billion, respectively.

[c]Officials from the Executive Office of the President noted that the expected launch date of C1 had slipped to late 2014 by the time of their decision.

[d]In May 2008, the NPOESS Executive Committee approved an additional sensor—the Total and Spectral Solar Irradiance Sensor—for the C1 satellite.

[e]These five sensors are: VIIRS, CrIS, OMPS-nadir, the Advanced Technology Microwave Sounder, and the Clouds and the Earth's Radiant Energy System/Earth Radiation Budget Sensor.

Because neither agency has finalized plans for its acquisition, the full impact of the task force decision on the expected cost, schedule, and capabilities is unknown. However, it appears likely that the combined cost of the separate acquisitions could be higher than the last NPOESS estimate, the schedule for the first satellite's launch will be later than the

last NPOESS estimate, and selected capabilities will be removed from the program.

- Cost: NOAA anticipates that the JPSS program will cost approximately $11.9 billion to complete through 2024.[18] Although this estimated cost is less than the baselined cost of the NPOESS program, DOD will still need to fund and develop satellites to meet the requirements for the early morning orbit. DOD's initial estimates are for its new program to cost almost $5 billion through fiscal year 2015.[19] Thus, it is likely that the cost of the two acquisitions will exceed the baselined life-cycle cost of the NPOESS program.

- Schedule: Neither NOAA nor DOD have finalized plans that show the full impact of the restructuring on the schedule for satellite development. We have previously reported that restructuring a program like NPOESS could take significant time to accomplish, due in part to the time taken revising, renegotiating, or developing important acquisition documents, including contracts and interagency agreements.[20] With important decisions and negotiations still pending, it is likely that the expected launch date of the first JPSS satellite will be delayed.

- Capabilities: Neither agency has made final decisions on the full set of sensors—or which satellites will accommodate them—for their respective satellite programs. Until those decisions are made, it will not be possible to determine the capabilities that these satellites will and will not provide.

Timely decisions on cost, schedule, and capabilities would allow both acquisitions to move forward and satellite data users to start planning for any data shortfalls they may experience. Until DOD and NOAA finalize their plans, it is not clear whether the new acquisitions will meet the requirements of both civilian and military users.

[18]NOAA officials reported that the JPSS cost estimate is at a higher confidence level than the previous NPOESS life-cycle cost estimates.

[19]This estimate is not a life-cycle cost estimate and could change as DOD completes its requirements review and analysis of alternatives for their new program. DOD has not yet developed a life-cycle cost estimate.

[20]GAO-06-573T.

NOAA and DOD Face Key Transition Risks That Threaten Satellite Continuity

Moving forward, the agencies face key risks in transitioning from NPOESS to their new programs. These risks include the loss of key staff and capabilities, delays resulting from negotiating contract changes and establishing new program offices, the loss of support for both agencies' requirements, and insufficient oversight of new program management.

- *Loss of key staff and capabilities*—The NPOESS program office is composed of NOAA, NASA, Air Force, and contractor staff with knowledge and experience in spacecraft procurement and integration, ground systems, sensors, data products, systems engineering, budgeting, and cost analysis. These individuals have knowledge and experience in the status, risks, and lessons learned from the NPOESS program. This knowledge will be critical to moving the program forward both during and after the transition period. However, program office staff have already begun leaving—or looking for other employment—due to the uncertainties about the future of the program office. Unless NOAA is proactive in retaining these staff, the new program may waste valuable time if staff must relearn program details and may repeat mistakes made and lose lessons learned by prior program staff.

- *Delays in negotiating contract changes and establishing new programs*—We have previously reported that restructuring a program like NPOESS could take significant time to accomplish, due in part to the time taken revising, renegotiating, or developing important acquisition documents, including contracts and interagency agreements.[21] According to NOAA officials, the plan for JPSS may require negotiations with contractors and between contractors and their subcontractors. In addition, both NOAA and DOD will need to establish and fully staff program offices to facilitate and manage the transition and new programs. However, these contract and program changes have not yet occurred and it is not clear when they will occur. These changes could take significant time to complete. Meanwhile, the NPOESS program office continues to support—and fund—development activities that may not be used in the new programs, because neither NOAA nor DOD have made key decisions on the technologies, such as the spacecraft and sensors, that will be included on the new programs. Until decisions are made on how the program is to proceed with contract changes and terminations, the contractors and program office cannot implement the chosen solution and some decisions, such as the ability to hold schedule slips to a minimum, could become much more difficult.

[21]GAO-06-573T.

- *Failure to support the other agency's requirements*—As a joint program, NPOESS was expected to fulfill many military, civilian, and research requirements for environmental data. The task force decision to restructure NPOESS noted that decisions on future satellite programs should ensure the continuity of critical satellite 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. DOD, NOAA, and NASA will still need to work together to ensure that requirements are known, agreed upon, and managed, and that changes in their respective program's capabilities do not degrade the continuity requirements. For example, NOAA officials reported that they do not plan to include the Microwave Imager/Sounder in their follow-on program and will instead procure data from a different sensor on an international satellite. However, it is not clear that NOAA's plans will meet the needs of all of DOD's users, including the Navy and Army. Similarly, it is not clear that DOD will continue to support the climate community's requirements for highly calibrated and accurate measurements. If the agencies cannot find a way to build a partnership that facilitates both efficient and effective decision-making on data continuity needs, the data continuity needs of both agencies may not be adequately incorporated into the new programs.

- *Insufficient 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. Transferring the program to NASA will not necessarily resolve existing cost, schedule, and subcontractor management issues. We recently reported that the acquisition challenges faced in major NASA acquisitions are similar to the ones faced by DOD acquisitions, including NPOESS.[22] Specifically, we reported that NASA has consistently underestimated time and cost and has not adequately managed risk factors such as contractor performance. Because of these issues, we listed NASA's acquisition management as a high-risk area in 1990, and it remains a high-risk area today.[23] In addition, our work on the GOES I-M satellite series found that NOAA did not have the ability to make quick decisions on problems because portions of the procurement were managed by NASA.[24]

[22]GAO, *NASA: Projects Need More Disciplined Oversight and Management to Address Key Challenges*, GAO-09-436T (Washington, D.C.: Mar. 5, 2009).

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

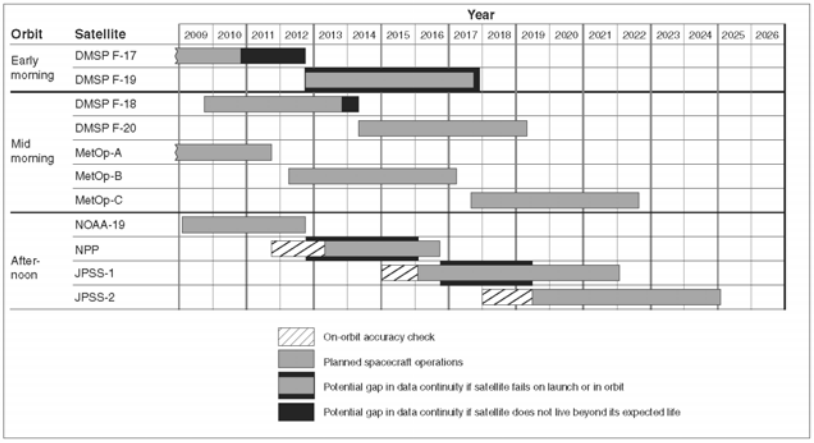
[24]GAO, *Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs*, GAO-06-993 (Washington, D.C.: Sept. 6, 2006).

Specifically, this management approach limited NOAA's insight and management involvement in the procurement of major elements of the system. 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. They could not provide a time frame for its completion. Without strong NOAA oversight of NASA's management of program components, JPSS may continue to face the same cost, schedule, and contract management challenges as the NPOESS program.

While NOAA, NASA, and DOD acknowledge that there are risks associated with the transition to new programs, they have not yet established plans to mitigate these risks. Until these risks are effectively mitigated, it is likely that the satellite programs' costs will continue to grow and launch dates will continue to be delayed. Further launch delays are likely to jeopardize the availability and continuity of weather and climate data. For example, the POES satellite currently in the afternoon orbit is expected to reach the end of its lifespan at the end of 2012. If NPP is delayed, there could be a gap in polar satellite observations in the afternoon orbit. Similarly, a delay in the launch of the first JPSS satellite may lead to a gap in satellite data after NPP reaches the end of its lifespan.

Data continuity gaps pose different implications for DOD and NOAA. For both agencies, a loss of satellite data represents a reduction in weather forecasting capabilities. Within the military, satellite data and products allow military planners and tactical users to focus on anticipating and exploiting atmospheric and space environmental conditions. For example, accurate wind and temperature forecasts are critical to any decision to launch an aircraft that will need mid-flight refueling. For NOAA, satellite data and products are provided to weather forecasters for use in issuing weather forecasts and warnings to the public and to support our nation's aviation, agriculture, and maritime communities. NOAA also faces risks in losing longer-term climate observations. Maintaining the continuity of climate and space data over decades is important to identify long-term environmental cycles (such as the 11-year solar cycle and multiyear ocean cycles, including the El Niño effect) and their impacts, and to detect trends in global warming. Figure 5 shows the current and planned satellites and highlights gaps where the constellation is at risk.

Figure 5: Planned Launch Dates and Potential Gaps in Satellite Data



Source: GAO analysis of DOD, NOAA, and NPOESS Integrated Program Office data.

Note: DOD is currently evaluating its options for the early morning orbit, including moving the DMSP F-20 satellite to the early morning orbit or acquiring additional satellites. Launch dates and gaps for the early morning orbit will remain uncertain until these decisions are made.

NPOESS Development Continues, but Demonstration Satellite Has Been Delayed and New Challenges Threaten Further Delays

While NOAA and DOD are establishing plans for separate acquisitions, the development of key NPOESS components is continuing. In recent months, the critical VIIRS sensor has been completed and integrated onto the NPP spacecraft. In addition, the program continues to work on components of the first and second NPOESS satellites, including sensors and ground systems. These components may be transferred to NOAA and DOD to become part of their respective follow-on programs. However, the expected launch date of the NPP satellite has been delayed by 9 months due to technical issues in the development of a key sensor, and the development of the VIIRS sensor for the first NPOESS satellite is experiencing cost overruns. In addition, the program is slowing down and may stop work on key components in order to address potential contract liabilities and funding constraints. This would further delay the launches

of the NPP satellite and the first NOAA and DOD satellites under their new programs.

NPOESS Components Making Progress, but Technical Issues Have Delayed NPP Launch

In recent months, selected components of the NPOESS program have made progress. Specifically, the program completed the development of the critical VIIRS sensor and delivered it to NASA for integration onto the NPP satellite. Four of the five sensors intended for NPP are now on the spacecraft. In addition, the program has continued to develop key sensors intended for the first NPOESS satellite (VIIRS, CrIS, OMPS, and the Advanced Technology Microwave Sounder sensors), and a key sensor for the second NPOESS satellite (the Microwave Imager/Sounder). These components may be transferred to NOAA and DOD to become part of their respective follow-on programs.

However, the program experienced technical issues on the Cross-track Infrared Sounder (CrIS) sensor intended for the NPP satellite. Specifically, in January 2009 after the CrIS sensor completed its thermal vacuum tests, an anomaly was discovered on a circuit card that then led to the discovery of unrelated design flaws on two additional circuit cards. During final testing of new parts in August 2009, components intended for CrIS were damaged after the subcontractor failed to adhere to proper test processes. After investigating the problem and possible solutions for several months, the program decided to replace damaged parts and send the instrument through a limited thermal vacuum test. In total, this testing error resulted in an 11-month delay in the delivery of CrIS and a 9-month delay to the NPP satellite launch date (bringing it to September 2011, at the earliest). In addition, the program continues to face technical challenges and cost overruns in developing the VIIRS sensor for the first NPOESS satellite. Details on the status of key components for NPP and the first two NPOESS satellites are provided in table 7.

Table 7: Status of Key Components of NPP and the First Two NPOESS Satellites (C1 and C2), as of March 2010

Satellite	Component	Program-identified risk level[a]	Status
NPP	Advanced Technology Microwave Sounder	Low	The sensor was integrated on the spacecraft in December 2006 and is awaiting delivery of the other sensors in order to complete integration testing.
	Clouds and the Earth's Radiant Energy System	Low	The sensor was integrated on the spacecraft in November 2008.
	Cross-track Infrared Sounder (CrIS)	Medium	Technical, process, and testing errors have delayed the expected shipment of the CrIS sensor from July 2009 to June 2010, and it is driving the NPP schedule. The program office is preparing for a final review of the sensor.
	Ozone Mapping and Profiler Suite (OMPS)	Medium	OMPS has been integrated onto the spacecraft, but has had continued technical issues. After analysis of the issues, the program decided not to modify this sensor.
	Visible/Infrared Imager/ Radiometer Suite (VIIRS)	Low	The sensor was shipped to integration facilities in January 2010 and was integrated onto the NPP spacecraft.
	Spacecraft	Low	The spacecraft has been completed and four of five sensors have been integrated on it.
	Ground processing segment	Medium	An NPP compatibility test is planned for the fall of 2010, but it requires all sensors to be integrated onto the spacecraft. NASA officials reported that the ground system is still risky for NPP, and they plan to remain vigilant to fix issues.
NPOESS C1	Advanced Technology Microwave Sounder	Low	The sensor is currently being built by the prime contractor. Although the effort is low risk and over 80 percent complete, the effort is taking more time than expected.
	Clouds and the Earth's Radiant Energy System	Low	A contract for this sensor's development was awarded in May 2009; delivery is expected in July 2012.
	Cross-track Infrared Sounder (CrIS)	Medium	Because the program needed to delay activities on this sensor in 2009, delivery of the sensor could be delayed by a full year.
	Ozone Mapping and Profiler Suite (OMPS)	High	This sensor is about 45 percent complete, according to program officials; however, the contractor recently found contamination on the sensor during testing. Inspection and re-testing are expected to delay the OMPS schedule by about 2 months.
	Space Environment Monitor	High	The program office was late in awarding the contract for the second phase of this sensor; this will likely delay the sensor's development by a few months. DOD is currently evaluating whether to include this sensor on its follow-on program; a decision is to be made by October 2010.
	Total and Spectral Solar Irradiance Sensor	Low	The sensor development contract was awarded in July 2009.
	Visible/Infrared Imager/ Radiometer Suite (VIIRS)	High	According to program officials, this sensor is about 60 percent complete; however, it has continued to experience significant cost overruns.
	Spacecraft	Medium	The spacecraft is on the critical path for NPOESS C1, which means that any delays in the spacecraft could delay the launch date. DOD and NOAA are currently evaluating whether they will use this or another spacecraft for their follow-on programs.
	Ground processing segment	Low	Hardware for the final two central data processing centers is expected to be delivered by the end of 2013.

Satellite	Component	Program-identified risk level*	Status
NPOESS C2	Microwave Imager/Sounder	Low	Development for this sensor is continuing; a final decision on whether DOD will continue development will be made by the end of this fiscal year.

Source: GAO analysis of program office data.

*Although the NPOESS program office has determined these risk levels for program components, NOAA and NASA officials felt that the risk levels for the NPOESS VIIRS and Microwave Imager/Sounder sensors, spacecraft, and ground systems are too low and that the risk level of the NPOESS OMPS sensor is too high.

New Challenges Threaten Further Delays

In the months leading up to an official transition from the NPOESS program to the successor NOAA and DOD programs, NPOESS officials face key challenges that further threaten environmental satellite continuity. Specifically, the NPOESS program is slowing down and may stop work on key components in order to address potential contract liabilities and funding constraints. According to agency officials, the prime contract includes a clause requiring termination liability be funded in the current year's budget. This means that if NPOESS development were to continue according to schedule, the program would need to stop all development work in August 2010 in order to fund the approximately $84 million in potential termination liability for this year. To mitigate this risk, in April 2010, the prime contractor was directed to slow down work on all development activities so that work could continue through the end of the fiscal year.

In addition, the National Defense Authorization Act for Fiscal Year 2010 placed limitations on the amount of DOD funding available to the program until certain requirements were met.[25] Although the program met those requirements in March 2010, agency officials noted that DOD funding could be rescinded if not obligated quickly. According to program officials, if these funds are rescinded, DOD may have to terminate the NPOESS contract by the end of the fiscal year.

[25]Pub. L. No. 111-84 § 913 (Oct. 28, 2009). This act directs the President to develop a strategy for the management and funding of the NPOESS program that would include a funding profile for each year of the program by department or agency. The President is also required to develop an implementing plan to carry out the management and funding strategy. The act prohibits the Air Force from spending more than 50 percent of the funds available to it for NPOESS until the management and funding strategy is submitted to the relevant congressional committees. When the strategy is submitted, the Air Force is prohibited from spending more than 75 percent of the funds available to it for NPOESS until the implementation plan is submitted to the relevant congressional committees.

Slowing or stopping work under either scenario could further delay the launches of the NPP satellite and the first NOAA and DOD satellites under their new programs. However, officials have not established detailed priorities among different components to guide any work stoppages. Unless selected components are able to continue scheduled development, the launches of NPP and the first few satellites could be further delayed.

Limitations on the Demonstration Satellite May Adversely Affect the Usefulness of Its Data

As originally designed, NPP was planned to reduce the risk associated with launching new sensor technologies in the NPOESS program and to ensure continuity of climate data with NASA's Earth Observing System satellites. Therefore, NPP was not expected to be an operational satellite used for weather forecasting. However, in March 2009, delays in the expected launch of the first NPOESS satellite led the Executive Committee to decide to use NPP data operationally. Because the NPP demonstration satellite was not designed as an operational asset, it has several limitations. These limitations include fewer ground-based data processing systems, fewer security controls, and a shorter satellite lifespan than current or planned operational satellites. These design limitations mean that in some cases, NPP's data will not be as timely and useful as current polar satellites or as secure as planned satellites. In addition, there is a risk of a gap in the nation's climate and weather data should the NPP satellite or its sensors fail before the next satellite is launched. Agency officials acknowledge these limitations and are assessing options to make NPP data more timely and secure.

NPP Will Have Fewer Ground-Based Data Processing Systems than NPOESS

While NOAA, NASA, and DOD plan to have a ground-based data processing system in each of four central data processing centers when NPOESS (or its successors') satellites are in operation, the data processing system will be in only two of the centers for the NPP demonstration satellite.[25] This arrangement means that the two centers that do not have the data processing systems will experience a lag in obtaining NPP data. Specifically, under current operations, the four satellite data processing centers receive polar satellite data within about 100 to 150 minutes. NPP's

[25]The four central data processing centers are NOAA's National Environmental Satellite, Data, and Information Service, the Air Force Weather Agency, the Naval Oceanographic Office, and the Fleet Numerical Meteorology and Oceanography Center. The two centers that will have a ground-based data processing system when NPP is in orbit are NOAA's National Environmental Satellite, Data, and Information Service and the Air Force Weather Agency.

data will be available to the two centers with the data processing system within approximately 140 minutes; it will be available to the two other centers within about 170 minutes. This presents a delay of 20 to 70 minutes from current operations for the two centers without the data processing system.

Because of this delay, NPP data will not be as useful to DOD as the data from legacy DMSP and POES satellites. DOD officials reported that they plan to incorporate NPP data when and where they can to supplement data from the legacy satellites. However, DOD's centers will not be able to incorporate NPP data into all of their operational products, due to the time delay. For example, officials from one data processing center reported that the delay in obtaining NPP data could adversely affect their atmospheric and oceanographic numerical weather prediction capabilities. This situation would be exacerbated if POES or DMSP satellites fail in orbit before the first NPOESS/JPSS satellite is launched because the DOD centers may not be able to use NPP data to make up for the data loss. According to DOD officials, the three DOD centers are currently investigating options to shorten the time it will take for the data to go from the one center with the data processing system to the other two that lack the system, but do not have a timeline for making decisions on how to proceed. NASA officials reported that there are other options for shortening the time lag. For example, JPSS officials are considering accelerating the development of the data processing systems in their new program. This could allow all four centers to have a processing system shortly after NPP is launched and would eliminate the additional time lag for two of the centers.

NPP Was Designed Using Information Security Guidelines That Are Now Outdated

When originally designed, the NPP ground systems included information security controls that were based on the DOD security requirements that existed at that time. However, these standards—approved in 1998—do not include all of the security controls applicable to newer systems. According to NOAA officials, the limitations in NPP's security controls relate primarily to the risk of data loss, denial-of-service, and continuity of operations, rather than a risk to the command and control of the satellite.

In 2008, program officials evaluated the security requirements of the NPOESS program. Specifically, they evaluated whether to increase the security controls before the NPP launch, before the first NPOESS satellite launch, or before the second NPOESS satellite launch. They decided against updating the NPP security requirements, because it would cost the program up to $280 million to make such a change, and could risk NPP's

scheduled launch date. According to NOAA officials, they recently evaluated the impact of the weaknesses in NPP's security controls and made decisions on a majority of security controls in April 2010.

NPP's Expected Life Span Is Shorter than That of NPOESS

The NPP satellite was only designed to support a 5-year mission life, unlike the 7-year mission life of the NPOESS satellites. Because NPP's design life is only 5 years, it has the potential to fail before the next satellite is launched. If NPP launches as planned in October 2011, the satellite, based on current design, may remain functional until 2016. Thus, data from the next polar-orbiting satellite may be needed as early as 2016.

Although the first JPSS satellite launch is planned for 2015, it may need a year or more to perform an on-orbit accuracy check.[27] Thus, it is very likely that there will be gaps in climate and weather data if NPP cannot survive beyond its design life. Further delays in the development and launch of the next satellite will increase the risk of a gap. NOAA officials acknowledge this limitation and are evaluating ways to mitigate the risk of a gap. NASA officials reported that the NPP spacecraft is based on a legacy design; thus, they estimate that the spacecraft will likely last for 7 years or more. However, they questioned the reliability of key sensors—particularly VIIRS, CrIS, and OMPS—on NPP, due to poor workmanship and mission assurance weaknesses during development.

Conclusions

At the end of this fiscal year, the federal government will have spent 16 years and over $5 billion to combine two legacy satellite programs into one, yet will not have launched a single satellite. Faced with expected cost growth exceeding $8 billion, schedule delays of over 5 years, and continuing tri-agency management challenges, a task force led by the President's Office of Science and Technology Policy decided to disband NPOESS so that NOAA and DOD could pursue separate satellite acquisitions. While the two agencies are scrambling to develop plans for their respective programs, it is not yet clear what the programs will deliver, when, and at what cost. Timely decisions on cost, schedule, and capabilities are needed to allow both acquisitions to move forward. As the agencies develop plans for their respective satellite programs, they face

[27] After a satellite has been launched, scientists perform an on-orbit accuracy check, called calibration and validation, to verify that the sensors accurately report ground and atmospheric conditions. While this process can take 6 months to 2 years, users may be able to use the satellite data before calibration and validation has been completed.

risks associated with the loss of critical staff with knowledge and experience, delays in negotiating contract changes and setting up new program offices, the two agencies not fulfilling each other's core requirements, and insufficient program oversight. Neither agency has developed plans to mitigate these risks.

Until the transition is completed, the NPOESS program is continuing to develop components of the NPP satellite and components of the first two satellites. However, program officials reported that they have slowed all development work, and may need to stop work on these deliverables because of potential contract liabilities and funding constraints. Slowing or stopping work could further delay the satellites' launches, and the program has not developed a prioritized list of what to stop first to mitigate impacts on satellite launches. Until it does so, there may be an increased risk of gaps in satellite data.

Because NPP was built to be a demonstration satellite, its data may not be as timely and useful as current polar satellites and not as secure as planned satellites. In addition, the limited lifespan of NPP further increases the risk of gaps in climate and weather data. Agency officials acknowledge these limitations and are assessing options to make NPP data more timely, but do not have time frames for deciding among alternative options.

Recommendations for Executive Action

In order to ensure that the transition from NPOESS to its successor programs is efficiently and effectively managed, we recommend that the Secretaries of Defense and Commerce take the following four actions:

- direct their respective NPOESS follow-on programs to expedite decisions on the expected cost, schedule, and capabilities of their planned programs;
- direct their respective NPOESS follow-on programs to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up new program offices, loss of support for the other agency's requirements, and oversight of new program management;
- direct the NPOESS program office to develop priorities for work slowdown and stoppage to allow the activities that are most important to maintaining launch schedules to continue; and

- direct NOAA and DOD officials to develop time frames for making key decisions on—or accepting the risks related to—the timeliness of NPP's data.

Agency Comments and Our Evaluation

We received written comments on a draft of this report from the Secretary of Commerce, who transmitted NOAA's comments (see app. II), the Director of Space and Intelligence within DOD (see app. III), and the Associate Administrator for the Science Mission Directorate of NASA (see app. IV). In addition, a senior policy analyst from the Office of Science and Technology Policy/Executive Office of the President provided technical comments on a draft of this report via email, which we incorporated as appropriate.

In their comments, both NOAA and DOD agreed with our recommendations and identified plans to implement them. For example, NOAA plans to work with NASA to develop requirements and acquisition plans, identify the organization and staffing, and establish a cost and schedule baseline for JPSS. In addition, DOD officials reported that the agency plans to make decisions on capability, cost, and schedule following a series of meetings taking place in June 2010.

In addition, regarding the potential need to slow down or stop work on the NPOESS program to deal with potential contract liabilities and funding constraints, NOAA, NASA, and DOD reported that the NPOESS program office has identified priorities for work stoppage so that key activities could continue. At the end of March 2010, the program executive officer provided high-level guidance on the priorities of the program, such as ensuring that NPP development continues and ensuring that key sensor development is transferred to the JPSS program. Subsequently, program officials stated that the contractor agreed to slow all of its development work through the end of the fiscal year to avoid a work stoppage. However, slowing all work activities does not reflect a prioritization of the most important activities. Unless the key activities that are on the critical path are able to continue scheduled development, the launches of NPP and the first few satellites could be further delayed.

NASA also commented on our finding that NOAA would need to provide enhanced oversight of NASA's management of the JPSS program. We called for enhanced oversight based, in part, on NASA's history of poor performance in managing major acquisitions. NASA officials asserted that the proper basis for comparison should not be their leading edge research missions, but, instead, should be the operational environmental satellite

missions it has developed for NOAA in the past. NASA noted that its role in JPSS will be structured similar to the Polar-orbiting Operational Environmental Satellite (POES) and Geostationary Operational Environmental Satellite (GOES) programs, where NOAA and NASA have a long and effective partnership. However, we believe that enhanced oversight is warranted. The JPSS program differs from the recent POES and GOES programs in that it includes leading edge sensor technologies. The complexity of these sensor technologies has been a key reason for the cost growth and schedule delays experienced to date on the NPOESS program. In addition, the program continues to discover technical problems on the sensors currently being developed for the follow-on programs. Thus, it will be important for both NOAA and NASA to ensure that the subcontractors are adequately managed so that technical, cost, and schedule issues are minimized or mitigated.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of this letter. We are sending copies of this report to interested congressional committees, the Secretary of Commerce, the Secretary of Defense, the Administrator of NASA, the Director of the Office of Management and Budget, and other interested parties. In addition, this report will be available on the GAO Web site at http://www.gao.gov.

If you have any questions about this report, please contact me at (202) 512-9286 or at pownerd@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix V.

David A. Powner
Director, Information Technology
Management Issues

Appendix I: Objectives, Scope, and Methodology

Our objectives were to (1) assess efforts to plan for separate satellite acquisitions; (2) evaluate the status and risks of key program components still under development; and (3) evaluate implications of using the demonstration satellite's data operationally.

To assess efforts to plan for separate satellite acquisitions, we reviewed the presidential directive that established the National Polar-orbiting Operational Environmental Satellite System (NPOESS) as well as materials related to the program restructuring in 2006. We also reviewed the White House task force's terms of reference and final decision to disband the NPOESS program. We reviewed preliminary plans for the National Oceanic and Atmospheric Administration's (NOAA) new program to replace two of the NPOESS satellites. We compared the strategy and plans to best practices for program planning and requirements management and met with members of the task force responsible for the final restructuring decision. We also interviewed agency officials from the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), and NOAA, as well as members of the NPOESS task force and the NPOESS program office.

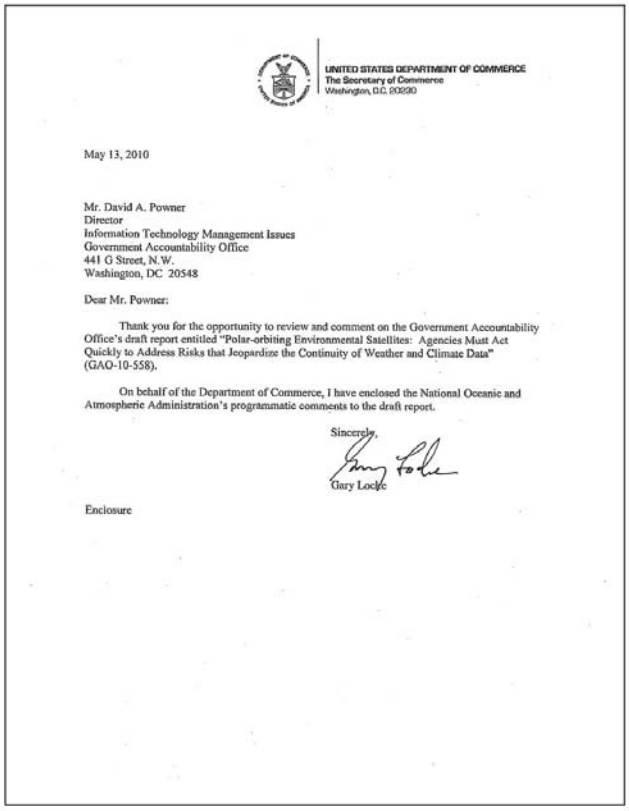
To evaluate the status and risks of key program components, we reviewed briefings, weekly updates, and monthly program management reports. We reviewed cost reports and program risk management documents and interviewed program officials to determine program and program segment risks that could negatively affect the program's ability to maintain the current schedule and cost estimates. We also interviewed agency officials from DOD, NASA, and NOAA and the NPOESS program office to determine the status and risks of the key program segments. We also observed senior-level management review meetings to obtain information on the status of the NPOESS program.

To evaluate plans for and implications of using the demonstration satellite's data operationally, we reviewed program documentation for using the demonstration satellite's data and compared them to plans for using the NPOESS satellite data. Additionally, we interviewed program office, NOAA, NASA, and DOD officials about plans for using the data.

We primarily performed our work at the NPOESS Integrated Program Office and at DOD, NASA, and NOAA offices in the Washington, D.C., metropolitan area. In addition, we conducted work at the Fleet Numerical Meteorology and Oceanography Center in Monterey, California; the Naval Oceanographic Office in Bay St. Louis, Mississippi; and the Air Force Weather Agency in Omaha, Nebraska.

We conducted this performance audit from August 2009 to May 2010 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.

Appendix II: Comments from the Department of Commerce



UNITED STATES DEPARTMENT OF COMMERCE
The Secretary of Commerce
Washington, D.C. 20230

May 13, 2010

Mr. David A. Powner
Director
Information Technology Management Issues
Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Powner:

Thank you for the opportunity to review and comment on the Government Accountability Office's draft report entitled "Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks that Jeopardize the Continuity of Weather and Climate Data" (GAO-10-558).

On behalf of the Department of Commerce, I have enclosed the National Oceanic and Atmospheric Administration's programmatic comments to the draft report.

Sincerely,

Gary Locke

Enclosure

Department of Commerce
National Oceanic and Atmospheric Administration
Comments to the Draft GAO Report Entitled
"Polar-orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks that Jeopardize the Continuity of Weather and Climate Data"
(GAO-10-558/May 2010)

General Comments

The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review the Government Accountability Office's (GAO) report on polar-orbiting environmental satellites. The following is NOAA's response to recommendations found in the draft report, as well as recommended changes for factual/technical information.

NOAA Response to GAO Recommendations

The draft GAO report states, "In order to ensure that the transition from [the National Polar-orbiting Operational Environmental Satellite System (NPOESS)] to its successor programs is efficiently and effectively managed, we recommend that the Secretaries of Defense and Commerce take the following four actions:"

Recommendation 1: "Direct their respective NPOESS follow-on programs expedite decisions on the expected cost, schedule, and capabilities of their planned programs."

NOAA Response: NOAA agrees with this recommendation. A transition team has been formed to manage the activities of transitioning the NPOESS activities to the Joint Polar Satellite System (JPSS) program. This team includes representatives from NOAA, the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD). DoD issued an Acquisition Decision Memorandum (ADM) on March 17, 2010, which directs the NPOESS Program Executive Officer to transition the NPOESS activities to JPSS and DoD (U.S. Air Force). These activities are underway. NOAA and NASA have signed a memorandum of understanding (MOU) to begin transition activities, which will focus on the cost, schedule and performance capabilities of the JPSS program.

Recommendation 2: "Direct their respective NPOESS follow-on programs to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up new program offices, loss of support for the other agency's requirements, and oversight of new program management."

NOAA Response: NOAA agrees with this recommendation. Under the NOAA NASA Transition MOU, the agencies will define the system concept for JPSS, set the level-1 requirements, establish the acquisition plans, determine the organization and staffing needed to run the program, and establish a schedule and cost baseline. Each of these will be subject to internal program management councils and to external independent review teams.

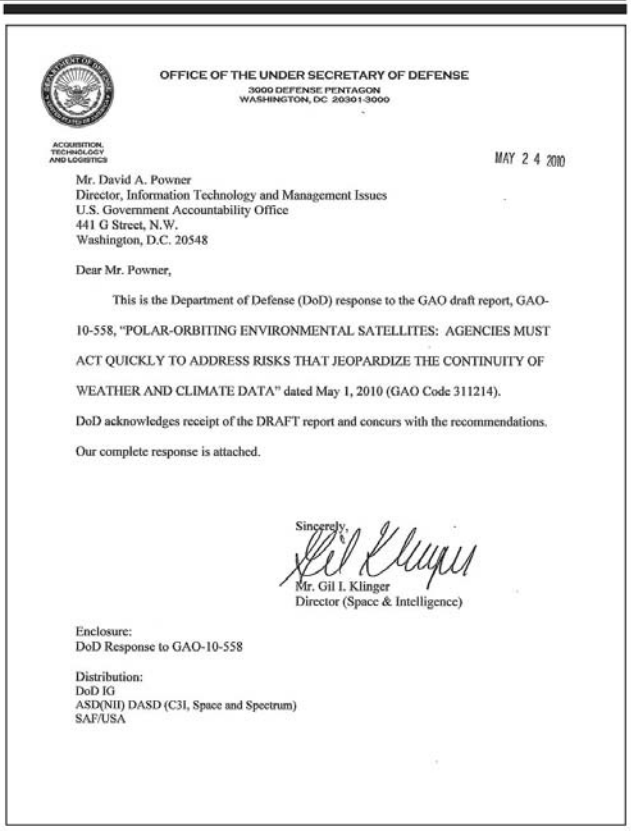
Recommendation 3: "Direct the NPOESS program office to develop priorities for work stoppage to allow the activities that are most important to maintaining launch schedules to continue."

NOAA Response: NOAA agrees with this recommendation. On March 17, 2010, DoD signed the Acquisition Decision Memorandum (ADM), "National Polar-orbiting Operational Satellite System (NPOESS) Program Restructure." In turn, the Program Executive Officer (PEO) provided ADM implementation guidance to the NPOESS System Program Director (SPD) on March 26, 2010. This guidance outlines priorities for work stoppage and provides transition guidance for those activities most important to maintaining launch schedules. Subsequently, the PEO and SPD have worked to refine the specifics of implementing the ADM.

Recommendation 4: "Direct NOAA and DOD officials to develop timeframes for making key decisions on–or accepting the risks related to–the timeliness of [NPOESS Preparatory Project's (NPP's)] data."

NOAA Response: NOAA agrees with this recommendation. The NPP data will be collected once per orbit and provided to users with timeliness comparable to the data from the current Polar-orbiting Operational Environmental Satellites (POES) and Metop satellites. NOAA continues its preparation to use NPP data on an operational basis. NOAA is also working to increase the number of products that will be available to users within the first 18 months from launch from 19 products to 54.

Appendix III: Comments from the Department of Defense



OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

MAY 24 2010

Mr. David A. Powner
Director, Information Technology and Management Issues
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Powner,

This is the Department of Defense (DoD) response to the GAO draft report, GAO-10-558, "POLAR-ORBITING ENVIRONMENTAL SATELLITES: AGENCIES MUST ACT QUICKLY TO ADDRESS RISKS THAT JEOPARDIZE THE CONTINUITY OF WEATHER AND CLIMATE DATA" dated May 1, 2010 (GAO Code 311214).

DoD acknowledges receipt of the DRAFT report and concurs with the recommendations.

Our complete response is attached.

Sincerely,

Mr. Gil I. Klinger
Director (Space & Intelligence)

Enclosure:
DoD Response to GAO-10-558

Distribution:
DoD IG
ASD(NII) DASD (C3I, Space and Spectrum)
SAF/USA

GAO DRAFT REPORT DATED APRIL 13, 2010
GAO-10-558 (GAO CODE 311214)

"POLAR-ORBITING ENVIRONMENTAL SATELLITES: AGENCIES MUST ACT QUICKLY TO ADDRESS RISKS THAT JEOPARDIZE THE CONTINUITY OF WEATHER AND CLIMATE DATA"

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense direct the DoD National Polar-Orbiting Operational Environmental Satellite System (NPOESS) follow-on program expedite decisions on the expected cost, schedule, and capabilities of their planned programs (p. 38/GAO Draft Report)

DoD RESPONSE: Concur. The DoD agrees that expedited decisions are necessary to ensure FY10 funds are applied where most needed. Decisions on the DoD early morning orbit program will be executed per established acquisition guidelines. USD(AT&L) issued Acquisition Decision Memorandums on 17 March and 10 May 2010. Decisions on capability, cost, and schedule will be made following the next round of critical decision meetings in mid June.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense direct the DoD NPOESS follow-on program to develop plans to address key transition risks, including the loss of skilled staff, delays in contract negotiations and setting up a new program office, loss of support for the other agency's requirements, and oversight of new program management. (p. 38/GAO Draft Report)

DoD RESPONSE: Concur. The DoD is assessing numerous risks associated with the transition. The DoD will ensure personnel for this effort have the requisite experience and skills (e.g. contracting, program management, systems engineering) to effectively manage the program.. The DoD will continue to work with NOAA to ensure that common areas (such as the NPOESS ground, C2, and IDPS) capabilities are arranged as necessary to support other agency needs.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense direct the NPOESS program office to develop priorities for work stoppage to allow the activities that are most important to maintaining launch schedules to continue. (p. 38/GAO Draft Report)

Attachment

DoD RESPONSE: Concur. On 17 March, the Under Secretary of Defense for Acquisition, Technology and Logistics signed the "Acquisition Decision Memorandum (ADM), National Polar-orbiting Operational Satellite System (NPOESS) Program Restructure." In turn, the Acting Program Executive Officer for Environmental Satellites (PEO/ES), provided ADM implementation guidance to the NPOESS System Program Director (SPD) on 26 March 2010. This guidance outlines priorities for work stoppage and provides transition guidance for those activities most important to maintaining launch schedules. Subsequently, the PEO and SPD have worked to refine the specifics of implementing the ADM.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense direct DoD officials to develop timeframes for making key decisions on – or accepting the risks related to – the timeliness of NPP's data (p. 38/GAO Draft Report)

DoD RESPONSE: Concur. DoD has accepted the current limitations on the timeliness of NPP data. We will continue to work with our agency partners to make sure the NPOESS follow-on data is made available in as timely a manner to support warfighter missions.

Attachment

Appendix IV: Comments from the National Aeronautics and Space Administration

National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001

MAY 14 2010

Reply to Attn of: SMD/Strategic Integration and Management Division

Mr. David A. Powner
Director, Information Technology Management Issues
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Powner:

NASA appreciates the opportunity to comment on your draft report entitled, "Polar-Orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks that Jeopardize the Continuity of Weather and Climate Data" (GAO-10-558). While no recommendations in the report were directed to NASA, the report contains a few points that require clarification.

With regard to the "Insufficient Oversight of New Program Management," section on page 28, the proper basis for comparison is not NASA's leading edge research missions, but the operational environmental satellite missions it has developed for NOAA in the past. NASA's role in the restructured program will be modeled after the procurement structure of the successful Polar Operational Environmental Satellite (POES) and Geostationary Operational Environmental Satellite (GOES) programs, where NASA and NOAA have a long and effective partnership. NOAA personnel will be integrated into the management structure and will co-chair the Program Management Councils that will govern the program. NOAA has identified and assigned a NOAA Program Director who works within the NASA Joint Agency Satellite Division to ensure timely and effective NOAA oversight.

With regard to the termination liability issue discussed on page 33, the Integrated Program Office (IPO), in consultation with NASA, NOAA, and DoD, provided direction to the prime contractor in early April that allows effort to continue through the end of the fiscal year. This plan stays within the allotted NOAA and DoD funding and maintains the termination liability funds, eliminating the necessity for a stop work order. It is critical that the sensor and ground system work continue without impact to the NPP mission environmental testing and planned launch in 2011.

Thank you again for the opportunity to review and comment on this draft report. We look forward to your final report to Congress.

Sincerely,

Edward J. Weiler
Associate Administrator for
Science Mission Directorate

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact	David A. Powner (202) 512-9286 or pownerd@gao.gov
Staff Acknowledgments	In addition to the contact named above, Colleen Phillips, Assistant Director; Kate Agatone; Neil Doherty; Franklin Jackson; Lee McCracken; and Matthew Strain made key contributions to this report.

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Congressional Relations	Ralph Dawn, Managing Director, dawnr@gao.gov, (202) 512-4400 U.S. Government Accountability Office, 441 G Street NW, Room 7125 Washington, DC 20548
Public Affairs	Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800 U.S. Government Accountability Office, 441 G Street NW, Room 7149 Washington, DC 20548

United States Government Accountability Office

GAO

Report to Congressional Committees

April 2010

ENVIRONMENTAL SATELLITES

Strategy Needed to Sustain Critical Climate and Space Weather Measurements

GAO-10-456

GAO
Accountability•Integrity•Reliability
Highlights

Highlights of GAO-10-456, a report to congressional committees

April 2010

ENVIRONMENTAL SATELLITES

Strategy Needed to Sustain Critical Climate and Space Weather Measurements

Why GAO Did This Study

Environmental satellites provide data on the earth and its space environment that are used for forecasting the weather, measuring variations in climate over time, and predicting space weather. In planning for the next generation of these satellites, federal agencies originally sought to fulfill weather, climate, and space weather requirements. However, in 2006, federal agencies restructured two key satellite acquisitions, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and the Geostationary Operational Environmental Satellite-R series (GOES-R). This involved removing key climate and space weather instruments.

GAO was asked to (1) assess plans for restoring the capabilities that were removed from the two key satellite acquisitions, (2) evaluate federal efforts to establish a strategy for the long-term provision of satellite-provided climate data, and (3) evaluate federal efforts to establish a strategy for the long-term provision of satellite-provided space weather data. To do so, GAO analyzed agency plans and reports.

What GAO Recommends

GAO is making recommendations to the President's Assistant for Science and Technology to establish and implement interagency strategies for the long-term provision of environmental observations. The Assistant's office neither agreed nor disagreed with the recommendations, but noted its plan to develop a strategy for earth observations.

View GAO-10-456 or key components. For more information, contact David A. Powner at (202) 512-9286 or pownerd@gao.gov.

What GAO Found

After key climate and space weather instruments were removed from the NPOESS and GOES-R programs in 2006, federal agencies decided to restore selected capabilities in the near term. However, neither the National Oceanic and Atmospheric Administration (NOAA) nor the Department of Defense (DOD) has established plans to restore the full set of NPOESS capabilities over the life of the program. Further, NOAA has not made any plans to restore the advanced climate capabilities of the instrument that was removed from GOES-R. Expected gaps in coverage for the instruments that were removed range from 1 to 11 years, and begin as soon as 2015. Until these capabilities are in place, the agencies will not be able to provide key environmental data that are important for sustaining climate and space weather measurements.

For over a decade, federal agencies and the climate community have clamored for a national interagency strategy to coordinate agency priorities, budgets, and schedules for environmental satellite observations over the long-term—and the governance structure to implement that strategy. In mid-2009, a White House-sponsored interagency working group drafted a report that identifies and prioritizes near-term opportunities for environmental observations; however, the plan has not been approved by key entities within the Executive Office of the President and there is no schedule for finalizing it. In addition, the report does not address costs, schedules, or the long-term provision of satellite data, and there is no process or time frame for implementing it. Without a strategy for continuing environmental measurements over the coming decades and a means for implementing it, agencies will continue to independently pursue their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and our nation's ability to understand climate change may be limited.

While federal agencies have taken steps to plan for continued space weather observations in the near-term, they lack a strategy for the long-term provision of space weather data. NOAA and DOD plan to replace aging satellites, and an interagency space weather program drafted two reports on how to mitigate the loss of key satellites and instruments. These reports were submitted to the Executive Office of the President's Office of Science and Technology Policy (OSTP) in the fall of 2009. However, OSTP has no schedule for approving or releasing the reports. Until OSTP approves and releases the reports, it will not be clear whether the reports provide a strategy to ensure the long-term provision of space weather data—or whether the current efforts are simply attempts to ensure short-term data continuity. Without a comprehensive long-term strategy for the provision of space weather data, agencies may make ad hoc decisions to ensure continuity in the near term and risk making inefficient investment decisions.

Contents

Tables

Figures

Abbreviations

DOD	Department of Defense
DMSP	Defense Meteorological Satellite Program
GOES-R	Geostationary Operational Environmental Satellite System-R series
GPS	Global Positioning System
JPSS	Joint Polar Satellite System
MetOp	Meteorological Operational (satellite)
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
POES	Polar Operational Environmental Satellites
USGEO	U.S. Group on Earth Observations
USGCRP	U.S. Global Change Research Program

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Accountability * Integrity * Reliability
United States Government Accountability Office
Washington, DC 20548

April 27, 2010

The Honorable Brian Baird
Chairman
The Honorable Bob Inglis
Ranking Member
Subcommittee on Energy and Environment
Committee on Science and Technology
House of Representatives

The Honorable Brad Miller
Chairman
The Honorable Paul Broun, Jr.
Ranking Member
Subcommittee on Investigations and Oversight
Committee on Science and Technology
House of Representatives

Environment-observing satellites provide data that are used for weather forecasting, as well as climate monitoring, prediction, and research. Current satellites provide measurements of the earth's atmosphere, oceans, land, and space environment. For example, satellites provide data on precipitation, cloud cover, sea surface temperatures, land vegetation, snow cover, and solar flares. These data are used to provide warnings of severe storms and hurricanes, and to monitor and predict seasonal, annual, and decade-long changes in the earth's temperature and ozone coverage. They are also used to observe and forecast space weather, which is when solar activities such as solar flares and solar winds are expected to affect space and earth assets (including satellites, airplanes flying at high altitudes, and the electric power grid).

In planning for the next generation of environmental satellites to help observe and predict weather and climate, federal agencies originally established plans for polar and geostationary satellites that would meet a wide variety of missions. Specifically, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program—managed by the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD)—was originally envisioned to fulfill

requirements for global observations of weather, space weather, and climate.[1] In addition, NOAA's Geostationary Operational Environmental Satellite-R series (GOES-R) program was originally envisioned to fulfill requirements for continuous observations of weather, climate, and space weather for the continental United States and adjacent oceans. However, both of these programs were restructured due to growing costs. These restructuring efforts involved removing selected climate and space weather instruments and reducing the capabilities of other instruments. As a result, the United States' ability to sustain important climate and space weather measurements over the long term was put at risk.

This report responds to your request that we (1) assess plans for restoring the capabilities that were removed from the NPOESS and GOES-R satellites, (2) evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided *climate* data, and (3) evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided *space weather* data. To assess plans for restoring the capabilities that were removed from the NPOESS and GOES-R programs, we compared the original program plans for sensors and products with current plans for these and other satellite programs and identified gaps over time. To evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided climate data, we compared plans for the provision of climate data with leading practices and past recommendations for the development of a long-term strategy, and we identified the shortfalls of and challenges to those plans. To evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided space weather data, we compared plans for the provision of space weather data with leading practices for the development of a long-term strategy, and we identified the shortfalls of and challenges to those plans. We also visited key weather, space weather, and climate facilities to obtain information related to federal strategic planning efforts for space-based observations and interviewed relevant agency officials. In addition, this

[1]During our review, the White House announced plans to restructure the NPOESS program so that NOAA and DOD would no longer continue to jointly procure the satellite system. The NOAA portion of this restructured program is called the Joint Polar Satellite System (JPSS). However, detailed plans about what the restructuring entails and when it will occur have not yet been established. Thus, in this report, we will continue to refer to this program as the NPOESS program.

report builds on work we have done on environmental satellites and climate change over the last several years.[2]

We conducted this performance audit from June 2009 to April 2010, 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. Additional details on our objectives, scope, and methodology are provided in appendix I.

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,

[2]GAO, *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, GAO-10-113 (Washington, D.C.: Oct. 7, 2009); *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); *Geostationary Operational Environmental Satellites: Acquisition is Under Way but Improvements Needed in Management and Oversight*, GAO-09-323 (Washington, D.C.: Apr. 2, 2009); *Environmental Satellites: Polar-orbiting Satellite Acquisition Faces Delays; Decisions Needed on Whether and How to Ensure Climate Data Continuity*, GAO-08-899T (Washington, D.C.: June 19, 2008); *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); *Geostationary Operational Environmental Satellites: Progress Has Been Made, but Improvements Are Needed to Effectively Manage Risks*, GAO-08-18 (Washington, D.C.: Oct. 23, 2007); *Environmental Satellite Acquisitions: Progress and Challenges*; GAO-07-1099T (Washington, D.C.: July 11, 2007); *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Challenges and Risks Remain*, GAO-07-910T (Washington, D.C.: June 7, 2007); *Polar-orbiting Operational Environmental Satellites: Restructuring Is Under Way, but Technical Challenges and Risks Remain*, GAO-07-498 (Washington, D.C.: Apr. 27, 2007); *Polar-orbiting Operational Environmental Satellites: Cost Increases Trigger Review and Place Program's Direction on Hold*, GAO-06-573T (Washington, D.C.: Mar. 30, 2006); *Geostationary Operational Environmental Satellites: Additional Action Needed to Incorporate Lessons Learned from Other Satellite Programs*, GAO-06-1129T (Washington, D.C.: Sept. 29, 2006); *Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs*, GAO-06-993 (Washington, D.C.: Sept. 6, 2006); and *Polar-orbiting Operational Environmental Satellites: Technical Problems, Cost Increases, and Schedule Delays Trigger Need for Difficult Trade-off Decisions*, GAO-06-249T (Washington, D.C.: Nov. 16, 2005).

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 trends and changes in the earth's climate. For example, these data are used to monitor and project seasonal, annual, and decadal changes in the earth's temperature, vegetation coverage, and ozone coverage.

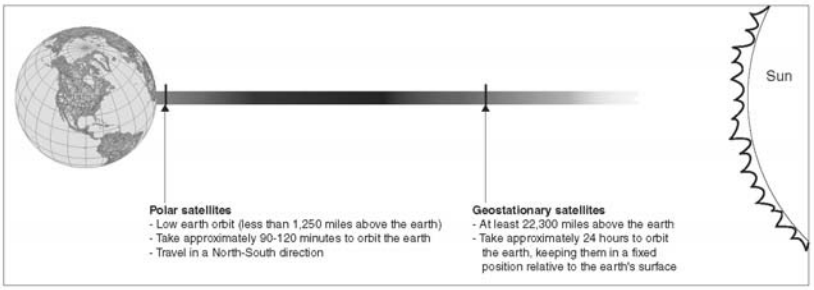
Current Environmental Satellite Programs Include Both Operational and Research Satellites

Environmental satellite programs generally fall into two categories: operational satellites and research and development satellites. Operational environmental satellites contribute to weather and climate predictions on a regular basis, and federal agencies sustain them by launching new satellites as older ones reach the end of their useful lives. Alternatively, research and development satellites are designed to test new technologies or to provide insights into environmental science. While there is not a commitment to sustain the capabilities demonstrated on research and development satellites on subsequent missions, these capabilities can be included on operational satellites if they demonstrate the usefulness of a new measurement or the maturity of new technology. Currently, the United States operates a fleet of operational environmental satellites, as well as multiple research and development satellites.

Operational Environmental Satellites

Operational environmental satellites conduct earth observations from space in either a low-earth polar orbit or a geostationary earth orbit. Polar-orbiting satellites circle the earth in an almost north-south orbit within 1,250 miles of the earth, providing global coverage of conditions that affect weather and climate. Each satellite makes about 14 orbits a day. As the earth rotates beneath it, each satellite views the entire earth's surface twice a day. In contrast, geostationary satellites maintain a fixed position relative to the earth from an orbit of about 22,300 miles in space. Figure 1 describes key characteristics of polar-orbiting and geostationary satellites.

Figure 1: Characteristics of Polar and Geostationary Satellites



Sources: GAO and MapArt.

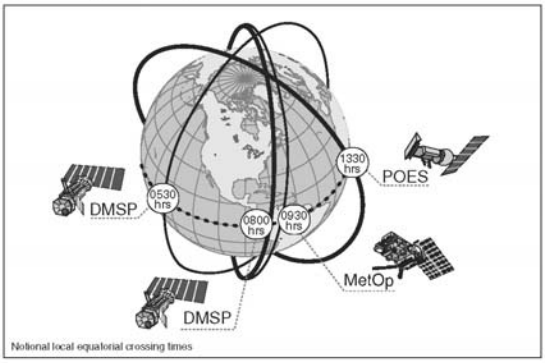
The United States currently operates two operational polar-orbiting meteorological satellite systems: the Polar Operational Environmental Satellites (POES) series, which is managed by NOAA, and the Defense Meteorological Satellite Program (DMSP), which is managed by the Air Force. The POES and DMSP programs provide data that are processed to provide graphical weather images and specialized weather products. They also provide the predominant input into numerical weather prediction models, a primary tool for forecasting weather. These satellites also provide data used to monitor environmental phenomena, such as ozone depletion, drought conditions, and energetic particle activity in the near-earth space environment, as well as data sets that are used by researchers to monitor climate change.

Currently, one POES and two DMSP satellites are positioned so that they can observe the earth in early morning, midmorning, and early afternoon polar orbits. In addition, a European satellite, called the Meteorological Operational (MetOp) satellite, provides observations in the midmorning orbit.[3] Together, they ensure that, for any region of the earth, the data

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

provided to users are generally no more than 6 hours old. Figure 2 illustrates the current operational polar satellite configuration.

Figure 2: Configuration of Operational Polar Satellites

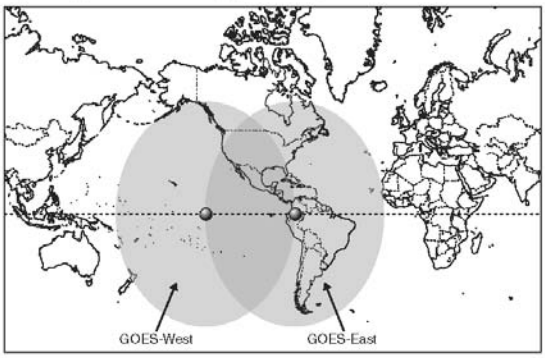


Sources: GAO analysis of NPOESS and DOD data; MapArt (globe).

NOAA, NASA, and DOD are currently developing the next generation of operational polar-orbiting environmental satellites, called NPOESS. This program was planned to converge the POES and DMSP satellite programs into a single program capable of satisfying both civilian and military requirements for earth and space weather, as well as climate monitoring. As currently defined, NPOESS consists of a series of four satellites, as well as a demonstration satellite called the NPOESS Preparatory Project (NPP). NPP is intended to reduce the risk associated with launching new sensor technologies and to ensure continuity of climate data. The agencies plan to launch NPP in 2011, with the other satellites following at regular intervals to ensure satellite coverage in two orbits through 2026. Due to poor program performance and interagency conflicts over system requirements, the NPOESS program is currently being restructured to allow separate acquisitions by NOAA and DOD. However, it is not yet clear how or when this transition will take place.

In addition to the polar satellite program, NOAA also manages an operational geostationary satellite program, called the Geostationary Operational Environmental Satellite (GOES) program. NOAA operates GOES as a two-satellite system that is primarily focused on the United States (see fig. 3). These satellites are uniquely positioned to provide broad, continuously updated coverage of atmospheric and surface conditions on the earth, as well as the space environment surrounding the earth. For example, geostationary satellites observe the development of hazardous weather events, such as hurricanes and severe thunderstorms, and track their movement and intensity to help reduce or avoid major losses of property and life. In addition, the geostationary satellites track space weather variables such as solar X-ray fluctuations and high-energy particles that are used in identifying emerging solar storms.

Figure 3: Approximate GOES Geographic Coverage



Sources: NOAA (data); MapArt (map).

NOAA is currently developing the next generation geostationary series, called GOES-R. GOES-R is expected to provide satellite data products to users more quickly and to provide better clarity and precision than prior geostationary satellites. It is expected to be a two-satellite system, launching in 2015 and 2017, and is considered critical to the United States' ability to maintain the continuity of data required for weather forecasting through 2028.

Research Satellites

In addition to operational polar and geostationary satellites, the United States operates research satellites to better understand scientific earth processes and to develop new technologies. Since the early 1990s, NASA has launched 18 research satellites under its Earth Observing System, and plans to launch 6 more by 2013.[4] These satellites continue to provide global and seasonal earth system measurements, which have provided a better understanding of human impacts on the earth, as well as improved disaster prediction and mitigation technologies. They are used both by NASA's research communities and by other agencies, including the U.S. Department of Agriculture, for operational and decision-making purposes. NASA is now planning the next generation of research satellites, called its Earth Systematic Missions program. This program consists of three series of satellites to advance understanding of the climate system and climate change. In addition to its earth observation activities, NASA has been working to understand and measure solar activity in the space environment. For example, the observations of solar winds from its Advanced Composition Explorer mission and solar X-ray images from its Solar and Heliospheric Observatory mission are used for both solar research and space weather forecasting.

DOD also develops environmental research satellites in support of its mission when a need is identified. For example, the Navy and others developed the WindSat program to demonstrate new capabilities for measuring the ocean surface wind vectors from space and to demonstrate an instrument that was originally planned for the NPOESS mission. In addition, DOD's Communication/Navigation Outage Forecasting System satellite is expected to develop a capability for detecting and forecasting space weather events that lead to disruptions in communication signals in high-frequency radios and Global Positioning System (GPS) satellites.

Environmental Satellite Data and Products

Environmental satellites gather a broad range of data that are transformed into a variety of products. Satellite sensors observe different bands of radiation wavelengths, called channels, which are used for remotely

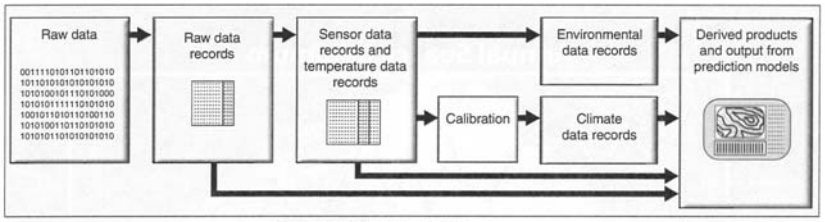
[4]NASA's Earth Observing System program consists of 24 coordinated polar-orbiting satellites designed to monitor and understand key components of the climate system and their interactions through long-term global observations. Many of these missions also have international partners. Key satellites within the Earth Observing System include the Aura satellite, which focuses on atmospheric chemistry and composition; the Aqua satellite, which focuses on the earth's water cycle, atmosphere, and land; and the Terra satellite, which focuses on land, oceans, and atmosphere.

determining information about the earth's environment. When first received, satellite data are considered raw data. To make them usable, NOAA, NASA, and DOD operate data processing centers that format the data so that they are time-sequenced and include earth location and calibration information. After formatting, these data are called raw data records. The data centers further process the raw data records into channel-specific data sets, called sensor data records and temperature data records. These data records are then used to derive weather and climate products called environmental data records and climate data records.

Environmental data records generally support near-term weather observations and include a wide range of atmospheric products detailing cloud coverage, temperature, humidity, and ozone distribution; land surface products showing snow cover, vegetation, and land use; ocean products depicting sea surface temperatures, sea ice, and wave height; and characterizations of the space environment. Combinations of these data records (raw, sensor, temperature, and environmental data records) are also used to derive more sophisticated products, including the forecasts that result from weather prediction modeling. In contrast, climate data records identify longer term variations in the climate and include observations of the land, ocean, and atmosphere.

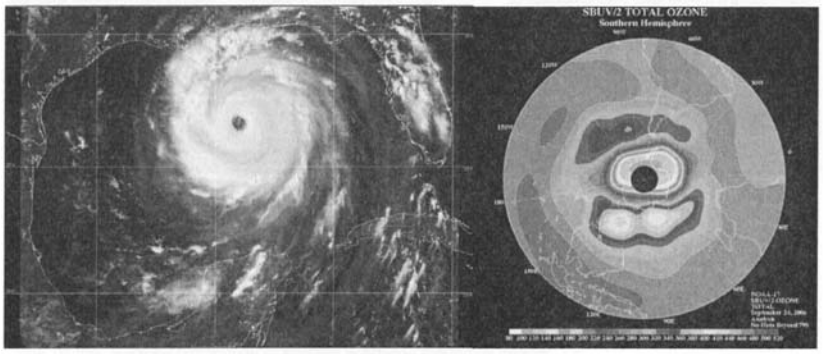
While environmental and climate data products use much of the same data, the two user communities' needs differ. In order to deliver timely weather forecasts and warnings, meteorologists require the rapid delivery of environmental data. Alternatively, scientists involved in climate monitoring, prediction, and research require accurate, precise, and consistent data over long periods of time. Figure 4 is a simplified depiction of the various stages of environmental satellite data processing, and figure 5 depicts examples of two different weather products. Figure 6 depicts an example of a climate data record.

Figure 4: Stages of Satellite Data Processing



Sources: GAO analysis of NASA and NOAA information.

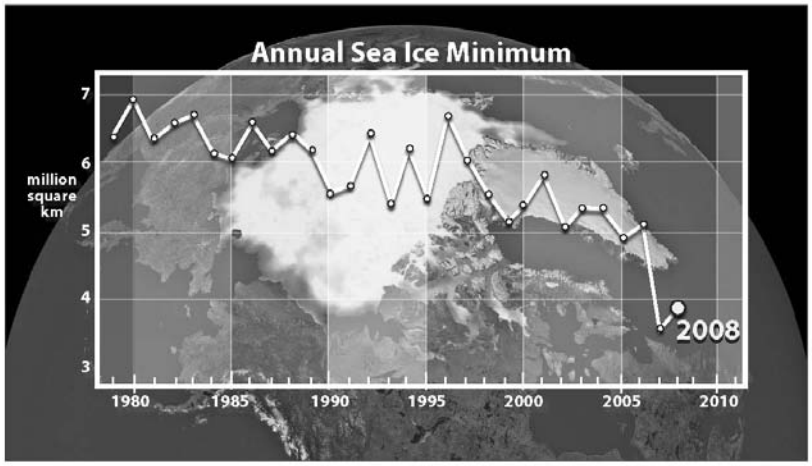
Figure 5: Examples of Weather Products



Source: NOAA's National Environmental Satellite Data and Information Service.

Note: The figure on the left is a POES Image of Hurricane Katrina in 2005, and the figure on the right is an analysis of ozone concentration produced from POES satellite data.

Figure 6: Example of a Climate Data Record



Source: NASA/Goddard Space Flight Center Scientific Visualization Studio.

Note: This image depicts the minimum sea ice concentration (the fewest number of square kilometers (km) of Arctic area covered with sea ice) in successive Septembers from 1979-2008. The data was collected by the Special Sensor Microwave/Imager sensor on DOD's DMSP satellites.

An Overview of Climate Products and Uses

One subset of satellite-provided environmental weather information is climate data. Satellite-provided climate data are used in combination with ground and ocean observing systems to understand seasonal, annual, and decadal variations in the climate. Satellites provide land observations such as measurements of soil moisture, changes in how land is used, and vegetation growth; ocean observations such as sea levels, sea surface temperature, and ocean color; and atmospheric observations such as greenhouse gas levels (e.g., carbon dioxide), aerosol and dust particles, and moisture concentration. When these data are obtained over long periods of time, scientists are able to use them to determine short- and long-term trends in how the earth's systems work and how they work

together. For example, climate measurements have allowed scientists to better understand the effect of deforestation on how the earth absorbs heat, retains rainwater, and absorbs greenhouse gases. Scientists also use climate data to help predict climate cycles that affect the weather, such as El Niño, and to develop global estimates of food crop production for a particular year or season. Table 1 provides examples of ways in which satellite-provided climate products are used.

Table 1: Examples of Satellite-Provided Climate Products and Their Uses

Products	Uses
Precipitation analysis Assesses the probability for accumulation of precipitation (rainfall or snowfall) or changes from normal precipitation amounts for given regions.	• Agricultural industry uses for decisions such as crop mixture, crop insurance needs, and timing and amount of irrigation needed. • Water managers use for plans in developing and operating water reservoirs, as well as predicting river flow. • Health officials use for studies of impacts to human health (e.g., malaria, cholera, and other water-borne diseases).
Land cover/vegetation and land use analysis Assesses the location, health, and types of plant life for given regions and areas of land that can be developed for urbanization or other land uses.	• Scientists and wildlife conservation managers use in studying the impacts of changes in land cover/vegetation on wildlife (e.g., loss of food source, habitat). • Forestry managers use for decisions on when and where to restrict burning in order to prevent wildfire outbreaks. • Transportation officials use in determining placement of highways and train routes. • Agricultural industry and humanitarian assistance planners use crop coverage to help predict world food supply and shortages. • Scientists and land use planners use to determine how certain areas will respond to changing weather, as well as to better understand global changes in greenhouse gases and the earth's heat retention.
Sea wave and wind analysis Assesses wave heights and wind conditions over the ocean to describe sea states and potentially adverse tropical weather.	• Marine cargo industry uses for routing and scheduling shipping routes. • U.S. Navy uses for military logistics and planning. • Petroleum industry uses in offshore drilling operations.
Sea ice analysis Assesses the location of ice and changes in ice characteristics.	• Marine cargo industry uses to identify available or emerging shipping routes. • U.S. Navy uses in Arctic sea ice models for long-range planning for fleet operations.
Land surface temperature analysis Assesses the probability for surface temperature ranges and deviations from normal temperatures for given regions.	• Health officials use in identifying potentially adverse health affects on humans (e.g., heat stress, disease outbreaks such as malaria and avian influenza). • Producers and consumers of natural gas and electricity use to identify changing energy demand based on changes in temperatures.
Cloud physics and aerosol analysis Assesses the presence of clouds, smoke, and dust and their impacts to satellite or aircraft instruments.	• The U.S. Air Force uses for military airborne planning and operations. • Climate scientists use to account for the effects that cloud properties may have on other satellite-based observations.

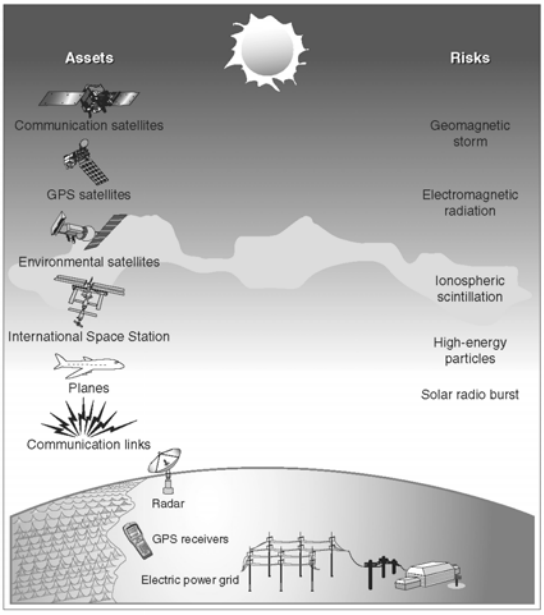
Products	Uses
Severe weather seasonal outlooks Assesses the probability of the number and severity of severe weather events such as hurricanes, floods, and tornadoes.	• Insurance industry uses in identifying potential liabilities and risk of losses. • The Federal Emergency Management Agency uses for emergency preparedness and response activities. • Weather forecasters use to help analyze the likelihood of certain weather events such as hurricanes.

Sources: GAO analysis of data from DOD, NASA, NOAA, the U.S. Group on Earth Observations (USGEO), the U.S. Global Change Research Program (USGCRP), and the National Research Council.

An Overview of Space Weather Products and Uses

Another subset of satellite-provided environmental weather information is space weather. Satellite-provided observations of space weather generally describe changes in solar activity in the space environment. Just as scientists use observations of weather that occurs on the earth's surface and in its atmosphere to develop forecasts, scientists and researchers use space weather observations to detect and forecast solar storms that may be potentially harmful to society. Examples of space weather observations include bursts of solar energy called solar flares, solar winds, geomagnetic activity associated with solar storms, solar X-ray images and fluctuations, and solar ultraviolet images and fluctuations. These activities can adversely impact space assets (such as communication, GPS, and environmental satellites), airplanes flying at high altitudes or over the poles, ground assets (such as the electric energy grid), and the communications infrastructure (including high-frequency radio communications and transmissions between GPS satellites and ground-based receivers). Figure 7 provides an illustration of the key assets that are affected by solar weather and the solar weather activities that could put these assets at risk, while table 2 provides examples of ways in which space weather products and services are used.

Figure 7: Key Assets and Risks in the Earth's Space Environment



Source: GAO.

Table 2: Examples of Satellite-Provided Space Weather Products and Their Uses

Products	Uses
Energetic particle analysis Assesses the occurrence of energetic electrons, protons, and heavy ions in space.	• Satellite operators use to protect satellite components from damage and to correct for satellite disorientation. • NASA space mission control managers use to assess potential damage to spacecraft and potential harm to astronauts. • The Federal Aviation Administration uses to assess potential radiation hazards to passengers during high-altitude flights.
Ionospheric disturbance analysis Assesses how solar activity disturbs the dynamic environment within the upper atmosphere.	• Military forces monitor for potential disruption to the Global Positioning System, which can affect military positioning, navigation, and timing of military operations. • Others interested in using GPS for land and sea-based navigation monitor for potential errors.
Solar X-rays and radio burst analysis Assesses bursts of solar radio waves and X-rays emitted from the sun.	• Satellite operators use to correct satellite orbital drift and geolocation errors. • The military uses to monitor potential radar interference, satellite communication interference, and high-frequency radio blackouts.
Solar wind analysis Assesses the path, severity, and timing of space weather events that are approaching the earth's space environment.	• Civilian and military space weather forecasters use to send out space weather warnings, watches, and alerts. • NASA researchers use to investigate the sun and its effects on the earth and solar system.
Geomagnetic storm analysis Assesses solar activity that causes disturbances of the earth's magnetic field.	• The military uses to assess potential launch trajectory errors and radar interference. • Electric power grid managers monitor for potential damage to or failure of the power grid.

Sources: GAO analysis of DOD, NOAA, and National Research Council data.

Federal Responsibilities for Environmental Satellites, Satellite Data Processing, and Climate and Space Weather Products

Three key federal agencies—NOAA, NASA, and DOD—are responsible for managing environmental satellite programs, processing the collected environmental data into usable climate and space weather products and services, and disseminating the data and products to others. Many other agencies use these data and products to support their missions. For example, the Department of Agriculture uses temperature, precipitation, and soil moisture data and products to inform farmers on what to plant, when to plant, and strategies to employ during the growing season, while the Department of Energy uses space weather information to help determine when the electrical grid could be damaged by solar events. These agencies also participate in one or more federal working groups that coordinate the agencies' needs for and uses of environmental satellite products. These interagency working groups are overseen by offices within the Executive Office of the President.

Climate Responsibilities

NOAA, DOD, and NASA manage multiple organizations with a diverse set of climate responsibilities. Specifically, NOAA has several organizations with responsibilities for developing and using satellite data to monitor and predict the earth's climate.[5] These include the following:

- The National Environmental Satellite, Data, and Information Service manages the development of environmental satellite products. It also has three data centers that archive environmental data and products related to climate, oceans, and geophysical features and disseminate these data and products to the public.
- The National Weather Service is responsible for weather, hydrologic, and climate forecasts and advisories for the United States, its territories, and adjacent waters and ocean areas for the protection of life and property and the enhancement of the national economy. Through its National Centers for Environmental Prediction's Climate Prediction Center, it disseminates products and services that describe the earth's climate and provides near-term climate predictions.
- The Office of Oceanic and Atmospheric Research has climate responsibilities focusing on understanding causes of global climate change and on improving operational climate forecasting capabilities through its Earth System Research Laboratory and Geophysical Fluid Dynamics Laboratory.

Organizations within DOD also have responsibilities for providing climate forecasts that are specifically tailored for military planning and operations. For example, the Air Force Weather Agency is responsible for providing environmental outlooks to support the Air Force and Army, including forecasts of the properties of clouds (such as density or ice content) and ground conditions to support planning for airborne and ground operations. In addition, the Navy's Naval Oceanographic Office tracks ocean currents for planning ship tracking and missions, and provides outlooks of the acoustical environment for submarines. The Navy's Fleet Numerical Meteorology and Oceanography Command provides environmental outlooks in support of naval operations, including outlooks on coastal and open ocean conditions.

[5]In February 2010, NOAA announced that it would create a NOAA Climate Service. However, it is not yet clear what the service's responsibilities will include.

NASA's Earth Science Division is responsible for advancing the understanding of the earth system and demonstrating new satellite technologies through its environmental research and development satellites. NASA currently demonstrates new measurements and technologies for measuring climate through various satellite and airborne missions, including the Earth Observing System.

In addition to NOAA, DOD, and NASA, the Department of the Interior's U.S. Geological Survey is responsible for operating the Landsat satellites, distributing the data, and maintaining an archive of Landsat 7 and other remotely sensed data.

Other agencies use climate products in their operations. For example, the Environmental Protection Agency uses sea level data and products to examine the potential societal impacts, adaptation options, and other decisions sensitive to sea level rise in coastal communities, while the Department of Homeland Security's Federal Emergency Management Agency uses climate research and predictions to help develop disaster preparedness and response plans. Additional processing and product development is done in partnership with universities, nongovernmental organizations, and industry. See appendix II for more information on federal agencies and their climate-related responsibilities.

Space Weather Responsibilities

NOAA, DOD, and NASA also manage organizations with responsibilities for space weather satellites and prediction. NOAA and DOD both obtain satellite and land-based measurements of solar activity and produce operational space weather products for a variety of users. Specifically, NOAA's National Weather Service manages the Space Weather Prediction Center, which is responsible for continuously monitoring space weather for civilian user communities, and provides official space weather warnings, watches, and alerts.[6] In addition, NOAA's National Environmental Satellite, Data, and Information Service has a data center that archives environmental data related to space weather and disseminates them to the public.

Complementing NOAA's responsibilities for civilian space weather forecasts, DOD's Air Force Weather Agency is responsible for

[6]According to agency officials, space weather warnings predict solar activities that are expected to have an impact within minutes to hours, while watches predict solar activities that are expected to have impact within 24 to 72 hours, and alerts indicate activity that has been observed or is currently ongoing.

continuously monitoring space weather for defense and intelligence user communities. The Air Force Weather Agency and NOAA products are similar, and the majority of the space weather data they use are the same. However, the Air Force customizes specialized products to provide space situational awareness for its users.[7] Both the Air Force and NOAA work together to ensure that both the civilian and military sectors understand and can respond to changes in the space environment.

NASA conducts space weather research and development activities using environmental satellites. For instance, NASA observes solar wind data from its Advanced Composition Explorer mission[8] and solar X-ray images from its Solar and Heliospheric Observatory mission to better understand the sun and its effects on the earth and solar system. Data from these satellites are used for solar research and are also used by other agencies for operational space weather forecasting, including watches and warnings.

Other federal agencies use space weather products to support their respective missions. For example, the Department of Transportation's Federal Aviation Administration examines radiation exposure at high altitudes, while the Department of Energy uses observations from space weather satellites to study possible impacts on electrical energy transmission through the energy grid. See appendix II for more information on federal agencies and their space-weather-related responsibilities.

Interagency Coordination of Satellite-Provided Environmental Observations

In addition to agencies with responsibilities for acquiring, processing and disseminating environmental data and information, there are two organizations—the U.S. Group on Earth Observations (USGEO) and the U.S. Global Change Research Program (USGCRP)—that are primarily responsible for coordinating federal efforts with respect to observations of the earth's environment. The National Space Weather Program serves as the coordinating body for space weather.

[7]Space situational awareness is an understanding of activity that is occurring in the space environment, including potential threats to space exploration and national defense readiness.

[8]The Advanced Composition Explorer is well beyond its design life and could fail at any time.

- USGEO is made up of representatives from federal agencies with a role in earth observations, as well as liaisons from the Executive Office of the President. The group's responsibilities include developing and coordinating an ongoing process for planning, developing, and managing an integrated U.S. earth-observing system consisting of ground, airborne, and satellite measurements.[9] USGEO reports to the National Science and Technology Council's Committee on Environment and Natural Resources.

- USGCRP consists of representatives from 13 federal departments and agencies, as well as liaisons from the Executive Office of the President and USGEO. Congress established USGCRP in 1990 to coordinate and integrate federal research on changes in the global environment and to discuss its implications for society. USGCRP reports to the National Science and Technology Council's Committee on Environment and Natural Resources.

- The National Space Weather Program is responsible for coordinating federal efforts and leveraging resources with respect to space weather observation. The program consists of representatives from eight federal agencies, who coordinate their activities through NOAA's Office of the Federal Coordinator for Meteorology.

Appendix III identifies the federal organizations that participate in these interagency coordination groups.

Executive Oversight of Federal Environmental Observations

The Executive Office of the President provides oversight for federal space-based environmental observation. Within the Executive Office of the President, the Office of Science and Technology Policy (OSTP), the Office of Management and Budget (OMB), and the Council on Environmental Quality carry out these governance responsibilities. In addition, the National Science and Technology Council and its Committee on Environment and Natural Resources provide the Executive Office of the President with executive-level coordination and advice. Table 3 identifies roles and responsibilities of organizations within the Executive Office of

[9]USGEO also supports the Global Earth Observation System of Systems, an international effort to share environmental data to support decision-making in nine societal benefit areas: agriculture, biodiversity, climate, disasters, ecosystems, energy, health, water, and weather. According to its charter, the Global Earth Observation System of Systems is to provide the overall conceptual and organizational framework needed to move toward integrated global earth observations to meet user needs.

the President that provide oversight of federal environmental observation efforts.

Table 3: Organizations within the Executive Office of the President That Provide Oversight of Environmental Observations

Organization	Oversight responsibility
OSTP	OSTP is responsible for, among other things, providing scientific and technical analysis with respect to major policies, plans, and programs of the federal government; leading an interagency effort to develop and implement sound science and technology policies and budgets; and building partnerships among federal, state, and local governments, other countries, and the scientific community. The Assistant to the President for Science and Technology is also the Director of OSTP.
OMB	OMB is responsible for overseeing federal program budget planning; evaluating the effectiveness of agency programs, policies, and procedures; assessing competing funding demands among agencies; and setting funding priorities.
Council on Environmental Quality	The council coordinates federal environmental efforts and works with agencies and other White House offices in the development of environmental policies and initiatives.
National Science and Technology Council	This is a cabinet-level council that coordinates science and technological policies among federal research and development entities and sets national goals for science and technology investments. The council's Committee on Environment and Natural Resources provides advice on federal research and development efforts in the area of environment and natural resources. The Assistant to the President for Science and Technology functions as the head of the council and its committees, while OSTP provides administrative support.

Source: GAO analysis of Executive Office of the President responsibilities.

Prior GAO Reports Recommended Developing Plans to Restore Cancelled Instruments

In recent years, we have issued a series of reports on the NPOESS and GOES-R satellite programs.[19] Both programs are critical to United States' ability to maintain the continuity of data required for weather forecasting and global climate monitoring through the years 2026 and 2028, respectively. However, both of these programs were restructured due to their complexity and growing costs. These restructuring efforts involved removing selected climate and space weather instruments. Specifically, on the NPOESS program, four instruments were removed and four had their capabilities reduced. On the GOES-R program, NOAA removed an advanced instrument that was important to the weather and climate community. In May 2008, we recommended that the agencies develop a long-term strategy for restoring the NPOESS sensors in order to guide

[19]The most recent GAO reports include GAO-09-564, GAO-09-323, GAO-08-518, and GAO-08-18.

short-term decision making and to avoid an ad hoc approach to restoring capabilities.[11] In addition, in April 2009, we recommended that NOAA develop a plan for restoring the advanced GOES-R capabilities that were removed from the program, if feasible and justified.[12]

Federal Agencies Have Not Established Plans to Restore All Capabilities Removed from the NPOESS and GOES-R Programs

Federal agencies have not yet established plans to restore all of the capabilities removed from the NPOESS[13] and GOES-R programs. As originally planned, the NPOESS and GOES-R programs included instruments and products to meet a wide range of user needs through 2026 and 2028, respectively. Specifically, both NPOESS and GOES-R were envisioned to fulfill requirements for weather, space weather, and climate monitoring. However, in 2006, both of these programs were restructured due to growing costs. These restructuring efforts involved removing selected climate and space weather instruments—and, in some cases, replacing them with a less-capable instrument. Table 4 lists the instruments that were removed or degraded.

Table 4: Instruments and Products Removed from the NPOESS and GOES-R Programs

Satellite program	Instrument	Instrument description	Restructuring decision/status
NPOESS	Aerosol Polarimetry Sensor	Retrieves specific measurements of clouds and aerosols (liquid droplets or solid particles suspended in the atmosphere, such as sea spray, smog, and smoke).	This instrument was cancelled from the two afternoon satellites (C1 and C3). Two products (aerosol refractive index and cloud particle size and distribution) will no longer be produced.
NPOESS	Conical-Scanning Microwave Imager/ Sounder	Collects microwave images and data needed to measure rain rate, ocean surface wind speed and direction, amount of water in the clouds, and soil moisture, as well as temperature and humidity at different atmospheric levels.	This instrument was cancelled from all four NPOESS satellites and is to be replaced by a less complex *Microwave Imager/Sounder* instrument on the second, third, and fourth NPOESS satellites. In combination with another instrument, the Microwave Imager/Sounder is expected to provide all of the products that were originally planned, except for a soil moisture product (which will be degraded).

[11]GAO-08-518.

[12]GAO-09-323.

[13]During our review, the White House announced plans to restructure the NPOESS program so that it would no longer be jointly procured. Because detailed plans for the NOAA portion (JPSS) and DOD portion have not been established, we focused on the NPOESS program.

Satellite program	Instrument	Instrument description	Restructuring decision/status
NPOESS	Earth Radiation Budget Sensor	Measures solar short-wave radiation and long-wave radiation released by the earth back into space on a worldwide scale to enhance long-term climate studies.	This instrument was cancelled from the two afternoon satellites (C1 and C3) and replaced by a legacy sensor (called the *Clouds and Earth's Radiant Energy System*) on the first satellite only. The legacy sensor is expected to provide all of the products that were originally planned.
NPOESS	Ozone Mapping and Profiler Suite (nadir/limb)	Collects data needed to measure the amount and distribution of ozone in the earth's atmosphere. Consists of two components (limb and nadir) that can be provided separately.	One part of this instrument (nadir) is to be included on NPP and on the first and third NPOESS satellites. The other part (limb) was canceled, but it will be included on NPP. Without the limb component, one product (ozone total column/profile) will be degraded.
NPOESS	Radar Altimeter	Measures variances in sea surface height/topography and ocean surface roughness, which are used to determine sea height, significant wave height, and ocean surface wind speed and to provide critical inputs to ocean forecasting and climate prediction models.	This instrument was cancelled from the two early morning satellites (C2 and C4). NOAA and the Navy are planning to procure separate altimetry satellites.
NPOESS	Space Environmental Sensor Suite	Collects data to identify, reduce, and predict the effects of space weather on technological systems, including satellites and radio links.	This sensor suite was cancelled from three NPOESS satellites (C2, C3, and C4) and replaced by a less capable and less expensive legacy sensor suite (called the *Space Environment Monitor*) on the first and third NPOESS satellites (C1 and C3). The legacy sensor will provide 5 of the 13 planned products. The 8 products that will no longer be produced include electric fields, geomagnetic fields and in situ plasma fluctuations.
NPOESS	Total Solar Irradiance Sensor	Monitors and captures total and spectral solar irradiance data.	This sensor was cancelled from the two early morning satellites (C2 and C4). NOAA plans to include a replacement sensor on the first NPOESS satellite. However, one product, solar irradiance, will no longer be produced by the second and fourth satellites.
GOES-R	Hyperspectral Environmental Suite	Measures atmospheric moisture and temperature profiles to develop weather products such as severe thunderstorm warnings and to monitor coastal regions for ecosystem health, water quality, coastal erosion, and harmful algal blooms.	This instrument was cancelled. This instrument was envisioned to provide a number of products that will be provided by another instrument. Fourteen products will not be provided. These include cloud base height, ozone layers, ocean color, turbidity, and cloud imagery.

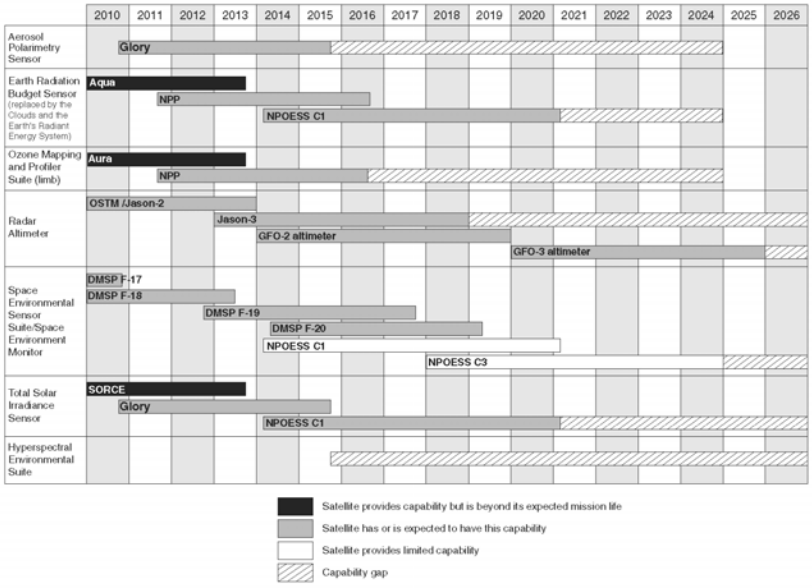
Sources: GAO analysis of NOAA, NASA, and DOD data.

Since June 2006, the agencies have taken steps to restore selected capabilities that were removed from NPOESS in the near-term; however, they do not yet have plans to restore capabilities for the full length of time covered by the NPOESS program. Specifically, the agencies decided to restore the capabilities of three NPOESS instruments through 2016 or

2021, the capabilities of a fourth instrument through 2018 for NOAA and through 2025 for the Navy, and to accept degraded capabilities in replacing a fifth instrument between 2019 and 2024.[14] The agencies have not yet made any plans to restore the capabilities of a sixth NPOESS instrument, and NOAA has not yet made plans to restore the capabilities of the GOES-R instrument. This leaves gaps in promised capabilities ranging from 1 to 11 years, depending on the instrument. Figure 8 provides a visual summary of plans and gaps in plans for key instruments through 2026.

[14]The program restored the Ozone Mapping and Profiler Suite (limb) to NPP; a Total Solar Irradiance Sensor to the first NPOESS satellite; and the Clouds and the Earth's Radiant Energy System sensor (replacing the Earth Radiation Budget Sensor) to NPP and the first NPOESS satellite. In addition, both NOAA and the Navy have taken steps to procure radar altimetry sensors to be included on other satellites. The Space Environment Monitor replaces 5 of the 13 space weather products that were to be provided by the Space Environmental Sensor Suite.

Figure 8: Current Plans and Potential Gaps in Coverage for Instruments Removed from NPOESS and GOES-R



Sources: GAO analysis of DOD, NOAA, and NASA information.

Notes: The Aqua, Aura, Glory, Ocean Surface Topography Mission (OSTM)/Jason-2, and the Solar Radiation and Climate Experiment (SORCE) satellites are part of NASA's Earth Observing System mission. The Geodectic/Geophysical Satellite Follow-On (GFO) missions (GFO-2 and GFO-3) are Navy satellites. Jason-3 is a NOAA satellite.

The Conical-Scanning Microwave Imager/Sounder is not included in this chart because NOAA, NASA and DOD agreed to include a less complex sensor on the second, third, and fourth NPOESS satellites, ensuring coverage through 2026.

Both DOD and NOAA officials reiterated their commitment to look for opportunities to restore the capabilities that were removed from NPOESS and GOES-R. However, agency officials acknowledge that they do not have plans to restore the full set of capabilities because of the complexity and cost of developing new satellite programs.

Until the capabilities that were removed from NPOESS and GOES-R are restored, there will be future gaps in key atmospheric measurements, including aerosols and key cloud properties. There will also be future gaps in oceanic measurements, including sea surface height and wave height. These gaps will reduce the accuracy of key climate and space weather products—and could lead to interruptions in the continuity of data needed for accurate climate observations over time. Meteorologists, oceanographers, and climatologists reported that these gaps will seriously impact ongoing and planned earth monitoring activities.

Federal Efforts to Ensure the Long-term Provision of Satellite Climate Data Are Insufficient

For over a decade, the climate community has clamored for an interagency strategy to coordinate agency priorities, budgets, and schedules for environmental satellites over the long term—and the governance structure to implement that strategy. Specifically, in 1999, the National Research Council reported on the need for a comprehensive long-term earth observation strategy and, in 2000, for an effective governance structure that would balance interagency issues and provide authority and accountability for implementing the strategy.[15] The National Research Council has repeated these concerns in multiple reports since then.[16] Similarly, in 1999, the Administrators of NOAA and NASA wrote letters to the White House's OSTP noting the need for an interagency strategy and

[15]National Research Council, Climate Research Committee, *Adequacy of Climate Observing Systems* (Washington, D.C.: 1999); National Research Council, Space Studies Board: Committee on Earth Studies, *Issues in the Integration of Research and Operational Satellite Systems for Climate Research: Part I. Science and Design* (Washington, D.C.: 2000).

[16]For example, see: National Research Council, Committee on a Strategy to Mitigate the Impact of Sensor Descopes and Demanifests on the NPOESS and GOES-R Spacecraft, *Ensuring the Climate Record from the NPOESS and GOES-R Spacecraft: Elements of a Strategy to Recover Measurement Capabilities Lost in Program Restructuring*, (Washington, D.C.: 2008); National Research Council, Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future, *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond* (Washington, D.C.: 2007); National Research Council, Board on Atmospheric Sciences and Climate, *From Research to Operations in Weather Satellites and Numerical Weather Prediction: Crossing the Valley of Death* (Washington, D.C.: 2000).

the means to implement it. They called for OSTP to work with OMB to better define agency roles and responsibilities and to align a satellite strategy with agency budgets. More recently, in 2008, a strategic policy research center recommended that the United States develop an overall plan for an integrated, comprehensive, and sustained earth observation system and the governance structure to support it.[17]

While progress has been made in developing near-term interagency plans, this initiative is languishing without a firm completion date, and federal efforts to establish and implement a strategy for the long-term provision of satellite data are insufficient. Specifically, in 2005, the National Science and Technology Council's Committee on Environment and Natural Resources established USGEO to develop an earth observation strategy and coordinate its implementation.[18] Since that time, USGEO assessed current and evolving requirements, evaluated them to determine investment priorities, and drafted the Strategic Assessment Report—a report delineating near-term opportunities and priorities for earth observation from both space and ground.[19] According to agency officials, this report is the first in a planned series, and it was approved by OSTP and multiple federal agencies in May 2009. However, OSTP has not yet forwarded the draft to the Committee on Environment and Natural Resources and the President's National Science and Technology Council because it is reconsidering whether to revise or move forward with the plan. USGEO officials could not provide a schedule for completing this near-term interagency plan.

This draft report is an important first step in developing a national strategy for earth observations, but it is not sufficient to ensure the long-term provision of data vital to understanding the climate. The draft report integrates different agencies' requirements and proposes continuing or improving earth observations in 17 separate areas, using both satellite and land-based measuring systems. However, the report does not include

[17]Center for Strategic and International Studies (Wigbels, Lyn et.al.), *Earth Observations and Global Change: Why? Where Are We? What Next?: A Report of CSIS Space Initiatives* (Washington, D.C.: July 2008).

[18]Interagency Working Group on Earth Observations, National Science and Technology Council, Committee on Environment and Natural Resources, *Strategic Plan for the U.S. Integrated Earth-Observation System* (Washington, D.C.: 2005).

[19]USGEO, *Observing Earth's Vital Signs, USGEO Strategic Assessment of Earth Observations: Near-Term Gaps and Opportunities (Draft)* (Washington, D.C.: May 2009).

costs, schedules, or plans for the long-term provision of satellite data. For example, it does not fully address the capabilities that were removed from the NPOESS and GOES-R missions. While the report notes the importance of continuing current plans to fly the Total Solar Irradiance Sensor on the NPP satellite and the Clouds and the Earth's Radiant Energy System sensor on the NPP and first NPOESS satellites, it does not make recommendations for what to do over the long term.

In addition, the federal government lacks a clear process for implementing an interagency strategy. Key offices within the Executive Office of the President with responsibilities for environmental observations, including OSTP and the Council for Environmental Quality, have not established processes or time frames for implementing an interagency strategy—including steps for working with OMB to ensure that agencies' annual budgets are aligned with the interagency strategy. As a result, even if an interagency strategy was finalized, it is not clear how OSTP and OMB would ensure that the responsibilities identified in the interagency strategy are consistent with agency plans and are funded within agency budgets.

Agency officials cite multiple reasons for the difficulties they have encountered over the last decade in establishing a national interagency plan for long-term earth observations. One issue involves conflicting priorities between and among agencies, including disconnects between the research and operational communities and between the weather and climate communities. Another issue is the lack of agreement on how and when to transition research capabilities to operational satellites—and how to fund them.

Without a long-term interagency strategy for satellite observations, and a means for implementing it, agencies face gaps in satellite data and risk making ad hoc decisions on individual satellites. For example, until recently, NASA's QuikScat research satellite provided measurements of the effect of wind on ocean surfaces, which were used by the National Weather Service to improve tropical and midlatitude storm warnings and by the National/Naval Ice Center to improve its understanding of Arctic and Antarctic ice environments.[29] However, NOAA does not plan to replace the satellite until at least 2014. This extended gap leaves the organizations that used QuikScat with degraded measurements. As

[29]The main antenna on the QuikScat satellite failed in November 2009, rendering it useless to forecasters. The satellite was 8 years past its expected life span.

another example, Landsat satellites have provided data on land cover change, vegetation mapping, and wildfire effects for over 35 years.[21] Currently, there are two Landsat satellites in operation, and both are long past their expected life spans. While there is a plan to develop and launch the Landsat Data Continuity Mission by June 2013, there is no commitment to ensure continuity after that mission.[22] Without Landsat or a similar satellite program, there will be a significant gap in land cover images and other important global climate data ranging from water management to agriculture.

Until an interagency strategy for earth observation is established, and a clear process for implementing it is in place, federal agencies will continue to procure their immediate priorities on an ad hoc basis, the economic benefits of a coordinated approach to investments in earth observation may be lost, and the continuity of key measurements may be lost. This will hinder our nation's ability to understand long-term climate changes.

Federal Agencies Lack a Strategy for the Long-term Provision of Space Weather Data

While key federal agencies have taken steps to plan for continued space weather observations in the near term, they lack a strategy for the long-term provision of space weather data. Similar to maintaining satellite-provided climate observations, maintaining space weather observations over the long term is important. The National Space Weather Program, the interagency coordinating body for the United States space weather community, has repeatedly recommended taking action to sustain the space weather observation infrastructure on a long-term basis.

Agencies participating in the National Space Weather Program have taken short-term actions that may help alleviate near-term gaps in space weather observations, but OSTP has not approved or released two reports that are expected to establish plans for obtaining space weather observations over the long term. Both NOAA and DOD are seeking to replace key

[21]The Landsat program is jointly managed by NASA and the U.S. Geological Survey.

[22]In August 2007, a White House working group called the Future of Land Imaging Interagency Working Group issued *A Plan for a U.S. National Land Imaging Program*. This report recommended that the Department of the Interior manage future Landsat programs and have NASA develop future satellites. However, this plan has not yet been implemented.

experimental space-observing satellites.[25] In addition, at OSTP's request, the National Space Weather Program reported in 2008 on the impacts for both operations and research of not having NASA's aging Advanced Composition Explorer or the planned space weather capabilities from the NPOESS program. It subsequently developed, again at the request of OSTP, two reports documenting specific recommendations for the future of space weather, one on what to do about the Advanced Composition Explorer and the other on the replacement of the space weather capabilities removed from the NPOESS program. The program submitted the reports in October and November of 2009, respectively. However, OSTP officials do not have a schedule for approving or releasing the reports.

While the agencies' short-term actions and the pending reports hold promise, federal agencies do not currently have a comprehensive interagency strategy for the long-term provision of space weather data. Until OSTP releases the reports, it will not be clear whether they provide a clear strategy to ensure the long-term provision of space weather data—or whether the current efforts are simply ad hoc attempts to ensure short-term data continuity. Without a comprehensive long-term strategy for the provision of space weather data, agencies may make ad hoc decisions to ensure continuity in the near term and risk making inefficient decisions on key investments.

Conclusions

Almost 4 years after key climate and space weather instruments were removed from the NPOESS and GOES-R satellite programs, there are still significant gaps in future satellite coverage. While individual agencies have taken steps to restore selected capabilities in the near term, gaps in coverage ranging from 1 to 11 years are expected beginning as soon as 2015. The gaps in satellite coverage are expected to affect the continuity of important climate and space weather measurements, such as our understanding of how weather cycles impact global food production, and

[25]NOAA has requested funding in fiscal year 2011 to refurbish NASA's Deep Space Climate Observatory spacecraft to replace the experimental Advanced Composition Explorer spacecraft and has requested funding to replace its Constellation Observing System for Meteorology, Ionosphere, and Climate. DOD issued a request for information to replace its experimental Communication/Navigation Outage Forecasting System satellite, which is designed to sense space weather that affects how the Global Positioning System, high-frequency radio, and other communications devices work in low latitude areas.

when radio and GPS satellite communications are likely to be affected by space weather.

Looking more broadly, despite repeated calls for interagency strategies for the long-term provision of environmental data (both for climate and space weather purposes), our nation still lacks such plans. Efforts to develop even short-term strategies have languished in committees and offices supporting the Executive Office of the President, and there is no schedule for them to be approved or released. Further, even if an interagency strategy for the long-term provision of environmental observations was established, there are not clear processes in place to implement it or align it with individual agencies' plans and annual budgets. Specifically, key organizations within the Executive Office of the President, including the Office of Science and Technology Policy, the Office of Management and Budget, and the Council on Environmental Quality, lack a coordinated process for ensuring that individual agencies align their plans and budgets to the greater good identified in an interagency plan.

Until the Executive Office of the President establishes comprehensive interagency strategies and internal processes that foster the implementation of these strategies, individual agencies will continue to address their most pressing priorities as they arise and opportunities to effectively and efficiently plan ahead will be lost.

Recommendations for Executive Action

In order to effectively address our country's need for sustained environmental observations, we recommend that the Assistant to the President for Science and Technology, in collaboration with key Executive Office of the President entities (including the Office of Science and Technology Policy, the Office of Management and Budget, the Council on Environmental Quality, and the National Science and Technology Council), take the following four actions:

- Establish a firm deadline for the completion and release of three key reports on environmental observations:
  - USGEO's report on near-term priorities and opportunities in earth observations, called the Strategic Assessment Report;
  - The National Space Weather Program's report on how to address the loss of the Advanced Composition Explorer capabilities; and

- The National Space Weather Program's report on how to address the space weather capabilities that were removed from the NPOESS program.

- Direct USGEO to establish an interagency strategy to address the long-term provision of environmental observations from satellites that includes costs and schedules for the satellites, as well as a plan for the relevant agencies' future budgets.

- Establish an ongoing process, with timelines, for obtaining approval of the interagency strategy and aligning it with agency plans and annual budgets.

- Direct the National Space Weather Program Council to establish an interagency strategy for the long-term provision of space weather observations.

Agency Comments and Our Evaluation

A senior policy analyst from the Office of Science and Technology Policy/Executive Office of the President provided comments on a draft of this report via e-mail. In addition, we received written comments on a draft of this report from the Secretary of Commerce, who transmitted NOAA's comments (see app. IV), and NASA's Associate Administrator for its Science Mission Directorate (see app. V). DOD officials declined to comment on a draft of the report.

The Executive Office of the President did not agree or disagree with our recommendations; however, officials noted that OSTP is currently revising USGEO's Strategic Assessment Report to update information on launch schedules and on the availability of certain measurements that have changed since completion of the report a year ago. Further, officials agreed that the Strategic Assessment Report is a first step in developing a strategy for earth observations, and noted that they plan to use the report as a basis for meeting congressional reporting requirements directing OSTP to develop a strategy on earth observations. In crafting this strategy, it will be important for OSTP to address long-term interagency needs and to work with OMB to ensure that the long-term plans are aligned with individual agencies' plans and budgets. If the plan does not include these elements, individual agencies will continue to address only their most pressing priorities, other agencies' needs may be ignored, and the government may lose the ability to effectively and efficiently address its earth observation needs.

In its comments, NOAA noted that it had completed its actions relative to delivering input to the Executive Office of the President for developing strategies for climate and space weather observations. We agree; it is now up to the Executive Office of the President to establish and implement an interagency strategy for the long-term provision of these observations. The agency also responded to our statement that it had not established plans to restore all of the capabilities that were removed from the GOES-R and NPOESS programs. Regarding GOES-R, NOAA stated that it will continue to evaluate the feasibility and priority of addressing requirements and determine the appropriate means to meet them.

Regarding NPOESS, NOAA noted that, in fiscal year 2009, the agency restored the highest priority climate sensors that were removed from the NPOESS program. NOAA also reported that the fiscal year 2011 President's Budget Request includes plans to restore additional key climate sensors on JPSS and other satellite programs. However, as discussed in our report, NOAA's efforts to restore sensors in 2009 addressed only selected near-term needs and did not address the full set of capabilities over the life of the NPOESS program. Further, regarding the fiscal year 2011 President's Budget Request, at the time of our review the full set of capabilities planned for the JPSS program had not yet been determined. For example, the Total Solar Irradiance Sensor (which was one of the high-priority sensors that was restored to the NPOESS program in fiscal year 2009) will not be included on the JPSS satellite, but could instead be included on another to-be-determined satellite. As noted several times in our report, we focused on the capabilities that were planned for the NPOESS program because plans for JPSS had not yet been finalized. We have ongoing work to examine the JPSS program, which will further evaluate NOAA's plans as they are solidified. In a final comment, NOAA stated that we did not distinguish between potential data gaps in existing and new capabilities, and suggested that we only use the term "gap" to describe the potential loss of an existing capability. Given that the requirements for the NPOESS programs were developed and validated by multiple agencies nearly a decade ago, and requirements for the GOES-R sensor were revalidated by NOAA in 2007, we believe it is appropriate to view the removal of these requirements as gaps—whether they represent existing or new capabilities.

In its written comments, NASA provided further details on its efforts to advance the understanding of earth systems and Heliophysics through environmental research satellites, and provided clarification on plans for future missions that are included in the fiscal year 2011 President's Budget Request. The agency also noted that OSTP developed a plan for the future

of the land-imaging program, under which NASA would develop future Landsat-like satellites on behalf of the Department of the Interior. However, this plan was established in 2007 and has not yet been funded or implemented. It is not clear that it will be implemented. This situation illustrates that having an approved plan is not enough to ensure that critical satellite capabilities are obtained, and reiterates the need for an ongoing process that aligns interagency strategies with individual agencies' plans and annual budgets.

OSTP, NOAA, and NASA also provided technical comments on the report, which we incorporated as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to interested congressional committees, the Secretary of Commerce, the Secretary of Defense, the Administrator of NASA, the Director of the Office of Science and Technology Policy, the Director of the Office of Management and Budget, and other interested parties. The report also will be available on the GAO Web site at http://www.gao.gov.

If you or your staff members have questions about this report, please contact me at (202) 512-9286 or pownerd@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix VI.

David A. Powner
Director, Information Technology Management Issues

Appendix I: Objectives, Scope, and Methodology

Our objectives were to (1) assess plans to restore capabilities that were originally planned for, but then removed from, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and Geostationary Operational Environmental Satellite-R series (GOES-R) satellites; (2) evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided climate data; and (3) evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided space weather data. To assess plans for restoring capabilities from the NPOESS and GOES-R programs, we compared the original program plans for sensors and products with current plans and identified gaps over time. We also observed monthly senior-level management review meetings, reviewed documentation from those meetings, and interviewed agency officials to obtain information on any changes in program plans.

To evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided climate data, we compared plans developed by the Department of Defense (DOD), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and a draft strategy developed by the Executive Office of the President's Office of Science and Technology Policy (OSTP) and the U.S. Group on Earth Observations for the provision of climate data with recommendations made by the National Research Council and GAO for the development of a long-term strategy. We identified the shortfalls of and challenges to those plans. We also visited NOAA's National Climatic Data Center, Climate Prediction Center, and Earth System Research Laboratory; the Navy's Fleet Numerical Meteorology and Oceanography Center and Naval Oceanographic Office; and the Air Force Weather Agency to obtain information on the uses and users of satellite data for climate monitoring and prediction, as well the need for interagency strategic planning for space-based climate observations. We also interviewed relevant agency officials.

To evaluate the adequacy of federal efforts to establish a strategy for the long-term provision of satellite-provided space weather data, we compared DOD, NASA, and NOAA plans for the provision of space weather data to leading practices for the development of a long-term strategy, and we identified the potential shortfalls of and challenges to those plans. We also identified OSTP plans for space weather. We attended a space weather events workshop to determine key issues related to long-term plans for space weather observations. We also visited the Air Force Weather Agency, the Space Weather Prediction Center, and NOAA's National Geophysical Data Center to obtain information on the uses and users of

satellite data for space weather monitoring and prediction, as well the need for interagency strategic planning for space weather observations. We also interviewed relevant agency officials.

We conducted our work at NOAA, NASA, DOD, and OSTP facilities in the Washington, D.C., metropolitan area. In addition, we conducted work at satellite data processing facilities in Asheville, North Carolina; Monterey, California; Boulder, Colorado; Bay Saint Louis, Mississippi; and Omaha, Nebraska. We selected these facilities because they host key military and civilian users of satellite data for weather, climate, and space weather forecasting. We conducted this performance audit from June 2009 to April 2010, 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.

Appendix II: Key Federal Organizations with Climate and Space Weather Responsibilities

Multiple agencies have a role in developing or using climate and space weather products. Table 5 lists key federal organizations' roles with respect to climate observation, while table 6 lists key federal organizations' roles with respect to space weather observation.

Table 5: Key Federal Organizations' Roles for Climate Observation

Federal agency/organization	Role/responsibility
Department of Agriculture	Monitors environmental conditions and exploits environmental observations and land remote sensing to map and monitor the health, quality, and production of US and global crop conditions for many applications including commodity price stabilization and food security. Environmental observations are used to aid in making payments to producers and as an input for monitoring program integrity for farm, conservation, and insurance programs. Environmental conditions are used as an input to monitoring forest health, wildland fire fuels, and fire behavior.
Department of Commerce/ National Oceanic and Atmospheric Administration	Monitors and predicts changes in the earth's environment and oceans and acquires and operates environmental satellites, including polar-orbiting and geostationary environmental satellites; also has multiple subagencies with responsibilities for using this satellite data to develop weather and climate products; manages the Polar Operational Environmental Satellite and Geostationary Operational Environmental Satellite programs, which provide environmental data used for developing graphical weather images and specialized weather products, forecasting weather through numerical weather prediction models and monitoring other environmental phenomena.
National Environmental Satellite, Data, and Information Service	Manages the development and operations of satellites and remote-based observations; its National Climatic Data Center stores and disseminates climate data observed through satellites and makes them accessible to the nation and public.
National Weather Service	Provides weather and climate forecasts for the protection of life and property and the enhancement of the national economy. One of several National Centers for Environmental Prediction within the National Weather Service, the Climate Prediction Center provides products and services that describe, assess, monitor, and predict (e.g., forecasts/outlooks ranging from days to seasons to years) the earth's environment.
Office of Oceanic and Atmospheric Research	Conducts analytical and theoretical climate research experiments to better understand and predict climate variability and change and to enhance society's ability to plan and respond to global change; includes labs, like the Earth System Research Laboratory, which conduct research to develop new or improved products/services and models.
Department of Commerce/ National Institute of Standards and Technology	Provides measurements and standards that support accurate and reliable climate observations; also performs calibrations and special tests of a wide range of instruments and techniques for accurate measurements.
Department of Defense	Manages the defense polar-orbiting operational satellite program, called the Defense Meteorological Satellite Program, which provides environmental data used for developing graphical weather images and specialized weather products, forecasting weather through numerical weather prediction models, and monitoring other environmental phenomena.

Federal agency/organization	Role/responsibility
U.S. Navy	Monitors environmental conditions that may impact military operations in the oceans and near coastal communities; its Fleet Numerical Meteorology and Oceanography Center monitors atmospheric and oceanographic data to provide tailored global weather forecasts and analyses on environmental conditions ranging from days to several months in advance that may affect Navy, Marine Corps, and other military planning and operations; its Naval Oceanographic Office analyzes oceanographic and hydrographic data to develop products that detail environmental conditions (e.g., acoustics and physics) from the ocean's floor to its surface.
Air Force Weather Agency	Monitors environmental conditions that may impact military operations on land, in the air, and in space; collects, analyzes, and predicts environmental information to provide tailored regional and global weather forecasts and effects caused by environmental conditions ranging from hours to several months in advance that may affect Air Force, Army, Special Operations, and intelligence community planning and operations.
Department of Energy	Conducts climate research in order to understand how energy production and use (e.g., changes in greenhouse gas and aerosol concentrations) may impact the global climate system. Develops models that simulate the effects of climate change and uses field and laboratory observations to interpret and extend the results of such model simulations.
Department of Health and Human Services	Uses satellite observations to conduct research related to environmental health and the health effects of climate changes, including effects of ultraviolet radiation/exposure (skin, eyes, immune system) and emerging infectious diseases.
Department of Homeland Security/ Federal Emergency Management Agency	Uses climate research and predictions to develop disaster preparedness and response plans.
Department of the Interior/ U.S. Geological Survey	Focuses on understanding past and present climate and their effects on landscapes, land cover and use, and ecosystems. Manages the Landsat satellite programs in conjunction with the National Aeronautics and Space Administration.
Department of State	Contributes to and participates in international coordination bodies, such as the United Nations Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change, which use U.S. climate assessments as the basis of certain findings in their international climate assessments, and helps facilitate federal agency coordination with international climate research efforts.
Department of Transportation	Conducts climate research to (1) examine the potential impacts of climate variability and change on transportation infrastructure and services; (2) increase energy efficiency and reduce greenhouse gases; and (3) improve transportation-related greenhouse gas data and modeling.
Environmental Protection Agency	Assesses the impacts of climate variability and change on air quality, water quality, aquatic ecosystems, and human health. From these assessments, it develops options for adaptation to be considered by decision makers.
National Aeronautics and Space Administration/Earth Science Division	Operates research satellites under the Earth Observing System program. Many of these satellites provide climate observations used by a variety of federal agencies, universities, and nongovernmental organizations. The agency's climate mission is to advance the state of science of the global integrated earth system, including interactions among the global and regional atmosphere, oceans, sea ice, lands, and ecosystems.
National Science Foundation	Educates the public and funds research to advance the state of science, including understanding climate elements such as physical, chemical, biological, and human systems and the interactions among them.

Federal agency/organization	Role/responsibility
Smithsonian Institution	Conducts research of atmospheric processes, ecosystem dynamics, natural and anthropogenic environmental change, and historical museum records/artifacts, as well as geologic records; its research is intended to have a long-term (i.e., decadal) perspective.
U.S. Agency for International Development	Uses satellite observations to provide U.S. and foreign decision makers—both in the United States and in the developing world—with information designed to support policy and program interventions for effective and timely response to drought and food insecurity.

Sources: GAO analysis of agency information from DOD, NASA, NOAA, the U.S. Group on Earth Observations (USGEO), and the U.S. Global Change Research Program (USGCRP).

Table 6: Key Federal Organizations' Roles for Space Weather Observation

Federal agency/organization	Role/responsibility
Department of Commerce/ National Oceanic and Atmospheric Administration	Monitors the space weather environment and provides operational forecasts, warnings, and alerts. Within the National Oceanic and Atmospheric Administration, the National Weather Service is responsible for providing weather forecasts for the protection of life and property and the enhancement of the national economy. Its Space Weather Prediction Center provides forecasts and warnings of space weather events that may impact space-based assets such as Global Positioning System (GPS) satellites, and earth-based assets such as the energy grid.
Department of Defense	Conducts space weather monitoring through the Air Force to mitigate and minimize adverse space weather impacts on operational readiness, mission operations, and military capabilities, as well as to provide military planners with space situational awareness.
Department of Energy	Uses observations from space weather satellites to detect nuclear events; in addition, it uses space weather data to examine possible impacts on electrical energy transmission (i.e., the energy grid).
Department of the Interior	Provides ground-based magnetometer data continuously from 14 observatories distributed across the United States and its territories through the U.S. Geological Survey; collects, transports, and disseminates these data for global-scale monitoring of the earth's magnetic field, which can be affected by space weather.
Department of State	The Department of State's Office of Space and Advanced Technology (OES/SAT) ensures that U.S. space policies and multilateral science activities, including space weather, support U.S. foreign policy objectives and enhance U.S. space and technological competitiveness. OES/SAT has primary responsibility for U.S. representation to the United Nations' Committee on the Peaceful Uses of Outer Space. The office also leads interagency coordination on all civil space-related international agreements and plays a key role in the implementation of National Space Policy focused on dual-use space applications such as space-based positioning, navigation, and timing, satellite-based remote sensing and earth observation, and space weather monitoring.
Department of Transportation	Examines space weather impacts to navigation (e.g., GPS) and radiation exposure at high altitudes; its Federal Aviation Administration considers space weather impacts in optimizing national and international aviation weather systems and services.
National Aeronautics and Space Administration	Develops and manages satellite operations that contribute to space weather observations; conducts research of the solar-terrestrial system to improve and advance our understanding of events and conditions in space and to develop and use new technology; explores how solar activity may potentially impact humans in space, as well as space-based assets such as solar research satellites like the Advanced Composition Explorer and Solar and Heliospheric Observatory and robotic assets that explore characteristics of other planets.
National Science Foundation	Conducts research to increase fundamental understanding of space environment processes and to improve space weather predictive capabilities.

Source: GAO analysis of agency information from the National Space Weather Program, Air Force Weather Agency, and Space Weather Prediction Center.

Appendix III: Federal Organizations That Participate in Interagency Coordination Groups

Interagency committees coordinate the interests of the multiple federal agencies whose missions involve environmental monitoring and research. These include the U.S. Global Change Research Program, which coordinates federal climate research efforts; the U.S. Group on Earth Observations, which plans for and coordinates earth observations; and the National Space Weather Program, which coordinates federal space weather monitoring, research, and forecasts. Table 7 identifies federal organizations that participate in these interagency coordination groups.

Table 7: Federal Organizations That Participate in Interagency Coordination Groups

Federal organizations	U.S. Group on Earth Observations	U.S. Global Change Research Program	National Space Weather Program
Agencies			
Department of Agriculture	X	X	
Department of Commerce	X	X	X
Department of Defense	X	X	X
Department of Energy	X	X	X
Department of Health and Human Services	X	X	
Department of Homeland Security	X		X*
Department of the Interior	X	X	X
Department of State	X	X	X
Department of Transportation	X	X	X
Environmental Protection Agency	X	X	
National Aeronautics and Space Administration	X	X	X
National Science Foundation	X	X	X
Smithsonian Institution	X	X	
U.S. Agency for International Development	X	X	
Executive Office of the President			
Council on Environmental Quality		X	
Office of Management and Budget	X	X	X
Office of Science and Technology Policy	X	X	X

Source: GAO based on interagency group documents.

*Agency officials noted that they are working with Homeland Security's Federal Emergency Management Agency to have it participate in the National Space Weather Program.

Appendix IV: Comments from the Department of Commerce

UNITED STATES DEPARTMENT OF COMMERCE
The Secretary of Commerce
Washington, D.C. 20230

April 9, 2010

Mr. David A. Powner
Director
Information Technology Management Issues
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Powner:

Thank you for the opportunity to review and comment on the Government Accountability Office's draft report entitled "Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements" (GAO-10-456). On behalf of the Department of Commerce, I have enclosed the National Oceanic and Atmospheric Administration's comments on the draft report.

Sincerely,

Gary Locke

Enclosure

Department of Commerce
National Oceanic and Atmospheric Administration
Comments to the Draft GAO Report Entitled
"Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements"
(GAO-10-456, April 2010)

General Comments

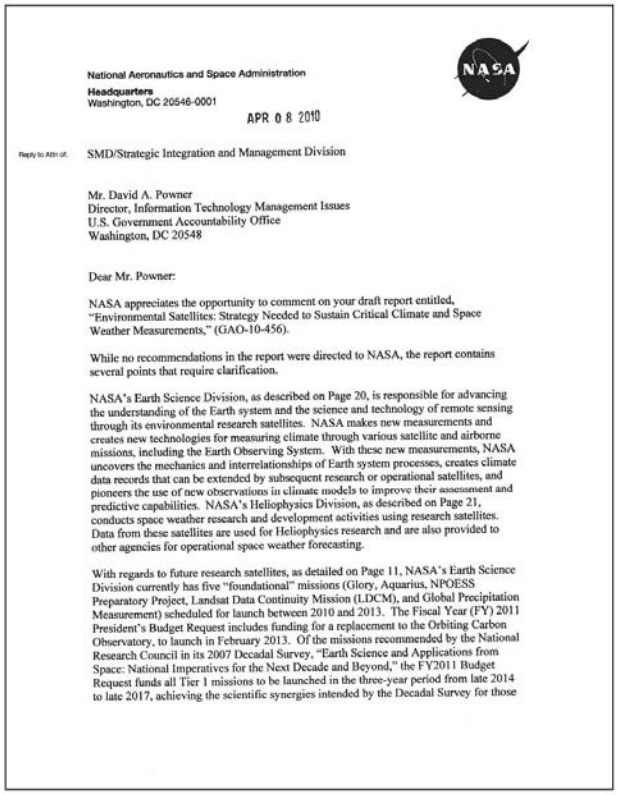
The Department of Commerce and the National Oceanic and Atmospheric Administration (NOAA) appreciate the opportunity to review this report on environmental satellites. The report describes four ongoing activities at the NOAA National Environmental Satellite, Data, and Information Service: (a) the full set of National Polar-orbiting Operational Environmental Satellite System (NPOESS) capabilities removed in 2006; (b) advanced climate capabilities for Geostationary Orbiting Environmental Satellite, Series R (GOES-R) removed in 2006; (c) a report submitted to the Executive Office of the President, which identifies and prioritizes near-term opportunities for environmental observations; and (d) two reports submitted to the White House's Office of Science and Technology Policy on how to mitigate the loss of key satellites and instruments.

The report accurately describes the status of items (c) and (d), as listed above. Our actions are complete. For item (a), the report states that NOAA has not established plans for recovering capabilities lost when NPOESS was restructured in 2006. NOAA does have a plan to restore capabilities for the climate sensors, which was implemented in fiscal year (FY) 2009, when NOAA began funding the National Aeronautics and Space Administration's (NASA) instrument development projects to restore the highest priority climate sensors that were removed from NPOESS in 2006. The FY 2011 President's budget request includes a plan for NOAA to continue restoring key climate sensors removed from NPOESS and host the climate sensors on a NOAA satellite program called the Joint Polar Satellite System (JPSS). Also included in the FY 2011 request is a plan to complete the development of the Jason 3 satellite with NASA and our European partners and plan for a continuity altimetry mission after Jason 3.

For item (b), the report states that NOAA has not made any plans to restore the advanced climate capabilities of the instrument that was removed from GOES-R. The referenced instrument is the Hyperspectral Environmental Suite (HES), an instrument concept for measuring high-resolution vertical profiles of temperature and water vapor and providing images of the coastal ocean. Early GOES-R instrument concept studies proved that the HES concept was too technically advanced to be accommodated on the GOES-R spacecraft. NOAA will continue to evaluate the feasibility and priority of addressing HES requirements and determine the most appropriate methods to meet them.

In general, the report does not differentiate between gaps in existing operational observation and delays, potential or real, in bringing new observations into operational use. We would suggest that the term "gap" only be utilized to describe potential loss of an existing operational capability or established climate record.

Appendix V: Comments from the National Aeronautics and Space Administration



National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001

APR 0 8 2010

Reply to Attn of: SMD/Strategic Integration and Management Division

Mr. David A. Powner
Director, Information Technology Management Issues
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Powner:

NASA appreciates the opportunity to comment on your draft report entitled, "Environmental Satellites: Strategy Needed to Sustain Critical Climate and Space Weather Measurements," (GAO-10-456).

While no recommendations in the report were directed to NASA, the report contains several points that require clarification.

NASA's Earth Science Division, as described on Page 20, is responsible for advancing the understanding of the Earth system and the science and technology of remote sensing through its environmental research satellites. NASA makes new measurements and creates new technologies for measuring climate through various satellite and airborne missions, including the Earth Observing System. With these new measurements, NASA uncovers the mechanics and interrelationships of Earth system processes, creates climate data records that can be extended by subsequent research or operational satellites, and pioneers the use of new observations in climate models to improve their assessment and predictive capabilities. NASA's Heliophysics Division, as described on Page 21, conducts space weather research and development activities using research satellites. Data from these satellites are used for Heliophysics research and are also provided to other agencies for operational space weather forecasting.

With regards to future research satellites, as detailed on Page 11, NASA's Earth Science Division currently has five "foundational" missions (Glory, Aquarius, NPOESS Preparatory Project, Landsat Data Continuity Mission (LDCM), and Global Precipitation Measurement) scheduled for launch between 2010 and 2013. The Fiscal Year (FY) 2011 President's Budget Request includes funding for a replacement to the Orbiting Carbon Observatory, to launch in February 2013. Of the missions recommended by the National Research Council in its 2007 Decadal Survey, "Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond," the FY2011 Budget Request funds all Tier 1 missions to be launched in the three-year period from late 2014 to late 2017, achieving the scientific synergies intended by the Decadal Survey for those

missions. Tier 2 missions are also accelerated by the Budget Request, with two to be launched by the end of 2020.

With regard to the Landsat family of satellites described on Page 20, the Landsat program is a joint effort between NASA and the U.S. Geological Survey (USGS). NASA develops and launches the Landsat satellites, while USGS is responsible for operating the satellites and distributing and archiving the data. The next Landsat mission, LDCM, is currently scheduled for launch between December 2012 and June 2013. With regards to the future of the Landsat program, as discussed on Page 32, in 2007, the Office of Science and Technology Policy issued a plan for a Department of the Interior-led U.S. National Land Imaging Program to acquire Landsat-type data beyond LDCM, but that plan has not yet been implemented. Under this construct, future Landsat-type satellites would be developed by NASA on a reimbursable basis, much like the civil weather satellites.

Thank you again for the opportunity to review and comment on this draft report. We look forward to your final report to Congress.

Sincerely,

Edward J. Weiler
Associate Administrator for
Science Mission Directorate

Appendix VI: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments	In addition to the individual named above, Colleen M. Phillips, Assistant Director; Bill Carrigg; Neil Doherty; Joshua Leiling; Kathleen S. Lovett; Lee McCracken; and Joseph D. Thompson made key contributions to this report.

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