

**U.S. HOUSE OF REPRESENTATIVES  
COMMITTEE ON SCIENCE AND TECHNOLOGY  
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT**

**HEARING CHARTER**

***Setting New Courses for Polar Weather Satellites  
and Earth Observations***

Tuesday, June 29, 2010  
10:00 AM - Noon  
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<sup>1</sup> 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)<sup>2</sup> 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,<sup>3</sup> and would manage the common data system to receive, store and share all data. These changes will be the focus of Administration witness testimony.

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<sup>1</sup> 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.*

<sup>2</sup> In concert with the Office of Management and Budget and the National Security Council.

<sup>3</sup> NOAA took on operating responsibility for Defense Meteorological Satellite Program (DMSP) satellites in 1998.

From the outset of the Committee's oversight,<sup>4</sup> 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).

**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 <sup>a</sup>	January 2011	March 2014	May 2016

Source: GAO analysis of program office and contractor data.

<sup>a</sup>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).<sup>5</sup> 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."<sup>6</sup> The Independent Review Team report stated, "**The IRT believes that this program**

<sup>4</sup> Mr. Dave Powner, GAO's witness, has testified at five of the seven previous hearings.

<sup>5</sup> 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.

<sup>6</sup> 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.

***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."<sup>7</sup> 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.<sup>8</sup> 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 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]

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<sup>7</sup> *Ibid.*; pp. 120, 125.

<sup>8</sup> 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.

- "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:

<b>Key area</b>	<b>NPOESS program after the Nunn-McCurdy decision (as of June 2006)</b>	<b>NPOESS program (as of February 2010)</b>	<b>NOAA and DOD acquisition plans (as of February 2010)</b>
Life-cycle range	1995-2026	1995-2026	JPSS: 1995-2024 DOD program: unknown
Estimated life-cycle cost <sup>a</sup>	\$12.5 billion	\$13.95+ billion <sup>b</sup>	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 <sup>c</sup> 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 <sup>d</sup> 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 <sup>e</sup> DOD program: unknown

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

<sup>a</sup>Although the life-cycle ranges for NPOESS are through 2026, the cost estimates for both NPOESS and JPSS are only through 2024.

<sup>b</sup>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.

<sup>c</sup>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.

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

<sup>e</sup>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."<sup>9</sup> 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<sup>10</sup>. For NOAA, on the other hand, the issue was time. Having no spare satellites in ground storage,<sup>11</sup> 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 5-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
<b>PM orbit:</b> Joint Polar Satellite System (NOAA and NASA costs)	2,526	382	1,061	1,160	960	740	610	4,490	11,929
<b>AM Orbit</b> DoD portion of the restructured NPOESS Program (DoD budget)	2,512	391	352	491	439	338	456	TBD	TBD
<b>Total</b>	<b>5,038</b>	<b>773</b>	<b>1,413</b>	<b>1,651</b>	<b>1,399</b>	<b>1,078</b>	<b>1,066</b>	<b>TBD</b>	<b>TBD</b>

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.

<sup>9</sup> 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.

<sup>10</sup> 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.

<sup>11</sup> The last current model, NOAA-19, has been in on-orbit storage since its launch February 6, 2009.

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.<sup>12</sup> The March submission fulfilled 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.<sup>13</sup> 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

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<sup>12</sup> Sec. 913, Public Law 111-884; October 28, 2009.

<sup>13</sup> 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.

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 the unhappy example of the GOES I-M program.<sup>14</sup> 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

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<sup>14</sup> Government Accountability Office. *WEATHER SATELLITES: Action Needed to Resolve Status of the U.S. Geostationary Satellite Program*. NSIAD-91-252. July 24, 1991.

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.<sup>15</sup> 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:

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.

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<sup>15</sup> 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.

## 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."<sup>16</sup>

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 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?

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<sup>16</sup> *Advancing the Frontiers of Space Exploration*, Barack Obama 2008, August 16, 2008. Accessed at <http://www.spaceref.com/news/viewsr.html?pid=28880> (June 24, 2010).

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 10 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."<sup>17</sup>

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

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<sup>17</sup> 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.

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 Acquisition, 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*