CONTINUING OVERSIGHT OF THE NATION'S WEATHER SATELLITE PROGRAMS: AN UPDATE ON JPSS AND GOES–R

HEARING

BEFORE THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
JOINT WITH THE
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

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WEDNESDAY, JUNE 27, 2012

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Wednesday, June 27, 2012

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Appendix 2: Additional Material for the Record

CONTINUING OVERSIGHT OF THE NATION'S WEATHER SATELLITE PROGRAMS: AN UPDATE ON JPSS AND GOES–R

WEDNESDAY, JUNE 27, 2012

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

The Subcommittees met, pursuant to call, at 2:08 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Paul Broun [Chairman of the Subcommittee on Investigations and Oversight] presiding.

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Subcommittees on Investigations & Oversight and Energy & Environment Hearing

Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES-R

Wednesday, June 27, 2011
2:00 p.m. to 4:00 p.m.
2318 Rayburn House Office Building

Witnesses

The Honorable Kathryn Sullivan, Ph.D., Assistant Secretary of Commerce for Environmental Observation and Prediction and Deputy Administrator, National Oceanic and Atmospheric Administration

Mr. Marcus Watkins, Director, Joint Agency Satellite Division, National Aeronautics and Space Administration

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

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
AND THE
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

HEARING CHARTER

Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES-R

Wednesday, June 27, 2012
2:00 PM – 4:00PM
2318 Rayburn House Office Building

Purpose

The National Oceanic and Atmospheric Administration's (NOAA) polar-orbiting and geostationary weather satellites are a fundamental aspect of our Nation's forecasting abilities. The purpose of this hearing is to examine the recent Government Accountability Office (GAO) reports on both weather satellite programs. The GAO reports titled *Geostationary Weather Satellites, Design Progress Made, but Schedule Uncertainty Needs to be Addressed* (GAO-12-576) and *Polar-Orbiting Environmental Satellites, Changing Requirements, Technical Issues, and Looming Data Gaps Require Focused Attention* (GAO-12-604) will be released at the hearing. The Committee is interested in further understanding the cost, schedule, and performance capabilities associated with NOAA's weather satellite programs.

Since 2003, there have been over ten hearings before the Science, Space, and Technology Committee or its subcommittees on NOAA's weather satellites. During this time, the GAO has played an invaluable role in monitoring the program and providing regular briefings and yearly reports. Given the present austere and uncertain funding environment, the Committee believes it is important to maintain its oversight of NOAA's weather satellite programs, which the GAO has determined are at risk of exceeding cost and schedule targets.

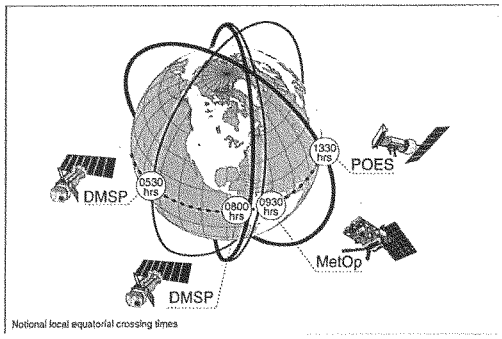
Background

Types of Satellite Systems

Since the 1960s, the U.S. has operated two separate operational polar-orbiting meteorological satellite systems, the Polar-orbiting Operational Environmental Satellite (POES) managed by the National Oceanic and Atmospheric Administration (NOAA), and the Defense Meteorological Satellite Program (DMSP) satellites developed by the Air Force. Polar-orbiting satellites transverse the globe from pole to pole, with each orbit being defined by the time of day they pass over the equator: early morning, late morning, and afternoon. Unlike geostationary weather satellites that offer persistent coverage over an area, each polar-orbiting satellite makes

approximately 14 orbits per day and is able to view the entire earth's surface twice per day. Currently, there is one operational POES satellite, the recently launched National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) satellite that has been renamed the Suomi National Polar-orbiting Partnership (S-NPP), two operational DMSP satellites, and a European satellite, called the Meteorological Operational (MetOp) satellite. Collectively, these satellites provide weather data to both the military services and NOAA's National Weather Service (NWS) that are normally no more than six hours old.

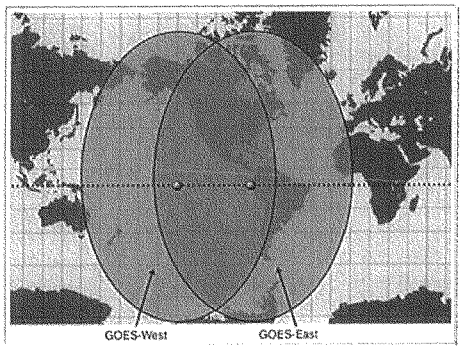
Figure 1: Configuration of Operational Polar Satellites



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

Polar-orbiting environmental satellites are equipped with an array of different sensors that collect a broad range of weather and climate data. The data is used to derive weather and climate products called environmental data records that include cloud coverage, temperature, humidity, ozone distribution, snow coverage, vegetation, sea surface temperature, sea ice and wave heights. In what has become familiar to most Americans, these environmental data records are used to produce such products as daily weather forecasts and weather prediction models.

Figure 2: Approximate GOES Geographic Coverage



In addition to polar-orbiting satellites, NOAA also operates Geostationary Observational Environmental Satellites (GOES). NOAA's GOES satellites operate from a geosynchronous orbit 22,300 miles above the Earth, which means they orbit the equatorial plane of the Earth at a speed matching the Earth's rotation. This vantage point allows the satellites to essentially "hover" continuously over one position on the surface of the earth and serve as a fixed eye on the continental United States with limited coverage of the polar regions.

The GOES system operated by NOAA utilizes two satellites – one fixed on the eastern U.S. and the other on the western U.S. At any given time, the GOES system also includes a third on-orbit "spare" called into duty either as an emergency back-up to the primary satellites or naturally sequenced into operations once an older satellite's service has degraded. There has been a GOES satellite in orbit providing continuous coverage over the U.S. since 1976. Today, there are four GOES satellites in orbit – GOES-13

and GOES-15 are operational; GOES-14 is in orbit and available as a backup, while GOES-12 is nearing the end of its service life and is providing limited coverage to South America.

Polar Orbiting Satellites

National Polar-orbiting Operational Environmental Satellite System (NPOESS)

In 1994, as part of an attempt to streamline government programs, a Presidential Decision Directive required NOAA and the DOD to converge the civilian POES and military DMSP polar-orbiting satellite systems, creating one program. Originally estimated to cost $6.5 billion over 24 years, the goal was to reduce duplication, thereby saving $1.3 billion. NPOESS also offered the opportunity for NOAA and NASA to assure continuity of the climate data that both agencies were collecting, and to claim a small portion of the Peace Dividend.[1] Instead, the NPOESS program was fraught with significant inter-agency management problems, delays, inefficiencies and severe cost overruns such that in February 2010, the Office of Science and Technology Policy (OSTP) announced a fundamental reorganization of the program.

NPOESS was established in 1994 in order to design, develop, construct and launch satellites into polar orbits so that NOAA and DOD would continue to receive daily data necessary for civilian and military weather forecasting needs. To manage the program, DOD, NOAA, and NASA formed a tri-agency Integrated Program Office (IPO). Despite the operations of the IPO, each of the agencies had individual responsibilities for the program. Responsibility for the overall management of the system and satellite operations was assigned to NOAA. The DOD was responsible for acquisition of the sensors, bus, and launch vehicle, and NASA was responsible for facilitating the development and incorporation of new technologies. In order to reduce the risk involved with developing and deploying brand new sensor technologies, the program planned to launch a demonstration satellite called the NPOESS Preparatory Project (NPP) in May 2006. The idea behind NPP was to test the viability of the new sensor technology and to validate and calibrate the sensor data collected against the existing NASA, NOAA and DOD satellites prior to the launch of the first operational satellite planned for 2008.

The Science, Space, and Technology Committee began serious oversight efforts in 2003, helping to reveal major performance problems and schedule delays for the primary imaging instrument, which caused significant cost overruns, all tied to a management structure that delayed rather than fostered decisions at critical moments. At the time, the life-cycle cost for NPOESS was roughly $6.5 billion, with the first of six satellites expected to be launched in 2009.

In 2005, the growth in cost estimates exceeded statutory limits triggering a Nunn-McCurdy[2] recertification. The recertification resulted in the elimination of two satellites and removal or downgrading of sensor capabilities - decisions driven by the Pentagon. Throughout 2006, NOAA, DOD and NASA worked to realign priorities within the restructured satellite system.

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[1] "NPOESS Lessons Evaluation," Aerospace Corporation, December 1, 2010.

[2] 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.*

Despite the similar goals of continuity of data and access to real-time weather information, NOAA and DOD differed when it came to climate-related sensors. NOAA wanted additional sensors; DOD did not consider these additional sensors a requirement, and they were removed as nonessential in the Nunn-McCurdy process. Only sensors that survived recertification would be equally funded by NOAA and DOD. Any additional sensors desired by NOAA required that full funding would come from NOAA's budget for development and incorporation of these climate sensors into the satellite system.

By 2009, the life-cycle estimate had grown to at least $14.9 billion for four satellites, the first of which would launch in 2014, and the DOD contracted with an Independent Review Team (IRT) to conduct an analysis of the chances of success of the NPOESS program. On June 1, 2009, the IRT issued a report with key findings about the program. The report determined that the current NPOESS program had an extraordinarily low probability of success.[3] The IRT also stated that although continuity of data was a critical priority for all agencies involved, it was at significant risk of gaps that could last for years. Finally, the IRT determined that NPOESS was being managed with cost as the most important parameter and not mission success. At a Science and Technology Committee hearing on June 17, 2009, witnesses testified before the Committee 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 Administration instructed a "divergence" of the NPOESS program. Satellites flying in orbits to collect early-morning observations would be developed and launched by DOD and called the Defense Weather Satellite System (DWSS). NOAA would do the same to collect observations in the afternoon orbit. NOAA would operate all the satellites while in orbit,[4] and would manage the common data system to receive, store and share all data. The late morning orbit was completely abandoned to the Europeans; the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) Polar System, which includes MetOp, is now responsible for this orbit.

JPSS

OSTP's announcement in February 2010 to split the NPOESS program included a new name for the program at NOAA, the Joint Polar Satellite System (JPSS). On March 12, 2010, OSTP issued a description of the implementation plan for the new program (see attachment A). The requirements for data to be collected did not change. NOAA will reimburse NASA to manage the JPSS program at the Goddard Space Flight Center.[5] In 2010, NOAA estimated that the life cycle costs of the JPSS program would be approximately $11.9 billion. The table below compares the planned costs, schedule and scope of the three programs over time.

Figure 3

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[3] NPOESS Independent Review Team, Final Report, June 1, 2009.
[4] NOAA took on operating responsibility for Defense Meteorological Satellite Program (DMSP) satellites in 1998.
[5] It remains to be seen how effective NASA will be in managing JPSS, as GAO listed NASA Acquisition Management on its 2011 'High Risk' Series because of "persistent cost growth and schedule slippage in the majority of its major projects."

Comparison of NPOESS to JPSS					
Key Area	**NPOESS program before it was restructured (as of May 2006)**	**NPOESS program after it was restructured (as of June 2006)**	**NPOESS program prior to being disbanded (as of February 2010)**	**NOAA and DOD acquisition plans (as of May 2010)**	**Current status**
Life cycle range	1995-2020	1995-2026	1995-2026	JPSS: 1995-2024 DWSS: not determined	2012-2028 DOD: uncertain
Estimated life cycle cost	$6.4 billion	$12.5 billion	$13.95+ billion[a]	JPSS: $11.9 billion DWSS: not determined	JPSS: $12.9 billion DOD: uncertain
Number of satellites	6 (In addition to NPP)	4 (in addition to NPP)	4 (in addition to NPP)	JPSS: 2 (in addition to NPP) DWSS: 2	JPSS: 2 (in addition to NPP, and potentially 2 other free flyers) DOD: uncertain
Number of orbits	3 (early morning, midmorning, and afternoon)	2 (early morning and afternoon; would rely on European satellites for midmorning orbit data)	2 (early morning and afternoon; would rely on European satellites for midmorning orbit data)	JPSS: 1 (afternoon orbit) DWSS: 1 (early morning orbit) (European satellites would provide midmorning orbit)	JPSS: 1 (afternoon orbit) DOD: 1 (early morning orbit) (European satellites would provide midmorning orbit)
Launch schedule	NPP by OCT 2006 C1 by NOV 2009 C2 by JUN2011	NPP by January 2010 C1 by JAN 2013 C2 by JAN 2016 C3 by JAN 2018 C4 by JAN 2020	NPP no earlier than SEP 2011 C1 by MAR 2014 C2 by May 2016 C3 by JAN 2018 C4 by JAN 2020	JPSS: *NPP- no earlier than SEP 2011 *JPSS-1 by 2015 *JPSS-2 by 2018 DWSS: no earlier than 2018	JPSS: *NPP- launched OCT 2011 *JPSS-1 no later than 2Q FY2017 *JPSS-2 no later than 1Q FY2022 *Free Flyers uncertain DOD: uncertain (2 DMSP's ready for launch, follow-on needed by roughly 2026)
Number of sensors	11 sensors and 2 user service systems	NPP: 4 sensors C1: 6 sensors C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors C1: 7 sensors[b] C2: 2 sensors C3: 6 sensors C4: 2 sensors	NPP: 5 sensors JPSS-1 and 2: 5 sensors[c] DWSS: 3 sensors	NPP: 5 sensors JPSS-1 and 2: 5 sensors Free flyers: uncertain DOD: uncertain

Source: GAO analysis of NOAA, DOD, and task force data (updated with NOAA data by Committee Staff)

[a] Although the program baseline was $13.5 billion in February 2010, GAO 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.

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

[c] The five sensors are ATMS, the Cloud and Earth Radiant Energy System (CERES), CrIS, OMPS, and VIIRS. NOAA also committed to finding an alternative spacecraft and launch accommodation for Total and Spectral Solar Irradiance Sensor, the Advanced Data Collection System, and the Search and Rescue Satellite-Aided Tracking System.

Following the decision to disband NPOESS, both NOAA and the DOD were directed to establish their own programs, establish requirements and transfer existing NPOESS contracts to the new programs. NOAA has established its JPSS program office but now plans to remove key requirements to keep the program within budget. The DOD established its DWSS program office but has now decided to terminate the program and reassess its requirements.

NOAA relies on NASA as the acquisition agency for its weather satellites. By 2011, NOAA and NASA had established separate but co-located JPSS program offices each with different roles and responsibilities delineated in an approved management control plan. NOAA is responsible for programmatic activities related to the JPSS satellite development, including managing requirements, budgets and interactions with the satellite data users. NASA is responsible for the development and integration of sensors, satellites and ground systems.

The joint NASA and NOAA JPSS team successfully launched the S-NPP satellite in October 2011 to provide data collection in the afternoon orbit. NOAA and NASA officials are currently working to complete the calibration and validation of the satellite's sensors by October 2013. According to the GAO, some issues have been encountered during this process that may lead to delays in developing satellite products.

JPSS will provide operational continuity of satellite-based observations and products for NOAA POES and the NASA Earth Observing System (EOS). The JPSS program includes five satellites, eight environmental sensors for weather and climate data, and a ground system for controlling the satellites and sensors in space as well as science data transmission and processing.

Figure 4: President's FY13 Budget Request ($ in millions)

	Prior	FY12	FY13	FY14	FY15	FY16	FY17	FY18-28	Total
FY13 PB Submit	3,380	924	917	956	959	944	921	3,889	12,890

Geostationary Satellites

GOES-R

The next-generation of GOES satellites, known as the GOES-R series, is currently under development. GOES-R is expected to significantly improve clarity and precision of environmental data and will be able to transmit that data at faster rates more frequently. Both improvements will enhance the quality and timeliness of information to the user.

In the original plan for the GOES-R program, NOAA estimated the life-cycle cost to be $6.2 billion for the period of 2007-2020 and an expected launch date in 2012. This would allow for the purchase of four satellites and included the development of two new major instruments, the Advanced Baseline Imager (ABI) and the Hyperspectral Environmental Suite (HES), as well as upgraded models of the space weather sensors. [6]

By September 2006, however, costs were escalating to a reported $11.4 billion. To reduce overall costs, NOAA significantly de-scoped the program by eliminating two of the four planned satellites and by cancelling the plans for the HES. The agency estimated the new program would cost $7 billion and would launch in December 2014.[7]

Once again in May 2007, NOAA changed its estimated life cycle cost to $7.67 billion – an increase of $670 million from the estimate reported not even a year prior. November 2007 brought more changes as many baseline program requirements were removed and treated as

[6] GAO, *Geostationary Weather Satellites: Design Progress made, but Schedule Uncertainty Needs to be Addressed* (GAO-12-576), June 2012, page 8.
[7] Ibid

contract options should funding allow. According to the GAO, the ABI instrument, which is designed to provide imagery and radiometric information of the Earth's surface, atmosphere and cloud cover, experienced technical issues primarily related to underestimating its design and development complexity. GAO went on to state:

> As a result, in September 2009, the program office rebaselined the cost and schedule targets of the Advanced Baseline Imager program. This increased contract costs from the most recent estimate of $375 million to $537 million, an increase of $162 million.[8]

In an effort to manage risks associated with the GOES-R program, significant capabilities were removed from ABI, which have resulted in an instrument that is significantly less capable than originally planned.

Most recently, NOAA decided to restore the program to the original four satellite procurement. Estimates for the GOES-R series now stand at $10.9 billion through 2036 – an increase of $3.2 billion over the previous cost estimate (for a two satellite system). The first of the series is currently scheduled to launch in October 2015.[9]

Figure 5: GOES-R Program Budget Profile

Prior Yrs ($M)	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FYTC	Total
2,792.9	615.6	802.0	950.8	844.7	781.7	706.3	578.7	2,787.6	10,860.3

The following table demonstrates key changes to the program since August 2006:

Figure 6: Key Changes to the GOES-R Program

	August 2006 (baseline program)	September 2008	November 2007	February 2011
Number of satellites	4	2	2	4
Instruments or instrument changes	• Advanced Baseline Imager • Geostationary Lightning Mapper • Magnetometer • Space Environmental In-Situ Suite • Solar Imaging Suite (which included the Solar Ultraviolet Imager, and Extreme Ultraviolet/X-Ray Irradiance Sensor) • Hyperspectral Environmental Suite	• Cancelled Hyperspectral Environmental Suite • De-coupled Solar Imaging Suite to the Solar Ultraviolet Imager and Extreme Ultraviolet/X-Ray Irradiance Sensor	No change	No change
Number of satellite products	81	68	34 baseline 31 optional	34 baseline 31 optional
Life cycle cost estimate (in then year dollars)	$6.2 billion—$11.4 billion (through 2034)	$7 billion (through 2028)	$7.67 billion (through 2028)	$10.9 billion (through 2036)*

Source: GAO analysis of NOAA data

[8] Ibid
[9] Ibid

JPSS Issues

Development of JPSS is underway; critical decisions and milestones are pending

Despite the fact that NOAA has made considerable progress in transitioning from NPOESS to JPSS, the program still faces several challenges. For instance, "selected sensors are experiencing technical issues and the impact of these issues had not yet been determined."[10] The program also faces several uncertainties, as NOAA is planning to "upgrade selected parts of the ground system to increase availability and reliability."[11] Also, "[t]he free flyer project is still in a planning stage because NOAA has not yet decided which satellites will host the instruments or when these satellites will launch."[12] Similarly, the program has not decided on a launch vehicle, and the JPSS-1 spacecraft is on the critical path with a critical design review (CDR) coming in September 2012.[13] These challenges and uncertainties call for continued oversight to ensure program and mission success.

Lack of a Cost and Schedule Baseline

NOAA has not yet established an overall program baseline that delineates the cost, schedule, and content of the entire program.[14] Managing a program without a baseline makes it more difficult for program officials to make informed decisions, and for program overseers to understand if the program is on track to successfully deliver expected functionality on cost and schedule. Program officials acknowledge that the lack of a baseline is a risk, and they are tracking it through their risk management program. Under NASA's acquisition life cycle, a program baseline is due at a key milestone scheduled for July 2013; however NOAA plans to produce an overall program baseline by the end of 2012.[15]

NOAA has not established plans to mitigate an expected gap in satellite data continuity

At the Committee's last oversight hearing of JPSS in September of last year, GAO reported that NOAA was facing a gap in satellite data continuity. GAO is now reporting that the risk of that gap is higher today, despite NOAA receiving all of the funding it requested last year. When the NPOESS program disbanded in 2010, NOAA anticipated launching satellites in 2015 and 2018. Over the past year, NOAA made changes to the program to ensure that NPP stayed on schedule. In doing so, the launch dates for JPSS-1 and JPSS-2 have been pushed back to March 2017 and December 2022, respectively. This would leave a gap of between 17 months to three years. (See figure 7)[16]

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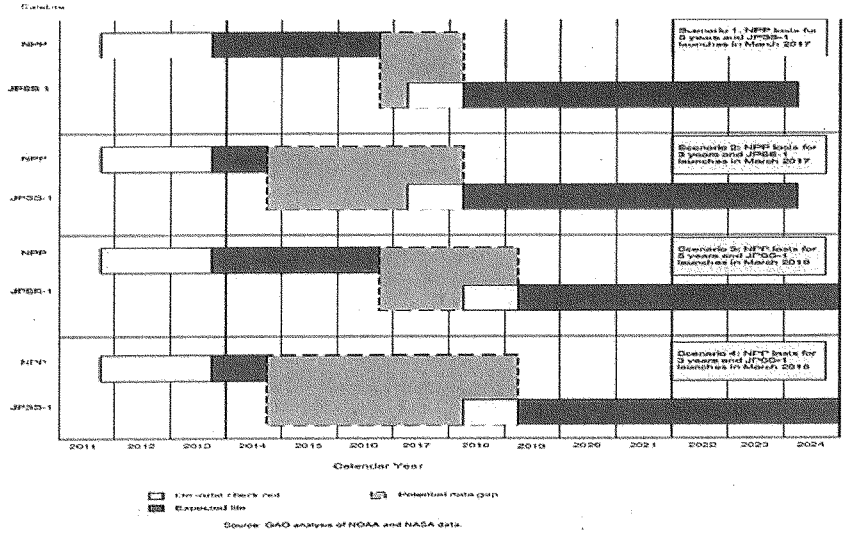
[10] GAO, *Polar-Orbiting Environmental Satellites: Changing Requirements, Technical Issues, and Looming Data Gaps Require Focused Attention*, GAO-12-604, June 2012, page 20.
[11] Ibid page 21
[12] Ibid page 19
[13] Ibid page 21
[14] Ibid page 23
[15] Ibid page 28
[16] Ibid page 26

Figure 7: Potential Gaps in Polar Satellite Data in the Afternoon Orbit



As stated above, the JPSS Program is working to mitigate the risks of a lack of a cost and schedule baseline, however, "NOAA has not established mitigation plans to address the risk of a gap in the afternoon orbit or potential satellite data gaps in the DOD and European polar satellite programs, which provide supplementary information to NOAA forecasts." As a result, GAO's JPSS report found that, "[b]ecause it could take time to adapt ground systems to receive alternative satellites' data, delays in establishing mitigation plans could leave the agency little time to leverage its alternatives."[17]

One of the main reasons the Administration has argued for full funding of the program is because of its importance to severe weather forecasting. Time and time again, the Administration indicated that insufficient funding would ensure a gap in data, which would in turn adversely affect the Nation's ability to predict extreme events such as "Snowmaggedon."[18] Even though NOAA received all of the funding it requested last year, the program's expected gap in coverage has grown. Despite NOAA's frequent warnings last year of a gap in data coverage, and their position that any gap could put lives, property, and critical infrastructure in danger, "the agency has not established plans to mitigate the gap."[19]

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[17] Ibid page 23

[18] Freedman, Andrew, "NOAA warns weather forecasts will suffer from budget cuts," Washington Post, March 31, 2011.

[19] See *supra* 10 page 27

GAO's report addresses this issue by stating, "[u]ntil NOAA identifies its mitigation options, it may miss opportunities to leverage alternative satellite data sources. Moreover, until NOAA establishes mitigation plans for a satellite data gap, it runs the risk of not being able to fulfill its mission of providing weather forecasts to protect lives, property, and commerce."[20] While NOAA has indicated that they will continue to use existing POES satellites as long as they can, and that there is no viable alternative to the JPSS program, GAO's report states that "it is possible that other government, commercial, or international satellites could supplement the data," but that it would take time to adapt NOAA systems to receive, process, and disseminate the data, "and that "[u]ntil NOAA identifies these options, it may miss opportunities to leverage these satellite data sources." [21]

NOAA has not established plans to mitigate the risk that the polar satellite constellation is becoming increasingly unreliable

As mentioned in the background section, NPOESS was designed to operate a constellation of satellites in three separate orbits (early morning, midmorning, and afternoon) so that measurements are no more than six hours old. After the Nunn-McCurdy restructuring in 2006, the program decided to rely on the European satellites for the midmorning data, and after the 2010 divergence, the program decided to rely on DOD to provide the early morning data. (It is worth noting that the European and DOD satellites will likely not fly the same instruments or collect the same data as NOAA will with the JPSS program. With respect to the early morning orbit, the National Weather Service (NWS) uses very little data from DMSP for numerical predictions, and the DOD has no plans for a follow-on program at the moment.) With regard to the entire constellation, and not just NOAA's portion, GAO reports, "recent events have made the future of this constellation uncertain."[22] GAO assessed this situation based on the following findings.

- NOAA is facing a potential gap in the afternoon orbit of between 17 and 53 months.[23]
- DOD terminated the DWSS program in early FY12. While it is developing plans for a follow-on program, "there are considerable challenges in ensuring a new program is in place and integrated with existing ground systems and data networks in time to avoid a gap in this orbit."[24] DOD does have two satellites in storage available for launch when needed; however, "civilian and military satellite experts have expressed concern that the DMSP satellites are quite old and may not work as intended," which could lead to a gap in this orbit as early as 2014.[25]
- For the mid morning orbit, NOAA will continue to rely on the European MetOp satellites which Eumetsat plans to launch until 2021. After that, the Europeans are proposing a follow-on program called Eumetsat Polar System-2nd Generation. In 2011, NOAA informed European officials that "due to the constrained budgetary environment, they will no longer be able to provide sensors for the follow-on program." As GAO states in

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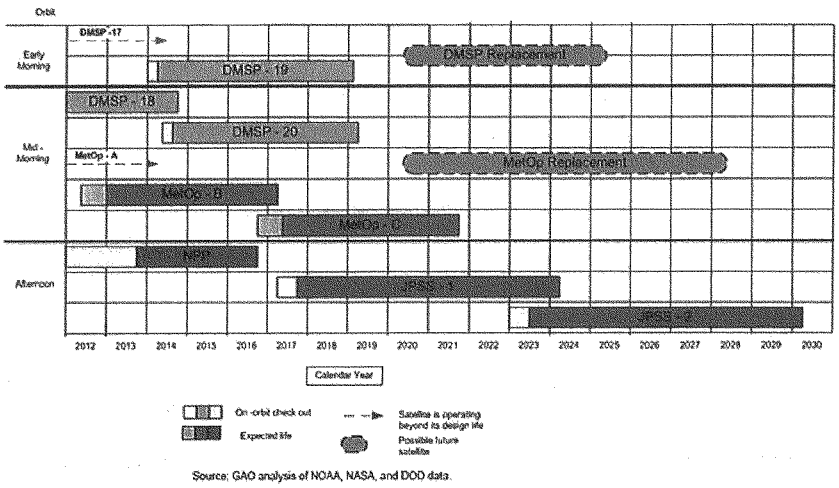
[20] See *supra* 10 page 27
[21] Ibid
[22] Ibid
[23] See *supra* 10 page 28
[24] Ibid
[25] Ibid

its report, "[d]ue to the uncertainty surrounding the program, there is a chance that the first European follow-on satellite will not be ready in time to replace MetOp at the end of its expected life. In that case, this orbit, too, would be in jeopardy."[26]

Figure 8: Polar Satellite Constellation



Source: GAO analysis of NOAA, NASA, and DOD data.

DOD and the Early Morning Orbit

The now defunct NPOESS program was first conceived of as a way to create synergies, reduce duplication, and find efficiencies between the separate polar orbiting weather satellites being developed, acquired, and operated by DOD and NOAA. As history has shown, the experiment failed miserably. Despite this failure, the DOD and NOAA still incorporate data from each other's current operational systems. NOAA and the NWS use data and imagery from the DMSP satellites, particularly to assist in the imaging of Alaska and other regions not covered continuously by the GOES system, and to get additional data beyond what is provided by the POES satellites. Similarly, the DOD receives data from the POES satellite to complement data derived from the DMSP satellites. DOD also uses NOAA ground stations.

After the initial divergence of the polar-orbiting programs, DOD initiated the DWSS program. The Administration eventually cancelled the program altogether in early 2012. DOD is not under the same schedule pressure as NOAA, and it is not facing a similar gap in coverage, as they have two DMSP satellites already built and waiting to launch when needed. Concerns have been raised, however, about the reliability of the DMSP satellites that have not been launched,

[26] Ibid

because the longer they sit in storage, the less confidence managers have that they will meet their expected operation capability when launched.[27]

Despite the divergence, NOAA and DOD interests are still related. The program decisions that each agency makes will have a direct impact on not only the other agency's system, but also the Nation's weather monitoring and forecasting capabilities as a whole. What instruments DOD decides to procure not only has a direct impact on what data NOAA can use to supplement its own data, but also the costs of sensor acquisition for future satellites, as well as risk reduction. Additionally, continued coordination is required to be able to receive and use data from each system in a meaningful manner that maximizes the full potential of each sensor and satellite.

Finally, as GAO mentioned in its JPSS report, the health of the entire polar-orbiting constellation is at risk,[28] and a contributor to this risk is the uncertainty associated with the DOD's program.

Cost Growth

From January to December 2011, NOAA conducted an independent cost estimate and validated that the cost of the full set of JPSS functions from FY12 through FY28 would be $11.3 billion. After adding sunk costs of $3.3 billion, the program's life cycle estimate totaled $14.6 billion. This amount is $2.7 billion higher than the $11.9 billion estimate for JPSS after the divergence in 2010 due to a program extension of four years, the addition of free flyers, cost growth associated with transitioning contracts from DOD to NOAA, and the program's decision to delay work because of budget uncertainties in 2011.[29]

Cost Cap

The President's FY13 budget proposal to Congress included a lifecycle cost cap for the JPSS program. This cost cap for the program is separate from the baseline reporting requirements outlined in statute.[30] It is also worth noting that despite assurances from the Administration, this cost cap can be breached simply with a new budget proposal, or OMB approval. In its analysis, GAO notes that the $12.9 billion life cycle cost cap is $1.7 billion below the independent cost estimate conducted last year.[31] How that shortfall is addressed is a key concern, as it could mean the descoping of sensors, diminished capabilities, a schedule slip, or a cost increase.

Free Flyers

One of the largest uncertainties associated with the current JPSS program is what NOAA plans to do with the Free Fliers - those satellites and sensors not associated with JPSS-1 or JPSS-2, but originally part of the NPOESS program. These free flyers are included in the JPSS program budget and the life cycle cost cap, but it is uncertain what the exact manifests will be, what the

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[27] See *supra* 10, page 28
[28] See *supra* 10, page 29
[29] See *supra* 10 page 13
[30] P.L. 109-155, P.L. 110-161, and P.L. 112-55
[31] See *supra* 10 page 18

cost estimates will be for the bus or ride share contribution, what the sensor development or launch schedule is, what launch vehicle NOAA will use, or what mission they will "share."

Many of the sensors and instruments that are being considered for this portion of the program are subject to international agreements. The SARR and SARP instruments are part of the international Cospas-Sarsat system designed to detect and locate Emergency Locator Transmitters (ELTs), Emergency Position-Indicating Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs). These instruments are provided by France and Canada and are scheduled for delivery in January of 2015, even though one component of the system is five months late. A-DCS provides worldwide in-situ environmental data collection and Doppler-derived location service with the basic objective of studying and protecting the Earth environment. This system was developed by the French and is expected to be delivered in May 2013. Additionally, TSIS TIM and TSIS SIM are also being considered for free flyers. The TSIS instruments are environmental sensors that measure the solar radiation striking the Earth. TSIS was originally demanifested as part of the Nunn-McCurdy process, reinstated by the Bush Administration two years later, demanifested again with the Obama Administration's decision to break up the NPOESS program, and restarted again in last year's budget submission.

The uncertainty associated with the free flyer program complicates the definition of requirements for the entire program, which in turn calls into question cost estimates as well as schedule milestones. Until the free flyer portion of the program is further defined it could pose a significant risk to the overall program. With the Administration capping the overall cost of the program at $12.9 billion, and a gap in coverage limiting schedule flexibility, few options exist for program managers to react to unforeseen problems. The descoping or demanifesting of sensors from the free flyer portion of the program may be one of those few options.

Restoration of Climate Sensors

NOAA priorities for JPSS lean heavily towards the continuity of weather observations. This includes continuing mission operations and ground system sustainment for S-NPP; launching JPSS-1 as early as possible; flying CrIS and ATMS on JPSS-1 and JPSS-2, launching JPSS-2 no later than the first quarter of 2022; and flying VIIRS on JPSS-1 and JPSS-2. The next priority NOAA has is meeting its obligation to not exceed the life cycle cost cap of $12.9 billion. NOAA prioritizes all other mission needs after those two elements. NOAA defines other mission requirements as the accommodation of A-DCS by the first quarter of 2017; the accommodation of TSIS as soon as possible, but no later than the first quarter of 2015; flying CERES on JPSS-1; and flying an OMPS-Nadir capability on JPSS-1 and JPSS-2. TSIS, CERES, and OMPS are climate sensors. A-DCS is an environmental data collection sensor supplied by France. Collectively, the Administration's FY2013 budget request for climate sensors is $17 million in 2013 and $203 million over the life of the program (See figure 9). The $12.9 billion life cycle cost cap reflects the initial $11.9 billion lifecycle cost cap adjusted for four years of additional operations and the inclusion of the Restoration of Climate Sensor Programs into JPSS.

Figure 9. President's FY13 Budget Request ($ in millions)

	Prior	FY12	FY13	FY14	FY15	FY16	FY17	FY18-28	Total
JPSS	3,380	924	900	900	900	900	900	3,883	12,687
Climate			17	56	59	44	21	6	203
FY13 PB Submit	3,380	924	917	956	959	944	921	3,889	12,890

Senate Proposal to Move NOAA Satellite Programs to NASA

The Senate Appropriations Committee, in their FY13 appropriations bill funding NOAA and NASA, has created a new budget account at NASA called Operational Satellite Acquisition. The Senate proposal recommends transferring $1.64 billion from NOAA to NASA for the procurement of operational weather satellites. While the funding level for the four satellite programs matches the Administration's FY13 request the transition of funding from NOAA to NASA effectively ends NOAA's management of its satellite acquisitions. The following chart depicts the Senate's proposed budget for each of the affected satellite programs.

Figure 10: NOAA Satellite Funding

Satellite	Funding (in millions)
GOES-R Series	$746.7
JPSS	$842
Deep Space Climate Observatory	$30
Jason-3 altimetry mission	$22.3
Total	**$1,641**

Although NASA already is the acquisition agency for NOAA's operational satellites, the Senate proposal directs NASA to work with NOAA to incorporate NOAA's operational requirements, reduce the overall life-cycle costs of the satellite programs and transfer the satellites to NOAA once they are launched and have completed all system checks. The Senate Appropriations Committee estimates the transfer will result in a savings of $117 million in FY13.

Senator Barbara Mikulski, chairwoman of the Senate Appropriations Commerce, Justice, State, subcommittee, said, "Unfortunately, the Committee has lost confidence in NOAA's ability to control procurement costs or articulate reliable funding profiles. Therefore, we have taken the unprecedented step of transferring responsibility for building our Nation's operational weather satellites from NOAA to NASA,"[32]

The Administration has yet to issue an official Statement of Administration Policy (SAP) to Congress.

[32] Chamberlain, Kenneth, "NASA Budget Would Be More of the Same... on the Surface," National Journal, May 18, 2012.

GOES-R Issues

Milestones

In 2007, NOAA developed the GOES-R management control plan which outlined schedules for the preliminary design review (PDR) and the critical design review (CDR) - two important steps in the development and acquisition of a program. The management control plan indicated that the flight project's PDR was to take place in April of 2010, and the CDR was to take place in July 2010. Similarly, the ground projects PDR was scheduled for July 2010 and the CDR was scheduled for July 2011. While the program has demonstrated progress towards completing its design, having completed the program PDR and working toward the program CDR later this summer, no aspect of the program (flight, ground, and program) completed their PDRs on time. While some portions were as much as 17 months late, "NOAA still expects to meet an October 2015 launch date for the first satellite in the series by utilizing planned schedule reserves."[33]

Technical Challenges Remain for Flight Segment

Despite considerable progress on the flight portion of the program, GAO's report highlights that, "each of the instruments and the spacecraft has recently encountered technical challenges." While NOAA has worked to address many of these challenges, some remain, such as signal blurring on the Advanced Baseline Imager's infrared channels and Geostationary Lightning Mapper emissions that are exceeding specifications.[34]

Ground Requirements and Schedule Issues Led to Revised Development Plan

In early 2011, NOAA discovered that the "software design requirements had not progressed enough to conduct the ground system's preliminary design review."[35] GAO's report found that the "ground system's development schedule included software deliveries from flight project instruments that were not properly integrated."[36] In order to address these problems, NOAA significantly revised the Core Ground System's baseline development plan and schedule by modifying its software development delivery plans. This change will result in a cost increase of $85 million.[37] Similarly, the program has cancelled a Core Ground System contract option worth approximately $50 million that was previously part of its original baseline. NOAA has indicated that this work could be done in-house after GOES-R is launched, but it has no plan in place to do so.[38]

Rising Costs and Depleting Reserves

Although NOAA has not changed its program cost estimates for the development of GOES-R and GOES-S, contact costs for the instruments, spacecraft, and ground system are rising.

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[33] See *supra* 6 page 16.
[34] See *supra* 6 page 17
[35] See *supra* 6 page 18
[36] Ibid
[37] Ibid
[38] See *supra* 6 page 19

Specifically, contractor estimated costs for flight and ground project components grew by $757 million, or 32 percent between January 2010 and January 2012, with the majority of the increases occurring in the last year. (See figure 8)[39] This has directly impacted program reserves. As GAO's report points out, between January 2009 and January 2012, the program reported that its reserves fell from 1.7 billion to 1.2 billion, a roughly 30 percent reduction.[40]

Figure 11: Growth in Estimated Contract Cost for Major Program Components

Major Components	Original contract award date	Percent complete (Nov 2011)	Contractor estimate at completion (Jan 2010)[a]	Contractor estimate at completion (Jan 2011)[a]	Contractor estimate at completion (Jan 2012)[a]	2 year change ($M)	2 year change (%)
Advanced Baseline Imager	Sep 2004	83%	$524M	$581M	$672M	+$148M	+28%
Space Environmental In-Situ Suite	Aug 2006	54%	69	81	97	+28	+41%
Extreme Ultraviolet/ X-Ray Irradiance Sensor	Aug 2007	58%	72	81	81	+9	+13%
Solar Ultraviolet Imager	Sep 2007	62%	139	168	182	+43	+31%
Geostationary Lightning Mapper	Dec 2007	57%	157	209	252	+95	+61%
Spacecraft	Dec 2008	32%	711	743	862	+151	+21%
Core Ground System	May 2009	29%	704	792	976	+272	+39%
Antennas	July 2010	37%	Not applicable[b]	119	130	+11[c]	+9%
Totals			2,376	2,774	3,252	+757[c]	+32%[c]

Sources: GAO analysis of NOAA and contractor-reported data.

[a] Contractor reported most likely estimate at completion.

[b] The antenna contract was not awarded until July 2010.

[c] Total 2-year change includes the 1-year change in antenna contract costs.

This is cause for concern because "about two-thirds of the development remains for the program's two most expensive components - the spacecraft and the Core Ground System."[41] Because of this concern, "the program's independent review board recently raised questions about the sufficiency of the program's near-term remaining reserves."[42] NOAA maintains that its reserves are within acceptable thresholds based on planned remaining development costs, however the program is now entering a phase in its program when cost and schedule growth are common. Furthermore, as GAO points out, "While the program may be within accepted levels as of February 2012, the reserves may not be matched to remaining development. Although the program restored two satellites to its budget baseline in February 2011, thereby adding approximately $3.2 billion to its total budget, it did not correspondingly change its program reserves. As a result, GAO states, "there is limited assurance that the reserves are appropriate for each satellite's remaining development."[43]

Integrated Master Schedule and Some Subordinate Schedules are Unreliable - Could Impact Launch Schedule

GAO explains the importance of having accurate and up to date schedules in its report by stating,

[39] See *supra* 6 page 20
[40] See *supra* 6 page 22
[41] Ibid
[42] See *supra* 6 page 23
[43] See *supra* 6 page 24

> "[t]he success in management of a large-scale program depends in part on having an integrated and reliable schedule that defines, among other things, when work activities and milestone events will occur, how long they will take, and how they are related to one another. Without such a schedule, program milestone may slip.[44]

In its findings, GAO concluded that, "[w]hile the GOES-R program has adopted certain scheduling best practices at both the program-wide and contractor levels, unresolved weaknesses also exist, some of which have contributed to current program milestone delays and a re-plan of the Core Ground System's schedule."[45] Similarly, GAO also stated that, "[w]ithout a proper understanding of current program status that a reliable schedule provides, managing the risks of the GOES-R program becomes more difficult and may result in potential delays in GOES-R's launch date."[46]

Although GOES-R has an Integrated Master Schedule (IMS) that is created manually once a month directly from contractor schedules, GAO believes that a dynamic IMS that automatically updates is appropriate for a program of GOES-R's size and complexity, and NOAA is in the process of developing such a schedule.[47] However, when GAO reviewed contractor level data to evaluate the reliability of the program-wide IMS, they found "weaknesses in each of the subordinate schedules when compared to the best practices and, when viewed in conjunction with manual program-level updates, [they] concluded that the program-level schedule may not be fully reliable."[48] In summarizing the state of the GOES-R program's schedule, GAO stated that, "[u]ntil the program implements a full set of schedule best practices, and uses it on succeeding schedule updates throughout the life of the program, further delays in the program's launch date may occur."[49]

Potential GOES Gap

According to GAO, "[t]he program recently determined that the likelihood of the first satellite meeting its planned October 2015 launch date is 48 percent. Based on this planned launch date, the program reports that there is a 37 percent chance of a gap in the availability of two operational GOES-series satellites." [50] With a likely gap in the afternoon orbit of the polar-orbiting program, and the possibility of gaps in all of the polar-orbits, any gap in geostationary coverage would be catastrophic.

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[44] See *supra* 6 page 25
[45] Ibid
[46] Ibid
[47] See *supra* 6 page 26
[48] See *supra* 6 page 26
[49] Ibid
[50] See *supra* 6 page 32-33

Attachment A

Detailed Instrument Descriptions

CrIS

Cross-track Infrared Sounder (CrIS) is the first in a series of advanced operational sounders that will provide more accurate, detailed atmospheric temperature and moisture observations for weather and climate applications. This high-spectral resolution infrared instrument will take 3-D pictures of atmospheric temperatures, water vapor and trace gases. It will provide over 1,000 infrared spectral channels at an improved horizontal spatial resolution and measure temperature profiles with improved vertical resolution to an accuracy approaching 1 Kelvin (the absolute temperature scale). This information will help significantly improve climate prediction and both short-term weather "nowcasting" and longer-term forecasting. It will also provide a vital tool for National Oceanic and Atmospheric Administration (NOAA) to take the pulse of the planet continuously and assist in understanding major climate shifts. The CrIS instrument is developed by the ITT Corporation, Ft Wayne, Indiana.

OMPS

Ozone in the atmosphere keeps the Sun's ultraviolet radiation from striking the Earth. The Ozone Mapping and Profiler Suite (OMPS) will measure the concentration of ozone in the atmosphere, providing information on how ozone concentration varies with altitude. Data from OMPS will continue three decades of climate measurements of this important parameter used in global climate models. The OMPS measurements also fulfill the U.S. treaty obligation to monitor global ozone concentrations with no gaps in coverage. OMPS is comprised of two sensors, a nadir sensor and limb sensor. Measurements from the nadir sensor are used to generate total column ozone measurements, while measurements from the limb sensor generate ozone profiles of the along-track limb scattered solar radiance. The OMPS instrument is developed by the Ball Aerospace & Technologies Corporation, Boulder, Colorado.

VIIRS

Visible/Infrared Imager Radiometer Suite (VIIRS) will combine the radiometric accuracy of the Advanced Very High Resolution Radiometer (AVHRR) currently being flown on the NOAA polar orbiters with the high spatial resolution (0.56 km) of the Operational Linescan System (OLS) flown on DMSP. The VIIRS will provide imagery of clouds under sunlit conditions in about a dozen bands, and will also provide coverage in a number of infrared bands for night and day cloud imaging applications. VIIRS will have multi-band imaging capabilities to support the acquisition of high-resolution atmospheric imagery and generation of a variety of applied products including visible and infrared imaging of hurricanes and detection of fires, smoke, and atmospheric aerosols. VIIRS will also provide capabilities to produce higher-resolution and more accurate measurements of sea surface temperature than currently available from the heritage AVHRR instrument on POES, as well as provide an operational capability for ocean-color observations and a variety of derived ocean-color products. The VIIRS instrument is developed by the Raytheon Company, El Segundo, California.

ATMS

The Advanced Technology Microwave Sounder (ATMS) will operate in conjunction with the CrIS to profile atmospheric temperature and moisture. The ATMS is the next generation cross-track microwave sounder that will combine the capabilities of current generation microwave temperature sounders (Advanced Microwave Sounding Unit – AMSU-A) and microwave humidity sounders (AMSU-B) that are flying on NOAA's POES. The ATMS draws its heritage directly from AMSU-A/B, but with reduced volume, mass and power. The ATMS has 22microwave channels to provide temperature and moisture sounding capabilities. Sounding data from CrIS and ATMS will be combined to construct atmospheric temperature profiles at 1 degree Kelvin accuracy for 1 km layers in the troposphere and moisture profiles accurate to 15 percent for 2 km layers. Higher (spatial, temporal and spectral) resolution and more accurate sounding data from CrIS and ATMS will support continuing advances in data assimilation systems and NWP models to improve short- to medium-range weather forecasts. The ATMS instrument is developed by the Northrop Grumman Corporation, Azusa, California.

CERES

The CERES measurements seek to develop and improve weather forecast and climate models prediction, to provide measurements of the space and time distribution of the Earth's Radiation Budget (ERB) components, and to develop a quantitative understanding of the links between the ERB and the properties of the atmosphere and surface that define that budget. The observations from CERES are essential to understanding the effect of clouds on the energy balance (energy coming in from the sun and radiating out from the earth), which is one of the largest sources of uncertainty in our modeling of the climate.

TSIS

TSIS measures the variability in the Sun's total output using two sensors. The Total Irradiance Monitor (TIM) is a broadband measurement while Spectral Irradiance Monitor (SIM) measures the spectral distribution of the solar irradiance between 0.2 & 2.7 μm. There is no operational heritage, but this instrument suite will continue the capabilities from the research measurements of TSIS on NASA's SORCE mission.

SARSAT

The Search and Rescue instruments are part of the international Cospas-Sarsat system designed to detect and locate Emergegency Locator Transmitters (ELTs), Emergency Position-Indication Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs).

A-DCS

The Advanced Data Collection System (A-DCS) provides a worldwide in-situ environmental data collection and Doppler-derived location service with the basic objective of studying and protecting the Earth environment.

Chairman BROUN. This joint hearing of the Subcommittee on Investigations and Oversight on the Committee of Science will come to order. This Joint Committee meeting with Subcommittee on Energy and Environment.

Good afternoon. First, I apologize for running late. I was on the floor, and please forgive me, my colleagues as well as all our witnesses, for running late, and I appreciate you all's patience.

Welcome to today's joint hearing entitled, "Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES–R."

In front of you are packets containing the written testimony, biographies, and truth in testimony disclosures for today's witnesses. Before we get started, since this is a joint hearing involving two Subcommittees, I want to explain how we will operate procedurally, so that all Members will understand how the question-and-answer period will be handled.

As always, we will alternate between the majority and minority and allow all Members the opportunity for questions before recognizing a Member for a second round of questions. We will recognize those Members that were present here at the gavel in order of seniority on the full Committee and those coming in after the gavel will be recognized in their order of arrival.

I now recognize myself for five minutes for an opening statement.

This is the ninth hearing this Committee has held on either the National Polar-Orbiting Environmental Satellite System, NPOESS, Program, or its successor, the JPSS Program, since 2003. That does not even include hearings related to Geostationary Observational Environmental Satellite and weather satellites in general. This level of oversight, continued under both Republican and Democratic administrations as well as Congresses, is indicative of how important weather satellites are to our society and to Members of Congress. Without both polar and geostationary satellites, our weather forecasting ability would be severely compromised.

Because of the importance of these programs, it is frustrating to watch them struggle. The original polar satellite program, NPOESS, was supposed to cost taxpayers $6.5 billion. That was supposed to get the taxpayers six satellites operating in three separate orbits, carrying 13 instruments which would launch around 2010. Instead, we now have a program that will only purchase three satellites and will operate in only one orbit and cost twice as much.

To make matters worse, one of those satellites is a research satellite that was never intended to serve operationally. NOAA is now dependent upon European partners for data from the mid-morning orbit, and it is anyone's guess what data the Department of Defense will supply from the early morning orbit.

Even more frustrating is the fact that this program still does not have a baseline cost or a schedule. I understand that NOAA is working towards developing this, but as they point out, the ground segment has already passed its critical design review, all of its contracts are signed, JPSS–1's instruments are 60 to 95 percent complete, and the spacecraft will essentially be a clone of the NPP bus, all indications of a mature program.

To quote the GAO report, not having a baseline, "makes it more difficult for program officials to make informed decisions and for program overseers to understand if the program is on track to successfully delivering expected functionality on cost and schedule."

I understand that NOAA has committed to developing a program under a lifecycle cost cap of $12.9 billion, but with an impending gap in coverage that limits schedule flexibility, the only option that NOAA may have to manage program risk is to diminish capability. I am also concerned that this $12.9 billion cap is $1.7 billion lower than the independent cost estimate conducted just last year.

I look forward to monitoring how NOAA decides to cover that shortfall and any future challenges. Just since our hearing last fall, the program has grown by $1 billion as a result of extending the program by four years, the addition of free flyers, contract transitions, and a work slowdown because of the 2011 budget. Also, the schedule has slipped approximately three months. One of the most concerning findings from the GAO report on JPSS pertains not to cost increases or schedule gaps in NOAA's afternoon orbit, but to the health of the entire polar orbiting constellation.

GAO points out that because of uncertainties in DOD's early morning orbit, as well as the European's mid-morning orbit, there is a risk of a data gap in each orbit, not just NOAA's. After the 2010 decision to split up the program, NOAA was only given responsibility for the afternoon orbit, but it is clear that the parties need to coordinate to identify synergies and to mitigate risks to the entire constellation.

GOES–R, on the other hand, seems to be making progress toward delivering its spacecraft and ground system within cost and schedule. This wasn't always the case, as the program was significantly de-scoped in 2007 in order to prevent cost growth and schedule slips. Still, there are some findings in the GAO report that require monitoring, such as the rate at which the program is burning through reserves and the fidelity of its schedules. Most concerning, however, is the GAO finding that there is only a 48 percent chance that the program will meet its 2015 launch date, and that there is a 37 percent chance that there will be a gap in the availability of two operational GOES-series satellites.

A gap in one program is bad enough. A gap in both programs would and could be—could and would be catastrophic.

I would be remiss if I did not at least mention the Senate Appropriations proposal to transfer the weather satellite programs from NOAA to NASA. I hope NOAA and NASA can provide their thoughts on this proposal, specifically how it would impact the current programs as well as the rest of their agencies.

I know these oversight hearings can sometimes be tough, but considering NOAA's current position, the House may be one of the agency's few friends, maybe the last friend. I hope not.

The Administration has proposed moving NOAA into the Department of Interior, and the Senate has proposed gutting the satellite program from NOAA, effectively removing $2 billion of NOAA's $5 billion budget. The Committee has a positive working relationship with the satellite sector of NOAA, which is typically forthcoming with information. Unfortunately, this was not the case with questions the Committee posed to NOAA last fall after the last hearing.

Although we sent questions on October 17, we did not receive a response until June 7, eight months later. I certainly hope NOAA will be more responsive to the questions that we will have after this hearing.

[The prepared statement of Dr. Broun follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT CHAIRMAN PAUL C. BROUN

I want to extend a warm welcome to our witnesses and thank them for appearing today.

This is the ninth hearing this Committee has held on either the National Polar-Orbiting Environmental Satellite System (NPOESS) program or its successor, the JPSS program, since 2003. That does not even include hearings related to the Geostationary Observational Environmental Satellite (GOES) and weather satellites in general. This level of oversight, continued under both Republican and Democratic administrations and Congresses, is indicative of how important weather satellites are to our society. Without both polar and geostationary satellites, our weather forecasting ability would be severely compromised.

Because of the importance of these programs, it is frustrating to watch them struggle. The original polar satellite program, NPOESS, was supposed to cost $6.5 billion. That was supposed to get the taxpayers six satellites, operating in three separate orbits, carrying 13 instruments, which would launch around 2010. Instead, we now have a program that will only purchase three satellites; that will operate in only one orbit; and cost twice as much. To make matters worse, one of those satellites is a research satellite that was never intended to serve operationally; NOAA is now dependent on European partners for data from the midmorning orbit, and it's anyone's guess what data the Department of Defense (DOD) will supply from the early morning orbit.

Even more frustrating is the fact that this program still does not have a baseline for cost and schedule. I understand that NOAA is working towards developing this, but as they point out, the ground segment has already passed its critical design review, all of its contracts are signed, JPSS–1's instruments are 60 to 95 percent complete, and the spacecraft will essentially be a clone of the NPP bus—all indicators of a mature program. To quote the GAO report, not having a baseline "makes it more difficult for program officials to make informed decisions and for program overseers to understand if the program is on track to successfully deliver expected functionality on cost and schedule."

I understand that NOAA has committed to developing the program under a life cycle cost cap of $12.9 billion, but with an impending gap in coverage that limits schedule flexibility, the only option that NOAA may have to manage program risk is to diminish capability. I am also concerned that this $12.9 billion cap is $1.7 billion lower than the independent cost estimate conducted last year. I look forward to monitoring how NOAA decides to cover that shortfall and any future challenges. Just since our hearing last fall, the program has grown by $1 billion as a result of extending the program by four years, the addition of free flyers, contract transitions, and work slowdown because of the 2011 budget. Also, the schedule has slipped approximately three months.

One of the most concerning findings from the GAO report on JPSS pertains not to cost increases or schedule gaps in NOAA's afternoon orbit, but to the health of the entire polar-orbiting constellation. GAO points out that because of uncertainties in DOD's early morning orbit, as well as the Europeans' midmorning orbit, there is a risk of a data gap in each orbit, not just NOAA's. After the 2010 decision to split up the program, NOAA was only given responsibility for the afternoon orbit, but it is clear that the parties need to coordinate to identify synergies and mitigate risks to the entire constellation.

GOES–R, on the other hand, seems to be making progress toward delivering its spacecraft and ground system within cost and schedule. This wasn't always the case, as the program was significantly descoped in 2007 in order to prevent cost growth and schedule slips. Still, there are some findings in the GAO report that require monitoring, such as the rate at which the program is burning through reserves, and the fidelity of its schedules. Most concerning, however, is the GAO finding that there is only a 48 percent chance that the program will meet its 2015 launch date, and that there is a 37 percent chance that there will be a gap in the availability of two operational GOES-series satellites.

A gap in one program is bad enough. A gap in both programs would be catastrophic.

I would be remiss if I did not at least mention the Senate Appropriations proposal to transfer the weather satellite programs from NOAA to NASA. I hope NOAA and NASA can provide thier thoughts on this proposal, specifically how it would impact the current programs as well as the rest of their agencies.

I know these oversight hearings can sometimes be tough, but considering NOAA's current position, the House may be one of the agency's few friends. The Administration has proposed moving NOAA into the Department of Interior, and the Senate has proposed gutting the satellite program from NOAA, effectively removing $2 billion of NOAA's $5 billion budget. The Committee has a positive working relationship with the satellite sector of NOAA, which is typically forthcoming with information. Unfortunately, this was not the case with questions the Committee posed to NOAA last fall after the last hearing. Although we sent questions on October 17, we did not receive a resonse until June 7—eight months later. I certainly hope NOAA will be more responsive to the questions we will have after this hearing.

Chairman BROUN. Now, I recognize Mr. Tonko, my good friend from New York, for his opening statement.

Mr. TONKO. Thank you, Mr. Chair, and thank you to our witnesses.

This Committee has been holding hearings to ask critical questions of the satellite programs since at least 2003. We have seen cycles of disaster as when we witnessed the JPSS, in its prior imposed guise, double in cost before the entire enterprise was redesigned and rebaselined.

We have witnessed Herculean efforts to restructure acquisition plans to get problems under control. Frankly, despite these efforts, we have not had much to cheer about with JPSS, and even GOES–R has been a source of concern.

However, my sense is that both of these programs are on sustainable paths. That said, it appears that an auditor at GAO could build a pretty good 20-year career out of simply tracking the weather satellite program, and that is a sorry state of affairs.

The group that sits before us today is not responsible for the mess. Rather, we are counting on them to get us out of a mess they inherited. It is our job to probe the answers they offer, assess whether the programs appear robust, and offer whatever advice and support we can to get these satellites launched and operating. Believe me, if we could have altered these acquisitions, we could have—would have, but these satellites and the instruments that are to fly on them are too important to our Nation to abandon this program.

I want to come away from this hearing with an understanding that there is solid planning going on to fill any data gaps, I want a firmer grasp of where remaining risks lie in each of these programs, and I want to know there are reasonable strategies for dealing with those risks.

In short, I want to leave with confidence that the management teams running the JPSS and GOES–R satellite programs are, indeed, up to the challenges.

In closing, Mr. Chair, I want to express my hope that we not leap to conclusions, either good or bad, about either of these programs. We should be cautious about these programs, but it appears that nothing staff learned in preparing for this hearing and nothing in GAO's testimony leads us to condemn either program or to conclude that things are off the tracks again.

I thank our witnesses for being here today and sharing information and providing the sort of in-depth discussion that is absolutely required, and I look forward to their testimony today.

Thank you, Mr. Chair, and I yield.

[The prepared statement of Mr. Tonko follows:]

PREPARED STATEMENT OF INVESTIGATIONS AND OVERSIGHT SUBCOMMITTEE RANKING MEMBER PAUL D. TONKO

This Committee has been holding hearings to ask critical questions of these satellite programs since at least 2003. We have seen cycles of disaster, as when we witnessed the JPSS—in its prior NPOESS guise—double in cost before the entire enterprise was redesigned and rebaselined. We have witnessed Herculean efforts to restructure acquisition plans to get problems under control. Frankly, despite those efforts, we have not had much to cheer about with JPSS, and even GOES–R has been a source of concern. However, my sense is that both of these programs are on sustainable paths. That said, it appears that an auditor at GAO could build a pretty good 20-year career out of simply tracking the weather satellite program, and that is a sorry state of affairs.

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Chairman BROUN. Thank you, Mr. Tonko. Appreciate that, and I agree with you. I am not sure if we are off track. I sure hope not, and I think we—it is one of the most bipartisan Committees in this very bipartisan overall Full Committee, and I appreciate that. I just want to get some information. I think both sides want to do just the same.

Just as we are going to do with the question-and-answer period, we will recognize not only the Chairs and Ranking Members of both Subcommittees before we go to the rest of the Members of the Committees, as I mentioned earlier we will—I will now recognize Dr. Andy Harris from Maryland for his statement.

Mr. HARRIS. Thank you, Mr. Chairman. Good afternoon. I would like to thank the witnesses for joining us to discuss NOAA's environmental satellite issues.

This is the second hearing we have had on NOAA's satellites in this Congress alone, and I understand this Committee has had many more over the past several Congresses. With this much oversight, we typically hope to see some improvement, and in some areas we have. However, with every step forward it seems we are taking two steps back.

The launch of the NPP satellite last October was certainly an achievement, and NOAA and NASA are to be applauded for the

successful launch. But the satellite was five years late, and some of the instruments are not working as well as they should be. The contracts for the Joint Polar Satellite System, JPSS, have finally been transferred from its predecessor program, and NASA and NOAA are making progress. But the threat of a data gap remains, the cost of the program has increased by $1 billion, squeezing funds available for important ground- and air-based weather systems.

The Geostationary Operational Environmental Satellite or GOES Program moves along, but NOAA is burning through its funding reserves quicker than anticipated, and risk has still not been reduced. Today we will be told that there is a possibility of a GOES gap right around the same time as the possibility of a JPSS gap. As we learned in an Energy and Environment Subcommittee hearing several months ago, the majority of the data used in weather prediction models by the National Weather Service comes from satellite data. The prospects of a JPSS coverage gap is troubling enough in itself, but the possibility of a concurrent gap in GOES coverage represents a truly scary scenario that significantly threatens U.S. lives and property.

Given these difficulties, perhaps it is time for us to seek a new paradigm for procuring data for weather forecasting. The current procurement process may simply not be working, and time is running out, but to date there appears little interest in pursuing alternative solutions. While there are no easy answers to this dilemma and the choices we make will require a significant effort and evaluation, we must accept that the status quo cannot continue.

Again, I thank the witnesses for being here with us today. I look forward to an informative discussion, and I yield back the balance of my time.

[The prepared statement of Mr. Harris follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON ENERGY AND ENVIRONMENT CHAIRMAN ANDY HARRIS

Good afternoon. I would like to thank the witnesses for joining us to discuss NOAA's environmental satellite issues.

This is the second hearing we have had on NOAA satellites in this Congress alone, and I understand this Committee has had many more over the past several Congresses. With this much oversight, we would typically hope to see some improvement. And in some areas, we have. However, with every step forward, it seems we are taking two steps back.

The launch of the NPP satellite last October was certainly an achievement, and NOAA and NASA are to be applauded for the successful launch. But the satellite was five years late, and some of the instruments are not working as well as they should be.

The contracts for the Joint Polar Satellite System (JPSS) have finally been transferred from its predecessor program, and NASA and NOAA are making progress. But the threat of a data gap remains, and the cost of the program has increased by $1 billion, squeezing funds available for important ground- and air-based weather systems.

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Again, I thank the witnesses for being here with us today, and I look forward to an informative discussion.

Chairman BROUN. Thank you, Dr. Harris.

The Chair now recognizes my good friend from North Carolina, Mr. Miller, for five minutes.

Mr. MILLER. Thank you, Chairman Broun. I want to thank both Chairs of the Subcommittees for holding the hearing today on two satellite programs; JPSS and GOES–R, that have unfortunately been a central part of this committee's oversight responsibility for years. I say unfortunately because the attention of oversight does not gravitate to programs that are running smoothly. It gravitates to programs that are a problem, and these programs had been a problem. Although they need to work. Though seldom the headline grabber, it is hard to overstate the importance of satellite programs for the lives of Americans. The daily life.

Satellite-based weather, inclement forecasts tell us whether to carry an umbrella on any given day, where to fly planes, what crops to plant, whether to run our power plant, how to plan military missions, when to take cover from deadly storms. When they work, when we get timely and accurate information, we are safer and more prosperous, but when satellite programs falter, we find that lives, property, infrastructure, and economic health are at risk.

During my tenure as Chairman of the Investigation Oversight Subcommittee of the Science Committee, we kept a very close eye on these two programs, particularly the Joint Polar Satellite System, or JPSS, recognizing that poor management and wasteful spending put more than federal jobs and money at stake. Until recently we have been profoundly disappointed, and even now the data gap that threatens our forecasting capabilities is just inexcusable.

But today I am cautiously optimistic that we are finally on the right path, that the Administration has put into—the work that the Administration has put into reorganizing and rescoping JPSS has put that program on a new path to mission success. Time will tell, but until then, until time does tell us, we will focus on the real and viable options we will need to use in order to get us through a difficult period.

At the same time, we have to keep a watchful eye on NOAA's progress on the Geostationary Operational Environmental Satellite System, R Series, or GOES–R, from their stations above the Equator that GOES satellite tracks weather across the western hemisphere. While the GOES program has not suffered from the same mismanagement and mistakes that have plagued the Polar Satellite Program, we have seen that preliminary cost estimates for these satellites have doubled, and as a result, NOAA has found it necessary to cut in half the number of satellites that are—that they have ordered.

Even so, we remain cautious to ensure that this program remains within budget and on schedule. And I don't claim to know how much a weather satellite should cost. I don't, in my normal life, buy satellites.

As with JPSS, we need to take a hard look at the necessary funding levels and reserves required to keep overall costs down and the project online.

I look forward to hearing our witnesses from GAO again, NOAA, and NASA, to discuss how these relevant agencies can keep these programs on track and in the process fulfill the promise of keeping Americans safer and our economy more efficient and productive.

Mr. Chairman, I yield back.

[The prepared statement of Mr. Miller follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON ENERGY AND ENVIRONMENT RANKING MEMBER BRAD MILLER

I want to thank both Chairs of the Subcommittees for holding today's hearing on two satellite programs—JPSS and GOES–R—that have been central to our Committee's oversight responsibilities for years.

Though seldom the headline grabber, it is hard to overstate the effect that satellite programs have on the life of Americans. For instance, satellite-based weather and climate forecasts tell us not only how to dress for the day, but also where to fly airplanes, what crops to plant, when to run our power plants, how to plan military missions, and when to take cover from deadly storms. When they are more timely and accurate, we are more prosperous and safer. When satellite programs falter, we put lives, property, infrastructure, and our economic health at risk.

But today, I am cautiously optimistic that the work the Administration put into reorganizing and rescoping JPSS has put the project on a new path to mission success. Time will tell. But until then, we should focus on the real and viable options we will need to use in order to get us through a difficult period.

At the same time, we have to keep a watchful eye on NOAA's progress on the Geostationary Operational Environmental Satellite System–R series, or GOES–R. From their stations above the Equator, the GOES system tracks weather across the western hemisphere.

While the GOES program has not suffered from the same mismanagement and mistakes that have plagued the polar satellite program, we have seen the preliminary cost estimate for these satellites double and, as a result, NOAA found it necessary to cut in half the number of satellites to be ordered. Even so, we remain cautious to ensure this program remains within budget and on schedule.

As with JPSS, we need to take a hard look at the necessary funding levels and reserves required to keep overall costs down and the project on time.

I look forward to hearing our witnesses from GAO, NOAA, and NASA discuss how the relevant agencies can keep these programs on track and, in the process, fulfill their promise of keeping Americans safer and our economy more efficient and productive.

Chairman BROUN. Thank you very much, Mr. Miller. I thought you went out and bought satellites every week or so.

Mr. MILLER. That was just bread and milk.

Chairman BROUN. Oh. Okay. Well, I just was confused, I guess.

At this time, I would like to introduce our first panel of witnesses. The first witness is the Honorable Kathryn Sullivan, Dr. Sullivan, Ph.D., the Assistant Secretary of Commerce for Environmental Observation and Prediction and the Deputy Administrator at NOAA. Our second witness is Mr. Marcus Watkins, the Director of the Joint Agency Satellite Division at NASA, and our final witness is Mr. David A. Powner, the Director of Information Technology Management Issues for the GAO. I thank you all for being here.

As our witnesses should know, spoken testimony is limited to five minutes each, after which Members of the Committee have five minutes each to ask questions. Your written testimony will be included in the record of the hearing. Because of the importance and the complexity of the issues before us today, I will allow you to go over five minutes if you need to. If you can make it within five minutes, please do so, and I am very proud of my colleagues for keeping theirs under five minutes. I was slightly over, I think.

It is the practice of the Subcommittee on Investigations and Oversight to receive testimony under oath, and we will use that practice today as well.

Do any of you have an objection to taking an oath?

Okay. Let the record reflect that the witnesses were all willing to take the oath by saying no and shaking their head from side to side, indicating such also.

You also may be represented by counsel. Do any of you have counsel here today?

All three, again, indicated shaking their head and saying no, so let the record reflect such, that the witnesses do not have counsel.

Now, if you would please stand and raise your right hand. Do you solemnly swear or affirm to tell the whole truth, and nothing but the truth, so help you God?

You may be seated. Let the record reflect that all the witnesses have taken the oath.

I now recognize our first witness, Dr. Kathryn Sullivan of the National Oceanic and Atmospheric Administration. Dr. Sullivan, you have five minutes. Thank you, ma'am.

STATEMENT OF DR. KATHRYN SULLIVAN, PH.D., ASSISTANT SECRETARY OF COMMERCE FOR ENVIRONMENTAL OBSERVATION AND PREDICTION, AND DEPUTY ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dr. SULLIVAN. Thank you. Good afternoon, Chairmen Broun and Harris, Ranking Members Tonko, Miller, and Members of the Subcommittees. You have my written statement. It gives you much more detail. I would like this afternoon just to highlight a few key points.

First, significant progress has been made in both the GOES–R and JPSS Programs. GOES–R remains on schedule for launch in the first quarter of fiscal year 2016. The Joint NOAA–NASA team has a history of working extremely well together and effectively. This has led to the completion of key program milestones and substantial demonstrable progress towards that launch date.

For JPSS substantial progress has also been made since I last testified before this Committee, most notably as cited the successful launch of the Suomi NPP Satellite. While there is more work that needs to be done to reach comparable maturity to the GOES–R Program, JPSS has come a long way.

Second, NOAA's priority is to maintain and improve the accuracy and reliability of the life- and property-saving weather forecasts, watches, and warnings that our Nation depends upon. To do this we must maintain schedule and costs so that each satellite is ready

for launch as close to the end of its predecessor's life as possible, ideally before. Meeting this priority requires established and stable requirements, strong, effective management with rigorous and dependent checks, and stable funding. We have achieved the stable requirements. We are committed to strong, effective management. We have independent checks in place, and we are working hand in hand with this Committee to assure the funding remains as stable as possible in this challenging fiscal environment.

Nobody cares about the products these satellites provide and the services they support more than NOAA. They are essential to our own mission performance and important to a very long list of government, private sector, and academic customers. As every successful business owner knows, it is essential to understand your customer in order to assure that you are meeting their needs. NOAA is the critical link between operational satellite observations and our users, and continuity of service is the most important thing we can do.

I would like to just illustrate briefly, if I may, some of the progress that the systems we are bringing online will support. One of our GOES satellites is currently watching Tropical Depression Debby, monitoring her every move and helping our forecasters predict where she will go next so they, in turn, can help emergency managers prepare.

I have brought some images along, and staff will provide them to you in hard copy, from relevant current events that demonstrates some of the advances that Suomi NPP is already providing to our forecasters and their emergency management partners. These are specifically some images from the Visible/Infrared Radiometer Suite or VIIRS. We have one that shows fires that are currently active in Colorado, Wyoming, and demonstrate the capability of VIIRS to not only see temperatures associated with wildfires far more intense than those that we could do before but also locate them more accurately on the ground to aid responders.

We also have some images of Hurricane Debby or Tropical Storm Debby that show the sort of detail on storm intensity that, again, the higher resolution and greater bands in the VIIRS imager will provide.

Turning now to some highlights of the progress in each of the programs, the GOES–R Series Program is on schedule and on budget for launching its first satellite in the first quarter of fiscal '16. Over the last year, some of the notable milestones achieved include successful completion of the mission and preliminary design review, passage of the key decision point approval to move toward mission critical design, successful completion of the instrument, spacecraft, and core ground segment critical design reviews. Good progress on construction of the ground antenna and our command and data acquisition sites, the selection of the launch service provider, which was completed this past April.

GOES–R remains within a solid lifecycle cost, and we are committed to maintaining that $10.8 billion figure. This includes development, launch, operations, and sustainment for four GOES Series spacecraft R, S, T, and U, plus the instruments and running them through 2036, as well as development of the ground system and procurement of the launch.

Last year, when I appeared before you to discuss the JPSS Program, we were still in the formulation phase. The transition from NPOESS, I believe, is now behind us. We have the proper program management in place, and the teams are working well together.

Again, major milestones have been achieved this past year, the launch and successful operations of Suomi NPP have been noted. We are already using Suomi NPP data operationally today at seven months post-launch, three times faster than has been achieved before. We have, we believe, a sound program office estimate for lifecycle costs and independent reviews, independent review teams in place, and we are proceeding towards the first key decision point in July of next year. This is the point in which, according to formal NASA practice, we will have a full detailed baseline for you.

I am confident the cost and schedule presented in the President's FY 2013 budget are sound, and they will support a successful program. This $12.9 billion figure retains the same instrument suite as was outlined in the February 2010, restructure decision. It includes over $4.3 billion in sunk costs that covered NOAA's contributions to NPP and the development of the instruments and ground systems, and the remaining will fund instruments to support two JPSS spacecraft, free flyer accommodations for instruments that cannot fit on that footprint, launch vehicles, the development of an updated ground system, and sustainment and operations through 2028.

As GAO points out and you all have noted, despite this progress we still face a gap in coverage. We agree with the GAO's recommendation to formally document our long-hailed and well-defined practices of using all available assets that can help mitigate such a gap and being ready to ingest the data from these sources. Our prime strategy remains to leverage any remaining capabilities of existing on-orbit assets from NOAA and to use our partnerships with international nations.

Finally, I would like to thank your Committees for their continued interest and support of NOAA satellite programs. With NASA as our acquisition agent and partner in these programs, we are on track and headed for success. We have strong and seasoned managers at the helm. They are supported by a dedicated and talented team of technical professionals. We have reaffirmed our international partnerships for the JPSS Program, and all parties are moving forward to meet their commitments. We take our life and property protecting mission very, very seriously. Our commitment to you to ensure that the progress we have seen in this past year continues, that these programs stay on schedule and on budget to deliver for our Nation, is rooted in our commitment to NOAA's mission for the country.

Thank you for the opportunity to testify to you here today. I look forward to our discussion, and I appreciate the extra time, Mr. Chairman.

[The prepared statement of Dr. Sullivan follows:]

WRITTEN STATEMENT BY
DR. KATHRYN D. SULLIVAN
ASSISTANT SECRETARY OF COMMERCE
FOR ENVIRONMENTAL OBSERVATION AND PREDICTION AND
DEPUTY ADMINISTRATOR
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
HEARING TITLED

CONTINUING OVERSIGHT OF THE NATION'S WEATHER SATELLITE PROGRAMS – AN UPDATE ON JPSS AND GOES-R

BEFORE THE
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT, AND
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

June 27, 2012

Good afternoon Chairman Broun and Chairman Harris, Ranking Member Tonko and Ranking Member Miller, and Members of the Subcommittees. My name is Dr. Kathryn D. Sullivan. I am the Assistant Secretary for Environmental Observation and Prediction for the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Thank you for the opportunity to join Mr. David Powner from the Government Accountability Office (GAO), and Mr. Marcus Watkins from the National Aeronautics and Space Administration (NASA) at today's hearing which will focus on GAO's most recent reviews of the Joint Polar Satellite System (JPSS) and the Geostationary Operational Environmental Satellite-R Series (GOES-R).

I have three key messages to convey, which I will expand upon more fully in my testimony and during our discussions today.

First: NOAA's satellite programs are critically important to providing the American people with accurate and reliable weather forecasts up to a week in advance. They also provide the vital "eye in the sky" that is so essential to issuing watches and warnings of severe weather (hurricanes, thunderstorms, tornadoes, and winter storms) that jeopardizes lives and property.

Second: NOAA has stabilized the management structure, staffing, funding, requirements, and oversight of these programs, leading to the completion of key program milestones. This gives us reason to have confidence in our ability to meet the cost, schedule, and performance milestones that lie ahead.

Third: These programs require stable budgets if they are to stay within their cost, schedule, and performance baselines. We must maintain schedule to ensure that each satellite is ready for launch before its predecessor satellite reaches its end of life; otherwise, we will have gaps in coverage that will erode the accuracy and reliability of the forecasts, watches, and warnings that our Nation has come to rely upon.

The GAO has consistently provided impartial assessments and valuable recommendations in support of our efforts, and I and my NOAA colleagues greatly appreciate the work of Mr. Powner and his team. They are a dedicated, competent group of individuals whose efforts have helped us strengthen our satellite programs and deliver these spacecraft to fulfill our mission. As in the past, we will be responsive to the recommendations in their latest reports. We are also thankful to the NASA team for their tremendous support for these and other NOAA satellite acquisition programs.

NOAA's Satellite Programs Are Critically Important

Both polar-orbiting and geostationary systems are vital to the accuracy and reliability of today's weather forecasts, but their roles are not identical. The observational data these systems provide represent the vast majority – more than 90 percent – of the data input to the National Weather Service's (NWS) numerical models for 3-7 day weather forecasts. Of that amount, polar-orbiting satellites, and here I'm including not only NOAA's spacecraft but also NASA's Earth Observing System, and NOAA and European instruments carried on European weather satellites, provide over 80 percent of the observational data for Numerical Weather Prediction models, with the rest of the data used in the models coming from geostationary and in-situ data[1]. The output from these models supports the 3- to 7-day weather forecasts on which American citizens, businesses, and industries have come to depend. Therefore, loss of polar-orbiting data would have the greatest impact on weather outlooks issued for day 3 and beyond.

NOAA's geostationary weather satellites provide the "eye in the sky" that allows weather forecasters to assess current conditions (i.e., 0-3 days) as they evolve and provide the critical watches and warnings of severe weather. With the significant number of extreme and costly weather events affecting the Nation in recent years, the public has come to increasingly rely on NOAA forecasts to support the protection of lives and property. Having an accurate forecasting and warning system in place is essential as businesses and families prepare for extreme weather events affecting lives and property.

NOAA Has Stabilized These Satellite Programs and Is Making Real Progress

The GOES-R Series Program continues to make good progress and remains on schedule and on budget. All five instruments, the spacecraft, ground system, algorithm and data product development, and antennae are under contract, and in April 2012, the selection of the launch service provider was announced. The GOES-R Series Program Office, composed of both NOAA and NASA personnel, is a high-caliber, smoothly functioning team. In May 2012, GOES-R, following a major review, was approved to enter its next phase of development, which includes a formal establishment of the program's schedule and cost projections. The first satellite in the GOES-R Series is making good progress towards its launch date in the first quarter of FY 2016.

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[1] NWS's Global Forecast System model data input for 3-7 day forecasts is approximately:

- Satellite data 94 percent:
  - Polar-orbiting satellite data: 84 percent (includes NOAA POES, NASA EOS, Metop)
  - Geostationary satellite derived winds: 10 percent (includes GOES)
- In-situ data: 6 percent (including all surface observations, all global upper air observations)

The JPSS Program is coming out of a difficult two-year transition from the old tri-agency NOAA-NASA-Air Force NPOESS program to a new NOAA JPSS program with NASA responsible for the acquisition. The transition is now behind us. The JPSS program office is running; the contracts have been transitioned to NASA; and the Suomi NPP satellite has been launched. The JPSS-1 satellite is ramping up since receiving its FY 2012 appropriations and is working towards its launch date in the second quarter of FY 2017. However, we are mindful that there is a long road between now and the launch of the JPSS-1 satellite which will require all the management and engineering skill of the JPSS team to ensure that the acquisition of the program goes well.

Satellite Program Budget Stability

We have worked hard over the past year to stabilize and improve the management of these vital programs and wish to work with you to ensure these satellite programs receive the stable and sufficient budget they need. . We are confident that we now have solid life cycle cost figures and budget profiles for both programs, and we are committed to meeting them.

We are grateful to the Congress and this Committee for your bipartisan recognition of the importance of these programs to the Nation and for the solid support you provided in the final FY 2012 appropriations bill. We hope to build on that foundation with the appropriations committees in the FY 2013 appropriations. Sufficient and stable funding for these programs will allow NOAA to achieve the GOES-R and JPSS launch readiness dates (LRD) on schedule, with their full instrument suite, and within budget.

I would now like to provide separate updates of the GOES-R and JPSS Programs.

Progress on the GOES-R Series Program

The GOES-R Series Program is NOAA's next generation geostationary satellite constellation. Geostationary satellites are our observational sentinels in space, providing constant watch for severe weather such as hurricanes, conditions conducive for tornadoes, flash floods, and wildfires. With two geostationary satellites always in operation (GOES-West and GOES-East), we are able to track severe weather from off the coast of Africa to our shores, across the continental U.S., and out to the waters surrounding Hawaii. This observation also allows us to track hurricane formation in the Atlantic and Pacific. An on-orbit spare satellite assures continuity of the mission. The GOES satellites also provide coverage from lower latitudes of Alaska to higher latitudes of South America. The GOES satellites complement ground-based observational systems such as Doppler Radar to provide NWS forecasters with near real-time data used to support operational weather forecasts.

Mr. Greg Mandt, the GOES-R Series System Program Director (SPD), and his team continue to provide strong management of this program, which remains within budget and on track to meet the first of the GOES-R Series satellite's launch readiness date in the first quarter FY 2016. Significant progress has been made, including:

- Successful completion of the GOES-R Mission Preliminary Design Review, followed by Key Decision Point Approval to proceed towards Mission Critical Design Review;
- Successful completion of the Critical Design Reviews for the GOES-R instruments, spacecraft and core ground segment;
- Increased use of the GOES-R Proving Ground to provide users with exposure to and familiarity with the GOES-R products; and
- Good progress on the construction of the ground antenna and command/data acquisition sites.

The Chairman of the GOES-R Standing Review Board (SRB), which provides non-advocate and objective reviews, recently reported that the GOES-R Program, including the Flight and Ground Projects and the Program Systems Engineering, has come together as a team and is working very well together. Following a detailed technical and programmatic review, the SRB recommended that the GOES-R Series Program proceed to Critical Design Review via a Joint NOAA/NASA Program Management Council (PMC) approval. The PMC, chaired by NOAA Administrator Dr. Jane Lubchenco, formally approved the GOES-R Series Program to proceed toward Critical Design Review which is the point where an assessment is made that the GOES-R Series Program is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints. This decision also reaffirmed the program's decision to exercise contract options for the GOES-T and -U spacecraft, agreeing that exercising these options represents the least-cost and highest mission assurance approach for maintaining the operational geostationary constellation.

While significant progress has been made, NOAA acknowledges that risks remain to achieving the GOES-R launch readiness in the first quarter of FY 2016. The program continues to be budgeted at a high confidence level, and Independent Cost Estimates conducted in 2007 and 2011 confirmed the overall consistency in the program's Life Cycle Cost projections. However, program budget reserves in FY 2013 are lower than the NASA standard of 20 percent due to delays incurred as a result of a nine month protest of the spacecraft contract combined with budget reductions in previous years. The program is maintaining the recommended level of funded schedule reserves, but parametric (or modeled) schedule estimates suggest a lower than desired schedule confidence (48 percent vs. 70 percent per NASA standards) to achieve its LRD.

The current GOES-R schedule reflects 164 days of schedule reserves. Further, recent history shows that GOES-R has been able to maintain a high-level of schedule stability, with only two changes to the LRD since 2007 which were due to the previously mentioned budget reduction and contract protest. Notwithstanding these challenges, the GOES-R Series Program remains within its Life Cycle Cost. Given the priority placed on minimizing gaps in geostationary coverage, the significant program progress to date, and the affirmative recommendation of the SRB, the NOAA/NASA PMC has affirmed that the greatest potential for maintaining constellation availability is to continue to aggressively manage the GOES-R schedule toward the planned first quarter of FY 2016 LRD.

Continued success of the GOES-R Series Program requires full funding of the President's FY 2013 Budget Request. The low budget reserve posture the program faces in the near years contributes to the need to fund the program at requested levels to minimize program's

vulnerability to disruptions or delays in funding. In doing so, the GOES-R Series Program will receive the programmatic and budget stability it needs to support mission success.

GAO Review of the GOES-R Program

The GAO offers four recommendations for the GOES-R Series Program. These recommendations include improving visibility into the Program's reserve posture throughout the life of the program; continuing to strengthen the program's use of scheduling best practices and its articulation of risks and risk mitigation plans; adding the risk that GOES-S milestones may be affected by GOES-R development to the program's critical risk list; and ensuring that this risk, along with the program-identified risk of funding stability, continue to be monitored and mitigated.

NOAA and the Department understand the recommendations that the GAO has brought forward and fully concur with the recommendations addressing visibility of reserves, scheduling best practices, and adding the risk associated with GOES-S milestones to the Program's critical risk list. Further, we concur with the intent of the recommendation associated with strengthening the program's articulation of risk and risk mitigation plans. The program has actions underway to improve the risk management process in the areas suggested by the GAO.

Progress on the JPSS Program

NOAA's Polar-orbiting Operational Environmental Satellite (POES) series provides surface and atmospheric information ranging over the entire Earth. Placed in the afternoon orbit, NOAA POES and NASA EOS satellites are crucial for NWS's 3-7 day weather forecasts and environmental modeling efforts. The last POES satellite, NOAA-19, was launched in early 2009. This satellite is operating normally, and currently serves as our primary satellite for the afternoon orbit. The Metop satellite constellation, which flies in the mid-morning orbit, is robust and NOAA uses these data in its numerical weather predication models.

When the NPOESS program was restructured in February 2010, NOAA, with NASA support had to address the following actions in parallel:

- Continue development and check out of key instruments for Suomi NPP to avoid a data gap and support NOAA's critical weather mission;
- Transfer existing contracts and award new contracts to support JPSS-1;
- Establish the cost, schedule, and performance baseline for the JPSS program;
- Develop national and international partnerships to provide cost effective means to meet some requirements; and
- Establish a NOAA-NASA team of experts to manage this complex endeavor.

As I will detail below, we have made remarkable progress on all of these fronts while working through extreme budget uncertainty, especially in FY 2011.

In October 2011, the Suomi NPP satellite was launched successfully. This mission serves as a critically important bridge between legacy satellites (NOAA's POES, NASA EOS), and the

future JPSS satellites that will use the same instruments as the Suomi NPP satellite. The success of the Suomi NPP mission also illustrates the strength of the NOAA/NASA partnership. NASA acquired the Suomi NPP spacecraft, developed one of the five instruments, co-funded another instrument with NOAA, and funded the satellite launch. NOAA's JPSS Program was responsible for the remaining three Suomi NPP instruments and the ground system. The Suomi NPP satellite has completed its commissioning phase. All instruments are currently operating and performing well, and the JPSS team continues to calibrate and validate the instrument data for operational use.

- Last month, the JPSS Program completed an optimization assessment to confirm that the content of program could be accomplished within the $12.9 billion life cycle cost, with a current cost to completion of $8.6 billion in the FY 2013 - FY2028 time period. The $12.9 billion includes: Costs through FY 2012, including NOAA's contribution to the NPOESS program including its share of the development costs of the Suomi NPP instruments and the common ground system.
- Operations and Sustainment for five satellites (Suomi NPP, JPSS-1, JPSS-2, Free Flyer 1, and Free Flyer 2) through FY 2028 (a four-year extension);
- Development of four spacecrafts (JPSS-1, JPSS-2, Free Flyer 1, and Free Flyer 2)[2]
- The JPSS program instruments being developed include: the Advanced Technology Microwave Sounder (ATMS), the Cross Track Infrared Sounder (CrIS), the Visible/Infrared Imager/Radiometer Suite (VIIRS), Ozone Mapping and Profiler Suite-Nadir (OMPS-N) and the Clouds and Earth's Radiant Energy System (CERES) all on JPSS-1 and JPSS-2; Ozone Mapping and Profiler Suite-Limb on JPSS-2; and TSIS, integration of SARSAT, and integration of A-DCS all on Free Flyer 1 and Free Flyer 2 (SARSAT and A-DCS are being developed by foreign partners and integrated by the JPSS program). Forty environmental data record products and many more intermediate products;
- JPSS Ground System including North and South Polar receiving sites (reducing data latency to half of historical values);
- Services supporting international and interagency partnerships (Metop, GCOM) and provision to make data available for Department of Defense use; and
- Direct read out transmission and software for worldwide use of Suomi NPP / JPSS products.

In the past year, significant progress has been made in the JPSS Program, including:

- Significant progress on calibrating the Suomi NPP instruments:
  - Advanced Technology Microwave Sounder data is already being used operationally to support NOAA's global numerical weather forecast system -- a record early operational use coming seven months earlier than expected.
  - Cross-Track Infrared Sounder (CrIS) instrument data is being incorporated on a test basis into NWS weather forecast models.
  - Visible/Infrared Imager/Radiometer Suite (VIIRS) instrument data is being reviewed by the National Ocean Service (NOS) for operational use of the ocean color data in its Harmful Algal Bloom forecasts. Once the VIIRS instrument has completed

[2] Cost for development and launch of Suomi NPP shared by NPOESS program and NASA. Operations and sustainment paid for by JPSS program.

calibration/validation and has been declared operational, NOS will access these data through the NOAA CoastWatch Program;

- Successful transition of all JPSS instrument and ground contracts from the former NPOESS Program;
- Eighty percent of the planned federal employees on the NOAA/NASA JPSS team are now on board (an increase of 70 percent since March, 2011)[3], including the addition of Mr. Harry Cikanek as Director of the Joint Polar Satellite System Office last fall. Mr. Cikanek has more than three decades of successful program management and systems engineering experience, and comes to us from NASA's Glenn Research Center, where he most recently served as deputy director of their engineering organization. NOAA considers this a significant improvement;
- Completion of the JPSS Management Control Plan, the Program Office Estimate of the JPSS life cycle cost, and the independent review of that life cycle cost estimate which informed the President's FY 2013 Budget for JPSS;
- Successful completion of the JPSS Systems Requirements Review, allowing the Program to proceed toward its first Key Decision Point, KDP-0 in July 2012. This is the decision point at which NOAA will confirm program requirements are properly formulated, and the proposed approaches to meeting these requirements are feasible within the budget allocated. KDP-0 approval allows the program to proceed towards its Program System Definition Review, which is currently scheduled for the second quarter of Calendar Year 2013.

Additionally, the JPSS Program recently completed an optimization assessment of the Program Office Estimate, which was developed to support the Life Cycle Cost and the President's FY 2013 Budget request. During the assessment, the JPSS Program reviewed whether it could minimize the gap and launch JPSS-1 at an earlier launch date than the second quarter FY 2017. With the FY 2012 appropriation, the JPSS-1 instrument development was ramped up after a hiatus in FY 2010 and FY 2011, while the program awaited funding; work has started on the JPSS-1 spacecraft; and needed IT enhancements are being applied to the ground system. With these and other activities that had been on hold, the JPSS Program determined that it would not be able to launch earlier without introducing technical risk to the JPSS-1 development. However, the JPSS Program will endeavor to maintain the launch date as much as practicable.

NOAA, through the JPSS Program, continues to support and strengthen international partnerships that relate to maintaining continuity of polar-orbiting satellite observational capability. To that end, I offer the following important updates:

- NOAA continues to work closely with its European operational satellite counterpart, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), in finalizing arrangements for their Metop-B launch no earlier than July 2012, and in preparing for the future launch of the Metop-C satellite. These satellites include NOAA-provided instruments developed under NOAA's POES Program.

[3] The NESDIS March 28, 2011 Quarterly Update to the Commerce, Justice, Science, and Related Agencies Appropriations Committees indicates that 83 FTE were on-board at the time of 175 planned FTE. Currently, NESDIS/NASA FTE amount to 141 FTE on-board of 173 planned FTE.

- NOAA is establishing agreements with EUMETSAT for data sharing and ground support as we each undertake development of the next generation of polar-orbiting satellites -- NOAA's JPSS, and the second generation EUMETSAT Polar System (EPS-SG).
- NOAA is pleased to be working with the Japan Aerospace Exploration Agency (JAXA). On May 18, 2012, JAXA successfully launched its first Global Change Observation Mission-Water (GCOM-W1) satellite, which carries the Advanced Microwave Scanning Radiometer (AMSR-2) instrument. Agreements are in place between NOAA and JAXA wherein JPSS provides ground support to receive and distribute GCOM-W1 data in return for access to these data, which help NOAA conduct assessments of precipitation, water vapor amounts, wind velocity above the ocean, sea water temperature, water levels on land areas, and snow depths.
- Partnerships with the Canadian and French Space Agencies have been reaffirmed, with these agencies providing the satellite assisted search and rescue (SARSAT) and the Advanced Data Collection System (A-DCS) instruments planned for launch by the JPSS Program.

I will conclude my discussion of the JPSS Program by noting that, despite significant fiscal pressures, this program has made tremendous progress since its inception in February 2010. The NOAA and NASA team is working well together towards meeting the goal of launch of the JPSS-1 satellite in early FY 2017. While the JPSS team has made significant progress, there are many challenges ahead which will require the full attention and expertise of the JPSS program management and engineering team. Support for the President's FY 2013 Budget and in future years will enable JPSS to achieve mission success.

GAO Review of the JPSS Program

The GAO's one recommendation for the JPSS Program is, given the importance of polar-orbiting satellite data to weather forecasts, NOAA should establish mitigation plans for risks associated with satellite data gaps in the afternoon orbit. Specific to this recommendation, NOAA is in the process of documenting in its mitigation plan, the long-standing arrangements with national and international partners to continue to provide observational data in the event of a delay in the launch of JPSS-1 or the early failure of Suomi NPP. Construction of JPSS-1 is well underway, with all contracts in place, the spacecraft under development and instruments from 60-90 percent built, and all elements progressing towards the JPSS-1 Preliminary Design Review.

Conclusion

I conclude this testimony by reaffirming three key messages.

NOAA's satellite programs are critically important to the American people. They involve significant investment on the part of the American taxpayer for an essential benefit given the role they play in providing global observations essential to providing life- and property-saving forecasts and warnings.

Significant progress is being made in the GOES-R and JPSS Programs. Our current operational environmental satellite constellations are healthy and providing needed coverage. Both the GOES-R and JPSS teams are working extremely well and effectively together, and each

team has made substantial, demonstrable progress towards launch of the next generation satellite systems. Their focus must remain on getting these very important next generation space assets developed and launched.

These programs require stable and sufficient budgets in order to minimize disruptions that may lead to launch delays and cost increases.

NOAA and the Department of Commerce thank the GAO for the very important contributions they are making to these programs. Mr. Powner and his team's recommendations offer us the opportunity for continuous improvement as we move forward on these endeavors to maintain the continuity of the operational environmental satellites that are so crucial to protecting American lives and property. We accept their recommendations and will be responsive to them.

Finally, I wish to say that NOAA appreciates the long-standing interest by the Committee and its staff regarding NOAA's satellite program. I am happy to answer any questions you may have.

Chairman BROUN. Thank you, Dr. Sullivan. Appreciate your testimony.

Now I recognize our next witness, Mr. Marcus Watkins of NASA. Mr. Watkins, you are recognized for five minutes.

STATEMENT OF MR. MARCUS WATKINS, DIRECTOR,
JOINT AGENCY SATELLITE DIVISION,
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. WATKINS. Thank you, Mr. Chairman. Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to appear here today to share information regarding the NASA role in and commitment to NOAA's Joint Polar Satellite System (JPSS) and NOAA's Geostationary Operational Environmental Satellite R Series (GOES–R) Program.

JPSS——

Chairman BROUN. Could you pull your microphone slightly closer?

Mr. WATKINS. Is that better, sir? Okay. JPSS and GOES–R are critical to the Nation's weather forecasting system, climate monitoring, and research activities. NASA and NOAA have been partners for over 40 years in developing the Nation's polar and geosynchronous weather satellites. With the President's direction in 2010, NASA and NOAA returned to the successful partnership for JPSS. Since that time the NASA Program Management Office was established, and it is nearly fully staffed.

In addition, NOAA and NASA have established joint program management counsels to oversee the NOAA portfolio of satellites and have integrated their decision-making processes to efficiently and effectively manage this cooperative activity. Over the last two years, the NASA and NOAA teams have strengthened their working relationship.

I am pleased to report that the NASA and NOAA team completed development of National Polar-Orbiting Partership (NPP), and it was successfully launched on October 28, 2011. Activation and initial checkout are now complete, and the JPSS Program has assumed operational control of the satellite, now renamed the Suomi National Polar-Orbiting Partnership. While Suomi NPP was not intended to be used as an operational asset, NOAA will be using Suomi NPP data in its operational weather forecasting models.

As a measure of how well the Suomi NPP mission is progressing, NOAA meteorologists are already using data products from the ATMS instrument in their weather forecasts, and we are getting excellent performance from the VIIRS instrument as well.

NASA, as NOAA's acquisition agent, now controls all of the JPSS instrument, spacecraft, and ground system contracts. The first JPSS satellite, JPSS–1, will essentially be a copy of Suomi NPP with upgrades to meet the JPSS level one requirements. Assuming full funding of the President's FY 2013 budget request for NOAA, it is anticipated that JPSS–1 will be ready to launch before the end of the second quarter of FY 2017, close to five years after the October launch of Suomi NPP.

In addition, the GOES–R Series Program of four geosynchronous satellites, continues to make progress towards launching GOES–R, the first satellite of the series in the first quarter of FY 2016. Again, assuming full funding the President's budget, the program completed its preliminary design review phase, and the GOES–R Series flight project conducted a successful critical design review for the spacecraft and awarded launch vehicle task orders to United Launch Services for the GOES–R and GOES–S missions, which will be launched on Atlas V–41 series launch vehicles.

Additionally, all flight instruments' critical design reviews are complete, and all of the flight instruments are in flight hardware, fabrication, integration, or tests.

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

[The prepared statement of Mr. Watkins follows:]

HOLD FOR RELEASE
UNTIL PRESENTED
BY WITNESS
June 27, 2012

Statement of
Marcus A. Watkins
Director, Joint Agency Satellite Division
National Aeronautics and Space Administration
before the
House Subcommittee on Investigations and Oversight
and
House Subcommittee on Energy and Environment
Committee on Science, Space and Technology
United States House of Representatives

Mr. Chairmen and Members of the Subcommittees, thank you for the opportunity to appear today to provide you information regarding the NASA role in, and commitment to, the National Oceanic and Atmospheric Administration (NOAA) Joint Polar Satellite System (JPSS) and Geostationary Operational Environmental Satellite-R Series (GOES-R) Programs. The JPSS and GOES-R Programs are critical to the Nation's weather forecasting system, climate monitoring and research activities.

JPSS Organization is Working Well

NASA and NOAA have been partners for over 40 years in developing the Nation's polar and geosynchronous weather satellites. With the President's direction in 2010, NASA and NOAA returned to this successful partnership for JPSS. The NASA program management office for JPSS has been established and is close to being fully staffed with a complement of 89 NASA civil servants and 225 support contractors. NOAA and NASA have established joint program management councils to oversee JPSS, and have integrated their decision-making processes to efficiently and effectively manage this cooperative activity. The NASA and NOAA teams have strengthened their working relationship over the last 2 years.

Suomi NPP Launch, Activation, and Initial Checkout are Complete

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) satellite – now renamed the "Suomi National Polar-orbiting Partnership," or "Suomi-NPP" - was developed to extend the record of key observations from the NASA Earth Observing System (EOS) series of satellites and to demonstrate technologies for the next generation of operational polar-orbiting meteorological satellites. I am pleased to report that the NASA-NOAA JPSS team completed development of Suomi NPP and it was successfully

launched on October 28, 2011. Suomi NPP activation and initial checkout are now complete and the JPSS program has assumed operational control of the satellite.

We are now in the middle of a planned, intensive 18-month validation period, during which we are comparing the performance of the new sensors both with data from on-orbit legacy instruments, and with high-quality ground-based and airborne calibration standards. As we characterize the performance of these new sensors, Suomi NPP provides feedback to improve the development of the operational instruments that will fly on JPSS.

While the satellite was not originally intended to be used as an operational asset, NOAA will be using Suomi NPP data in its operational weather forecasting models. As a measure of how well the Suomi NPP mission is progressing, NOAA meteorologists are already using data products from the Advanced Technology Microwave Sounder (ATMS) instrument in their weather forecasts, and our analyses are indicating that we are getting excellent performance from the Visible Infrared Imager Radiometer Suite (VIIRS) instrument as well as the other instruments on Suomi NPP.

JPSS Transition is Complete and JPSS-1 is on Track

In addition to the successful Suomi NPP launch, the transition from the NPOESS program to the new JPSS program is now complete. Consistent with the President's FY13 budget request, NOAA and NASA have committed to deploy and operate JPSS through FY 2028 within a total life cycle cost of $12.9 billion. Of this total, $4.3 billion are costs through FY 2012, including development of the Suomi NPP instruments under the former NPOESS program and the development of the common ground system. The remaining $8.6 billion will fund the development and operations of the JPSS-1, JPSS-2, Free Flyer-1 and Free Flyer-2 satellites, instruments (including climate sensors), and launch vehicles, as well as development of the updated ground system. This updated ground system will provide operations and sustainment for Suomi NPP, JPSS-1, and -2 and access to data from the Japan Aerospace Exploration Agency's Global Change Observation Mission.

NASA, as NOAA's acquisition agent, now manages all of the JPSS instrument, spacecraft, and ground system contracts. The first JPSS satellite, JPSS-1, will be a copy of Suomi NPP with upgrades to meet the JPSS Level 1 requirements. The instrument vendors continue to make progress in the manufacture of the flight units for JPSS-1, and the spacecraft is currently in development at Ball Aerospace. The launch vehicle proposals are being evaluated, and selection is currently expected later this summer. If the Congress fully funds the President's FY 2013 budget request for NOAA, it is anticipated that JPSS-1 will be ready to launch before the end of the second quarter of FY 2017, close to five years after the October launch of Suomi NPP.

In May 2012, the JPSS Program conducted its first milestone review for the entire program since transition. The program successfully completed its Systems Requirements Review (SRR), conducted by an independent, non-advocate board, with a recommendation to continue

formulation heading towards establishment of a formal program baseline in the summer of 2013. The Joint NOAA and NASA Program Management Council will convene for the JPSS program Key Decision Point -1, which will establish a formal program baseline.

GOES-R Series Program Continues to Make Progress

The GOES-R Series Program of four geosynchronous satellites continues to make progress toward launching GOES-R, the first satellite of the series, in the October 2015 timeframe. In May of this year, the GOES-R Series Program successfully completed its formulation phase by conducting a Joint NOAA and NASA Program Management Council Key Decision Point- C (KDP-C) meeting to formally baseline the life cycle cost and launch readiness dates for the program. NASA conducts a KDP-C meeting to determine whether a program or project is ready to proceed from the formulation phase to the implementation phase.

While the program was completing its Preliminary Design Review phase, the GOES-R Series Flight Project conducted a successful critical design review for the spacecraft and awarded launch vehicle task orders for United Launch Alliance to utilize the Atlas V series of launch vehicle to place GOES-R in orbit. Additionally, all flight instrument critical design reviews are complete, and all of the flight instruments are in flight hardware fabrication, integration or test. At this time, it is anticipated that all instruments will be delivered to the spacecraft vendor for integration on the spacecraft by the end of fiscal year 2013. Capping off a successful and busy year, the GOES-R Series Program is planning a Mission Critical Design Review to be conducted in August.

Conclusion

NASA and NOAA are committed to the JPSS and GOES-R programs, and ensuring the success of these programs is essential to both agencies and the Nation. The NASA and NOAA teams have established strong working relationships and are striving to ensure that weather and environmental requirements are met on the most efficient and predictable schedule without reducing system capabilities or further increasing risk.

With the launch of Suomi NPP in October 2011, the first fruits of the NASA-NOAA partnership for JPSS are being realized. With your continued support, NASA and NOAA expect this partnership to successfully develop and deliver the JPSS-1 mission on time for launch in FY 2017, thus ensuring continued support of NOAA's weather and environmental monitoring program.

Mr. Chairmen, I appreciate the continued support of these Subcommittees and the Congress, and I would be pleased to respond to any questions you or the other Members of the Subcommittees may have.

Chairman BROUN. Thank you, Mr. Watkins. Appreciate your testimony.

And now our final witness is Mr. David Powner of the Government Accountability Office. Mr. Powner, you have five minutes. Thank you, sir.

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

Mr. POWNER. Chairman Broun, Chairman Harris, Ranking Members Tonko, Ranking Member Miller, and Members of the Subcommittees, we appreciate the opportunity to testify this afternoon on the JPSS and GOES–R Programs.

Starting with JPSS, this nearly $13 billion acquisition is proceeding along with a planned launch date of the first satellite by March 2017. This afternoon I would like to provide an overview of progress to date, the program's current cost estimate, key risks to the program, and potential gaps in data satellite continuity.

Starting with progress. NPP, the planned demonstration satellite now used for operations, was successfully launched in October 2011, and the instruments were commissioned by March 2012. NOAA has made good progress transferring management and contracting responsibilities from the old NPOESS Program. Also, solid development has occurred on all five sensors associated with the first satellite. Specifically, all five are at least 60 percent complete, and two are 85 percent complete.

Last September when I testified before you, the overall program cost was $11.9 billion. After recent reconciliations of various cost estimates, the program determined that the new cost estimate should be about $14.6 billion, an increase of $2.7 billion from last year's hearing. In working with OMB, NOAA officials told us that they expect the program to be funded at roughly $900 million a year, but that OMB placed a lifecycle cap on the program at $12.9 billion.

Therefore, the program faced a funding gap of $1.7 billion, and our report being released today highlights options NOAA was considering to address this nearly $2 billion funding gap, which included removing certain sensors.

To its credit, NOAA has recently made some tough decisions to address this funding gap. At a high level, their plan is to take a more effective approach to the operations and maintenance phase and to fly three sensors on other satellites. This approach to a rideshare arrangement with the three sensors clearly helps reduce program costs but, like most options, has tradeoffs. In this case, this approach raises schedule risks since the launch dates are no longer in the hands of the JPSS Program.

Other risks to the program reside with the launch vehicle. No decision has yet been made on which launch vehicle will be used.

Finally, turning to potential gaps in satellite data, we continue to be concerned about the afternoon orbit and highlight a potential 17-month gap if NPP lasts five years and the JPSS hits its March 2017 launch date. In our opinion, this is the best-case scenario. If

NPP lasts less than five years and if JPSS launch date slip, this gap could be greater.

We also highlight continuity concerns for the first time regarding DOD's early morning orbit and the European midmorning orbit. For example, the follow-on European satellite may no longer be supported with NOAA-funded sensors due to constrained budgets. Given these concerns, we have recommended that NOAA establish mitigation plans for pending satellite gaps for all three orbits. NOAA plans to issue a report by August to address this recommendation.

In summary, NOAA and NASA continue to make progress on JPSS. However, three areas deserve Congressional oversight. First, how NOAA and NASA operate within the $12.9 cap, how the rideshare arrangement proceeds with certain sensors since significant cost savings is associated with this approach, and third, how the satellite constellation, all three orbits, will be effectively managed to ensure critical weather and climate data.

Next, I would like to turn to the GOES–R Program. This nearly $11 billion acquisition is proceeding toward an October 15 launch date for its first satellite. What I would like to do is highlight progress to date on GOES, the program's cost profile, including use of management reserves, and observations on the program's schedule and launch dates.

Before I get into these specifics, I would like to clarify the scope of the GOES–R Program. Originally it was a four-satellite program in 2006 that was to cost about $11 billion. So the program eliminated a key sensor and dropped two satellites, among other things, to keep the cost around $7.7 billion.

So, for about five years, we had a fairly stable program, two satellites at $7.7 billion. As part of the fiscal year 2012 budget request, NOAA added the two satellites back and increased the lifecycle cost to $10.9 billion, so we are back to where we were in 2006; four satellites costing about $11 billion.

Starting with progress, the program has completed preliminary design reviews for the flight and ground segments and for the program overall. The program is to have its critical design review in August, meaning that all designs are complete and that the program overall is ready for full-scale development.

Regarding costs, the program continues to operate within the $7.7 billion lifecycle cost for the first two satellites. This is the case despite the fact that in our report, we highlight cost increases associated with sensors, the spacecraft, and the ground components over the last two years that tally about $750 million. Most notably the Advanced Baseline Imager (ABI) grew $148 million, and the ground segment grew nearly $300 million.

Despite this contractor cost growth, the program has been able to operate within the $7.7 billion overall estimate by using management reserves. Initially the bucket tallied $1.7 billion, and it is now down to about $1.2 billion.

A few points here on management reserves. Thirty percent have recently been used and significant development remains. Two-thirds of the development for the spacecraft and the ground segments remains. In addition, during the course of our review, we found that the transparency associated with the use of and the re-

maining balance of the reserves was not where it needed to be, and we made associated recommendations to address that.

Turning to schedule and launch dates, first, some of the key design reviews were late. We also performed a detailed review of the spacecraft, ground segment, and two sensors. Our review exposed some questions with the current schedules and raised some questions ultimately about the October 2015, launch date.

In addition, NOAA risk logs identify schedule risks associated with the key sensor and also with the flight and ground segments, and finally, NOAA's own assessment claims that there is only a 48 percent confidence level that the program will meet its October 2015, launch date. We made recommendations to address these concerns, Mr. Chairman.

In summary, to date the GOES–R Program has been able to operate within the cost estimate of $7.7 billion and the current schedule by effectively using cost and schedule reserves. More transparency is needed on the use of the reserves. In addition, questions about the reliability of the program schedule and their own assessment show that the October 2015, launch date could slip.

This concludes my statement. I would be pleased to respond to questions.

[The prepared statement of Mr. Powner follows:]

United States Government Accountability Office

GAO

Testimony
before the Subcommittees on Energy and Environment and Investigations and Oversight, House Committee on Science, Space, and Technology

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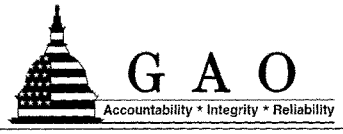
ENVIRONMENTAL SATELLITES

Focused Attention Needed to Mitigate Program Risks

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



GAO-12-841T

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

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

As requested, this statement summarizes our two reports being released today on (1) the status, plans, and risks for JPSS and (2) the status, schedule management, and risk management processes within the GOES-R program.[1] In preparing this testimony, we relied on the work supporting those reports. They each contain a detailed overview of our scope and methodology, including the steps we took to assess the reliability of cost and schedule data. As noted in those reports, we found that the JPSS cost and GOES-R contractor cost data were sufficiently reliable for our purposes. Further, while we found that the GOES-R schedule and management reserve data were not sufficiently reliable, we reported on the data's shortcomings in our report. All of our work for the reports was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Since the 1960s, the United States has used both polar-orbiting and geostationary satellites to observe the earth and its land, oceans, atmosphere, and space environments. Polar-orbiting satellites constantly circle the earth in an almost north-south orbit, providing global coverage

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

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

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

Events Leading to the JPSS Program

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

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

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

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

Even after this restructuring, however, the program continued to encounter technical issues, management challenges, schedule delays, and further cost increases. Therefore, in August 2009, the Executive Office of the President formed a task force, led by the Office of Science and Technology Policy, to investigate the management and acquisition options that would improve the program. As a result of this review, the Director of the Office of Science and Technology Policy announced in February 2010 that NOAA and DOD would no longer jointly acquire NPOESS; instead, each agency would plan and acquire its own satellite system. Specifically, NOAA and NASA would be responsible for the afternoon orbit, and DOD would be responsible for the early morning orbit. The partnership with the European satellite agencies for the midmorning orbit would continue as planned.

When this decision was announced, NOAA immediately began planning for a new satellite program in the afternoon orbit—called JPSS—and DOD began planning for a new satellite program in the morning orbit—called the Defense Weather Satellite System. NOAA transferred management responsibilities to its new satellite program, defined its requirements, and transferred contracts to the new program. Specifically, NOAA established a program office to guide the development and launch of the NPOESS Preparatory Project (NPP)[5]—a demonstration satellite

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

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

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

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

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

Overview of the GOES Program

In addition to polar-orbiting satellites, NOAA operates GOES as a two-satellite geostationary satellite system that is primarily focused on the United States. The GOES-R series is the next generation of satellites that NOAA is planning; the satellites are planned to replace existing weather satellites that will likely reach the end of their useful lives in about 2015.

NOAA is responsible for overall mission success for the GOES-R program. The NOAA Program Management Council, which is chaired by NOAA's Deputy Undersecretary, is the oversight body for the GOES-R

[6] See, for example, GAO, *Polar-Orbiting Environmental Satellites: Agencies Must Act Quickly to Address Risks That Jeopardize the Continuity of Weather and Climate Data*, GAO-10-558 (Washington, D.C.: May 27, 2010). Our report being released today on polar-orbiting satellites includes a full list of related GAO products.

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

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

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

NOAA has since developed a continuity plan that generally includes the key elements we recommended. As a result, NOAA has improved its

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

ability to fully meet its mission-essential function of providing continuous satellite imagery in support of weather forecasting.

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

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

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

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

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

The removal of these elements from the JPSS program will affect both civilian and military satellite data users. The loss of certain sensors could cause a break in the over 30-year history of satellite data and would hinder the efforts of climatologists and meteorologists focusing on understanding changes in the earth's ozone coverage and radiation budget.[11] The loss of ground-based receptor stations means that NOAA may not be able to improve the timeliness of JPSS-2 satellite data from 80 minutes to the current 30 minute requirement, and as a result, weather

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

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

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

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

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

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

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

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

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

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

the early morning, midmorning, and afternoon orbits by relying on DOD satellites for the early morning orbit, the European satellite program for the midmorning, and NOAA's JPSS program for the afternoon orbit.

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

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

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

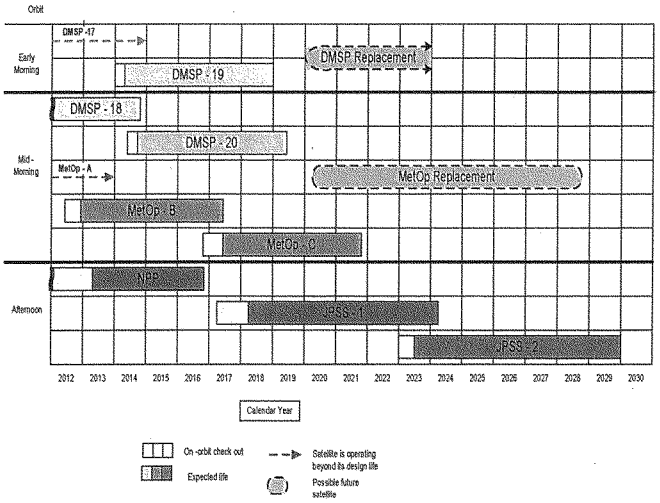
- **Midmorning orbit**—The European satellite organization plans to continue to launch Meteorological Operational (MetOp) satellites that will provide observations in the midmorning orbit through October 2021. The organization is also working to define and gain support for the follow-on program, called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

- **Afternoon orbit**—There is likely to be a gap in satellite observations in the afternoon orbit that could last well over one year. According to

our analysis, this gap could span from 17 months to 3 years or more. In one scenario, NPP would last its full expected 5-year life (to October 2016), and JPSS-1 would launch as soon as possible (in March 2017) and undergo on-orbit checkout for a year (until March 2018). In that case, the data gap would extend 17 months. In another scenario, NPP would last only 3 years as noted by NASA managers concerned with the workmanship of selected NPP sensors. Assuming that the JPSS-1 launch occurred, as currently scheduled, in March 2017 and the satellite data was certified for official use by March 2018, this gap would extend for 41 months. Of course, any problems with JPSS-1 development could delay the launch date and extend the gap period. Given the history of technical issues and delays in the development of the NPP sensors and the current technical issues on the sensors, it is likely that the launch of JPSS-1 will be delayed. While the scenarios in our analysis demonstrated gaps lasting between 17 and 53 months, NOAA program officials believe that the most likely scenario involves a gap lasting 18 to 24 months.

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

Figure 1: The Polar Satellite Constellation



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

According to NOAA, a data gap would lead to less accurate and timely weather prediction models used to support weather forecasting, and advanced warning of extreme events—such as hurricanes, storm surges, and floods—would be diminished. To illustrate this, the National Weather Service performed several case studies to demonstrate how its weather forecasts would have been affected if there were no polar satellite data in the afternoon orbit. For example, when the polar satellite data were not used to predict the "Snowmaggedon" winter storm that hit the Mid-Atlantic coast in February 2010, weather forecasts predicted a less intense storm, slightly further east, and producing half of the precipitation at 3, 4, and 5 days before the event. Specifically, weather prediction models under-

forecasted the amount of snow by at least 10 inches. The agency noted that this level of degradation in weather forecasts could place lives, property, and critical infrastructure in danger.

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

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

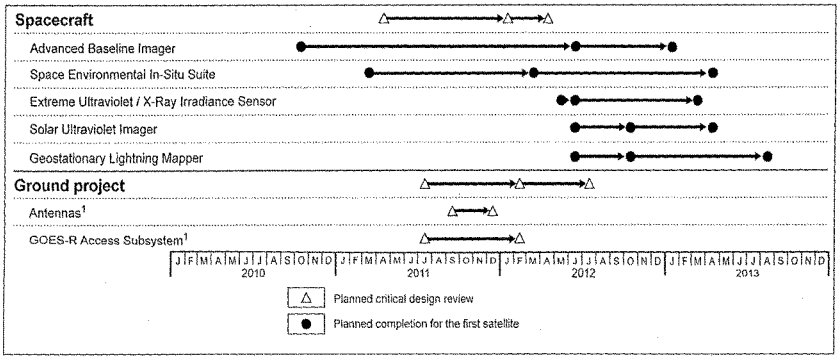
While the GOES-R program has made progress in completing its design, many key milestones were completed later than planned. The program demonstrated progress toward completing its design in part by completing its set of preliminary design reviews, which indicated readiness to proceed with detailed design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

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

were also later than the dates established following award of the contracts for the instruments, spacecraft, and ground system components. For example, the program's preliminary design review was completed 19 months later than planned, and its critical design review is expected to be completed 13 months later than planned.

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

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



Source: GAO analysis of agency data.

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

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

GOES-R has also encountered a number of technical challenges, some of which remain to be fully addressed. For example, in early 2011 the

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

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

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

manually once a month directly from at least nine subordinate contractor schedules.[13]

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

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

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

Table 1: Practices Utilized in Selected GOES-R Schedules

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

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

Key

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

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

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

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

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

Selected schedule weaknesses existed across each of the four schedules analyzed. For example, each of the contractor schedules either did not include information on allocation of resources or allocated too much work to many of its resources. In addition, none of the contractors had completed usable schedule risk analyses that included risk simulations. Particularly important is the absence of a valid critical path[15] throughout all the schedules. Establishing a valid program-level critical path depends on the resolution of issues with the respective critical paths for the spacecraft and Core Ground System components. Without a valid critical path, management cannot determine which delayed tasks will have detrimental effects on the project finish date.

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

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

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

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

Delays in GOES-R's launch date could impact the continuity of GOES satellite coverage and could produce milestone delays for subsequent satellites in the series. Program documentation indicates that there is a 37 percent chance of a gap in the availability of two operational GOES-series satellites at any one time given the current October 2015 launch readiness date and an orbital testing period, assuming a normal lifespan

for the satellites currently on-orbit. Any delays in the launch readiness date for GOES-R, which is already at risk due to increasing development costs and use of program reserves, would further increase the probability of a gap in satellite continuity. This could result in the need for NOAA to rely on older satellites that are not fully functional.

Implementation of Recommendations Should Help Mitigate Risks of the Two Programs

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

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

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

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

and the program-identified funding stability risk are adequately monitored and mitigated.

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

In summary, after spending about $3.3 billion on the now-defunct NPOESS program, NOAA officials have established a $12.9-billion JPSS program and made progress in launching NPP, establishing contracts for the first JPSS satellite, and enhancing the ground systems controlling the satellites and processing the satellite data. In the coming months, program officials face changing requirements, technical issues on individual sensors, key milestones in developing the JPSS satellite, and important decisions on the spacecraft, launch vehicles, and instruments that are not included on the JPSS satellite. In addition, NOAA has not established plans to mitigate the almost certain satellite data gaps in the afternoon orbit or the potential gaps in the early and mid-morning orbits. These gaps will likely affect the accuracy and timeliness of weather predictions and forecasts and could affect lives, property, military operations, and commerce. Until NOAA identifies its mitigation options, it may miss opportunities to leverage alternative satellite data sources.

Completing many of GOES-R's early design activities is an accomplishment for this complex program, but this accomplishment has been accompanied by milestone delays and increased contractor cost estimates for GOES-R's components. The unreliability of GOES-R's schedules adds further uncertainty as to whether the program will meet its commitments. NOAA has taken steps to improve schedule reliability, but until the program implements and uses a full set of schedule best practices throughout the life of the program, further delays to program

milestones may occur. Moreover, until all contractor and subcontractor information is included in the program's integrated master schedule and regular schedule risk assessments are conducted, program management may not have timely and relevant information at its disposal for decision making, undercutting the ability of the program office to manage this high-risk program.

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

GAO Contact and Staff Acknowledgments

If you have any questions on matters discussed in this testimony, please contact David A. Powner at (202) 512-9286 or at pownerd@gao.gov. Other key contributors include Colleen Phillips (Assistant Director), Paula Moore (Assistant Director), Shaun Byrnes, Kate Feild, Nancy Glover, Franklin Jackson, Fatima Jahan, and Josh Leiling.

Chairman BROUN. Thank you, Mr. Powner, and I thank the whole panel for your testimony.

Reminding Members the Committee rules limit questioning to five minutes each. Ordinarily, the Chair would open the first round of questions, but I am going to defer to the Full Committee Chair, Mr. Hall, to begin the first round of questions.

Mr. Hall, you are recognized for five minutes.

Chairman HALL. Mr. Chairman, thank you.

I, you know, the Senate proposed—I think the Senate Commerce, Justice, and Science Appropriations Subcommittee proposed—in some report language to transfer funding for weather satellite acquisition from NOAA to NASA, and I am as bad as Mr. Miller about not knowing what a satellite might cost. I remember one time when I left the Texas Judge's seat in my little hometown to go to Austin to take on a job as a state senator; our kids had to change schools, and my wife and I both assured them we would help them with their schoolwork, and the first week they studied how much was the national debt. And it got my little kid in trouble because he gave them the answer I gave him; a hell of a lot, he said. That wasn't what the teacher was looking for, but maybe Mr. Miller and I might know that a satellite costs a hell of a lot.

But the Senate proposed to transfer the weather satellite from NOAA to NASA. I guess my question is, is this going to result in cost savings? I ask Dr. Sullivan that. She might have one answer and maybe Mr. Watkins might have another, and I might have another, but—and you don't have to answer that now but in a minute—will this result in any efficiencies, or will it streamline management? Will it increase the likelihood of the program's success by meeting mission requirements on schedule and within budget?

Would you like to answer that, Dr. Sullivan? Do you have an opinion on that, probably?

Dr. SULLIVAN. The Administration is taking the Senate's proposal very seriously, Mr. Hall, and is analyzing potential impacts in all of those areas and the points that the Senate highlighted in their proposal. We don't have an official position from the Administration yet, so I can't give you details of those considerations.

We share the Senate's concerns about growth in the program costs and the consequences that this has had on other elements of NOAA's budget, so we certainly appreciate where they are coming from on this and are working very diligently to look at the possible impacts, assess the places where they assert there will be savings, and look at the things we hold as priorities: mission assurance, management stability and effectiveness, and maximum continuity of data.

Chairman HALL. That is the sound of a good soldier. What is your real opinion? If you want to give it. If you don't, I understand.

Dr. SULLIVAN. Well, I have highlighted the areas where I would focus my analysis on, and I'm a scientist, so, you know, I would go with the analysis of what we think impacts in those areas might be, and we were sharing those with the appropriators and with the Administration.

Chairman HALL. Mr. Watkins.

Mr. WATKINS. Yes, sir. We have been working with the Administration, again, to assess the Senate's proposal. At this point in time that continues to go on. Again, we, too, would want to make sure that we are able to maintain overall schedules and the concerns of getting these critical space assets in space as soon as possible.

Chairman HALL. Okay. I guess—your answer is not no, and it is not yes. I guess can we expect the Administration to take any position on this, on a change like this, and if so, when would it happen?

Mr. WATKINS. Sir, I don't know the answer to that question. It's my understanding that the Administration has taken this under advisement, and their process is ongoing.

Chairman HALL. Once again I give an illustration in my own life. I went before a big company to borrow a lot of money one time, and they said, Mr. Hall, we will listen to your ignorant proposal with an open mind, and that is kind of what I am getting here. You must have an opinion, both of you, on that. You work for NOAA, you work for NASA, you are high up there.

The proposed transfer is not a trivial thing, and I just got about 40 more seconds. I guess my question is why hasn't the Administration, why have they been silent, and can we expect them to take a position? The proposal is not trivial. The satellite program represents a significant portion of NOAA's overall budget. Let's also not forget that NASA also has its hands full already with its own acquisition problems as the GAO listed on its high-risk series. In the decision also the program of such a domestic fashion should be fully reviewed by the authorizing committees. While I share the Senate's frustrations in these programs, I hope that this decision is not made in the backroom as always, and I am committed to working with the Administration some, as much as I possibly can, and the Senate and my House colleagues to ensure that our Nation maintains its critical weather forecasting capabilities. It is very important.

My time is up, and I yield back.

Chairman BROUN. Thank you, Chairman Hall. I now recognize my Ranking Member, Mr. Tonko from New York, for five minutes.

Mr. TONKO. Thank you, Mr. Chair. The odds are extremely high that there will be a gap in data between the end of NPP's productive life and the time that JPSS–1 can be launched and data brought online. In fact, the NPP may not even last the projected five years for which we are looking. As a result, we need a clear plan for how to cope with the data gap, so to speak, a gap that may start sooner rather than later.

Dr. Sullivan, what is NOAA's plan for filling that gap, and who have you assigned to manage the effort to identify other data sources and ensure that the data we can get will work seamlessly in our weather prediction models?

Dr. SULLIVAN. Thank you, Mr. Tonko, for that question. Our mission to deliver accurate and life and property protecting forecasts is one that we take extremely seriously, and so I can assure you that no one is more concerned about and working harder on this gap than my colleagues and I at NOAA do.

You have asked the single most common question we receive from Congress, from our weather enterprise stakeholders, that I ask myself, and if I had a silver-bullet answer to magically fix it,

I assure you I would give it to you. There is no easy direct substitute on orbit, just go get it, for the data of the precision and the accuracy and the compatibility that JPSS is designed to provide.

What we are doing and we are working very hard at this, we have been renewing and reconfirming written and firm commitments with international partners for mutual aid. These are arrangements akin to utility companies mutual aid arrangements in the time of a storm. We have used such arrangements in the past in instances where we had temporary outages of a GOES satellite back in March of 2010 I believe it was and years prior when other nations have had more extended gaps in their geostationary coverage.

So we are working those, we are ensuring they are in place. We have good understanding of the technical characteristics of many of those data streams. Many of them we use as complementary data to improve the forecasts off of our core data streams today.

We have begun the efforts with our modeling centers and our weather service to look at what technical changes would be needed if we did need to and wish to take data streams in that we don't commonly. I would cite one there. The Defense Department's satellite has a microwave imager sounder, the data from which we don't commonly use. It has noise characteristics and bias that are not suitable for our normal weather models. We have worked hard over the last year to whittle those down and understand how we could accommodate those. That has shortened the time frame, the runway it would take to incorporate those data. We will continue such efforts.

The GAO rightfully, we believe, points out that these plans should be better documented. That is a fair comment. We will deliver on that. They rightly point out that it is not enough just to list out a roster of things one might do. We really need to take the positive steps as your question is suggesting——

Mr. TONKO. Uh-huh.

Dr. SULLIVAN [continuing]. To be sure that we are technically ready as well, and we are beginning on that work and will document it appropriately.

Mr. TONKO. And who is leading that, who is taking that effort up?

Dr. SULLIVAN. Our international partnership work and the overall effort for gap assessment is being led by our Associate Administrator for NESDIS, Mary Kicza, and we have as I alluded to, colleagues within both our algorithm shops and the National Weather Service engaged as well. And I assure you I keep a close eye on it.

Mr. TONKO. Uh-huh, and Mr. Powner, do you have any comment or views on this matter?

Mr. POWNER. Well, clearly we would like to see those plans documented. A couple thoughts here, though. One is the one thing that NOAA and NASA do control is keeping JPSS launch date where it currently is. You need to keep that on track, because if that slips more, the gap becomes even greater. So that is one thing you need to really focus on keenly.

The other thing is with NPP over the next year as you look at calibration and validation activities, there might be a greater indi-

cation on how long NPP will last. So the key is to try to get NPP to last as long as you can, and that picture should become clearer when you go through calibration and validation, but you really need to keep that first JPSS–1 on track.

Mr. TONKO. Uh-huh.

Dr. SULLIVAN. Mr. Tonko, I would just add, we completely agree with that. I thought your question was directed more towards alternative data streams. I endorse my colleague's comments.

Mr. TONKO. Okay. Thank you, and Mr. Powner, you have seen a lot of program teams come and go, and do you have a view on the current JPSS Program Manager and team that you would be willing to share?

Mr. POWNER. Yeah. I think there is strong program management there. We have seen many program managers over the years testifying before this Committee, and clearly when you look at where the program is now, it is in a much better position than where it has been in the past, and when you look at the aggressive mitigation of risk, one of the key things to highlight, the $1.7 million—billion funding gap to get down to the cap on the program is being aggressively worked by the program. Those plans make sense right now. Obviously we need to see more details, but I think the aggressive management of risk has been where we want it.

Mr. TONKO. Thank you. Thank you very much.

Chairman BROUN. Thank you, Mr. Tonko. Now I recognize my colleague from Maryland, Dr. Harris.

Mr. HARRIS. Thank you very much, Mr. Chairman.

Chairman BROUN. You have five minutes.

Mr. HARRIS. As I indicated in my opening statement, you know, the status quo with respect to weather satellite programs may simply not be a sustainable option, and a question we should be asking and exploring is to what alternative options we have.

To that end, I would like to enter into the record a piece by University of Washington Atmospheric Scientist Cliff Mass, entitled, "Weather-X."

Chairman BROUN. And without objection.

[The information may be found in Appendix 2.]

Mr. HARRIS. Thank you very much. Dr. Mass makes the argument that NOAA should consider pursuing a model similar to that which NASA pursued with SpaceX. Mass argues that the weather data necessary for forecasts could be provided by a private company that could build, launch, and maintain the satellites.

Dr. Sullivan, what is NOAA's philosophy towards the type of alternative private model that Dr. Mass has suggested?

Dr. SULLIVAN. Well, I would say I have not read the blog post in detail, Dr. Harris, so I can't comment on the particulars that are sited there. In general, my posture would be that innovative ideas deserve careful exploration.

My administrator just testified before another committee at this chamber last week about the desirability and the importance of the Weather Service, as indeed all of NOAA, being resilient and adaptable for the changes that are coming ahead and the changes in our customer base and the demands for our products and services, the changes of our challenges of our fiscal times. So those are important attributes for any organization to have.

Mr. HARRIS. Sure, and I understand there are private sector models of this type currently being proposed to NOAA. At a hearing earlier this year, we heard from a company proposing to launch a hyperspectral sounder that would provide dramatically improved severe storm forecasting capability, and with that in mind, could you be specific about how NOAA is evaluating these proposals? I mean, who is in charge of these evaluations, and how specifically they would go forward if they could?

Dr. SULLIVAN. Well, I think there are two different characteristics there. The proposal that I understand was brought to us with respect to that hyperspectral instrument was that we procure the instrument or the data from it as a substitute for current data. Our environmental satellite service organization in concert with the National Weather Service evaluate those proposals to determine the suitability of data and the judged reliability, feasibility of the proposal in terms of technical maturity and cost reliability and the estimates. All satellites and all instruments are very easy in Power Point. Most are much harder in actuality, so we look for some evidence that we have got a viable path.

To my mind, the SpaceX type model is an altogether different thing. If the proposal is that a third party actually set their standards, set their targets, and decide to go do something and open a new market, which is, in a nutshell, my understanding of the SpaceX proposal, and as I think we have seen NASA do, one applies a very different posture to a proposal like that. We have not had such a one come before us at NOAA. I think we would take a similar kind of posture.

Weather forecasting to protect the lives and livelihoods of Americans is not the same commodity as tickets to ride. So the details might well turn out differently.

Mr. HARRIS. Okay, but there is some method. I mean, is someone, for instance, is there someone actively pursuing the—or investigating this Weather-X proposal? I mean, is there any discussion at NOAA at all about the potential for commercialization as NASA has done with SpaceX?

Dr. SULLIVAN. I am not aware that——

Mr. HARRIS. Not as an individual effort. You are waiting to be reactive, not proactive about it.

Dr. SULLIVAN. I wouldn't characterize it that way, Dr. Harris. We interrogate and interact with the private sector abundantly. As you know, there is a very vibrant private sector weather enterprise that has privatized the dissemination portion of the enterprise. It used to be, once upon a time, government as well. We engage with potential providers of launch services and instruments quite frequently. We put an RFQ out in 2008, prior to letting instrument contracts for JPSS to take extra care and be sure there were not candidate providers we had overlooked.

So I think we are more active than your question suggests. I just don't know if anyone yet has seen the Weather-X blog. It had not been brought to my attention until your question.

Mr. HARRIS. Well, it will be in the record so they can see if they—I would hope that someone would be, you know, watching something, again, by university scientists being published. Even if it is in a blog.

At the same prior hearing on NOAA weather data, a panel of outside experts all recommended that NOAA undertake an observing system simulation experiment, an OSSE, which I hope you are familiar with the concept, which would quantitatively evaluate different capabilities and options to determine the best mix of systems that NOAA should pursue.

Now, absent one—an OSSE—NOAA is basing its weather data planning mostly on subjective opinions.

So, Dr. Sullivan, when will NOAA finally undertake an OSSE on these systems?

Dr. SULLIVAN. We agree with the characterization of OSSEs as a highly rigorous and very good way to assess total ensembles of observing systems. We do use them, and we have used them periodically in the past. We have neither the high-performance computing capacity nor the manpower, frankly, to devote to a standing large effort to run multiple OSSEs. That—we are sort of rate limited in that step.

We did, as you know, I believe, conduct an OSSE or more appropriately, an observing simulation experiment, to evaluate the potential loss of data of weather forecasting in the midlatitudes like the Snowmageddon example that I think we spoke about at this hearing last year.

So we do them selectively. I am sure they will come into play as we look at some of the gap mitigation strategies that may lie before us. We would love to do, have the capacity to do, more of them. They are an important and rigorous tool.

Mr. HARRIS. Well, thank you very much.

Chairman BROUN. The Chairman's time has expired.

Mr. Miller, you are recognized for five minutes.

Mr. MILLER. Thank you, Mr. Chairman.

I mentioned before we had many hearings in this Committee on—or these Subcommittees on these programs but particularly the JPSS Program and its predecessor program, the late unlamented NPOESS Program. The hearings seem to have a familiar pattern to them. We have someone from NOAA or NASA or other government agencies saying these programs have been a big problem, they have been messed up, but we are fixing it now, things are on track now, and then we had Mr. Powner say, no, no, they are still messing up, and he has always been right.

But I have heard, Mr. Powner, in your testimony today, I heard terms I have never heard come from your mouth. Good progress, solid development. Do you think that particularly the JPSS is on track, and what are the remaining issues and risks? What else can go wrong? In the past it has been true that everything that could go wrong has, but do you think, what do you think could still go wrong, and how much under control is that?

Mr. POWNER. Well, clearly it is a much better picture than we testified on in the past, Ranking Member Miller. I think the challenge, the couple of challenges that we see with JPSS is operating within the $12.9 billion gap cap because the program when you reconcile cost estimates, it was somewhere around $14.6. So operating within that cap there is still that $1.7 billion delta. There is a plan to address that, but I think that will be a challenge going forward.

In addition, associated with addressing that $1.7 billion gap, this arrangement where you have a ride-share arrangement with certain sensors, and you are flying them outside of the JPSS Program, there is some big cost savings associated with that, and I think it is important to keep an eye on that, because that is where you are likely going to get the savings is the way I see the current plan.

Mr. MILLER. Okay. Dr. Sullivan, that may have sounded mildly critical, but if you had been here before, you know that was lavish praise.

How confident are you in that $12.9 billion figure for lifecycle cost analysis? What are the risks of that not being the right number or something going wrong?

Dr. SULLIVAN. Mr. Miller, I don't buy satellites every day, either, but I have been around space systems a good bit. I think that sounded right on the mark. These are complex programs. They always need carefully watched. I never rested easy until the wheels stopped on the runway after a mission, and I don't intend to rest easy until we have got these systems in orbit now as well.

So I think Mr. Powner has characterized things quite fairly and quite properly. We will stay right on the bubble.

Having said that, I am confident that we have a solid figure in the $12.9 billion number. The elements of work that were done to move from the $14.6 down to the $12.9 I think were solidly done. They capitalized on experience with NPP, as has been mentioned earlier in questioning. They took some conservative estimates that were based on unknowns and unproven capabilities and performance, modified those downward. They dove into remaining elements that were heritage legacy from the ill-fated and never lamented NPOESS and scrubbed those back. With respect to the ground system, as Mr. Powner has noted, moved the ground system to a different set of architectures that are less proprietary, more commercial, off the shelf, modern network protocols.

So a lot of substantive technical things were done to stack up that new estimate, and I have a strong confidence in it and also very high and continued scrutiny.

Mr. MILLER. Okay. Mr. Watkins, your testimony was also very optimistic about the GOES–R Program, and it does sound like it is on track, but it is the instruments that still have a ways to go and developing them and integrating them, and we know that that has frequently been a stage at which things can go wrong.

What confidence do you have that the instruments included like the lightning mapper, I have never bought a lightning mapper either, will succeed and it will be on time and on budget?

Mr. WATKINS. I think one of the things that is critical is that NOAA and NASA got started very early on with the instrument developments, and the instruments, when you look across satellite programs are usually the place where you begin to run into the problems. And so I think the fact that they started the instrument developments very early, the fact that they had developed instrument prototypes, the instruments are on the path to being completed on time. You mentioned the lightning mapper. That is going to be the first time that we actually will fly that instrument, and it, too, is progressing along very well.

So we are confident in the approach that was taken with the instrument developments and the ways in which they are currently being managed.

Mr. MILLER. Okay. My time has expired, Mr. Chairman.

Mr. HARRIS. [Presiding] Thank you very much. I now recognize the gentleman from California, Mr. Rohrabacher, for five minutes.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

Mr. Watkins and maybe Dr. Sullivan may have some insight on this as well, how much money has just evaporated from the NPOESS Program? What do we have? We have some things that are left from this debacle that are worth something, but how much can you say is an actual total loss of value for the American taxpayer?

Mr. WATKINS. Do you want me to—so where we are today, tied to the NPOESS Program, approximately $4.3 billion has been spent to date. Now, out of those resources we had the development of instruments that are ultimately going to be flying on——

Mr. ROHRABACHER. Okay.

Mr. WATKINS [continuing]. JPSS–1——

Mr. ROHRABACHER. Right.

Mr. WATKINS [continuing]. Instruments that were, that are flying on Suomi NPP, the fact that we had developed a ground system that is actually being utilized today in order to operate the Suomi NPP mission, and instrument developments across the board, again, for JPSS–1.

So a lot of the costs that have been spent to date are actually being utilized as part of the overall JPSS–1 Program.

Mr. ROHRABACHER. Right. That is the basis of my question. How much have we lost? How much, I mean, it is not—there is no loss at all? It is not really a debacle? It's an ideal program or——

Mr. WATKINS. No. Sir——

Mr. ROHRABACHER. We have been told just the opposite, that we are representing at least hundreds of millions of dollars, if not billions of dollars of actual evaporation of wealth.

Mr. WATKINS. Sir, we would have to take that under advisement and get back to you.

Mr. ROHRABACHER. That would be nice. Thank you very much.

Mr. WATKINS. Okay. We will take that action.

Mr. ROHRABACHER. Because I do recognize as you were pointing out and people should understand while evaluating this program, it is—of the $4 billion it is not all gone.

Mr. WATKINS. No.

Mr. ROHRABACHER. There is a large chunk of it which we will use eventually, however, that doesn't necessarily make up for the cost overrun concept here where it started at such a low level and ended up escalating, I mean, over double was—as it stands now when it could go up more.

Just a little bit about this Senate recommendation that Chairman Hall brought up in terms of procurement of weather satellites from going from NOAA to NASA rather than being this joint system that created so much havoc with NPOESS. The suggestion is is that we take this procurement decision-making process out of the hands of NOAA and NASA and give it to NASA, and that is what you didn't want to comment on until we got the Administration

come down with our policy, and it is perfectly understandable. That is what you have to do.

But let me just ask about common sense here. NOAA is the agency that utilizes this technology. NOAA is the one that is going to utilize it, and doesn't it make sense that NOAA and other agencies such as the Geological Survey, to assume a greater role in actually procuring the equipment they need rather than NASA, who is basically aimed at exploration and—of space? Wouldn't it make sense to actually go the other direction, that we are giving more rights to NOAA to make those decisions rather than sharing it with NASA, which is not going to be necessarily utilizing the equipment after it has already been procured?

Dr. SULLIVAN. I think the logic you enunciate, Mr. Rohrabacher, was some of the logic that drove the decision to unwind the NPOESS Program to get end-mission responsibility aligned as tightly as possible with fiscal resources and program management. My colleagues at NASA appreciate the importance of this mission to the country as well as we do. I am confident that Congress in its wisdom does direct this change.

Mr. ROHRABACHER. I would think, I would hope that people start looking at that because if we are going to transfer it to, we are going to transfer authority and put some—and focus authority, it should be on the people who are going to use the system that they are ordering, and also it would again go to the heart of the matter of let's have NASA focus on what it does, which is space exploration, and let's have NOAA and Geological Survey and others focus on their mission, which is to look at the Earth. NASA's mission is not that.

One last thing, Mr. Chairman, with your permission, the—another issue as brought up Chairman Harris during his questions dealt with the privatization and looking at SpaceX as a model, which will save the taxpayer enormous amounts of money in the long run because it has proven successful or at least now if it keeps proving itself successful. We—there are equivalents in NOAA to this, and there are equivalent things in most major agencies. If we are going to bring down this $1.5 trillion worth of deficit spending that we have every year, we have got to find ways of making those type of savings as represented by SpaceX.

And let me just note that NOAA has a fleet of ships in order to transport their various programs and their various missions around and determining what the weather is like. I would see there would be an equivalency of SpaceX transporting things into space and does a better job than just leaving it to a government agency. I would say that there is also an equivalency in NOAA that instead of maintaining a fleet, that could be contracted out, and we would probably save money. I know we looked at that several years ago, and we didn't have the political will to move forward on that, but maybe the fact that we are about ready to go under because of deficit spending will encourage us to look at those type of alternatives.

Thank you very much, Mr. Chairman.

Mr. HARRIS. Thank you very much, and now I recognize the gentlelady from California, Ms. Lofgren, for five minutes.

Ms. LOFGREN. Thank you, Mr. Chairman, and I was very interested in listening to Mr. Rohrabacher's questioning about responsibility and NOAA versus NASA, and Mr. Rohrabacher and I don't always agree on things, but I think his line of questioning is one that I have as well, which is if we are going to look at NOAA to be our lead in the science of all of this, you know, maybe we ought to think about vesting more completely the responsibility with you instead of having you ask your brother agency. And I am sure that is going to lead to what we really want. I guess that would be my statement rather than a question. I won't put you on the spot.

You know, when you think about the history of what is going on, I mean, it was really in 2005, I think, that the cost overruns were so outrageous that they really, they triggered the Nunn-McCurdy Program breach review, and at the time, we had a Republican President and a Republican committee, and even the leadership of this Committee couldn't get the attention of the President at that time. And when you think about that to where we are today, we have made tremendous progress. It doesn't mean we have to be satisfied with where we are. I don't think anyone is. I am not hearing that from any of the witnesses. But we have made tremendous progress, and we have got to make more.

Here is the question. It is easy for us in the Congress to look at the Administration whether—of either party and complain, but sometimes we need to turn the attention on ourselves, and so this is the question for you if you can answer. We have not had stable funding because of our inability to appropriate in the normal course of business.

How would a continuing resolution, if that is what we end up with again this year, impact your programs? Dr. Sullivan and Mr. Watkins, if you could answer that, it would be very helpful.

Dr. SULLIVAN. Thank you, Ms. Lofgren. I appreciate your remarks and your question. With respect to continuing resolution, one big item that would concern me there is FY 2013 is when GOES–R has a scheduled budget bump in order to accommodate purchase of a launch vehicle. So if we are unable to proceed with the launch vehicle scheduling and acquisition, that could compromise schedule.

With respect to JPSS, if we were held on a continuing resolution at the appropriated level of the FY '12, plan, that is in line with what we would, what we have come forward for in the President's budget, so I would forecast with the same caveats of forecast. Less impact on JPSS but an impact of concern on GOES–R.

Mr. WATKINS. The only thing that I would add to that is that with respect to the GOES–R Program, currently we are at a budget in this fiscal year at 615. We plan to be increased to 803, and so if we were actually under a continuing resolution that went beyond the first quarter of the fiscal year, it would begin to have severe negative impacts to the cost and the schedule of specifically the GOES–R mission.

And so the continuing resolution hurts us a lot more in the GOES–R Program.

Ms. LOFGREN. So if we do that, what I am hearing is it could end up costing us more, assuming we continue with both program efforts down the line. And if we didn't, I mean, this is a lot of money.

I mean, where I come from this sounds like a lot of money, and yet when you think about what is going on in terms of very severe weather impacts, what was there, $60 billion in fiscal year 2011 on dramatic events, and I guess my questions maybe you can't answer.

If you can get a 10 or 15 percent increase in damage for lack of warning, I mean, have you done an analysis of what kind of warning leads to what kind of decrease in damage on the ground if it is a hurricane or if it is a tornado or if it is whatever kind of event?

Dr. SULLIVAN. Ms. Lofgren, we have not seen any rigorously evaluated economic studies that make that trace all the way through improvement of a warning, improvement of a forecast, improvement of a warning, to improvement of the human response to that warning. So I can't give you a well-vetted figure.

Ms. LOFGREN. Well, maybe that is something we ought to ask the post-docs of the world to take a look at, but we do know, just anecdotally, that adequate warning in tornado alley made a huge difference in terms of loss of life, and it would be good to have some analysis, because if we are talking, you know, a 10 or 15 percent reduction in loss on a $60 billion figure, that is way more than we are talking about to create the warning, and with that I think my time has expired, and I move to yield back.

Mr. HARRIS. Thank you very much, and now I recognize the gentleman from Mississippi, Mr. Palazzo, for five minutes.

Mr. PALAZZO. Thank you, Mr. Chairman. As the Chairman of the Space and Aeronautics Subcommittee, I would like to echo Chairman Hall's concerns regarding the Senate's proposal to transfer $1.6 billion from NOAA to NASA for the procurement of weather satellites. From my perspective, Mr. Hall raised the most important point when he said NASA has its hands full. We are hearing about cancelled Mars and astronomy missions, delayed testing for SLS, continuing issues with the James Webb Space Telescope, and the list goes on and on.

If this Senate proposal goes through, NASA will now own these troubled weather satellites also. Just based on their history, I would say there is a good chance we will have additional cost overruns, and now NASA, not NOAA, will have to cover in the NASA budget.

So with that, Mr. Watkins, the devil is always—the detail is always—the devil is always in the details. Can you—it feels like a late afternoon. Has NASA done anything to analyze this switch from NOAA to NASA?

Mr. WATKINS. Again, sir, we have been working with the Administration as they are taking this Senate proposal under advisement, and that is continuing as we speak today. They were looking across critical assets of satellite programs, they are looking at the overall budget, they are looking at the overall schedule, as well as the critical need to get these data products into weather prediction.

And so it is a very complicated thing to evaluate, and they are in the process of evaluating the Senate proposal.

Mr. PALAZZO. So then, basically, you will take your analysis, and you will provide that to the Administration, and is that where his statement of administration policy comes from, that Chairman Hall

requested and no one was able to tell him when they may receive that?

Mr. WATKINS. I don't know the answer to that question, sir. We will have to get back to you.

Mr. PALAZZO. Okay. Say when there are cost overruns just based on the history of this program, what missions is NASA going to have to reduce their funding for or eliminate such as earth sciences or——

Mr. WATKINS. At the current time, again, the NASA role in the weather satellite programs on behalf of NOAA is one of an acquisition agent, and we implement these critical products on behalf of NOAA. All of the funding that currently is tied in with this program is NOAA funding. It comes to NASA, and we build their satellites and launch them, and then, you know, commission them and bring back the critical data.

And so at this point there are zero NASA dollars involved.

Mr. PALAZZO. So the $1.6 billion transfer, if it ends up costing $2 billion, NOAA will basically pick up that extra $400 billion, I mean, $400 million and transfer that to NASA?

Mr. WATKINS. Sir, I was only speaking of the existing relationship. I wasn't speaking of the Senate proposal. Again, I think all of that would have to be evaluated.

Mr. PALAZZO. Okay. Thank you. Dr. Sullivan, the recommendation to sever the NPOESS Program came from an independent review team chaired by Mr. Tom Young. It is our understanding that Mr. Young is engaged in another review for NOAA, and I have got several questions related to that.

What has NOAA charged him to look at? Will this review address the funding shortfall identified by GAO? Will this review provide recommendations or just findings? Will this review be available to Congress, and also, will the findings be reviewed, vetted, and edited by the Administration prior to sharing with Congress?

Dr. SULLIVAN. Thank you, Mr. Palazzo, for your question. Tom Young does, indeed, chair our Independent Review Team that is charged with looking across the entire NOAA satellite portfolio. It is a late afternoon. His co-chair is a retired Air Force General, Tom Moorman. The rest of the panel, we can provide you the names, are very experienced space professionals.

Their charge is to look at any and all aspects of budget management, technical formulation that contribute to or detract to mission assurance in our satellite programs, assess them and provide both findings and recommendations. It is—they brief me directly, they write their report, their reports are not redacted by someone before reaching the NOAA Administrator and, nor as I understand at least, are they in any way redacted before they come to this Committee or other committees of this chamber and your colleagues on the other side of the Hill, whether verbally or written.

Mr. PALAZZO. Thank you. I yield back, Mr. Chairman.

Mr. HARRIS. Thank you very much. I recognize the gentleman from California, Mr. McNerney, for five minutes.

Mr. MCNERNEY. Thank you, Mr. Chairman.

Dr. Sullivan, I can imagine what things were like when the budget reduction became known and uncertainty in what your

funding was going to be like. It must have been a sense of panic and scramble.

Let me ask you, has that passed now, or are things still in a scramble mode to try and figure out what is going to happen or how you are going to deal with this shortfall?

Dr. SULLIVAN. May I just clarify, Mr. McNerney, that you are referring to the continuing resolution in FY 2011, or did you have some other budget issue in mind?

Mr. MCNERNEY. Yes, the continuing resolution.

Dr. SULLIVAN. That—FY 2011 was a very difficult year with a final appropriation not in hand until some time, I forget the exact calendar date of the enactment and then we had spend plan negotiations with various chambers to get alignment on the use of those funds. So it was very late in the year. It was less than 30 days before the end of the fiscal year before we had full agreement from all parties on the Hill about how to spend our resources.

That is, as you suggested, extremely difficult to manage. While it is difficult to manage a federal agency itself, it is extremely difficult to maintain continuity and performance for contractors, for our university colleagues who were subject to that uncertainly

For JPSS in particular, the level of the CR, the level of spending that we were held at because of the CR, even when supplemented by the better part of $90 million by reprograming that the Administration requested and the Congress approved, still was far below. It was hundreds of millions below the target level for the ramp-up of JPSS.

So with that backdrop I would say a few things. I would say that rather like the ripple on a carpet or a bedspread, when you give it a good shake, some of that is still moving through the system in terms of delays that were incurred that don't just go instantly away when a funding stream is restored, and we are still seeing some of that consequence. It definitely did strain the team. It strained in terms of professionalism and acuminated desire to keep moving. Of course, it creates tensions within a team. I think largely the team is past that. The trust and battle rhythm of the NOAA and NASA team around JPSS has improved notably in the 12, 13 months since I have been aboard.

The final thing I would say, though, is, you know, the general climate of uncertainty certainly is a tension that we all have to bear, and we certainly hear about it also from our contractors as perhaps you do as well. They have got a battle rhythm and a certain headcount running on the factory floors that are building these spacecraft, and to be assured of being able to continue them, will they have to think about moving those workforces around? One of the things that I think we all worry about is, across all federal programs, if the funding is that uncertain, can the Federal Government have confidence of getting the A–Team on these programs if there are steadier income streams from commercial context in the case of this business sector? Might we be concerned about having lesser quality of talent applied to our work and doing the public's good?

Mr. MCNERNEY. We are all concerned about the data gap, if it is going to be bad enough for the public to notice, if it is going to be bad enough to cause additional damage due to poor forecasting

and so on. I am a mathematician for my background, and I did a lot of time modeling. Do you think the modeling, the mathematical modeling is going to pick up a lot of that slack, given the data from other sources and the older satellites?

Dr. SULLIVAN. So I am a geologist, Mr. McNerney. I don't think I will attempt the same estimate that you will.

Mr. MCNERNEY. Okay.

Dr. SULLIVAN. But that is an important and open question that we will be looking at. I think the prospect is certainly there. The other forms of data, proxy data, if you will, might be able to substitute and lessen the degradation of forecasts. The afternoon orbit specifically as almost a piece of real estate is an important point here in terms of sampling the atmosphere at the peak of midday heating when it is, you know, the dynamics are fully active. So there is a question of, can you get some other sounding data from a different instrument, and then there is the added question of, and does it give you that same time coverage in terms of the daily cycle of the Earth, and then how old are the data by the time you get them into your models? All of those would be factors in how much we could mitigate the forecast degradation.

Mr. MCNERNEY. Well, there is certainly—with the current capabilities, and we would see a significant dropoff if that, if the dropoff happened today, if the data gap happened today. We would see a significant dropoff. Is that correct?

Dr. SULLIVAN. We have run a number of studies to assess that about a year and a half ago, I think, they were completed. Statistically they scatter, of course, a little bit as you would expect. The most notable outcome in that was a simulation without polar-orbiting data, without afternoon polar data for the big snowstorm called Snowmageddon. And in that case, we had substantial forecasters in both the track of the storm and the total precipitation fell in the storm. The three or four other cases that we studied showed a varying sensitivity. Generally some degradation, not all as severe as the Snowmageddon case.

Mr. MCNERNEY. Thank you. My time has expired.

Mr. HARRIS. Thank you very much, and we have a few more—I have a few more questions, so we will do a second round. I recognize myself for the five minutes, first five minutes.

Dr. Sullivan, one of the most troubling findings from GAO's JPSS report is that the entire polar-orbiting constellation, not just the afternoon orbit, appears to be at risk. DOD still has DMSP satellites available for the early morning orbit, but they may not operate as expected because they have been in storage for so long.

DOD also hasn't figured out what is it going to do after the DMSP program. The Europeans are experiencing their own financial problems, and NOAA has indicated that it will not supply sensors to the Next Generation Program for the mid-morning orbit.

Since its inception the NPOESS Program has always intended on operating satellites in three separate orbits that would ensure that no observations were more than six hours old.

Now, understanding that your shop, NOAA, is only responsible for the afternoon orbit, do you have any idea what the Administration as a whole is doing to protect the entire constellation?

Dr. SULLIVAN. Dr. Harris, I know the Administration has convened a National Earth Observations Task Force to look across all of the civilian agencies and try to get a better handle and greater coordination across those assets and their capabilities. I am not aware of an active interagency group. It may just be my ignorance that is looking more at the White House levels, specifically at the DMSP or DWSS and NOAA constellations.

I would say that our own program managers are maintaining very active liaison with both Air Force weather and space and missiles command out in Los Angeles. So we are interacting closely with them. We have a very long history of collaboration and mutual support with the Defense Department. I believe both parties recognize and appreciate the other's equities quite well and try to maintain high levels of mutual awareness and information so that we can do—we can do what we can do with the resources and latitude available to us to complement and support each other.

Mr. HARRIS. But does the—do you know, does the Administration plan to mitigate the risks or how are they going to mitigate the risk of a gap in those other orbits, not NOAA's afternoon orbit but the other orbits, which inform you and the National Weather Service for your forecasts and models?

Dr. SULLIVAN. I know of no specific plan for those mitigations at this time, Dr. Harris.

Mr. HARRIS. Now, the GAO's testimony indicates that NOAA will have to shed some capability in order to live within the Administration's cost cap. Options listed by the GAO include the loss of climate sensors, which would cause a break in the over-30-year record of some measurements, the loss of ground-based reception stations that would degrade the timeliness of data from 30 minutes to 80 minutes, or the loss of data processing systems at two Navy locations that would impact the data used by warfighters.

What, if anything, does NOAA plan to remove? I mean, what—have you prioritized what will be removed?

Dr. SULLIVAN. I can assure you we have very clear prioritization of the factors that make the greatest contributions to our primary weather forecasting mission, and the decisions we have made to date and any that are driven by circumstances we face in the future will be made in accordance with those priorities.

Having said that, as I believe Mr. Powner pointed out in his testimony, the options that we have worked on, the reanalysis that we have worked on, since their first look gives us confidence that the sensors can, in fact, be accommodated inside the $12.9 billion lifecycle cost cap. We did decide, and we think it is a prudent action, to drop the number of ground stations from the very high number that was contained in the old NPOESS so-called distributed receptor network and rely more critically on one at each pole. So two stations that see lots of every polar pass, Svalbard and McMurdo, with a backup at high latitudes in our own Fairbanks site. Those give us very good coverage for all polar-orbiting birds.

Yes, the initial target of a 30-minute time delay or latency for JPSS data has been relaxed to 80. Our current performance, however, is 120, so that is still a substantial improvement over current performance and should make a notable improvement to forecasting.

With respect to the data centrals, I think that reflects, in part, an evolution of ground system structure from very tailored, very unique, to each service and each provider towards more common, unified ground stations. We certainly can take on the development of tailored interfaces for NOAA satellite data for the Air Force or the Navy if they wish, but at this point, with our budget constraints, we have let those partners know that would have to be on a reimbursable basis. The Air Force is assessing its own ground system options, both for current DMSP fly operations and for DWSS or whatever that will be, and I am not aware of any detailed plans from them yet.

Mr. HARRIS. Now, with regards to the GAO report, this controversy about whether the cap is, whether the shortfall is $1.7 or $2.7 billion, because the GAO report states that NOAA validated the cost of the full set of JPSS functions would be $11.3 billion from FY 2012 to 2028. After adding the agency's cost of $3.3, the program's lifecycle cost estimate total, $14.6, which is $2.7 billion higher than that $11.9 billion estimate for JPSS when NPOESS was disbanded in 2010.

So according to NOAA officials this increase is primarily due to a four-year extension of the program, the addition of previously unbudgeted items such as free flyers, costs associated with transitioning contracts from DOD to NOAA, and the program's decision to slow down work on lower-priority elements because of the budget constraints of 2011.

The GAO then states that in working with OMB to establish the President's FY 2013 budget request NOAA officials stated that they agreed to fund JPSS at roughly $900 million per year through 2017, merge funding for the two climate sensors into the JPSS budget, and to cap the JPSS lifecycle cost at $12.9 billion through 2028.

Because this cap is $1.7 billion below the $14.6 lifecycle cost, NOAA decided to remove selected elements from the satellite program.

Now, so do you—is a shortfall of $1.7 or $2.7 below the expected lifecycle cost? Mr. Powner, maybe you can—what is your finding?

Mr. POWNER. So the gap is $1.7 billion. It is from $14.6, that was the cost when you reconciled the various cost estimates, but the program, just to keep it simple, the program was capped at $12.9, so there was this $1.7 that the program was trying to get down to. And, again, I think their approach as we understand it is there are two primary ways in which they are going to reduce—address the $1.7 million gap. One is they found a more efficient way to operate and maintain the satellites which Dr. Sullivan referred to and then also, too, there is this savings through this ride-share arrangement with the free flyers where the climate sensors are still included, but they are going to fly them outside of the JPSS Program.

There are still some details we want to see about both those things and how that tallies up to $1.7. That is why I made the comments, the question, still questions about operating within the $12.9 cap.

Mr. HARRIS. Dr. Sullivan, is that an accurate assessment of where the $1.7 is going to be made up?

Dr. SULLIVAN. It is, sir.

Mr. HARRIS. Okay. Thank you very much.

I recognize Mr. McNerney for five minutes.

Mr. MCNERNEY. Thank you, Mr. Chairman.

Mr. Powner, one thing that really stuck out about your oral testimony here was the 48 percent confidence level that NASA will meet the 2015 launch date. Is that in your mind the biggest threat, is that, not making that launch date?

Mr. POWNER. Yeah. So a couple things. We did some very detailed schedule analysis, and so there were things we went into great detail on, two of the sensor schedules as well as the spacecraft and ground, and we had some questions about how the schedules were being managed and the rigor you want with that. Ultimately what that all means is it calls into question whether you can hit key milestones. So these milestones all need to be hit to ultimately reach the launch date.

That coupled with the fact that their own internal assessment showed that there was only a 48 percent confidence level that they were going to hit the October, 2015, date raised questions about whether they will be able to do that. I think, and we are under the impression that if you raised it to 70 percent confidence level, which is, I think, what the program ultimately likes to operate under, that does push that launch date into early 2016. I think there is a 4- or 5-month slip roughly there, but those are the questions that, you know, need to be considered going forward, how solid is that October 2015. There are question marks there clearly.

Mr. MCNERNEY. Can you be as specific as you can in giving us recommendations on how we can reach that October 2015 launch date or achieve that date?

Mr. POWNER. Well, one of the things we did do in our report is we had very detailed recommendations on how the program could be more rigorous in managing their schedules. So, for instance, we found things like not all subcontractor activities were included in schedules, critical paths weren't identified. That is very important so you can identify the long pole in the tent, those types of things.

And those are the recommendations we have, so hopefully that will be helpful in ultimately achieving that launch date.

Mr. MCNERNEY. Thank you.

Mr. WATKINS. The one thing I would like to add is——

Mr. MCNERNEY. Sure.

Mr. WATKINS [continuing]. As David pointed out, Mr. Powner pointed out, clearly we have listened to and taken seriously the recommendations from GAO. We have already implemented a lot of the changes or improvements that he identified with respect to scheduling and reporting.

The other thing that I would say is I think the largest risk to that October 2015 launch date right now is, again, with stability associated with funding, again, because of where we are today at 615 and needing to go to 803. In the next fiscal year if we are under a continuing resolution, it is going to have a negative impact on our ability to maintain the October 2015 launch readiness date in addition to the items that he pointed out.

Mr. MCNERNEY. That makes sense. It was gratifying to hear about your partnership with NOAA on the Joint Polar Satellite. I want to get a good feel for how much benefit has been achieved by

that. Are the roles for each of your agencies and the responsibilities, decision-making authority, governance and program oversight clear? In other words, are these clear between your two agencies?

Mr. WATKINS. Yes, they are, and in fact, I mean, I think one of—since the separation between the Defense and the civilian side for weather satellites, if you look at the overall performance that we, NOAA and NASA, have been able to achieve, first and foremost with maintaining that we would launch Suomi NPP on time in the October 2011 time period, we maintained that schedule. When you look across the schedules associated with the JPSS–1, we are currently on track. We share meetings together, the key decision points are jointly chaired between our respective agencies, and our programs are fully integrated at a Green Tech facility, which is outside of Goddard Space Flight Center. The teams are working extremely well, and it is a very good partnership.

Dr. SULLIVAN. If I may, Mr. McNerney, I just, I would endorse Marcus's comments. There is a 40-year-long partnership between NASA and NOAA in providing the Nation with weather satellites. We came back to that model in essence with the unwinding of the NPOESS Program, and if I could use the analogy, since JPSS moved out of the dysfunctional household of NPOESS, we have got a new team aboard. They have set fresh marks. They have, and, again, the 13 months I have been around they have been very consistently meeting those marks. We see great value, great productivity in the partnership and great value for the taxpayer, not duplicating a top-notch space acquisition function within that—within NOAA when we have an outstanding one in the partner agency.

Mr. MCNERNEY. Okay. I have one more question, Mr. Chairman. Has there been analysis of the anticipated operational period of the NPP satellite? What are we looking at here in terms of what confidence we have in that continued performance of that instrument?

Mr. WATKINS. I will take the beginning of that. Again, the NPP spacecraft was developed for a five-year life, and you know, we have launched it last October. The calibration validation period is going along as planned. In fact, we are a little ahead of schedule with some of the products that have already been received well by the National Weather Service and implemented into their algorithms that has led towards additional forecasting capabilities. The checkout across all of the instruments is looking good. The satellite is operating well.

Again, you know, there are issues that you have the first time you are flying a spacecraft, and this one wasn't to be operational initially, but we haven't seen anything that is outside of the ordinary with launching of a new satellite.

Dr. SULLIVAN. And the ground system is performing well. We are making progress towards adding, again, the redundancy and IT security robustness that we will need to have in place when JPSS–1 comes along to meet the criticality one requirements that NOAA has.

It was remarked, and I forget by whom earlier in the hearing that none of the instruments on NPP are performing as they should. I ask Mr. Watkins to correct me if I misstate anything, but my tracking of the technical data is that all of them are, in fact, performing at or above spec with some anomalies that are needed

to be worked out, but the technical team has shown a very good acumen of jumping on top of those and digging down and understanding the root causes and developing corrective actions, which is what you do with space systems.

Mr. MCNERNEY. Okay. Thank you. My time is up.

Mr. HARRIS. Thank you very much. I want to thank the witnesses for your valuable testimony and the Members for their questions. The Members of either Subcommittee may have additional questions for the witnesses, and we will ask you to respond to those in writing.

The record will remain open for two weeks for additional comments from Members. The witnesses are excused. The hearing is now adjourned.

[Whereupon, at 3:47 p.m., the Subcommittees were adjourned.]

ANSWERS TO POST-HEARING QUESTIONS

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QUESTIONS FOR THE RECORD
U.S. House Committee on Science, Space, and Technology
Subcommittees on Investigations & Oversight and Energy & Environment Joint Hearing

"Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES-R"

Wednesday, June 27, 2012

The Honorable Kathryn Sullivan, Ph.D.
Deputy Administrator, National Oceanic and Atmospheric Administration

Questions submitted by Dr. Paul Broun, Chairman, Subcommittee on Investigations & Oversight and Dr. Andy Harris, Chairman, Subcommittee on Energy and Environment

1) One of the biggest questions facing NOAA is its plan for the so-called free flyer satellites. Is NOAA planning to build dedicated satellites to fly the orphaned sensors, host the sensors on other U.S. government or commercial satellites, or launch them along with the JPSS satellites?
    a. What spacecraft will these instruments fly on?
    b. What launch vehicles will they share, and how much will it cost?
    c. Why does NOAA need to fly these instruments at all if they are not viewed as important enough for the actual JPSS satellites?
    d. When will NOAA decide what instruments it will fly as part of this program?
    e. If NOAA decides to remove any instruments, when would that take place?

2) The Administration has committed to keeping the life cycle costs of JPSS below $12.9 billion. What prevents the Administration from submitting a budget request that exceeds that cost?

3) At last year's JPSS hearing on September 23, there seemed to be confusion as to whether or not climate sensors had been restored to the JPSS program. As I understand it, Ozone Mapping Profiler Suite (OMPS), Clouds and Earth Radian Energy System (CERES), and Total Solar Irradiance Sensor (TSIS), are three climate specific sensors that are planned for the JPSS mission.
    a. Is the primary mission of the polar satellites weather or climate?
    b. Are any of the data generated by these three sensors used for short-term or five to seven day weather forecasts?

4) It seems like we rely more and more on international partners for critical weather data every day. Many of these partners have economic troubles worse than our own. How will NOAA be able to produce the severe storm forecasts and predictions if these international partners fail to fund their own satellite programs?

5) Are there international satellites currently on orbit, or in the planning stages, that could provide any data similar to what JPSS will provide?

6) Regarding JPSS, NOAA has indicated that the ground segment has already passed its critical design review, all of its contracts are signed, JPSS-1's instruments are 60-95 percent complete, and the spacecraft will essentially be a clone of the NPP bus. Would you characterize JPSS as a new program?

7) According to the GAO report, NOAA may discontinue plans for a network of ground-based receptor stations, an Interface Data Processing Segment at two Navy locations and support ground operations for any future DoD polar orbiting satellite program due to cost growth.
   a. When will NOAA make a decision on which aspects of the JPSS ground system will be cut in order to rein in the program's cost growth?

8) The GAO reports that NOAA was using outdated security measures for its ground systems that dated back to 1998. How has NOAA improved its security requirements for the JPSS ground systems?

9) What has NOAA done to establish a permanent backup capability for the satellite data communications link from Svalbard, Norway to the United States?

10) I understand that the GOES-R integrated master schedule is generated monthly with scheduling information from contractors. GAO cites concerns with this practice, specifically unresolved weaknesses with the way the GOES-R program tracks scheduling. Furthermore, GAO states that a dynamic integrated master schedule that automatically updates from contractor schedules is a more appropriate method for tracking program milestones and potential delays.
   a. Do you agree with GAO's assessment that a dynamic integrated master schedule is a more appropriate methodology to use for a program of this size and complexity? If so, why has NOAA not yet adopted such a strategy?

11) The management control plan NOAA is using for GOES-R dates back to 2007. This plan outlines schedules for the preliminary design review and critical design review. Although there has been progress on making these milestones, completion of these tasks has been late in every instance, some by as much as 17 months.
   a. Does NOAA plan to update the management control plan to more accurately reflect the timing realities of making these milestones?
   b. Given that the October 2015 launch window was set by the 2007 management plan and there have been significant delays in meeting milestones, why does NOAA believe, with only a 48% confidence, that it can still make this launch date?

12) The GAO GOES-R report indicates that the program has burned through a significant portion of its reserves in the last two years. The program also added two more satellites as well.

a. Does the current level of reserves support 2 or 4 satellites?

13) We have heard that the likelihood of the GOES-R satellite meeting its October 2015 launch date is now 48 percent, and that there is a 37 percent chance of a gap in the availability of two operational GOES-series satellites.
   a. What are NOAA's contingency plans in the event of a gap?
   b. What will be the effect to weather forecasting if there is a gap in GOES coverage?
   c. If the GOES-R launch slips by four months, what will the probability of the gap be then?

14) The GLM has experienced some nontrivial technical challenges including electronics failing during testing, image signal problems, and emissions exceeding requirements. Can you explain how these problems are impacting the schedule for developing this sensor and what corrective actions the contractor is undertaking to get it back on target with respect to cost?

15) As is often the case, when one part of a project is late, that delay causes a snowball effect that leads to further delays in the program. The GAO reports that the ground system for GOES-R was experiencing such delays and recently switched to an approach where software capabilities could be delivered incrementally.
   b. How much more will this new approach cost versus the original plan for developing the ground system?
   c. Will this new approach significantly complicate testing and verification of the software?
   d. How will the new approach reduce the risks to the schedule and launch date?

16) In 2011 the decision was made to cancel certain options to the ground system project, partly due to funding constraints from that fiscal year.
   a. What capabilities is NOAA losing by canceling these options?
   b. Are there any plans to restore these options?
   c. Could this work be performed after the launch of GOES-R?

17) The GAO reports that the contractor estimated costs for the GOES-R core ground system grew by almost 40 percent between 2010 and 2012.
   e. What are the problems driving this massive increase in cost?
   f. Are the problems with the spacecraft and sensors also driving the costs associated with the ground system?

<u>Questions submitted by Rep. Dana Rohrabacher</u>

1) NASA mentioned they are using instruments for JPSS-1and a ground system for NPP mission. Apparently, not all of the $4.3 billion was wasted. JPSS has benefited some. However, we need more insight on how much and where.
   a. How much money has evaporated from NPOESS?
   b. What was left from this debacle and how much was salvaged in terms of cost?

2). NOAA stated, "The logic to unwinding the NPOESS was to get end-mission responsibilities to align as tightly as possible with physical resources and program management." Transferring responsibilities to the end user or NOAA indeed makes sense because they operate the weather satellites for forecasting and climate monitoring.
   a. What are the economic benefits in gravitating responsibilities to end-users?

3) What are the primary reasons for cost escalation of the current and planned system of NOAA weather satellites?

4) What are some options for reducing costs and delays in designing, building, launching, and operating weather satellites?

5) What would be the tradeoffs if NOAA pursued a "cheaper, better, faster" approach that was tried at NASA?

6) What are NOAA's primary concerns if weather satellites were commercialized/privatized?

7) Is there a role for private sector weather satellites to provide data continuity if NOAA satellites are beyond their design life in orbit and replacement satellites are not able to be launched in time?

8) Is there a role for the private sector to provide some redundancy for weather satellites in case of launch failure or malfunction in orbit?

9) What would be the pros and cons to NOAA if the agency transitioned from being a provider of weather satellite information to being only a consumer?

QUESTIONS FOR THE RECORD
U.S. House Committee on Science, Space, and Technology
Subcommittees on Investigations & Oversight and Energy & Environment Joint Hearing

"Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES-R"

Wednesday, June 27, 2012

Mr. Marcus Watkins
Director, Joint Agency Satellite Division, National Aeronautics and Space Administration

Questions submitted by Dr. Paul Broun, Chairman, Subcommittee on Investigations & Oversight and Dr. Andy Harris, Chairman, Subcommittee on Energy and Environment

1) What are the outstanding technical issues for the sensors on JPSS? The GAO report indicated that they are experiencing issues but can you provide a more detailed update?

Answer:

Joint Polar Satellite System (JPSS) has five sensors in the payload complement: Advanced Technology Microwave Sounder (ATMS), Cross-track Infrared Sounder (CrIS), Ozone Mapping and Profiler Suite (OMPS), Visible Infrared Imaging Radiometer Suite (VIIRS), and Cloud and Earth's Radiant Energy System (CERES). All of these instruments are in various stages of manufacturing and testing, when technical issues related to parts and manufacturing are typically identified. All of these instruments were qualified in support of the Suomi National Polar Orbiting Partnership (SNPP) mission that launched in 2011.

As of August 2012, ATMS and CrIS have resolved their currently known technical issues. The OMPS instrument has had a series of problems with electronic boards including parts, connectors, and manufacturing processes. The Single Board Computers (SBC) were rebuilt and will be delivered to the OMPS vendor for testing in September. Other electronic board issues have been resolved.

The CERES instrument recently experienced issues with the internal calibration hardware, which is necessary for on-orbit performance. Retesting of the hardware is in process to determine the root cause of the problem. The CERES instrument was preparing for final acceptance review when the issue occurred. There is ample schedule margin to resolve the CERES issue before it is scheduled to ship to the spacecraft vendor for integration.

The design of the VIIRS instrument is technically difficult to manufacture. The primary issue with VIIRS has been the build and alignment of the Aft Optics Assembly containing the cryogenically cooled short/medium and long wavelength detectors. Problems with the build of the detector assemblies have been resolved and they are now working through alignment. The VIIRS SBC's are also being replaced due to on-orbit performance issues found on SNPP.

Of the JPSS-1 instrument suite, the VIIRS instrument is on the critical path. All the instruments' scheduled delivery dates support the current launch readiness date with more than acceptable

margin, and in most cases significantly more. All technical issues uncovered thus far are manageable within the cost and schedule margins of the flight project. Mitigations have been put in place for identified risks, and acceptable margin is in place for future unknown issues.

2) The ABI has experienced some nontrivial technical challenges involving its wiring boards and signal problems in several of its infrared channels. Can you explain how these problems are impacting the schedule for developing this sensor and what corrective actions the contractor is undertaking to get it back on target with respect to cost?

Answer:

The Advanced Baseline Imager (ABI) instrument contractor had difficulty meeting the industry standard "IPC-6012B" specification for Printed Wiring Board (PWB) manufacturing. NASA and the ABI contractor (Exelis) evaluated the PWB deviations and made decisions to re-manufacture the boards that were critical to mission success. Other deviations were accepted as technically acceptable after test and inspection by NASA. As of this writing, all PWBs for all flight models have been received and have passed NASA inspection. To minimize schedule impact, Excelis and NASA were able to devise a test program that began testing with a combination of flight and non-flight PWBs until all flight boards were available. As a result, there was minimal impact on the overall instrument schedule.

The ABI Visible and Infrared channels were experiencing a problem with unintended light leaking into the optical path through the spectral filters. The problem was resolved by adding a blocking coating to the edges of the filters where the unwanted light was entering the system. The instrument has been reassembled and testing has confirmed that the fix was successful. The investigation and resolution of this issue resulted in an approximately seven-month delay in delivery of the ABI Flight Model-1. Nevertheless, the scheduled delivery date for the ABI Flight Model-1 still meets the date by which the instrument is needed (the need date) with margin for integration with the spacecraft.

The costs associated with resolving these issues are now unrecoverable; however, since these specific design issues are resolved, they will not cause a future cost overrun. The sunk cost represents an overrun on the ABI contract, but it does not increase the overall GOES-R life cycle cost because the GOES-R Flight Project was able to fully cover the cost impact using the funding it holds for development issues.

3) The GLM has also experienced some nontrivial technical challenges including electronics failing during testing, image signal problems, and emissions exceeding requirements. Can you explain how these problems are impacting the schedule for developing this sensor and what corrective actions the contractor is undertaking to get it back on target with respect to cost?

Answer:

The technical challenges encountered with the Geostationary Lightning Mapper (GLM) program have been exclusively with non-flight, "engineering development unit (EDU)" hardware, which is used as a tool to test and improve designs for the flight instrument build, thus ensuring a good GLM flight design. The three concerns cited in the question are:

- The initial EDU power-on failed and was found to be caused by corrosion on the power electronics board. Corrective action was implemented and new EDU boards were built resulting in a successful power-on.
- The image signal problems are the electrical crosstalk observed in the image during EDU testing. This issue was mitigated in the flight hardware design by improving the electrical isolation of the signal chain. A ground software filter has been also developed to remove the noise in the image. Scientists representing the user community have determined that the effect of electrical crosstalk, even uncorrected, would not prevent GLM from meeting its performance specification.
- The emissions exceeding requirements was observed during electro-magnetic compatibility (EMC) testing of the EDU, a test designed to ensure the electronics design was functionally viable prior to moving into to the flight build. To address the exceedances, a team of multidisciplinary technical experts was formed from a variety of organizations both within and outside of the GLM Program. This team reviewed the electronics and made multiple design changes to address the EMC exceedances.

The GLM electronics schedule has been impacted primarily by the EMC exceedances, which necessitated a significantly greater redesign effort than had been anticipated. The instrument delivery schedule was impacted by approximately 10 months. However, fabrication of the flight electronics is now underway with scheduled receipt of all boards supporting the integration and test of the GLM instrument and delivery according to the date by which the instrument is needed (the spacecraft need date).

The costs associated with resolving these issues are now unrecoverable; however, since these specific design issues are resolved, they will not cause a future cost overrun. The sunk cost represents overrun on the GLM contract, but it does not increase the overall GOES-R life cycle cost because the GOES-R Flight Project was able to fully cover the cost impact using the funding it holds for development issues.

The GOES R GLM is a new instrument capability that has never been flown before and is an exciting addition to the GOES-R complement of instrument capabilities to monitor and provide early warning of dangerous weather events. As with any development program, technical issues will arise and the Project's budget was structured to deal with such challenges.

The contractor and the government team are taking the following actions to reduce schedule and schedule risk, which should help avoid future cost increases:

- The contractor has assigned a dedicated production engineer to monitor daily progress on board fabrication. Each board is being individually tracked through the manufacturing process and actively ushered to the next process to avoid inadvertent "down time" in manufacturing.
- Two separate vendors are fabricating the boards in parallel to mitigate delays.
- GLM contractor is in the process of incentivizing their board suppliers for early delivery.
- GLM contractor has completed a dry-run of all instrument integration & test and calibration activities on the EDU to rehearse processes and procedures.
- Ground support equipment improvements have been identified to reduce instrument-handling times.

- GLM contractor is fabricating a second flight electrical harness and is considering fabricating a second flight electronics box, which can be delivered earlier than the remainder of the GLM instrument to keep the spacecraft integration on schedule even if there are further delays to the electronics.

Material requested for the record on page 51, line 1169, by Rep. Rohrabacher during the June 27, 2012, JPSS and GOES-R hearing.

NASA defers to NOAA for a response to this question.

Material requested for the record on page 59, line 1364, by Rep. Palazzo during the June 27, 2012, JPSS and GOES-R hearing.

The Administration continues to evaluate the Senate proposal.

QUESTIONS FOR THE RECORD
U.S. House Committee on Science, Space, and Technology
Subcommittees on Investigations & Oversight and Energy & Environment Joint Hearing

"Continuing Oversight of the Nation's Weather Satellite Programs: An Update on JPSS and GOES-R"

Wednesday, June 27, 2012

Mr. David Powner

Director, Information Technology Management Issues, Government Accountability Office

Questions submitted by Dr. Paul Broun, Chairman, Subcommittee on Investigations & Oversight and Dr. Andy Harris, Chairman, Subcommittee on Energy and Environment

1) The GAO report points to the future health of the entire polar-orbiting constellation as a major issue of concern. The reliance on international partners and the uncertainty of the future DOD weather satellite program are the main reasons for this concern. What capabilities, if any, will NOAA lose without the DOD and European Systems?

The loss of polar satellite observations from DOD or European systems would result in fewer satellite observations covering the globe throughout the day. Without polar observations in the early morning and midmorning orbits to supplement NOAA's observations in the afternoon orbit, NOAA could have less accurate and timely weather prediction models to support weather forecasting, and the agency's ability to provide advanced warning of extreme events—such as hurricanes, storm surges, and floods—could be diminished.

2) What confidence does GAO have that NOAA will make an October 2015 launch date for GOES-R given their history with meeting major design review milestones in the program thus far?

A number of factors significantly reduce our confidence that NOAA will meet an October 2015 launch date. First, major program milestones, such as preliminary design reviews and critical design reviews for both the flight and ground segments, have experienced delays of up to two years. Going forward, all of the key remaining milestones need to be reached on schedule for the currently-planned launch date to be met. Given NOAA's

record of missing planned milestones, future slips seem likely. Second, GAO recently found weaknesses in scheduling practices for contractors of the program's main components the program's major contractors that have the potential to further delay the launch date if left unaddressed. Finally, the program's own schedule risk analysis indicated that there is a 48 percent confidence level that the program will meet its current launch readiness date of October 2015.

3) At last September's hearing, there seemed to be confusion as to whether or not climate sensors had been restored to the JPSS program. As I understand it, the Ozone Mapping Profiler Suite, or OMPS sensor, the Clouds and Earth Radian Energy System, or (CERES) sensor, and the Total Solar Irradiance Sensor, or (TSIS), are three climate specific sensors that are planned for the JPSS mission.

a) Would removing the OMPS, CERES or TSIS instruments from the JPSS manifest reduce the risk of the overall program? Why or why not?

Because the CERES and OMPS instruments have either completed or almost completed development, it is not clear that removing these instruments from the JPSS program would significantly reduce the risk of the overall program. Moreover, both of these instruments were included on the predecessor satellite, called Suomi NPP, which means that there are already lessons learned—and therefore reduced risk—in integrating and testing them.

Unlike CERES and OMPS, the TSIS instrument is not planned to be included on the first JPSS spacecraft. NOAA is planning to include TSIS with other instruments on a separate satellite (called a free-flyer) and to launch this satellite in mid-2016. When faced with a program cap of $12.9 billion, NOAA officials considered removing TSIS from the JPSS program to limit costs, but were able to find other ways to keep costs down. In general, removing an instrument from a satellite program could reduce the technical complexity—and associated schedule and cost risks— for the program; however, doing so would result in the loss of expected functionality.

4) Regarding JPSS, NOAA has indicated that the ground segment has already passed its critical design review, all of its contracts are signed, JPSS-1's instruments are 60-95 percent complete, and the spacecraft will essentially be a clone of the NPP bus. Would you characterize JPSS as a new program?

Although the JPSS program includes technology developments from the NPOESS era that are well under way and in certain cases nearing completion, it is a new program in the sense that it has a new management and reporting structure for which NOAA is accountable. In addition, NOAA established requirements for the program in September 2011 but plans to re-evaluate and modify the requirements—including adjustments to selected sensors and ground systems—to keep overall program costs at $12.9 billion.

5) The GAO report points out several problems with the ABI and GLM sensors. Do you believe the corrective steps NOAA and NASA are taking to address these issues are sufficient? What additional steps could they take to reduce risks to this sensor development effort?

The GOES-R program office is monitoring problems with the ABI and GLM sensors and has plans in place to address them. Moreover, the Flight Project Office has taken steps to resolve several technical problems with the sensors through additional engineering support and redesign efforts. For example, at the time of our review, corrective design actions were being identified to eliminate emissions that exceeded specifications for the GLM prototype unit, and flight equipment was being redesigned to eliminate ghosting in the ABI proto-flight model.

NOAA has defined the policies and procedures it needs to effectively manage and mitigate sensor development and other program risks, yet work remains in fully implementing its risk process. Two additional efforts could help to further reduce development risks for these instruments. As recommended in our report, the program should work to eliminate weaknesses in scheduling practices for these instruments, thereby reducing the likelihood of future delays in the remaining phases of the GOES-R program. We also recommended that the program conduct timely evaluations for all potential risks in its risk list—including those related to these sensors— to ensure that they are being adequately addressed. Doing so would improve the program's advance

warning of potential issues and provide time to adopt or revise effective mitigation strategies.

6) As is often the case, when one part of a project is late, that delay causes further delays in the program. The GAO report indicated that the ground system for GOES-R was experiencing such delays and recently switched to an approach where software capabilities could be delivered incrementally.

a. How much more will this new approach cost versus the original plan for developing the ground system?

b. Will this new approach significantly complicate testing and verification of the software?

c. How will the new approach reduce the risks to the schedule and launch date?

a) Program officials have stated that the revised plan is expected to cost $85 million more than the original plan through to completion of the Core Ground System.

b) According to program officials, the new approach involves more verification and testing activities associated with an increased number of software deliveries, as well as the existence of multiple active baselines, both of which require additional government oversight and continuous monitoring. The new approach also involves closely coupled interdependencies among activities and resources, which could make integration more challenging. However, the revised development plan and schedule are also expected to provide additional flexibility in the systemwide schedule and in determining the content of each build increment.

c) While the additional points of coordination in the new ground system approach have the potential to increase the complexity of specific testing and verification tasks, an incremental approach such as the new approach to ground system development can reduce overall risk. This approach aligns with the information technology management reforms initiated by the Office of Management and Budget to reduce the cost and schedule overruns that typically arise from lengthy system development efforts. Furthermore, with an incremental build approach, work can be performed in areas where requirements are fully mature, while refinement of requirements can continue in other areas. Thus, issues found in areas with less robust requirements would not require as much rework as they would have under the previous GOES-R approach.

7) In 2011 the decision was made to cancel certain options to the ground system project, partly due to funding constraints from that fiscal year.

a. What capabilities is NOAA losing by canceling these options?

b. Are there any plans to restore these options?

c. Could this work be performed after the launch of GOES-R?

a) Nine of the optional products that were available to users on satellites prior to GOES-R have been cancelled. Among these products are those monitoring low cloud and fog data, the detection of sulfur dioxide (which can lead to acid rain), and the amount of liquid water per unit volume of air. Users affected by the loss of these products include the U.S. Department of Agriculture, which uses cloud-based information on clouds data to develop weather forecasts used by farmers, and the Department of Defense, which relies on the cloud-based products as input into weather prediction models for forecasting of high-altitude winds, which are used to navigate ships and planes.

b and c) According to program officials, the work to be performed under the cancelled contract options could be addressed by NOAA after GOES-R satellites are launched; however, there are currently no plans in place to do so.

8) The GAO report indicated that the contractor estimated costs for the GOES-R **core ground system grew by almost 40 percent between 2010 and 2012.**

a. What are the problems driving this increase in cost?

b. Are the problems with the spacecraft and sensors also driving the costs associated with the ground system?

a) The recent growth in contract costs is due in part to the additional labor and engineering support needed to address technical and programmatic problems. The cost growth includes costs associated with the Core Ground System's revised development plan, a series of engineering change proposals in areas such as security requirements and architecture, and unplanned systems engineering efforts for integration and testing.

b) Technical hardware issues associated with the spacecraft and sensors were not the primary cost drivers for the ground system. Sensor software deliveries that had not been defined or could not be met in the ground system schedule contributed to schedule integration problems and subsequent cost growth for the ground system.

Appendix 2

Additional Material for the Record

WEATHER-X BLOG BY CLIFF MASS: SUBMITTED BY REPRESENTATIVE ANDY HARRIS, CHAIRMAN, SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

Cliff Mass Weather Blog

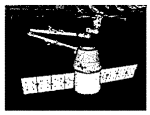
This blog provides updated forecasts and comments on current weather or other topics

Thursday, June 14, 2012

Weather-X

There has been a lot of press coverage of late about the successful commercial space venture Space-X. This private sector effort was able to build a launch vehicle (Falcon-9) and a spacecraft (Dragon) that not only worked flawlessly, but made a delivery to the international space station. With NASA out of the manned space business for a while with the end of the Space Shuttle program, this feisty young company has taken on a role previously held only by a U.S. government agency, and they did it far faster and cheaper than a Federal entity could ever do. To its credit, NASA has been supportive of Space-X's activities.

Falcon-9



Dragon

So now let's consider weather prediction. A portion of U.S. numerical weather prediction has been done outside of the National Weather Service/NOAA and the U.S Navy (Fleet Numerical): in the private sector and academic institutions (like the UW). However, the core global prediction infrastructure for the U.S. has really been a NWS function and most of the non-governmental efforts are dependent on NWS global grids, data assimilation, and other products.

Unfortunately, the current situation is not good. The National Weather Service prediction efforts are crippled by inadequate computer infrastructure, lack of funds for research and development, an awkward and ineffective research lab structure out of control of NWS leaders, and government personnel rules that don't allow the NWS to replace ineffective research and development staff. Lately there has been talk of furloughs for NWS personnel and a number of the NWS leadership are leaving. The NWS has fallen seriously behind its competitors (e.g., the European Center for Medium Range Weather Forecasting, UKMET office, Canadian Meteorological Center) even though the U.S. has a huge advantage in intellectual capital (U.S. universities and the National Center for Atmospheric Research are world leaders in field, as are several U.S. government research labs--e.g, NRL Monterey).

So we have a U.S. government entity that has lost leadership in a key technological field of huge importance for the nation. It no longer has the resources to be state-of-the-art and is hemmed in by ponderous governmental regulations. Sounds quite a bit like NASA's situation, doesn't it? *And might the solution be the same?* Could a private company develop the capability for state of the art global prediction, high resolution regional prediction, and the ability to move into the probabilistic prediction we know represents the future? *Is it time for Weather-X?*

The clear answer ... you bet.

Let me be honest, I am really surprised that a private sector firm hasn't taken on this challenge already, considering the obvious potential to create a forecast entity that could produce a product that would be in considerable demand. For example, U.S. companies are spending millions of dollars to get the European Center (ECMWF) forecast model output—and it is possible to do far better than the ECMWF.

To create this new firm one would need large computer resources (.5 to 1 petaflops would be a good place to start). That would cost 10-15 million dollars to buy from scratch, but many companies (e.g., Microsoft, Google, Boeing, Amazon, IBM, major defense contractors, and more) have it already.

The new firm would need computer models, but those are already freely available, and research folks

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Contributions provide needed support for the weather prediction research and studies of Northwest weather that make this blog possible. Your help has funded critical hardware needs for the regional weather modeling effort. Last year I also provided an undergraduate scholarship to a student interested in weather prediction. You can help by clicking here.

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My Weather Segment is on KPLU!

Friday's at 9 AM right after Birdnote. 88.5 in the Puget Sound area. KPLU Web Site. Want to ask a question I can answer during the show? Click here

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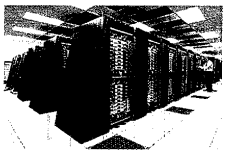
- NW Windstorms-Science Cafe-2
- NW Windstorms-Science Cafe-3
- Windstorm Talk at City Hall

like myself could easily be bribed to help with some research grants (trust me on this!). In fact, the research community would be lining up at the door to help if some $ was available.



The most difficult aspect is the data assimilation part... securing all the satellite and observational assets needed to initialize the forecasts---but many of those are in the public domain and I suspect that some deals could be made with NASA, NOAA, and the European Space Agency. And there are some potentially very useful data sets that the NWS can't afford today that would be a substantial value (e.g., weather data from commuter planes).

Yes, it would probably take 5-25 million dollars to get started on this, but consider that the folks at Space-X invested 100 million dollars for a venture that was **far** more speculative. Local investors are willing to spend as much or more ON A BASKETBALL TEAM.

There is no doubt this idea would work. The best weather forecasts in the world would be a valuable commodity for many industries that would be ready to pay (e.g., renewable energy, agriculture, power generation and distribution, shipping...the list is endless). Want to make your search engine attractive? Have the best forecasts available on it!

Some of you might argue that my colleagues in the NWS might not be pleased about such an upstart. But if NASA can happily agree to work with a private sector firm to take on some of its work, why should the NWS be any different? I suspect the private sector could fulfill this function more effectively and at less cost. And the benefit to the nation of vastly improved weather prediction guidance could be enormous.

As noted above, there are several companies that already have the computer and IT infrastructure in place to take this on (such as Microsoft, Google, Apple, and Amazon). Several of them are found here in the Northwest. All that is missing is the vision to see the opportunity and seize it.

Posted by Cliff Mass at 8:44 PM

+3 Recommend this on Google

10 comments:

Unknown said...

The main concern I'd have about privatizing NWP is the hindering of science. If a private company improves a NWP model or some data assimilation method, will it share the results with the scientific community? Not likely. Science can be crippled with privatization.

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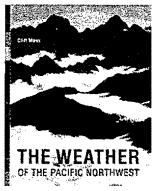

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