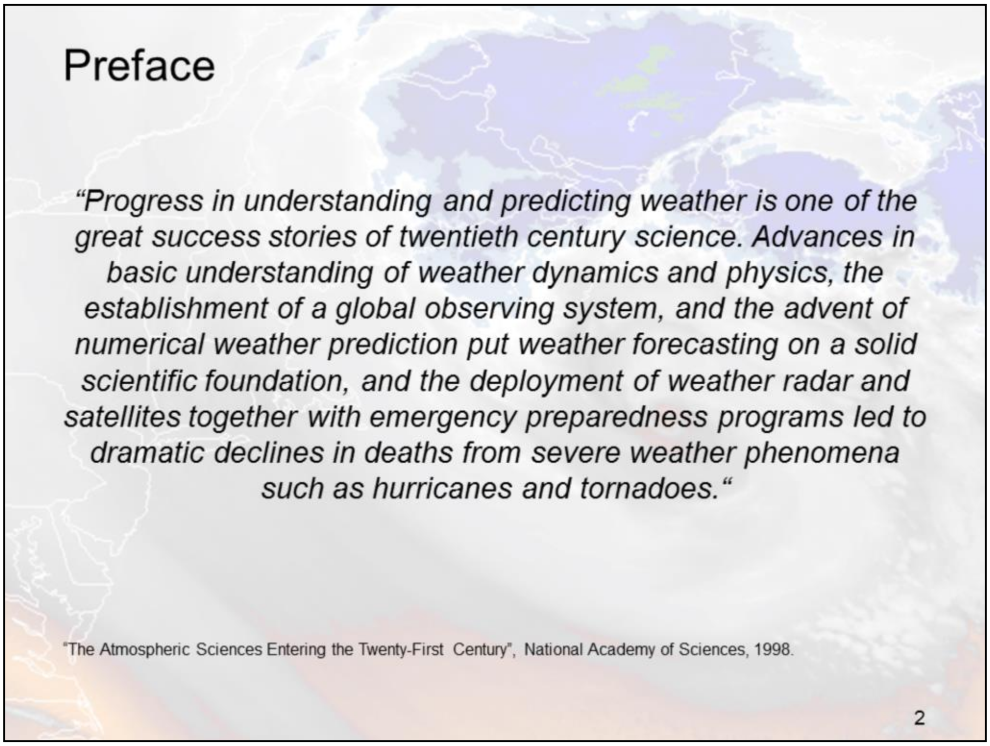

NOAA NESDIS Independent
Review Team
Final Report
2017



"The Atmospheric Sciences Entering the Twenty-First Century" (https://www.nap.edu/read/6021/chapter/9)

Acknowledgements

- The following organizations provided numerous briefings, detailed discussions and extensive background material to this Independent Review Team (IRT):
  - National Oceanic and Atmospheric Administration (NOAA)
  - National Aeronautics and Space Administration (NASA)
  - Geostationary Operational Environmental Satellite R-Series (GOES-R) Program Office
  - Joint Polar Satellite System (JPSS) Program Office
  - NOAA/National Environmental Satellite, Data, and information Service (NESDIS) IRT Liaison Support Staff
    - Kelly Turner — Government IRT Liaison
    - Charles Powell — Government IRT Liaison
    - Michelle Winstead — NOAA Support
    - Kevin Belanga — NESDIS Support
    - Brian Mischel — NESDIS Support
- This IRT is grateful for their quality support and commitment to NESDIS' mission necessary for this assessment.

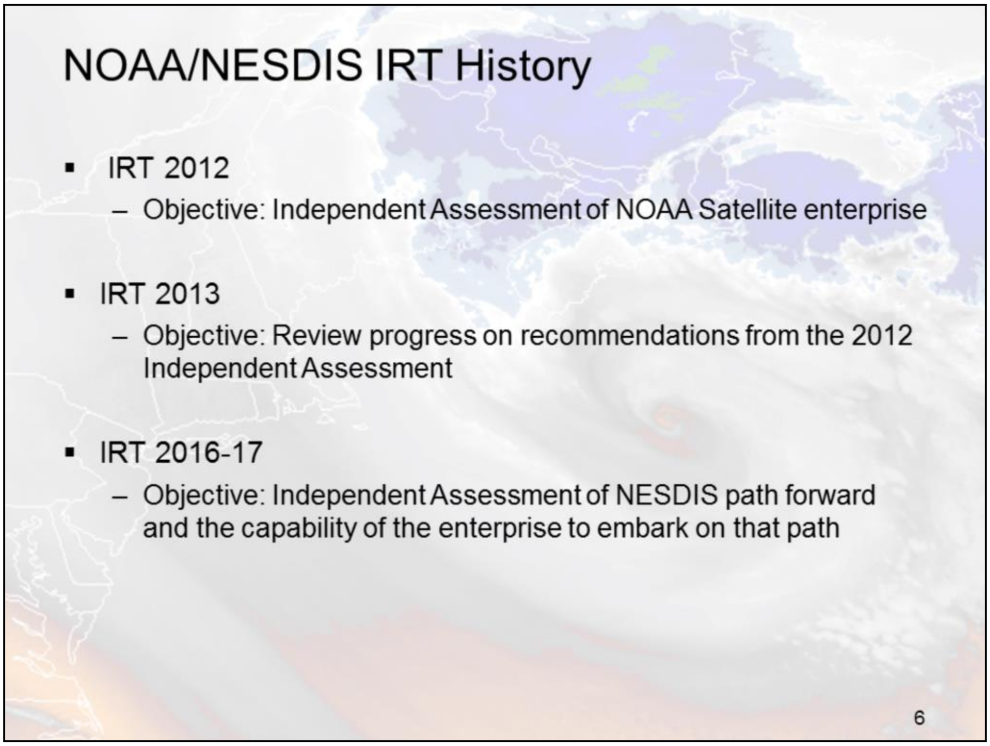
Overview

- Objective
- NESDIS IRT History
- Methodology
- Summary of IRT Findings
- Summary of 2016-2017 Report
- Findings, Recommendations and Comments
- Appendices
  - Appendix A: IRT Members and Support, Biographies
  - Appendix B: Interviews Conducted
  - Appendix C: NESDIS Presentations Provided
  - Appendix D: Acronym List

Objective

Independent Assessment of NESDIS path forward and the capability of the enterprise to embark on that path

5



There have been three independent reviews of NOAA/NESDIS activities. The first was conducted in 2012 with a report documenting findings and recommendations dated July 20, 2012. An assessment of the NOAA satellite enterprise was the subject of the 2012 review. A follow-up review was conducted in 2013 with the results presented in a report dated November 8, 2013. The purpose of the 2013 review was to assess progress on recommendations from the 2012 Independent Assessment.

This report contains the results of the 2016-17 review which had as its objective an Independent Assessment of the NESDIS path forward and the capability of the enterprise to embark on that path. While the focus of the 2016-17 review was the future, it is appropriate to examine past and present activities to have a valid initial condition for the assessment of the future.

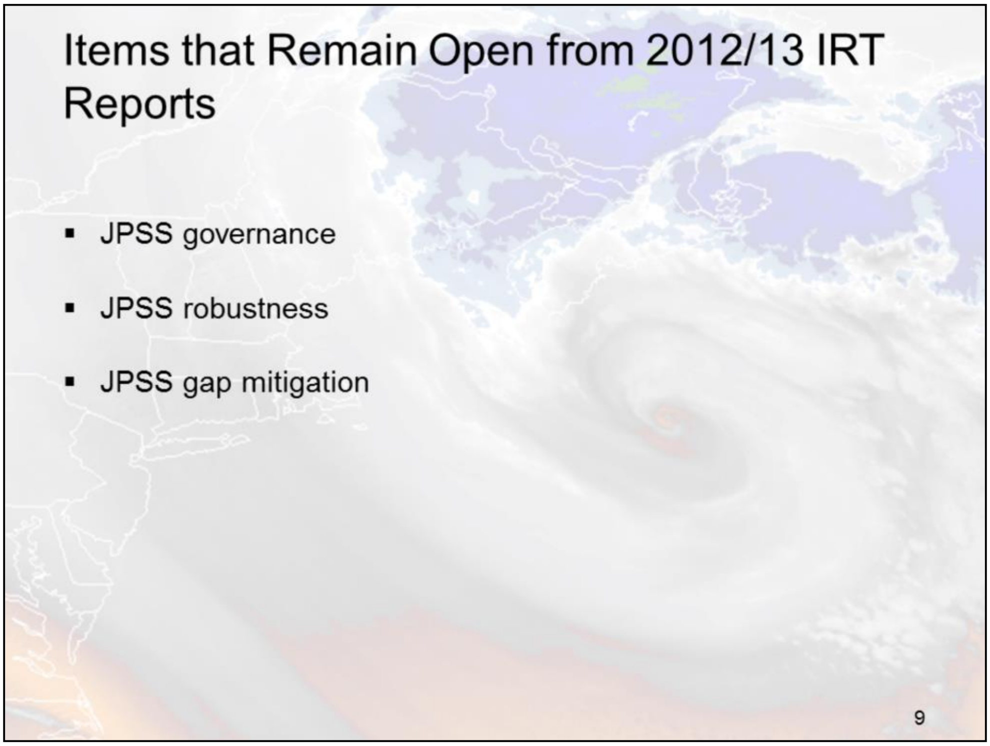
Methodology

- September 29-30, 2016
  - Received presentations on NESDIS portfolio, NESDIS Strategic Plan, Programmatic Structure, Future Architecture, and Information & Data Management
- November 16, 2016
  - NOAA senior leadership interviews
- November 29-30, 2016
  - IRT interviews of NASA and NESDIS leadership
  - Received follow-up presentation on the NESDIS Future Architecture, JPSS Gap Contingency, and the Integrated Ground Enterprise
- December 7, 2016
  - IRT Chair met with NASA and NOAA senior leadership regarding JPSS Program
- December 13-14, 2016
  - Additional interviews with NASA and NOAA leadership; IRT caucus for report generation
- January 31-February 1, 2017
  - IRT report writing
- February 20-21, 2017
  - IRT report writing
- February 28, 2017
  - Presentation and final report submission to NESDIS

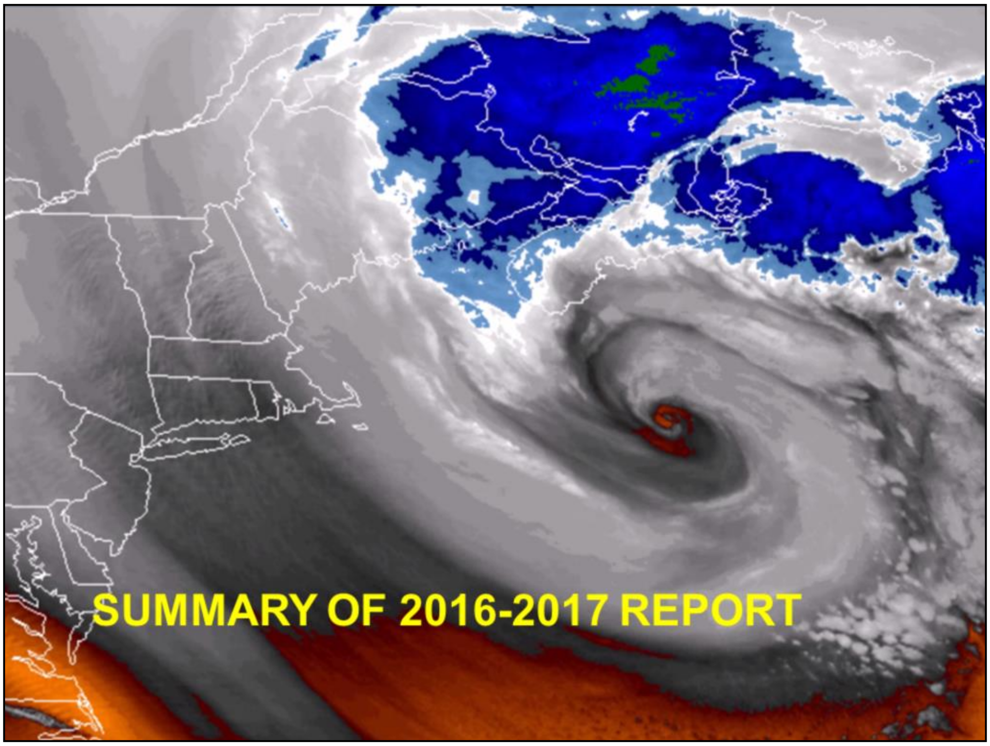
7

Summary of IRT Findings

- 2012: Highly negative and questioned the ability of DOC/NOAA/NESDIS to successfully accomplish its weather satellite mission.
- 2013: Indicated measurable improvement with critical JPSS issues requiring attention.
- 2016-17: Continued, significant improvement with a positive outlook for the future. IRT Findings and Recommendations to potentially enhance future success are discussed in this report.



There are important items that remain open from 2012 and 2013. This does not imply that progress has not been made, however it does suggest that more actions are required. These subjects are discussed in the current report.


SUMMARY OF 2016-2017 REPORT

IRT 2016-17 Summary

- It is the judgment of the IRT that the NESDIS path forward is positively established and that NESDIS is capable of embarking on that path.
- The NOAA/NESDIS weather, severe storm and environmental intelligence mission is critically important to our lives and property, national security, economy, and quality of life. Acknowledgement of the importance and ensuring the implementation of the enabling capabilities consistent with the criticality of the mission, at all leadership levels, is mandatory.
- NASA is an important part of the Nation's weather and severe storm mission. The relationship between NOAA and NASA needs to be better defined and strengthened.

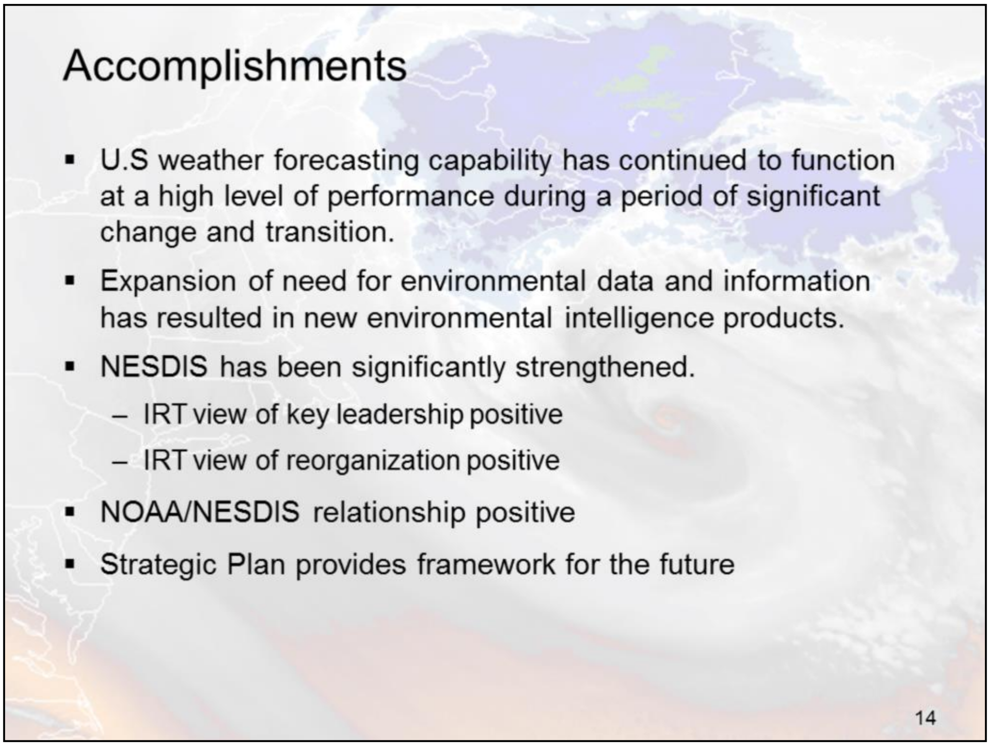
IRT 2016-17 Summary (2)

- JPSS governance, robustness and potential gap mitigation are continuing significant concerns.
- Future space and associated ground systems must be robust with “two failures to a gap” criterion and provide “equal or better” weather forecasting and severe storm monitoring performance.
- JPSS and GOES-R follow-on (beyond current four) decisions are imminent and require attention. Given the time available, additional GOES and JPSS satellite systems should be acquired, unless new technology and/or commercial solutions can be demonstrated to be robust and “equal or better” to the existing performance baseline.

IRT 2016-17 Summary (3)

- Weather forecasting and severe storm monitoring are influenced by a multitude of interacting factors: satellite system performance; ground system; weather models; algorithms; etc. This suggests that an end-to-end system analysis is necessary to properly balance these contributors.

13



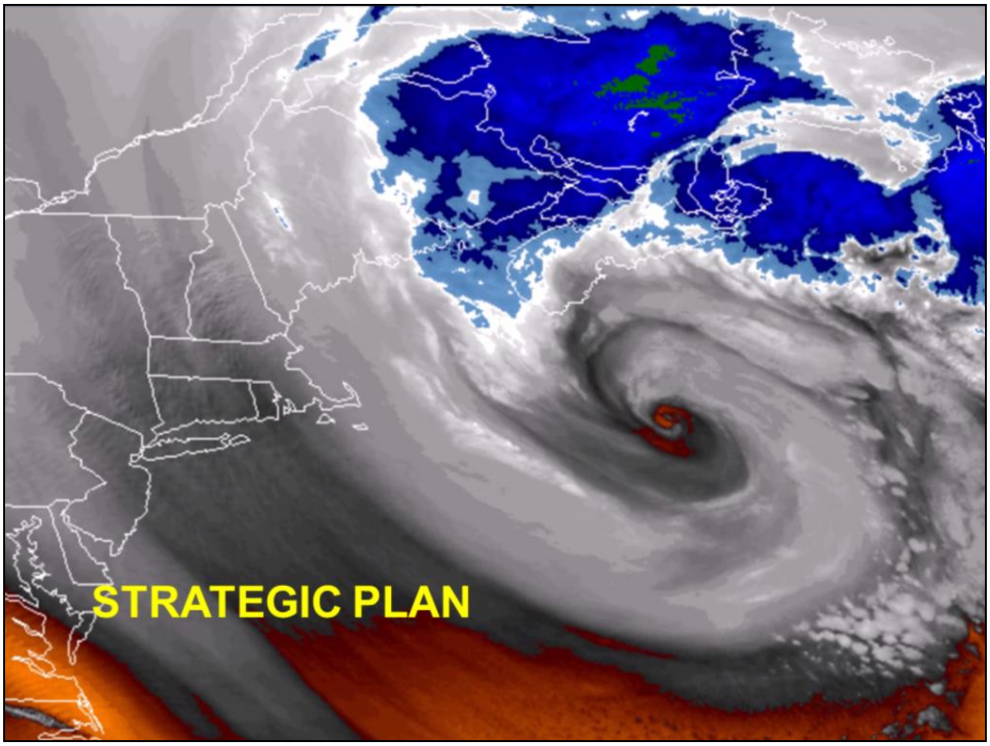
NOAA/NESDIS and NASA accomplishments have been significant. Some of the more noteworthy accomplishments are given on this and the following chart.

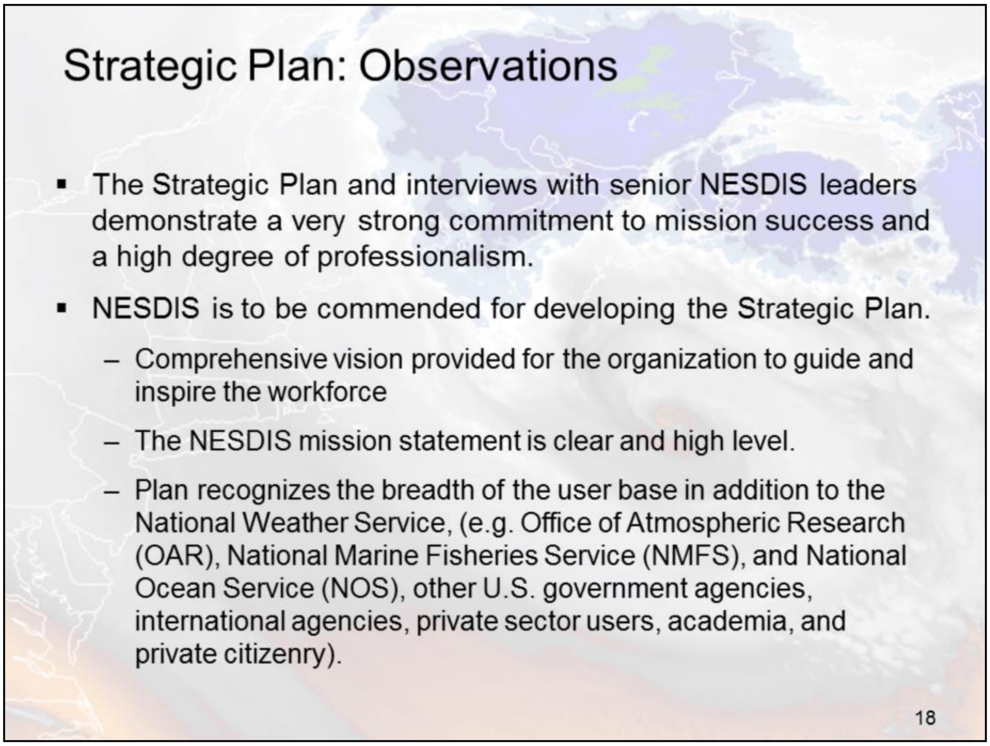
There has been a period of significant change and transition from the beginning of planning for GOES-R, the demise of NPOESS, the utilization of SNPP for providing operational data and the initiation of JPSS. This period can be characterized as a time of setbacks, challenges, and significant accomplishments. During this multi-year period, the U.S. weather forecasting and severe storm warning capability has functioned at a high level of performance. This accomplishment is a tribute to the exceptional people at NOAA and NASA. In addition, new use-inspired research utilizing NESDIS data integrated with other data sources is providing additional products in support of environmental intelligence

Accomplishments (2)

- GOES-R
  - Successful program implementation
  - Robust program
  - Successful launch and initial satellite operations
  - Preliminary results very encouraging
- JPSS
  - First launch scheduled for 2017
  - Four systems under contract or contract option
- NESDIS has established both an architecture and systems engineering capability to undertake future planning.

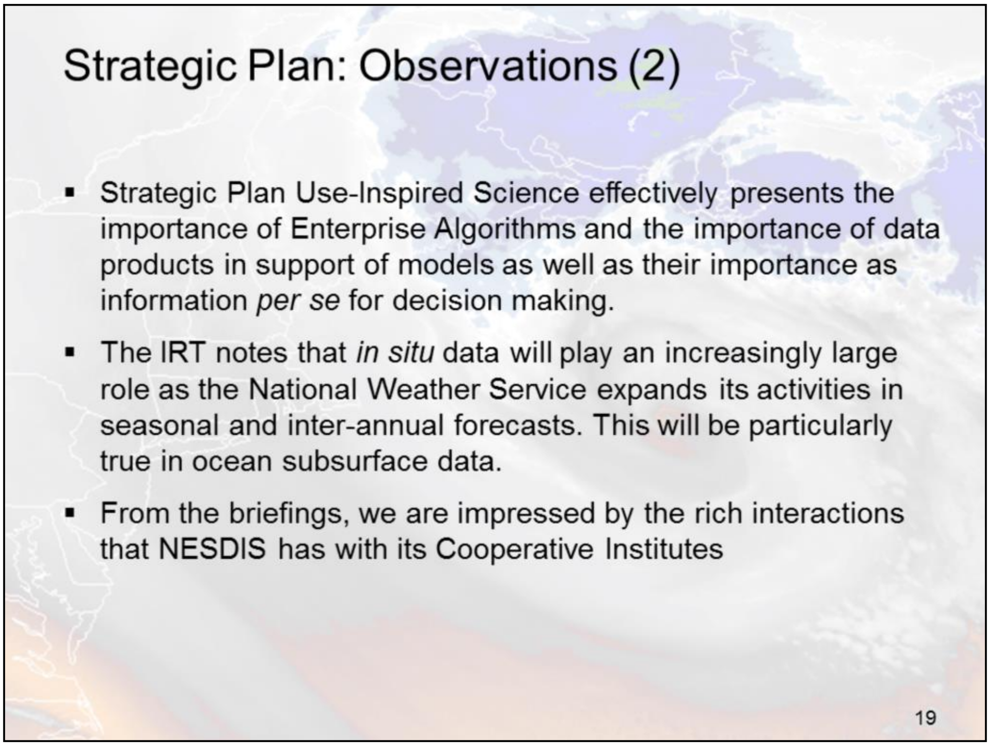

FINDINGS, RECOMMENDATIONS, AND
COMMENTS


STRATEGIC PLAN



The NESDIS leadership has developed a Strategic Plan that will be extremely useful in moving forward and they are to be commended.

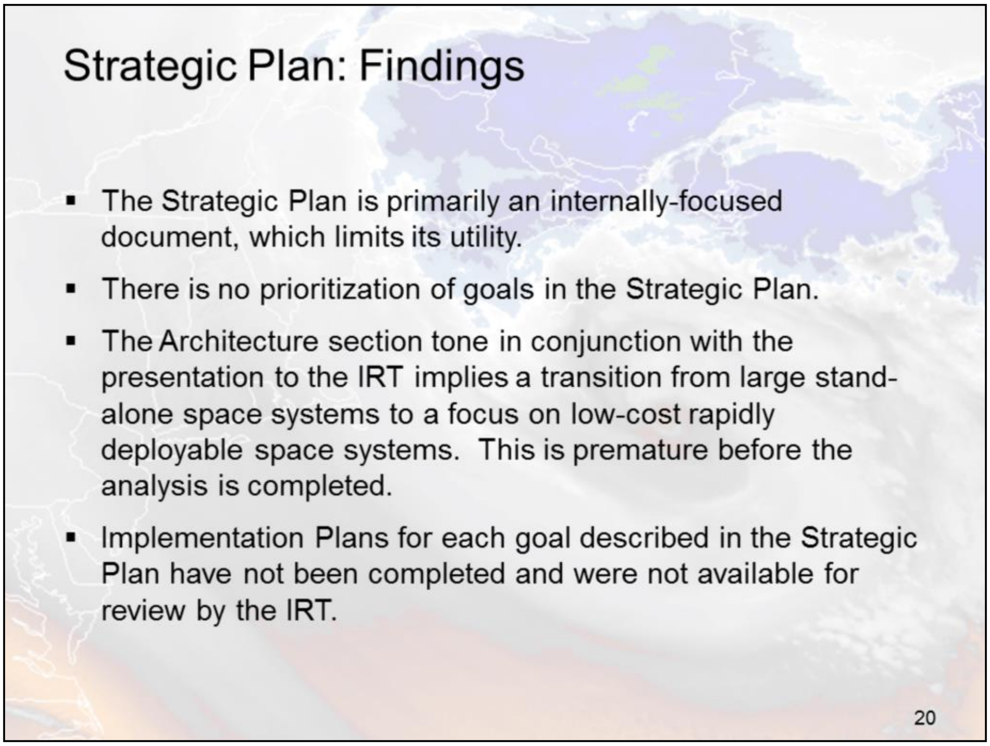
The Strategic plan is particularly useful in clearly identifying the NESDIS mission statement and vision for how to accomplish that mission. Very importantly, it recognizes the breadth of commitments to its own people and to the user base beyond the organization’s traditional (and most important) customer, the National Weather Service, namely other line offices within NOAA, DOC, other U.S. government agencies, international agencies, commercial users, academia, and private citizens.



Science is applied throughout NOAA, from fundamental research to use-inspired research. The latter most often sees science products transition to operations, applications (information products), and in commercialization. Within NESDIS, there is a strong research focus on algorithm development, data science, data quality, and reference data sets, which supports science in all other parts of NOAA as well as the private and academic sectors, especially through its three cooperative institutes.

In addition, NESDIS provides data for assessments, environmental monitoring and trends. And through partnerships, NESDIS develops information products for environmental intelligence. All of these products require the integration of satellite data with in-situ data. This use-inspired research is critical to achieving NOAA’s mission and the demand will only increase as evidenced by the large list of products they have already developed. Also, the demand for sub-seasonal and seasonal forecasts is increasing, along with the growing need for coastal intelligence, with the latter requiring more integration with ocean research and data.

The NESDIS Cooperative Institutes represent a good news story because of the high quality and value of the research they conduct in support of the NESDIS mission, particularly in bringing new capabilities such as JPSS and GOES-R on line.

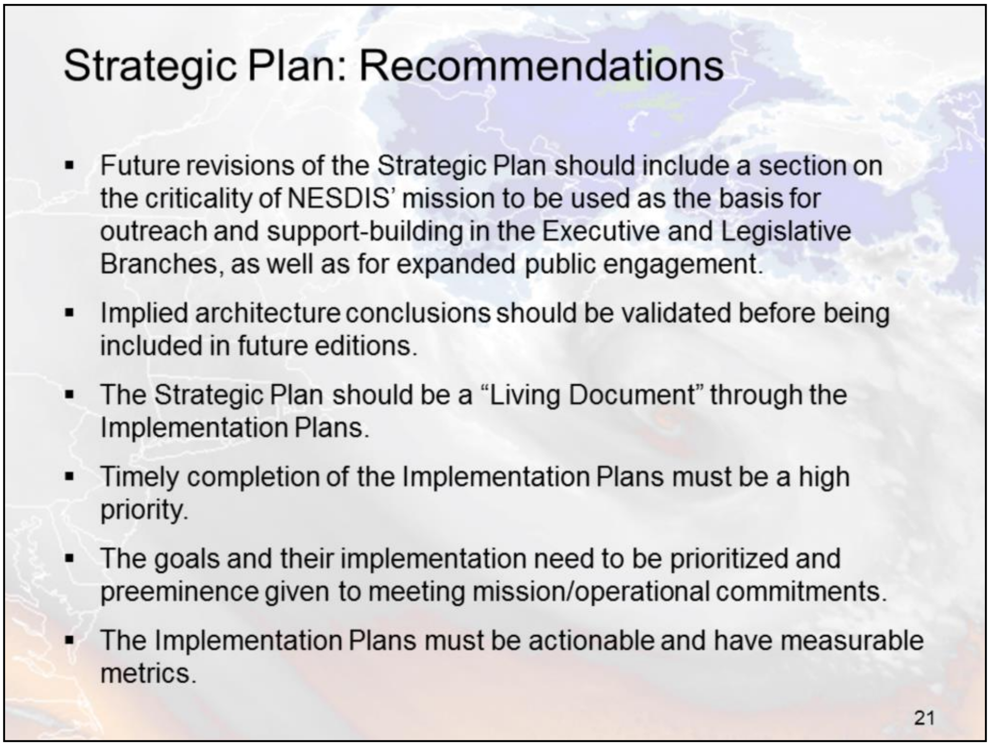


As the nation's operational space agency for environmental observations, NESDIS is vital to the protection of lives and property and the Strategic Plan should be proactive in raising the priority of NESDIS at the national level. This would well serve NESDIS for external outreach and support-building in the Administration and the Congress, improve their ability to recruit and retain talented employees, and serve as the basis for expanding public outreach as well.

The Strategic Plan lists six goals which could be seen as equal: Continuity, Data & Information, Architecture, Use-Inspired Science, Partnerships, and People. The IRT sees the first two of these as primary to the NESDIS mission and therefore preeminent, whereas the other goals are mission-enabling to successful accomplishment of them.

Some of the wording in the Architecture section of the Strategic Plan and the tone of the Architecture Study presentation to the IRT can lead one to believe NESDIS is predisposed toward a future architecture based on multiple small, low-cost satellites and/or commercial solutions. Any decisions in this regard cannot be made before a thorough analysis is completed.

The IRT is concerned that the Implementation Plans are not complete and drafts were not available for review given that the Strategic Plan was approved in August 2016.



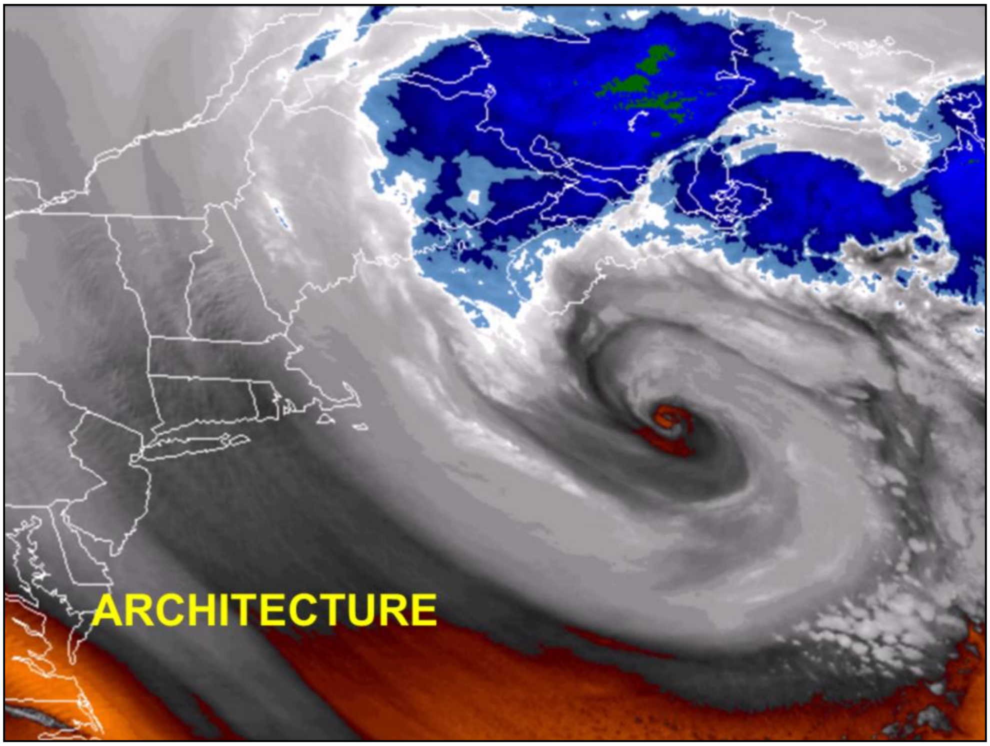
The IRT believes the strategic importance of the NESDIS mission is not sufficiently appreciated or understood outside of NOAA. As such, the organization should put into the Strategic Plan a clear statement of the criticality of its mission and also establish a dynamic outreach program as a high priority goal in the Plan. This would enhance the ability of NESDIS to obtain the resources necessary to accomplish its mission.

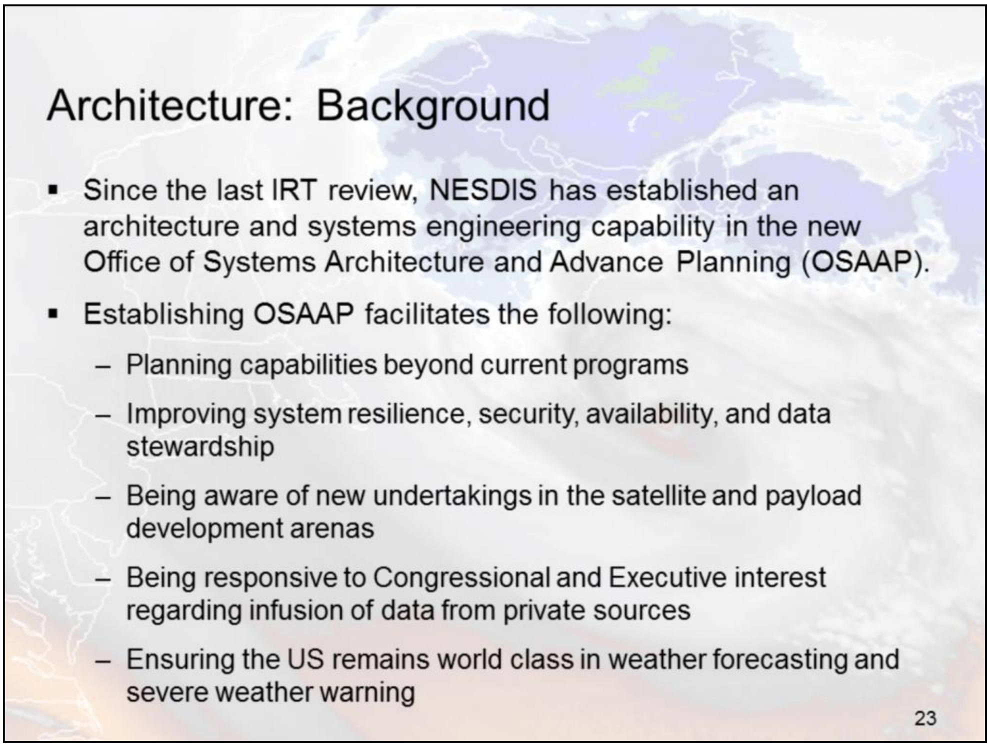
The IRT is concerned that the Strategic Plan includes words that imply some specific architectural approaches in implementation are being favored by NESDIS. This wording should not appear in future iterations of the Strategic Plan unless and until they are validated.

Atmosphere, ocean, and solar observations and forecasting, as well as technology development, are all constantly evolving with new scientific discoveries and engineering developments. Therefore, is essential that NESDIS complete Implementation Plans which are responsive to the NESDIS strategic goals, and are fiscally sound, and achievable. This must be a high priority for NESDIS leadership.

In both the Strategic Plan and Implementation Plans, goals must be prioritized with preeminence given to meeting operational commitments.

Actionable and measureable metrics are needed to constantly assess progress toward success of the Implementation Plans.

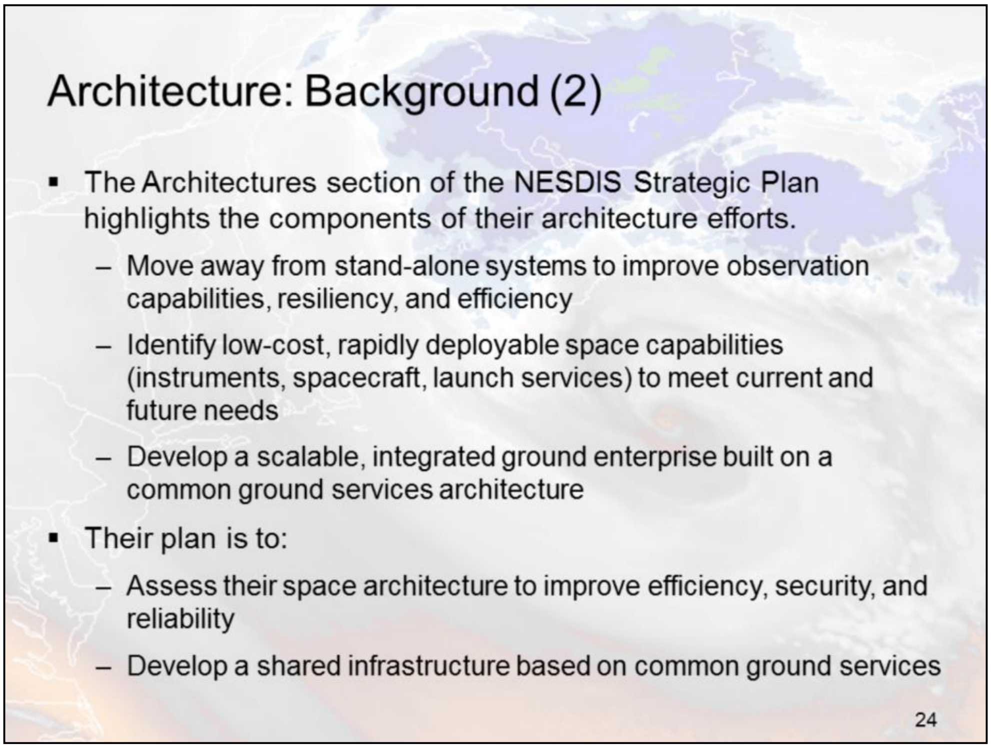

ARCHITECTURE



NESDIS is currently faced with challenges such as:

- what path to follow beyond established programs (particularly GOES-R and JPSS)
- how to successfully integrate and manage several stand alone ground programs, including programs soon to be transferred from NASA
- how to deal with an emerging commercial marketplace for weather and environmental data
- how to progress in the long term given the significant changes underway in the space industry.

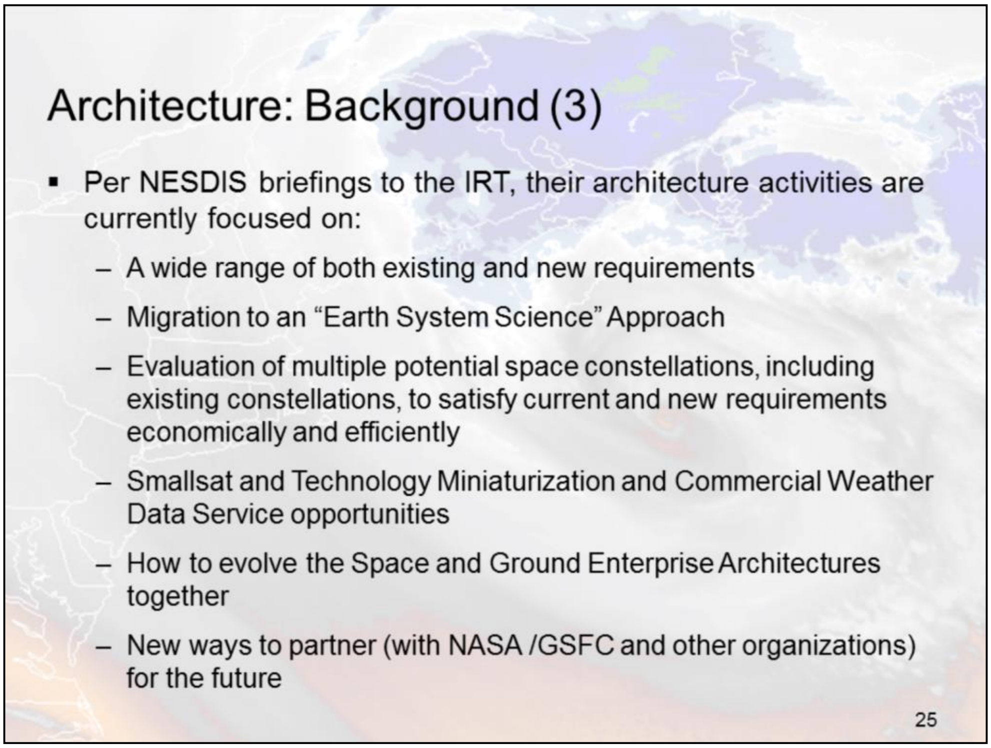
NESDIS recently established its OSAAP (Office of Systems Architecture and Advance Planning) office with the responsibility to examine current and future requirements and to assess space and ground capabilities for the future. They have formed a small joint team of experienced NOAA and NASA engineers to evaluate the current space environment and to map plans for the future.



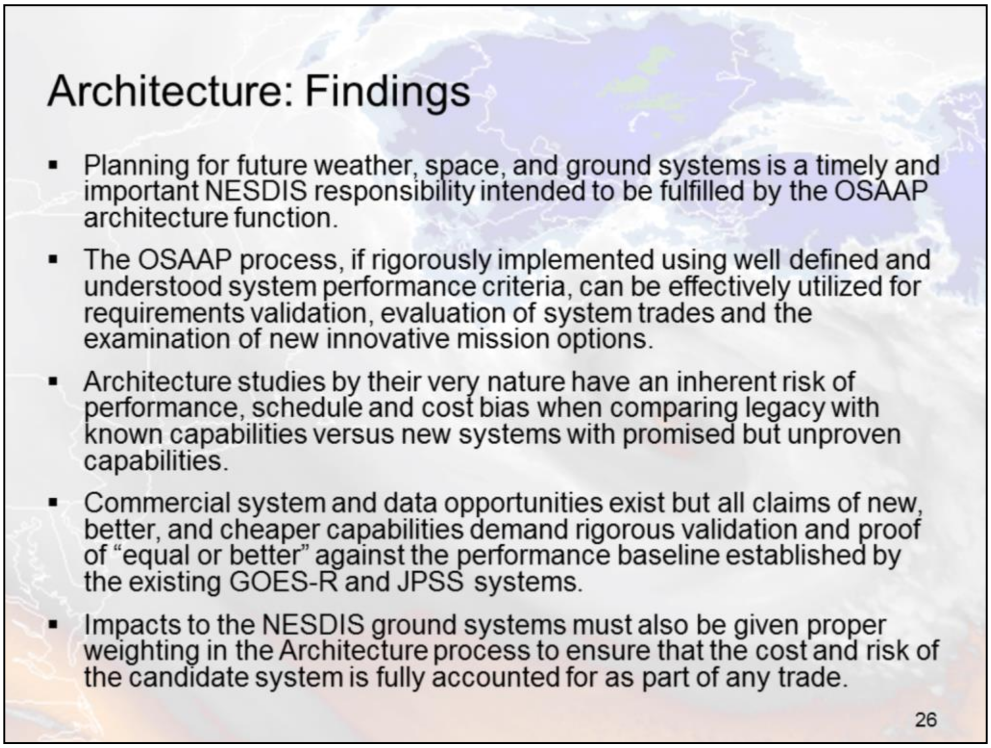
The NESDIS through its OSAAP team is working to respond to the NOAA Administrator 2017 Guidance memorandum which directs them to: " Develop a space based observing enterprise that is flexible, responsive to evolving technologies, and economically sustainable"

The Architectures section of the NESDIS Strategic Plan describes a general approach to move away from "stand-alone" space and ground programs with the goals of improving observation capabilities, improving system resiliency, and reducing costs of building and sustaining future systems. An element of this approach is to identify low-cost and rapidly deployable space systems and determine if they meet current or planned future needs.

The plan also describes a goal for the ground enterprise of developing an integrated and scalable common ground services architecture, that can meet existing requirements while also being able to incorporate emerging capabilities such as commercial data storage and application, and source-agnostic data ingestion.



NESDIS is taking a broad view of the architecture effort required to achieve its “Earth System” migration strategy. There are many requirements including new requirements related to expected future needs. Beyond the existing system architecture, the team is also considering potential system improvements, the incorporation of new technologies, commercial weather capabilities, new data sources, and potential partnering opportunities.



Planning for future weather, space, and ground systems is a timely and important NESDIS responsibility. OSAAP has been given this architecture function and is staffed by NOAA and NASA personnel with a plan to complete its initial analysis in the next few months. The OSAAP process, if rigorously implemented and validated, can be very valuable as a tool for evaluation and selection of system concepts. To do so, it must apply well defined and understood system performance criteria, to evaluate system trades and examine new innovative mission options.

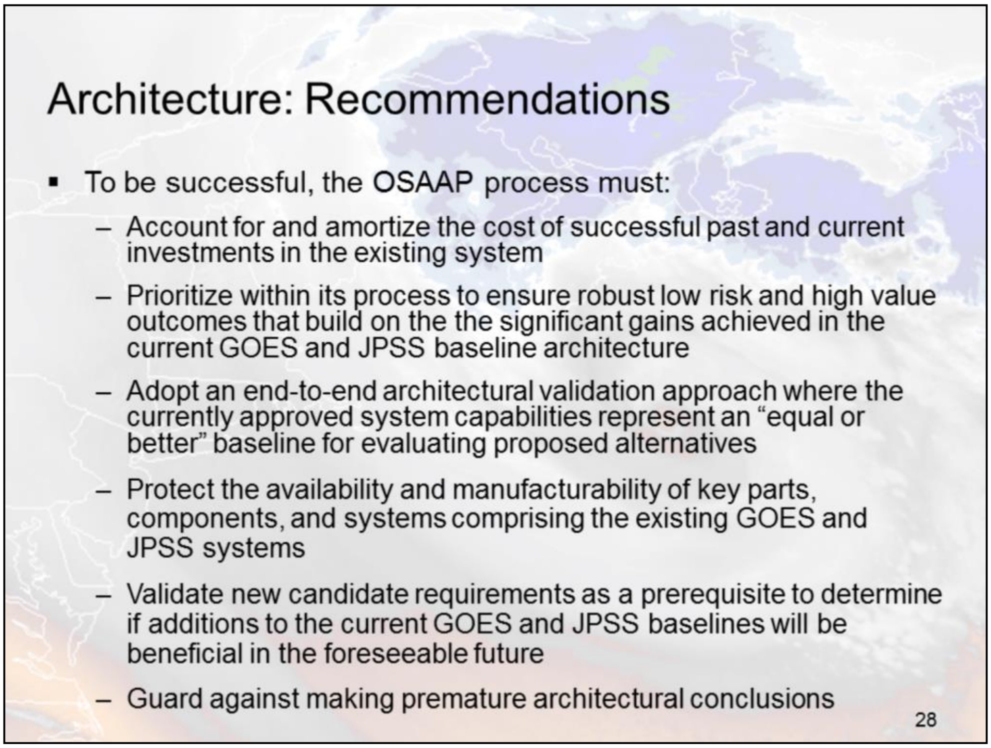
An overriding IRT concern is that architecture studies by their very nature have an inherent risk of performance, schedule and cost bias when comparing legacy with known capabilities versus new systems with promised but unproven capabilities. Within this context, commercial system and data opportunities may exist but it is essential that all claims of new, better, cheaper etc. have due dilligence applied through rigorous validation against the legacy "equal or better" performance baseline established by the existing GOES-R and JPSS systems.

Impacts to the NESDIS ground systems must also be given proper weighting in the Architecture process to ensure that the cost and risk of a candidate system is fully accounted for as part of any trade.

“Equal or Better”

- The principle “Equal or Better” applies to:
  - Quality of severe storm monitoring and weather forecasting.
  - Quality of observational measurements as determined by the impact on severe storm monitoring and weather forecasting
  - Neither should be allowed to degrade

27



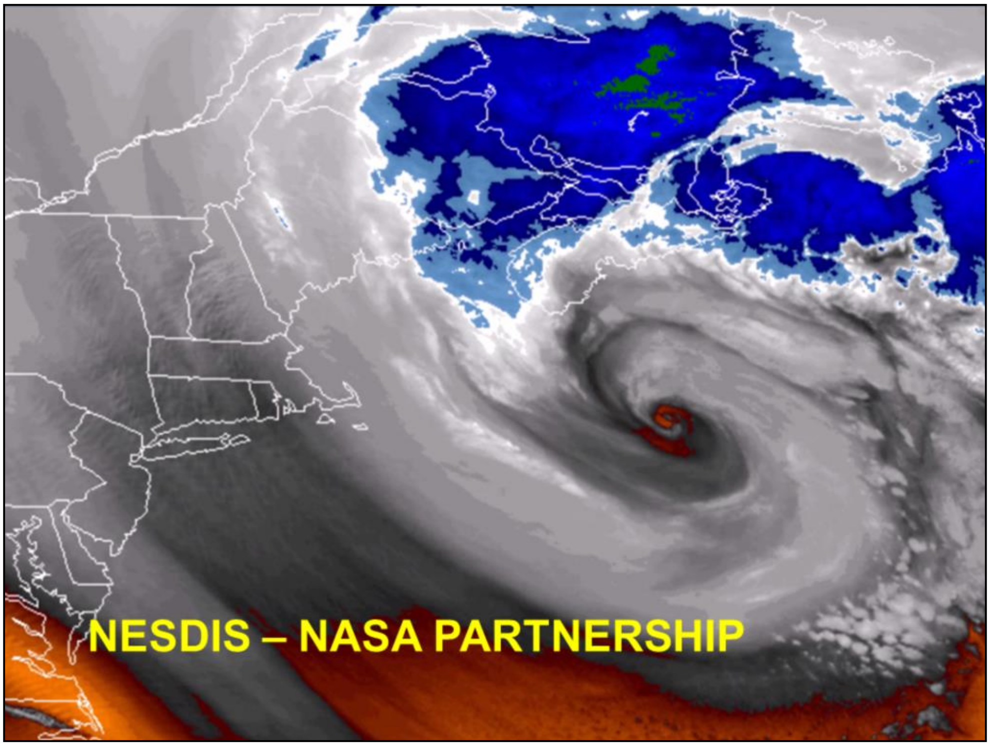
Weather forecasting is dependent on the quality of data and specific data types provided by the existing systems. Thus, NESDIS must ensure that any future architecture approach meet the “equal or better” principle as the minimum acceptable capability.

An extension of the “equal or better” principle is also relevant to the system design when considering the true cost of such a system. Thus, any cost trade study must fairly account for the true amortized cost of the current system against the cost risk associated with the development of a new system. As part of this cost assessment, the delta cost to the ground system must also be considered.

There are also schedule and technology risks related to the legacy system specific to the future availability of key components and systems, especially related to critical sensor technologies. NESDIS should make every effort to mitigate these risks through early procurements or other protective measures that ensure the timely availability of critical sensor hardware.

The validation recommendation suggests establishing a P3I (Pre-Planned Product Improvement) approach into the architecture process.

The IRT cannot over-emphasize the importance of not implying preconceived conclusions until the analysis is complete.


NESDIS – NASA PARTNERSHIP

NOAA/NESDIS and NASA/GSFC have worked together on building weather satellites since the first polar-orbiting Television InfraRed Observation Satellite (TIROS) satellite was launched in 1960, demonstrating the ability of TV type imagery to contribute to improved weather forecasts. The first geosynchronous satellite (SMS-1) was launched in 1974. It demonstrated the ability of using geosynchronous orbit to stare at the earth for severe storm warning and weather forecasting purposes. The first GOES (SMS-3) was launched in 1975.

In the early 2000's, NOAA embarked on ambitious new programs for both Geostationary observations (GOES-R series) and Polar-orbiting observations (NPOESS, which became JPSS). GOES-R and JPSS have reached major milestones, with the launch of GOES-R (now GOES-16) in November of 2016 and the upcoming launch of JPSS-1 scheduled for Q4FY17.

There are complex aspects of the NOAA/NASA relationship involving DOC/NOAA/NESDIS and NASA/GSFC that need further definition and resolution to establish a truly effective partnership.

The IRT heard in multiple ways that the relationship and communication between NESDIS HQ and NASA/SMD has been steadily improving. This is encouraging and important, as both have mutually supportive strategic objectives in transitioning from R&D sensing to operational observations, as well as achieving implementation of current programs. It is also apparent that the relationship between NESDIS and GSFC has improved over the last several years. The early definition of the GOES-R program, as well as the transition from NPOESS to JPSS were challenging for both organizations. These transitions are now behind us.

The GOES-R and JPSS programs have been challenging, in addressing the requirements of the NWS for significantly improved data to be used in forecasting and models. These challenges are multi-faceted. Technically, the design and development of new sensors, and integration of multiple instruments on each of the platforms, requires significant engineering skill and government oversight.

Programmatically, the institution and management of major contracts and the control of costs on these large programs requires vigilance and the ability to identify and implement tradeoffs over time. It is difficult to explain the costs of these programs to outsiders, and yet it is essential to understand the components of cost and why these are necessary to meet the national weather information needs. Emerging commercial capabilities may, in the long run, contribute beneficially to weather forecasting, when they can meet the NOAA requirements.

Program governance remains both a challenge and a work in progress for the NOAA/NASA team. The IRT has stated in the past, and still believes, that the GOES-R governance model is more efficient and effective than the model put in place for JPSS. On JPSS, Level 1 direction goes from the NOAA JPSS Director through the NASA HQ JASD office to the NASA program. On GOES-R, it is direct from the Program Manager to NASA/GSFC. On JPSS, there are two program directors, one in NOAA and one in NASA and they have been physically separated; on GOES-R there is only one Director and an integrated NOAA-NASA office. As a consequence of these differences, the IRT remains concerned that the JPSS lines of responsibility, authority and accountability are not as clear as they should be and that the organization is more complex than necessary.

The IRT is encouraged by recent direction coming from the NASA and NOAA Administrators that is focused on transitioning from development to operational readiness. New program managers have been identified and charged to refine the JPSS structure, governance process, and roles and responsibilities of the parties involved. The GOES-R governance model is the starting point for the discussions, but not necessarily the end-point for JPSS. The opportunity presents itself to create an efficient and effective model that will lead to improved future collaboration.

The IRT has some concern that both of the new program managers are acting (detailed) in their positions; no commitment to keeping them in place has been made. In part, this situation acknowledges that the ultimate outcome of any restructuring is unknown; consequently, the leadership positions and their roles and responsibilities are also to be defined and may call for different personnel. In this sense, the acting program managers serve as transition leaders.

On the other hand, having acting leaders can result in the team not taking new directions seriously, on the assumption that any changes made are temporary and subject to change under subsequent leadership. Both of the new leaders are well-known and well-respected; nonetheless there is risk of continuing inefficiency and uncertainty until the restructuring is completed and fully executed under permanent management.

As noted earlier, the two program teams are physically separated; integration of these teams will allow for more effective and efficient program management.

In many of its interviews, the IRT asked the question of whether NASA was a partner or a "contractor" to NOAA. No crisp answer to this question emerged. The IRT concluded that in fact NASA plays both roles, depending on the activity.

NOAA/NESDIS has an ambitious strategic plan, and has embarked on multi-faceted studies of ground and space architectures to meet the needs of the future. The IRT believes that NOAA could increase the involvement of NASA as a partner in its strategic activities and that NASA could proactively support NOAA in these endeavors. As an example, they could together define an R&D program specifically designed to develop and transfer technology to NOAA programs.

The immediate benefits would be the deep expertise that NASA can bring, in development of concepts, architectures and sensors to meet future requirements. This is something that NASA does often and well, for all of its missions. NASA's deep engineering and scientific experience can be brought to the table and integrated with NOAA's history of operating spacecraft and delivering essential data to the nation. NASA can also benefit NOAA in helping to define appropriate acquisition concepts and processes to achieve NOAA's future goals.

As a practical matter, when NASA is managing an acquisition for NOAA, it is performing the role of an agent who delivers a capability to NOAA and who brings to the table program management, engineering depth, well-honed processes and acquisition experience. NOAA has defined the requirements, controls the funding, and has a lead role in keeping its stakeholders informed of progress. Both NOAA and NASA must recognize and understand the impact of risk, be clear on status and issues, look for schedule and budget efficiencies, and work together to develop solutions when issues arise. The IRT believes that this is not strictly a contractor relationship, and in fact requires that NOAA and NASA sustain a strong partnership to achieve mission success. NASA and NOAA are both government entities, faced with the constraints and challenges imposed by Congress and other stakeholders, and invited to explain programs externally. They must have a common understanding of status, and should individually and collectively recognize and act on emerging problems and identify solutions that will meet the needs of NOAA.

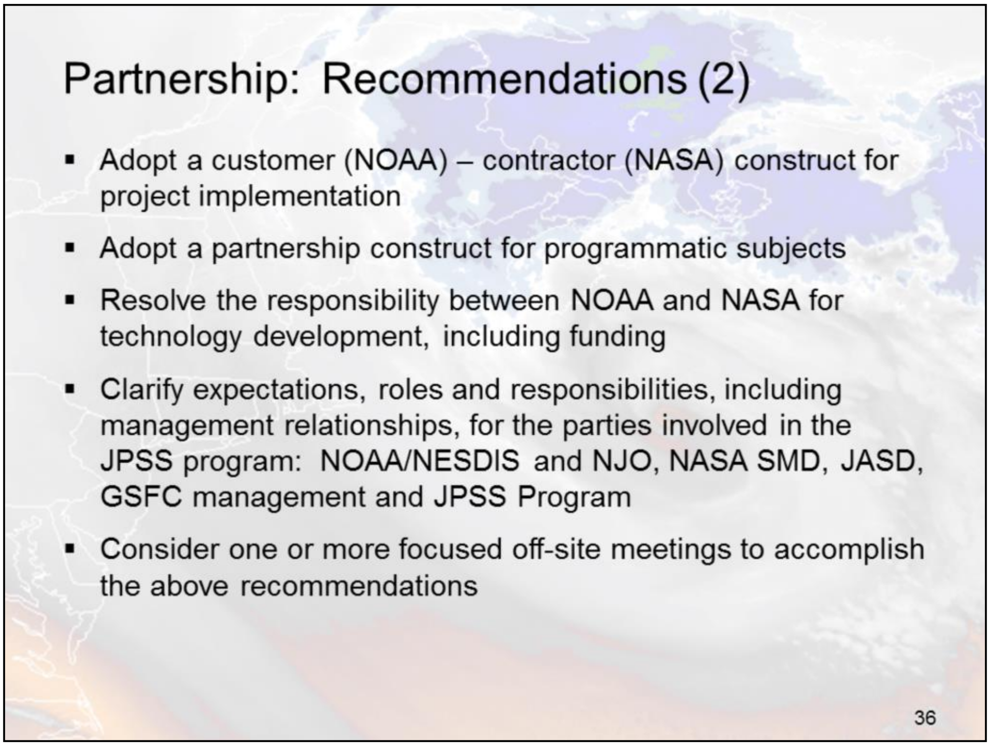
The DOC has a key role in assuring the success of the satellite programs. These programs are vital to the nation's economic interests and the safety of its citizens. As the overarching administrative organization, DOC can provide advocacy and influence to broaden the understanding and smooth the implementation of these programs. Absent that advocacy, the forward movement of these programs could be impeded, to the detriment of the nation.

In addition to advocacy, there are many practical areas where DOC can facilitate the actions needed for the satellite programs to run efficiently. The IRT considers the following three efficiency improvements to be essential:

- Facilitate the approval of necessary procurement actions to help keep the development schedule on track

- Delegate authority and responsibility to NESDIS, the executing organization with the expertise and knowledge required to run an effective program

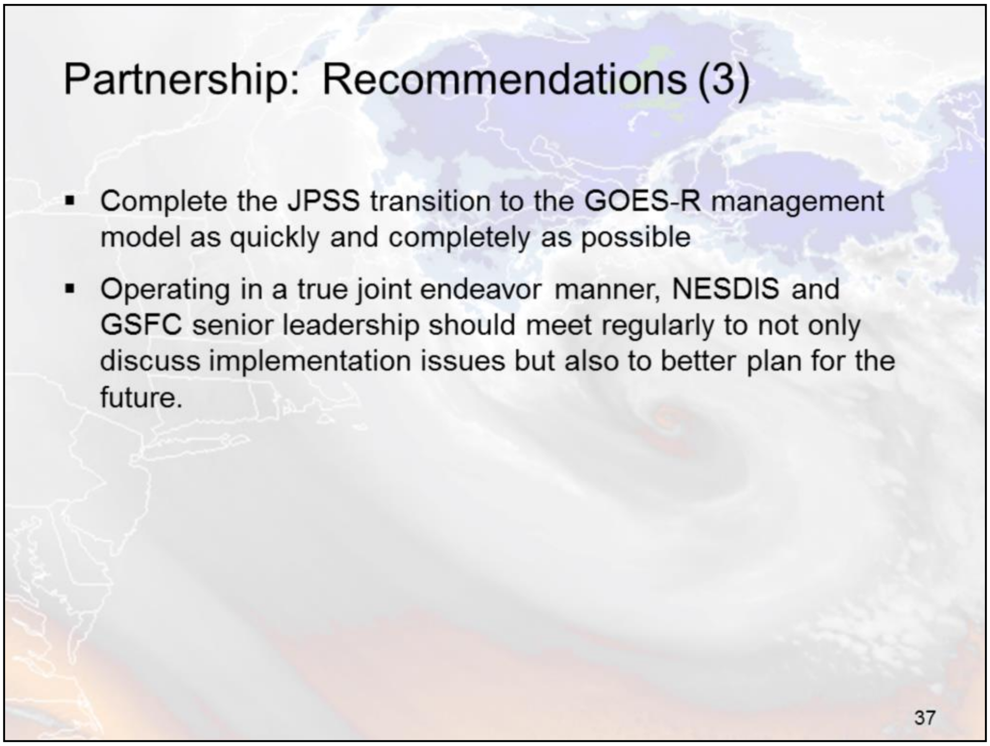
- Streamline key department processes such as hiring and contracting which currently introduce delays, inefficiencies and sub-optimal decisions into the overall satellite program.



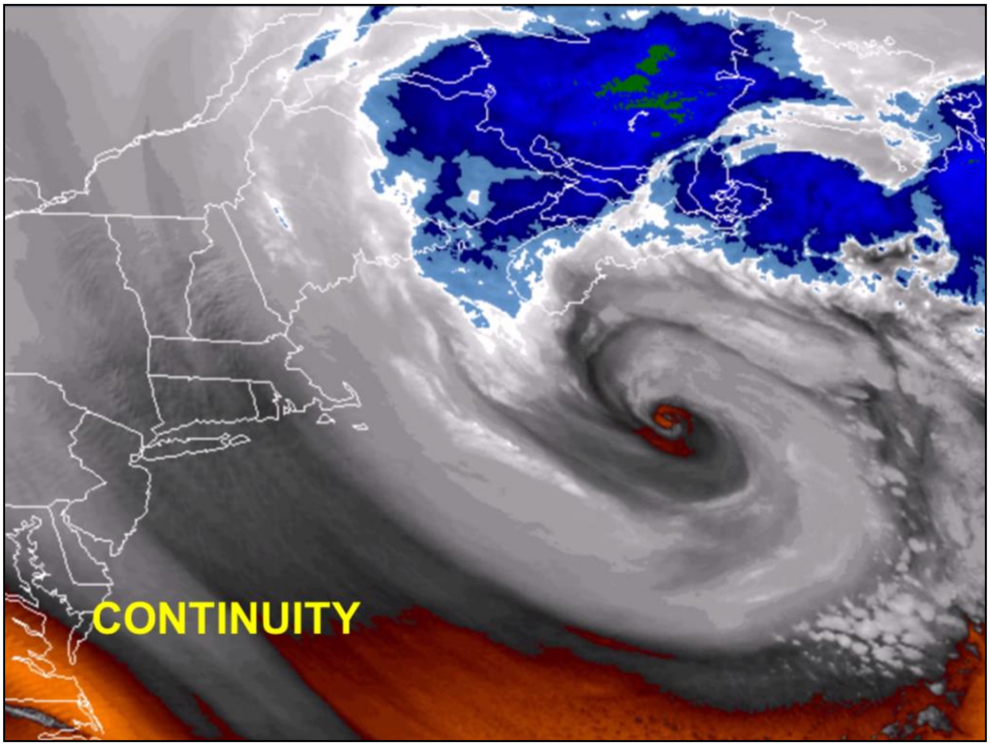
IRT believes it is critical that all parties involved work together, with sufficient focus and outside the demands of daily activity, to clarify roles, responsibilities and expectations in implementing the operational programs and addressing larger programmatic subjects. This is particularly important for JPSS whose program governance model is complex and whose relationship with NASA HQ is not totally clear. Both differ from how GOES-R is managed. Clarity on roles and responsibilities will undoubtedly strengthen the partnership and contribute positively to mission success.

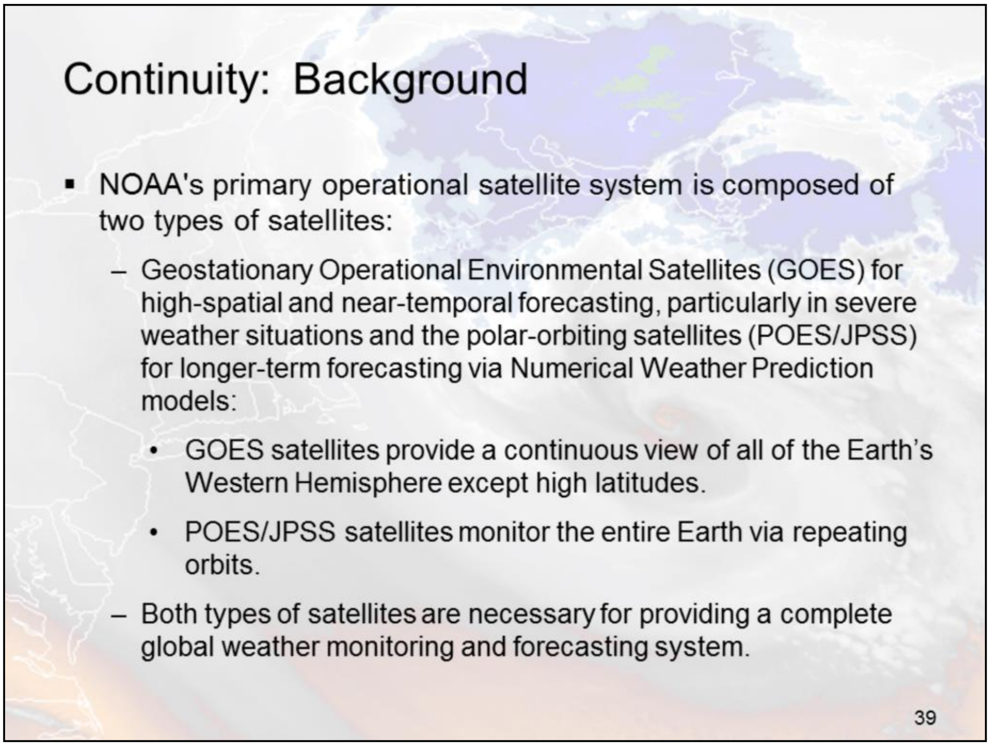
NOAA/NESDIS will be well-served by involving NASA/GSFC in its planning for the future. NESDIS should take advantage of GSFC program management, system engineering and acquisition capability. GSFC should be proactive in bringing ideas to NESDIS, both in its current programs and in its future planning. GSFC is invested in and is a partner in the NESDIS satellite enterprise. Both parties will benefit from working more closely in planning for the future.

The IRT is concerned about the impermanence of the current leaders assigned to the program by NOAA and NASA, who are both said to be acting in their positions. We think that identification of the permanent solution, as expeditiously as possible, will help with the stability and progress of the program. We also think that the stature and experience of the leaders should be commensurate with the size and importance of this national program.



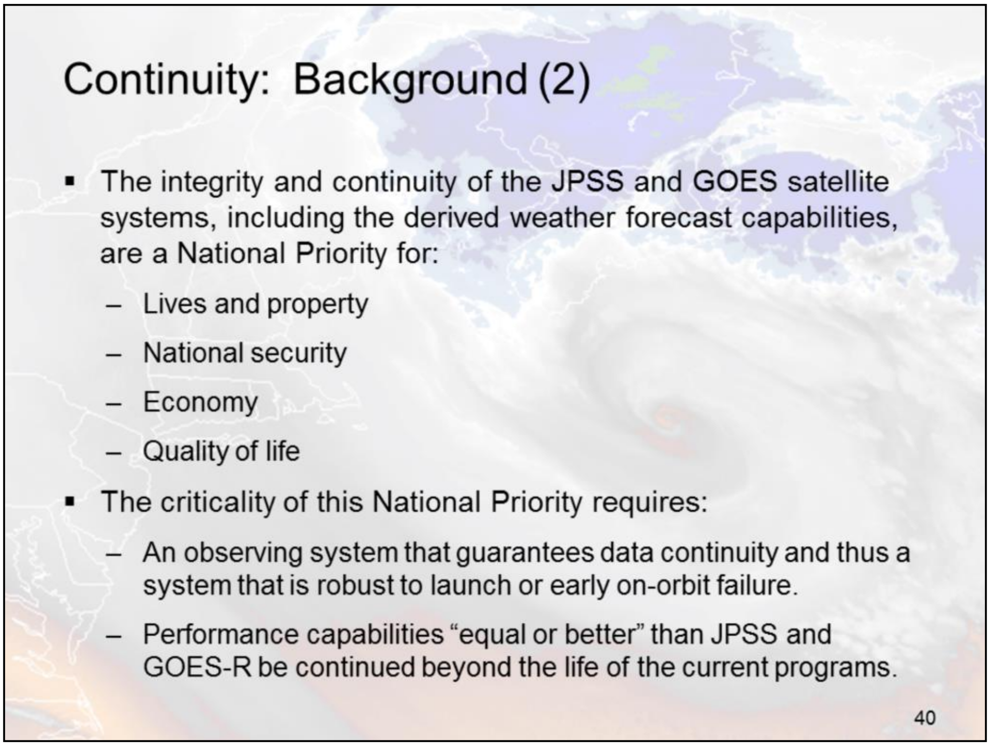
Recent direction has charged the GSFC and NESDIS JPSS programs to develop a new structure and governance process for the JPSS program. The IRT is encouraged by this, and is reinforcing the need to implement this goal quickly. While it is not specifically in the direction given to the program managers, the governance role of NASA HQ (SMD/JASD) also needs to be addressed and clarified.


CONTINUITY



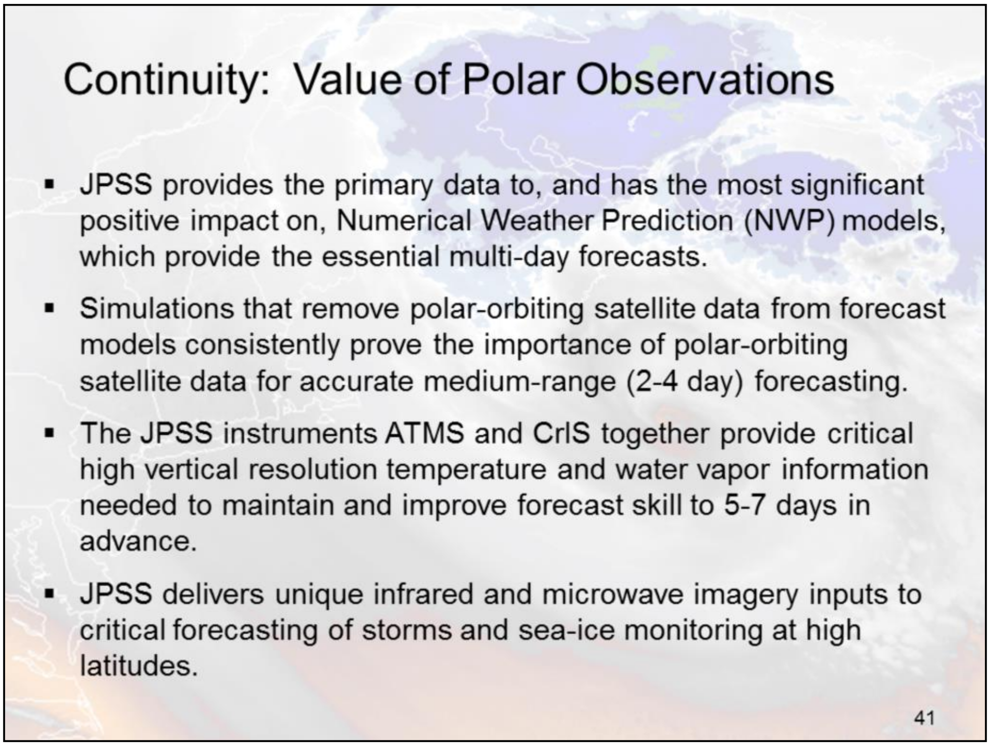
Because the GOES satellites stay above a fixed spot on the Earth's surface, they provide a constant vigil for the atmospheric "triggers" of severe weather conditions such as tornadoes, flash floods, hail storms, and hurricanes. When these conditions develop, the GOES satellites are able to monitor storm development and track their movements. GOES satellite imagery is also used to estimate rainfall during the thunderstorms and hurricanes for flash flood warnings, as well as appraise snowfall accumulations and overall extent of snow cover.

The polar satellites, Polar Operational Environmental Satellites (POES) and JPSS, provide visible, infrared and microwave radiometric data that are used for imaging purposes, radiation measurements, and temperature and humidity profiles. The polar orbiters' ultraviolet sensors also provide ozone levels in the atmosphere and are able to observe the "ozone hole" over Antarctica during mid-September to mid-November.



Despite rumors to the contrary, “The Weather Channel” is not the source of the Nation’s weather observations. They get them from NOAA and then use them to make their own unique forecast. This is true for all organizations that are in the business of producing weather forecasts for their clients. Without both the *in situ* and satellite observations that are provided by NOAA, there would be no weather forecasts beyond looking out the window. Consequently, it is a National Priority that this stream of data be provided in an uninterrupted fashion to the users of this data, including NOAA itself. Without this data, the weather forecasting and severe storm monitoring capability of the Nation would be dangerously compromised.

Both JPSS (including its predecessor programs such as TIROS and POES) and GOES have been around a long time. They are operational programs and as such, require the capability to flow critical weather data even in the face of a major failed system. There is no foreseeable end to these programs and the continuity of these programs is essential, and this continuity does not end with JPSS-4 and/or GOES-U. Given the long time (many years to more than a decade) that these types of high-technology programs take to define, design, build, test, and launch, it is essential that planning for these follow-on programs start now, and it is the main objective of this section on Continuity to make this point clear.

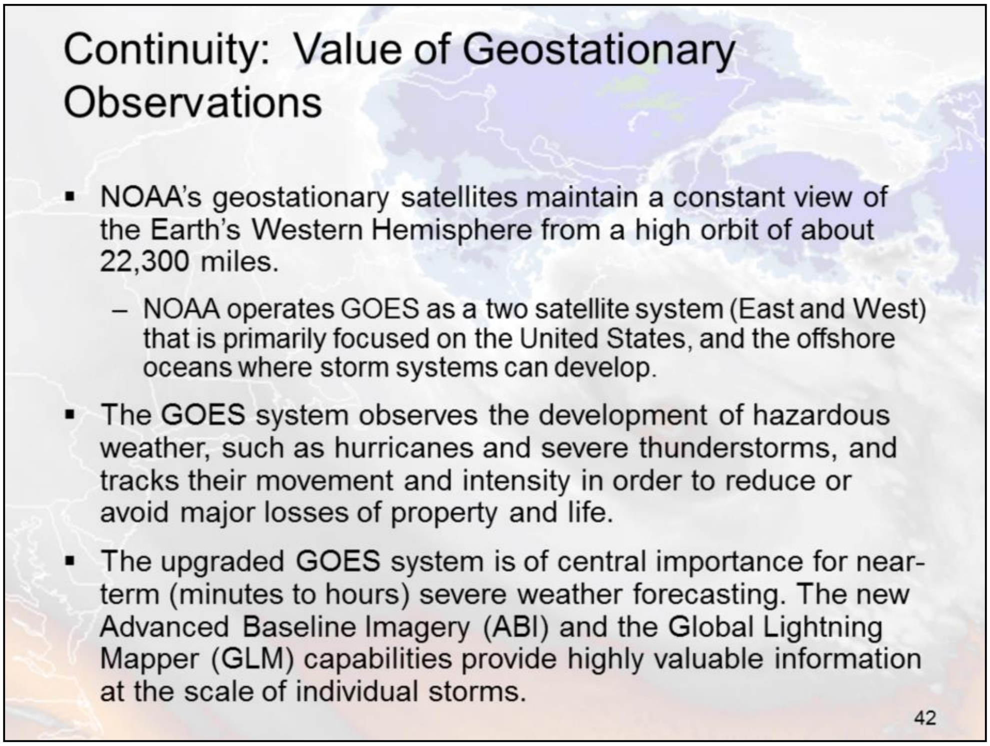


Polar orbiting satellites, due to their global coverage and variety of sensors that can be deployed from Low Earth Orbit, are the primary source of data for medium range forecasting, which is provided by Numerical Weather Prediction models.

The JPSS ATMS & CrIS instruments also provide data critical for extreme weather events, including hurricanes and severe weather outbreaks.

Predictions for Super-Storm Sandy provide excellent examples of value:

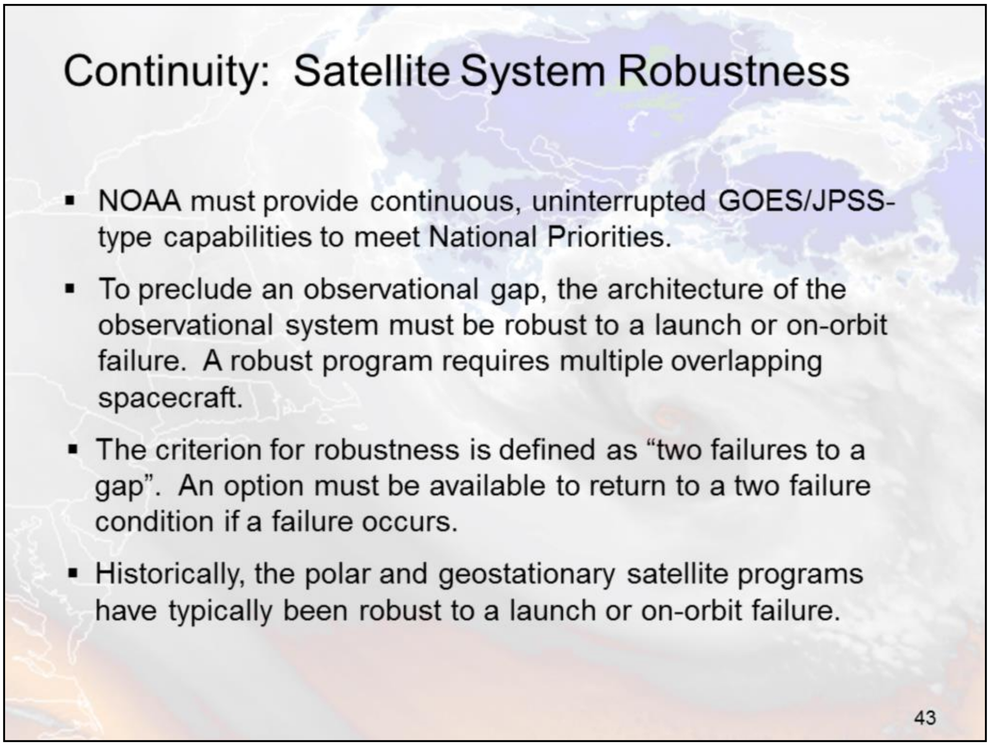
- Both the European and US weather centers have warned that without an operational fleet of polar-orbiting satellites, they would have missed the Super-Storm Sandy forecast. In fact, the models would have shown that Sandy would have headed out to sea well east of New Jersey. This would have been a disastrous forecast, given the left hook that Sandy made into New York City.



The Nation's geostationary satellites are uniquely positioned to provide timely environmental data to meteorologists and their audiences on the Earth's atmosphere, its surface, cloud cover, and the space environment. This system is composed of two satellites: GOES-East to observe the environment from the mid-west to the east coast as well as the development of storm systems off the African coast; and GOES-West to observe the environment from the mid-west out beyond Hawaii, including the development of storm systems west of Hawaii.

The GOES satellites' ability to provide broad, continuously updated coverage of atmospheric conditions over land and oceans is essential to NOAA's weather forecasting operations, particularly in severe weather conditions, e.g., tornadoes, where developments are occurring on the time scale of minutes to hours.

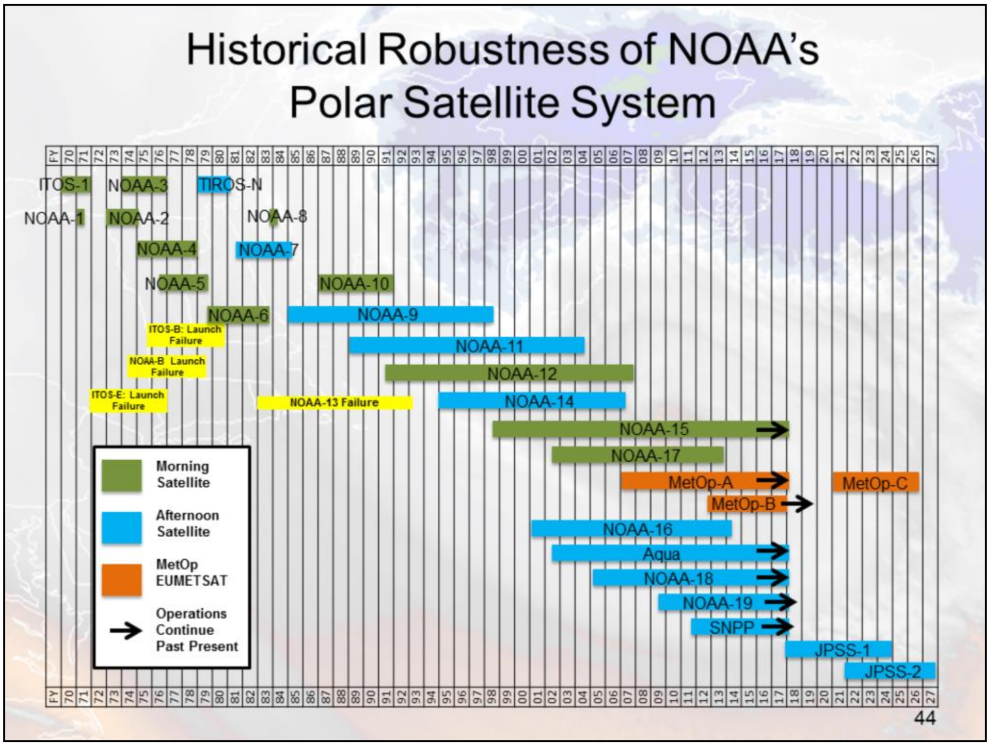
The GOES-16 ABI and GLM instruments also offer the opportunity to be combined with *in situ* observations from radar and Mesonet stations to significantly extend tornado warning times and reduce false alarms.



The definition of robustness was recommended by the 2013 NESDIS IRT Report and accepted by NESDIS.

For JPSS, this translates into always having at least two operational satellites (meaning being able to provide the Key Performance Parameters) on orbit at all times and the ability to replace any failed satellite in a timely manner.

Similarly, for GOES, this translates into always having at least three operational satellite on orbit at all times (since the observational system is defined as two satellites, one for the East Coast/Atlantic Ocean and another for the West Coast/Pacific Ocean), and the ability to replace any failed satellite in a timely manner.

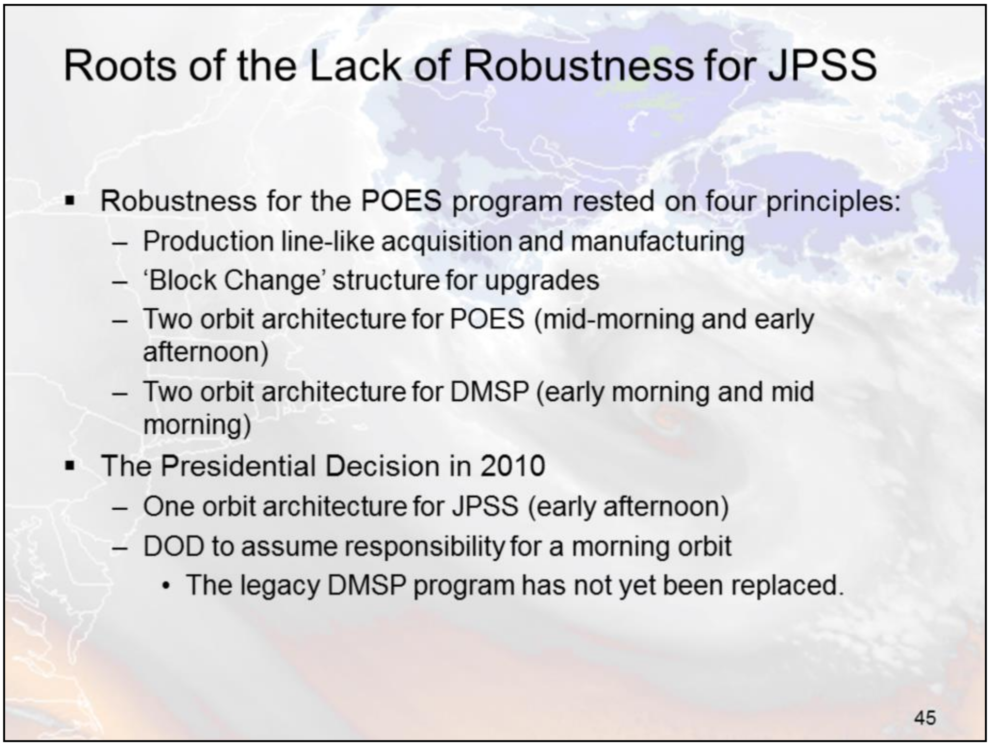


POES satellites were built in blocks of satellites where major technology changes were incorporated periodically via block changes. In this way, several near-identical satellites could be built one after the other in a production line mode. This resulted in not only cost savings, but it also created a robust program where the components and sub-systems of downstream satellites became the spares for the satellite getting ready to launch. In addition, the POES architecture supported a two orbit (morning and afternoon) system, which added system robustness. Given this steady stream of satellites, whenever there was a launch vehicle or on-orbit failure there was another POES satellite ready to launch on short notice. As can be seen above, this resulted in a very robust system, especially in the later years, typically with multiple satellites on-orbit at any given time. With 24 satellites developed in the series, these satellites were produced at an average rate of one satellite every 1.8 years. For more than four decades, the Nation was well served by this approach.

This chart, updated from the 2013 IRT Report, also shows the inclusion of NASA's Aqua satellite, which provides data from advanced sensors (AIRS, AMSU and MODIS) that is important to improved weather forecasts. Additionally, the European EUMETSAT series of satellites, known as MetOp, is shown. By agreement between NOAA and EUMETSAT in the late 90's, the Europeans provide coverage of the morning orbit (previously provided by NOAA) and NOAA provides coverage of the afternoon orbit. These changes occurred in consonance with the emergence of the NPOESS program in the mid-90's , which was to converge the Defense Meteorological Satellite Program (DMSP) and POES programs. In the aftermath of the NPOESS cancellation in 2010, NOAA's JPSS program was initiated to re-instate a civilian weather satellite development program. S-NPP, JPSS-1, and JPSS-2, shown above, are all part of this program.

For additional information see the 2013 IRT report.

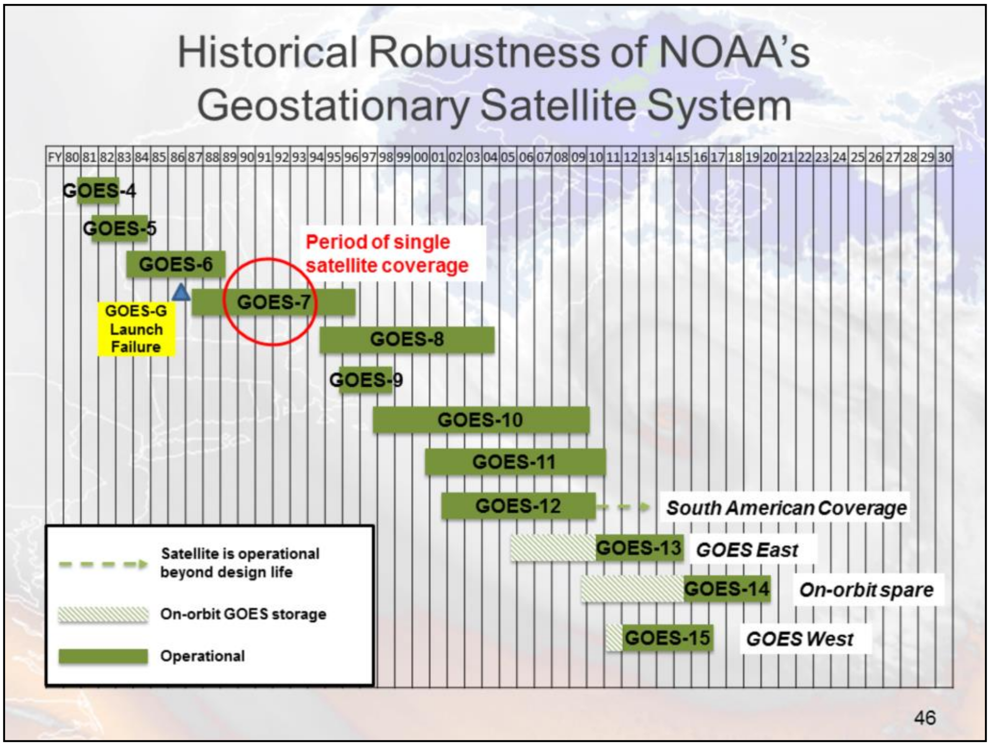
Note: POES satellites are given a NOAA-xx designation after launch.



Restructuring the National Polar-orbiting Operational Environmental Satellite System (*February 1, 2010)* “The major challenge of NPOESS was jointly executing the program among three agencies of different size with divergent objectives and different acquisition procedures. The new system will resolve this challenge by splitting the procurements. *NOAA and NASA will take primary responsibility for the afternoon orbit, and DOD will take primary responsibility for the morning orbit.* The agencies will continue to partner in those areas that have been successful in the past, such as a shared ground system. The restructured programs will also eliminate the NPOESS tri-agency structure that that has made management and oversight difficult, contributing to the poor performance of the program.” (emphasis added)

The DOD has not yet replaced the legacy DMSP program in the morning obit and as a consequence, the US Polar Platform Program became a one-orbit program, and therein, the architecture was inherently far less robust than POES or DMSP. In the future, the US will depend upon MetOp series of EUMETSAT for the morning orbit.

This inherent weakness was compounded when the Joint Polar Satellite System (JPSS) Level 1 Requirements Document made no mention of System Robustness or Gap Mitigation. Final Version: 1.7 June 27, 2013.

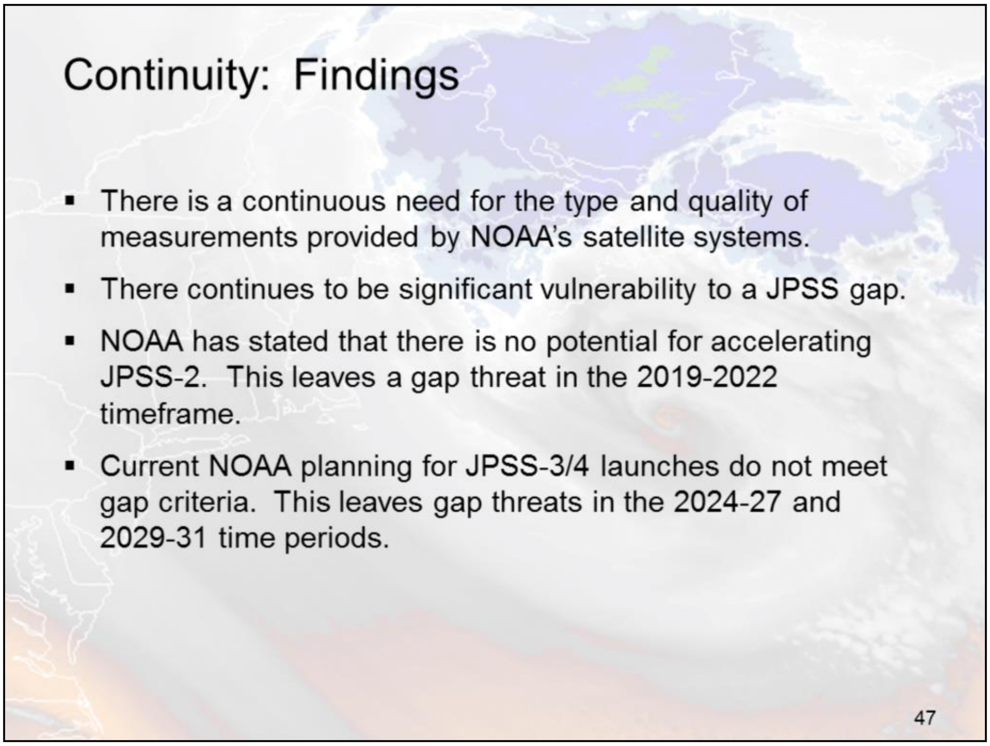


This chart, taken from the 2013 IRT report, depicts the historical flow of the civilian geostationary orbiting weather satellite system known as Geostationary Operational Environmental Satellites (GOES). The GOES series of satellites provide continuous imagery and atmospheric measurements of Earth's Western Hemisphere and space weather monitoring. It also is the primary tool for the detection and tracking of hurricanes, tornadoes, and other forms of severe weather. GOES is nominally a 2 geostationary satellite system, with one monitoring the eastern half of the country out to the coast of Africa where hurricanes form, and the other monitoring the Western half of the nation including Hawaii and Alaska. While initiated more recently than POES, the Nation has, nonetheless, become dependent on GOES, including seeing its cloud motion imagery on the evening and late night television weather forecasts for more than 30 years. As a two satellite system it requires three satellites in order to be two failures from a gap.

As in the case of POES**,** the GOES satellites were built in blocks of satellites where major technology changes were incorporated periodically via block changes. In this way, several near-identical satellites could be built one after the other in a production line mode. This resulted in not only cost savings but also created a robust program where the components and sub-systems of downstream satellites became the spares for the satellite getting ready to launch. As can be seen in the chart, this resulted in a reasonably, but not perfectly, robust system in the early years. This is also true with the current program in development. However, this was not the case when the program attempted to transition from a spin stabilized satellite configuration to a non-spinning satellite configuration in the late 80's. Developmental problems arose not only with the spacecraft, but also with the instruments. After the GOES-G launch vehicle failure in 1986, and the subsequent failure of GOES-6 in 1989, GOES-7 became the Nation's only geostationary satellite, and it had to be moved back and forth between the East and West orbital slots during their respective storm seasons. Fortunately, an agreement was reached with the Europeans to "borrow" one of their geostationary satellites to help out the U.S., as this single U.S, satellite situation persisted for almost 6 years. This situation was such a major National disaster that 6 congressional hearings were held during the summer of 1990 as Congress pressed DOC, NOAA and NASA to understand how this had happened, and to fix the situation as soon as they possibly could. Finally in 1994, GOES-8 was launched, followed shortly thereafter by GOES-9, and the program has been robust ever since. It is this type of gap that the recommendations of this report are aimed at preventing for the current non-robust

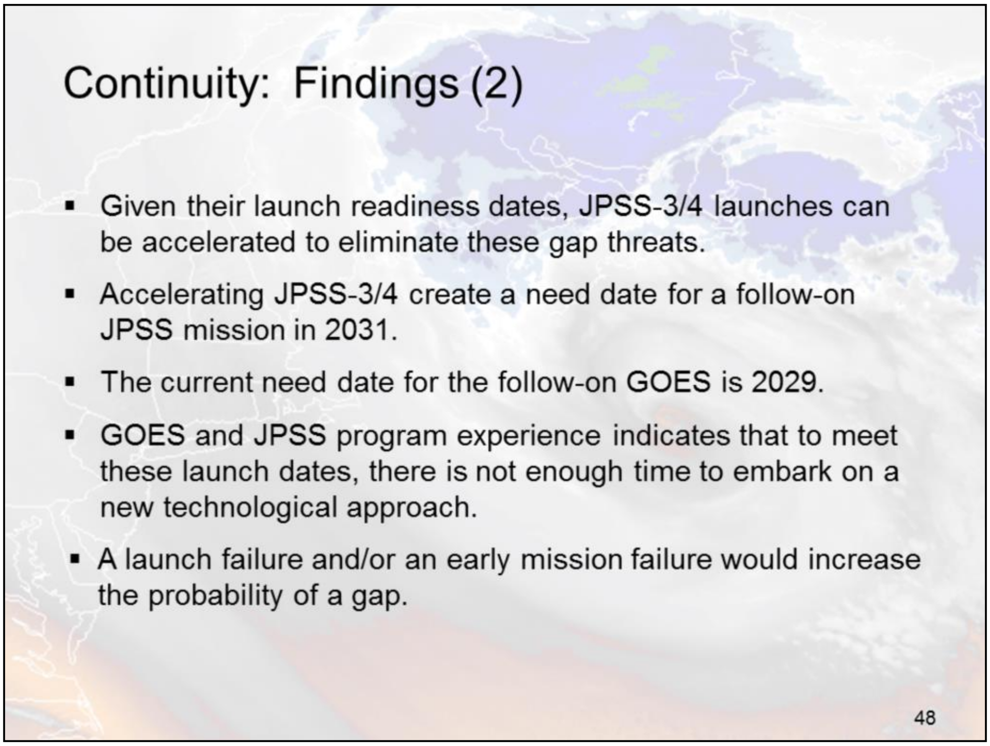
JPSS program.

For additional information see the 2013 IRT report.



This and the next chart represent the “Bottom Line” of the IRT’s analysis of the GOES & JPSS robustness situation.

One of the very significant points is that, while the GOES and JPSS satellite programs are very large undertakings in and of themselves and have been difficult to sustain from a budget perspective, they must be continued for the foreseeable future. Additionally the JPSS program continues to be vulnerable to gaps as described above.



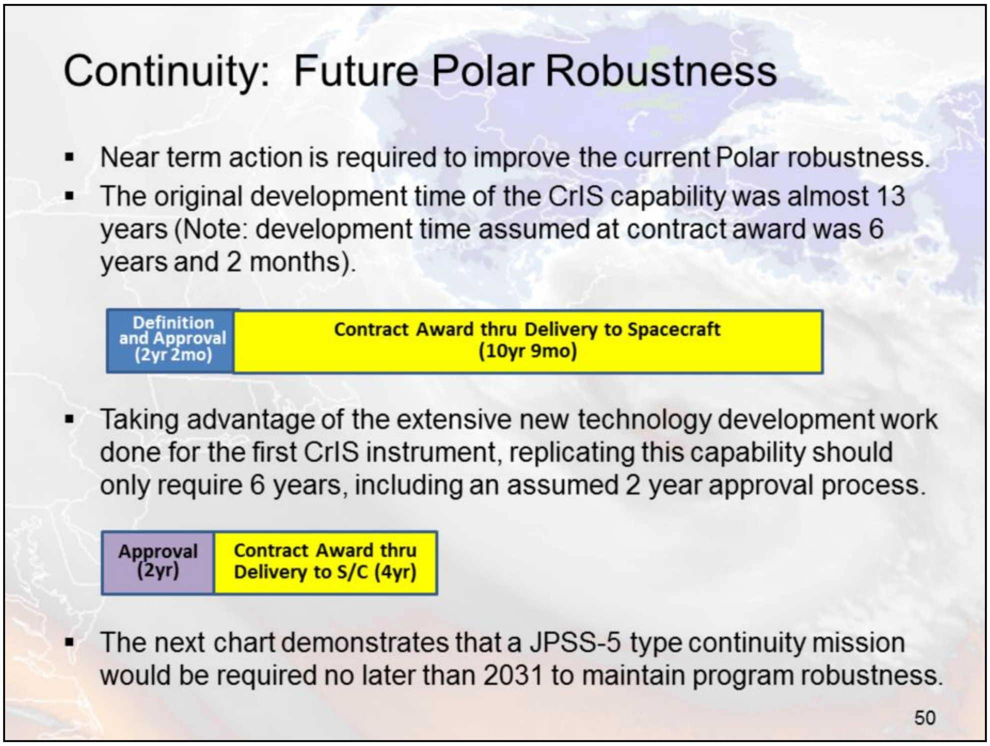
Recognizing the increased risk to a gap in coverage associated with the current NESDIS flyout plan, the IRT believes that the launches of JPSS-3/4 should be accelerated consistent with their planned launch readiness dates and the desire to reduce the possibility of undesired gaps in coverage. As a consequence, an additional JPSS continuity mission will be required earlier, i.e., in 2031.

The IRT's analysis demonstrates that the time is almost past to start working on needed post-GOES-U and JPSS-4 missions. This will also have the additional benefit of providing the needed time to develop potentially lower cost new technologies and/or commercial approaches to meet the Nation's needs in the weather forecasting area in the future. To help mitigate against parts obsolescence issues, the procurement of the necessary parts to replicate GOES-U and JPSS-4 must be initiated as soon as possible, nominally in FY19. And no later than FY24, a GOES continuity mission needs to be fully approved for development and be available for launch no later than 2029. Similarly, no later than FY26, a JPSS continuity mission needs to be fully approved for development and be available for launch no later than 2031.

Finally, taking advantage of the additional time provided by the continuity missions, concept studies and the approved process for the development of new technologies/commercial approach needs to be initiated soon.

Continuity: Findings (3)

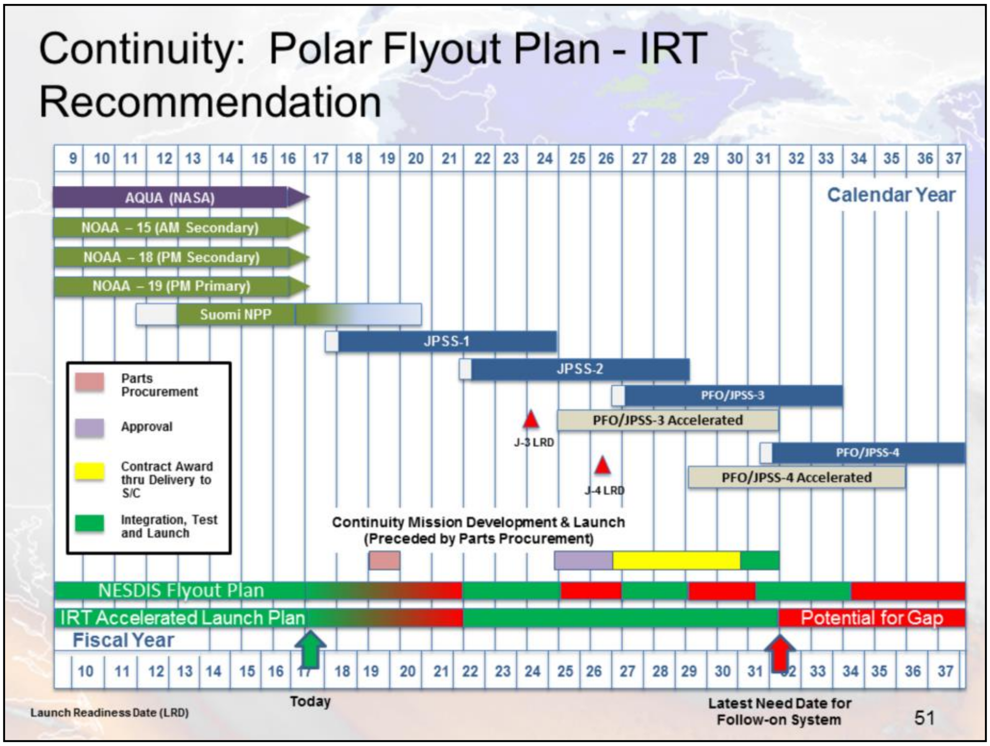
- For JPSS, development of CrIS or ATMS type capabilities could take many forms, for example:
  - A fleet of smallsats with instruments incorporating new technology
  - Some or all of the existing instruments each on separate smaller spacecraft
  - Commercial solutions
  - Other
- For GOES, the development or commercial pathway is less clear, but there might be an opportunity to disperse some of the payload across commercial communication satellites.



As noted above, the development of the S-NPP CrIS instrument took almost 13 years from the start of the concept studies (July 1997) to award of the contract (August 1999) to delivery of the completed CrIS instrument to the S-NPP S/C in June 2010. At the time of contract award, the estimated development time for the CrIS instrument was 6 years 2 months. Thus the actual development time took twice as long as originally anticipated. This long time period is primarily due to the CrIS instrument being built to meet exceedingly difficult new requirements. Such capability improvements take a long time to go from concept development to design to a fully tested instrument. The GOES ABI instrument development is a similar example. This lengthy development time is not at all out-of-family with similar complex instrument development activities across both NOAA and NASA, where a recent Aerospace Corporation study[1] indicated that such developments take 12-16 years from instrument formulation to launch.

However, the good news is that once the very difficult development phase has been completed, copies can be made quite efficiently and in a very timely manner. As an example, taking advantage of the Harris Corp's development of the GOES ABI instrument, the Japanese purchased a copy of ABI referred to as the Advanced Himawari Imager (AHI), which was delivered to the Japanese S/C for integration, test and launch in only about 48 months from award of contract. Thus the same assumption can be made for delivering JPSS instrument copies, cutting the time to obtain approval and deliver a CrIS instrument copy from almost 13 years to about 6 years.

[1] “Schedule Analysis in Support of GOES- Next Planning”, Aerospace Corporation, October 31, 2014



The launch date and check-out & storage time period for the JPSS-1 & JPSS-2 satellites are in accordance with NESDIS's current/ flyout plan[2], the launch readiness dates for the JPSS-3/4 satellites are taken from the NESDIS Gap Mitigation Plan[3], and the JPSS-3/4 launch dates were chosen by the IRT to maximize robustness in the FY 22-31 time period:

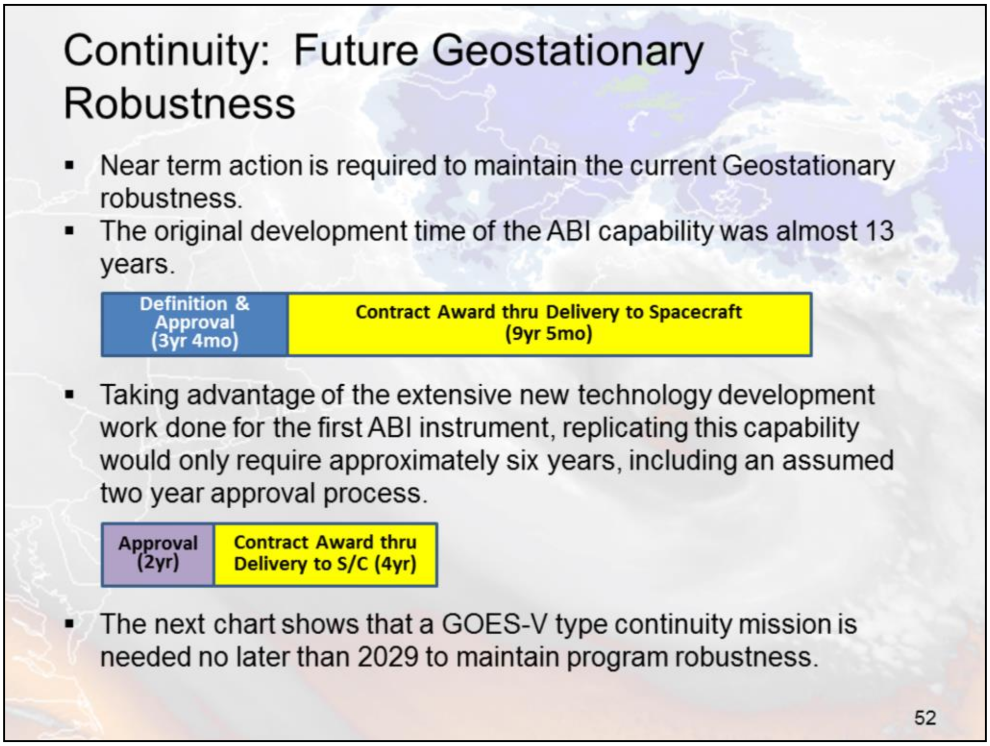
- The top portion of this chart depicts both the current schedule associated with the on-orbit NOAA-15/18/19 satellites, plus NASA's Aqua satellite, as well as the "fly-out" plan for the upcoming JPSS 1/2 satellites, and the IRT's recommended plan for JPSS-3/4.
- The middle portion of this chart depicts the information from the previous chart concerning the development time of the required continuity mission overlaid on this schedule chart to put it into the context of the existing and planned fleet of JPSS satellites.
- The bottom portion of this chart shows when the robustness criteria (2 failures to a gap) is met (green) and when it is not (red) for both the NESDIS flyout plan (4 potential gaps) and the IRT's recommended launch sequence (a potential gap in the 2019-22 timeframe and starting again in FY32) .

Putting all this together, assuming 6 years from the initiation of the budget approval process to delivery of CrIS type instruments to the S/C, followed by 15 months to launch (12 months for Integration& test, and 3 months for the launch campaign), it can be seen that such an endeavor must be preceded by the previously noted parts procurement activity in FY19, with the budget approved and the continuity mission under contract no later than FY26 in order to meet the 2031 need date such that robustness can be extended for another 5 years into FY 36. This assumes no failures in the JPSS 1-4 program.

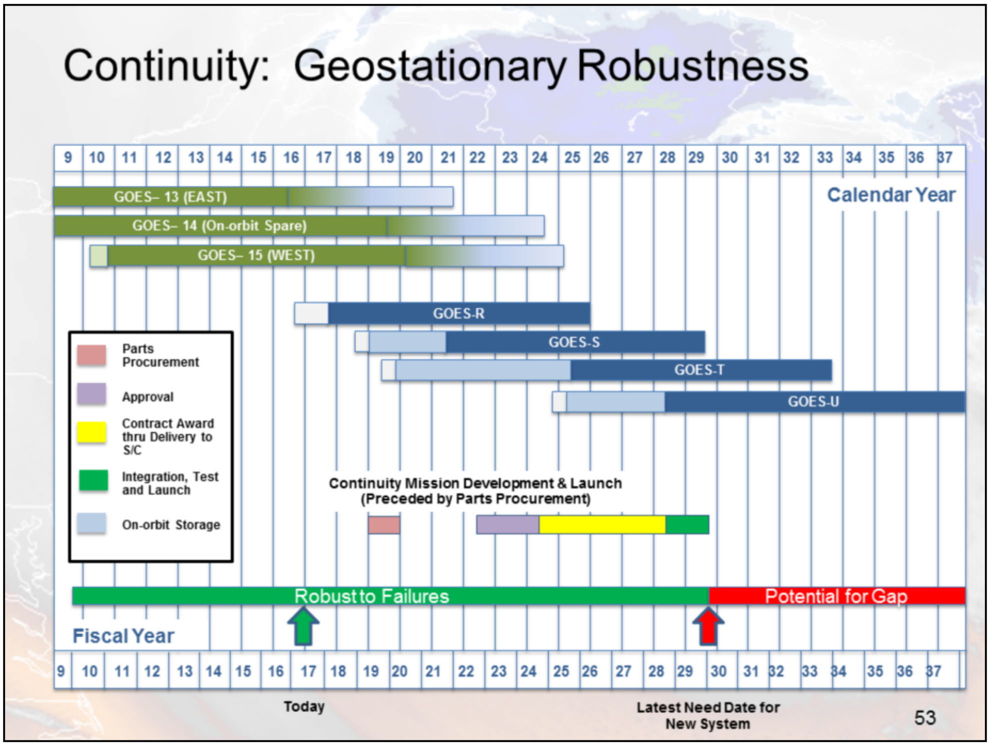
It should also be clear that any desire to follow a JPSS-5 continuity mission with a new technology/commercial approach, must also get started soon. This assumes an CrIS like development effort in terms of the time that it takes to develop such a brand new capability.

[2] http://www.jpss.noaa.gov/launch_schedule.html

[3] NOAA Gap Mitigation for Observations from Polar-Orbiting Environmental Satellites, NESDIS, November 29, 2016



As noted above, the development of the GOES ABI instrument took almost 13 years from the start of the concept studies (May 2001) to award of the contract (September 2004) to delivery of the completed ABI to the GOES-R S/C in February 2014. This long time period is primarily due to the ABI instrument being built to meet exceedingly difficult new requirements. The GOES-16 ABI now on-orbit scans the skies five times faster than today's GOES spacecraft, with four times greater image resolution, and three times the spectral channels. It also provides high-resolution, rapid-refresh satellite imagery as often as every 30 seconds, providing more detailed examination of a storm to determine whether it is growing or decaying. Such capability improvements take a long time to go from concept development to design to a fully tested instrument. The JPSS CrIS instrument development is a similar example of this time schedule. As with the polar satellite, this lengthy time is similar to complex instrument development activities across both NOAA and NASA.

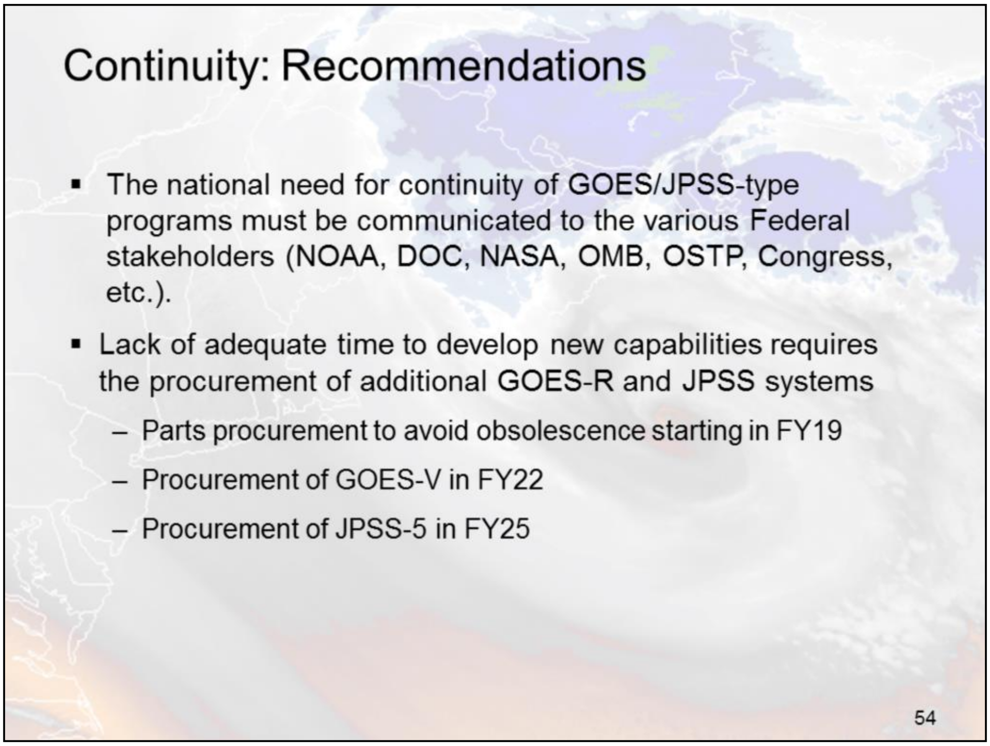


The launch dates and check-out & storage time periods for the GOES R-U satellites are consistent with NESDIS's flyout plan[2], except for GOES-R which is shown as the actual launch date of Nov. 19, 2016:

- The top portion of this chart depicts both the current schedule associated with the on-orbit GOES-13/14/15 satellites, plus the new GOES-16 satellite, as well as the "launch & store" plan for the upcoming GOES-S/T/U satellites.
- The middle portion of this chart depicts the information from the previous chart concerning the development time of the required continuity mission overlaid on this schedule chart to put it into the context of the existing and planned fleet of GOES satellites.
- The bottom portion of this chart shows when the robustness criteria (2 failures to a gap) is met (green) and when it is not (red; starting in FY 30) .

Putting all this together, assuming 6 years from the initiation of the budget approval process to delivery of ABI type instruments to the S/C, followed by 15 months to launch (12 months for Integration and test and 3 months for the launch campaign), it can be seen that such an endeavor must be preceded by the previously noted parts procurement activity in FY 19, and under contract no later than FY 24 in order to meet the 2029 need date such that robustness can be extended for another 4 years thru approximately FY 33. This assumes no failures in the GOES R-U program.

It should also be clear that any desire to follow a GOES-V continuity mission with a new technology/commercial approach, must also get started soon. This assumes an ABI like development effort in terms of the time that it takes to develop a brand new capability for imaging. We also note that the Global Lightning Mapper also meets very challenging measurement requirements.

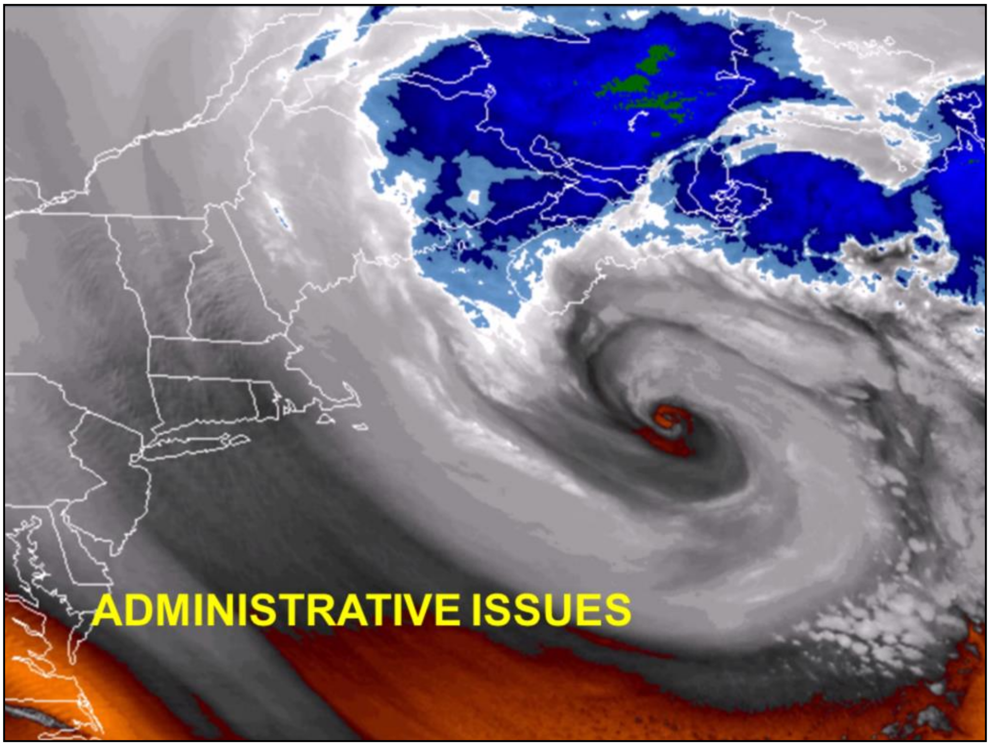


This and the following chart summarize the points that have been discussed in this section of the IRT report into specific recommendations.

Continuity: Recommendations (2)

- To address the potential for a gap in the 2019-22 timeframe and to add flexibility to respond to potential failures
  - Study the possibility of being able to launch JPSS-2 earlier, possibly only with ATMS and CrIS
  - Similar to the established JPSS-3 option, create an option for the launch of JPSS-4 only with ATMS and CrIS
  - Examine other potential partial replacement options such as EON-MW
- Technology development and examination of commercial approaches to develop options to replace GOES and JPSS need to be initiated as soon as practical.
- The JPSS program should examine developing a launch vehicle strategy to allow launch on need.

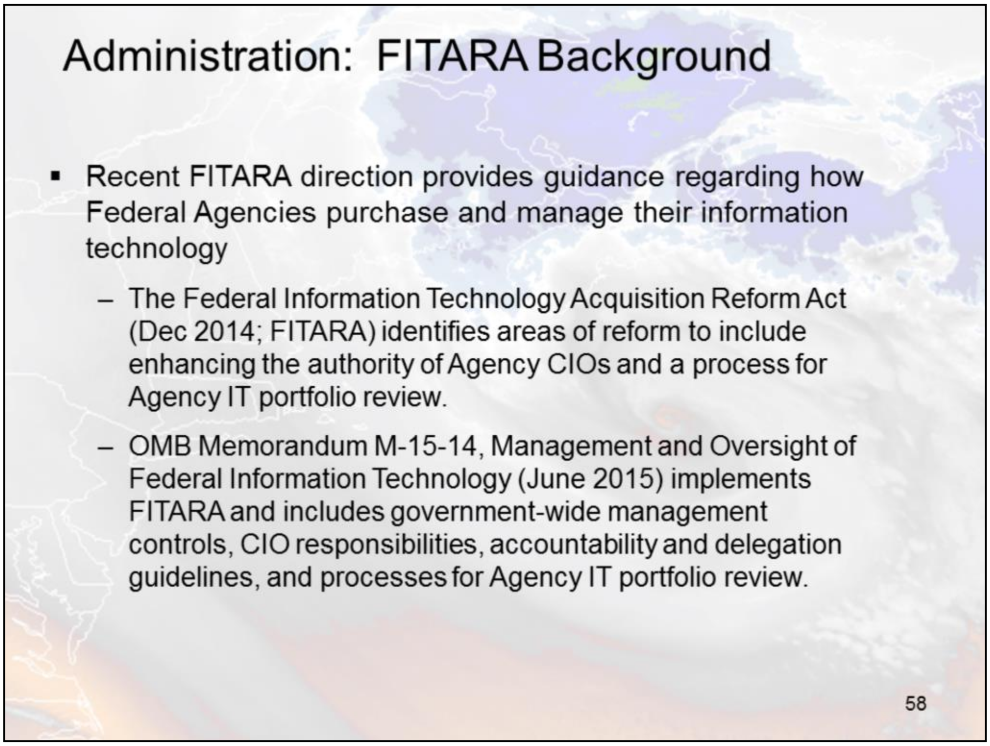
55


ADMINISTRATIVE ISSUES

Administration: Staffing Observations

- NESDIS is currently ~20% understaffed.
- 70% of the vacancies are technical positions.
- The current average time to hire is reported to be 10 months.
- Staffing issues are not consistent with the priority associated with the Nation's civil weather program.
- IRT strongly believes that the senior management of DOC, NOAA, and NESDIS must give timely attention to this important issue.

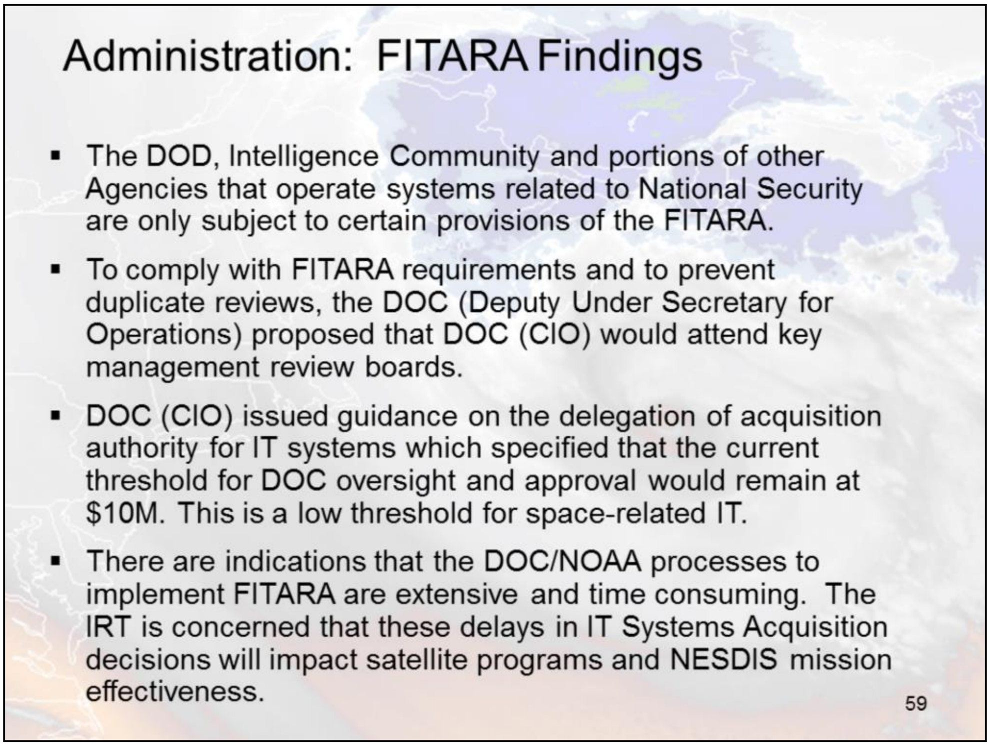
57



Over the course of the last two years, there has been high level guidance and direction regarding how Federal Agencies purchase and manage their Information Technology. This direction has significant implications for DOC, NOAA, and NESDIS and offers challenges for NESDIS satellite programs.

In December 2014 Congress passed the Federal Information Acquisition Reform Act. This far reaching Act identifies areas of reform from enhancing Agency CIO authorities and mandating common processes for Agency IT portfolio review.

To implement FITARA, OMB issued a far reaching memorandum, M-15-14 in June 2015 to include government wide management controls, CIO responsibilities, accountability and delegation of authority guidelines and processes for Agency IT portfolio review.

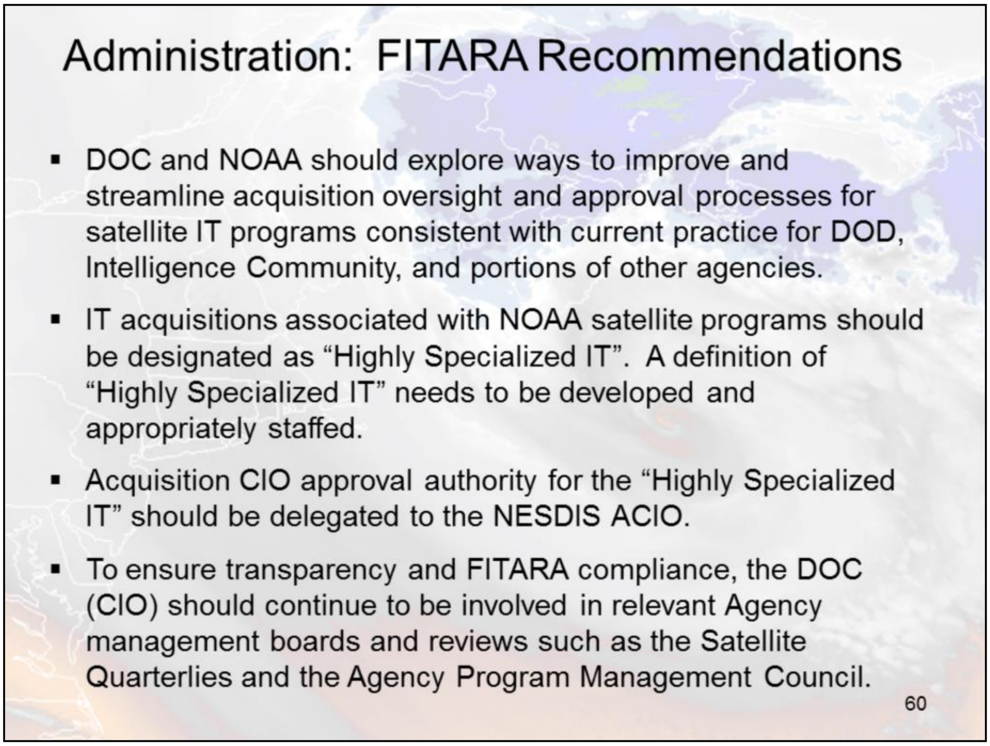


While FITARA and the OMB memorandum are applied government wide, there was an exception for the DOD, the Intelligence Community and portions of other agencies that operate systems related to National Security. These agencies are subject to only certain provisions of the act and OMB direction. The idea of seeking an exception in the name of national security merits some examination.

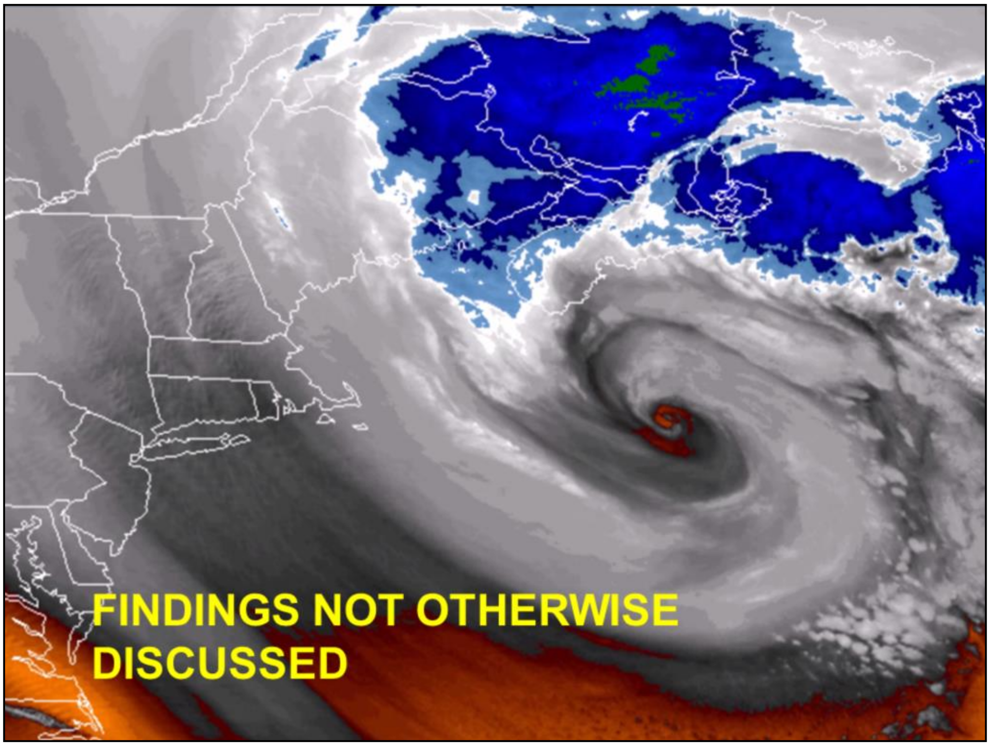
To comply with FIRARA and to prevent the inefficiencies regarding duplicate review, the DOC (Deputy Under Secretary for Operations) proposed that the DOC CIO attend key management reviews.

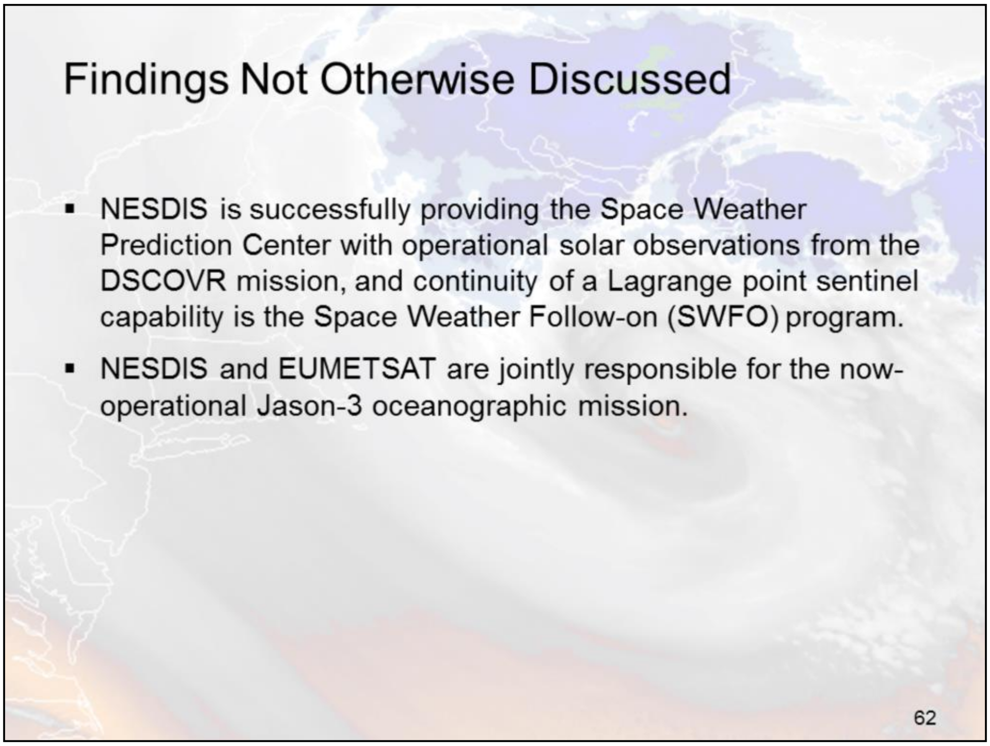
In a memo dated August 30, 2016, the DOC (CIO) issued guidance on the delegation on authority to the NOAA (CIO). Of special note, the memo specifies that the current threshold for DOC (CIO) oversight would remain $10M and greater. This has particular significance for NESDIS as a great majority of their IT acquisitions in support of satellite programs far exceed the $10M cap.

There are indications that the DOC /NOAA processes to implement FITARA are extensive and time consuming.



The products from NOAA Satellite Programs are becoming increasingly critical to the Nation’s well being by providing crucial information to protect the Nation’s environment, security, economy and quality of life. Given this mission criticality, the pervasiveness of the IT infrastructure that supports these space programs: and the substantial financial scale differences between this IT and traditional DOC and NOAA IT systems, the IRT believes that it is extremely important that the DOC (CIO), the NOAA (CIO), and the NESDIS (CIO) policies, rules and responsibilities be re-examined to insure efficiencies are realized and mission continuity maintained. The recommendations on this slide should be included as this re-examination. Moreover, the IRT also believes that this re-examination is especially timely given the opportunities represented by the new Administration.

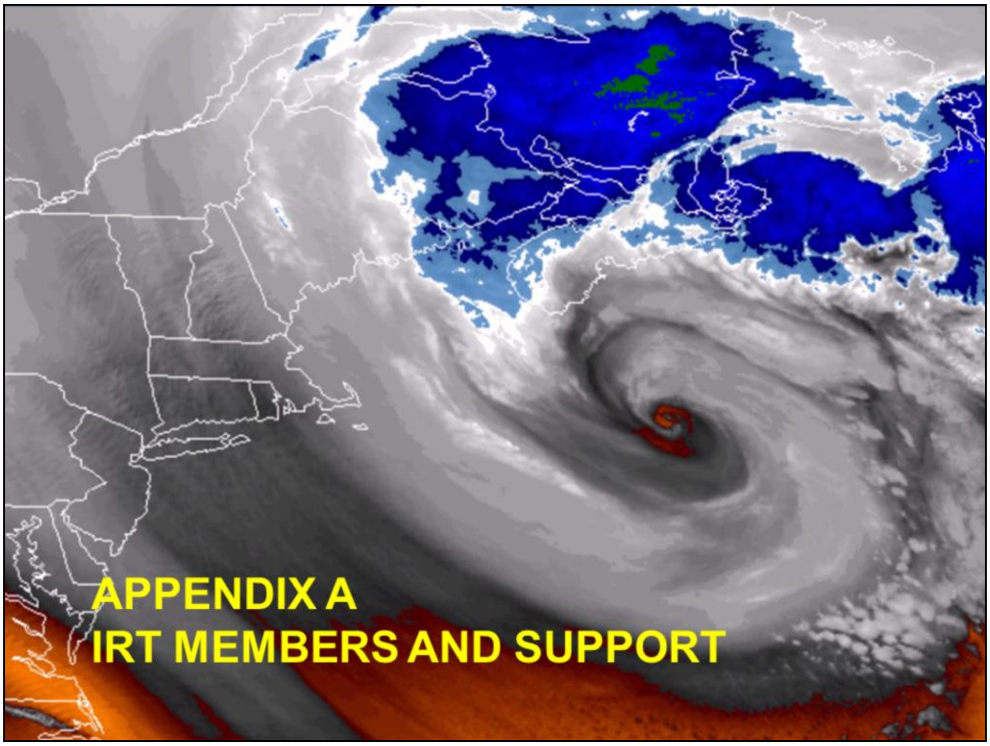

FINDINGS NOT OTHERWISE
DISCUSSED



While GOES-R and JPSS/PFO are the flagship flight programs for NESDIS, the IRT wants to also acknowledge the importance of the space weather and sea surface height observations being made by the DSCOVR and Jason-3 missions respectively. These successful programs have evolved from cooperation with NASA, the French Space Agency CNES, and EUMETSAT for Jason-3 and with NASA and the USAF (which provided the launch) for DSCOVR.

The DSCOVR mission, launched in February, 2015, will be followed by the Space Weather Follow-on (SWFO) program which will consist of two satellites, two launch vehicles, and two sets of sensors, with the first satellite to be available when DSCOVR reaches its predicted end of mission life in FY22. Continuity of solar observations in support of the NWS Space Weather Prediction Center's mission is discussed in the National Space Weather Strategy (October, 2015).

Jason-3 was launched in January, 2016 and is providing important ocean observations in support of ocean circulation modeling. Continuation of operational sea surface topography measurements after Jason-3 is important.


APPENDIX A
IRT MEMBERS AND SUPPORT

IRT Membership

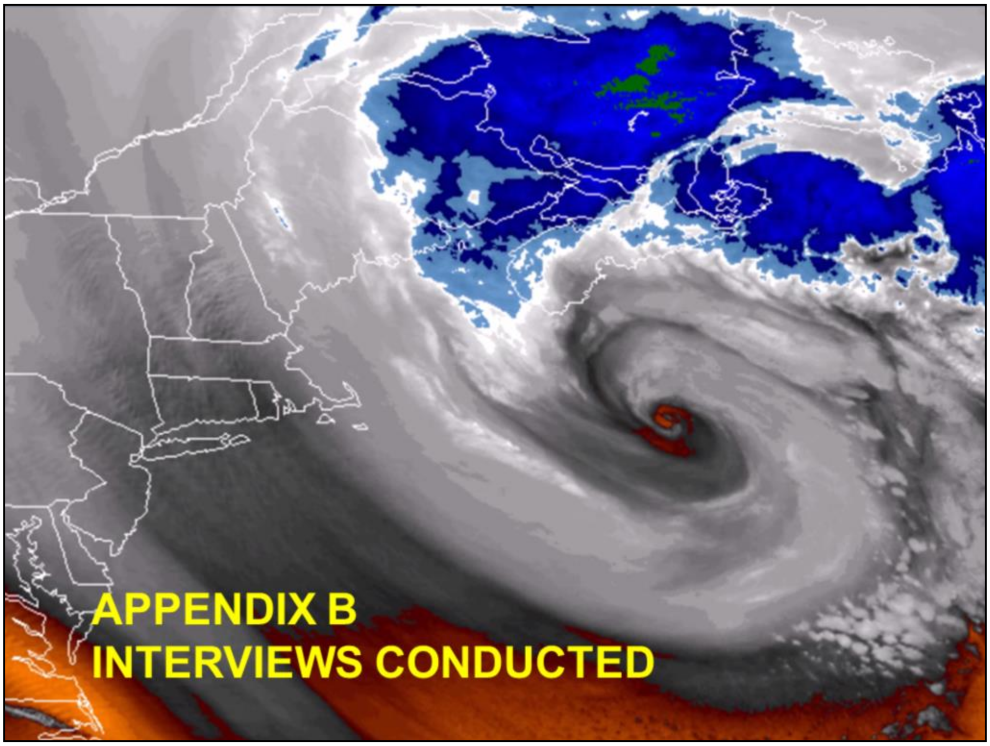
- A. Thomas Young (Chair)
- Dr. Berrien Moore III
- Gen (ret) Thomas S Moorman Jr.
- Dolly Perkins
- Lt Gen (ret) J. Thomas Sheridan
- Dr. Joe M. Straus (JPSS SRB Chair)
- William Townsend (GOES-R SRB Chair)
- Steven Battel
- Jonathan Malay
- Dr. Susan Avery

IRT Secretariat Staff:

- Brian Mischel	Executive Secretary
- Meredith Wagner	Executive Support
- Alexandra Hervey	Executive Support

IRT Member Biographies

IRT Member	Previous Experience
A. Thomas Young	• President, Martin Marietta Corporation • Director, Goddard Space Flight Center • Chairperson of numerous IRTs for civil and national security sectors
Dr. Berrien Moore III	• VP For Weather & Climate Programs, University of Oklahoma • Executive Director, Climate Central • Director, Institute for the Study of Earth, Oceans and Space, University of NH
Thomas S. Moorman, General, USAF (Retired)	• Vice Chief of Staff, United States Air Force • Commander, Air Force Space Command • Staff Director, National Reconnaissance Office (NRO)
Dolly Perkins	• Deputy Director, Technical, Goddard Space Flight Center • Director, Flight Projects, Goddard Space Flight Center
Jonathan Malay	• President, American Meteorological Society and American Astronautical Society • Director, Lockheed Martin Corporation • Meteorologist/Oceanographer, U.S. Navy
Dr. Susan Avery	• Senior Fellow at Consortium for Ocean Leadership • President Emerita, Woods Hole Oceanographic Institute • Director, Cooperative Institute for Research in Environmental Sciences (CIRES)
Steven Battel	• President, Battel Engineering • AIAA Fellow, Member of National Academy of Engineering • Member of Aeronautics & Space Engineering Board (ASEB) for National Academies
John T. "Tom" Sheridan, Lt. General, USAF (Retired)	• VP for National Security Space Business, The SI Group • Commander, USAF Space and Missile Systems Center (SMC) • Deputy Director, National Reconnaissance Office
Dr. Joe Straus	• Executive Vice President, Aerospace Corporation • Chair, Space Communications and Navigation Committee, Int'l Astronautical Congress • Standing Review Board Chair, JPSS
William Townsend	• Standing Review Board Chair, GOES-R • VP, Exploration Systems, Ball Aerospace & Technologies Corp. • Deputy Director, Goddard Space Flight Center


APPENDIX B
INTERVIEWS CONDUCTED

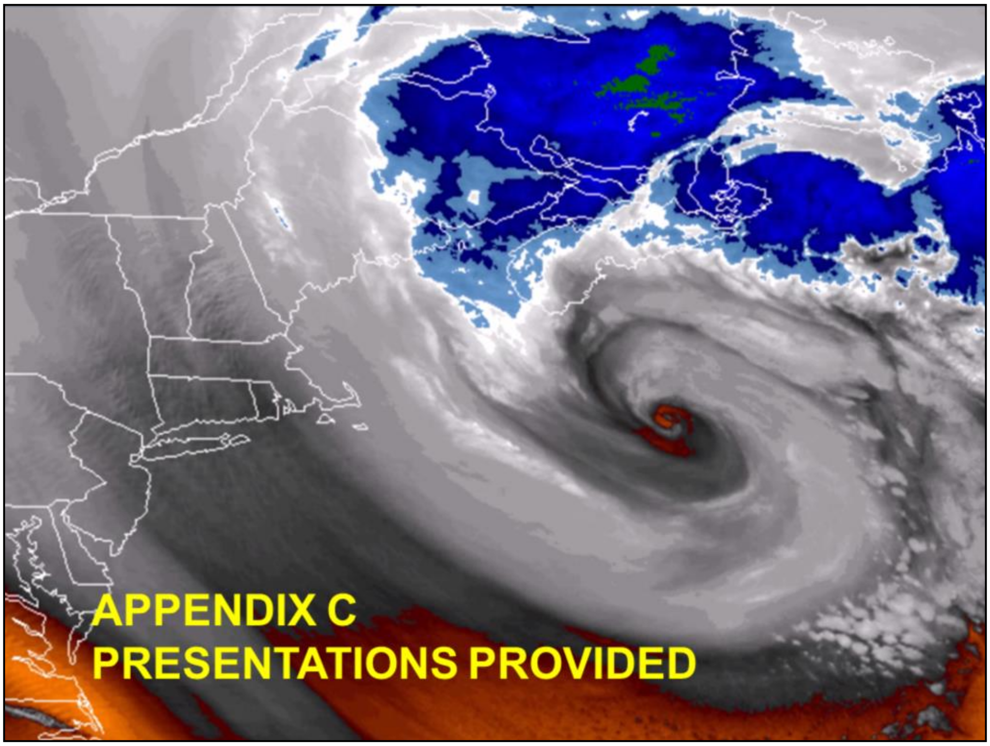
Interviews Conducted

Name	Org	Title
Kathy Sullivan	NOAA	Under Secretary of Commerce and NOAA Administrator
Ben Friedman	NOAA	Deputy Undersecretary for Operations
Steven Volz	NESDIS	Assistant Administrator
Chris Scolese	NASA	Director, Goddard Space Flight Center
Irene Parker	NESDIS	Chief Information Officer
Orlando Figueroa	NESDIS	Consultant to NESDIS; former Deputy Center Director for Science and Technology, Goddard Space Flight Center
Zach Goldstein	NOAA	Chief Information Officer
Michael Freilich	NASA	Earth Science Division Director
Greg Robinson	NASA/SMD	Deputy Associate Administrator for Programs
Louis Uccellini	NOAA/NWS	Assistant Administrator
Sandra Smalley	NASA	Joint Agency Satellite Director
Robert Lightfoot	NASA	Associate Administrator
Thomas Zurbuchen	NASA	Associate Administrator, Science Mission Directorate
VAdm (Ret.) Manson Brown	NOAA	Assistant Secretary of Commerce and NOAA Deputy Administrator
Cherish Johnson	NESDIS	Chief Financial Officer/Chief Administrative Officer

67

Interviews Conducted (2)

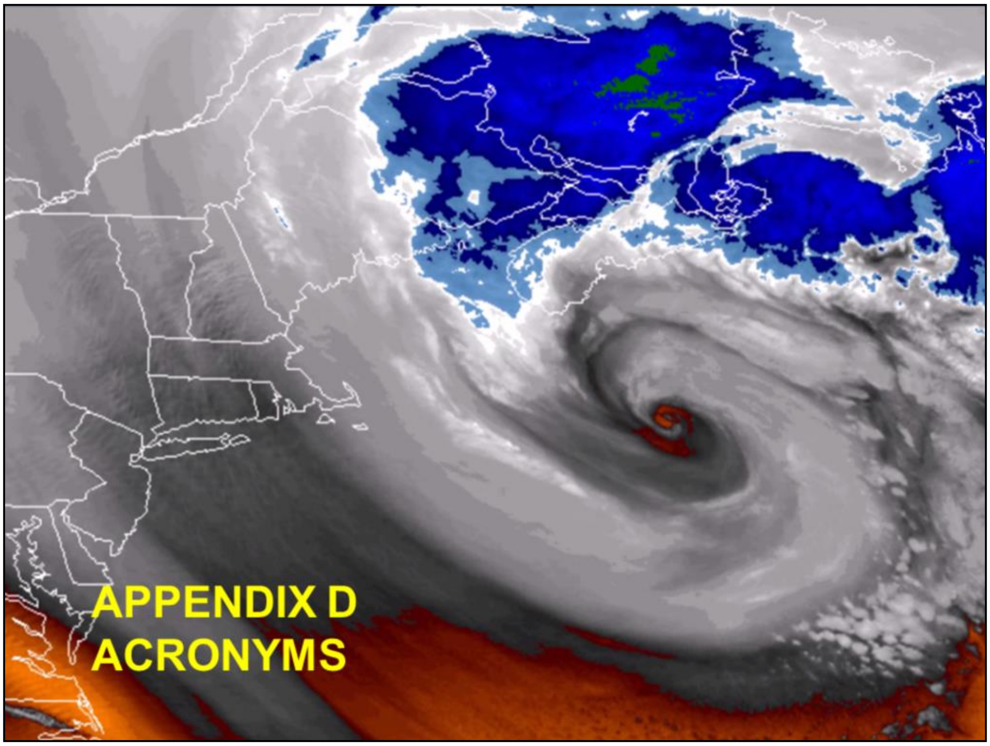
Name	Org	Title
Karen St. Germain	NESDIS	Director, Office of Systems Architecture and Advanced Planning
Tom McCarthy	NASA/GSFC	Acting JPSS Program Manager
Mike Kalb	NESDIS	Deputy Director, Center for Satellite Applications and Research
Steve Petersen	NESDIS	Director, Office of Satellite Ground Services


APPENDIX C
PRESENTATIONS PROVIDED

NESDIS Presentations Provided

Presenter	Org	Presentation Topic
Stephen Volz	NESDIS/AA	Previous IRT Recommendations, NESDIS Implementation, and Future Look Ahead
Cherish Johnson	NESDIS/CFO	NESDIS Reorganization Implementation
Thomas Burns	NESDIS/DAAS	Current Status of Programs and Future View
Stephen Volz	NESDIS/AA	NESDIS Strategic Plan: Charting a New Direction
Stephen Volz	NESDIS/AA	NESDIS Programmatic Structure: Present and Future
Karen St. Germain	NESDIS/OSAAP	NESDIS Systems Architecture and Advanced Planning
Irene Parker	NESDIS/CIO	NESDIS Information & Data Management
Margarita Gregg Mike Kalb Steve Goodman Mitch Goldberg	NESDIS/NCEI NESDIS/STAR NESDIS/GOES-R NESDIS/JPSS	Science at NESDIS: Science/Data Priorities and Mission Requirements
Karen St. Germain	NESDIS/OSAAP	NSOSA Architecture Study
Tom Burns	NESDIS/DAAS	NOAA Gap Mitigation for Observations from Polar-Orbiting Environmental Satellites
Steven Petersen	NESDIS/OSGS	Enterprise Ground

70


APPENDIX D
ACRONYMS

Acronyms

AA	Assistant Administrator
ABI	Advanced Baseline Imager
AHI	Advanced Himawari Imager
AIAA	American Institute of Aeronautics and Astronautics
AIRS	Atmospheric Infrared Sounder
AMSU	Advanced Microwave Sounding Unit
AOA	Analysis of Alternatives
ATC	Assurance Technology Corporation
ATMS	Advanced Technology Microwave Sounder
CAG	Cost Analysis Group
CERES	Clouds and Earth's Radiant Energy System
CBU	Consolidated Back-Up
CFO	Chief Financial Officer
CIO	Chief Information Officer
CIRES	Cooperative Institute for Research in Environmental Sciences
CLASS	Comprehensive Large Array-data Stewardship System
CNES	Centre National d'Etudes Spatiales
COMS	Communication, Ocean, and Meteorological Satellite
COSMIC	Constellation Observing System for Meteorology, Ionosphere, and Climate
CrIS	Cross-track Infrared Sounder (CrIS)
CU/LASP	University of Colorado/Laboratory for Atmospheric and Space Physics
CWDP	Commercial Weather Data Pilot
CY	Calendar Year
DAAS	Deputy Assistant Administrator for Systems
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
DSCOVR	Deep Space Climate Observatory
EON-MW	Earth Observing Nanosatellite-Microwave
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EXIS	Extreme Ultraviolet and X-ray Irradiance Sensors
FITARA	Federal Information Technology Acquisition Reform Act
FY	Fiscal Year

72

Acronyms (2)

GEO	Geostationary Earth Orbit
GLM	Global Lightning Mapper
GOES-R	Geostationary Operational Environmental Satellites
GOMS	Geostationary Operational Meteorological Satellite
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
HQ	Headquarters
HR	Human Resources
IOC	Initial Operating Capacity
IR	Infrared
IRT	Independent Review Team
IT	Information Technology
JASD	Joint Agency Satellite Division
JPSS	Joint Polar Satellite System
KPP	Key Performance Parameters
L/V	Launch Vehicle
LMATC	Lockheed Martin Advanced Technology Center
LEO	Low Earth Orbit
LND	Launch Need Date
LOS	Launch On Schedule
MODIS	MODerate-resolution Imaging Spectroradiometer
NASA	National Aeronautical and Space Administration
NCEI	National Center for Environmental Intelligence
NESDIS	National Environmental Satellite, Data, and Information Service
NJO	NOAA JPSS Office
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Admospheric Administration
NOS	National Ocean Service
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRO	National Reconnaissance Office
NSOF	NOAA Satellite Operations Facility
NSOSA	NOAA Satellite Observing System Architecture
NWP	Numerical Weather Prediction

Acronyms (3)

NWS	National Weather Service
OAR	Office of Atmospheric Research
OMB	Office of Management and Budget
OMPS	Ozone Mapping and Profiler Suite
OPM	Office of Personnel Management
OSAAP	Office of Systems Architecture and Advance Planning
OSGS	Office of Satellite Ground Systems
P3I	Pre-Planned product Improvement
PAC	Procurement, Acquisition and Construction
PFO	Polar Follow-On
POES	Polar Operational Environmental Satellites
PPBE	Planning, Programming, Budgeting & Executing
R&D	Research & Development
RBI	Radiation Budget Instrument
RDT&E	Research, Development, Test & Evaluation
S/C	Spacecraft
SE	Systems Engineering
SEISS	Space Environment In-Situ Suite
SES	Senior Executive Service
SMC	Satellite Missile Center
SMD	Science Mission Directorate
SMS	Synchronous Meteorological Satellites
S-NPP	Suomi-NPOESS Preparatory Program
SRB	System Review Board
STAR	Center for Satellite Applications and Research
SUVI	Solar Ultraviolet Imager
SWFO	Space Weather Follow On
TBD	To Be Determined
TDRSS	Telemetry and Data Relay Satellite System
TIROS	Television InfraRed Observation Satellite
VIIRS	Visible Infrared Imaging Radiometer Suite