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HEARING TITLED
EXAMINING THE NATION'S CURRENT AND NEXT GENERATION WEATHER SATELLITE PROGRAMS
BEFORE THE
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COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
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Chairmen Bridenstine, Ranking Members Bonamici, and Members of the Committee, I am Dr. Stephen Volz, the Assistant Administrator of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS). Thank you for the opportunity to participate in today's hearing, and I am pleased to join the other witnesses – Mr. Stoffler from the United States Air Force (USAF), and Mr. Powner and Ms. Chaplain from the Government Accountability Office.

NESDIS supports NOAA's mission of science, service, and stewardship through our satellite missions, data centers, data and information products, services, and use-inspired science. It is an end-to-end responsibility that underpins NOAA's value to the Nation. The United States depends on NOAA to provide satellite data and imagery for meteorological and space weather forecasts and emergency services. NESDIS' responsibility is to collect and provide the critical satellite Earth observations and other essential environmental information needed for disaster preparedness, all hazards response and recovery, and the protection of the Nation's critical infrastructure and natural resources. The 24 hours-per-day, 7 days-per-week, 365 days-per-year global coverage provided by NESDIS generates an uninterrupted stream of environmental data products. These products and information enable services used across the country in preparation for weather, oceans, and climate events that impact our daily lives, and national safety, and provide essential information for national, regional, and local emergency managers and officials.

The reach of NESDIS extends across many weather and hazard events, from supporting the forecasting of severe droughts in California to monitoring ash from volcanic eruptions over the Alaska Peninsula. Our nation's most dangerous and costly hurricanes have been closely monitored by forecasters and the general public alike using observations and analyses based on data from NESDIS satellites. NESDIS data and information also provide foundational support for a constantly evolving array of applications and products used for the monitoring and research of Earth and its space environment. All of this is achieved through an increasingly capable global constellation of environmental satellites.

While NOAA continues to provide the highly accurate and reliable delivery of data, information, products, and services the organization is known for, we are now also taking time to assess the current state of the enterprise and evaluate changing technology, emerging partnership opportunities, and national trends. In the coming years, NOAA's satellite constellation will undergo significant enhancements and experience fundamental changes. NOAA's satellite systems are moving beyond the operation of distinct and separate observing systems to an integrated global observation system that can more efficiently merge observations from polar and low-Earth orbits with geostationary and other orbits, and that is sensitive to emerging technologies in both satellite and ground systems.

NOAA's Current Satellite Observation enterprise

The breadth of space-based observational capabilities and observing platforms operated by NOAA ranges from satellites in the polar orbit - providing global coverage - such as the NOAA/NASA Suomi National Polar-orbiting Partnership (Suomi NPP), Jason-2 and-3, Polar-orbiting Operational Environmental Satellites (POES), and the Defense Meteorological Satellite Program (DMSP), to satellites in geostationary orbit, such as NOAA's Geostationary Operational Environmental Satellites (GOES) - providing regional coverage - which orbit nearly 22,240 miles away, and the nation's first operational satellite in deep space, the Deep Space Climate Observatory (DSCOVR), nearly one million miles away, midway between the Sun and the Earth.

Polar and Low-Earth Orbit Satellites

NOAA's polar-orbiting operational environmental satellites provide full global coverage for a broad range of weather and environmental applications, supporting both short-term weather forecasting and long-term climate records. NOAA's current operational polar-orbiting satellites include NOAA-15, NOAA-18, NOAA-19, and Suomi NPP.

Placed in the afternoon orbit, the NOAA/NASA Suomi NPP satellite is NOAA's primary operational polar-orbiting spacecraft and provides critical observations to support NOAA's three to seven-day operational weather forecasts, operational weather "nowcasting" in Alaska and polar regions, and environmental monitoring and prediction. Launched in October 2011, Suomi NPP's Advanced Technology Microwave Sounder and Cross-track Infrared Sounder instruments provide data to NOAA's operational numerical weather prediction models. The Visible Infrared Imaging Radiometer Suite instrument provides a wide range of environmental observations, data, and imaging capabilities including critical environmental products relating to snow and ice cover, clouds, fog, aerosols, fire, smoke plumes, dust, vegetation health, phytoplankton abundance, and chlorophyll. The satellite also includes the Ozone Mapping and Profiler Suite which takes global measurements of stratospheric ozone levels. Combined, these instruments have revolutionized forecasters' ability to make long range forecasts.

The NOAA/NASA Suomi NPP satellite continues to function well, completing its fourth year on orbit on October 28, 2015. The vehicle and instruments are all operating within specifications, though the scan drive motor on the ATMS instrument is showing signs of aging. A program of drive motor reversals was undertaken last year in order to extend the life of the motor.

Also in low-Earth orbit, NOAA operates both the Jason-2 and Jason-3 satellites as part of the international Ocean Surface Topography Mission. The Jason mission is a partnership among NASA, France's Centre National d'Etudes Spatiales (CNES), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and NOAA NESDIS. The Jason satellites provide sea surface height measurements using satellite altimetry. These data, provided operationally with a low latency, are used in studies and forecasts for tsunami dynamics, El Niño Southern Oscillation, eddy dynamics, ocean boundary currents and coastal and shallow water tides. Ocean heat content is also derived from Jason observations, and is an important factor in magnifying hurricane intensity, and impact to coastal communities such as the Gulf Coast states and eastern seaboard. The U.S. Navy's ability to conduct tactical and strategic operational planning depends upon accurate ocean models that include satellite altimetry data. On June 1, 2016, CNES handed NOAA official operational control of the Jason-3 satellite which is now taking operational, highly-detailed measurements in conjunction with Jason-2.

The Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) mission, a joint research mission between the United States and the National Space Organization of Taiwan (NSPO), launched six satellites in a low-Earth orbit constellation in 2006. COSMIC data are used to provide three-dimensional profiles of temperature, humidity, and pressure measurements of the atmosphere, and provide electron density in the ionosphere. COSMIC data provide measurements of these atmospheric qualities in a manner complementary and independent of observations from the Suomi NPP satellite. Data collected by COSMIC are especially useful for forecasting tropical cyclones, including typhoons and hurricanes, because COSMIC is able to provide critical observations of water vapor, the fuel that drives tropical cyclones. These measurements are high resolution in the vertical direction, allowing scientists to determine how much water is present at what height in the atmosphere. The COSMIC satellites are aging, and currently only four of the original six are operating.

Geostationary Operational Environmental Satellites

In geostationary orbit, NESDIS operates GOES-13 in the "GOES-East" position at 75° W and GOES-15 in the "GOES-West" position at 135° W. GOES-14 is available as an on-orbit spare, located at 105° W.

NOAA's two operational GOES satellites provide consistent and reliable monitoring of the entire Western Hemisphere and are critical for identifying and tracking severe weather, snow storms, and tropical cyclones. In addition to providing crucial near-real time imagery, on-board sensors detect cloud formation, land and ocean temperatures, as well as monitor activities of the sun like solar flares, which can disturb Earth's magnetic field. NOAA also uses GOES to identify when emergency locator beacons on ships and planes or with hikers and snowmobilers have been activated. The GOES satellites relay the alert to first responders so that they may initiate search and rescue activities, while the SARSAT instruments on the NOAA POES and EUMETSAT Metop satellites provide precise locations of activated beacons.

GOES-East and GOES-West are providing data every 15 minutes to weather forecasters to support their forecasts and warnings. Although GOES-West experienced a component anomaly

(i.e., loss of one of the two remaining star trackers) in April 2015, the satellite continues to operate on the single remaining star tracker and continues to meet all user performance requirements. The GOES-West Solar X-Ray Imager and X-Ray Sensor are acting as primary instruments, providing operational measurements, for NOAA's Space Weather Prediction Center. In November 2015, the GOES-East sounder filter wheel stalled. However, the imager continues to operate normally and is meeting all essential NWS weather forecasting needs. The current on-orbit spare, GOES-14, is in normal configuration, instead of storage mode configuration, to provide quick services as a backup. GOES-14 has been periodically providing 1-minute Super Rapid Scan Operations to help algorithm developers, research partners, and forecasters prepare for the advanced capabilities available on the next-generation R-series geostationary satellites. All of the GOES-14 payload instruments are fully functioning without any performance degradation.

DSCOVR

NOAA's DSCOVR satellite is currently positioned approximately one million miles away in order to meet NOAA's operational requirement for continuous measurement of solar wind. The DSCOVR satellite will become the nation's first operational deep space satellite later this month, when NOAA's Space Weather Prediction Center expects to officially transition their operational solar wind data from NASA's Advanced Composition Explorer research satellite to data provided by DSCOVR.

National Centers for Environmental Information

These observing systems generate comprehensive environmental observations that are integrated and harmonized with other data collected by NOAA observing systems (e.g. radars, ships, buoys, aircraft, etc.) and observing systems operated by other nations. These data form the basis of the most comprehensive collection of national and global Earth environmental observations available for retrospective analyses and applications. NESDIS is the official source for atmospheric and space weather, climate, coastal, oceanographic, and geophysical environmental data and information. Access to reliable and accurate long-term records of this data and information is critical to satisfying the Nation's wide range of businesses, education, and government needs, including policies and decisions that have an impact on water and energy management, manufacturing, transportation, defense, food production, public health, and many other socio-economic issues. NESDIS' authoritative data and information products enable decision makers to make confident knowledge-based determinations about maximizing opportunities and minimizing threats from the environment.

The Future of NESDIS Data and Observational Systems

Next Generation Satellite Systems

With the next generation of environmental observation satellites on the horizon, NOAA is poised to once again significantly improve weather forecasting and severe weather prediction. The DSCOVR satellite lifted off from Cape Canaveral Air Force Station on February 11, 2015, and Jason-3 was launched less than a year later on January 17, 2016. Within the next year, NOAA

plans to launch GOES-R, JPSS-1, and the first six COSMIC-2 satellites, which is the next step in building NOAA's future constellation.

The first satellite in NOAA's next generation geostationary satellite series, GOES-R, is scheduled to launch November 4, 2016. It will be known as GOES-16 once operational, and will scan Earth five times faster at four times the image resolution and triple the number of spectral channels than the current GOES generation. This increase in data and information means improved satellite imagery of severe weather will be available, giving forecasters even more tools to issue timely warnings during severe weather events. In addition, improved space weather observations from GOES-R will complement those from the newly launched DSCOVR mission, providing a comprehensive look at incoming solar storms and at the underlying solar activity that generates these storms.

The GOES-R Series will also carry the first lightning mapper ever flown in geostationary orbit. The revolutionary Geostationary Lightning Mapper (GLM) will map total lightning (in-cloud and cloud-to-ground) continuously over the Americas and adjacent ocean regions providing hemispherical lightning observations for the first time. Increases in lightning flash rate are often a predictor of impending severe weather, meaning the total lightning data from GLM has the potential to increase lead time for the issuance of severe thunderstorm and tornado warnings.

Following GOES-R, NOAA's JPSS-1 satellite is scheduled for launch no later than the second quarter of FY 2017. Once operational, the satellite will be known as NOAA-20. JPSS-1 has five highly-sensitive instruments on board, the same type as those currently being successfully flown on the NOAA/NASA Suomi NPP satellite. Five years of operations with the NOAA/NASA Suomi NPP satellite have prepared NESDIS, and its users, for the great performance and value of this breakthrough operational polar-orbiting satellite. With the launch of JPSS-1, NESDIS will deliver to operations a new, upgraded ground system with enhanced reliability, security, and data timeliness. This system will not only operate NOAA's JPSS-1, Suomi NPP, and other polar-orbiting spacecraft, but will also ingest and process their data, providing information to users around the globe.

After commissioning is completed, the JPSS-1 satellite will fly one half orbit ahead of Suomi NPP in the same orbital plane. This means that JPSS-1 will operate about 50 minutes ahead of Suomi NPP, allowing for important overlap in observational coverage. The data from both satellites will provide critical observations and continue to be entered into National Weather Service numerical weather prediction models, thereby continuing the improvements in medium and long-term weather forecasts and severe weather prediction.

Launched on April 15, 2006, four of the six COSMIC satellites are operating six years beyond their design life and are in need of replacement. In order to maintain and increase the level of coverage provided, NOAA plans to launch COSMIC-2A in early 2017 and is considering COSMIC-2B in 2020 (contingent on the outcome of an ongoing evaluation of possible commercial solutions). The COSMIC-2 constellation will include advanced technology that will significantly increase the geographic coverage, quantity, and quality of observations. Under a partnership agreement between the United States (NOAA and the USAF) and NSPO, the COSMIC-2 mission will develop and deploy an operational constellation of 12 Global

Navigation Satellite System (GNSS) Radio Occultation satellites. The first six will be launched into an equatorial orbit and augment the current COSMIC satellites. Replacement of the polar-orbit could occur through a commercial data buy or could be satisfied through launch of COSMIC-2B into polar-orbit to replace the aging COSMIC satellites. The COSMIC-2 program is expected to provide up to 8,000 temperature and humidity measurements worldwide per day, almost ten times the number of daily measurements that COSMIC-1 currently provides, which we anticipate will increase the benefits to weather forecasting. If the GNSS RO polar-orbit data are not replaced before the remaining four COSMIC satellites fail, there may be degradation to NWS forecasts.

These launches are only the beginning of a series of next-generation environmental observing satellites to take flight. Development of both the GOES-R Series and JPSS satellites are in progress. GOES-S is nearing completion of satellite integration and preparations for its environmental test campaign, while the GOES-T and –U component development is well underway. JPSS-1 took another step closer to its launch in early 2017 with the integration of its fifth and final instrument in February 2016. In April 2016, the satellite began environmental testing, the next step in launch preparation. All four JPSS-2 instruments are in the parts procurement, sub-assembly integration, and test phase. Some significant risks have been successfully addressed as these instruments progress. The spacecraft work for JPSS-2 was initiated in July 2015, and the first review milestone for it was successfully conducted last fall.

NOAA has also received funding and approval from Congress in the FY 2016 appropriations bill for the JPSS Program to initiate the Polar Follow On (PFO) JPSS-3 and JPSS-4 satellites. With this funding, the JPSS Program now includes five polar-orbiting satellites, each with critical sounding and imaging instruments, and a versatile ground segment. These are: Suomi NPP, JPSS-1, JPSS-2, JPSS-3, and JPSS-4. They enable the JPSS program to provide polar coverage through the 2030s to ensure continuity and robustness of critical polar-orbiting weather satellite observations.

The President's FY 2017 budget has proposed $393 million for the development of JPSS-3 and -4. This is an increase of $23 million from the 2016 enacted budget for PFO, and it shows continued commitment by the Administration to this critical program that will help to sustain coverage of the afternoon polar orbit that is so critical to U.S. weather forecasting.

Enterprise Ground and Space Architectures

A significant portion of what NESDIS does is not just in space, but on the ground as well. Everything from satellite operations to data ingestion, validation and calibration, distribution, product development, and archiving occur through ground systems and data management centers. NESDIS is preparing for the future by integrating ground services in order to leverage technology to achieve efficiencies, accelerate the development and delivery of operational products, reduce cost and risk, and consolidate functions where possible, while improving cybersecurity, communications and data archiving capabilities. In order to facilitate the development of integrated systems and the creation of state-of-the-art science products, NESDIS has already begun a transition to enterprise algorithms. Currently, work is being conducted to update NOAA Heritage Cloud, Cryosphere, Volcanic Ash, and Aerosol algorithms to work on

data from JPSS satellites and to migrate software databases for several POES and GOES algorithms in order to bring consistency across the GOES-R and JPSS suite of products. NESDIS is also ensuring user readiness not only with the NWS, but also to meet the broad set of NOAA mission needs across the National Ocean Service, the National Marine Fisheries Service, and the Office of Marine and Aviation Operations.

Architecture Studies and Future Planning

In 2015, NESDIS began a comprehensive review of all observing system requirements and capabilities to determine potential challenges and begin identifying possible solutions. The purpose of the NOAA Satellite Observing System Architecture Study is to determine the most cost effective space segment architecture for performing NOAA weather, space weather, and environmental remote sensing missions, beyond the current program of record for operations beginning in the 2030s. The study is working to identify the user needs that drive NOAA missions and develop new concepts and options for Earth observing instruments and their space-based platforms. This also means conducting observing system analyses while considering system complexity, cost, risk, and launch options. The goal is to seek and maintain constellations which can be met with stable budget requirements, and which are agile and resilient.

Partnerships

The combined effect of NOAA's next generation of GOES-R Series and JPSS/PFO satellites will provide a significant improvement over NOAA's previous observing capabilities and will provide critical observations through the mid-2030s. Earth's weather systems are a global phenomenon, however, and NOAA's satellites are only one piece of the global observing constellation.

NOAA and NESDIS accomplish much of what we do because of the scientific and data exchange with our partners, built on years of cooperation and formal agreements that are underpinned by a full, open, and timely data sharing policy. Successful partnerships allow us to meet our mission cost-effectively and to be more responsive to the needs of our users and stakeholders. Our key foreign partners, including Europe and Japan, maintain very capable and reliable observation systems, providing NOAA access to their critical data at no charge. To support this international collaboration, the NOAA coordinates global solutions to shared challenges through multilateral organizations, maintaining and expanding bilateral partnerships, and continually promoting the adoption of full and open data policies.

In addition, interagency collaboration allows us to leverage the capabilities, capacity, and/or infrastructure of other U.S. agencies in support of the NESDIS mission, and vice versa. These partnerships have the potential to provide a better return on investment for the U.S. Government as a whole.

Currently, NOAA shares data, and sometimes instruments, with several international satellite programs. In return, NOAA receives access to *in situ* data from countries around the world, and satellite data from missions including the Meteosat and Metop series of satellites from EUMETSAT, Himawari-8 from the Japan Meteorological Agency (JMA), GCOM-W1 from the

Japan Aerospace Exploration Agency, COSMIC from the National Space Organization of Taiwan (NSPO), the Sentinel series from the European Commission and Jason-2 and -3 in partnership with NASA, CNES, and EUMETSAT. The Argos program, which represents one of these long standing collaborative efforts, has lasted over 30 years and is utilized for wildlife tracking, weather buoys, and other environmentally-critical assets. Our partners for the Argos program include the CNES, EUMETSAT, and the Indian Space Research Organisation (ISRO). Cospas-Sarsat is another example of a shared international satellite resource that aides in a search and rescue system, with NOAA providing a platform on our space vehicles for partnering instruments. The governing parties of the system are the U.S. (NOAA), France (CNES), Russia (Morsviazsputnik), and Canada (National Search-and-Rescue Secretariat) and are the signatories to the *International Cospas-Sarsat Programme Agreement* (ICSPA, 1988).The future of robust and cost-effective global Earth observation relies on the continuation of existing, and the cultivation of future, interagency and international partnerships.

In order to produce the three- to seven-day weather outlooks that our nation depends on every day, data and information are needed from three complementary polar orbits. In order to provide these forecasts, critical for the timely notice of severe weather events, NOAA and EUMETSAT have agreed to share the burden of operating polar-orbiting satellites for the next twenty five years. Under this agreement, known as the Joint Polar System Agreement, NOAA and EUMETSAT will split responsibility for the two primary orbits and agree to openly share data from our respective missions. EUMETSAT satellites cover the mid-morning orbit while NOAA is responsible for the afternoon orbit—continuing a partnership that began under the 1998 Initial Joint Polar-orbiting Operational Satellite System Agreement. NWS Alaska region has used imagery from the USAF DMSP to supplement imagery from NOAA POES and Suomi NPP and Metop satellites. Recently, NOAA has included some DMSP data from the third orbit, early morning, into its NWP models. While these data have been available, the DMSP data are not optimized for input into the NWS NWP, therefore, loss of the data would not degrade the model output. NOAA is monitoring the development of the Weather Satellite Follow On to determine how and whether these data could be useful for NWP.

NOAA's geostationary satellites join the EUMETSAT's Meteosat satellites and JMA's Himawari-8 satellite to form a virtual global geostationary constellation. This coordinated global constellation is reinforced by mutually supportive back-up agreements between NOAA and JMA and NOAA and EUMETSAT in recognition of the necessity of a global commitment to uninterrupted observations, and the full, open, and timely sharing of global environmental data and information.

Within the United States, NOAA has strategic partnerships with both NASA and the Department of Defense to achieve the level of robust and reliable Earth observations required by the nation at all times. We have been working closely with NASA, our acquisition partner, to build and operate NOAA's next-generation operational environmental satellite constellations, the JPSS and GOES-R Series programs.

NOAA also works closely with the USAF on several missions in a coordinated project-based partnership. Primary command and control for the USAF's DMSP is jointly managed by NOAA and the USAF 50th Operations Group Detachment 1, both operating out of NOAA's Satellite

Operations Facility in Suitland, Maryland. NOAA specifically operates the ground systems development and oversees daily operation of the DMSP satellites. Operations are also supported by a back-up facility located at Schriever Air Force Base in Colorado Springs, Colorado, under the leadership of the 6th Space Operations Squadron.

Five USAF DMSP satellites, launched between 1997 and 2009, are currently operational. Flying in the early-morning polar orbit, these satellites monitor global information such as clouds, precipitation, ice, snow cover, temperature, water vapor, and wind speed, and are essential contributors to the global polar constellation.

Another coordinated project, the DSCOVR mission, is a partnership between NOAA, NASA and the USAF. NOAA is responsible for operating the satellite as well as processing, distributing, and archiving the data, while NASA held the responsibility of preparing the spacecraft and its instruments (with support from NOAA), developing the ground segment, and managing the launch and activation. The USAF funded and oversaw the launch services for the spacecraft and provided the launch vehicle, a Falcon 9 Rocket, via their launch services contract with SpaceX.

The USAF is also partnering with NOAA, NASA, and NSPO to launch and operate COSMIC-2. The USAF will provide two space weather payloads that will fly on the first six satellites (COSMIC-2A). These include the Radio Frequency Beacon transmitter and the Ion Velocity Meter instruments.

NOAA has partnered with CNES, the Department of National Defense of Canada (DND), and the USAF in the Cooperative Data and Rescue Series program for the continuity of the Argos data collection and the Search and Rescue Satellite Aided Tracking (SARSAT) missions from polar orbiting satellites. CNES and DND have built the Argos and SARSAT payloads, and NOAA is developing plans with USAF to integrate these sensors onto a commercially hosted payload via the USAF Hosted Payload Solutions contract. Execution of this program, with a launch readiness date in early FY 2021, will ensure continuity of both the Argos and SARSAT missions.

Future Commercial Partnerships

The first 50 years of satellite weather observations have been dominated by government observing systems, assets, and partnerships. However, the environmental observing community is now on the cusp of a shift in space-based weather observations toward commercialization. We recognize that partnerships with the commercial sector and academic institutions could provide flexibility and allow for innovative approaches to augmenting and potentially fulfilling national observing requirements more easily.

For NOAA, this opens up the possibility that some environmental observation requirements may be met or supported by observations obtained from commercially owned and operated observing systems. To explore this possibility effectively, NOAA has developed a Commercial Space Policy, which details the principles the agency will apply when considering commercial solutions to meet mission requirements. NESDIS, in accordance with the policy, is developing the Commercial Space Activities Assessment Process that will guide our engagements with

industry as new space systems are defined, developed, and deployed. Engagement with the commercial sector involves an open dialogue in which mission requirements are explained and updated, and the production processes and contractual relationships are clearly defined. Underpinning this dialog, and NESDIS' observatory system planning, is a commitment to continue delivering essential products and services to the National Weather Service, and other key users, without interruption or degradation.

On May 24, 2016, NESDIS released a Request for Information (RFI), which closed on June 13, 2016, to support NOAA's Commercial Weather Data Pilot (CWDP) and to assess GNSS RO commercial opportunities to meet NOAA's needs. The CWDP will evaluate commercial data to demonstrate the quality of the data and its impact on weather forecast models, as well as informing NOAA's process for ingesting, evaluating, and utilizing commercial data in the future. The RFI is the first step to potentially bring radio occultation data from commercial companies to NOAA. The RFI seeks pre-launch data in order to facilitate broad participation and will gather the latest industry input as we consider what criteria will be included in a subsequent Request for Proposals (RFP), the next step in carrying out the Pilot. NOAA will use the results of the FY 2016 CWDP to inform how funds will be spent on commercial sources of data. In FY 2017, the President's Budget requests funding to continue activities started in CWDP in FY 2016, and provides an opportunity for NOAA to assess whether to acquire Global Navigation Satellite Systems radio occultation instruments for COSMIC-2B mission or to pursue a GNSS RO commercial data buy.

Conclusion

The importance of environmental satellites to monitor and understand our planet's complex systems was realized over 50 years ago with the launch of the world's first weather satellite. Since then, that single satellite has grown into a global network of systems with increasingly capable satellites, models, and processing and distribution systems that provide an ever growing catalog of products, information and services. Along with the rest of the environmental observing community, NOAA's NESDIS has continued to evolve, becoming a leader in this global endeavor.

Looking toward the future, NESDIS will continue to effectively provide the highly accurate and consistent delivery of data, information, products, and services that our users expect and the Nation depends on, while developing future systems to respond to changing technology, emerging partnership opportunities, and national trends.

With several of NOAA's next generation weather and climate satellites (including JPSS-1, COSMIC-2 and GOES-R) set to launch in the near future, similar constellation growth is occurring within our partner organizations, as well as an emerging relationship with the commercial sector and an increased focus on data integration, curation and fusion, this is a particularly exciting and evolutionary time for NESDIS and the global observing system.