WRITTEN STATEMENT
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Thank you, Mr. Chairman and Members of the Subcommittee, for the opportunity to testify before you regarding the National Oceanic and Atmospheric Administration's (NOAA) activities with other U.S. Government agencies in the area of space exploration. I am Gregory Withee, Assistant Administrator for NOAA's Satellite and Information Services and am responsible for end-to-end management of NOAA's satellite, data and information programs.

Space, and our ability to access, operate in and explore it, continues to capture the imagination. The human concept of space has evolved over the past 60 years from a place to gaze at in wonderment to realizing a valuable real-estate that supports a multi-billion dollar private sector. In the 1940s and '50s, the U.S. military led space development with its research on rockets and sensors. This provided the foundation for the work that we do at NOAA as the U.S. civilian operational environmental satellite service, as well as the research and development work conducted by the National Aeronautics and Space Agency (NASA). These activities also support a growing communications and remote sensing industry, both within the U.S. and foreign countries.

Today, I will highlight some of the work we undertake at NOAA in space as well as the critical partnerships with NASA, the Department of Defense (DoD), the private sector, and international partnerships that enable us to accomplish our mission in service to the American public.

NOAA's Contribution to Space Exploration

Space, from the Sun to Earth's upper atmosphere, is a strategic and economic frontier. This space environment influences a multitude of human activities and presents numerous scientific challenges. NOAA's Space Environment Center (SEC) has a central role in conducting research to understand the space environment, and performs critical space weather operations for the nation.

SEC continually monitors and forecasts Earth's space environment. The Center provides accurate, reliable, and useful solar-terrestrial information; conducts and leads research and development programs to understand the environment and to improve services; advises policy makers and planners; plays a leadership role in the space weather community; and fosters the commercial space weather services industry.

While NASA continues its lead role in deep space exploration, space is the arena within which NOAA's Geostationary Operational Environmental Satellites (GOES), Polar-orbiting Operational Environmental Satellites (POES), and the forthcoming National Polar-orbiting Operational Environmental Satellite System (NPOESS) operate. NOAA works very closely with NASA, DoD, and the private sector to build, launch, and operate satellites at various levels in space - GOES at 22,000 miles and POES at 520 miles above the Earth's surface - to support our Earth observing mission. These satellites also have special sensors on-board that contribute to the operational exploration of near Earth space - the Solar X-ray Imager and the Space Environment Monitor - which tell us of operating conditions such as solar flares or ionic storms, and provide information essential to the health and safety of our spacecraft and to human life on Earth.

With the successful recent launch of a Solar X-ray Imager on the GOES spacecraft, SEC has moved the country into a new era of solar observational capabilities and forecasting of solar disturbances. The Solar X-ray Imager (SXI), the first operational solar imager ever flown in space, was launched on GOES-12. Rather than having redundant military and civilian solar X-ray imagers, the first SXI was funded by the U.S. Air Force and built by NASA for flight on NOAA's GOES. SXI greatly advances NOAA's space weather forecasting and research capabilities and expands the ability of the NOAA GOES satellites to monitor not only Earth's environment, but also the Sun and space weather disturbances caused by violent solar activity.

We also receive data from NASA and DoD satellites that are combined with NOAA's satellite data to provide the basis of space weather forecasts. These forecasts are provided to other satellite operators and users on Earth, allowing preventive action to protect vital infrastructure. NOAA provides critical weather and space-based support to NASA and DoD during satellite and Space Shuttle launches and landings, and for operations at the International Space Station (ISS). In fact, without the critical data the SEC provides, NASA astronauts would be unable to safely take spacewalks to work outside of the Space Station. The protection of life and property from space weather is a key requirement that NOAA will continue to support with future GOES and NPOESS systems.

SEC is striving to utilize and enhance the observational capabilities of NOAA for the Nation's benefit. Observations from satellites such as GOES, POES, NPOESS are essential to improve our understanding of the solar-terrestrial system and to provide timely and accurate forecasts. SEC invests significant effort evaluating the need for new data, and participating in other agency, institution, or international programs that hold promise for providing data crucial for improving space weather services.

SEC performs a vital role for the nation in conducting and coordinating research and its application. As described in the recent National Research Council report – A Decadal Research Strategy in Solar and Space Physics (2003), NOAA should assume full responsibility for space-based solar wind measurements, expand its facilities for integrating data into space weather models, and with NASA should plan to transition research instrumentation into operations. As discussed in the National Space Weather Program Implementation Plan (2000), interagency programs cannot succeed in meeting the Nation's needs without NOAA SEC observations, research, model development, and transition to operations. And, as emphasized in DoD's National Security Space Architect Study (2000), NOAA's current and planned activities are essential to meet Department of Defense's space weather needs.

NOAA's Collaboration with Other Space Operators

The collaboration among space operators is closely coordinated and mutually beneficial. NASA and DoD conduct critical research and development activities, that NOAA assesses and incorporates, as needed, onto its civil operational spacecraft. The space industry provides expertise to assist us in our respective missions. Increasingly, collaboration with private sector and foreign remote sensing operators provides data and information from their platforms that NOAA and other government agencies, such as U.S. Department of Agriculture, U.S. Department of Energy and the U.S. Department of the Interior, use to implement their respective missions.

Collaboration requires a great deal of coordination within the U.S. and internationally. Within the U.S. Government, the Office of Science and Technology Policy provides a mechanism for space policy coordination. Internationally, the Committee on Earth Observing Satellites, and the World Meteorological Organization provide venues for coordinating with other civil space operators. Because building, launching and operating in space is a very expensive undertaking, these coordination mechanisms provide an opportunity for all members to ensure data access and archive from their individual platforms without duplication of effort.

The premise of the Earth Observing Summit that will occur at the U.S. State Department on July 31 among thirty Ministerial level delegates is that by developing a global strategy and partnership using space based observations with *in-situ* measurements, we will be able to better understand short-term and long-term trends in natural cycles and the environment.

NOAA's Coordination with NASA and DoD

NOAA works very closely with NASA and DoD in all aspects of our mission. For nearly 60 years, the U.S. Government has been successfully developing and applying space based Earth remote sensing to meet the information needs of Federal and state agencies, and the general public. Today NOAA, NASA, and DoD are planning the next generation environmental operational satellites, and they are working with other Federal and non-Federal users (including

the private sector and foreign remote sensing systems partners) to reduce the cost and provide maximum benefit to the U.S.

Historically, NOAA's satellite program has been built and operated primarily to support the needs of NOAA's National Weather Service's forecasting and warning responsibilities. However, NOAA's satellite systems, address numerous climate and global change requirements needed for atmospheric, terrestrial, and oceanic applications. For example, satellite data are an important component in the emerging ocean observing system. In addition, information from NOAA and non-NOAA satellites produced and distributed by NOAA play a vital support role to U.S. economic, homeland, and national security. A recent example of this was the use of NOAA imagery products that supported operations during Operation Enduring Freedom, and Operation Iraqi Freedom, in particular detecting and monitoring dust storm events in Afghanistan and Iraq.

NOAA, NASA and DoD Partnerships in Future Spacecraft Systems

Polar-orbiting Systems

On 5 May 1994, the President directed the convergence of the NOAA's POES program and DoD's DMSP to become NPOESS, designed to satisfy both the civil and national security operational requirements. NASA contributes to this effort through the new remote sensing and spacecraft technologies of its Earth Observing System (EOS) mission. The President also directed the DoD, DOC, and NASA to establish an Integrated Program Office (IPO) to manage this converged system. On May 26, 1995, DoD, DOC, and NASA signed the Memorandum of Understanding that provides the guidelines under which the IPO operates. Under the terms of the MOU, NOAA has overall responsibility for the converged system, as well as satellite operations; DoD has the lead on the acquisition; and NASA has primary responsibility for facilitating the development and incorporation of new technologies into the converged system. NOAA and DoD equally share NPOESS costs, while NASA funds specific technology projects and studies.

NPOESS is a major system acquisition estimated to save approximately $1.6 billion to the taxpayer compared to the cost of operating 2 separate systems. NASA, in cooperation with NOAA, will launch the NPOESS Preparatory Program (NPP) satellite in 2006 as a risk reduction/early delivery program for 4 critical NPOESS sensors, early delivery, test and evaluation of the command and control and data retrieval for NPOESS.

Geostationary Systems

In response to validated user requirements from Federal, state, and local government agencies, private sector, and academia, NOAA is developing its next generation of geostationary and polar-orbiting satellites. The GOES R-Series will continue the NOAA-NASA partnership for geostationary satellites but with the prospect of greater integration of activities. To effectively and efficiently meet the GOES R-Series system requirements, a complete end-to-end (data

sensing to information access) approach must be adopted. To facilitate this end-to-end approach, the NOAA-NASA teams are being more closely integrated so that the space and ground systems are developed and acquired as one, not separately, to ensure launch by 2012. The instruments on the GOES-R will continue to fly the space environment monitoring sensors.

Select Examples of NOAA, NASA, and DoD Cooperation

The 3 agencies collaborate in many efforts that are complementary and mutually beneficial. Highlights of select examples of NOAA, NASA, and DoD cooperation are listed below:

Sensor Development

For many years, NOAA and NASA had a unique relationship developing instruments for Earth observing satellites. NASA funded and conducted the Operational Satellite Improvement Program (OSIP) from 1964 to 1982. The specific purpose of the OSIP was to improve NOAA's operational system by developing, testing, and demonstrating new components of the operational system, or improving the existing components, before NOAA made them integral to the operational system. The program funded "first unit developments", bringing research and development to the level needed for hand-off to NOAA operations. Under this program, NASA funded the first of the series of polar orbiters - Television and Infrared Observation Satellite (TIROS-N) and Improved TIROS Operational System (ITOS-I) - and NOAA funded the follow-ons. NASA also funded the 2 prototype GOES, and the addition of an atmospheric sounding capability to the GOES imager system.

Continuing the sensor development activities discussed above for GOES, POES, and NPOESS, NOAA's research Environmental Technology Laboratory has been involved in studies of various remote sensors such as microwave sounders, lidars and radar systems and has worked with DoD on the properties of ocean surfaces, and their interaction with radio waves. NOAA's ocean laboratories and university partners have developed systems that are used to calibrate ocean measurements from satellites.

Research to Operations

NOAA and NASA have recognized the value of definitive plans for the process of handling research to operations. Working closely with NASA, NOAA is working to develop its own technology infusion roadmaps, as a follow-up to NASA's Earth Science Enterprise Research Strategy and Application Strategy roadmaps. NASA's Moderate-resolution Imaging Spectroradiometer (MODIS) (a multichannel imager flying on NASA's TERRA and AQUA satellites) is the research predecessor for NPOESS' operational Visible/Infrared Imaging Radiometer Suite (VIIRS) instrument. NASA's Atmospheric Infra-red Radiation Sounder (AIRS) is now flying on NASA's AQUA satellite and providing atmospheric profiles of temperature and humidity. Information from the NPOESS Cross-track Infra red Sounder (CrIS) and the GOES Hyperspectral Environmental Suite (HES) will be used by NOAA customers

much in the same fashion as AIRS is today.

NOAA and NASA jointly funded a study by the National Academy of Sciences/National Research Council Committee on NASA-NOAA Transition from Research to Operations (CONNTRO). The May 2003 final report is called *"Satellite Observations of the Earth's Environment, Accelerating the Transition from Research to Operations."* Recommendations from that report are being examined and jointly considered by NASA and NOAA. In an effort to maintain cognizance of technologies being undertaken by DoD agencies, NOAA participates in regular meetings with the intelligence community, the U.S. Air Force Space Technology organization (called National Space Architecture), and the U.S. Navy Space Experiments Review Board (SERB).

Collaborative Activities in Ground Systems Support

NOAA operates two Command and Data Acquisition Stations (CDAS), one in Wallops, Virginia (WCDAS), and the other in Fairbanks, Alaska (FCDAS), and a Satellite Operations Control Center in Suitland, Maryland. The primary responsibility of the CDAS is to track, command, and receive telemetry and imagery data from NOAA's geostationary and polar orbiting spacecraft. In addition to supporting the NOAA spacecraft, the CDAS provide a wide range of cooperative support services for NASA and DoD. The FCDAS is a primary site for acquiring data from DMSP on a cost reimbursable basis.

NOAA is also partnering with the U.S. Navy in the acquisition of data from the Windsat/Coriolis mission. Beginning in January 2003, FCDAS began acquiring data from this spacecraft which provides ocean surface wind information and important risk-reduction for similar instruments planned for NPOESS. The FCDAS is also a telecommunications hub for the NASA EOS spacecraft AQUA, flowing data from the NASA antennas at Poker Flats, Alaska to processing centers in the lower 48 states. FCDAS and WCDAS also track and gather space environmental data from the NASA IMAGE and ACE spacecraft to support NOAA's Space Environment Center's operations in Boulder, Colorado.

NASA and NOAA also are exploring mutual backup agreements for spacecraft data acquisitions at both Fairbanks and Wallops to provide a more robust ground to satellite network.

Products and Services Developed Through Collaborative NOAA, NASA, and DoD Efforts

There are a number NOAA products and services that are developed using data from NOAA, NASA, and DoD. Select examples include:

<u>Search and Rescue Satellite-Aided Tracking (SARSAT) System</u>
SARSAT operates on the NOAA POES and GOES spacecrafts. The purpose of the SARSAT program is to relay distress alert and location information to search and rescue organizations worldwide. In order to coordinate U.S. activities in support of this program, NOAA has

established a partnership with the U.S. Air Force, the U.S. Coast Guard, and NASA for the operation of the system. To date, the SARSAT program is credited with rescuing approximately 14,000 people worldwide.

Satellite Data Assimilation

The Joint Center for Satellite Data Assimilation (the Center) is a formal tri-agency program among NOAA, NASA, and DoD to improve utilization of satellite data, and prepare for future instruments in numerical weather prediction models. The goal of the Center is to accelerate and improve the scientific methods for assimilating satellite observations into operational numerical models. Established in FY2002, the Center now has critical mass of scientists from NASA, NOAA, and DoD are collocated in a new joint facility at the World Weather Building in Camp Springs, Maryland. Through explicit coordination and joint funding of research, the agencies have realized several improvements to operational forecasts, for example, by incorporating NASA research satellite data and improving radiative transfer methods.

Human Space Flight Support

The NOAA's National Weather Service has a long history of providing weather support for NASA. In the past, NOAA provided direct weather support to NASA for the Mercury, Gemini, Apollo, and other programs. The Spaceflight Meteorology Group (SMG) of NOAA's National Weather Service provides meteorological support for launches and landings of the Space Shuttle and other programs. SMG provides unique world-class weather support to the U.S. Human Spaceflight effort by providing weather forecasts and briefings to NASA personnel. Space radiation information and forecasts used in the flight operations for both the Space Shuttle and the Space Station, comes directly from NOAA's Space Environment Center to NASA before and during all Shuttle flights.

Space-based Oceanography

NOAA utilizes data from DoD and NASA spacecraft to implement its ocean and coastal mission. Extensive use of Sea-viewing, Wide-Field-of-view Sensor (SeaWiFS) data from a joint NASA-Orbital Imaging mission is used to support biological oceanography. Data from the JASON missions operated by NASA and the European Space Agency, measures sea surface height. These data are used in hurricane forecasting models. Sea surface temperature remains a critical requirement of many agencies to support their respective missions.

NOAA's Coastal Remote Sensing Program (CRS) includes activities such as the Coastal Change Analysis Program and other marine applications of satellite data such as harmful algal blooms, ocean color, and sea surface temperature. Other activities include NOAA's Coastal Change Analysis Program, land cover analysis, benthic habitat mapping, estuarine habitat, coastal water quality, harmful algal bloom forecasts, and topographic change mapping.

In conclusion, Mr. Chairman and members of the Subcommittee, NOAA is pleased to have had the opportunity to provide you an overview of our collaborative activities with NASA and DoD in the area of space exploration and space activities. A key element to our strategy is partnering

with other agencies, such as NASA and DoD, the space industry, our international partners, and academia. These partnerships have proved to be wise investments for NOAA and the Nation.

Mr. Chairman and Subcommittee members, this concludes my testimony. I would be happy to answer any questions.