Department of Commerce

In FY 2001, the Department of Commerce (DoC) engaged in a wide variety of activities that furthered U.S. interests in aeronautics and space, including satellite operations and licensing, technology development, trade promotion, and civilian and commercial space policy support. Most notably, DoC joined other U.S. Government agencies in applying airborne and space-based resources to the relief efforts following the September 11 terrorist attacks on the World Trade Center and the Pentagon. Specifically, a number of National Oceanic and Atmospheric Administration (NOAA) line offices contributed significantly to these efforts, namely the Office of Marine and Aviation Operations (OMAO), National Ocean Service (NOS), and Oceanic and Atmospheric Research (OAR). The OMAO's Aircraft Operations Center (AOC) provided support to NOS's Remote Sensing Division. Teaming with NOS, Optech, Inc., and the University of Florida, AOC made available and operated NOAA's Citation jet, and coordinated its flights with the Federal Aviation Administration (FAA) and North American Aerospace Defense Command (NORAD). The Citation flew over both sites at the request of the Army's Joint Precision Strike Demonstration project, collecting high-resolution aerial photography and LIDAR (Light Detection and Ranging) data from a system provided by Optech, Inc., of Canada.

NOS's National Geodetic Survey (NGS) directly supported search and recovery efforts at both the World Trade Center and the Pentagon disaster sites by using its mapping and remote-sensing capabilities. The Army Joint Precision Strike Demonstration coordinated a highly detailed mapping mission at both disaster sites using LIDAR technology. LIDAR is an active remote-sensing system used to profile or scan terrain elevations. NOS, the NOAA Office of Marine and Aviation Operations, Optech, Inc., and the University of Florida teamed up to fly the LIDAR in NOAA's Cessna Citation. The images, which were created by the LIDAR system and produced by NOAA, were provided as digital surface models that offered an accurate bird's eye view of the scene. They provided three-dimensional positioning of the building structures and the surrounding area, at 15cm accuracy, which helped the rescuers and engineers locate original support structures, stairwells, elevator shafts, and basements. The LIDAR data, traditional high-resolution aerial photography, and accurate Global

Positioning System (GPS) measurements are all connected to the National Spatial Reference System (NSRS), which serves as a base reference for location information, and proved to be invaluable to the rescue efforts. In this way, the rescuers had one base reference system to efficiently locate utilities and building structures, which had been rendered indistinguishable as a consequence of the attacks. NOAA later returned to the World Trade Center site to provide data for change analysis. The crews were able to pinpoint their recovery efforts by using photographs that revealed the degree of the damage and the distribution of debris.

LIDAR data was also used to monitor structural movement of damaged buildings in the area of the disaster and to calculate the volume of rubble. For example, as the recovery efforts descended into the World Trade Center Tower basements, LIDAR images provided very accurate height measurements that could be used to mitigate potential flooding from the surrounding rivers. NOAA also flew a mission over the Pentagon site to map it with LIDAR for reconstruction purposes.

A NOAA pilot on temporary duty with NASA flew an aircraft equipped with the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) system at the request of the Environmental Protection Agency (EPA) in order to identify and locate asbestos fallout from the WTC plume. NOAA/OAR scientists also assisted EPA efforts to assess ground-level air pollution problems in New York that were primarily associated with asbestos released as the buildings fell.

On July 23, 2001, NOAA’s National Environmental Satellite, Data, and Information Service (NESDIS) launched the Nation’s newest Geostationary Operational Environmental Satellite-12 (GOES-12). GOES-12 is the first in the GOES series to carry a new Solar X-Ray Imager (SXI) capable of producing images of the Sun at 1-minute intervals. The SXI provides a continuous sequence of coronal x-ray images that will be used by NOAA’s Space Environment Center (NOAA/SEC) and the broader community to monitor solar activity for its effects on the Earth’s upper atmosphere and near space.

GOES-8 continued to view environmental events over the East Coast of North and South America and over the Atlantic Ocean; GOES-10 continued to view the West Coast and the Pacific Ocean, including Hawaii. Similar to the other operational GOES, GOES-11 and GOES-12 are in place to be used to monitor Earth’s atmosphere and surface to support NOAA’s forecasting and warning programs.

GOES-2 was de-orbited in May 2001 after 24 years of onorbit operations. Launched in 1977, the satellite was initially used for

imaging operations and later supported the Pan-Pacific Education and Communication Experiment (PEACESAT) administered by the University of Hawaii. In addition, NOAA-10 was deactivated in August. Since its launch in 1986, the satellite was fully operational for almost 5 years, and served secondary functions until its deactivation.

NESDIS continued to operate two polar-orbiting environmental satellites, NOAA-15 and NOAA-16, to provide a continuous flow of data to support weather forecasting and monitoring of environmental events around the world. In the U.S., NOAA's National Weather Service (NWS) used the data primarily for long-range weather and climate forecasts. These satellites are the first of 2 in a series of 5 polar-orbiting satellites with improved imaging and sounding capabilities that will operate over the next 12 years. The new microwave instruments on NOAA-15 and NOAA-16 have enabled NOAA short-term weather forecasting and warning programs to measure moisture in the atmosphere for identifying heavy precipitation conditions. The direct broadcast, on a free and open basis, of Advanced Very High Resolution Radiometer (AVHRR) instrument data provides imagery to scientific, commercial, and educational groups throughout the world. In addition, the search and rescue instruments on these satellites continue to support a global community that has established ground stations that "listen" for distress beacons relayed through the NOAA polar-orbiting and Russian Cospas satellites.

As part of NOAA's interagency activities, it represented the DoC interests in several subteams under the National Security Council Space Policy Coordinating Committee. NOAA also continued its work with the Department of Defense (DoD) and NASA as part of the Integrated Program Office (IPO) that is managing the development of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) commenced 7 years ago. NPOESS represents a major step toward the merger of U.S. civilian and military operational meteorological satellites into a single, integrated, end-to-end satellite system. NPOESS is designed to replace the current NOAA Polar-orbiting Operational Environmental Satellites (POES) and the Defense Meteorological Satellite Program (DMSP) systems.

Under a robust sensor risk-reduction effort that has been focused on early development of the critical sensor suites and algorithms necessary to support NPOESS, the IPO has awarded contracts for design and development of the following NPOESS instruments: Ozone Mapping and Profiler Suite (OMPS); Cross-track Infrared Sounder (CrIS); Global Positioning System Occultation Sensor (GPSOS); and the Visible/Infrared Imager Radiometer Suite (VIIRS). In August 2001, preliminary design efforts were

completed for the last of five critical advanced technology imaging/sounding instruments for NPOESS, and an instrument development contract was awarded for the Conical-scanning Microwave Imager Sounder (CMIS). In 2001, the IPO continued work on competitive Program Definition and Risk Reduction contracts to define the requirements for the NPOESS total system architecture, including space, ground processing, and command, control, and communications components, as well as to develop specifications for sensor/spacecraft integration.

The IPO continued to support its partners in final development of the joint DoD/IPO WindSat/Coriolis mission that is designed to provide a space-based test and demonstration of passive microwave polarimetric techniques to derive measurements of ocean surface wind speed and direction. This 3-year mission will continue the development of improved microwave measurement capabilities from the Special Sensor Microwave Imager and Sounder (SSMI/S) on DMSP to CMIS on NPOESS. In addition, the IPO continued to comanage development of the NPOESS Preparatory Project (NPP) designed to reduce the potential risks incurred during the transition from POES and DMSP to NPOESS. NPP is also designed to provide continuity of the calibrated, validated, and geo-located NASA EOS Terra and Aqua missions systematic global imaging and sounding observations for NASA Earth Science research. As part of the convergence of the DoC and DoD meteorological satellite programs (POES and DMSP) into NPOESS, the IPO and NESDIS continued to operate the DMSP satellites and prepared for the launch of the next replacement satellite (DMSP F-16). During the course of the year, four DMSP satellites continued to contribute atmospheric, ocean, and space weather measurements to DoD and NOAA operational forecast centers.

NOAA/NESDIS continued to lead the National Hazard Information Strategy (NHIS), which is an interagency initiative to reduce disaster losses through better information. Under this initiative, efforts to develop the Hazard Mapping System (HMS) succeeded in achieving progress on applications for smoke and fire detection for State and Federal agencies. The HMS is an interactive processing system that allows analysts in the NESDIS Office of Satellite Data Processing and Distribution to integrate data from various sources, such as GOES, polar-orbiting data (AVHRR), detection of fire from the NASA Moderate Resolution Imaging Spectroradiometer (MODIS), and Defense Meteorological Satellite Program/Operational Linescan System (DMSP/OLS) nighttime lights detection technique. This composite data set is used to compile a quality-controlled display of fire locations for the continental United States.

In FY 2001, the national Search and Rescue Satellite-Aided Tracking (SARSAT) and international Cospas-Sarsat programs, led by NOAA/NESDIS in collaboration with the U.S. Coast Guard, U.S. Air Force, and NASA, contributed to the rescue of 178 lives in the U.S. and more than 1,000 worldwide. The SARSAT program uses search and rescue payloads on NOAA and Russian satellites to detect emergency beacons used by aviators and mariners in distress. During the year, South Africa and Nigeria joined the Cospas-Sarsat program, bringing the total number of member States to 33. Planning also continued for placing search and rescue payloads on the European Meteosat Second Generation and Indian Insat-3 geostationary satellites.

In FY 2001, the NESDIS/National Climatic Data Center (NCDC) archived 2.3 terabytes of POES data and 16.2 terabytes of GOES data. Approximately 300 customers requested satellite products. A data set of surface temperatures was recently developed from a combination of in situ, satellite, ship, and buoy observations. This blended source of information provides a comprehensive analysis of surface temperature anomalies throughout the globe. In support of NOAA efforts to improve access to GOES retrospective data, NCDC awarded a contract to Marada Corporation in June 2001 to conduct a 1-year study of design options for online access to GOES data.

NCDC supported the International Satellite Cloud Climatology Project (ISCCP) by serving as the Sector Processing Center (SPC) for both operational morning and afternoon NOAA polar orbiter satellites and, secondly, as the ISCCP Central Archive (ICA). In its role as the SPC, NCDC provided ISCCP level B2 data, which consists of a spatially sampled version (approximately 30 km resolution) of the Global Area Coverage (GAC) data routinely produced by NOAA from the AVHRR instrument onboard the operational NOAA polar orbiters. In its role as the ICA, NCDC acted as the official archive of ISCCP data, serviced customer orders from this archive, and also provided correlative data to some of the ISCCP participants.

Throughout FY 2001, NCDC responded to data requests from customers supporting the NOAA mission. The Great Lakes Environmental Research Lab, which is part of NOAA, ordered approximately 1,000 GOES images to study the El Niño-induced weather patterns from Central America and South America. The National Centers for Environmental Prediction (NCEP) acquired GOES-8 data to help map aerosol distribution from space. Scientists developed new algorithms to study the effects of aerosols on regional climate patterns and used aerosol properties retrieved from the GOES-8 Imager to compare against ground-

based Sun photometer measurements.

Space environment monitoring data from the geostationary and polar-orbiting operational satellites were processed and archived at the NOAA/NESDIS National Geophysical Data Center (NGDC). Space environment, atmospheric, and oceanic monitoring data recorded on operational Defense Meteorological Satellite Program (DMSP) satellites were also processed and archived. Analyses of the DMSP archives produced the first global database of visible-to-near-infrared emissions. The emission database was used to produce a map of changes in emission intensity from 1992 to 2000, which are then related to analysis of urban sprawl. NOAA personnel developed a new Satellite Archive Browse and Retrieval system to provide a variety of online, automated services from imagery browsers to high volume, full resolution data transfers. This archive and access system was modified to accept moderate resolution imagery collected on NASA's Earth Observing Satellite (EOS) as a joint venture with NASA to address the long-term archive of EOS data.

In conjunction with the GOES-12 satellite launch and the Solar X-ray Imager (SXI) that it carries, the first new instrument in over 20 years designed to improve space weather forecasting and monitoring, NGDC helped to develop a real-time system that will provide data to commercial space weather vendors, scientists, educators, and the public. NGDC worked in close cooperation with NOAA's Space Environment Center to produce the software to process, archive, and access SXI data within minutes of the recording.

Charged under the 1992 Land Remote Sensing Policy Act to license private remote-sensing satellite systems, NOAA approved four new licenses for commercial systems in FY 2001, including second-generation electro-optical/multispectral systems, and high-resolution synthetic aperture radar. NOAA also approved 6 foreign agreements of its licensees, totaling an investment of up to $110 million in U.S. systems.

Additionally, NOAA and DoC's International Trade Administration (ITA) commissioned a remote-sensing policy study from the RAND Corporation. This study was conducted with the aim of better understanding the role that U.S. Government policies and regulations play in shaping prospects for the commercial remote-sensing satellite industry. The study provided recommendations to U.S. Government and industry to mitigate technical, market, policy, and regulatory risks.

In the international space arena, NOAA/NESDIS continued to improve and enhance its ongoing activities in FY 2001. NOAA

participation in the United Nations Committee on Peaceful Uses of Outer Space (COPUOS) played a key role in facilitating negotiations that established the U.N. COPUOS Action Team on Disaster Management. State Department Environmental Defense Funding was awarded to NOAA through its role as the Chair of the Committee on Earth Observation Satellites (CEOS) Disaster Management Support Group (DMSG). This funding, together with assistance from the United Nations Office of Outer Space Affairs (OOSA) and the European Space Agency (ESA), is to be used in support of disaster workshops to bring together practitioners and space agencies that have developed space technology solutions for disaster management in developing countries. NOAA managers also negotiated a renewal of the Radarsat-1 Memorandum of Understanding resulting in signature by the NOAA and NASA Administrators and the Director-General of the Canadian Space Agency. This agreement maintains NOAA access to Radarsat-1 data until Radarsat-2 becomes operational. NOAA's ongoing space relations with Japan also continued in 2001, with completion of a new proposal to NASDA for cooperation on their Advanced Land Observing Satellite (ALOS) mission. NOAA continued to provide, as the sole DoC representative, overall responsibility for observational issues on the U.S. delegations to the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Commission on Sustainable Development (CSD).

NESDIS's significant multilateral space activities also continued through its prominent activities in the Integrated Global Observing Strategy (IGOS). NOAA developed, with an IGOS visibility team, IGOS-related language and concepts for endorsement at the April 2001 intergovernmental Commission on Sustainable Development (CSD) at the United Nations Headquarters in New York City. In particular, they worked to insert language in support of full and open data sharing, and to find an integrated global observing strategy for documents being prepared for the World Summit on Sustainable Development (WSSD). NOAA also organized, with its IGOS Partners, an IGOS exhibit and side-event in connection with the CSD.

In coordination with the French, Canadian, and European Space Agencies, the DoS, and other U.S. agencies, NOAA became a member to the International Charter on Space and Major Disasters. NOAA also worked closely with the DoS to obtain an Export License for four-line elements and perturbation software to allow EUMETSAT to calibrate and validate NOAA instruments on their METOP satellites. In addition, the NOAA/DoS collaboration helped to expedite approval of a Technology Assistance Agreement between EUMETSAT and ITT. European cooperation with NOAA was further enhanced through an energetic effort to re-focus NOAA and

U.S. Government polar satellite cooperation with EUMETSAT. NOAA obtained EUMETSAT funds, in agreement with NASA, for testing NOAA instruments scheduled to fly in a changed METOP-1 launch environment. NOAA, with NASA and DoD, its partners in the NPOESS, drafted a new Joint Polar Transition Agreement for negotiation with EUMETSAT.

The NOAA Assistant Administrator for Satellite and Information Services participated in a July 26, 2001, inaugural ceremony in San Jose, Costa Rica, that celebrated the NOAA-facilitated transfer to Costa Rica of a satellite ground station that brings high-resolution digital imagery from GOES satellites to the Central American region. The imagery is collected through RAMSDIS units installed in Costa Rica, Nicaragua, and Guatemala. NOAA has commenced efforts to establish agreements with Belize, El Salvador, Guatemala, Honduras, Nicaragua, and Panama for installation of RAMSDIS systems.

In addition, Australia and NOAA signed a historic Science and Technology Arrangement for collaboration on coral reef research. The Acting NOAA Administrator signed the Arrangement in January 2001 to establish a Coral Reef Virtual Laboratory that will help researchers better understand and monitor coral reef health. Excessive temperatures can cause bleaching of the corals that are detrimental to island reef structures and the attendant marine ecosystem. The health of the coral reefs will be monitored by using satellite-observed sea surface temperatures and will contribute to mitigation activities under the arrangement.

NOAA/NESDIS worked with NASA, the French space agency, and EUMETSAT to fashion cooperation for the eventual transitioning of research satellite altimetry missions of the follow-on Jason series of satellites to operational status. The four agencies also received recognition for preparing to commit resources to the identified satellite altimetry requirements in the Oceans Theme of the IGOS. NOAA/NESDIS also focused efforts of the Assistant Administrator, in coordination with NASA and NOAA/NWS counterparts, to represent U.S. interests in the January 2001 World Meteorological Organization (WMO) Consultative Meeting on High-Level Policy on Satellite Matters. This effort also included NOAA inputs to a new WMO Technical Document on the role of satellites in WMO programs. NOAA/NESDIS contributed, and prompted contribution by other foreign space agencies, to a May 2001 University of Miami international infrared radiometer calibration and inter-comparison exercise in connection with the CEOS Working Group on Calibration and Validation.

In FY 2001, the NOAA/NESDIS Office of Research and Applications (ORA) and NASA established the Joint Center for Satellite Data

Assimilation (JCSDA) to accelerate the use of satellite data in weather-prediction models. The JCSDA is a "virtual center," involving scientists from NASA and NOAA who work in tandem to transition research, algorithms, and techniques in satellite data assimilation. The objective is to maximize the significant investment that has been put into current observing systems and prepare for the explosion of data that will be available from future systems, such as the convergence of the NPOESS constellation of satellites.

NOAA's AOC supported hurricane research and surveillance, winter storms research, coastal mapping, snow surveys (for hydrological forecasting), air chemistry studies, and global climate research by providing specially designed and instrumented aircraft for operations. Highly trained pilots, scientists, engineers, and technicians operate these aircraft. In FY 2001, AOC also made significant improvements to NOAA's "hurricane hunter" technology. In conjunction with flights of the NOAA G-IV hurricane surveillance jet far out over the Pacific Ocean, a WP-3D Orion flew into winter storms off the West Coast, collecting meteorological data for computer models to improve forecasts of severe Pacific storms approaching the United States. An Inmarsat communications system was installed on the P-3 for this mission that enabled immediate, real-time storm data and voice transmissions to forecasters. The system was later installed on NOAA's other P-3, giving both aircraft the capability to transmit immediately to the National Hurricane Center during missions flown over the course of the 2001 hurricane season.

NOAA's NOS continued to use GPS and remote-sensing technology to meet its mission of mapping the national shoreline, producing airport obstruction charts, and monitoring and analyzing coastal and landscape changes. NOS/NGS continued work on advancing centimeter-level positioning accuracy of GPS through its National Continuously Operating Reference Stations (CORS) program. It added 31 new stations to the National CORS network during FY 2001. At the end of the fiscal year, the network contained 229 sites. NOS continued upgrading the sampling rate of all Nationwide Differential GPS (NDGPS)/DGPS sites from 30 seconds to 5 seconds to better serve those involved in Geographical Information Systems (GIS) development and/or kinematic applications. In another effort to better serve those in the GPS and GIS communities, NOS hosted a CORS Industry Forum in March 2001. The Forum presented the current status of the CORS program and solicited input from existing and prospective partners to determine the future direction of CORS. A joint effort was undertaken between NOS and the FAA Tech Center in Atlantic City, NJ, to establish a T1 Internet connection to download GPS data from

approximately 50 sites contained in the Wide Area Augmentation System/National Satellite Test Bed (WAAS/NSTB) network. Many of these sites are being incorporated into the CORS network. This software will allow the streaming of FAA data into hourly files. CORS was also utilized in the response and recovery efforts of the World Trade Center disaster. The New Jersey Institute of Technology and the U.S. Coast Guard increased the data collection rate at nearby stations to better position the airplanes that were mapping the affected area via remote-sensing techniques.

Also in the past year, NOS developed the Online Positioning User Service (OPUS) as a means to facilitate GPS users' access to the NSRS. OPUS allows users to submit their GPS data files to NOS, where the data will be processed to determine a position using NOS computers and software. Each submitted file is processed with respect to three CORS sites. While it is not a real-time feedback, it is very valuable for checking data that is brought in from the field.

NGS continued its effort as a key partner in the NASA Synthetic Vision System (SVS) program by providing essential data and information to be incorporated into this system. NASA is working with industry to create Synthetic Vision, a virtual reality display system for the cockpit. This program could offer pilots a clear, electronic picture of what is outside their windows, regardless of the weather or time of day.

NOS continued to provide access to data it currently collects and maintains within the Aeronautical Survey Program (ASP). It also continued to derive specialized data to support the SVS. These data include obstruction data, runway positional information, digital terrain models, and orthorectified imagery. In FY 2001, two test sites were selected, Dallas-Fort Worth, Texas, and Eagle County, Colorado. This data provides the backbone of the SVS system, which is used to provide the required positional accuracy and the scene replication data needed for safe air navigation in low-visibility situations.

NOS has collaborated with the FAA Aviation Systems Standards (AVN), the University of Florida Geomatics Department, and Optech Inc. to test the feasibility of using an Optech 33 kHz Airborne Laser Terrain Mapper (ALTM) for FAA programs (AVN-Flight Check/National Aeronautical Charting Office (NACO)-Flight Edit) and the NOS Aeronautical Survey Program.

NOS continued to participate in the Safe Flight 21 program, which is led by the FAA. This is a joint Government/industry initiative designed to demonstrate and validate, in a real-world environment, the capabilities of advanced surveillance systems

and air traffic procedures that will move the national airspace system forward in the 21st century. Enabling technologies include Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B). The NOS role is to provide accurate data referenced to the NSRS. It provides orthorectified imagery and then generates a highly detailed digital map of the test airports. The data sets include runways, taxiways, vehicle roads, signs, centerline paint stripes, all movement areas, and other detailed information to help air traffic controllers safely move aircraft and ground vehicles around the airfield.

The NOS Coastal Services Center (CSC) continued to expand its efforts to make remote-sensing data, information, and technology accessible to the coastal resource management community in FY 2001. One of CSC's most significant efforts was to manage the NOS coral mapping efforts in the Pacific Ocean. This effort is based primarily on remote-sensing technology, using satellite and airborne platforms to develop the coral reef map products. This is an ongoing collaborative activity and includes the participation of many program offices within NOS, as well as contracts with the private sector for product development.

Another significant activity included the beginning of outsourcing efforts for remote-sensing products and services. NOS released a contract to private industry for the development of satellite-based, land cover and "change" data sets in the coastal areas of the Great Lakes region. These products will meet the guidelines and standards of the NOAA Coastal Change Analysis Program (CCAP). In FY 2001, NOS also developed these products for the main eight islands of Hawaii. Commercial, high-resolution satellite data were purchased to support various land-based resource management projects in the Pacific Islands and coastal regions of the mainland. Other outsourcing activities included the initiation of a contract to collect elevation data from LIDAR technology for the Willapa Bay region of Washington.

NOS also continued to support remote-sensing and GIS activities in partnership with the coastal management community. These data were used to support the land cover mapping of the main eight islands of Hawaii, to verify historical logging activities for an ecological characterization project in Alaska, and to estimate visitor use for two National Marine Sanctuaries located off the coasts of Georgia and Texas.

NOS outreach and educational activities included the development of a remote-sensing training course for GIS professionals, Web-based materials that focus on the coastal applications of remote sensing, and CD-ROM products that demonstrate how remote-sensing technology is being used in specific State and local coastal

resource management applications. NOS continued to develop its internal NOAA relationships and to foster its relationships with other civil agencies that have mutual interests in remote-sensing and Earth observation technologies within the coastal zone, such as the U.S. Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), EPA, and NASA's Earth Science Enterprise.

The NOAA/National Marine Fisheries Service (NMFS) Office of Habitat Conservation has been interacting with the Naval Oceanographic Office at Stennis Space Center in Mississippi for several years on a project to acquire high-resolution imagery of the Sacramento River. The aim is to monitor areas along the river that are accessible by threatened and endangered species of interest to NMFS. Previously, the Navy collected very-high-quality imagery along the Sacramento River, from Shasta Dam downstream to the Delta (i.e., the entire portion of the river accessible to resources of interest to NMFS). That imagery was processed by the Naval Oceanographic Office and sent to NMFS as 2 sets of a 6-volume series of hard-copy images of the Sacramento River. The last volume was received during summer 2001. Copies were then sent to the NMFS field office in Santa Rosa, California, for immediate use in assessments for both the Endangered Species Act and the Sustainable Fisheries Act. The imagery has allowed NMFS staff engineers and biologists to examine details of the river that have enhanced project planning, impact assessment, and evaluation of potential restoration activities.

During FY 2001, following completion of a NMFS-led restoration effort to enhance lateral growth of the Atchafalaya River Delta under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA), the NMFS Office of Habitat Conservation used National Imagery Systems and other data to track changes in the delta from 1998. Louisiana has 40 percent of the wetlands in the continental U.S., yet the State experiences 80 percent of the loss (the CWPPRA was instituted to combat this loss). The imagery collected under this project was utilized by the USGS and analyzed by NMFS. This imagery has revealed observations of large areas of accretion on the lateral edges of the delta, which demonstrates the success of the NMFS-led restoration effort.

NOAA's Special Agents and Fisheries management officials leveraged high-tech tools to assist them in their work of protecting and managing the Nation's marine living resources. One of these tools is a national Vessel Monitoring System (VMS), which routinely uses satellite-based monitoring systems to monitor compliance with domestic and international fishing regulations, as well as receive real-time catch data. NOAA's Fisheries Office for

Law Enforcement (OLE) continued to expand its national VMS program. This program is the vehicle to provide infrastructure, economies of scale and coordination across NOAA Fisheries' regions and offices. It is designed to ensure standards-based consistency for enacting national policies concerning fishing data confidentiality, systems security, and legal evidence handling. The current regional VMS systems are designed to be linked to OLE HQ servers and use standardized hardware, communications software, and formats. An integral part of the national VMS program is the ability to afford wide-area network connectivity for all of the major enforcement and VMS monitoring offices.

NOAA's SEC, the Nation's official source of space weather alerts and warnings, continued to monitor continually and forecast Earth's space environment by providing accurate, reliable, and useful solar-terrestrial information.

SEC conducted research into phenomena affecting the Sun-Earth environment, including the emission of electromagnetic radiation and particles from the Sun, the transmission of solar energy to Earth via solar wind, and the interactions between the solar wind and Earth's magnetic field, ionosphere, and atmosphere. In conjunction with the U.S. Air Force, SEC continued to conduct Space Weather Operations (SWO) to monitor solar and geomagnetic activity 24 hours a day; disseminate information on the solar-terrestrial environment; alert private, commercial, Government, and military users to possible disruptive or dangerous changes in the space environment; issue daily forecasts of space environment conditions; and act as the World Warning Agency for the space environment. The SEC continued to operate a Data Acquisition and Display System to gather current space weather data for distribution to Government and private sector users and for subsequent archiving by NOAA's NGDC.

More than 20 years of joint effort between the U.S. Air Force, NASA, and NOAA culminated in the development of a real-time image processing system, to improve space weather alerts and forecast the effects of such disturbances. The system, installed on one of NOAA's geostationary satellites (GOES-12), includes a flexible "movie" player for visualization and assessment of dynamic changes in the sun's corona, as provided by the new SXI data. Data from the instrument was first recorded on September 7, 2001. The images, which revealed solar details such as coronal holes, active regions, flare locations, and a wealth of other detail, achieved all expectations. The instrument is being tested and calibrated to optimize products that will come out of the images.

Real-time tracking of NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) commenced from NOAA's Fairbanks

ground station. IMAGE is the first mission dedicated to "seeing" Earth's space environment and watching solar activity drive space weather. Through a partnership between NASA, NOAA, and the Communications Research Laboratory in Japan, the IMAGE satellite broadcasts images of space weather in real time, and ground stations receive the images and transfer them to the SEC.

SEC collaborated with NASA in planning Living with a Star, a guide providing K–12 educators with materials and resources that are useful for understanding connections between the Sun and Earth. The two primary goals of this effort are to disseminate educational resources about the Sun and to facilitate the involvement of space scientists in education.

DoC also engaged in a variety of non-NOAA aerospace activities. The Technology Administration (TA) engaged in a number of space-related activities through the Office of Space Commercialization (OSC) and the National Institute of Standards and Technology (NIST). OSC continued to serve as the principal coordinating unit within the DoC on space-related issues, coordinating positions with and disseminating information to various bureaus with separate space-related responsibilities and authorities, including NIST, NOAA, the International Trade Administration (ITA), the National Telecommunications and Information Administration (NTIA), and the Bureau of Export Administration (BXA).

In June, OSC published the 2001 Trends in Space Commerce report, providing an overview of the commercial space market and projections for future growth. The analysis included highlights on competitiveness comparing the U.S. with other nations in the fields of space commerce, space transportation, satellite communications, remote sensing and the Global Positioning System. The report projected a $93.4 billion worldwide market for the space industry in 2001, with $77.74 billion in revenue expected from satellite communications, the largest and fastest growing segment of the industry.

OSC assumed an active role in interagency space matters under the Space Policy Coordinating Committee (PCC) established by the National Security Council. OSC cochaired the Space PCC Sub-Team on commercial space issues, overseeing the development of strategies for the use of commercial remote-sensing satellite systems by the military and for commercial use of the International Space Station. OSC also participated in Space PCC Sub-Teams focused on space transportation, spectrum, and international issues.

Within the White House-led Interagency Working Group on the

Future Use and Management of the U.S. Space Launch Bases and Ranges, OSC collaborated with the U.S. Air Force and the FAA Office of the Associate Administrator for Commercial Space Transportation (AST) to assure full consideration of the needs of commercial users of the two major Federal space launch facilities. As part of a separate effort, OSC, FAA/AST and IT's Office of Aerospace worked closely to coordinate industry positions on outside funding for Federal launch bases and ranges.

Through OSC and NOAA, DoC continued to promote the interests of commercial, scientific, and Government users of GPS as a key member of the Interagency GPS Executive Board. OSC played a critical role in defending GPS radio spectrum from encroachment by ultra-wideband emitters and other potential interference sources, working with the NTIA as well as civil and military Federal agencies. OSC also continued to host the offices and meetings of the IGEB, to engage in international outreach missions to promote GPS, and to participate in the GPS modernization program.

OSC continued to represent U.S. industry interests during bilateral negotiations with the European Commission on satellite navigation. OSC also participated in bilateral consultations with Japan led by the DoS to affirm the two nations' mutual commitment to promote and use GPS as an international standard for satellite navigation and timing.

In the area of satellite remote sensing, OSC, NOAA, and IT's Office of Aerospace (OA) continued to represent commercial interests as part of the Remote Sensing Interagency Working Group (RSIWG). Led by the DoS, the RSIWG is charged with coordinating policy for the export of U.S. remote-sensing satellite systems and negotiating government-to-government agreements covering the safeguarding of those systems' technology.

During FY 2001, NIST performed a broad range of measurements and standards-related research, technology transfer, and industry support in the areas of aeronautics and space. NIST continued to provide radiometric calibration support for NASA's EOS program to ensure the accuracy of the sensors used in global remote sensing. NIST also provided the radiometric calibration of NOAA's Marine Optical Buoy (MOBY), which furnishes accurate data necessary to calibrate and validate satellite ocean color measuring instruments such as the Sea-Viewing Wide Field-of-View Sensor (SeaWifs) and MODIS. NIST started a multi-year effort to improve calibration techniques for radiometers used for remote sensing. These new developments should provide greater measurement accuracy in satellite applications such as measuring Earth's temperature, wind speed over the ocean, sea salinity, and locating resource position.

The NIST Manufacturing Extension Partnership (MEP) helped hundreds of U.S. aerospace parts and systems manufacturers increase sales and productivity and reduce costs through adoption of lean manufacturing and other competitive processes. As one example, RoBrad Tool & Engineering, Inc., an 80-employee machine shop that supplies precision subassemblies for Boeing and Honeywell, came to the Arizona extension center to reengineer its setup processes. Conversion techniques prescribed by the Arizona center reduced RoBrad's setup times by 42 percent and saved $300,000 a year in setup costs.

To improve the security of communications between space-based and ground-based operations, NIST's Cryptographic Module Validation Program worked with NASA to develop and use new cryptographic modules and cryptographic algorithm implementations. To reduce interference between aircraft navigation systems, external radiation, and onboard laptops and cell phones, the Naval Surface Warfare Center provided funding to NIST to compare alternatives and to deliver efficient techniques and methodologies for measuring aircraft radiation shielding. With funding from FAA, NIST helped set interference measurement policy. To reduce potential interference between ultra-wideband broadcast signals and GPS systems, NIST and the NTIA worked on characterizing ultra-wideband emissions for simulated interference studies.

NIST continued to work with the NASA Jet Propulsion Laboratory on the Condensate Laboratory Aboard the Space Station (CLASS) project, which will develop microgravity measurement instruments for Bose-Einstein condensates, an atomic-level phenomenon for which a NIST scientist received the 2001 Nobel Prize in physics. NIST scientists also prepared a Shuttle experiment involving the rapid stirring of xenon in microgravity, a process that decreases its viscosity, something never seen before in such a simple fluid. Results from this experiment should help predict flows occurring in the manufacture of ordinary plastics.

NIST continued to provide the tools, methodologies, standards, and measurement services needed by aerospace parts manufacturers and assemblers to maintain their accurate and traceable use of the International System of Units (SI) of length, mass, and time, as well as their derived units (force, acceleration, sound pressure, and ultrasonic power). For example, NIST provided calibration services in the areas of electrical measurements and microwave parameters to numerous aerospace corporations such as Boeing, General Dynamics, Lockheed Martin Astronautics, McDonnell Douglas Corporation, Northrop Grumman, and TRW Space and Electronics.

NIST's Advanced Technology Program supported efforts of an industry team at the Ohio Aerospace Institute of Cleveland to develop technologies that make product design concurrent with manufacturing, thereby reducing design time, improving quality, and potentially reducing the cost of creating new products in a range of industries. Demonstration of the technology will focus on a jet engine, nacelle, and fuel nozzle.

NIST continued its NASA-funded research on microgravity-based fires and fire suppression. NIST studied flame extinction in microgravity in order to improve methods for ensuring fire safety during long-duration space missions. To characterize the size distribution of smoke generated in microgravity, NIST and NASA researchers measured and compared the output of approved spacecraft smoke detectors with 1-g results and model predictions. A computer program was developed to simulate the effects of g-jitter on small combustion experiments being conducted in NASA drop towers, the Space Shuttle, and the International Space Station.

NIST worked with aerospace manufacturers to develop "predictive process engineering" models, metrology, and standards, intelligent manufacturing control systems, and product interoperability protocols and knowledge representation schemes for Computer-Aided Design (CAD) systems. NIST developed software for testing the Air Transport Association's IGExchange, a specification that allows the aerospace industry to develop Extensible Markup Language (XML)-based dynamic graphics. In collaboration with NASA, NIST helped deploy on a telescope in Hawaii a unique infrared-imaging instrument similar to NIST systems aerospace companies have commercialized for space missions.

NIST worked with NASA to develop an optics metrology laboratory and capability for NASA optics. NIST also developed optical disk image and storage standards for NASA, which is interested in using optical tape for storing satellite imagery. With funding from NASA and in collaboration with Stanford University, NIST deployed a new class of optical detectors with sufficient speed and resolution to provide entirely new information from space, such as the detailed characterization of light being emitted from pulsars.

NIST scientists developed tools to accelerate the introduction of new materials and processes in the manufacture of aerospace engine components; these include multi-component alloy thermodynamics, phase diagrams, solidification, and diffusion. Additionally, NIST cooperated with the NASA Glenn Research Center to broaden the use of advanced ceramic materials that, due to their brittleness, currently have limited applications. The two agencies developed standard test methods for quantifying the

fracture resistance of brittle, monolithic ceramics in a manner suitable for use by aerospace designers. NIST also developed object-oriented finite element software to enable virtual measurements of the thermal conductivity of ceramic thermal barrier coatings used to extend the operating temperature and life of jet turbine blades.

NIST continued to support the Primary Atomic Reference Clock in Space (PARCS), a laser-cooled cesium clock being developed for deployment on and use with the International Space Station's onboard scientific and technical applications. The PARCS project has completed its first two NASA reviews and is scheduled to fly in early 2005. NIST also continued to provide synchronization support for NASA's Deep Space Network, used for space navigation and tracking.

NIST provided a number of key NIST facilities to NASA science missions, including NIST's synchrotron (SURF III), the Solar Radiation and Climate Experiment (SORCE), and the TIMED (Thermosphere Ionosphere Mesosphere Energetics and Dynamics) spacecraft. SURF III was used as a source of soft x rays and vacuum ultraviolet light to calibrate mirrors, detectors, and spectrometers used in spacecraft that study solar flares and astronomical bodies.

NIST completed the radiometric calibration of the NIST Advanced Radiometer (NISTAR) and Earth Polychromatic Imaging Camera (EPIC), both planned for deployment on the NASA Triana satellite. NISTAR will measure the absolute irradiance of the Earth. EPIC will provide hourly, spatially resolved measurements of cloud properties, and ozone and aerosol levels of the Earth's atmosphere.

In FY 2001, ITA's OA played a central role in the organization and coordination of the Commission on the Future of the United States Aerospace Industry, established by Congress to study issues associated with the future of the industry in the global context, particularly in relation to national security. The Commission is required to issue a report for the President and Congress in late 2002 recommending actions by Federal agencies to maintain a robust industry in the future. OA contributed a staff member to colead a team on global issues and assist the Commission in developing recommendations on issues including export control, technology transfers, subsidies/offsets, trade agreements and policies, regulations and standards, and international mergers and teaming.

OA worked closely with other U.S. agencies to renew the Czech government's 1-year tariff waiver on imports of U.S. large civil

aircraft, helicopters, and certain spare parts through December 31, 2002. The DoS, the office of the U.S. Trade Representative (USTR), and the U.S. Embassy in Prague joined efforts in convincing Czech officials to eliminate the tariff differential between U.S. and EU aircraft by renewing the tariff waiver. Without the waiver, the Czech Republic levies a 4.8 percent tariff on U.S. aircraft, while no tariff is assessed on EU aircraft. The Czech government confirmed its intention to join the World Trade Organization (WTO) Trade in Civil Aircraft Agreement (which, among other things, binds tariffs on aircraft and parts to zero) as part of any future multilateral trade negotiations. OA encourages as many countries as possible to sign the WTO Agreement on Trade in Civil Aircraft as part of their WTO accession process.

Efforts by OA, USTR, and the DoS to open Russia's highly protectionist aerospace market met with some success during FY 2001. In August 2001, the Russian government repealed Resolution #716, which had linked obtaining tariff waivers for imported aircraft to purchases of Russian-made aircraft.

OA continued to monitor and address European government loans to Airbus for the development of the A380 super jumbo jet. In January 2001, a U.S. interagency team, led by USTR and DoC, held consultations with the EU in Washington. U.S. officials expressed concern about Government loans and the extent to which they are compatible with the WTO. The EU responded that any Government loans would be compatible with the 1992 U.S.-EU Large Civil Aircraft Agreement, which allows for direct Government loans that match up to 33 percent of total aircraft development costs. In April 2001, the EU provided information about the loans as required in the 1992 agreement. OA personnel continued analyzing this data, and the U.S. Government requested further information from the EU to better understand their compatibility with both the 1992 Agreement and WTO disciplines.

OA organized a number of aerospace-related activities under the U.S.-China Joint Commission on Commerce and Trade (JCCT) aimed at fostering greater bilateral trade in this sector. The Chinese participated in training programs sponsored by the FAA and offered by the American Association of Airport Executives. Delegations of Chinese from various disciplines in the aviation community visited the United States and participated in the annual meetings of the Airports Council International, the National Business Aviation Association, and the General Aviation Manufacturers Association.

OA continued to play a critical role in the U.S. Government team seeking resolution of the dispute over the European Union regulation that restricts the registration and operation in the EU of

aircraft modified with noise suppression technology, including aircraft engine "hushkits" and replacement engines. OA and other agency representatives participated in bilateral discussions with EU officials under the mediation of the International Civil Aviation Organization (ICAO) Council President. The U.S. Government team also vigorously supported the recommendation for a new aircraft noise standard and related procedures by an ICAO technical working group and subsequent adoption of the standard by the ICAO Council. Through extensive technical discussions and negotiations with other ICAO members, the U.S. Government successfully achieved the key objective of endorsement by all ICAO members of new aircraft-noise-related policy guidance. ICAO adoption of this policy guidance is anticipated to significantly contribute to resolution of the "hushkit" dispute. The U.S. Government will continue bilateral negotiations with European officials to seek withdrawal of the hushkit regulation prior to April 2002.

During discussions with European officials in FY 2001, OA and other Federal agencies raised concerns over the European Commission's plans to establish a European Aviation Safety Agency (EASA) to regulate civil aircraft safety in the EU and other European states. OA has concerns with provisions that link aircraft safety to international trade considerations. DoC championed a proposal to amend the EASA regulation in a way that would remove the linkage between trade considerations and the oversight of aircraft safety.

OA and TA's OSC continued to participate in efforts led by USTR to monitor Chinese compliance with the quantitative restrictions and pricing provisions of the U.S.-China Commercial Space Launch Agreement. Ongoing and new proliferation-related sanctions on China have limited the ability of foreign satellite manufacturers and operators to select a Chinese launch vehicle, thereby reducing China's participation in the commercial market. China had relatively few new commercial contracts, and the interagency working group discovered no new violations of the agreement.

In FY 2001, OA continued to assist the U.S. aerospace industry through trade promotion events. To promote the export of U.S. aerospace products, ITA sponsored Aerospace Product Literature Centers at five major international exhibitions and air shows in Australia, China, France, Taiwan, and the United Kingdom. More than 4,000 trade leads were generated through this program. Working with the American Association of Airport Executives, OA sponsored the 6th Annual Eastern European Airport and Infrastructure Conference and Trade Show in Budapest, Hungary. The office also cosponsored, with Senator Rockefeller, Congressman Oberstar, and Federal agencies, a China seminar

that showcased a variety of U.S. products and services.

With support from OA, Secretary Evans visited the Paris Air Show in June 2001. In meetings with representatives of leading U.S. aerospace exporters and with his counterparts in foreign governments, Secretary Evans called for improvements in the international trade regime to facilitate U.S. export sales. OA arranged visits to the U.S. Pavilion by more than 20 delegations from outside the United States. Those visits helped generate sales leads for U.S. exhibitors.

OA, in coordination with ITA's Advocacy Center and overseas offices, provided advocacy to support U.S. companies in international aerospace competitions. The competitions include commercial aircraft sales for the Boeing Company, helicopters, airport construction, commercial space projects, and air traffic management projects.

Secretary Evans oversaw the official signing ceremony for the sale of 30 Boeing aircraft worth over $1.6 billion to four Chinese airlines. The contract and signing ceremony, coordinated by OA, highlighted the importance of international cooperation in this sector, especially in the wake of the September 11 terrorist attacks and their toll on the U.S. aircraft industry.

As the lead advisory agency for Federal Government telecommunications issues, the National Telecommunications and Information Administration (NTIA) undertook a number of policy initiatives regarding satellites and other space-based communications systems. Specifically, NTIA provided policy guidance on the restructuring of the International Telecommunications Satellite (INTELSAT) Organization and the International Mobile Satellite (INMARSAT) Organization. The restructuring has been successfully completed. NTIA continued to manage the Federal Government's use of the radio spectrum, including assignments for NASA, DoD, NOAA, and other Government satellite programs. NTIA worked closely with other U.S. regulatory authorities and commercial satellite users to prepare for U.S. participation at the ITU World Radio Conference (2003) to protect spectrum allocations for GPS.