

THE FEDERAL PLAN FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

FISCAL YEAR 2008 EXECUTIVE SUMMARY

For Fiscal Year (FY) 2008, the President's budget requests over a total of \$3.79 billion for meteorological services and supporting research. Of the requested total, over \$3.05 billion is designated for operations and over \$740.6 million for supporting research. Table ES-1 lists a breakout of the FY 2008 budget proposal.

For FY 2008, 94.5 percent of the total funds requested will go to the Departments of Commerce (DOC), Defense (DOD), and Transportation (DOT). The distribution among these three departments is DOC 52.1 percent, DOD 28.3 percent, and DOT 13.1 percent. The other Federal agencies will share the remaining 5.5 percent.

The FY 2008 request represents an increase of 1.2 percent above the over \$3.74 billion appropriated in FY 2007. Within the three major departments, DOC's request is essentially flat; DOD an increase of 10.1 percent, and DOT a decrease of 9.4 percent. The overall DOD increase is mainly the result of

increases in AF and DMSP requested funding. DOT's decrease is attributable to a decrease in FAA's operations requests.

The budget requests for the other departments are as follows:

- Department of Agriculture (USDA) a decrease of 11.5 percent,
- Department of the Interior (DOI) no change,
- Environmental Protection Agency (EPA) no change,
- National Aeronautics and Space Administration (NASA) an increase of 2.2 percent, and
- the Nuclear Regulatory Commission (NRC) no change.

Figure ES-1 depicts each agency's proportion of the requested FY 2008 Federal budget for meteorological operations and supporting research. Each agency's portion of the requested funding for meteorological operations is shown in Figure ES-2. Of the over \$3.04 billion requested for meteorological operations, DOC, DOD, and DOT

account for 98.6 percent of the funds. Overall, operational spending increased by 2.5 percent. Figure ES-3 depicts each agency's portion of the proposed Federal supporting research budget. Unlike operations, DOC, DOD, and NASA account for the major share (90.5 percent) of the supporting research budget. Overall, supporting research spending decreased by 3.5 percent.

All agencies project a personnel total of 12,260 full-time equivalent (FTE) to be employed in Federal meteorological operations in FY 2008. This figure represents a decrease of 2.7 percent from the 12,598 FTE employed in FY 2007, with the largest shares of the decrease attributed to reductions in DOD/Navy and DOT/FAA personnel.

Table ES-1. Federal Budget for Meteorological Operations and Supporting Research, FY 2008 (in thousands of dollars)

Agency	Operations	% of TOTAL	Supporting Research	% of TOTAL	TOTAL	% of TOTAL
Agriculture	\$19,563	0.6	\$29,216	3.9	\$48,779	1.3
Commerce	1,871,181	61.5	99,298	13.4	1,970,479	52.1
Defense	665,728	21.9	404,187	54.6	1,069,915	28.3
Homeland Security	21,540	0.7	0	0.0	21,540	0.6
Interior	2,400	0.1	0	0.0	2,400	0.1
Transportation	462,117	15.2	32,514	4.4	494,631	13.1
EPA	0	0.0	9,000	0.6	9,000	0.2
NASA	2,389	0.1	166,400	22.5	168,789	4.5
NRC	120	0.0	0	0.0	120	0.0
TOTAL	\$3,045,038	100.0	\$740,615	100.0	\$3,785,653	100.0

Total = \$3.79 Billion

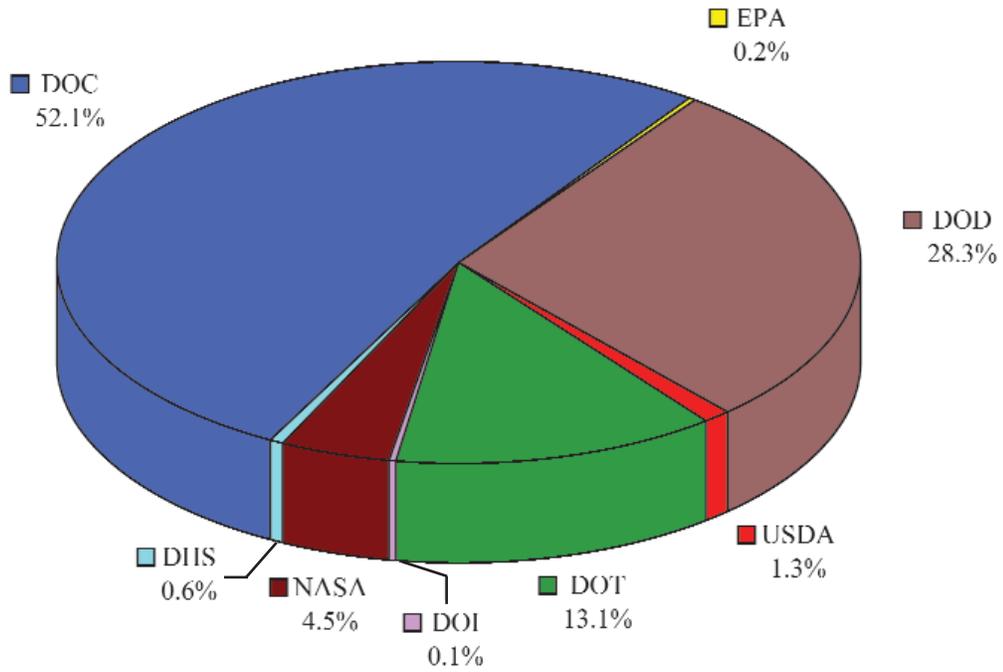


Figure ES-1. Agency Percent of Total Federal Budget for Meteorological Operations and Supporting Research, FY 2008.

Total = \$3.05 Billion

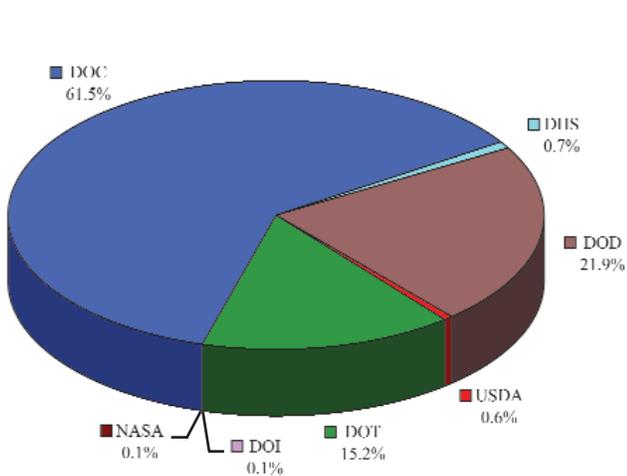


Figure ES-2. Agency Percent of Federal Budget for Meteorological Operations, FY 2008.

Total = \$741 Million

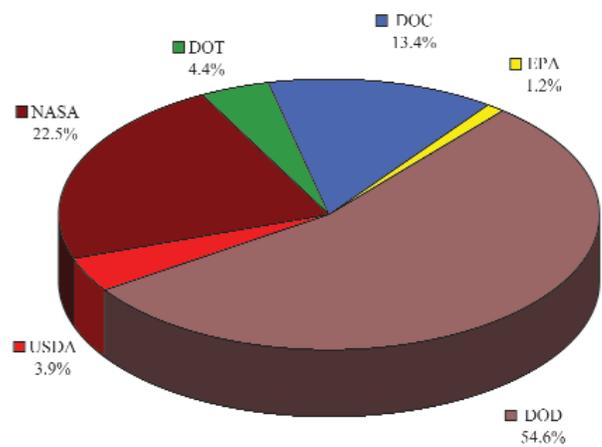


Figure ES-3. Agency Percent of Federal Budget for Supporting Research, FY 2008.

MAJOR PROGRAMS--DOC, DOD, and DOT

NEXT GENERATION WEATHER RADAR (NEXRAD)

The NEXRAD Program, which was initiated in FY 1981, was responsible for procurement, installation, and operation of the Weather Surveillance Radar-1988 Doppler (WSR-88D). The first limited production WSR-88D system was installed at Oklahoma City, Oklahoma in May 1990, and commissioned 4 years later in February 1994. The original program plan called for a total of 161 radars. In response to a National Research Council report, three additional radars were added and raised the total to 164 radar sites (158 operational sites and six support sites). By agency, as of June 2001, the DOC/National Weather Service had commissioned 120 operational sites, the DOD (USAF and Army) had commissioned 26 sites (within the states and overseas), and the DOT/FAA had commissioned 12 sites. DOD has three systems at Keesler AFB, Mississippi, for training; DOC/NWS has one each at the National Reconditioning Center and the NWS Training Center in Kansas City, Missouri, and one at the Radar Operations Center in Oklahoma City, Oklahoma. In 2004, an additional Doppler radar (installed by Enterprise Electronics) was commissioned in Evansville, IN, to augment coverage for southern Indiana and western Kentucky, bringing the count of operational radars to 159.

AUTOMATED SURFACE OBSERVING SYSTEM (ASOS)

The ASOS program began in 1983 as a joint development effort between the DOC, DOD, and DOT/FAA. Installation of ASOS units started in 1992. A total of 1,002 units have been purchased. The NWS has purchased, accepted, and commissioned 313 sites. The FAA has purchased 570 units, all of which have been accepted and com-

missioned by the NWS. The Navy has purchased and accepted 72 sites. The Air Force has purchased and accepted 47 sites. Collectively, a total of 1,002 ASOS sites have been commissioned.

The Air Force Observing System-21st Century (OS-21) program is providing a state-of-the-art life-cycle replacement for Air Force observing equipment. OS-21 includes five different configurations: fixed, deployable, remote, manual, and upper air. Installation of 110 fixed systems, designated the FMQ-19, at Air Force bases and Army posts worldwide began in summer 2002, and is scheduled for completion in 2007. The manual version is intended for tactical operations and will continue upgrades begun under the Manual Observing System and Tactical Meteorological Observing System modification programs.

In support of operations, the Air Force purchased commercial off-the-shelf (COTS) remote miniature weather sensors to provide accurate real-time weather information from forward unmanned locations, and has since deployed remote miniature sensors to Afghanistan and Iraq.

AUTOMATED WEATHER INFORMATION SYSTEMS (AWIS)

The DOC, DOD, and DOT require AWIS to facilitate the collection, processing, and interpretation of meteorological data. AWIS are being procured to provide an automated, high-speed, user-friendly man/machine interface to access and process large volumes of sophisticated meteorological data. AWIS supports the timely production of accurate and geographically precise warnings, forecasts, and special tailored products. They also provide the communications capability for expeditious product dissemination. Major agency systems classified as AWISs are: NOAA's Advanced Weather Interactive Processing System (AWIPS), FAA's Weather and Radar Processor (WARP), Air Force's Joint Environ-

mental Toolkit (JET), and the Navy's Naval Integrated Tactical Environmental Subsystem (NITES).

AWIPS

In February 1997, the Secretary of Commerce approved the limited deployment of AWIPS at over 40 sites. On April 9, 1998, the Secretary authorized full-scale production and deployment of AWIPS, through Build 4.2, for the remaining 95 systems. Installation of these 95 systems began in September 1998, and was completed in June 1999. An Operational Test and Evaluation of the commissioning software load (Release 4.2) was successfully conducted from mid-May through June 1999. AWIPS commissioning began in January 2000, was completed in November 2000, with 139 NWS systems commissioned at 122 Weather Forecast Offices (WFOs), 13 River Forecast Centers (RFCs), the Spaceflight Meteorology Group (SMG), and 4 National Centers for Environmental Prediction (NCEP). The NWS successfully completed the final development phase release of AWIPS (Build 5) in early 2003, completed deployment of its first Operational Build (OB1) that summer, completed deployments of OB2 in December 2003, OB3 in August 2004, OB4 in February 2005, and OB5 in December 2005. Deployment of Operational Builds continued after that at a rate of about two per year. The Operational Builds deliver new functionalities and enhancements in the areas of warning product generation and warning support, hydrological product generation, data and imagery display, communications and infrastructure. Of note within the operational builds of AWIPS is an evolution of the architecture to the Linux open source operating environment which was started in 2001, and will continue through to its planned completion in 2007.

WARP

The FAA's WARP will greatly enhance the dissemination of aviation weather information throughout the National Airspace System (NAS). WARP will automatically create unique regional, WSR-88D-based mosaic products and send these products, along with other time-critical weather information, to controllers through the Advanced Automation System (AAS), as well as to pilots via the aeronautical data link.

JET

JET will replace several disparate legacy weather systems with a single, integrated means of supporting both garrison and deployed operations, including a "first-in" weather forecasting capability. Combining forecasting, product-tailoring, and mission-impact capabilities in an interactive, network-centric, standards-based package; JET accesses, processes, analyzes, tailors, and integrates terrestrial and space weather information into command and control systems to guide warfighter decision-making. This effort will eliminate Air Force weather weapon system redundancies and inefficiencies, reduce the burden on system administrators, and ultimately extend, consolidate, or replace the following systems: Operational Weather Squadron Production System Phase II, the New-Tactical Forecast System, the Joint Weather Impacts System, and the Army's Integrated Meteorological System Weather Toolkit.

NITES

The current series of NITES (I - IV) were reengineered from the Tactical Environmental Surveillance System and other legacy systems of the early 1990's. These NITES systems are fielded through fiscal year 2010 and have various capabilities to ingest, process, fuse, display, and disseminate meteorological and oceanographic (METOC) information and its impact

on tactical operations. In early 2000, the NITES II application software was redesigned to align with the Global Command and Control System (GCCS) Family of Systems 4.x, provide increased flexibility, enable operating system and/or hardware independence, and improve user operability with a new graphical-user interface for tactical decision aid applications. The NITES II redesign suite of software is integrated with both GCCS-Maritime (M) and GCCS-Joint (J) 4.x versions.

The Navy will field a follow-on system, called "*NITES - Next*," to increase the capabilities for ashore, afloat and mobile METOC support to naval tactical operations and be interoperable with the other services. NITES - Next will have four components including: tactical applications, a forecaster's toolkit, a data services package, and the ability to collect METOC information through organic sensors for rapid environment analyses. *NITES - Next* will interface with the data providers/users using Web services and take advantage of the future DOD Global Information Grid and Navy FORCEnet architectures. Navy is also analyzing how to efficiently and effectively leverage the Air Force's Joint Environmental Toolkit (JET) Program for meteorological and environmental impact support.

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)

On October 3, 1994, NOAA, DOD, and the National Aeronautics and Space Administration (NASA) combined the nation's military and civilian environmental satellite programs to create an Integrated Program Office (IPO) to develop, manage, acquire, and operate the national polar-orbiting meteorological satellite system, subsequently designated the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The IPO

is organizationally located within NOAA and is headed by a System Program Director (SPD) responsible to the Program Executive Officer (PEO) for Environmental Satellites who in turn reports to the NPOESS Executive Committee (EXCOM). This committee, which consists of the Under Secretary of Commerce for Oceans and Atmosphere, the Under Secretary of the Air Force, and the NASA Administrator serves as a board of directors to ensure that overall program plans also meet the individual needs of the three participating agencies.

Pursuant to Section 2433 of Title 10, United States Code, Congress was notified on September 28, 2005, that NPOESS Program Acquisition Unit Cost (PAUC) would be exceeded by 15 percent. Since fall 2005, the fundamental structure of the management structure of the management chain at the IPO has been changed to improve lines of communication and reporting. The PEO and Staff were added to work interagency and external activities which allow the SPD to focus on the acquisition process. After further cost and alternatives were analyzed, a subsequent certification notification went to Congress on January 12, 2006, indicating cost growth of greater than 25 percent. This notification begins the Nunn-McCurdy certification process, which requires the Under Secretary of Defense (USD) for Acquisition, Technology and Logistics (AT&L) certify to Congress that 1) such acquisition program is essential to national security; 2) there are no alternatives that provide equal or greater military capability at less cost; 3) the new estimates of the program costs are reasonable; and 4) the management structure for the program is adequate to manage and control costs.

On June 5, 2006, the USD (AT&L) certified to Congress that the NPOESS program met the four Nunn-McCurdy criteria and sent an Acquisition Decision Memorandum (ADM) to the three

agencies. The restructured NPOESS program, delineated in the ADM, includes two Engineering and Manufacturing Development (EMD) satellites, with the option, in FY 2010, of exercising a procurement option for two additional NPOESS satellites. The restructured program includes: the Visible/Infrared Imager/Radiometer Suite (VIIRS); Microwave Imager/Sounder; Search and Rescue Satellite Aided Tracking (SARSAT), Cross-track Infrared Sounder (CrIS), Advanced Technology Microwave Sounder (ATMS), Advanced Data Collection System (ADCS), Cloud and Earth Radiant Energy System (CERES) [to be flown on satellite C-1 only]; Ozone Mapping and Profile Suite (OMPS) Nadir and the Space Environment Monitor (SEM). The Conical Scanning Microwave Imager/Sounder (CMIS) is terminated while developing a competition for a new Microwave Imager/Sounder (MIS) starting with the second EMD satellite. The restructured program provides for continuity of existing programs, constellation management flexibility, and the most capability for the least costs, while maintaining growth potential to achieve the original capability envisioned for NPOESS.

Per the Nunn-McCurdy decision, the Aerosol Polarimetry Sensor (APS), Total Solar Irradiance Sensor (TSIS), OMPS Limb, Earth Radiation Budget Suite (ERBS), Altimeter (Alt), Survivability Sensor (SuS) and the Full Space Environment Sensors (SESS) were demanifested. The agencies are working with the Executive Office of the President to evaluate options for restoring the highest priority measurements. NASA and NOAA restored the de-manifested OMPS Limb instrument to the NPOESS Preparatory Project (NPP). NPP is the joint NASA/IPO instrument risk reduction project designed to function as a bridge between the NASA Earth Observing System (EOS) program and NPOESS

for development of the ATMS, CrIS, OMPS, and VIIRS sensors. It will additionally serve as an initial check-out of the Command, Control, and Communications for the NPOESS program.

NPOESS was initially designed as a completely U.S. program in all three sun-synchronous orbits, distinguished by early-, mid-, and late-morning equatorial crossing times. NPOESS is now a two-orbit rather than three-orbit program that will use data from the European Meteorological Operational (MetOp) satellites provided by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) for the mid-morning orbit. Defense Meteorological Satellite Program (DMSP) satellites will provide flexibility depending on the health of the constellation in either early-morning or mid-morning orbits. The launch schedule for the restructured program is the NPOESS Preparatory Project (NPP) - January 2010; the two EMD satellites C-1 - January 2013 and C-2 January 2016; and an option in FY 2010 for block upgrade satellites C-3 - January 2018 and C-4 - January 2020. Table 3.1 summarizes the instruments originally and currently scheduled for the NPOESS orbits.

OTHER AGENCY PROGRAMS

For FY 2008, the Department of Agriculture (USDA) requested \$48.8 million for meteorological operations and supporting research. Operationally, the USDA supports specialized weather observation networks and also conducts an active supporting research program to ensure an abundance of high-quality agricultural commodities, while minimizing the adverse effects of agriculture on the environment. Under supporting research, USDA focuses on the interactions of weather and climate with plant and animal production and water resources management.

The Department of the Interior's (DOI)

FY 2008 request of \$2.4 million is primarily to support the Bureau of Land Management's Remote Automatic Weather Station (RAWS) program.

The Environmental Protection Agency (EPA) budget request for FY 2008 is \$9.0 million, the same amount as in FY 2007, to provide user-appropriate and scientifically credible air-quality and meteorological programs and models to support regulatory applications.

NASA's FY 2008 request is for just over a total of \$168.7 million--over \$2.3 million for operations and over \$166.4 million for supporting research. These funding levels are composed of the estimated meteorology share of the supporting research and analysis programs as well as Earth Observing System (EOS) and Earth Probe instruments, EOS science, and the EOS Data Information System elements of the NASA Office of Earth Science budget.

The Nuclear Regulatory Commission's (NRC's) request for \$120,000 in FY 2008 is for operations. The NRC will dedicate these funds to obtain and analyze meteorological data and information related to siting new nuclear power plants and safe operation of nuclear facilities, to the protection of public health and safety, and protection of the environment.

FEDERAL COORDINATION (See Appendix A for complete details.)

NATURAL DISASTER REDUCTION

INTERDEPARTMENTAL HURRICANE CONFERENCE

The OFCM annually hosts the Interdepartmental Hurricane Conference (IHC) to provide a forum for the responsible Federal agencies, together with representatives of the user communities such as emergency management, to review the nation's hurricane forecast and warning program and to make recommendations on how to

improve the program. The OFCM hosted the 61st IHC in New Orleans, Louisiana, March 5-9, 2007. The theme of the 2007 conference was *The Nation's Hurricane Program: An Interagency Success Story*. The conference attendance was more than 190 for the eighth consecutive year. VADM Conrad C. Lautenbacher, Jr., USN (Ret.), Under Secretary of Commerce for Oceans and Atmosphere and Administrator of the National Oceanic and Atmospheric Administration (NOAA), set the tone for the meeting during his Monday afternoon keynote address-*The Nation's Hurricane Program: An Interagency Success Story*. He also paved the way for the rollout of the *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead*, one of the conference's principal objectives, by stating that the plan provides a comprehensive strategy to help meet the needs of the tropical cyclone warning and forecast centers and guide improvements in the nation's tropical cyclone forecast and warning program over the next decade. Objectives of the 2007 IHC included the following: (1) review the nation's tropical cyclone forecast and warning program from end-to-end, and update the *National Hurricane Operations Plan* for 2007; (2) evaluate the 2006 Joint Hurricane Testbed (JHT) results and successfully transition research results into operations, as well as potential candidates for 2007 and beyond; and (3) address and build upon the actions and results from the 60th IHC [rollout the *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead* and begin addressing recommendations; and examine how hazard risk reduction improvements can be made through stronger partnerships and alliances]. The IHC proved to be an extremely valuable forum to bring the operational and research communities together to produce the best possible tropical cyclone forecast and warning program, to address the needs of

the Federal agencies and user communities that have a stake in the nation's tropical cyclone program, and also to build interagency consensus for the new strategic research plan for tropical cyclones. Actions resulting from the conference are: (1) publish the *2007 National Hurricane Operations Plan* by May 15, 2007; (2) establish the Working Group for Tropical Cyclone Research to implement the recommendations of the new strategic research plan for tropical cyclones; (3) implement the *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead* [develop a succinct 10-year implementation plan to address the strategic plan's research priorities and update annually; and establish a joint action group to develop a strategic/implementation plan for improved tropical cyclone reconnaissance and surveillance systems]; (4) work with diverse user groups to develop and test message format modifications (60th IHC action) [improved formats and products based on the latest communications technologies should be investigated (a related effort included a collaborative technical workshop, hosted by Texas A&M University in December 2006, to ensure that the new NWS storm-based (polygon) warnings meet the needs of both the public and private sector); two types of messages should be considered (technical and actionable); empirical research should be encouraged and supported to develop and test modifications to current terminology used to define levels of hurricane threat (e.g., watch, warning, CAT 1-5, etc.); current status (work ongoing)]; and (5) the OFCM will coordinate bringing together the appropriate Federal agencies to begin the process of reviewing and improving the national hurricane warning "system" (60th IHC action) [all elements of the full end-to-end "system" (e.g., protocols, responsibilities, NGOs, communications, etc.); current status (completed exploratory review at two loca-

tions-Charleston County, SC, and Mobile County, AL; final report is currently being drafted; the results of the 61st IHC workshop, *Hazard Risk Reduction through Stronger Partnerships and Alliances*, provided additional insights into ongoing efforts related to this action item)]. In May 2007, the 45th edition of the *National Hurricane Operations Plan (NHOP)*, which provides the basis for hurricane reconnaissance for the 2007 season and details Federal agency responsibilities, operations, and procedures; products; aircraft, satellite, radar, and buoy data collection; and marine weather broadcasts, was published based on the inputs and discussions from the 61st IHC. The comprehensive *NHOP* was critical to ensuring successful weather and reconnaissance operations for the 2007 hurricane season. The 2008 IHC is being planned for Charleston, South Carolina.

TROPICAL CYCLONE RESEARCH AND DEVELOPMENT PLAN

The tropical cyclone forecast and warning program is an interdepartmental collaboration to provide the United States and designated international recipients with forecasts, warnings, and assessments concerning tropical and subtropical weather systems. The three centers that cooperate to provide the operational forecast and warning services are the Tropical Prediction Center/National Hurricane Center (TPC/NHC), the Central Pacific Hurricane Center (CPHC), and the Joint Typhoon Warning Center (JTWC). The plan, *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead*, was published in February 2007, and provides a strategy for continuing to improve the effectiveness of operational forecasts and warnings through strategic coordination and increased collaboration among the major players in the operational and research and development (R&D) communities. The plan represents

extensive efforts by the Joint Action Group for Tropical Cyclone Research (JAG/TCR), established by the Federal Coordinator for Meteorological Services and Supporting Research in 2005, to respond to a principal action item, proposed at the 58th Interdepartmental Hurricane Conference in 2004, to develop a comprehensive strategy for tropical cyclone R&D to guide interagency efforts over the next decade. The action item was reviewed and supported by both the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) in November 2004, and the Federal Committee for Meteorological Services and Supporting Research (FCMSSR) in December 2004. The plan notes that vast improvements in tropical cyclone prediction are attainable with focused research efforts; enhanced transition of research to operations capabilities; and strong interagency partnerships, coordination, and planning. The capability to gain skill in forecasting rapid intensity changes and to improve predictions of hurricane intensity and structure, sea state/storm surge, and precipitation is currently on the horizon, much as improving hurricane track was two decades or so ago. The ultimate goal is to prevent loss of life and injuries and to reduce the nation's vulnerability to these potentially devastating storms. This goal can and must be accomplished for the good of the nation.

EXPLORATORY REVIEW

During this period, the OFCM conducted an exploratory review, a first step in an end-to-end assessment of our national warning system for natural and technological hazards (with an initial focus on tropical cyclones). The exploratory review was responsive to an Interdepartmental Hurricane Conference action item as well as a recommendation of the *Interagency Strategic Research Plan for Tropical Cyclones-The Way Ahead*. It was performed in

two locations prone to tropical cyclones-Mobile County, Alabama, and Charleston County, South Carolina. The emphasis of the review was on the tropical cyclone information flow from the emergency management community to the various organizations and entities and citizens of a community. The objectives of the exploratory review were to: (1) understand and document the information flow; (2) summarize information flow requirements and gaps; and (3) provide follow-on considerations to improve the flow that would ultimately aid in saving lives, reducing injuries, and protecting property. The review noted that the majority of citizens receive tropical cyclone information through one or more communications means: television, radio, newspaper media; computer internet and email; and NOAA Weather Radio. The review also noted the need to continue efforts to ensure the poor, elderly, disabled, non-English speaking, individuals with medical concerns, and those in outlying areas receive vital tropical cyclone information. The review also noted that NOAA Weather Radio should be used as much as possible to disseminate evacuation notices as well as tropical cyclone and other weather warnings; community-based organizations such as churches, civic groups, and neighborhood associations should be encouraged to form notification call trees to further disseminate information; and Mobile and Charleston Counties and the entire network of public and private entities involved in improving the public alert and warning system must continue to account for the entire demographics of the at-risk population. The OFCM is preparing the report for the exploratory review which the office has begun, with an initial focus on tropical cyclones, in an end-to-end assessment of our national warning system for natural and technological hazards. The report will include recommendations for future

work and inclusion of information dissemination issues for other hazards such as tornadoes and human-caused hazards.

URBAN METEOROLOGY

NATIONAL WILDLAND FIRE WEATHER NEEDS ASSESSMENT

An important contribution to urban meteorology during the period of this report is related to the *National Wildland Fire Weather Needs Assessment* which is being conducted by OFCM. The formation of the Joint Action Group for National Wildland Fire Weather Needs Assessment (JAG/NWFWNA) and conduct of the assessment is responsive to ICMSSR Action Item 2005-1.1 where ICMSSR "concurred that OFCM should move forward to form a Joint Action Group (JAG) under the Committee for Environmental Services, Operations, and Research Needs (CESORN), to review the needs and requirements for wildland fire weather information, to include identifying organizational responsibilities and addressing the following issues: data collection, fire weather research, weather forecast services, data assimilation, air quality, information dissemination, education and outreach, and user response." An abundance of accumulated biomass in forests and rangelands, persistent drought conditions, and encroaching urbanization are contributing to larger, more costly wildland fires; and to effectively manage and suppress wildland fires, fire managers need timely, accurate, and detailed fire weather and climate information. 2005 and 2006 were record years for acres burned; acres burned have trended upwards more than 100 percent since the mid-1980's; and wildland fire suppression, preparedness, fuels management, and other activities receive approximately \$2.7 billion in Federal annual funding.

An important benchmark is the June 2005 Western Governors' Association

(WGA) meeting where they approved Policy Resolution 05-04: National Wildland Fire Weather Program. Within the policy, the WGA urged NOAA to have the OFCM complete a *National Needs Assessment Report* of Federal, state, and local fire managers' needs for weather information in their wildfire and prescribed fire decision making processes and a framework to meet those needs by the National Weather Service and Predictive Services. The JAG/NWFWNA was established in December 2005, and has moved forward to conduct the assessment. The OFCM conducted a Special Session on wildland fire weather and climate use in decision making at the 3rd International Fire and Ecology Congress, November 14, 2006, in San Diego, California; briefed the Interdepartmental Committee for Meteorological Services and Supporting Research at its July 18, 2006, and May 31, 2007, meetings; presented a summary of user needs and issues at the June 10-12, 2007, Western Governors' Association meeting in Deadwood, South Dakota; and is completing a detailed report of user needs and issues, and a framework to meet the needs. In connection with this activity, the Chairman of the Western Governors' Association, Governor M. Michael Rounds, in a June 26, 2007 letter, thanked the Federal Coordinator and the OFCM team for the great work on the wildland fire needs assessment, and for the Federal Coordinator's presentation of the initial assessment to the governors at the WGA Annual Meeting in Deadwood, South Dakota.

CLIMATE

The OFCM supports the U.S. Climate Change Science Program (CCSP). The OFCM arranged for the former Director of the CCSP to brief the Federal Committee for Meteorological Services and Supporting Research (FCMSSR) so that member agencies can stay abreast of the program and coordinate priorities for

atmospheric requirements through the OFCM for inclusion in CCSP, and forwarded to the CCSP results of a Climate Services Survey to identify new climate products and services that have been developed and implemented since the Board on Atmospheric Sciences and Climate defined "climate services" in 2001, as "the timely production and delivery of useful climate data, information, and knowledge to decision makers." Also the Federal Coordinator, through his participation on the Committee on Environment and Natural Resources (CENR), reviewed and provided concurrence on a number of U.S. CCSP Synthesis and Assessment Products

Additionally, the OFCM is preparing for a meeting of the Committee for Climate Analysis, Monitoring, and Services which will be centered on extreme weather events. The goal is to be proactive in answering a number of questions, to include:

- Are the numbers and magnitude of extreme weather events on the increase?
- Can these extreme weather events be related to climate change?
- What is our capability to model and forecast these extreme events?
- Do our climate models have any skill in forecasting extreme events?
- What are the needs and requirements for climate services related to extreme weather events?
- What are the gaps in our capabilities to meet these needs?
- What will it take to fill these gaps—more research (basic and applied), more/better observations, improved models, etc.?

WEATHER INFORMATION FOR SURFACE TRANSPORTATION

Since 1998, the OFCM has made weather services and research and development (R&D) activities supporting the surface transportation com-

munity a priority for the Federal meteorological community. In December 2002, the OFCM published the comprehensive report, *Weather Information for Surface Transportation-National Needs Assessment Report*, which provides the first-ever compilation and analysis of weather support needs across six surface transportation sectors (roadway, railway, transit, marine transportation, pipeline systems, and airport ground operations). In August 2004, OFCM established the Working Group for Weather Information for Surface Transportation (WG/WIST) to develop both a *WIST R&D Plan* and a *WIST Implementation Plan*. The OFCM also conducted two WIST workshops June 6-7 and June 13-14, 2006, with the objectives to: (1) help determine the priorities for the surface transportation weather information research needed to provide improved weather information and services to the surface transportation community; (2) gather and crossfeed information concerning ongoing or planned (next 3 years) surface transportation weather-related research and development; and (3) hear from workshop attendees on what they see as a vision (3-10+ years) on how weather information will be used to optimize surface transportation operations and safety, and what specific hurdles must be overcome to reach such a vision. Information from these workshops has been reviewed and organized to support continued progress in this important area, which will lead to the *WIST R&D Plan* and *WIST Implementation Plan* mentioned above. In addition, in August 2006, OFCM published the report, *Weather Information for Surface Transportation-Update on Weather Impacts and WIST Results*. This update focused on the status of transportation weather issues in the nation and the results achieved since the first WIST report in 2002. It also highlighted areas where further steps can be made in the near term. When

statewide transportation incident reporting systems are implemented, we will be able to monitor, assess, and manage transportation weather risks, as well as evaluate the benefits of WIST-informed transportation decisions. R&D programs are in progress to improve warnings and decision support systems, implement weather-responsive traffic management in communities, and provide the observational support necessary for location-specific WIST

During the period of this report, OFCM attended and participated in the National Research Council Transportation Research Board (TRB) 86th Annual Meeting in Washington, D.C., January 21-25, 2007; the Intelligent Transportation Society of America (ITS-A) 2007 Annual Meeting and Exposition in Palm Springs, California, June 4-6, 2007; and the Mid-Continent Transportation Research Symposium in Ames, Iowa, August 16-17, 2007.

Very importantly, from July 25-27, 2007, OFCM and the Federal Highway Administration Road Weather Management Program cosponsored the Third National Symposium on Surface Transportation Weather in Vienna, Virginia. The symposium theme was *Improving Commerce and Reducing Deaths and Injuries through Innovative, Weather-related R&D and Applications for the Surface Transportation System*. The goal of the symposium was to advance the state of the surface transportation weather enterprise, including the use of weather and climate information to support decision making, safety, and productivity within the six surface transportation modes and related industries. Objectives were to: (1) Articulate a clear observation strategy for surface transportation weather that defines the types of data that are needed and the optimal mix of observing platforms required to meet those needs; (2) Identify the priorities, challenges, and opportunities for

research and development that will contribute to saving lives, reducing injuries, and improving efficiency in the nation's surface transportation infrastructure; (3) Define the needs for advanced computing capacity required for surface transportation weather modeling and for the assimilation of data from multiple data sources; (4) Identify the needs for new products and services driven by current operations or concepts for future surface transportation systems; (5) Investigate opportunities to document and substantiate the socioeconomic impacts of improved surface transportation weather products and services; (6) Identify the potential and emerging information dissemination technologies available to get the "right message" to surface transportation weather stakeholders; and (7) Establish partnerships with the stakeholder community to ensure that customers and stakeholders understand how to effectively use surface transportation weather products and services in their decision-making processes.

Information stemming from the eight symposium sessions was summarized into categories that cut across many of the sessions. The categories are: current and emerging capabilities and transition of research to operations activities to improve products and services; getting the right message out-need for social science involvement; education and outreach; need for metrics to measure success and guide resource allocation; gaps and research priorities; and opportunity for a near-term intermodal initiative. Action items from the symposium are:

- The background work has been done and there is a need for more significant interagency coordination and support.
- Within the OFCM infrastructure, ICMSSR should consider raising the level of agency representation for WG/WIST to a level more appropriate for supervising work that falls within

and under the WG/WIST's purview.

- The community should seriously consider requesting OFCM-sponsored Joint Action Group(s) be formed to accomplish actions outlined below. The JAG(s) would be aligned under the WG/WIST.

- Develop an integrated observing strategy to include identification of critical new surface transportation weather and road condition sensor needs.

- Establish several high-level R&D priorities for agencies to focus on and to collaborate with the academic community and the private sector.

- Improve interagency coordination of products and services for common applications (joint use/cross-feed/new requirements).

- Consider sponsoring a multi-mode surface transportation weather demonstration project (road/rail/maritime/pipeline/etc.).

- Conduct socioeconomic surveys of impacts and needed format/semantic changes to improve understanding and usability of required products and services.

- Consider fast tracking a Post-Doctoral position assigned to the National Centers for Environmental Prediction/Environmental Modeling Center, focused on surface transportation needs for modeling and prediction and products and services.

Subsequent to receiving a summary of the symposium, Mr. Jeffrey N. Shane, Undersecretary of Transportation for Policy, U.S. Department of Transportation, especially noting the research priorities detailed in the summary, stated that he is working hard to scope out some fresh approaches to financing and program organization for surface transportation weather. Mr. Shane also noted that this could be an important opportunity to "mainstream" our weather-related research and ensure a more predictable funding stream.

SPACE WEATHER

It was noted at the November 16, 2004, and December 1, 2004, meetings of the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) and Federal Committee for Meteorological Services and Supporting Research (FCMSSR), respectively, that the National Space Weather Program (NSWP) was nearing the end of its 10-year period to accomplish its overarching goal to achieve an active, synergistic, interagency system; providing timely, accurate, and reliable space weather warnings, observations, specifications, and forecasts by 2007. It was also noted that it was time to perform an interagency assessment to look at the progress toward meeting its goals. A National Space Weather Program Assessment Committee was formed by OFCM to perform the assessment, which was led by Dr. Louis J. Lanzerotti, Distinguished Research Professor, Center for Solar-Terrestrial Research, New Jersey Institute of Technology. The charge to the Assessment Committee was to review the NSWP to quantify and document the progress toward meeting the NSWP stated goals in observations, research, modeling, transition of research to operations, and education and outreach; to see if the program is still on target and moving in the direction pointed to by the *Strategic Plan*; to determine whether the strategic goals should be adjusted at this time based on emerging/evolving requirements; and to suggest a way ahead which will form a basis for a new strategic plan covering the next 10 years. The committee's activities in conducting the assessment included briefings at OFCM; visits to the National Security Space Office, National Reconnaissance Office, NOAA's Space Environment Center, U.S. Geological Survey, Air Force Space Command, Air Force Weather Agency, Air Force Space Weather Operations, STRATCOM,

and Air Force Research Laboratory; community and user questionnaires; and issuance of a September 2005 interim report. Important reference sources were the *National Security Space Architecture 2000: Space Weather Architecture*; U.S. Department of Commerce Service Assessment, April 2004; and the *National Academies report, The Sun to the Earth-and Beyond: A Decadal Research Strategy in Solar and Space Physics, 2002*.

In its *Report of the Assessment Committee for the National Space Weather Program* (June 2006), the Assessment Committee concluded that, since the program's inception in 1995, it has had a number of noteworthy achievements, most of which likely would not have been attained without the program's existence. The committee also found shortfalls in the program. The report identified the significant potential of the NSWP to enhance the nation's space weather mission through improved operational capabilities, which capitalize on the transition of innovative research. Moving NOAA's operational space weather prediction center (i.e., the Space Environment Center) from its research organization to the National Weather Service was a positive step to improve operational focus within the NSWP. The committee made a number of recommendations to further strengthen the NSWP in the areas of (1) centralized program management, national priorities, and increased effectiveness; (2) continuity of data sources; (3) strengthening the science-to-user chain; and (4) public and user awareness of space weather.

It was agreed that the *Report of the Assessment Committee for the National Space Weather Program* should proceed for consideration by the National Space Weather Program Council (NSWPC), and that the Program Council should be the executive agent for FCMSSR for continuing activities in this area. The NSWPC has

accepted the report and has begun taking actions to address the report's recommendations.

Space weather activities include continuing to implement the recommendations of the *Report of the Assessment Committee for the National Space Weather Program*, and creating a Space Weather Implementation Plan (SWxIP) as requested by the Committee on Environment and Natural Resources (CENR) Subcommittee for Disaster Reduction (SDR). Space weather was identified as one of the SDR's Grand Challenges for Disaster Reduction and SDR requested that the OFCM spearhead an effort, through the NSWP, to develop the SWxIP.

The OFCM also sponsored the American Meteorological Society policy workshop on "Integrating Space Weather Observations and Forecasts into Aviation Operations" which was held November 29-30, 2006, in Washington, D.C., that led to recommendations on how to improve the safety and operations of the aviation system through better integration of space weather information. The workshop revealed that there are four main policy issues that need to be addressed to ensure the best use of current space weather information: communication, standardization of information and regulations, education and training, and cost benefit and risk analysis. The report of the policy workshop was issued in March 2007; it provided detailed recommendations for each of the main policy areas.

The OFCM also formed a Joint Action Group for Space Environment Sensors (JAG/SES) to address guidance from the Office of Science and Technology Policy (OSTP), requesting that the OFCM conduct, through its Federal coordinating infrastructure, an assessment of the impacts on the National Space Weather Program of Nunn-McCurdy certification of the National Polar-orbiting Operational Environmental Satellite System

(NPOESS) program, which resulted in a significant decrease in the capability of the space environment sensor (SES) suite previously manifested on NPOESS. The assessment will be completed in the fall of 2007.

On April 4-5, 2007, the OFCM participated in the first-ever Space Weather Enterprise Forum which was held in Washington, D.C. NOAA and NASA, in cooperation with partner agencies, sponsored the forum to address the economic, societal, and national security impacts of space weather with a principal focus on assessing the growing future needs of a rapidly growing technological world economy. Special focus was given to the impact of space weather on national security, aviation, communications, global positioning system applications, spacecraft operations, space exploration, and electric power grids. The OFCM also participated in Space Weather Workshop April 24-27, 2007, in Boulder, Colorado. The Space Weather Workshop, which was sponsored by NOAA's Space Environment Center and partners, is for users and researchers interested in space weather.

PHASED ARRAY RADAR

The OFCM Joint Action Group for Phased Array Radar Project (JAG/PARP) completed the report, *Federal Research and Development Needs and Priorities for Phased Array Radar* (June 2006). It is responsive to ICMSSR Action Item 2004-2.3 where ICMSSR supported the joint action group's "continued work to identify and document the potential needs and benefits that phased array radar and an adaptive radar sensing strategy would address, and to integrate those identified needs into a multiagency-coordinated R&D plan that would focus R&D efforts on meeting each agency's need." The report identified research and development for the next 9 years to capitalize on the replacement oppor-

tunity. This would include research to reduce risk, determine the capability of multifunction phased array radar (MPAR) to meet multiple user needs concurrently, develop a full MPAR prototype, and perform a cost analysis to determine system affordability. Delays in performing the necessary MPAR research, development, and testing could result in a missed opportunity to replace legacy radars. At its July 18, 2006, meeting, ICMSSR decided that an MPAR interagency working group should be established within the OFCM infrastructure with a defined charter to develop a strategy to address the key findings and recommended next steps in the MPAR report, and agency comments from the ICMSSR meeting. The Working Group for Multifunction Phased Array Radar (WG/MPAR) was established in September 2006. Cochairs for WG/MPAR are Dr. James F. Kimpel, Director of the NOAA National Severe Storms Laboratory (NSSL); Col Michael Babcock, USAF, Air Force Weather Deputy for Federal Programs; Mr. James H. Williams, Director of Systems Engineering for the Federal Aviation Administration; and Mr. Kevin "Spanky" Kirsch of the Science and Technology Directorate, Department of Homeland Security.

Benefits of an affordable MPAR include: potential replacement for the aging fleet of mechanically scanning radars over the next 20 years; allows consolidation of multiple single-mission radars into a single system, reducing the national radar fleet by more than 40 percent, saving nearly \$5 billion over a 30-year lifecycle; provides both air and weather surveillance from a single radar site; no moving parts, lower maintenance costs; multiple transmit/receiver components, avoiding single point of failure; scalable design of prototype will provide proof of concept for future MPAR; better weather measurements; increased safety and capacity in severe weather

conditions; terminal and en route surveillance; homeland security; and discrimination of non-meteorological hazards such as volcanic ash, airborne debris, smoke detection and tracking, and biological scatterers such as bird flocks.

Future efforts include: (1) Develop an affordable MPAR prototype for civilian use; (2) Refine radar requirements and lay the groundwork for MPAR cost/benefit analysis; (3) Implement the 9-year research and development plan proposed in the report, *Federal Research and Development Needs and Priorities for Phased Array Radar*; (4) Establish contacts and initiate partnerships with industry leaders in phased array technology; (5) Coordinate agency programming for the MPAR risk reduction effort; (6) The Board on Atmospheric Sciences and Climate evaluation of the MPAR planning process to date, *Evaluation of the Multifunction Phased Array Radar Planning Process*; (7) The MPAR Symposium, October 10-12, 2007, in Norman, Oklahoma, which will engage Federal stakeholders, academia, and industry; (8) Working Group for Multifunction Phased Array Radar (WG/MPAR) continue to refine user requirements; and (9) solidify technical requirements for the MPAR system, including engineering trade studies to balance user needs with lowest cost.

In a June 1, 2007 letter of commendation to the Federal Coordinator, Brig Gen Lawrence A. Stutzriem, USAF, Director of Weather, emphasized that MPAR will have a direct influence on the Air Force's capabilities. He also noted that other relevant, important projects in which OFCM is engaged include space weather, wildland fire, tropical cyclones, weather information for surface transportation, and volcanic ash. Also, in a January 31, 2007, Program Decision Memorandum issued by VADM Conrad C. Lautenbacher, Jr., USN (Ret.), Undersecretary of

Commerce for Oceans and Atmosphere and NOAA Administrator, the Admiral emphasized evaluating the electronically steered MPAR as an alternative to mechanically steered conventional radar to meet severe and non-severe weather and aviation weather service requirements and to track the release of toxic agents as input into atmospheric dispersion forecasts; and, also, if the technical trade-off study and preliminary cost-benefit analysis support transitioning MPAR to operations, development of a transition plan for this purpose. The Program Decision Memorandum also included highlights for OFCM's hurricane, wildland fire, and weather information for surface transportation activities.

ATMOSPHERIC RESEARCH AND DATA ASSIMILATION/DATA MANAGEMENT

Advances in data assimilation are key to meeting virtually any forecast goal relating to model performance. It was stated in the *Strategic Plan for the U.S. Integrated Earth Observation System* (April 2005) that "In order to take the 'pulse of the planet,' we must establish a valid end-to-end process that will take us from observations to user-related products. Scientific needs for this end-to-end process require that we ... assimilate the Earth observation data streams into models (eventually in real time) ..." and "Data assimilation may be the most critical path through which advances in forecasting convective precipitation will be modulated." At its November 16, 2004, meeting, the Interdepartmental Committee for Meteorological Services and Supporting Research (ICMSSR) supported action to examine gaps in data assimilation and data management capability, articulate challenges that lie ahead in meeting future requirements, and propose strategy to address gaps in capability and future challenges. And Action Item 2004-1.2 from the Federal

Committee for Meteorological Services and Supporting Research (FCMSSR) December 1, 2004, meeting, recommended that: FCMSSR agencies will support R&D needs and requirements based on agency priorities and will continue to identify issues and concerns that are necessary for the development of capabilities required to realize societal benefits; Federal requirements and capabilities in key areas like data assimilation need to be surveyed and further addressed; and FCMSSR agencies will support and facilitate opportunities for the transition of research into operational applications.

The data assimilation survey and follow-on strategy was briefed at the July 18, 2006, ICMSSR meeting. It was noted that the focus of the report which is being prepared is on data assimilation for the purpose of improving forecast skill of a numerical weather prediction (NWP) model; the scope of data assimilation is restricted to incorporation of observational data as a forcing factor in cycles of forward NWP models; and broader definition of data assimilation would be addressed through inclusion of related activities such as climate reanalysis, trace constituent monitoring, and air quality. Key data assimilation issues are:

- Data delivery and standard formatting.
- How best to evolve assimilation techniques over time to meet future application challenges.
- Early delivery of new instrument data.
- Testing and transitioning new data assimilation techniques and concepts into "hardened" data assimilation instruments for operational use.
- Availability of high performance computing and trained personnel.
- Data staging and delivery required for Global Earth Observation System of Systems (GEOSS)-level infrastructure capability.

• Education and public outreach: implications for data assimilation and modeling.

Data gathering and data assimilation activity analysis tasks are essentially complete; the report framework and key issues have been defined by the data assimilation group; and next steps are being defined. The draft report, *Federal Meteorological Data Assimilation Capabilities*, will be coordinated with ICMSSR at its November or December 2007 meeting.

CROSSCUTTING HYDROMETEOROLOGICAL ASSESSMENT

During this period the OFCM began a crosscutting assessment of Federal agency hydrometeorological products, services, and supporting research. The three primary objectives of the assessment are: (1) define the needs and requirements for hydrometeorological products, services, and supporting research for the Federal agencies and the customers they support; (2) investigate agency plans and alternatives for satisfying new requirements; and (3) create more efficient and effective partnerships among the agencies to better leverage subject-matter expertise and resources to meet the growing needs for better hydrometeorological products and services. Agencies which will be involved include: NOAA (National Weather Service and National Ocean Service-principal providers); Department of Interior (U.S. Geological Survey-stream flow, streamgaging, flood monitoring, ground-water climate response network; U.S. Bureau of Reclamation-dams, reservoirs, and *Agrimet* and *Hydromet* operations; U.S. Fish and Wildlife Service-coastal ecosystems; and National Park Service-tourism and natural resource monitoring and management); Department of Agriculture (USDA-drought monitor; National Resources Conservation Service-conservation and watershed planning); Department of Defense (U.S. Army

Corps of Engineers-flood plain management, Gulf Coast Hurricane Protection System); Department of Homeland Security (Federal Emergency Management Agency-National Flood Insurance Program, flood hazard mapping, post-storm data acquisition; U.S. Coast Guard-protect against degradation of natural resources associated with maritime transportation, fishing, and recreational boating); Environmental Protection Agency-water resource protection; and National Aeronautics and Space Administration-remote sensing. A key element of the assessment is to engage the users of this Federal information and the OFCM is ensuring that we understand the needs of user groups such as the National Emergency Management Association, International Association of Emergency Managers, Association of State Floodplain Managers, National Hydrologic Warning Council, American Meteorological Society, and the media (e.g., The Weather Channel and other TV broadcasters).

nization International Airways Volcano Watch

- *Federal Meteorological Handbook No. 11-Doppler Radar Meteorological Observations; Part A-System Concepts, Responsibilities and Procedures*

- *Federal Meteorological Handbook No. 11-Doppler Radar Meteorological Observations; Part C-WSR-88D Products and Algorithms*

PUBLICATIONS

The following publications were prepared in hardcopy and/or have been placed on OFCM's Web site (www.ofcm.gov):

- *The Federal Plan for Meteorological Services and Supporting Research-Fiscal Year 2007*

- *National Hurricane Operations Plan*

- *Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead*

- *Federal Plan for Cooperative Support and Backup Among Operational Processing Centers*

- *The National Volcanic Ash Operations Plan for Aviation and Support of the International Civil Aviation Orga-*

