

## **BUDGET ACTIVITY: OCEANIC AND ATMOSPHERIC RESEARCH**

For FY 2012, NOAA requests a net decrease of \$11,233,000 and an increase of 4 FTE over the FY 2010 enacted level, after the technical transfer of programs to the new Climate Service, for a total of \$212,013,000 and 472 FTE for the Office of Oceanic and Atmospheric Research (OAR). This increase includes \$2,768,000 in inflationary adjustments. The technical transfer proposed for the creation of the new Climate Service line office includes \$225,899,000 and 276 FTE associated with the Climate Program Office, the Geophysical Fluid Dynamics Laboratory, and components of the Earth System Research Laboratory (ESRL), including the Chemical Sciences Division, Physical Sciences Division, and Global Monitoring Division.

As part of an effort to strengthen science along with the reorganization, NOAA will look to OAR to play an expanded role as the incubator and integrator of science and technology across NOAA. The agency will rely on OAR to coordinate and develop such emerging and integrative subjects as ocean acidification, renewable energy, “warn on forecast,” unmanned aircraft systems and autonomous underwater vehicles, and emphasize areas that are important challenges for NOAA, such as ecosystem science beyond the scope of fisheries-related applications. OAR will also serve as a programmatic lead for environmental modeling as we move to truly integrated modeling that spans the full domain of physical, chemical, and biological. When mature, the products or activities of these subjects will transition to another Line Office for operation or application.

### **BASE JUSTIFICATION FOR FY 2012:**

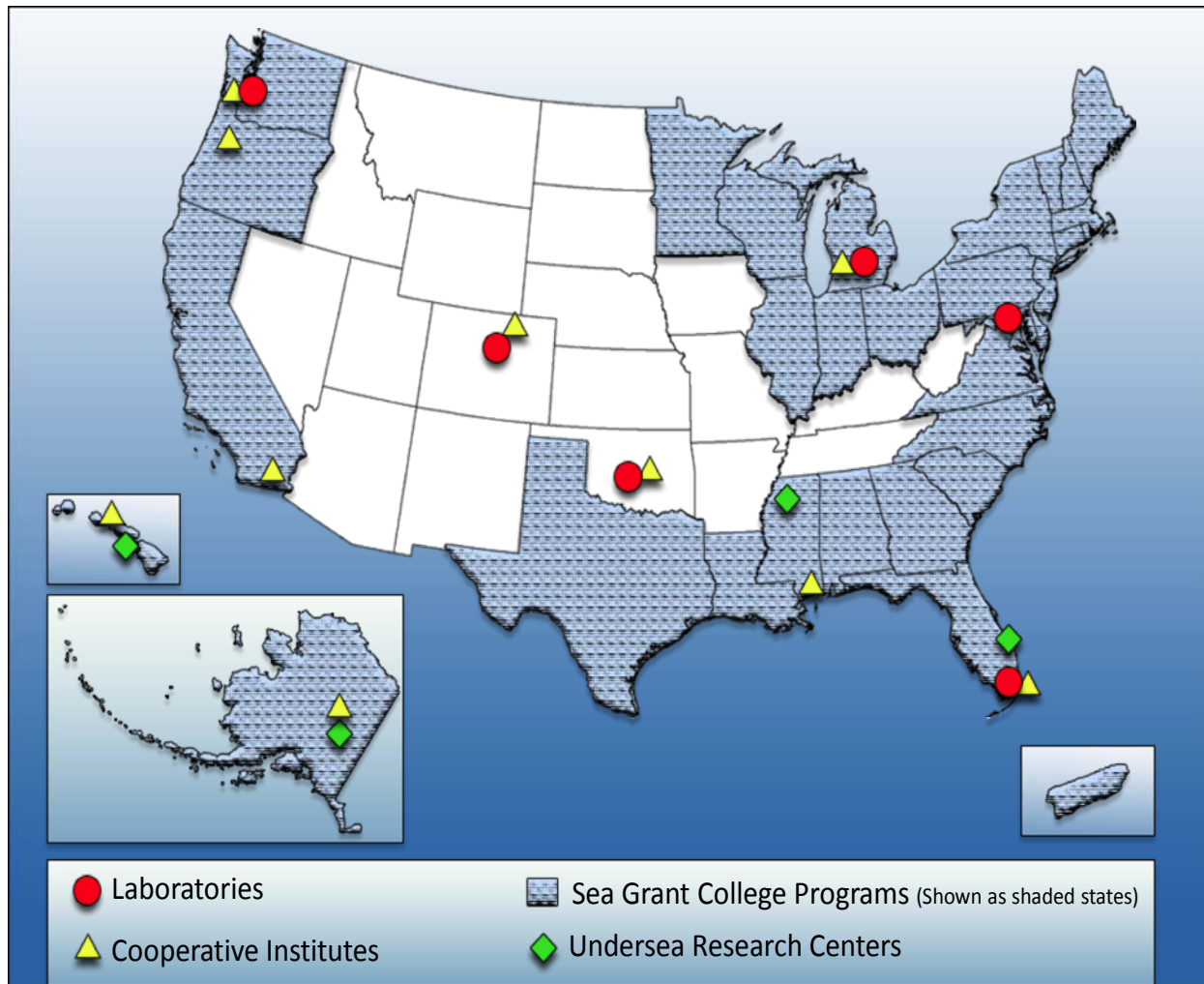
The OAR base budget (\$227,514,000 and 469 FTE) is organized into 4 subactivities under the Operations, Research, and Facilities account:

- Climate Research (\$22,182,000 and 110 FTE) includes interdisciplinary Laboratories and Cooperative Institutes that provide a unique OAR climate role via Earth systems modeling; improve observing and monitoring systems essential for climate, oceanographic, and ecosystems research, monitoring and data management; and advance research capabilities for seasonal, interannual, and longer-term climate variability.
- Weather and Air Quality Research (\$50,647,000 and 183 FTE) includes Laboratories and Cooperative Institutes and Weather and Air Quality Research Programs that develops improved understanding and forecast capabilities for atmospheric events that endanger lives and property;
- Ocean, Coastal, and Great Lakes Research (\$121,972,000 and 163 FTE) includes Laboratories and Cooperative Institutes, the National Sea Grant College Program, Ocean Exploration and Research, and Other Ecosystem Programs, which develop innovative management tools through a better understanding of habitats, processes, and resources;
- Information Technology Research & Development (\$13,213,000 and 13 FTE) includes High Performance Computing Initiatives, which seek to accelerate the adoption of advanced computing, communications, and information technology throughout NOAA.

OAR conducts research and development relevant to NOAA's mission. OAR operates through a national network of laboratories and other university-based research programs. OAR manages its budget through five organizational components: Laboratories and Cooperative Institutes, National Sea Grant College Program, Office of Ocean Exploration and Research (OER), Office of Weather & Air Quality, and the NOAA High-Performance Computing and Communications Program.

## OAR Laboratories and Cooperative Institutes

OAR has six laboratories across the United States that administer and manage research programs, emphasize theoretical and analytical studies, and conduct laboratory experiments and field observations. These laboratories collaborate with numerous external partners, including NOAA-funded cooperative institutes. The primary purposes of the laboratories and cooperative institutes are to improve NOAA products and services and to provide the basis for improved decision making by policy makers and the public.



### Research Laboratories

- **Air Resources Laboratory (ARL)** is headquartered in Silver Spring, MD, and has research divisions in Oak Ridge, TN, Idaho Falls, ID, and Las Vegas, NV. ARL carries out research on air quality, atmospheric dispersion, and climate, with a focus on conditions near the Earth's surface that affect people and ecosystems. ARL's air quality work includes improving NOAA's operational air quality prediction capabilities for ozone and fine particulate matter and providing information on the relationships between sources of air pollution and sensitive ecosystems (e.g., sources of mercury affecting water bodies). ARL also improves the Nation's ability to respond to significant unexpected releases of harmful materials into the atmosphere from nuclear mishaps, volcanic eruptions, industrial accidents, terrorist attacks, and other events. ARL's work includes the development of widely used atmospheric

dispersion prediction tools and improving the Nation's ability to predict dispersion of materials in urban areas. ARL's climate work includes improving the understanding climate processes, variability, and change through the development and application of specialized climate measurements systems and the analysis of key global climate observations. More information about ARL is available at <http://www.arl.noaa.gov/>.

- **Atlantic Oceanographic and Meteorological Laboratory (AOML)** in Miami, FL, conducts research in oceanography, tropical meteorology, atmospheric and oceanic chemistry, and acoustics. AOML scientists study hurricanes, ocean current and temperature structures, ocean-atmosphere chemical exchanges, coral reefs and the coastal ocean. AOML primarily contributes scientific research to improve prediction and forecasting of tropical cyclones and severe weather, better use and manage marine resources, better understand the factors affecting both climate and environmental quality, and to improve ocean and weather services. More information about AOML is available at <http://www.aoml.noaa.gov/>.
- **Global Systems Laboratory (GSL)** in Boulder, CO, incorporates new findings in atmospheric, oceanic, and hydrologic sciences into systems designed to improve understanding of climate and weather at all time scales through new observation techniques, innovative diagnostic and predictive models, advanced computational analysis, and leading-edge workstation display technology. More information about the Global Systems Division (being converted to a Laboratory in the proposed NOAA reorganization) can be found within the current Earth System Research Laboratory web site: <http://www.esrl.noaa.gov/gsd/>.
- **Great Lakes Environmental Research Laboratory (GLERL)** in Ann Arbor, MI, conducts integrated interdisciplinary environmental research in support of resource management and environmental services in coastal and estuarine waters, with a primary emphasis on the Great Lakes. The laboratory performs field, analytical, and laboratory investigations to improve understanding and prediction of biological and physical processes in estuaries and coastal areas and interdependencies with the atmosphere and sediments. GLERL emphasizes a systematic approach to problem-oriented research in order to develop effective environmental service tools. More information about GLERL is available at: <http://www.glerl.noaa.gov/>.
- **National Severe Storms Laboratory (NSSL)** in Norman, OK, conducts weather research aimed at improving the accuracy and timeliness of forecasts and warnings of hazardous weather events such as thunderstorms, blizzards, ice storms, flash floods, tornadoes, and lightning. NSSL has a varied research mission supporting an enhanced understanding of weather processes, improved forecast and warning techniques, new operational applications and advanced radar technologies, and a series of field studies to support theoretical research and modeling. Advances at NSSL contribute to improved operational capabilities, knowledge, and techniques at the National Weather Service and other agencies. More information about NSSL is available at: <http://www.nssl.noaa.gov/>.
- **Pacific Marine Environmental Laboratory (PMEL)** in Seattle, WA, carries out interdisciplinary scientific investigations in oceanography, marine meteorology, and related subjects. Open-ocean observations and modeling work at PMEL improve our understanding of the various processes operating in the world oceans. These observations also support NOAA's environmental forecasting capabilities and services that support marine commerce and fisheries, including tsunami forecasting, ocean circulation, and fish and shellfish stocks

prediction. PMEL also supports an undersea observation and research program in Newport, OR. More information about PMEL is available at: <http://www.pmel.noaa.gov/>.

Cooperative Institutes (<http://www.nrc.noaa.gov/ci>)

OAR has cooperative institute partnerships with academic and scientific institutions to foster long-term collaborations dedicated to advancing oceanic and atmospheric research. These cooperative institutes are usually co-located with one or more NOAA facilities to promote scientific exchange and technology transfer, and provide valuable capabilities and expertise to supplement OAR laboratory work.

The primary purpose of each institute is to create a mechanism to bring together the resources of a research-oriented university or institution, OAR, and other branches of NOAA in order to develop and maintain a center of excellence in research. Each Cooperative Institute represents a synergy that has brought together NOAA and premier academic and scientific institutions in a mutually beneficial arrangement to address issues of national and international significance unique to these partnerships. Among the broad range of topics that Cooperative Institutes address are the Earth's oceans, the Great Lakes, inland waters, Arctic regions, solar terrestrial environment, the intermountain West, and the atmosphere. These partners pool resources to produce the best possible interdisciplinary scientific research and outreach. The institutes are:

- The **Cooperative Institute for Alaska Research (CIFAR)**, located at the University of Alaska-Fairbanks, AK, conducts research on ecosystem function, coastal hazards, and climate change and variability. CIFAR collaborates primarily with the Climate Service (CS) and PMEL.
- The **Cooperative Institute for Limnology and Ecosystems Research (CILER)** is a ten-member consortium of academic institutions in the Great Lakes region. CILER is administratively housed at the University of Michigan in Ann Arbor, MI. CILER conducts research on Great Lakes forecasting, invasive species, observing systems, protection and restoration of resources, and integrated assessment. CILER collaborates primarily with GLERL.
- The **Cooperative Institute for Marine and Atmospheric Studies (CIMAS)**, located at the University of Miami in Miami, FL, conducts research on climate variability, fisheries dynamics, regional coastal ecosystem processes, human interactions with the environment, air-sea interactions and exchanges, and integrated ocean observation. CIMAS collaborates primarily with AOML and the NMFS Southeast Fisheries Science Center.
- The **Cooperative Institute for Mesoscale Meteorological Studies (CIMMS)**, located at the University of Oklahoma (OU) in Norman, OK, conducts research on basic convective and mesoscale research, forecast improvements, climatic effects of/controls on mesoscale processes, socioeconomic impacts of mesoscale weather systems and regional-scale climate variations, Doppler weather radar research and development, and climate change monitoring and detection. CIMMS collaborates primarily with NSSL and several NWS components.
- The **Cooperative Institute for Marine Resource Studies (CIMRS)**, located at Oregon State University, Corvallis, OR, conducts research on West Coast fisheries, ocean environment, and marine mammal acoustics. CIMRS collaborates primarily with PMEL and NWFSC.

- The **Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT)**, located at Florida Atlantic University's Harbor Branch Oceanographic Institution in Fort Pierce, FL, conducts research on the development of advanced underwater technologies, exploration and research in the frontier regions of the eastern U.S. continental shelf, and vulnerable deep and shallow coral reefs. CIOERT collaborates primarily with the Office of Ocean Exploration and Research (OER) as a NOAA Undersea Research Program (NURP) regional center. Since this center replaced four NURP undersea research centers on the East Coast, it is identified as an undersea research center on the above OAR map.
- The **Cooperative Institute for Research in the Atmosphere (CIRA)**, located at the Colorado State University in Fort Collins, CO, conducts research on satellite algorithm development training and education, regional- to-global-scale modeling systems, data assimilation, climate-weather processes, and data distribution. CIRA collaborates primarily with the Boulder Labs and NESS satellite programs.
- The **Cooperative Institute for Marine Ecosystems and Climate (CIMEC)** is a consortium of seven California universities, led by Scripps Institution of Oceanography at the University of California, San Diego (SIO/UCSD), that includes: California State University, Los Angeles (CSU LA); Humboldt State University; the University of California, Santa Barbara (UCSB); and University of California, Santa Cruz (UCSC). CIMEC conducts research under four research themes: (1) climate and coastal observations, analysis, and prediction; (2) climate research and impacts; (3) marine ecosystems; and (4) ecosystem management. CIMEC replaced the Joint Institute for Marine Observations.
- The **Cooperative Institute for Research in Environmental Sciences (CIRES)**, at the University of Colorado, in Boulder, CO, conducts research on advanced modeling and observing systems, climate system variability, geodynamics, integrative activities, planetary metabolism, and regional processes. CIRES collaborates primarily with the OAR Climate Program Office (CPO) and ESRL.
- The **Joint Institute for Marine and Atmospheric Research (JIMAR)**, located at the University of Hawaii in Honolulu, HI, conducts research on tsunamis and other long-period ocean waves, equatorial oceanography, climate, fisheries oceanography, tropical meteorology, and coastal research. JIMAR collaborates primarily with NOAA's Boulder Labs, PMEL and NMFS programs.
- The **Joint Institute for Marine Observations (JIMO)**, located at Scripps Institution of Oceanography (SIO) at the University of California-San Diego, conducts research on climate and coastal observations, analysis, and prediction, research on biological systems, research in extreme environments, and R&D on observations systems. JIMO collaborates primarily with CS and PMEL.
- The **Joint Institute for the Study of the Atmosphere and Ocean (JISAO)**, located at the University of Washington in Seattle, WA, conducts research on climate, environmental chemistry, marine ecosystems, and coastal oceanography. JISAO collaborates primarily with PMEL and NMFS programs.
- The **Northern Gulf Institute (NGI)** is a consortium of universities, led by Mississippi State University, which includes the University of Southern Mississippi, Louisiana State University, Florida State University, and the Dauphin Island Sea Lab at Stennis Space Center, MS. NGI

conducts research on ecosystem management, geospatial data integration and visualization in environmental science, climate change and climate variability effects on regional ecosystems, and coastal hazards. NGI collaborates primarily with AOML, PMEL, and GLERL.

### **National Sea Grant College Program (<http://www.seagrant.noaa.gov/>)**

Congress established the National Sea Grant College Program in 1966 to enhance the development, use, and conservation of the Nation's coastal, marine and Great Lakes resources. The legislation establishes a network of Sea Grant Colleges to conduct education, training, and research in all fields of marine study. It also directs that grants and contracts may be awarded to "any individual; any public or private corporation, partnership, or other association or entity (including any Sea Grant College, Sea Grant Institute or other institution) or any State, political subdivision of a State, or agency or officer thereof." The National Sea Grant College Program Office is located in Silver Spring, MD. Currently, there are 32 university-based Sea Grant programs located in every U.S. coastal and Great Lakes state, Vermont, and Puerto Rico. Most Sea Grant programs include multiple campuses of different universities across the state. These programs have aligned their efforts around the NOAA National Sea Grant College Program Strategic Action Agenda, which focuses on four critical areas: Safe and Sustainable Seafood Supply, Sustainable Coastal Development, Healthy Coastal Ecosystems, and Hazard Resilience in Coastal Communities.

### **Office of Ocean Exploration and Research (<http://explore.noaa.gov/>)**

The Office of Ocean Exploration and Research (OER) is comprised of the former NOAA Undersea Research Program (NURP) and the Ocean Exploration (OE) Program. OER's two primary functions are exploration and research:

- *Exploration:* This program supports: (1) exploring unknown and poorly known ocean areas; (2) mapping the physical, geological, biological, chemical, and archaeological aspects of the oceans; (3) utilizing new sensors and systems for ocean exploration; and (4) engaging a wide variety of audiences by innovative means, including new telepresence technologies. OER operates the NOAA Ship *Okeanos Explorer*, a converted T-AGOS class vessel dedicated to supporting NOAA ocean exploration missions.
- *Research:* OER utilizes a network of regional undersea centers and CIOERT to focus on the following areas: (1) core research based on national and regional undersea priorities, including frontiers of the extended continental shelf and deep and shallow corals; (2) development, testing, and transition for advanced technologies associated with ocean observatories, submersibles, advanced diving technologies, remotely operated vehicles, autonomous underwater vehicles, and new sampling and sensing technologies; (3) discovery, study, and development of natural resources and products from ocean, coastal, and aquatic systems; and (4) undersea science-based education and outreach programs to enrich ocean science education and public awareness of the oceans and Great Lakes.

### **Office of Weather & Air Quality**

The Office of Weather & Air Quality (OWAQ) has two major missions. The first is to provide research and development that supports more accurate and timely warnings and forecasts of: (a) high-impact weather that causes loss of life and property and (b) air quality parameters, including ozone and aerosols/particulate matter, which impact human health, cause crop damage, and affect private-sector planning for power generation. The second is to support research that provides the scientific basis for air quality decision-makers to develop policies and plans that effectively protect public health while also maintaining a vital economy. The Office manages the U.S. Weather Research Program (USWRP).

### **NOAA High-Performance Computing and Communications Program (HPCC)**

HPCC supports many NOAA Strategic Plan objectives through support of information technology (IT) research targeted at improving NOAA's mission, services, and science education. HPCC seeks to make major improvements in the ability to forecast weather and climate, and to disseminate environmental information by stimulating modernization of NOAA's computationally intensive services. HPCC provides NOAA with "mission" agency representation in the Interagency Working Group on IT R&D.

### **Proposed Reorganization to establish a Climate Service line office:**

OAR will transfer the Climate Program Office, the Geophysical Fluid Dynamics Laboratory, and components of the Earth System Research Laboratory (ESRL), including the Chemical Sciences Division, Physical Sciences Division, and Global Monitoring Division, to the Climate Service.

This reorganization will allow NOAA to provide a reliable and authoritative source for climate data, information, and decision-support services and to more effectively coordinate with other agencies and partners. This reorganization reflects NOAA and DOC changing to meet the current circumstances and future challenges of climate change and the public's need for strong climate science and service delivery capabilities.

NOAA carefully considered how existing Line Offices will be affected by this reorganization. NOAA's centralized research Line Office, OAR will continue to serve all of NOAA by supporting and producing preeminent mission driven research. NOAA concurs with NAPA's assessment that, OAR, "provides particularly important institutional glue to support innovation across NOAA." In addition NAPA concluded that, "all parts of NOAA benefit from OAR's work to incubate fundamentally new approaches to mission-centered science, a capability best sustained by maintaining a nimble, freestanding OAR Line Office." OAR serves as the focus for long-term research in NOAA; an innovator and incubator of new science, technologies, and applications; an integrator of science and technology across all of NOAA to attain mission objectives; and a provider of science program analysis and policy support to the NOAA Chief Scientist. OAR, along with our partners, strengthens the science that underpins NOAA's products and services. In addition, OAR supports the Department of Commerce's and Administration's initiatives to generate new, cutting-edge scientific understanding of technical, economic, social, and environmental systems. This reorganization also signifies an opportunity to strengthen NOAA science and address critical needs that have been identified in recent years.

### **Research and Development Investments:**

The NOAA FY 2012 Budget estimates for its activities, including research and development programs, are the result of an integrated requirements-based strategic planning process. This process provides the structure to link NOAA's strategic vision with programmatic detail and budget development. The goal is to maximize our use of resources while optimizing our capabilities. OAR requests \$175,074,000 for investments in R&D and infrastructure to support R&D in the FY 2012 Budget.

NOAA's strategic planning process makes specific reference to the objectives and milestones outlined in the NOAA 5-Year Research Plan for 2008-2012. The strict management of planning against these investment criteria, objectives, and milestones leads to NOAA budget proposals that reflect the research and development needs of the organization. The NOAA Research Council - an

internal body composed of senior scientific personnel from every line office in the agency - is tasked with developing NOAA's 5-Year Research Plan. The Council provides corporate oversight to ensure that NOAA's research activities: are of the highest quality, meet long-range societal needs, take advantage of emerging scientific and technological opportunities, and shape a forward-looking research agenda.

**Significant Adjustments-to-Base (ATBs):**

NOAA requests a net increase of 0 FTE and \$2,768,000 to fund adjustments to current programs for OAR activities. The increase will provide inflationary increases for non-labor activities, including service contracts, utilities, field office lease payments, and rent charges from the General Service Administration (GSA).

NOAA requests the following technical transfers for a net change to NOAA of \$0:

From Office	Line	To Office	Line	Amount
OAR	Competitive Research	OAR	Integrated Ocean Acidification	\$4,000,000
NMFS	Climate Regimes & Ecosystem Productivity	OAR	Integrated Ocean Acidification	\$1,500,000

OAR requests technical adjustments to transfer \$4,000,000 from the OAR Competitive Research Program line to the OAR Integrated Ocean Acidification line and \$1,500,000 from the NMFS Climate Regimes & Ecosystem Productivity line to the OAR Integrated Ocean Acidification line. This realignment will facilitate the integration of all NOAA ocean acidification activities into a NOAA ocean acidification program.

NOAA also requests the following transfers to the new Climate Service (CS) for a net change to NOAA of \$0:

From Office	Line	To Office	Line	Amount (\$000)/FTE
OAR	Climate Labs & Coop. Institutes	CS	Climate Research - Modeling	\$14,877/ 53 FTE
OAR	Climate Labs & Coop. Institutes	CS	Climate Research - Physical Sciences	\$2,993/ 25 FTE
OAR	Climate Labs & Coop. Institutes	CS	Climate Research - Chemical Sciences	\$9,203/ 36 FTE
OAR	Climate Labs & Coop. Institutes	CS	Climate Research - Global Monitoring & Research	\$6,240/ 25 FTE
OAR	Competitive Research Program	CS	Climate Research - Modeling	\$4,832/ 15 FTE
OAR	Competitive Research Program	CS	Climate Research - Physical Sciences	\$301/ 5 FTE
OAR	Competitive Research Program	CS	Climate Research - Chemical Sciences	\$4,828/ 4 FTE
OAR	Competitive Research Program	CS	Climate Research - Global Monitoring & Research	\$7,365/ 15 FTE



OAR	Competitive Research Program	CS	Climate Research - Competitive Research Program	\$68,595/ 44 FTE
OAR	Competitive Research Program	CS	Integrated Climate Service - NIDIS	\$9,762/ 1 FTE
OAR	Competitive Research Program	CS	Integrated Climate Service - Regional Services	\$788/ 3 FTE
OAR	Competitive Research Program	CS	Integrated Climate Service - Communication & Education	\$1,400/ 0 FTE
OAR	Competitive Research Program	CS	Observations & Monitoring - Ocean Observations	\$40,378/ 19 FTE
OAR	Competitive Research Program	CS	Observations & Monitoring - Climate Data & Information Services	\$1,014/ 0 FTE
OAR	Competitive Research Program	CS	Observations & Monitoring - Environmental Sciences	\$483/ 0 FTE
OAR	Competitive Research Program	CS	Observations & Monitoring - Atmospheric Observations	\$453/ 1 FTE
OAR	Regional Climate Assessment	CS	Integrated Climate Service – Assessment Services	\$9,000/ 0 FTE
OAR	Climate Data & Information	CS	Climate Research - Competitive Research Program	\$1,133/ 1 FTE
OAR	Climate Data & Information	CS	Integrated Climate Service - NIDIS	\$3,753/ 0 FTE
OAR	Climate Data & Information	CS	Observations & Monitoring - Climate Data & Information Services	\$2,395/ 0 FTE
OAR	Climate Data & Information	CS	Observations & Monitoring - Ocean Data & Information Services	\$12/ 0 FTE
OAR	Climate Data & Information	CS	Observations & Monitoring - Atmospheric Observations	\$4,787/ 2 FTE
OAR	Climate Operations	CS	Climate Research - Modeling	\$320/ 0 FTE
OAR	Climate Operations	CS	Integrated Climate Service - Regional Services	\$593/ 0 FTE
OAR	Climate Other Partnership Programs	CS	Climate Research - Chemical Sciences	\$350/ 0 FTE
OAR	Climate Other Partnership Programs	CS	Climate Research – Global Monitoring & Research	\$100/ 0 FTE
OAR	Climate Other Partnership Programs	CS	Climate Research – Competitive Research Program	\$645/ 0 FTE
OAR	Climate Other Partnership Programs	CS	Integrated Climate Service – Regional Services	\$3,000/ 0 FTE
OAR	W&AQ Labs & Coop. Institutes	CS	Climate Research - Modeling	\$3,456/ 4 FTE
OAR	W&AQ Labs & Coop. Institutes	CS	Climate Research - Physical Sciences	\$7,472/ 22 FTE
OAR	W&AQ Labs & Coop. Institutes	CS	Climate Research - Chemical Sciences	\$3,800/ 0 FTE

OAR	W&AQ Labs & Coop. Institutes	CS	Climate Research - Global Monitoring & Research	\$192/ 1 FTE
OAR	W&AQ Other Partnership Programs	CS	Climate Research – Physical Sciences	\$500/ 0 FTE
OAR	W&AQ Other Partnership Programs	CS	Climate Research – Chemical Sciences	\$500/ 0 FTE
OAR	Research Super-computing	CS	Climate Research - Research Super-computing (PAC)	\$10,379/ 0 FTE
<b>Total OAR</b>				(\$225,899)/ (276) FTE

NOAA requests a technical adjustment to move \$225,899,000 and 276 FTE from OAR to CS. These funds will be used to support the formation of the Climate Service as a new NOAA line office.

#### Other Adjustments:

The NOAA FY 2012 Budget for OAR also requests other adjustments in the amount of \$4,637,000 to restore funds that were anticipated in FY 2011 to be transferred from the Department of Agriculture related to the Promote and Develop (P&D) account. The P&D transfer represents funds derived from duties on imported fisheries products and are transferred to NOAA from the Department of Agriculture. The annualized FY 2011 Continuing Resolution provided \$36,056,800, including carryover, less than requested in FY 2011 President’s Budget due to a downturn in the international fisheries markets. To address the difference between estimated and actual transfer amounts in FY 2011, NOAA allocated the shortfall in the transfer to each of its seven line offices, taking a 1.06 percent reduction to each Program, Project, or Activity (PPA) line. For FY 2012 NOAA requests an adjustment to offset the impact of the FY 2011 shortfall.

From Office	Line	To Office	Line	Amount
OAR	All	OAR	All	\$4,637,000

#### Administrative Cost Savings:

The Administration is pursuing an aggressive government-wide effort to curb non-essential administrative spending called the Administrative Efficiency Initiative (AEI). In order to be good stewards of taxpayer money, the Federal Government should continue to seek ways to improve the efficiency of programs without reducing their effectiveness. As such, the President directed each agency to analyze its administrative costs and identify savings where possible. After reviewing its administrative costs, OAR believes that it can generate \$3,235,000 in administrative cost savings. OAR has targeted a number of areas to achieve these savings, at both the Line Office Headquarters level and throughout the program offices. Using NOAALink, OAR anticipates generating savings through more strategic sourcing of products and services. Consolidation of products will enable buying in bulk to reduce prices. Consolidation of services will also result in dollar savings by reducing the number of contracts to be managed. Besides NOAALink, OAR believes it can find other efficiencies among its contract expenditures, such as by reducing staff on IT and administrative services contracts. OAR plans to consolidate SharePoint and Graphic Services between IT and Communications. Additional savings will come from absorbing inflationary cost adjustments (ATBs). In the area of human capital, OAR expects to reduce its costs by canceling some planned hires, downgrading some positions, and working to reduce its workers compensation costs. Administrative

savings in the areas of logistics planning and general administrative support have been identified by limiting of the use of overnight mail services as well as consolidating services through a single provider. OAR has also identified savings tied to IT-related items, primarily through delaying the refresh of computer equipment and eliminating redundant software licenses. In addition, OAR expects to reduce costs through business process reengineering. The \$3,235,000 in administrative savings identified above represent real reductions to OAR's funding level and will help reduce overall spending by the Federal government. Moreover, OAR is ready to work toward other efficiencies identified by Department's review teams.

### Headquarters Administrative Costs:

In FY 2012, OAR Line Office headquarters will use \$6,102,800, after instituting planned savings as a result of the AEI mentioned above, in funds to support general management activities, financial and budgeting, and IT related expenses, as well as supporting facilities and other general operating costs. These funds also include support for service contracts, utilities, and rent charges from the General Services Administration. As part of the AEI, OAR has reviewed its Line Office Headquarters costs and will be able to reduce previously planned costs by \$670,000. Specifically, OAR will use headquarters administrative funds to support the following:

Headquarters Program Support Type	Description	FY 2012 Amount	FY 2012 FTE associated with OAR Line Office HQ
General Management & Direction	Includes Assistant Administrator's office, public affairs, information services	\$2,171,600	10.4
CFO Operations	Includes Budget, Finance and Accounting	\$1,497,900	14.1
CIO Operations	Includes IT-related expenses and other CIO related activities	\$746,200	5.8
CAO Operations	Includes Facilities and Security costs, as well as other CAO related activities	\$803,200	0
Human Resources	All HR services, including EEO	\$856,500	14.3
Procurement services, Acquisitions, and Grants Management Operations		\$697,400	6.0
<b>Total before AEI savings</b>		<b>\$6,772,800</b>	<b>50.5</b>
<i>AEI Savings</i>		<i>(\$670,000)</i>	-
<b>Total post AEI savings</b>		<b>\$6,102,800</b>	<b>50.5</b>

NOAA recognizes the need to improve the transparency of the policies and procedures used by its line office headquarters to bill component programs for management and administrative services. NOAA is currently re-evaluating, standardizing, and documenting these policies and procedures for each line office. Prior to the beginning of FY 2012, NOAA will publish its policies and procedures for assessing headquarters and administrative costs within the line offices on the NOAA CFO public website along with other budget and finance documents. NOAA looks forward to working with the

Congress and other interested parties to increase the transparency and confidence in NOAA's financial management.

## **APPROPRIATION ACCOUNT: OPERATIONS, RESEARCH, AND FACILITIES**

### **SUBACTIVITY: CLIMATE RESEARCH**

The objectives of the Climate Research sub-activity are to:

- Pursue earth systems modeling as a unique OAR climate role.
- Conduct research and develop technology to improve observing and monitoring systems essential for climate, oceanographic, and ecosystems research, monitoring, and data management;
- Advance research capabilities for seasonal, interannual, and longer-term climate variability.

Climate research has the mission of monitoring and understanding the Earth's climate system to predict both the potential long-term changes in global climate as well as shorter-term climate variations that are of societal and economic importance. More information on OAR's climate research is available at: <http://www.oar.noaa.gov/climate/>.

### **LABORATORIES AND COOPERATIVE INSTITUTES**

#### **Climate Observations and Monitoring**

OAR's Climate Observations and Monitoring provides and interprets oceanographic data and conducts research relevant to decadal climate change and coastal ecosystems. On a global scale, Atlantic Oceanographic and Meteorological Laboratory (AOML) scientists are studying the dynamics and variability of ocean currents, the redistribution of heat, salt and momentum through the oceans, the interactions between oceans, climate, and coastal environments, the influence of climate changes and of the ocean on extreme weather events as well as the exchange of CO<sub>2</sub> between the ocean and the atmosphere and its effects on global warming and climate change. This research is conducted through numerous open-ocean cruises aboard NOAA's research vessel, the *Ronald H. Brown*, and by using commercial shipping vessels and autonomous vehicles. AOML designs new instrumentation, improves old, and analyzes satellite-based instruments, numerical models and other large ocean and atmospheric datasets. AOML hosts NOAA's Global Ocean Observing System (GOOS) Center, which provides ocean surface and sub-surface data to NOAA's National Centers for Environmental Prediction (NCEP) in support of seasonal-to-interannual climate forecasts and which also generates data for decadal-scale climate research. This program supports NOAA's climate goal by laying a framework for future research that promises to improve the ability of climate models to predict summer rainfall and hurricane activity for the Western Hemisphere. The scientific community has shown excellence in: implementing and maintaining the ocean observing system, distributing data to science and operational centers, and monitoring and assessing critical ocean parameters related to climate.

Excellence in the implementation and maintenance of the ocean observing system has resulted in the following AOML accomplishments:

- Carried out all Expendable Bathythermograph (XBT) transects to: monitor meridional heat advection in the Atlantic Ocean, complement Argo float observations in all ocean basins for upper ocean heat studies, and monitor western boundary currents and mesoscale features in all ocean basins.
- Contributed to the deployment and data management of the global array of Argo floats.

- Managed the deployment and data quality control and distribution of the global drifter array for surface current measurements and for validation of satellite-derived sea-surface temperature fields.
- Developed and started implementing a Meridional Overturning Circulation (MOC) observational network in the South Atlantic Ocean.

### **Climate Observations and Analysis**

OAR's Climate Observations and Analysis provides core infrastructure activities (research, technology development and observing system implementation) that are central to meeting NOAA's climate goals. These include (1) providing instrumentation to support the National Weather Service (NWS)/National Data Buoy Center (NDBC) Tropical Moored Observations in the Pacific (TAO); (2) establishing and maintaining moored buoys in the Atlantic (PIRATA) and Indian Ocean (RAMA) tropical moored buoy arrays; (3) conducting Argo float deployment and research activities; (4) monitoring ocean carbon uptake and storage; (5) conducting moored and underway CO<sub>2</sub> measurements; (6) conducting research on the issue of Ocean Acidification; (7) conducting NOAA/National Science Foundation (NSF) operations in support of the global CLIVAR Repeat Hydrography program; (8) maintaining certain global ocean reference station time series moored arrays; (9) conducting Marine Aerosol; (10) Atmospheric Chemistry; (11) Air Quality research cruises; (12) conducting autonomous glider sections of western boundary currents in the Solomon Sea; (13) observing ocean modeling system adequacy studies; and (14) participating in ocean data management and information technology activities.

The following is a more detailed description of the PMEL Climate Activities currently being conducted:

- Tropical Moored Time Series Buoy Arrays: PMEL has sole responsibility for maintaining the PIRATA Array in the Atlantic (17 sites) and the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) in the Indian Ocean. RAMA was initiated in 2004 as a multi-national undertaking. At present, 22 sites are occupied, 15 of which are instrumented with NOAA/PMEL moorings. All moored surface buoys report data in near real time using the Argos data telemetry system. Eventually, a 44-mooring array is anticipated, depending on the availability of funding and international commitments.
- Ocean Carbon Uptake and Storage: PMEL, along with AOML, has defined a long-term program to quantify the role of the oceans in the sequestration of carbon dioxide, through the development of CO<sub>2</sub> measurements aboard buoys, research ships and vessels of opportunity. Funded by the Climate Service together with NSF and NASA, the PMEL carbon program includes projects such as CLIVAR/ CO<sub>2</sub> Repeat Hydrography, Ocean SITES moored CO<sub>2</sub> measurements, and surface underway CO<sub>2</sub> measurements. The PMEL ocean carbon program has also initiated an assessment of the role of coastal oceans in the global carbon cycle and the impacts of ocean acidification on marine resources using short-term funding sources.
- Ocean Climate Stations: This global network of PMEL Ocean Climate Station (OCS) surface moorings carry a full suite of meteorological, carbon flux, subsurface physical and in some cases biogeochemical sensors for monitoring and understanding the global climate system. The PMEL OCS program is a NOAA contribution to the global network of Ocean SITES time series reference stations. All data are publicly available. PMEL has a long-term OCS south of the Kuroshio Extension (KEO), while JAMSTEC operates the station north of the Kuroshio Extension (JKEO). Since June 2007, PMEL OCS program has had a mooring at Ocean Station PAPA in the Northeast Pacific Ocean that

- also contributes to the ocean acidification program. A new reference station mooring is planned for long-term deployment in the southwest Indian Ocean in late FY 2011.
- Argo Floats: PMEL provides Argo floats for the International Argo array, funding about 55 floats in FY 2010. Argo is an international program to increase oceanographic data for operations and research purposes by developing an observation system akin to the global atmospheric observation system. PMEL also contributes to improvements in quality control for salinity measurements of Argo floats. PMEL is advocating the implementation of additional measurement capabilities within the Argo program, notably adding oxygen and nutrient measurement capability to the floats. PMEL provides approximately ten percent of the total international Argo float array.
  - Atmospheric Chemistry Program: PMEL conducts aerosol investigations in marine areas, from coastal investigations to larger-scale experiments downstream of major continental land masses and industrialized areas. In FY 2010, PMEL led the ship borne portion of the CALNEX project, a collaboration between the California Air Resources Board and NOAA to determine the sources and airborne aerosol particles and particulate matter from the Los Angeles and San Francisco Bay areas and determine the effects of these aerosols on the environment.
  - Autonomous Glider Sections in the Solomon Sea: PMEL and Scripps Institute of Oceanography scientists have deployed autonomous gliders to make a series of detailed current observations along pre-programmed transect routes in the Solomon Sea. This work began in 2007, and eight sections have been completed. In addition to the NOAA support, NASA has provided support for a post-doctoral fellow to study the data and compare it with numerical model results. NASA is supporting parallel model studies at UCLA. Western Boundary Currents such as the currents being studied in the Solomon Sea provide key information about ocean circulation patterns and their impact on global climate.
  - Data Management: PMEL has a leadership role in the Data Management and Communication (DMAC) activities of the Global Integrated Ocean Observing System. The PMEL DMAC activity, supported by PMEL base funds as well as funds from NOS and NESS, provides improved management and availability of the wide array of ocean-related data collected by member nations.
  - Tropical Ocean SITES: PMEL contributions to Ocean SITES include all ATLAS moorings within the TAO, PIRATA, and RAMA arrays. In addition, embedded within these tropical moored buoy arrays are specially instrumented reference sites for air-sea heat, moisture, and momentum fluxes (four in the Pacific, four in the Atlantic, and two in the Indian Ocean).

While the above descriptions focus on the ocean data collected by PMEL scientists, PMEL scientists also use these data to conduct research on today's critical ocean-climate questions, ranging from seasonal-to-interannual climate variability and its impact on national and global populations to longer-term climate impacts on scales of a decade or longer.

These programs provide a major portion of the U.S. contribution to the global ocean observations for climate, which are required to monitor, understand, and forecast the Earth's climate system. This information is crucial for the future health of the entire planet. It contributes to forecasts of natural disasters such as major El Niños, which occur on interannual time scales. A major El Niño, such as the unpredicted 1981-1982 event, can cost the U.S. economy billions of dollars. Floods, droughts, heat waves, and extreme weather events are all influenced by the climate system. Our ability to predict them depends on ongoing climate measurements, especially in the 70 percent of the globe

covered by the ocean. For example, sea-level rise depends on the heat content of the ocean, which is monitored by both the Argo float and repeat hydrography programs.

### **Atmospheric Observations & Monitoring / Plume Dispersion**

OAR's Atmospheric Observations & Monitoring/Plume Dispersion includes two activity areas:

1. Research related to climate observations. This has three sub-activities:
  - a. Making and organizing high-quality observations of climate variability and change and key physical and chemical processes that influence climate. This includes taking measurements at experimental sites that characterize how the atmosphere, land surface, and flora affect each other, e.g., water from the soil and plants is transferred to the air, affecting atmospheric humidity and temperature and influencing agriculture and drought. Such information is important for evaluating and improving models of the climate, as the fluxes of energy and moisture between the land and air are crucial factors in climate variability and change. Another example of specialized observations is leading the establishment of an international network to take highly accurate and reliable measurements of the atmosphere above the Earth's surface, which would increase the value of existing measurements (e.g., satellite) by providing a stable reference characterization of atmospheric conditions.
  - b. Analyzing climate observations to determine what natural climate variability has occurred in the past and what climate trends have occurred. These analyses are used to evaluate and improve climate models and to inform national and international climate assessments.
  - c. Investigating how regional climate models and observations can be effectively combined to improve projections of the future, improving the Nation's ability to understand localized impacts of climate change.

This work is important because there are still significant uncertainties about details of how and why climate changes. Reducing those uncertainties is essential for improving the understanding of natural climate variability and climate trends and for improving projections of future climate to inform mitigation and adaptation decisions. Observing and analyzing the climate are essential steps for making those improvements. Specialized climate observations provide the core information required for improving decisions. Analysis of climate observations is an essential complement to significant investments in climate observations (e.g., via satellite) and climate modeling. These analyses verify that observations are trustworthy; improve the understanding of trends, their significance, and the climate systems; and help ensure that the models are accurate. The end result of all of these activities is to improve the reliability and comprehensiveness of the information used to guide climate mitigation and adaptation activities.

2. Improved characterization and prediction of how airborne hazardous materials are dispersed. Hazardous materials include smoke, harmful chemicals, radioactive materials, and biological agents—released either accidentally or intentionally. Wind and turbulence are key factors influencing how such materials are transported. OAR's Air Resources Laboratory (ARL) is studying winds and turbulence in urban environments (where most people live) and is investigating improved techniques for measuring and predicting such winds. OAR also develops widely used tools for predicting dispersion for a broad range of applications, including chemical, radiological, and biological hazards. OAR's work on dispersion tools includes improving the accuracy; adding specialized tools for specific applications (e.g., short-range chemical incidents); and providing better ways for decision-makers to understand predictions and their associated uncertainties.

OAR's plume dispersion activities provide essential information for first responders and emergency, industrial, agricultural, and transportation managers to minimize risks to health, safety, and economic



activities. If emergency managers do not know where hazardous materials will spread, they cannot effectively evacuate people and industrial and transportation companies cannot take other protective measures. NOAA's plume dispersion information and tools are used for a wide range of situations, including oil drilling platform disasters, chemical plant explosions, containment failures at nuclear reactors, and the spread of plant pathogens. Thousands of people and groups use these tools, including the National Weather Service, other Federal agencies (e.g., the Forest Service), other countries' weather services, and universities. These dispersion tools have also been applied to air quality issues, such as wildfire smoke, dust, and volcanic ash.

### **Schedule and Milestones:**

#### Atlantic Oceanographic and Meteorological Laboratory (AOML)

- Observing Systems: AOML will continue to maintain observing systems, monitoring and analysis of critical climate-related parameters such as ocean heat content, meridional heat advection, sea level trends, ocean acidification, and ocean currents.

#### Pacific Marine Environmental Laboratory (PMEL)

- Tropical Moored Arrays for Climate: The PIRATA array will be maintained in the tropical Atlantic. The RAMA array in the tropical Indian Ocean is planned for completion in 2014, although the schedule of completion could slip due to uncertainties in international partnerships. In the case of all three moored arrays, the corresponding milestone is to deploy and maintain a certain number of moorings, and visit and refresh each existing mooring at least once a year.
- Ocean Carbon Uptake and Storage: Repeat hydrography cruises are carried out approximately every year. These are repeats of full ocean-depth cross sections of the Atlantic (A), Pacific (P), Indian (I), and Southern (S) Oceans (very long north/south transects are divided) originally done more than ten years ago, during other international ocean monitoring programs, and show the long term changes in ocean temperature, salinity, CO<sub>2</sub> and other chemical concentrations, and other water properties. Ocean heat content can be inferred from the data. NOAA has the lead responsibility for a cruise in 2012 (A16N), two cruises in 2013 (A16S and P02), and one cruise in 2014 (P16S). The new Ocean Acidification program beginning in FY 2012 is closely related to the ongoing ocean carbon work.
- Air-Sea CO<sub>2</sub> Exchange: The ocean helps regulate atmospheric CO<sub>2</sub> concentrations through air-sea exchange. The rate of exchange can be determined by making high-resolution measurements on research and vessel-of-opportunity ships. The PMEL CO<sub>2</sub> Program currently maintains instruments that collect CO<sub>2</sub> information from a variety of ships as they transit the oceans. Measurements are underway on three ships in the equatorial Pacific and three ships off the Pacific coast of North America. This is a very cost-effective way to monitor the oceans, requiring no funded research ship time and little intervention by scientists.
- CO<sub>2</sub> Time Series: Time series measurements of ocean carbon and air sea exchange help provide information on carbon cycle variability on time scales ranging from hours to years. The PMEL CO<sub>2</sub> Program is building a network of CO<sub>2</sub> moorings to make high resolution time series measurements in the global ocean. There are 13 CO<sub>2</sub> moorings at present.
- Ocean Climate Stations: This program maintains Ocean Sites mooring in the Kuroshio Extension region and at station PAPA in the Pacific. It will expand to the Agulhas Current in FY 2011. Moorings are visited and refreshed at least once each year.
- Argo Floats: PMEL provides Argo floats for the Argo array. The global array consists of 3,000 floats, each with an expected life span of four years. PMEL replaces approximately 60 floats per year that have reached the end of their useful lives.

- Aerosol Program: This program conducts a major survey cruise to monitor marine aerosols and air quality approximately every other year. The CalNex cruise begins in May 2010.
- Autonomous Glider Sections in the Solomon Sea: This program makes two sections per year across the Solomon Sea, and conducts numerical modeling studies to help interpret the observations.

#### Air Resources Laboratory (ARL)

- Climate Assessments: This activity contributes to national/international climate assessments (e.g., Intergovernmental Panel on Climate Change) to inform climate mitigation and adaptation (ongoing).
- Climate Observing Systems: This activity conducts studies on the design and evaluation of an international climate-quality observation system for the near-surface atmosphere, which will provide essential information for understanding and predicting climate change. The initial study will cover new international observations in FY 2012; more complete assessments will be performed later.
- Atmospheric Studies: This activity conducts studies characterizing the climatology of the lowest portion of the atmosphere, which is the portion of the atmosphere that directly affects people, agriculture, and ecosystems. A study on conditions in the Arctic will be published by FY 2012, and more comprehensive global analyses will be completed by FY 2014.
- Spatial Variability: This activity performs studies of spatial variability around surface climate stations to improve interpretation of regional climate variability and change and to support model evaluation. Beginning with the evaluation of new approaches in FY 2011, regional studies will take place in FY 2012, followed by initial assessments in FY 2013. Finally, applications to other climate regions will be developed (FY 2013 and beyond).
- Snow Measurement Technology: This activity will report on automated snow measurement technologies to improve characterization of snowfall variability and change, an important influence on water resources in cold and mountainous regions. Algorithms will be evaluated in FY 2011; the broader technology will be assessed by FY 2013.
- Surface Energy Fluxes: Begin studies of physical energy fluxes in different regions to improve climate projections beginning with study preparations in FY 2011 and FY 2012, and conduct regional evaluations annually after that.
- Urban Meteorology: Improve dispersion predictions through studies of urban meteorology. Begin with a vertical profile study in FY 2011 and conduct studies of urban-suburban interface in FY 2012-FY 2015.
- Dispersion Forecast System: Updates to dispersion forecast system, used by National Weather Service and others, for international through local incidents will be completed annually.

#### Deliverables

The value of the ocean observing system can be assessed by the type and quality of products derived from it and from its scientific and operational value. The current observing system was designed with the objective to assess key climate-related parameters. The full implementation of the observing system will lead to the correct analysis of climate signals and reduction of errors in climate forecasts.

For each of the observation programs, the deliverables and outputs are the observational data, quality controlled, and made available on a publically accessible web site. For programs such as Argo floats, involving measurements by multiple institutions, a single data center web site is typically maintained with the data from all providers available from the single site. The remaining deliverables

are scientific papers in the peer-reviewed literature, giving the results of the research done with the data sets and other studies.

Each of the data collection outputs identified below assumes a certain amount of funding from external sources that is the best estimate at this time. If that funding fails to materialize as planned, the targets are subject to modification.

#### Performance Goals and Measurement Data

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Percent of labs that have had formal expert peer reviews in the past 4 years and were rated effective in terms of quality, mission relevance, and performance	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	100%	100%	100%	100%	100%	100%
<b>Description:</b> This performance measure is recognized by the National Academy of Sciences report <i>Evaluating Federal Research Programs</i> which states that “The most effective means of evaluating Federally funded research programs is expert review.”						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Estimates of meridional heat transport (number of reports/year)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	8	8	8	8	8	8
<b>Description:</b> Provide reports on the state of the ocean and meridional heat transport in the Atlantic Ocean, derived from Expendable Bathythermograph (XBT) observations. This heat transport is a key part of global heat distribution within climate models. XBT's are the marine equivalent of atmospheric dropsondes. The expected outcome from these reports is advancement in the state of knowledge of oceanic meridional heat transport and an associated reduction in the uncertainty associated with modeled estimates of heat transport over time.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Estimates of global heat storage (number of reports/year)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	4	4	4	4	4	4
<b>Description:</b> Provide reports on the state of the ocean: global estimates of heat storage in the mixed layer, derived from Argo floats, XBT, CTDs, and mooring observations. The expected outcome from the reports is an increase in understanding of the trends in the amount of heat storage in the mixed layer, which is a key indicator of global change.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Estimates of global surface currents (number of reports/year)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	4	4	4	4	4	4
<b>Description:</b> Provide reports on the state of the ocean: global surface currents. The outcome of these reports is a continual improvement in the precision with which the state of the ocean and, in particular, the global estimates of surface currents can be described.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
XBT transects in high density mode in the Atlantic Ocean	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	18	18	18	18	18	18
<b>Description:</b> Conduct XBT transects (lines of measurement) in the Atlantic Ocean in high density mode to obtain upper ocean thermal profiles to measure upper ocean temperatures and monitor surface and subsurface currents.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Increased percentage of global in-situ ocean observing system (GOOS) implementation.	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	63%	65%	66%	67%	68%	68%
<b>Description:</b> This measure represents the U.S. contribution to the international global ocean observing system (GOOS). There are eight individual ocean observing systems and one data management system that make up the global IOOS. The percent completion of the eight systems determines the cumulative total percent of this performance measure.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Reduced error in global measurement of sea-surface temperature (SST) ( <sup>o</sup> C)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	0.50 <sup>o</sup> C	0.35 <sup>o</sup> C	0.35 <sup>o</sup> C	0.35 <sup>o</sup> C	0.35 <sup>o</sup> C	0.35 <sup>o</sup> C
<b>Description:</b> This measure shows progress in accurately measuring the global sea surface temperature and reflects how improvements in ocean observations will decrease the uncertainty in global sea surface temperature measurements, which will ultimately play a role in calculations of the ocean-atmosphere exchange of heat and the heat storage in the global ocean.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of regions for which a surface-flux study has been conducted	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	0	0	1	2	3	4
<b>Description:</b> "Surface flux" refers to the exchange of energy (e.g., heat) and substances (e.g., water) between the land surface and the atmosphere. These fluxes are critical drivers of climate change because they affect air and land temperatures and other important aspects of the climate. These fluxes also drive important climate-related phenomena, e.g., droughts and such weather-related phenomena as the development of storms. Surface fluxes vary significantly with surface and weather conditions. Lack of understanding about fluxes in different regions and situations are key uncertainties in climate and weather models, limiting the accuracy of forecasts. The measurements taken in this work and the related analyses will provide essential information for improving the representation of the fluxes in climate and weather models, improving the accuracy of both weather and climate forecasts.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of studies on the design and evaluation of an international climate-quality observation system for the atmosphere above the surface.	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>

	0	1	1	1	1	2
<b>Description:</b> The observing system will provide essential information for understanding and predicting climate change						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of dispersion prediction system updates provided to the National Weather Service (Plume Dispersion)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	2	3	4	5	6	7

**Description:** The updates of the HYSPLIT dispersion model provided to NWS will contribute to improved outcomes by improving the accuracy and usefulness of NWS dispersion prediction products. The updates will also improve the ease-of-use and flexibility of the software for meeting NWS needs. NWS uses HYSPLIT for dispersion predictions for applications range from local chemical releases to international radiological incidents providing information to customers ranging from local emergency managers to the World Meteorological Organization.

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**PROGRAM CHANGES FOR FY 2012:**

No program changes are proposed for FY 2012.

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## **APPROPRIATION ACCOUNT: OPERATIONS, RESEARCH, AND FACILITIES**

### **SUBACTIVITY: WEATHER AND AIR QUALITY RESEARCH**

The objectives of the Weather and Air Quality Research sub-activity are to:

- Support research and development that provides the Nation with more accurate and timely warnings and forecasts of high impact weather events and improved air quality information; and
- Support research that provides the scientific basis for informed management decisions about weather and air quality

To support these objectives, Weather and Air Quality research supports theoretical frameworks, remote sensing technologies, and scientific understanding to improve weather forecasts; air quality forecasts; and crosscuts of weather, air quality, and climate change. Activities include (1) development and assessment of new, cost-effective atmospheric observing systems; (2) development of data acquisition, management, analysis, and display systems; (3) development and verification of numerical models and other techniques to provide prediction guidance for weather, particularly high-impact events; and (4) transfer of research results to aid the research and policy communities and improve operational warnings and forecasts. More information on this sub-activity is available at <http://www.research.noaa.gov/weather/>.

#### **LABORATORIES AND COOPERATIVE INSTITUTES**

The Weather and Air Quality Research Labs and Cooperative Institutes (CIs) are charged with the mission of advancing scientific understanding of the Earth. Researchers at the labs and CIs strive to provide more accurate and timely warnings and forecasts of various high-impact weather, water, and air quality events, such as severe storms, tsunamis, and elevated levels of ozone and aerosols (particulate matter). These events often disrupt economic productivity, impact human health, or cause loss of life and property. The laboratories emphasize theoretical and analytical studies, laboratory experiments, and field observations. The primary purpose of OAR's research is to improve NOAA services and to provide the basis for improved decision making by policymakers and the public. The laboratories collaborate closely with university-based CIs and sponsor research through other universities, state and Federal agencies, and private enterprises.

#### **Hurricane Research**

OAR's Hurricane Research, within the Atlantic Oceanographic and Meteorological Laboratory (AOML), focuses on improving the understanding and prediction of hurricane track and intensity change through directed research and the transfer of research results to the operational hurricane forecast components. NOAA Research and transition efforts include (1) coordination of NOAA's annual hurricane field program, the Intensity Forecast Experiment (IFEX), a partnership among AOML, NWS Environmental Prediction, and Tropical Prediction Centers, and NESS, supported by the NOAA Aircraft Operation Center's research/reconnaissance aircraft; (2) theoretical and numerical modeling research to improve hurricane forecast guidance, including the preparations of storm surge atlases and wind field diagrams; (3) analysis of data from models and field programs to improve understanding of physical processes that effect hurricane track and intensity changes; (4) providing leadership and critical assistance to the NOAA Hurricane Forecast Improvement Project (HFIP); and (5) active participation in and support of the Joint Hurricane Testbed.

#### **Severe Storms Research**

The Severe Storm Research within OAR seeks to improve the accuracy and timeliness of forecasts and warnings of hazardous weather events such as blizzards, ice storms, flash floods, tornadoes,

and lightning. The National Severe Storms Laboratory (NSSL) accomplishes this goal through a balanced research program that conducts research in three general areas including Severe and Hazardous Weather research, Storm-scale Hydrometeorology research, and Weather Radar Research development. These programs aim to (1) advance the understanding of weather processes; (2) improve and develop new forecast and warning techniques and applications and evaluate them for operational use; (3) transfer knowledge, techniques, and applications to the NWS and other agencies; (4) develop enhancements for the NEXRAD Doppler weather radar, the cornerstone of the radar network now operated by NWS offices across the United States; (5) develop new radar technologies (e.g., dual-polarization and phased-array radar); and (6) conduct field programs that use mobile, in situ, and remote observational capabilities to collect data that support theoretical research.

### **Air Quality Research**

OAR's Air Quality Research conducts field studies and long-term measurements and develops numerical models to address a wide range of critical air quality issues. The Air Resources Laboratory (ARL) addresses pollutants including ozone, particulate matter, mercury, nitrogen, and volcanic ash. These pollutants can have significant impacts to and/or implications for human and ecosystem health and to industrial and transportation activities. Field activities include development and evaluation of new measurement approaches, short-term field experiments to characterize key chemical and physical processes, and long-term monitoring of selected trends. Models are developed to forecast selected pollutants and to better understand sources and receptors of pollution. The activities produce (1) information about air quality for air quality planners, managers, and forecasters; (2) models for National Weather Service operations; and (3) recommendations for measurement approaches for the air quality community.

OAR's air quality activities respond to significant societal needs and associated direction from Congress to address those needs. Air pollutants are a primary cause or significant contributor to a number of important societal issues. These include health impacts, such as respiratory ailments (millions of cases annually), deaths caused by heart attacks (tens of thousands of cases annually with tens of billions of dollars in associated losses), and permanent neurological deficits (affecting tens of thousands of newborns annually). As the recent Icelandic volcano eruption demonstrated, accurate volcanic ash predictions have very large economic impacts and are essential to safe operation of aircraft. Accurate information about air quality trends and sources of pollution affecting key ecosystems is also required to optimize the tens of billions of dollars spent annually on air pollution controls and to inform international regulations (e.g., regarding mercury emissions). Finally, contamination of fish by mercury (which primarily comes from air pollution) can affect the value of recreational and commercial fishing industries.

### **Advanced Computational Analysis & Display**

OAR's Advanced Computational Analysis & Display provides observing, prediction, computer and information systems that deliver environmental products ranging from local to global predictions of short-range, high impact weather and air quality events to longer-term intra-seasonal climate forecasts. These systems are designed to improve our understanding of weather at all time scales by incorporating new findings in atmospheric, oceanic, and hydrologic sciences. New observation techniques and assessments, innovative diagnostic and predictive models, advanced computational tools and techniques, and leading edge workstation display technology are developed to improve the quality and usability of forecast information. In conjunction with the Cooperative Institute for Research in the Atmosphere (CIRA) and the Cooperative Institute for Research in Environmental Sciences (CIRES), the Global Systems Laboratory (GSL) develops environmental products to serve the needs of operational weather forecasters, emergency managers, transportation and energy providers, and the general public, as well as environmental scientists seeking ways to improve

operational weather products. GSL also works closely with the Developmental Testbed Center (DTC), a distributed facility with NCAR where new models and techniques can be tested and evaluated by the numerical weather prediction community.

Current activities include assimilation of data from satellites, radars, aircraft, ground stations, and other remote sensors into research and operational atmospheric models to improve forecasts and warnings. For example, studies have concluded that assimilating Global Positioning System meteorological (GPS-Met) data results in at least a 10 percent improvement in the atmospheric water vapor forecast. GPS-Met data measure the total amount of water vapor in the atmosphere and are used to verify the accuracy of satellite, radiosonde, and other upper-air moisture measurements. These and other upper-air and surface observations collected by an environmental information system called the Meteorological Assimilation Data Ingest System (MADIS) are also used to improve the prediction models and provide situational awareness to National Weather Service forecasters. MADIS currently ingests data from over 60,000 surface mesonet stations operated by both government and private entities throughout the country, and makes these data available over the web to the public.

GSL conducts advanced data assimilation studies to support NOAA's Hurricane Forecast Improvement Project (HFIP) and the Hazardous Weather Testbed/Warning on Forecast (HWT/WoF) project. GSL's key participation in the HWT/WoF centers on the development of the High-Resolution Rapid Refresh (HRRR), a 3-km model updated hourly. This model is running experimentally at GSL and is currently scheduled for implementation at NWS/NCEP for 2014 or later pending the availability of sufficient high performance computing. This rapidly-updated and high resolution model is expected to support severe hazardous weather forecasts, airport terminal weather forecasts, and renewable energy forecasts.

In addition to the HRRR model, GSL also develops local, regional, and global weather models. Local models and local data assimilation technologies can provide forecast resolutions of 500 meters and update as rapidly as every hour. Such local models greatly improve short-range forecasting and are essential for forecasting flash floods, landslides, wildland fire progression, toxic plume dispersion, and other events where weather information on a very local scale is critical. Development of an ensemble of models is also progressing to provide a range of possible forecast scenarios that can assist emergency managers with decision making. Other projects under development and improvement include (1) two complex global models, the FIM (Flow-following, Finite-volume Icosahedral Model) and its nonhydrostatic version, the NIM (Nonhydrostatic Icosahedral Model) that have the potential to improve prediction time scales in NOAA global forecasts from hours to at least weeks and the potential to bridge the gap between 14-day weather forecasts and seasonal climate forecasts; (2) the Observing System Simulation Experiment (OSSE) which can be used to test the possible effectiveness of an unmanned aircraft system mission or the release of balloon radiosondes into the path of approaching severe weather; (3) advanced capabilities for the Advanced Weather Interactive Processing System II (AWIPS II), the next generation forecast information and workstation including FX-Net, a spin-off system that allows AWIPS to be displayed on a laptop in the field for use by the NWS Incident Meteorologists on site at wildland fires, toxic spills, and other events and FXC, a system that provides real-time collaboration between remotely-located forecasters, emergency managers, and others; (4) systems development with NWS and the FAA to support implementation of the Next Generation Air Transportation System (NextGen); and (5) Science On a Sphere (SOS), an environmental science exhibit which extends NOAA's ability to help achieve a key goal in NOAA's strategic plan of increasing environmental literacy. Building on NOAA's collective experience and knowledge of the Earth systems, NOAA uses Science on a Sphere as an instrument to enhance informal educational programs in science centers, universities, and museums across the world.

## **Tsunami Research**

OAR's Tsunami Research supports the NWS Tsunami Warning Centers by conducting research and development on to improve tsunami forecasting. NOAA develops and transfers the Pacific Marine Environmental Laboratory's (PMEL) research results to NWS to improve forecast abilities and modeling which provide valuable information to decision makers. The Tsunami Project seeks to mitigate tsunami hazards in all the coastal states and territories through improved tsunami warnings using state-of-the-art instrument systems developed by the Laboratory's Engineering Development Division and tsunami forecast models developed by NOAA's Center for Tsunami Research (NCTR).

PMEL has developed engineering technology and numerical models to greatly improve the delivery of reliable tsunami forecasts to citizens in U.S. coastal communities. PMEL engineers and tsunami scientists have developed a forecast system which integrates observational data, model output, and scientific decision-making by forecasters which can deliver accurate and timely forecasts that have been proven in sixteen tsunami events since testing of this system began. NOAA needs to continue the development and implementation of this system to ensure the protection of all coastal communities.

Additional research capabilities will provide Tsunami Warning Center staff with improved methods of product delivery that will give emergency managers and the public more time and information to take the proper actions. The tsunami research program will also provide operational model access to scientists of foreign nations and to academic institutions to encourage more widespread use of the technology and to foster scientific improvements to the tsunami forecast system.

Besides providing more complete and accurate information to emergency managers, one of the major benefits that improved tsunami forecasts provide is the economic benefit to communities from the avoidance of unnecessary evacuations. In 2003, and again for the Samoan tsunami of 2009, use of the tsunami forecast system resulted in avoided general evacuations of the coastal areas on the island of Oahu. Based on past similar evacuations and adjusting for inflation, Hawaii officials estimated they avoided costs of over \$60 million for the 2003 event and again avoided costs in the tens of millions of dollars for the Samoan tsunami.

## **Unmanned Aircraft Systems**

OAR's Unmanned Aircraft Systems (UAS) is an initiative that accelerates the research, development, and transition of innovative new observational platforms and forecast tools to advance NOAA's Earth-system product, service, and information enterprise. UAS platforms represent a collaborative effort of several organizations within NOAA and partnerships with other agencies, including NOAA laboratories, National Weather Service, National Ocean Service, Marine and Aircraft Operations, and NOAA Cooperative Institutes, NASA, and DOE. This initiative is linked closely to the needs of multiple Federal, state, and local agencies. Specific UAS applications in weather research range from (1) hurricane reconnaissance and research to help improve hurricane track and intensity forecasts, to (2) monitoring of Pacific atmospheric river moisture transport and characteristics to help improve west coast winter precipitation and flood forecasts. Specific UAS activities include (1) monitoring high-impact oceanic weather, including flights into tropical depressions that documented higher wind speeds than found by conventional platforms, and successfully launching UAS from NOAA ships and meteorological flights along the CA coast documenting oceanic evaporation rates; and (2) polar surveys and assessments, including 17 flights across Greenland glaciers, documenting melt-water lakes, and marine monitoring.

Unmanned Aircraft Systems have the potential to revolutionize NOAA's ability to monitor and understand the global environment, filling information gaps from Earth surface instruments to satellites and from the ocean surface to the seafloor. This initiative will research the potential of UAS

to provide a broad and synoptic view of our ocean and marine environments that meets tomorrow's needs of government, environmental managers, scientists, businesses and the public. These systems may also provide viable alternatives to aging aircraft platforms.

Preliminary results of NOAA field demonstrations conducted in partnership with other Federal agencies suggest UAS do offer unique observing capabilities that other observing systems cannot provide for enhanced horizontal coverage, time, and vertical profiling of the Earth. In parallel, Federal ocean agencies have agreed to form a partnership on all aspects of the conduct of unmanned systems, demonstrated by the formation of a Task Force for Unmanned Systems reporting to the working group and subcommittee structure of the National Science and Technology Council.

### **Schedule and Milestones:**

#### **FY 2012**

- Create a database of quality-controlled radar data observations for severe weather events (the Warn-on-Forecast (WoF) database) including: tornadic supercell thunderstorms, non-tornadic supercell thunderstorms, tornadic non-supercell thunderstorms, multicell thunderstorms, hailstorms, convective lines, quasi-linear squall line tornadoes, flash flood producing convection, and complex storm interactions.
- Develop improved automated radar quality control software.
- Determine which data assimilation methods are most accurate and cost-effective when applied to radar data at convection-resolving scales.
- Explore the predictability of severe thunderstorms using a numerical modeling approach.
- Document current NWS forecaster practices for determining and generating severe weather watches and warnings. Identify gaps in extending watch and warning capabilities.
- Develop and implement a new tsunami forecast system at the NOAA Tsunami Warning Centers by completing tsunami forecast models (75 in the initial group due to be completed by September, 2012) and installation and testing of the tsunami forecasting software system.
- Examine tornadogenesis using VORTEX2 observational datasets and high resolution numerical weather prediction models. Examine the predictability of small-scale phenomena (such as tornadoes or other localized severe weather) using high resolution numerical weather prediction models.
- Conduct yearly experiments in the Hazardous Weather Testbed (HWT). Integrate Social Science experts to examine the impact of probabilistic warnings on public perception.
- Coordinate and conduct yearly Intensity Forecast Experiments in partnership with NWS, NESS, and Aircraft Operations Center (AOC) to collect high quality observations in support of operations and Hurricane Forecast Improvement Project's (HFIP). These experiments will help meet the need to improve hurricane track and intensity forecasts.
- Continue development and testing of new instrumentation, in particular the G-IV tail Doppler radar.
- Develop and test ensemble Kalman filter data assimilation system for possible implementation in NOAA's operational hurricane regional model system (HWRF). Test impact of assimilation of airborne and ground-based Doppler radar data.
- Develop and test advanced nesting capability for possible implementation into HWRF to enable simulations at resolutions down to 1 km.

#### **FY 2013**

- Complete study assessing ways of providing severe weather forecast uncertainty. Perform case studies with Warning on Forecast/High-Resolution Rapid Refresh (WoF-HRRR) nesting design, including new data assimilation techniques at HRRR and WoF scales.

- Complete specification of basic components of a complete WoF system, including data conversion and quality control, ensemble initialization, storm-scale forecast model, data assimilation system, display, and diagnostic software, along with all needed computer communication packages.
- Transition Mobile Atmospheric River Monitoring System /Quantitative Precipitation Estimation (MARMS/QPE) to the National Climate Data Center (NCDC).
- Further investigate and utilize the Dual Polarization data from the WSR-88D. Dual Polarization data may be useful for development of volcanic ash detection algorithms, for improved ground-clutter rejection techniques, for discrimination between different predominate hail sizes within a storm, and for development of a tornado debris signature detection algorithm.
- Coordinate and conduct yearly Intensity Forecast Experiment in partnership with NWS, NESS, and the AOC to collect high quality observations in support of operations and HFIP need to improve hurricane track and intensity forecasts. Continue development and testing of new instrumentation, in particular a scanning microwave radiometer (HIRAD) for surface wind field estimation in partnership with NASA.
- Develop and test observing system sensitivity analysis (OSSE) using ensemble Kalman filter data assimilation system and NOAA's operational HWRF. Focus will be on developing synthetic airborne Doppler radar and Lidar observations from high-resolution nature runs of hurricanes.
- Continue tests of the advanced nesting capability for possible implementation into HWRF to enable simulations at resolutions down to 1 km with a focus on coupling the new nests with the operational ocean and wave models.

#### **FY 2014**

- Complete an operational demonstration with the NWS operations of a WoF system during the severe weather season with WoF nested inside the HRRR.
- Complete report documenting major findings from VORTEX2.
- Develop a statistically-based algorithm from the WSR-88D historical reanalysis severe weather detections to identify uncertainty parameters and produce a probabilistic warning guidance prototype for severe weather.
- Incorporate Dual Polarization radar data to improve QPE.
- Perform radar data analysis to improve understanding of convective weather systems through comparisons among various radar systems and partnering with data assimilation experts.
- Coordinate and conduct yearly Intensity Forecast Experiment in partnership with NWS, NESS, and AOC to collect high quality observations in support of operations and HFIP need to improve hurricane track and intensity forecasts. Continue development and testing of new instrumentation, in particular a Doppler wind Lidar (DWL) in partnership with NASA.
- Continue tests of ensemble Kalman filter data assimilation system for possible implementation in NOAA's operational HWRF. Test impact of assimilation of radar reflectivity data using OSSE and operational support equipment (OSE) approaches.
- Develop and test advanced physics packages for possible implementation into a HWRF to enable simulations at resolutions down to 1 km. Focus will be on air-sea fluxes and boundary layer.
- Implement High Resolution Rapid Refresh (HRRR) model at NWS/National Centers for Environmental Prediction (NCEP) depending on availability of necessary high performance computing resources.

## **FY 2015**

- Complete a report documenting the readiness of WoF technology and utility of transitioning WoF functionality to operations.
- Assess the use of frequently updated national scale and local ensembles for probabilistic forecasts in the WoF context and determine methods for best communicating uncertainty in warnings to both forecasters and non-NOAA customers with help from Social Science woven into Meteorology (SSWIM).
- Test and evaluate a Probabilistic Hazard Information grid in the HWT based on the results of the historical reanalysis of WSR-88D and other sensor data.
- Expand HL-RDHM and QPE testbeds to other seasons/regions.
- Perform radar data analysis to improve data quality and usability through signal processing improvements. Signal processing improvements may be used to identify and mitigate Wind-farm clutter and to detect tornado signatures using spectral analysis.
- Coordinate and conduct yearly Intensity Forecast Experiment in partnership with NWS, NESS, and AOC to collect high quality observations in support of operations and HFIP need to improve hurricane track and intensity forecasts. Continue development and testing of new instrumentation, in particular a low-altitude unmanned aerial system (UAS) for sampling the boundary layer of the hurricane core.
- Continue tests of ensemble Kalman filter data assimilation system for possible implementation in NOAA's operational HWRF. Test impact of assimilation of satellite microwave radiance data using OSSE and OSE approaches.
- Develop and test advanced physics packages for possible implementation into HWRF to enable simulations at resolutions down to 1 km. Focus will be on microphysics and aerosol.

## **FY 2016 and Beyond**

- Develop the initial data mining applications to identify severe weather signatures in model analyses.
- Demonstrate and test a probabilistic warning system using model assimilation analyses as a prototype for WoF.
- Improve temporal/spatial resolution of MARMS/QPE.
- Continue to maintain and develop research radar systems (NO-XP, KOUN, mobile radars) to support scientific inquiry. Maintenance and development activities include the hardware and software required to collect data, as well as the software needed to perform data analysis and display.
- Address fundamental science questions that may limit WoF utility, including effects of model error on thunderstorm evolution, needed accuracy of storm environmental conditions, and errors in conversions from model data to observational data. VORTEX2 data will assist this evaluation (2018).
- Provide NOAA management with information needed to decide whether to make WoF operational, including the total costs of going forward (2018). Conduct real-time tests of WoF system in HWT in collaboration with NWS forecasters and collect data needed to verify WoF predictions. Collaborate with NWS forecasters to evaluate WoF and develop new display capabilities for use in warning operations. Evaluate WoF predictions using rigorous verification measures and use knowledge gained to further improve WoF system (2020).
- Coordinate and conduct yearly Intensity Forecast Experiment in partnership with NWS, NESS, and AOC to collect high quality observations in support of operations and HFIP need to improve hurricane track and intensity forecasts. Continue development and testing of new instrumentation.

- Continue tests of ensemble Kalman filter data assimilation system for possible implementation in NOAA's operational HWRF. Test impact of assimilation of satellite microwave radiance data using OSSE and OSE approaches.
- Develop and test advanced physics packages for possible implementation into HWRF to enable simulations at resolutions down to 1 km. Focus will be on microphysics and aerosol.

**Deliverables:**

**FY 2012**

- Report documenting the relative value of different data sources, new data assimilation and modeling techniques appropriate for use in WoF and a design to optimize WoF via nesting inside the HRRR. Report assessing the ways of providing severe weather forecast uncertainty.
- Incorporate Dual Polarization radar data to improve QPE products.
- Regional, atmosphere-only assessments of mercury source-receptor relationships to inform air quality and environmental decision-makers.
- Improvements to web-based delivery of atmospheric forecast information to support emergency managers, air quality forecasters, and other stakeholders (annual).
- Improvements to volcanic ash prediction system to support safe and efficient flight operations (annual).
- Findings from instrument evaluations and regional field studies of ammonia exchange between the land and atmosphere.
- Use of measurements of air pollutants in precipitation to evaluate and improve NOAA's operational air quality forecast model.
- Improved nesting capability for the operational HWRF that can be tested for implementation in operations.
- Ensemble Kalman filter data assimilation system that can be tested and evaluated for implementation into operations.
- High-quality hurricane observations from airborne experiments for use in hurricane regional model data assimilation and evaluation, in particular dropsondes, Doppler radar, in-situ, and stepped frequency microwave radiometer.

**FY 2013**

- Report documenting the major components of a WoF system with operational demonstration of some WoF components in the pseudo-operational environment of the HWT.
- Recommendations for improvements to address seasonal biases in particulate matter forecasts.
- High-quality hurricane observations from airborne experiments for use in hurricane regional model data assimilation and evaluation, in particular dropsondes, Doppler radar, in-situ, and stepped frequency microwave radiometer.
- Observing system sensitivity analysis capability utilizing the ensemble Kalman filter data assimilation system and the improved nesting for HWRF.
- Fully coupled advanced nesting capability for testing and evaluation in the operational HWRF model system.

**FY 2014**

- Report documenting major findings of the VORTEX2 field phase.
- High-quality hurricane observations from airborne experiments for use in hurricane regional model data assimilation and evaluation, in particular dropsondes, Doppler radar, in-situ, and stepped frequency microwave radiometer.



- Findings from field studies of ammonia exchange between the land and atmosphere in a second region.
- Report documenting the impact of improved physics for air-sea fluxes and boundary layer on hurricane track and intensity forecasts using regional HWRF model system.
- Report documenting the impact of assimilating DWL and radar on hurricane track and intensity forecasts using the regional HWRF model system

**FY 2015**

- Report documenting the assessment of operational readiness of WoF technology, with computer code and documentation suitable for transitioning to operations.
- Preliminary development of a tornado debris signature algorithm using Dual Polarization radar data.
- High-quality hurricane observations from airborne experiments for use in hurricane regional model data assimilation and evaluation, in particular dropsondes, Doppler radar, in-situ, and stepped frequency microwave radiometer.
- Report documenting the impact of improved physics for microphysics and aerosol on hurricane track and intensity forecasts using the regional HWRF model system.
- Report documenting the impact of assimilation radar reflectivity on hurricane track and intensity forecasts using the regional HWRF model system.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Percent of labs that have had formal expert peer reviews in the past 4 years & were rated effective in terms of quality, mission relevance, & performance	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	100%	100%	100%	100%	100%	100%
<b>Description:</b> This performance measure is recognized by the National Academy of Sciences report <i>Evaluating Federal Research Programs</i> which states that “The most effective means of evaluating Federally funded research programs is expert review.”						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
High quality data sets from IFEX hurricane missions (missions – dependent on number of storms flown)	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	20	20	20	20	20	20
<b>Description:</b> Provide high-quality data sets for use for use in data assimilation and evaluation of hurricane modeling system (20 missions per year – dependent on number of storms flown)						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Tests of hurricane observing system improvements	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5	5	5	5	5	5
<b>Description:</b> Provide reports on impact of new and existing observing systems on hurricane track and intensity forecasts using regional HWRF model system (5 of reports per year)						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Reports on improvements to the high-resolution regional hurricane forecast system (HWRF)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5	5	5	5	5	5
<b>Description:</b> Provide reports on impact of improved nesting capability and advanced physics packages applicable at 1-km horizontal resolution on hurricane track and intensity forecasts using regional HWRF model system (5 reports per year).						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Demonstrate improved tornado warning lead time (Severe Storms Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	13	13	14	14	14	14
<b>Description:</b> This goal shows the amount of warning the public is given for tornadoes (national average, in minutes) by NWS. NSSL conducts research that leads to improved warning skill scores.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of regional assessments of atmospheric mercury source-receptor relationships (Air Quality Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	0	1	1	1	1	2
<b>Description:</b> This provides key information for air quality and environmental policy-makers and managers and for negotiators for international agreements—enabling them to effectively target mercury emissions reductions.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of completed field studies of ammonia exchange between the air and land (Air Quality Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	0	1	1	2	2	3
<b>Description:</b> This provides essential information for air quality, agriculture, and environmental policy-makers and managers. It also addresses a key uncertainty in air quality models. Each study addresses different regions/land uses (e.g., fertilized farm fields, concentrated animal feeding operation).						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of updates provided to the National Weather Service for the volcanic ash forecast system (Air Quality Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	7	8	9	10	11	12
<b>Description:</b> This provides improvements to a forecast system used to inform pilots where volcanic ash is located, enabling them to avoid in-flight catastrophes. Examples of improvements include better use of satellite observations to estimate volcano source strength and improved flexibility for configuring simulations for various types of eruptions.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Demonstrate improvement in accuracy of the 3-hour cloud ceiling for aviation forecast (Advanced Computational Analysis and Display)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5%	10%	15%	18%	20%	20%
<b>Description:</b> This measure demonstrates improvements to the cloud ceiling for aviation forecast are derived from the implementation of short-range, rapidly updated models at NWS/NCEP. Better awareness of expected cloud ceiling over the next 3-hour period is critical to airline safety.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Increase the number of Inundation Forecast Models developed for specific high-risk areas (Tsunami Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	65	75	77	79	81	83
<b>Description:</b> This is an important effort related to tsunami readiness, particularly with respect to the areas that need to be evacuated for various levels of anticipated inundation.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Reduce the cost of the DART network operation and maintenance (2010 baseline; Tsunami Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5%	10%	15%	20%	25%	30%
<b>Description:</b> PMEL contributes to this performance measure through a contract from NDBC. Funding is presently directed at reducing costs through development of a self-deploying buoy that reduces vessel time on station, reduces the size requirement of the servicing vessel, and improves safety. Progress is being made, but there are no operational systems of this type currently deployed by NWS.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Demonstrate improved tsunami flooding warning accuracy	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	67%	72%	77%	80%	82%	84%
<b>Description:</b> The accuracy of the warning is determined by comparing it after the fact to the actual tide-gauge measurements. PMEL contributes to this performance measure through the implementation of the new tsunami forecasting system and the development of the interface software that integrates incoming observations, propagation model, and the appropriate inundation forecast models to produce a tsunami forecast. Upon completion of the tsunami forecast system in 2012, we anticipate a target accuracy of the new system at 80 percent compared to observed tide gage records.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct Unmanned Aircraft Systems (UAS) field tests – number of field tests: number of operational transition plans	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	2:1	2:1	2:1	2:1	2:1	2:1
<b>Description:</b> Field tests (with NASA, DOE, & other agencies) focus on data collection over vast, remote areas, including the Gulf of Mexico & Atlantic (e.g., hurricane tests), Central Pacific (e.g., endangered species at the Papahānaumokuākea Marine National Monument), and Arctic (e.g.,						

measuring changes in pack ice). Promising technologies and concept of operations successfully demonstrated during field tests will be selected for further development and transition planning for operational application.

## **WEATHER AND AIR QUALITY RESEARCH PROGRAMS**

Weather and Air Quality Research Programs encourage cooperation with external experts in critical fields of research. NOAA's external partners include Federal, state, and local government entities, universities, and industry. Currently, two primary research programs are supported under this line.

### **Tornado/Severe Storm Research (Multi-Function Phased-Array Radar)**

NOAA is developing new technologies for detecting tornadoes and other forms of severe weather and for disseminating this information to emergency managers, the media, and the general public for appropriate action. Multi-function Phased-Array Radar (MPAR) has the potential to significantly extend lead times for detecting tornadoes and other forms of severe and hazardous weather. Electronically steered beams and faster scan rates can reduce the time it takes to make a complete Doppler radar observation from 4.5 minutes to less than one minute. Coupled with artificial-intelligence-based decision-support systems, tornado lead times could be increased from the current 14 minutes to over 20 minutes.

Major components of this program are (1) continued research support on MPAR technology, (2) engaging industry in a risk reduction effort leading to fabrication of a prototype, and (3) experimentation with a phased-array research testbed at the National Severe Storms Laboratory (NSSL) in Norman, OK. Congress established a joint R&D program for NOAA, DOD, and FAA to investigate the feasibility and benefits of using military phased- array radars for improving severe weather forecast and warning systems. U.S. Navy SPY-1 Phased-Array Radar technology holds considerable promise for making significant improvements to the existing WSR-88D system. NOAA/NSSL is designated to operate and maintain the equipment, provide facilities, approve associated research, and otherwise assist in all related efforts that may arise. Research at NSSL has led to, among other things, the NWS Doppler Weather Radar known as NEXRAD. This radar has saved thousands of lives and significant property loss by helping NWS forecasters extend tornado and severe weather warning lead times from a few minutes to a national average of almost 14 minutes. Since NEXRAD was deployed in the early 1990's, and since it historically has taken 25 or more years to develop and deploy a new radar system, NSSL has begun the MPAR program to provide NWS (in partnership with the FAA) with an alternative highly advanced radar to the aging NEXRAD. It is expected that ultimately the MPAR radar will be more efficient to operate than the NEXRAD and will reduced long-term maintenance costs.

### **U.S. Weather Research Program (USWRP)**

Through its U.S. Weather Research Program (USWRP), NOAA seeks to improve weather and air quality forecast information and products by funding, facilitating, and coordinating cutting-edge research to improve weather predictions, with a special focus on hurricanes and precipitation. USWRP works in close collaboration with the National Weather Service (NWS) to transition this research into useful weather and air quality applications. The USWRP supports societal impact studies in weather and a set of related program projects to provide outreach, linkage, and coordination among NOAA, other government agencies, and the academic and private sectors, both in the U.S. and abroad. Within NOAA, the Office of Weather and Air Quality (OWAQ) Program manages the overall USWRP effort in support of research for air quality forecasting, societal benefits, and related weather research through projects with such internal and external partners as the National Center for Atmospheric Research (NCAR). USWRP project activities include:

- The Joint Hurricane Testbed, where the latest research findings and techniques in hurricane science are tested by scientists and evaluated by operational meteorologists for use at NOAA's National Weather Service's Tropical Prediction Center.
- The Air Quality Program, which supports improvements of 1-3 day forecasts of tropospheric ozone and the development of a forecast capability for fine particulates in the atmosphere, both of which can cause serious pulmonary illnesses. The advances in air quality forecasts are transitioned to NWS operations.
- The Hydrometeorological Testbed (HMT), an ongoing research project supported by NOAA, the USWRP, and other government agencies, such as the State of California and the U.S. Army Corps of Engineers, to improve forecast capabilities of heavy rainfall events. Although the HMT plays a key role in the weather objective to improve precipitation forecasts, it also has climate change implications in terms of a trend towards greater seasonal extremes. The initial research and forecasting technique development occurs in the western U.S. and provides improved warnings of impending storms to state, local, and Federal governmental entities; emergency managers; and reservoir operators. The majority of the base funding for this activity goes to NOAA's Physical Sciences Laboratory and can be found in the NOAA Climate Service base narrative. USWRP supplements that funding and is a mechanism for engaging external partners in this effort that is of key interest to both NOAA's Weather and Climate goals.
- High-resolution numerical models, which accommodate the high resolution spatial and temporal processes required to support weather and flood forecasting. OWAQ supports Federal and university partnerships that are needed to develop techniques to quickly assimilate high-resolution observations from radar (both operational and experimental phased array), satellite, and other sources into models. USWRP will improve existing high-resolution models and develop techniques to produce high-resolution, probabilistic forecasts (using ensembles) in collaboration with the NWS.
- The Societal Impacts Program, which determines the socioeconomic benefits of improved weather forecasts and the optimum presentation of the forecasts to the public and decision-makers, especially improving our understanding of how uncertainties are handled in the models and forecasts. The program is critical for setting weather research priorities and identifying which areas of research will produce the greatest benefits. This program resides at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, and is supported through a broad agency grant.

#### **Schedule & Milestones:**

##### **FY 2013**

- Complete analysis and associated report based on field study by the Office of Weather and Air Quality (OWAQ) Programs for air quality forecasting, societal benefits, and related weather research projects.
- Complete report documenting the baseline performance of quantitative precipitation forecasts (QPF) for extreme precipitation events on the U.S. West Coast, and identification of major error sources.

##### **FY 2014**

- Complete report from Hydrometeorology Testbed (HMT) describing the path forward to improve west coast QPF in extreme precipitation events.

##### **FY 2016**

- Based on hazardous weather testbed (HWT) findings, complete report to NWS documenting potential for improved tornado warnings.

**Deliverables/Outputs:**

- Report documenting potential for improved tornado warnings produced in collaboration with NWS forecasters within the NOAA hazardous weather testbed (HWT) (FY 2015).
- Joint Hurricane Testbed will evaluate 10 scientific findings per year through FY 2016 for possible inclusion in the tool kit for operational forecasters to use in the forecasting of hurricanes.
- Hydrometeorology Testbed will conduct one field study per year through FY 2016.
- Improved Numerical Weather Models: Test two or more major capability change in the numerical weather model physics, data set assimilation, or model resolution reduction per year in one of NOAA’s research or operational centers through FY 2016.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Joint Hurricane Testbed (JHT) Evaluations	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5	5	5	5	5	5
<b>Description:</b> Evaluation of new scientific findings or development of forecaster tools for potential use in operations.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Field study and science reports (OWAQ Programs)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	1	1	1	1	1	1
<b>Description:</b> Perform a scientific air quality field study with experimental data collections followed by completed analysis and report the following years.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Hydro – meteorology Testbed Field Studies	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	1	1	1	1	1	1
<b>Description:</b> Conduct a field study with experimental data collections, scientific evaluation, and consult with operational forecasters on how to improve flood forecasting.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Improved Numerical Weather Model Changes or Tests (USWRP)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	2	2	2	2	2	2
<b>Description:</b> Make changes to the physical parameterization of experimental forecast models and address the uncertainties in numerical weather predictions. This contributes to the improvement of the 1-5 day precipitation forecasts for the U.S., which are issued on a region-by-region basis.						

## PROGRAM CHANGES FOR FY 2012:

### **Weather & Air Quality Research Labs & Cooperative Institutes: Wind Boundary Layer Research to Support Clean Energy Generation (Base Funding: 0 FTE and \$0; Program**

**Change: +0 FTE and +\$2,000,000)** NOAA requests an increase of \$2,000,000 and 0 FTE for a total of \$2,000,000 and 0 FTE for wind boundary layer research to support clean energy generation by advancing weather forecast quality and accuracy to allow for faster and more efficient implementation of wind power usage in the United States.

#### **Proposed Actions:**

NOAA proposes to improve the Nation's understanding of the atmospheric phenomena driving and determining boundary layer winds. By developing more accurate wind forecasts and allowing for more accurate predictions of wind power production, this critical investment will help facilitate the expansion of U.S. clean energy generation. To achieve this end, the following two actions are proposed:

1. Deploy wind test beds. To improve short-term operational predictions, NOAA will deploy wind test beds in different regions of the Nation. Regional testbeds are needed because different factors that influence weather, including wind speeds and wind direction, can vary by region. Testbeds will be deployed in the Pacific Northwest, offshore along the Atlantic Coast, the Appalachian region, the inter-mountain west, and California. These test beds will help determine the optimal mix of instrumentation needed for wind resource characterization and forecast improvement. NOAA will perform scientific analyses and develop Numerical Weather Prediction (NWP) models using the data collected at the test beds.

These test beds will be comprised of standard instruments for obtaining wind measurements, such as wind profiling radars and sodars (sound detection and ranging to measure wind profiles). In addition, a Halo Photonics pulsed Doppler-lidar (light detection and ranging technology) system will be purchased and adapted for remote operation and read-out. The lidar data will be especially valuable in the post-project analysis of times when the forecasts were wrong, for model initialization during research model runs to diagnose and improve model performance, and for verification of model output.

2. Improve the HRRR weather model. Additional operational observations will be obtained and assimilated into the High-Resolution Rapid Refresh (HRRR) weather model. NOAA will leverage high performance computing investments that the agency has already made to facilitate improved NWP forecasts. The additional observations collected at the test beds will be used to initialize the HRRR model and equip it with more accurate initial values of weather parameters so that it can produce a more accurate forecast of wind speeds and direction. Even a small improvement in wind *speed and direction* forecast accuracy will result in a very large improvement in the accuracy of our wind *power* prediction because an increase in wind speed increases the amount of wind power produced that is equal to the cube of the wind speed.

The wind test beds and the improved weather forecast models will represent a core national investment that the private sector could leverage to develop tailored products and operate the Nation's electric grid more efficiently, including contributing to efforts to develop a reliable Smart Grid. Smart Grid technology allows for two-way communication and two-way flow of electricity between utility companies and customers, thereby enhancing flexibility and greater efficiency of electric grid operations.

Additionally, improved weather predictions will allow the Nation to obtain larger amounts of energy from renewable resources, use current energy sources more efficiently (i.e., fossil fuels and nuclear energy), reduce the cost of renewable energy, and improve grid stability. There are two main reasons that more accurate forecasts of winds will save money. First, improved wind predictions will reduce the “wind-integration cost” levied on wind energy that is based primarily on the fact that wind is a variable energy source (not dispatchable) and there are inaccuracies in predictions of wind energy across given time periods. Improved forecasts of winds and the resulting increases in accuracy of predicting wind energy production will lower wind-integration charges. Second, improved forecasts of winds will allow grid operators to use smaller amounts of fossil fuel reserves. Once grid operators have more confidence that wind farm operators can deliver the amount of wind energy they schedule (promise) to provide in the next few hours and in the next 24 hours, operators will not have to keep as many spinning and operational reserves on-line and ready to compensate for errors in wind energy forecasts. These improvements in observations and predictions are necessary before renewable energy can provide a significant portion of the total U.S. energy supply, which would reduce the Nation’s dependence on foreign oil and increase our energy security and independence.

**Statement of Need and Economic Benefits:**

NOAA can help achieve significant benefits for the Nation and enable \$2 to \$4 billion savings to the energy industry within only a few years by providing enhanced weather forecasts. Providing weather observations and predictions is a core NOAA mission, and OAR is well positioned to perform this research to develop improved operational forecasts that will benefit the renewable energy industry.

Additionally, this initiative will contribute to improvements in other weather applications, such as aviation forecasts, as well as fire weather, air quality, severe weather, and dispersion predictions for the release of hazardous materials into the atmosphere.

**Base Resource Assessment:**

Currently no resources are dedicated to this effort.

**Schedule and Milestones:**

- Purchase Halo Photonics pulsed Doppler-lidar (light detection and ranging technology) system and adapt for remote operation and read-out (FY 2012).
- Deploy and operate test bed in meteorologically distinct regions of the nation (FY 2012-FY 2016).
- Improve HRRR weather models (FY 2012-FY 2016).
- Perform model analysis and evaluate the meteorological models (FY 2012-FY 2016).
- Ingest and assimilate additional observations, e.g., from wind farms, to improve weather forecast model output (FY 2012-FY 2016).

**Deliverables:**

- Improved research-grade weather forecast capability designed for transition to operations.
- An assessment of the optimal mix of instrumentation needed for wind resource characterization and forecast improvement, for consideration in developing a national network for wind energy.

**Performance Goals and Measurement Data**

<b>Performance Goal:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of Wind Test Beds (yearly)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0	1	1	1	1	1



<b>Without Increase</b>	0	0	0	0	0	0
<p><b>Description:</b> Deploy wind test beds, collect observations, in different regions of the Nation. The sensors at each testbed will collect weather observations that will allow us to increase the skill and accuracy of our forecasts of winds. Different regions of the Nation have different weather conditions, partly based on such issues as the proximity of mountains or coasts. These test beds will allow us to determine the best types and minimum numbers of sensors, per unit area, needed to achieve the improvement in wind forecasts that the wind energy industry has told us is needed for wind energy to be economically competitive.</p>						

<b>Performance Goal:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative improvement in accuracy of forecasted wind speed and direction and accuracy of forecasted timing, amplitude, and duration of wind-ramp events.	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0	2%	4%	6%	8%	10%
<b>Without Increase</b>	0	0	0	0	0	0
<p><b>Description:</b> High-resolution rapid refresh (HRRR) is a research weather model that has demonstrated better results than the NWS operational weather forecast model (RUC). We will use the observations collected at the test beds to create a wind forecast that is sufficiently improved for the private sector to use as a basis for predicting wind energy production in given time periods (e.g., the next 60-90 minutes and the next 24 hours). The amount of wind energy produced is proportional to the wind speed raised to the third power (i.e., the cube of the wind speed). Thus, a small improvement in wind speed forecast accuracy will lead to a large improvement in accurately predicting how much wind energy can be produced.</p>						

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Weather and Air Quality Research

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	10
22 Transportation of things	10
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	15
23.3 Communications, utilities and miscellaneous charges	10
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	950
25.6 Medical care	0
25.7 Operation and maintenance of equipment	5
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	300
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	700
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	2,000

**Tornado Severe Storm Research / Phased Array Radar: Multi-Function Phased Array Radar (Base Funding: 4 FTE and \$4,037,000; Program Change: +0 FTE and +\$6,000,000):** NOAA requests an increase of \$6,000,000 and 0 FTE for a total of \$10,037,000 and 4 FTE to continue research to demonstrate that MPAR technology can cost-effectively replace aging operational weather and aircraft tracking radars. The MPAR program is jointly funded by NOAA and the FAA, and both agencies are coordinating their budget requests.

**Proposed Actions:**

This investment in MPAR provides the resources needed for the next step of the project that engages industry to add polarization to the radar by FY 2014. Polarization is not currently available on phased array radars but is a requirement for the NWS. Matching funding will be provided by the FAA to fulfill its requirement for airport terminal weather and aircraft tracking. It is important that the leading agencies establish a joint risk-reduction R&D program in the near future, given the potential for savings, complexity of the mission, the technology involved, agency go/no-go decision points, and the long lead times required for interagency acquisition times. In FY 2012, a contract vehicle will be put in place to acquire a dual-polarized MPAR antenna. Subsequently, the following will happen:

- Research and development will be performed to determine how best to add dual polarization to the MPAR to provide improved rainfall and hail estimates and meet new NWS baseline requirements (FY 2012-FY 2014; \$600K in FY 2012).
- Contract out design and fabrication of dual-polarized, single-faced, PAR demonstrator with FAA (FY 2012-FY 2013; \$5,000K in FY 2012).
- Verify through research that tornado warnings can be improved by scanning the atmosphere faster, by focusing radar beams primarily on critical regions within storms (vs. wasting resources on non-storm areas), and by using new knowledge gained on tornado evolution (FY 2012-FY 2016; \$400K in FY 2012).
- Studies will be performed to assess MPAR polarized antenna array configurations for both weather (NOAA weather and FAA airport terminal weather mission) and air surveillance operations (FAA mission) (FY 2014-FY 2016).
- With industry, design, fabricate, and acquire a fully functional, four-faced, polarized MPAR prototype antenna (FY 2014-FY 2017).

The intent is to complete risk reduction activities and research needed to inform decision makers within NWS and FAA on the feasibility of deploying MPAR as a solution to future NWS and FAA radar requirements.

**Statement of Need and Economic Benefits:**

By 2020 more than 350 FAA radars and by 2025 nearly 150 weather radars will need to be either replaced or have their service life extended. If MPAR is successful and implemented as a replacement radar, estimated multi-agency savings could total \$4.8 billion in acquisition costs (\$1.8 billion if replacing all existing radars with similar technology) and life-cycle costs over 30 years (\$3.0 billion due to fewer radars) (Federal Research and Development Needs and Priorities for Phased Array Radar FCM-R25-2006). Given that it historically takes 20 to 25 years to perform the research, develop a prototype, test, and deploy new weather radar systems, it is imperative this activity begin now since the FAA radars are already past end of life (and costing increasing amounts of money to extend their life), while the NWS radars are reaching their expected end of life in only 15 years.

The current need is to measure phenomena such as tornadoes on the time scale that they occur (minutes) and to initialize high resolution cloud models with high resolution radar data to move

current operational warnings from “warn on detection” to “warn on forecast.” Independent reports supporting the need for a risk reduction of phased array technology including:

- The National Research Council's (NRC) 2002 report, “Weather Radar Technology beyond NEXRAD” identified phased array radar as a candidate technology. The technical characteristics, design, and costs of PAR systems should be established.
- The June 2006 Office of the Federal Coordinator for Meteorology (OFCM)-sponsored report, “Federal Research and Development Needs and Priorities for Phased Array Radar” (FCM-R25-2006), called for the establishment of a Multi-function Phased Array Radar (MPAR) risk-reduction research and development (R&D) program and creation of an interagency MPAR Working Group (WG/MPAR) to coordinate and report on the R&D activities of participating agencies.
- The March 2007 U.S. DOC Office of Inspector General Audit Report concluded that “PAR is a very promising technology that has been proven effective for military applications, and has the potential to revolutionize weather forecasting...(Report No. DEN-18354-7-0001 2007, pg 14).
- The 2008 NRC “Evaluation of the Multifunction Phased Array Radar Planning Process,” an evaluation of the Multifunction Phased Array Radar planning process, concluded “the MPAR R&D program be continued with the objective of evaluating the degree to which a deployable MPAR system can satisfy the national weather air surveillance needs cost-effectively.”

**Base Resource Assessment:**

The MPAR program base funding of \$4,037,000 provides for weather-related research on and maintenance of the 30-year-old phased-array antenna donated from the Navy that had been used for tracking missiles. The new investment in MPAR will provide the resources for the next steps of the project, namely to engage industry in: (1) adding polarization to the radar by 2014 so as to meet NWS operational requirements and (2) designing, fabricating, and acquiring a fully functional, 4-faced, polarized MPAR prototype antenna by 2017.

**Schedule and Milestones:**

- FY 2012:
  - Complete Request for Information (RFI) for design proposals for a dual-polarized PAR demonstrator radar.
- FY 2013:
  - Complete analysis demonstrating improved severe weather observing and monitoring service improvements.
  - Complete pre-prototype construction of a polarized phased array radar sub-arrays.
- FY 2014:
  - Complete construction of at least two candidate dual polarized demonstrator radars.
  - Complete assessment of PAR antenna array configurations needed to build a fully functional MPAR prototype.
- FY 2015:
  - Complete contract signing to engage industry in construction of at least two MPAR prototypes (at least two vendors).
- FY 2016:
  - Complete study and a report that documents potential for improved tornado warnings produced in collaboration with NWS forecasters within the NOAA hazardous weather testbed (HWT).

**Deliverables:**

- By FY2012:
  - Accept delivery of five to six different contractor designs for Phase I: dual polarized PAR sub-antenna array.
  - Contract completed to engage 3 contractors in fabrication of dual polarized, phased array antenna sub-arrays (Phase II).
- By FY 2013:
  - Report summarizing MPAR’s potential service improvements.
- By FY 2014:
  - Final design selected for dual polarized antenna completing Phase II.
- By FY 2015:
  - Final antenna array configuration design selected for full demonstrator radar; Phase III begins.
- By FY 2016:
  - Completed multi-faced, dual polarized antenna demonstrator; Phase IV begins – design and fabrication of final prototype.
  - Report documenting potential for improved tornado warnings produced in collaboration with NWS forecasters within the NOAA hazardous weather testbed (HWT).

Phase I & II: Dual Polarized Prototype:

- FY 2012: \$1 million to conduct research through Cooperative Institute to evaluate dual polarized designs; \$5M for design (by a contractor to be determined through competitive procurement).
- FY 2013: \$6 million for fabrication and demonstration of dual polarized PAR prototype (by a contractor to be determined through competitive procurement).

Phase III: Multi-Faced, Dual Polarized Prototype:

- FY 2014: \$6 million for contract preparation, design solicitation, and contract award for 5-6 contractors to design multi-faced PAR demonstrators
- FY 2015 – FY 2016: \$6 million for fabrication by two to three contractors to build multi-faced, dual polarized MPAR demonstrators (pre-prototypes).

**Performance Goals and Measurement Data**

<b>Performance Goal:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Demonstrate Dual Polarization capability for Phased Array Radar Technology as part of MPAR risk reduction (% complete)	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0%	10%	50%	100%	100%	100%
<b>Without Increase</b>	0	0	0	0	0	0
<b>Description:</b> This measure tracks the completion of a polarized version of the MPAR (NWS requirement), which is a key step in the risk reduction process and in proving (or not) that MPAR is a viable alternative to the aging NWS/NEXRAD and FAA systems.						

<b>Performance Goal:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Demonstrate multi-faced capability for Phased Array Radar Technology as part of MPAR risk reduction (% complete)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0%	0%	0%	10%	20%	50%
<b>Without Increase</b>	0	0	0	0	0	0
<b>Description:</b> This measure tracks the completion of the demonstration of multi-faced capability. It is a risk reduction element with respect to adding more than one antenna face to the demonstration PAR. Uncertainties to be investigated include how to handle weather events that cross from one antenna field of view to the second antenna field (continuity issue), how to process the radar data from each antenna face separately and simultaneously (to maximize processing speed leading to faster warnings), and how to allow each antenna face to operate independently with respect to radar beam scan strategies (to maximize concentration of effort on hazardous weather events and minimize time spent on non-hazardous events).						

<b>Performance Goal:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Demonstrate improved tornado warning lead Time (minutes)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	13	14	14	15	16	17
<b>Without Increase</b>	13	13	13	13	13	13
<b>Description:</b> This measure tracks the demonstrated improved tornado warning lead time. Using the demonstration PAR, forecasters within the Hazardous Weather Testbed issue mock tornado warnings to show that faster scanning (4x over existing NEXRAD) increases fidelity of developing hazardous weather events (e.g., tornadoes) and allows faster and more confident tornado warnings than can be issued with existing technology.						

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research

Subactivity: Weather and Air Quality Research

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	5,000
25.2 Other services	475
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	25
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	500
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	6,000

**Weather & Air Quality Research Labs & Cooperative Institutes (Base Funding: 162 FTE and \$40,387,000; Program Change: +0 FTE and +\$25,000):** NOAA requests an increase of 0 FTE and \$25,000 for a total of \$40,387,000 and 162 FTE to support existing program requirements within this subactivity but not provided for in the FY 2010 Consolidated Appropriations Act. This funding will support one half of a work year for a Cooperative Institute scientist to develop improvements in tornado modeling.



**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research

Subactivity: Weather and Air Quality Research

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	\$0
11.1 Full-time permanent	0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	25
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	0
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	25

**US Weather Research Program (USWRP) / THORPEX (Base Funding: 0 FTE and \$1,300,000; Program Change: -0 FTE and -\$1,300,000):** NOAA requests a decrease of 0 FTE and \$1,300,000 to reduce the base funding for research activities associated with The Observing System Research and Predictability Experiment (THORPEX), for a total remaining program of 0 FTE and \$0.

**Proposed Actions:**

Recent research funded under THORPEX has focused on ensemble forecast systems and in improving the predictability of and reducing uncertainty associated with weather forecasts. The research has accelerated improvements in operational performance of numerical weather and ocean prediction and in the accuracy of atmospheric forecasts of the water cycle on timescales from hours to weeks. This research has also provided key information for the National Unified Operational Prediction Capability (NUOPC) under developed between NOAA, the Navy, and the Air Force.

When created, THORPEX was designed to be an international, multi-agency project ending in 2015. NOAA has worked closely with other federal agencies and international partners to support THORPEX since its inception. Although this successful project was scheduled to end in 2015, NOAA is eliminating its base contribution to this international effort several years earlier, as projects will be completed sooner than originally planned while still accomplishing much of proposed research. Although THORPEX projects will no longer receive USWRP funding starting in 2012, other NOAA programs will continue to support research to improve the accuracy of numerical weather and ocean predictions.

**Statement of Need and Economic Benefits:**

THORPEX is an international research and development program responding to the weather related challenges of the 21st century to accelerate improvements in the accuracy of one day to two week high impact weather forecasts for the benefit of society, the economy and the environment. THORPEX research topics include: global-to-regional influences on the evolution and predictability of weather systems; global observing system design and demonstration; targeting and assimilation of observations; and societal, economic and environmental benefits of improved forecasts. These topics still remain important areas of study for NOAA and will be pursued and funded by other NOAA programs.

**Base Resource Assessment:** OAR's base funding for THORPEX would be terminated.

**Schedule and Milestones:** None

**Deliverables:** None

**Performance Goals and Measurement Data**

<b>Performance Goal:</b>	<b>FY 2011 Target</b>	<b>FY 2012 Target</b>	<b>FY 2013 Target</b>	<b>FY 2014 Target</b>	<b>FY 2015 Target</b>	<b>FY 2016 Target</b>
No. of probability tools developed or model changes made through the THORPEX program						
<b>With Decrease</b>	1	0	0	0	0	0
<b>Without Decrease</b>	1	1	1	1	1	1
<b>Description:</b> Use of ensemble computer models to improve numerical weather models, forecasts, and decision-making for the U.S, Mexico, and Canada.						

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research

Subactivity: Weather and Air Quality Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	-55
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	-12
25.1 Advisory and assistance services	-433
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-800
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-1,300

**Weather & Air Quality Research Labs & Cooperative Institutes: Unmanned Aircraft Systems (UAS) (Base Funding: 4 FTE and \$6,000,000; Program Change: -0 FTE and -\$3,000,000):**

NOAA requests a decrease of \$3,000,000 and 0 FTE for a total program of \$3,000,000 and 4 FTE to reflect the planned completion of the High-Altitude Long-Endurance (HALE) UAS testing and demonstration program. The UAS Program has identified and demonstrated several UAS technologies using various platforms and payloads. In particular, NOAA and NASA have successfully demonstrated the long range and endurance potential of high altitude UAS during FY 2010 with the first science flights of the Global Hawk flown from the NASA Dryden Flight Research Center in California to observe dust plumes from the Gobi Desert traversing the Pacific Ocean; polar vortex and ice conditions of the Arctic; and tropical cyclones in the Eastern Pacific, Atlantic, and Caribbean undergoing various stages of genesis, intensification, and dissipation. The results of the test observing missions over the Atlantic Ocean, Central Pacific, and the Arctic will be fully evaluated and assessed by the end of FY 2011. Preliminary results suggest UAS will provide significant benefit to a possible future expansion of NOAA's suite of observing capabilities as a technology which may be capable of expanding NOAA's observational reach with greater efficiency and less risk to human life than current methods. Development of a UAS strategic plan and business case for UAS acquisition and partnerships is underway. As a result, NOAA leadership will be able to make an informed decision about the desired level of access to and use of UAS technologies for achieving its science, service, and stewardship missions.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research

Subactivity: Weather and Air Quality Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	-100
22 Transportation of things	0
23.1 Rental payments to GSA	-50
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	-100
24 Printing and reproduction	-20
25.1 Advisory and assistance services	-400
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	-80
31 Equipment	-8
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-2,242
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-3,000

**Nutrient & Mercury Speciation Measurement Stations (Base Funding: 0 FTE and \$650,000; Program Change: 0 FTE and -\$650,000):** NOAA requests a decrease of 0 FTE and \$650,000. In the Consolidated Appropriations Act, 2010, Congress provided additional funds for evaluating nutrient and mercury air pollution, their impact on sensitive ecosystems, and measurement approaches. With these additional funds, NOAA collected detailed mercury measurements in West Virginia and in Pennsylvania to assess mercury transport and deposition and to evaluate low-cost approaches for measuring mercury deposition. In addition, NOAA collected ammonia (a common airborne nutrient) measurements with the intent of evaluating whether new instrumentation could be used to more effectively measure how ammonia moves between the land and the air. In FY 2012, the NOAA will utilize the measurements made by this project, but will not continue those measurement activities. In FY 2012, NOAA will continue to provide important information about air quality by supporting analysis of the observations previously collected to understand the sources of mercury that reach sensitive ecosystems, the impact of air quality policies, and the suitability of new approaches for measuring the exchange of mercury and ammonia between the land and atmosphere.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	-300
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	-15
31 Equipment	-35
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-300
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-650

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## **APPROPRIATION ACCOUNT: OPERATIONS, RESEARCH, AND FACILITIES**

### **SUBACTIVITY: OCEAN, COASTAL, AND GREAT LAKES RESEARCH**

The objectives of the Ocean, Coastal, and Great Lakes Research subactivity are to:

- Improve the protection, restoration, and management of coastal and ocean resources;
- Monitor ocean, coastal, and Great Lakes ecosystems, including coral;
- Support ecosystem modeling and forecasting;
- Encourage technology transfer and efficient resource management; and
- Increase the pace of discovery in unknown and poorly known areas of the world's oceans.

To achieve these objectives, OAR conducts research and monitoring activities supporting ecosystem management. This includes ecosystem research to analyze ecosystem management decisions and their outcomes; integrated observing and data management systems; outreach and education to improve public understanding and use of coastal and marine resources; partnerships for place-based ecosystem approaches to management; and international diplomacy, negotiation, and partnerships.

The Ocean, Coastal and Great Lakes Research subactivity develops innovative management tools through a better understanding of our ocean and Great Lakes habitats and resources. The research serves to increase our understanding of coastal and marine processes for the purpose of protecting and restoring ecosystems. Efforts include predicting, monitoring, and mitigating the effects of change on ecosystems (e.g., invasive species, human activities such as energy production, land-based sources of pollution, climate change).

More information on research in this subactivity is available at <http://www.research.noaa.gov/oceans/>.

### **LABORATORIES AND COOPERATIVE INSTITUTES**

**Great Lakes Research** consists of integrated, interdisciplinary environmental research in support of resource management and environmental services in coastal and estuarine waters with a primary emphasis on the Great Lakes. The Great Lakes Environmental Research Laboratory (GLERL) performs field, analytical, and laboratory investigations to improve understanding and prediction of biological and physical processes in estuaries and coastal areas and their interdependencies with the atmosphere and sediments. GLERL emphasizes a systems approach to problem-oriented research to develop environmental service tools.

The **Vents Program** at the Pacific Marine Environmental Laboratory (PMEL) conducts ocean exploration and research directed toward understanding and predicting large-scale oceanographic processes and consequences of submarine volcanism and hydrothermal activity. Because the chemistry of the ocean is a result of these processes, they affect all marine ecosystems to some degree. Another important aspect of the program is to understand how submarine volcanic and hydrothermal processes create and, in major ways, sustain both living and non-living real and potential marine resources.

A new discovery has led to a third programmatic emphasis: understanding how submarine volcanic and hydrothermal activity contributes to the budgets and cycles of CO<sub>2</sub> in the marine environment. These processes may be relevant factors in ocean acidification and air-sea exchanges of this CO<sub>2</sub>. The Vents Program is a leader in development of marine technologies that concentrate on seafloor observations. The Vents Program continues to be an internationally recognized pioneer in ocean exploration, which strengthens science at NOAA. It also serves as a major science and technology

resource for the NOAA Office of Ocean Exploration and Research. Vents base funds support PMEL Engineering and Information Technology functions, which are core PMEL laboratory capabilities that have provided significant advances in ocean observing and communications technologies, and support other critical NOAA objectives such as conducting research on the ocean and its impact on global climate and developing improved tsunami measurements and forecasts.

**Ecosystems Fisheries Oceanography Coordinated Investigations (Eco-FOCI)** is a collaborative research effort by scientists at PMEL and the Alaska Fisheries Science Center to improve the understanding of the productive ecosystems in the Gulf of Alaska, Bering Sea, and Arctic waters. These ecosystems support economically valuable fisheries (e.g. pollock, shellfish, and salmon). This research provides predictions and forecasts to the North Pacific Fishery Management Council which is responsible for allocating fish landings by commercial fishermen. PMEL research, combined with its year-round observing capability and the development of regional predictive ocean models and combined with NMFS ecosystem models, will make significant contributions to predictions beyond the seasonal range to ensure healthy ecosystems that support sustainable fisheries in the Alaska Large Marine Ecosystems. In addition, PMEL conducts research on Arctic climate change and its impact on ecosystems, including loss of Arctic summer sea ice.

The **Integrated Coral Observing Network (ICON) Program** at the Atlantic Oceanographic and Meteorological Laboratory (AOML) acquires and integrates near real-time data from in situ, satellite, radar, and other data sources at important U.S. and international coral reef ecosystems. These integrated data are used to develop ecological forecasts for Marine Protected Area (MPA) managers and researchers to understand and predict coral reef ecosystem response to climate change, such as coral bleaching, ocean acidification, harmful algal blooms, ocean current shifts, spawning, migration, and other marine phenomena. These growing, highly intensive, hourly data sets, currently collected from over 120 sites from around the world, are being used to establish status and long-term trends against which to measure climate change and to provide information essential for sound management decisions and long-term planning. With a diverse staff of oceanographers and marine biologists, AOML is able to use multi-disciplinary approaches to improve NOAA's management activities.

**Ecosystem Research and Modeling** conducts observational research and modeling to assess the impact on marine ecosystems and human and animal health from land-based sources of pollution and water use practices. Efforts include analysis of oceanographic, nutrient, and microbiological data in order to enable management decisions that protect coastal and marine ecosystems. Scientists work in cooperation with other NOAA Line Offices, other Federal, state, and local authorities (including the EPA and U.S. Army Corps of Engineers), and academia to maximize research knowledge for use in economically and environmentally important projects. For example, research and modeling efforts contribute to an integrated ecosystem assessment for South Florida ecosystem restoration that will serve to rate the success of remediation efforts and to guide the management process. Tools and technologies are developed, as needed, to meet analysis and modeling demands.

#### **Schedule & Milestones:**

##### **2011 - 2013**

- Data collection from long-term continuous time series of critical biophysical data from moored arrays in the Bering Sea.
- Field work in the Chukchi Sea (sponsored by DOI/BOEMRE) consisting of moorings and hydrographic surveys of the water column to evaluate changes in ice thickness and determine the relationships among climate change, ice thickness and biological productivity.

- Gulf of Alaska ecosystem assessment in coordination with the North Pacific Research Board and State of Alaska.
- Establish quality-controlled data set at the La Parguera, Puerto Rico, monitoring station to complement data set from the MAP- CO<sub>2</sub> buoy for OA characterization at Media Luna Reef.
- Establish first continuous annual hourly data compilation at Laolao Bay, Saipan, for utilization by Saipan's Coastal Resources Management division in characterizing that bay's ecosystem dynamics.
- Establish new monitoring station at Half-Moon Cay, Belize, as part of the new NOAA/CARICOM MOU, which has as its goal the establishment of a Caribbean-wide ocean and weather network (NOS has lead).

#### **2011 – 2015**

- Develop forecasts and models to support an expanding suite of integrated ecosystem status and health forecasts that provide coastal decision-makers better insight into the consequences of their actions in the context of societal needs and desires.
- Ecosystem assessment related to the South Florida Ecosystem Restoration Program.
- Ecological forecasting related to the Integrated Coral Observing Network Program.
- Research monitoring of nutrients and microbes in the coastal zone impacted by treated wastewater and inlet discharges as part of the Florida Area Coastal Environment Program.
- PMEL scientists will continue to explore and characterize new hydrothermal vent areas, primarily in the Pacific Basin, with actual locations dependent on external partner's needs and on scientific merits of proposed locations. For instance, Indonesia was explored in 2010; follow up activities in subsequent years in that region will depend on initial findings and on the ability to carry out research in this area. Acoustic research will be widespread around the world's oceans, especially in the Arctic and Antarctic, in conjunction with geophysical and biological questions. It is anticipated that the Vents seafloor volcano observatory (NeMO, located off the Oregon coast) will be connected to the new cabled observatory being developed by NSF. PMEL and Vents will play a major role in developing experiments and instrumentation in conjunction with this major NSF initiative.

#### **2012-2015**

- Synthesis of the Chukchi Sea data
- Ecosystem assessment for the Gulf of Alaska data synthesis phase.
- The Bering Sea Ecosystem Study will conclude the synthesis phase of its field work and begin development of an integrated ecosystem assessment.
- Continue to build upon long-term data sets begun at Puerto Rico, USVI, Port Everglades, Cayman Islands, and other sites.
- Work with Ocean Acidification partners to establish long-term complementary data sets at U.S. States & Territories outlined in their five-year plan.
- Continue to compile long-term data sets and ecological forecasts within ICON Network and in collaboration with other networks and programs.

#### **Deliverables/Outputs:**

- Coupled trophic model for use in ecosystem assessments.
- Technical documents and/or peer-reviewed manuscripts summarizing multi-year data sets of nutrient and microbiological concentrations in the coastal zone receiving land-based sources of pollution. Report results can be used to assess the performance of coastal outfall. Data can be used to support management and legislative decisions.

- The ICON program will integrate data and provide automated and validated ecological forecasts of coral bleaching. Historical field observations and ecosystem forecast models will be used to develop web-based products that forecast coral bleaching events.
- Annual Arctic Report Card
- Maintenance of the Bering Sea Climate and Ecosystem Observational Network
- Availability of quality controlled data from moorings, drifting buoys, and water column sampling (temperature, salinity, oxygen, fluorescence, nutrients, currents, zooplankton bio-volume, and atmospheric variables), peer-reviewed scientific publications, and advice to various Federally-sponsored decision-makers, such as the Endangered Species Biological Research Teams, the Committee of Scientific Advisors on Marine Mammals (U.S. Marine Mammal Commission), and the North Pacific Fisheries Management Council.
- Program deliverables include new discoveries related to seafloor volcanic eruptions and hydrothermal venting and their impact on ocean ecosystems. Deliverables will be the number of sites characterized each year and the number of scientific findings published in the scientific literature.
- Instruments will be developed to support Vents explorations and research, both from ship-based surveys and from the cabled observatory. Significant discoveries, when they occur, will be announced to the media, and research cruises will continue to provide blogs in real time to share the excitement of new findings. Reviews of the Vents scientific program will be completed by the external review team.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Percent of labs that have had formal expert peer reviews in the past 4 years and were rated “effective” in terms of quality, mission relevance, and performance	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	100%	100%	100%	100%	100%	100%
<b>Description:</b> This performance measure is recognized by the National Academy of Sciences report <i>Evaluating Federal Research Programs</i> , which states that “The most effective means of evaluating federally funded research programs is expert review.”						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Number of coastal, marine, and Great Lakes ecosystem sites adequately characterized for management (Ecosystem Research & Modeling)	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	4	4	4	4	4	4
<b>Description:</b> This performance measure for coastal sites characterized is intended to monitor environmental changes and impact of remediation efforts. Characterizations utilize periodic oceanographic (physical, chemical, and biological) and meteorological data derived by in-situ sensors. 120 stations are sampled bi-monthly via ship and small boat to characterize for management by public utilities the following four sites: FL Bay, FL Keys Reef Tract, SW FL Shelf (South Florida Ecosystem Restoration Program for SFL Ecosystem Restoration Management - as mandated by Congress) and the SE Florida Coral Reef Tract (Florida Area Environment Program)						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of tools, technologies, and information services that are used by NOAA partners/customers to improve ecosystem-based management (Ecosystem Research & Modeling)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	4	4	4	4	4	4
<b>Description:</b> This performance measure is for the development and validation of molecular assays that focus on land- and human-based pollution sources. These assays are used by resource-managers to more effectively characterize coastal impacts and support management decisions. Customers include the EPA and other partners.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management (ICON Program)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	11	11	11	11	11	11
<b>Description:</b> This performance measure is for the development and production of coral bleaching forecasts used to identify events and support management decisions. Forecasts are developed using oceanographic data from in-situ sensors at US sites (the Florida Keys National Marine Sanctuary, the La Parguera Estuarine Preserve, and the Salt River Bay National Historical Ecological Preserve, and Laolao Bay). Forecasts are produced hourly for 11 sites, therefore there are 264 forecast per day. For simplicity, this performance measure is parsed by site.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of coastal, marine, and Great Lakes issue-based forecast capabilities developed and used for management (ICON Program)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	60	60	60	60	60	60
<b>Description:</b> PM is for coral reef sites characterized to monitor environmental change. Characterizations utilize hourly oceanographic and meteorological data derived by satellite and in situ sensors.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Cumulative number of coastal, marine, and Great Lakes ecosystem sites adequately characterized for management (Great Lakes Research)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	10	15	20	25	30	35
<b>Description:</b> This performance measure is for Great Lakes sites characterized to monitor environmental changes. Characterizations utilize periodic oceanographic (physical, chemical, and biological) and meteorological data derived by in-situ sensors.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Peer-reviewed journal articles published in the scientific literature (Eco-FOCI)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	20	20	20	20	20	20

**Description:** Peer-reviewed publications are a recognized benchmark of scientific productivity related to Fisheries-Oceanography Coordinated Investigations (FOCI) research.

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of papers published highlighting research results at hydrothermal vent sites (Vents Program)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	8	8	8	8	8	8

**Description:** Peer-reviewed publications are a recognized benchmark of scientific productivity related to VENTS activity. Technical reports are generated to provide additional data or distribute data and information in additional publication formats (e.g. for transmission to managers).

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of coastal, marine, and Great Lakes ecosystem sites adequately characterized for management (Vents Program)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	3	3	3	3	3	3

**Description:** This performance measure is for Vents Program sites characterized to monitor environmental changes and impact of submarine volcanism and hydrothermal activity on large-scale oceanographic processes (e.g., carbon cycling, ocean circulation, ocean acidification). Characterizations utilize periodic chemical, biological, and geophysical data derived by in-situ sensors.

**NATIONAL SEA GRANT COLLEGE PROGRAM** (<http://www.seagrants.noaa.gov/>)

The National Sea Grant College Program (Sea Grant) is a national network of 32 programs dedicated to helping citizens utilize scientific information to support a vibrant economy while ensuring ecological sustainability. Sea Grant was established by Congress in 1966 to enhance the development, use, and conservation of the Nation’s marine and Great Lakes resources. The 32 state Sea Grant programs, located in every coastal and Great Lakes state and Puerto Rico and Guam, serve as the core of a dynamic national network of more than 300 participating institutions involving more than 3,000 scientists, engineers, outreach experts, educators and students. The Sea Grant network addresses key issues and opportunities in areas such as sustainable coastal development, hazard resilient coastal communities, safe and sustainable seafood, coastal ecosystem health, and adaptation to climate change. As a non-regulatory program, Sea Grant focuses on generating and disseminating science-based information to a wide range of groups including commercial and recreational fishermen, educators, fish farmers, state and local planning officials, port and harbor commissioners, seafood processors and retailers, and natural resource, water and environmental quality managers.

The Sea Grant model integrates research, outreach, and education. On-the-ground experts, located in every coastal and Great Lakes state, translate sound scientific information into tools, products and services that benefit coastal residents and their communities every day. Sea Grant experts implement national priorities at the local and regional level, while also identifying citizens’ needs in order to inform state, regional, and national research agendas. This two-way flow of services and information ensures that Sea Grant solutions meet demonstrated needs, help support businesses, and enable policy-makers to make balanced, well-informed decisions.

At the heart of this model are strong trust-based relationships anchored by Sea Grant's unique role as an honest broker of information (non-advocacy). Sea Grant's locally-based professionals (more than 360 extension agents strong) live in, and are intimately connected to, the communities they serve. As both trusted residents and coastal experts charged with providing balanced and reliable science-based information, Sea Grant personnel are effective in delivering relevant solutions to coastal residents.

Sea Grant's program activities fall into the following four focus areas and two cross-cutting efforts:

- *Hazard Resilience in Coastal Communities* – Sea Grant objectives are to: 1) Promote widespread understanding: Assess short and long-term risk for residents and businesses and ensure that forecast and other information is available and useful to help save lives; 2) Increase capacity: Help communities plan to reduce risk, pinpointing vulnerabilities and using technologies to prepare for and mitigate hazards; and 3) Ensure an effective response to coastal catastrophes: Make products and services available to support crisis decision-making, mobilize our network to provide rapid response strategies, and partner with emergency responders. Sea Grant's base budget is expanded in the FY 2012 President's Budget to allow for the program to expand its community based hazard resilience efforts. This cross-cutting effort focuses on a variety of natural and technological hazards (including climate change). These efforts will complement each other, with the hazards portion targeting the socio-economic impacts of climate change on communities.
- *Sustainable Coastal Development* – Sea Grant objectives are to: 1) Strengthen local economies: Provide science-based information and techniques that enhance waterfront economic activities while sustaining the natural coastal environment; 2) Ensure public access: Preserve and enhance public access to the Nation's beaches and waterfronts through access-related needs assessments, legal analysis, and technical assistance; and 3) Support sustainable planning: Engage coastal communities and decision-makers in planning processes that identify and pursue sustainable economic development policies and programs.
- *Safe and Sustainable Seafood Supply* – Sea Grant objectives are to: 1) Ensure the sustainability of fisheries: Engage harvesters, recreational fisherman, producers and managers in ways to minimize threats, and enhance the productivity and management of wild fisheries; 2) Support a viable domestic seafood industry: Provide innovative approaches and techniques that ensure financial competitiveness and environmental responsibility; and 3) Ensure the health and safety of seafood: Enhance training and technical assistance programs related to the application of standards for safe domestic and imported seafood.
- *Healthy Coastal Ecosystems* – Sea Grant objectives are to: 1) Support ecosystem-based approaches to managing the coastal environment: Increase the capacity of managers to consider the entire ecosystem; 2) Restore the function and productivity of degraded ecosystems: Identify and evaluate innovative policies, technologies, and methods to restore the services provided by our Nation's ecosystems; and 3) Promote stewardship of healthy ecosystems: Provide life-long learning programs that enhance understanding of coastal, ocean, and Great Lakes environments and the services they provide.
- *Climate Change Adaptation* – Sea Grant objectives for this cross-cutting area are to: 1) Improve understanding: Help citizens and decision-makers understand climate change processes and the expected effects on coastal resources and communities; 2) Increase

capacity of coastal communities to respond to climate change: Identify viable strategies and formulate plans to prepare for, mitigate and adapt to these impacts.

- *Education* – Sea Grant objectives for this cross-cutting area are to: 1) Provide national leadership in marine literacy for grades K-12: Develop innovative science curricula and teacher training programs, and embrace new technologies to enhance learning; 2) Develop professionals who understand marine and aquatic science: Recruit and train undergraduate and graduate students to deal with coastal economic and environmental challenges. Support the Knauss Marine Policy Fellowship that brings highly qualified graduate students with an interest in national policy decisions affecting natural resources to Washington to work for one year in government.

*Program Evaluation* – Sea Grant has implemented a rigorous four-year external performance review process for its federally sponsored university-based state programs. Performance review teams are comprised of highly experienced, distinguished, knowledgeable individuals. Performance is judged quantitatively using performance benchmarks and metrics that were developed with the help of outside experts. Foremost among these benchmarks is a program's impact on mission and programmatic objectives as well as its connection with users of science-based information. Individual program performance is used to determine merit-based funding for each state program.

### **Aquatic Invasive Species Program (AIS)**

Aquatic invasive species disrupt the stability of coastal ecosystems, thereby affecting recreational, economic, and other beneficial uses of coastal resources. They constitute one of the largest present and future threats to coastal ecosystems and economies, and they have been responsible for some of the most dramatic fishery losses in recent times (e.g., Lake trout, turbot, whitefish, and salmon in the Great Lakes). Hundreds of millions of dollars are spent each year to mitigate the effects of invasive species and to prevent new invasions.

The AIS program provides critical support to national, regional and state efforts to manage invasive species, including: development of new control technologies, research into identification, assessment, and management of the risk of new invasions, education and outreach on how businesses, communities, and individuals can prevent invasions or effectively respond to them. This support is targeted at issues of highest local, state and national importance, as identified in peer- and publically-reviewed state invasive species management plans, fishery council ecosystem management plans, and other sources.

The AIS Program involves cooperation and coordination between state and local governments, NOAA and other Federal agencies, the academic community, and other organizations and individuals. This program is a critical component of the Department of Commerce's support of the interagency Aquatic Nuisance Species Task Force (which NOAA co-chairs) and National Invasive Species Council (which DOC co-chairs). The AIS program responds to the mandates identified in the National Aquatic Nuisance Prevention and Control Act, the National Sea Grant College Program Act, and Executive Order 13112.

### **Marine Aquaculture Program**

The United States faces a seafood deficit amounting to greater than \$8 billion annually. Currently, more than 80 percent of the U.S. seafood supply is imported, and about half of these imports are from aquaculture. Marine aquaculture in U.S. waters has the potential to help meet the growing demand for domestic seafood, in addition to assisting in rebuilding some fishery stocks. Sea Grant, in concert with the rest of the NOAA Marine Aquaculture Program, is at the forefront of efforts to grow



the U.S. marine aquaculture industry through an integrated program of research, education, and technology transfer that is focused on key scientific, engineering, environmental, and socioeconomic issues that currently inhibit this emerging industry.

Sea Grant works with other NOAA line offices (NMFS, NESS, NOS) to support NOAA's efforts to increase the domestic production of safe and sustainable seafood via aquaculture in ocean, coastal, Great Lakes areas. Environmentally and economically sustainable aquaculture helps meet the increasing demand for seafood, creates and sustains jobs and stabilizes economies in coastal working waterfronts, and supports efforts to manage and rebuild wild fish stocks. Sea Grant addresses sustainable aquaculture by funding competitive extramural research and transferring research and technology via the Sea Grant education and extension network. Sea Grant competitively funds external partners to promote sustainable aquaculture by: developing new species suitable for aquaculture; field-testing new environmentally compatible production systems to mitigate the environmental impacts of aquaculture; developing new technologies, including offshore, near-shore, and re-circulating aquaculture systems; improving and clarifying the regulatory framework and coastal zoning for aquaculture; addressing sociological and economic issues related to aquaculture; and providing coastal planning tools to site aquaculture facilities. In addition, Sea Grant develops collaborative studies with international partners on ecosystem effects for aquaculture in coastal ecosystems. NOAA's aquaculture education and extension network facilitates the transfer of research into business operations, as well as informs the public and practitioners about key issues and information related to aquaculture. Sea Grant's aquaculture extension agents, who live and work in coastal communities, promote an environmentally friendly and profitable aquaculture industry that will alleviate stress on natural fish stocks, create jobs, provide healthy protein to Americans at a reasonable cost, improve food safety, and help alleviate our Nation's trade deficit.

#### **Schedule & Milestones:**

By FY 2012:

- Fifteen individuals will be trained in marine aquaculture and/or direct marketing business practices.

By FY 2014:

- Create and transfer at least 80 tools/technologies to coastal managers.
- Complete training of over 3000 seafood processors in HACCP.
- Restore over 2,800 acres of degraded ecosystems.
- Engage over 550 coastal communities in activities (e.g. visioning, resource inventories, analysis of development policies) that address the sustainability of economic and environmental resources.
- Provide 150,000 coastal resource managers with information/training in local hazard resiliency, and hazard mitigation tools, techniques, and best practices.

By FY 2015:

- Assist 200 coastal communities adopt smart growth principles.

#### **Deliverables/Outputs:**

By FY 2016:

- 2.4 million resource managers, decision-makers, and the general public will have attended Sea Grant sponsored/organized conferences, workshops and meetings.
- Sea Grant will have leveraged nearly \$200 million.
- 4,200 peer-reviewed journal articles/book chapters.
- 3,600 graduate students supported.
- 900 students will have received PhD or MS/MA degrees with Sea Grant assistance.
- 15,600 conferences, workshops and meetings sponsored /organized by Sea Grant.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Percent of Sea Grant College Programs that have had formal expert peer reviews in the past 5 years and were rated “effective” in terms of quality, mission relevance, and performance	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	100%	100%	100%	100%	100%	100%
<b>Description:</b> This performance measure is recognized by the National Academy of Sciences report <i>Evaluating Federal Research Programs</i> that states “The most effective means of evaluating federally funded research programs is expert review.”						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of fishermen, resource managers, consumers and seafood businesses (harvesters, aquaculturists, processors and recreational fishermen) who modify their practices using knowledge gained in fisheries sustainability, seafood safety, and the health benefits of seafood	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	125,000	150,000	175,000	200,000	225,000	250,000
<b>Description:</b> This measure tracks Sea Grant success in having stakeholders adopt responsible fishery practices. Stakeholders who recognize the value of responsible use are more likely to adopt such practices. For example, Sea Grant efforts to educate fishermen on the benefits of using circle hooks as an alternative to j-hooks has decreased bycatch and increased the survival of hooked and released fish. Responsible harvesting and processing techniques and practices include measures to minimize bycatch and habitat destruction, ensure seafood safety, and support sustainability.						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of coastal communities that have adopted / implemented sustainable (economic and environmental) development practices and policies (e.g., land-use planning, working waterfronts, energy efficiency, climate change planning, smart growth measures, green infrastructure) as a result of Sea Grant activities	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	175	275	340	400	460	510
<b>Description:</b> This metric tracks communities that have made strides in sustainable development with Sea Grant aid – moving beyond analysis and planning and into implementation.						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of coastal communities that adopt/implement	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>

hazard resiliency practices to prepare for and respond to/minimize coastal hazardous events

190	290	440	500	550	600
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**Description:** This metric tracks Sea Grant’s contribution to individuals, businesses, and communities that develop comprehensive emergency preparedness and response plans to increase their resiliency and enable them to respond effectively. Sea Grant will contribute to this by building a sound knowledge base to improve forecasting capabilities, by identifying development and best management practices that reduce the vulnerability of people, buildings and businesses to coastal hazards, and by advancing ways communities can manage and recover from these events when they occur.

**OCEAN EXPLORATION AND RESEARCH (<http://explore.noaa.gov/>)**

The Office of Ocean Exploration and Research (OER) connects NOAA’s exploration mission activities with targeted undersea research aimed at providing the foundation of information necessary to support NOAA’s management responsibilities. The efforts undertaken by OER represent a continuum that begins with exploration and discovery, and ultimately results in scientific understanding applied to real world management solutions. OER provides NOAA and the Nation with a unique capability to explore new ocean areas and phenomena as well as a means to align purposeful and focused research with important discoveries. OER collects the information required to identify new ecosystems, habitats, and resources, as well as to conduct the research necessary to gauge their health, determine how they function and change over time, and to understand how human activities may affect their long-term stability. In addition, OER investigates newly observed ocean phenomena such as underwater volcanic eruptions, and ensures that data and information are made available to scientists and decision-makers working on significant environmental challenges such as climate change and ocean acidification.

OER core activities include (1) supporting interdisciplinary expeditions to characterize new ocean areas and phenomena; (2) conducting cutting edge transformational research to address National priorities and to identify new and emerging issues; (3) working with partners to develop new underwater technologies focused on increasing the pace and efficiency of ocean exploration and research; and (4) engaging a broad spectrum of stakeholders and audiences through education and outreach. OER is comprised of two unique programs: the Ocean Exploration Program (OE), and the National Undersea Research Program (NURP).

**Ocean Exploration Program (OE)**

The Ocean Exploration Program was created in 2001 in response to the recommendations of the President’s Panel on Ocean Exploration, and NOAA is currently the only Federal agency with a dedicated program for exploring unknown and poorly known ocean areas and phenomena. Specifically, OE efforts focus on the first step of the scientific process – initial investigation of the unknown to characterize natural features and phenomena. Areas to be explored are identified by working with other NOAA programs and Federal agencies, as well as the academic community, and emphasis is given to areas where there is consensus that the potential for discovery is high.

Results from OE efforts include a variety of products such as maps and geospatial databases and models, inventories and samples of living and non-living marine resources, oceanographic and atmospheric data, multimedia products such as video and still images, and peer-reviewed reports and journal articles. These results provide a critical baseline of knowledge which serves to catalyze new lines of research and inquiry, support management decisions at multiple scales, and improve

ocean literacy and stewardship through education and outreach. OE accomplishes its mission in the following distinct ways:

- **Core Exploration Program:** OE provides funding through grants and intra- and interagency transfers to interdisciplinary teams of scientists through an annual announcement of opportunity and competitive peer-review proposal process. Thus, these efforts have very specific objectives and the principle investigators bear the responsibility of delivering the data and results within two-years after the grant is approved. Current areas of investment include exploring natural environments and phenomena, searching for and identifying shipwrecks and submerged paleo-landscapes once inhabited by humans, and development of advanced underwater technologies. OE also provides funding through grants to support the development of education and outreach products that draw from the exploration expeditions. Finally, OE uses contracts and interagency transfers to secure keys assets such as ships and submersibles to support the proposals that are selected.
- **NOAA Ship *Okeanos Explorer*:** In FY 2005, Congress directed the U.S. Navy to transfer the 224 foot survey vessel USNS Capable to NOAA for conversion to the Nation's first vessel dedicated to exploring the ocean. Renamed the *Okeanos Explorer*, the vessel was outfitted to support three primary missions: (1) deep ocean high-resolution mapping; (2) deep water high-definition filming and sampling using a sophisticated dual-body remotely operated vehicle (ROV); and (3) a satellite-based broad-band transmission "telepresence capability, which will allow teams of scientists to lead expeditions from shore-based "Exploration Command Centers (ECC)." Unlike the efforts funded through peer-review, the *Okeanos Explorer* systematically explores unknown areas and delivers data and a standard suite of products to scientists and educators on shore in real-time, as well as soon after an expedition is completed. The missions undertaken by the *Okeanos Explorer* provide a foundation of information to support a multitude of projects and interests.

With the new ship came new responsibilities for OE to invest in dedicated mission equipment and upkeep, the personnel to operate the mission systems, managing the data and information acquired, and developing and delivering the data and products. OE also uses funding to compensate scientists for time spent in leading expeditions from the shore-based ECCs.

- **Partnership Projects:** OE invests in a variety of small- and large-scale projects with Federal and non-Federal partners who have a shared interest in ocean exploration, as well as funding they can apply to leverage the OE investment. The following three examples highlight large-scale, multiyear exploration partnerships:
  - **Telepresence:** In June 2009, the University of Rhode Island (URI) and the Institute for Exploration (IFE) opened the "Inner Space Center" (ISC) at URI's Narragansett Bay campus. The ISC is equipped to receive data and information from the *Okeanos Explorer* and transmit it to the shore-based ECCs, which are staffed by teams of scientists and educators. The ISC also is equipped with a full production studio that provides for conducting live events during expeditions, as well as the development of post-processed videos and other products. The University of New Hampshire also partners in this endeavor and has a sophisticated ECC at their Integrated Ocean and Coastal Mapping facility that is dedicated to acquiring, processing, and developing products from the multibeam mapping system on the *Okeanos Explorer*.
  - **Extended Continental Shelf Mapping (ECS):** In FY 2007, OE joined an interagency task force formed under the Interagency Committee on Ocean Science and

Resource Management (ICOSRMI) to plan and prepare for new investments in field surveys to identify potential extensions of the U.S. Exclusive Economic Zone (EEZ) using the criteria set forth in Article 76 of the UN Convention on the Law of the Sea, which defines how coastal States may define their ECS. In collaboration with several Federal agencies, OE invests funds to support bathymetric mapping, geophysical and seismic surveys, data management and analysis, and the development of products to help define the ECS. In addition to mapping unknown territory, information on habitat and resources is also being collected.

- *National Ocean Partnership Program (NOPP)*: Under the auspices of NOPP, OE has partnered with the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) over the past several years to investigate and characterize offshore BOEMRE lease blocks in advance of BOEMRE decisions on oil and gas exploration and development. These efforts have focused on the Gulf of Mexico, and will be extended to the Mid-Atlantic region. Under this partnership, BOEMRE funds peer-reviewed scientific investigations and OE provides the ships and submersible. Both BOEMRE and NOAA benefit from the information that is collected.

### **National Undersea Research Program (NURP)**

The National Undersea Research Program (NURP) was created in 1980 based on National Academy of Sciences Report recommendations that NOAA support undersea research facilities through partnerships with universities or oceanographic institutions. Through this model, NURP leverages the skills and resources of its academic partners to meet NOAA undersea research requirements. The NURP mission is to place scientists underwater - either directly through the use of submersibles and diving techniques, or indirectly using remote and autonomous technologies – to support underwater research necessary to further our understanding of ocean ecosystems, their resources, how they function, and the impact of human activities.

The NURP mission complements the OE mission and focuses on the subsequent stages of the scientific process. Specifically, this includes (1) providing access to facilities, equipment, technologies, information, and expertise to support undersea research efforts by institutions of higher education and other educational marine and ocean science organizations; (2) development, testing, and transition of advanced undersea technology associated with ocean observatories, submersibles, advanced diving technologies, remotely operated vehicles, autonomous underwater vehicles, and new sampling and sensing technologies to support NOAA's research mission and programs; (3) conducting transformational, cutting-edge marine research that follows up on discoveries; and (4) conducting mandated studies of underwater diving techniques and equipment suitable for protection of human safety and improvement in diver performance.

The NURP network is currently comprised of an East Coast Cooperative Institute for Ocean Exploration, Research, and Technology (CIOERT), the Aquarius Reef Base (University of North Carolina, Wilmington), the Hawaii Undersea Research Lab (HURL), and the West Coast and Polar Regions (WCPR) Undersea Research Center, which receive funding in accordance with Public Law 111-11 Title XII Subtitle A Part II – NOAA Undersea Research Program Act of 2009. Regional center funding is distributed equally (50 percent) to east and west coast centers, and program administration support is set at 10 percent of the appropriation.

- CIOERT focuses on identifying and investigating habitats on the eastern continental shelf and slope, developing new sensors and systems to support underwater research, and works closely with the NOAA Coral Reef Conservation Program on research efforts associated with deep and shallow water coral ecosystems in response to management needs.

- The University of North Carolina, Wilmington, operates the NOAA-owned Aquarius Undersea Laboratory, the world's only research saturation facility, to conduct marine ecosystem and coral research, undersea technology testing, training and outreach.
- The Hawaii Undersea Research Laboratory operates the Pisces IV and Pisces V, which are 2000m depth capable submersibles to support studies on the effect of invasive species on black coral habitats, assess Pacific monument and fisheries habitats, and survey marine cultural heritage resources (NOAA owns Pisces V).
- The WCPR at the University of Alaska, Fairbanks supports development of sensors for extreme environment (undersea and high latitude) studies, and development and use of miniature oceanographic data recorders carried by marine mammals and other pelagic species.

In summary, the Ocean Exploration Program provides the Nation with a one-of-a-kind capability focused on discovering and characterizing ocean areas and phenomena that we currently know nothing about. Through interdisciplinary expeditions and projects, the program maximizes the potential for discovery of new ecosystems and habitats, as well as new living and non-living marine resources. Such knowledge is fundamental for managing ocean areas in a sustainable manner, and serves to increase our understanding of earth system processes.

Complementing this, NURP provides a long established connection to the external academic community, which augments NOAA's internal management-oriented research capabilities. NURP allows the academic community to collaborate on large-scale, long-term research efforts, helping NOAA and the Nation transition discoveries to refined research, and ultimately management. Furthermore, the NURP network provides scientists access to specialized and unique tools and technologies not available within NOAA, as well as the ability to work in concert with the academic community to evolve these technologies to meet new demands.

#### **Schedule & Milestones:**

- One to two BOEMRE-NOAA Partnership joint expeditions per year to explore and characterize habitats and ecosystems in deep water areas.
- Lead an extramural program in support of new tools and technologies (specific to sensor development) associated with ocean acidification.
- The *Okeanos Explorer* will explore unknown and poorly known regions in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea beginning in 2012.
- Develop annual extramural competition for an OER exploration and discovery missions.
- Develop annual extramural competition for an OER Marine Archaeology program.
- Develop peer-reviewed and approved professional education products for use in local, regional, and national curricula for Ocean Exploration Signature Mission.
- During FY 2011 - 2012, One joint NOAA-BOEMRE exploration and characterization of habitats in deep waters of the Mid-Atlantic Bight.
- By FY 2012, *Okeanos Explorer* will be home-ported in Narragansett Bay, RI.
- During FY 2010 - 2016, Release annual OER Ocean Exploration announcement of opportunities.
- During FY 2010 - 2016, Release annual OER Marine Archaeology program announcement of opportunities.

- During FY 2010 - 2016, prepare one set of peer-reviewed and approved set of education products per Ocean Exploration Signature Expedition.

**Deliverables/Outputs:**

- Develop undersea technology tools to advance exploration, research, and measurement of ocean characteristics.
- Conduct targeted research to follow-up and transition discoveries to management and operations.
- Explore, map and visualize maritime wrecks and paleo-landscapes.
- Conduct systematic exploration, mapping and characterization of unknown areas in national and international waters using the NOAA Ship *Okeanos Explorer* and provide information and products to multiple users through telepresence links.
- Conduct Autonomus Underwater Vehicle (AUV) mapping and habitat characterization surveys.
- Develop peer-reviewed and approved professional education products for use in local, regional, and national curricula for Ocean Exploration Signature Mission.
- Complete BOEMRE-NOAA Partnership Joint expeditions to explore and characterize habitats and ecosystems in deep water areas.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Annual number of coastal, marine, and Great Lakes ecosystem sites adequately characterized for management	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	6	6	6	6	6	6
<b>Description:</b> Conduct joint expeditions with DOI's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) to explore and characterize habitats and ecosystems in deep water areas of the Gulf of Mexico and the Mid-Atlantic Bight.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Develop undersea technology tools (to advance exploration, research, and measurement of ocean characteristics)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	1	1	1	1	1	1
<b>Description:</b> OER will be a NOAA and national focal point for the design, development, deployment, testing, evaluation, application, and transition to operational status of new marine technologies including instrument systems, sensors, and platforms.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct targeted research to follow-up and transition discoveries to management and operations	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	6	6	6	6	6	6
<b>Description:</b> Research within OER will be conducted by means of targeted efforts implemented by the long term extramural partnership enterprises as well as through grants solicited and funded by OER.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct mapping and ecosystem surveys per ECS task force directives	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	2	3	3	3	0	0
<b>Description:</b> The Extended Continental Shelf mapping (ECS) effort is a high-level interagency multi-year effort to define the potential extension of the US continental shelf under international law. In essence, once the US accedes to the UN Law of the Sea and this work is completed, it has the potential to more than double the size of the continental shelf under US jurisdiction - an area larger than our terrestrial lands.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct regional analysis of potential ECS based on data collected during surveys	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	0	1	2	2	2	0
<b>Description:</b> The ECS effort is a high-level interagency multi-year effort to define the potential extension of the US continental shelf under international law. In essence, once the US accedes to the UN Law of the Sea and this work is completed, it has the potential to more than double the size of the continental shelf under US jurisdiction - an area larger than our terrestrial lands.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Explore, map and visualize maritime wrecks and paleo-landscapes	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	4	4	4	4	4	4
<b>Description:</b> OER Marine Archaeology program explores and discovers maritime heritage sites significant to American and World history using the latest in advanced technology. Sites include shipwrecks, prehistoric submerged landscapes, and other maritime cultural sites. The program supports the research and protections standards enumerated in the UNESCO Convention on the Protection of the Underwater Cultural Heritage.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct systematic exploration, mapping and characterization of unknown areas in national and international waters using the NOAA Ship <i>Okeanos Explorer</i> and provide information and products to multiple users through telepresence links (Number of unknown areas characterized, mapped, and explored)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	6	8	8	8	8	8
<b>Description:</b> The <i>Okeanos Explorer</i> offers a new approach to discovery: systematic exploration. This approach includes: (a) telepresence, the ability to bring scientific expertise virtually to the vessel through live connections between shore and sea, (b) a next-generation multi-beam sonar system, and (c) a highly sophisticated, remotely-operated vehicle (ROV). The three key elements work together seamlessly: the ship's telepresence system delivers live images from the ship's dedicated ROV as well as maps from its multi-beam sonar to support live interactions between dedicated centers located throughout the world and the <i>Okeanos Explorer</i> .						



<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Conduct AUV mapping and habitat characterization surveys	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	2	2	2	2	2	2
<b>Description:</b> Autonomous Underwater Vehicles (AUVs) provide NOAA with a capability that significantly improves on its ability to collect marine observation data for all of its mission areas. AUVs will provide a broad and synoptic view of our ocean and marine environments that meets tomorrow's needs of government, environmental managers, scientists, business, and the public. OER utilizes and manages AUVs through its extramural partners, and leads in the development of new technologies and approaches for the efficient use of NOAA AUVs.						

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Prepare peer-reviewed and approved professional education products for use in local, regional, and national curricula to enhance ocean science and literacy	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	8	8	8	8	8	8
<b>Description:</b> Education and outreach to school children and the public are essential elements of the program to convey the importance of protecting these irreplaceable resources. OER's education program covers workshops to teach the teachers, and provide a wide variety of lesson plans through the award- winning website: <a href="http://oceanexplorer.noaa.gov/">http://oceanexplorer.noaa.gov/</a> .						

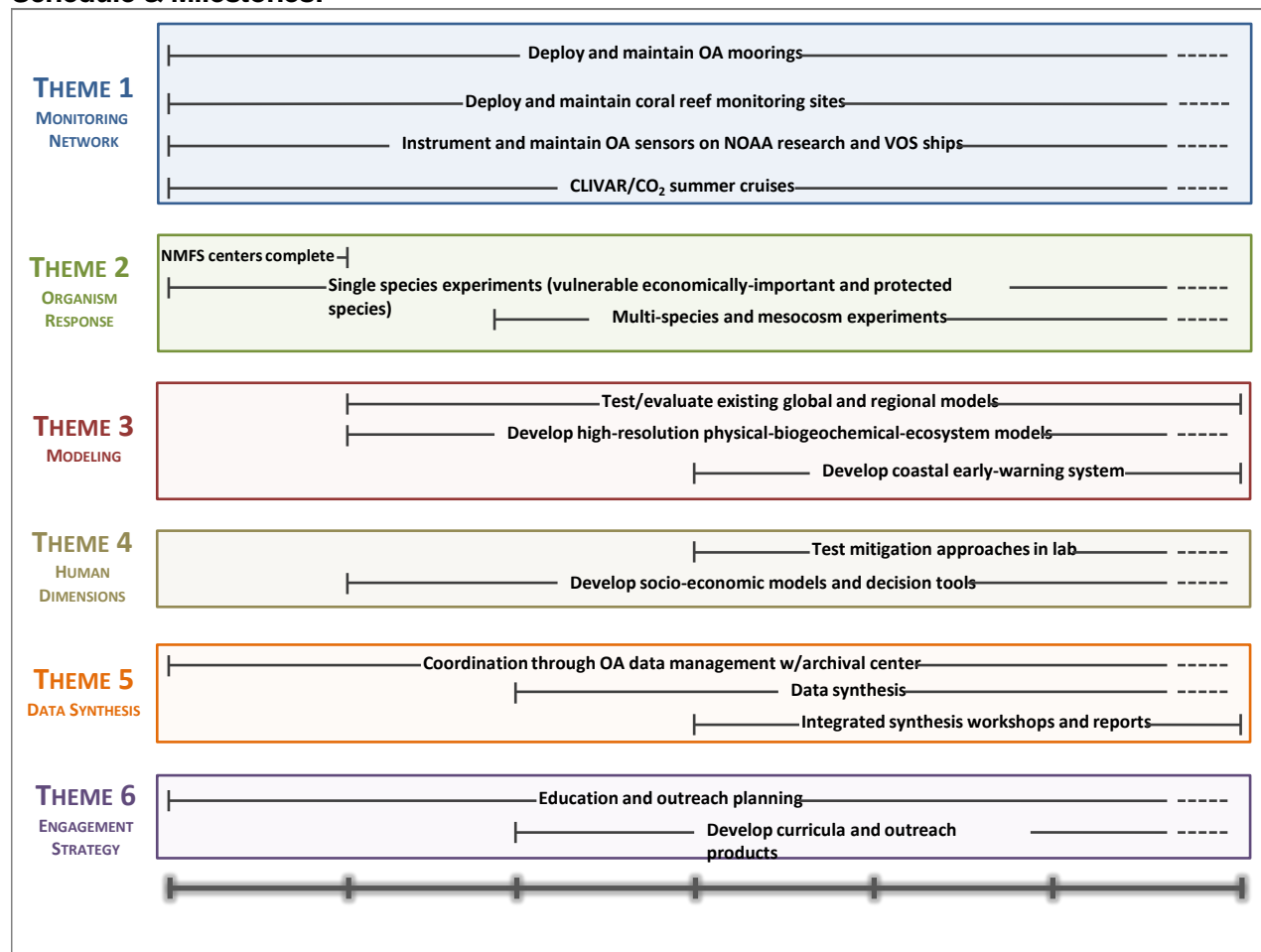
## **OTHER ECOSYSTEMS PROGRAMS**

### **Integrated Ocean Acidification (OA)**

NOAA is poised to lead the national effort in understanding the impact of ocean acidification (OA) on the Earth's environment and to conserve and manage the impacted marine organisms and ecosystems in U.S. marine and Great Lakes waters. The ocean acidification research field is young, and little is known about how ocean acidification will affect marine resources, ecosystem services, and the ocean economy. There is solid evidence, however, that some marine ecosystems are presently exposed to corrosive, or acidified, waters and the impact to the nation's economy could be significant. Both of these findings highlight the urgency of this problem and the significant research need. NOAA's investment in the research described in the NOAA OA Implementation Plan will accelerate understanding to a pace that can adequately inform national and international climate mitigation and adaptation decision-making that will best conserve marine ecosystems and sustain the critical services that oceans, coastal, and Great Lakes ecosystems provide to the national economy

OA activities will include (1) development and deployment of advanced technologies and sensors on mooring platforms in the Pacific, Atlantic, and Gulf of Mexico to conduct physiological assessments of OA on commercial and recreational important species; (2) establishing a coral reef monitoring network, as well as carbonate analytical capabilities to ensure consistent sampling and measuring methods and long term monitoring of coral reefs; (3) field and laboratory organism response experiments conducted by NMFS as identified in OAR's Implementation Plan; (4) development of new technologies and ecosystem monitoring systems including better models and dedicated research programs on physiological and ecosystem-level responses; (5) development of ecosystem/socioeconomic models; (6) coordination of OA monitoring and impacts research with other Federal, national and international ocean science bodies; and (7) providing grants for critical research projects, and encouraging coordination with other participating agencies under the National Oceanographic Partnership Program.

## Schedule & Milestones:



### Key:

----- Denotes a task/activity likely to continue beyond FY2016.

### Deliverables/Outputs:

- Standardized chemical and biological monitoring protocols for the measurement of CO<sub>2</sub> system parameters and physiological effects on marine organisms;
- New technology that allows for accurate, in-situ measurements of the carbon system throughout the water column and is adapted for use on a variety of platforms (i.e., ships, moorings, floats and gliders);
- Monitoring program that will quantify the status and trends in ocean acidification and effects on marine and Great Lakes species;
- Predictions of pH and carbonate saturation in the future ocean using global climate change model projections;
- Comprehensive evaluation and characterization of the threat ocean acidification poses by resolving the direct and indirect ecological impacts to economically-important species and NOAA-managed protected species;
- Regional biogeochemical and ecological models developed through the synthesis efforts of existing models and the incorporation of new knowledge gained on the impact of ocean acidification;

- Retrospective perspective on past observed variations in the ocean chemistry using historical data, paleoceanographic studies, and multidecadal hindcasting;
- Accurate socio-economic forecasts that will estimate how ocean acidification will affect the public and the economy through impacts on ecosystem services;
- Recommended atmospheric limit for CO<sub>2</sub> based on projected losses of marine resources, ecosystem services, and economic losses due to the degree of ocean acidification at different CO<sub>2</sub> emission scenarios;
- Decision support tools and requisite scientific knowledge for understanding and responding to ocean acidification in support of ecosystem based management and other related management schemes, such as fisheries management and coastal and marine spatial planning;
- Ocean acidification data archival in a national ocean acidification information center;
- Public web access to a national ocean acidification information portal; and
- Educational and outreach products and services (e.g., aquarium and museum exhibits, interactive website, K–12 curriculum, informational and training workshops, short web documentaries, summary literature, community lecture series, and interpretive signage) to increase the dialogue among scientists, policy-makers, teachers, and the public.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Improve confidence of the impacts of ocean acidification for each large marine ecosystem studied ( <i>IPCC reports</i> * % Low - High ratings)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	5%	10%	20%	40%	60%	60%
<b>Description:</b> The uncertainty is a designated level of understanding assessed by a panel of NOAA investigators with regards to the anticipated impacts of ocean acidification on each of the ten Large Marine Ecosystems (LME) based upon the IPCC criteria (including likelihood and confidence). This designation is evaluated on an annual basis and expresses an aggregate of the uncertainties associated with each of the critical LME's facets posited to be impacted by ocean acidification.						

\* From the IPCC Third Assessment Report: "An explicit uncertainty range is a likely range. Estimates of confidence are: very high (95 %); high (67-94 %); medium (33-66 %); low (5-32 %); very low (< 5 %).

<b>Performance Measure:</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of sites with mean annual ocean acidification index (Aragonite Saturation State) determined to be within 0.2 units	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	10	15	20	25	30	30
<b>Description:</b> This measure represents an annual inventory of in situ-based fixed and underway observing platforms dedicated to monitoring the rate, magnitude, and dynamics of ocean acidification in response to increasing atmospheric carbon dioxide. These ocean acidification observing platforms are defined by their inherent ability to fully constrain the carbonic acid system and must be capable of resolving decadal changes in ocean chemistry in response to ocean acidification.						

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## PROGRAM CHANGES FOR FY 2012:

**Ocean Exploration & Research: *Okeanos Explorer*: ROV and Telepresence (Base Funding: 2 FTE and \$4,300,000; Program Change: +0 FTE and +\$1,500,000):** NOAA requests an increase of \$1,500,000 and 0 FTE for a total of \$5,800,000 and 2 FTE to provide the scientific and technical support to operate the dedicated mission equipment that is permanently installed on the NOAA Ship *Okeanos Explorer*, and to provide additional days-at-sea to increase the reach and scope of telepresence activities. Specifically, this overall program will support: (1) operation of the telepresence technology which enables scientists, educators, and others to participate and lead ocean exploration missions from remote shore-based Exploration Command Centers (focus for the new funding, including additional days-at-sea) and (2) the operation and upgrade of the ship's dedicated science platforms (autonomous and remotely-operated vehicles).

The Office of Ocean Exploration and Research (OER) activities address the following Goals of NOAA's 5 Year Research Plan for 2008-2012:

- Advancing understanding of ecosystems to improve resource management
- Exploring our Oceans
- Advancing in-situ and surface-based data collection capabilities and associated platforms and systems.

### **Proposed Actions:**

The *Okeanos Explorer* offers a new systematic approach to discovery and exploration which includes the following key elements:

- (a) telepresence, the ability to bring scientific expertise virtually to the vessel through live connections between shore and sea;
- (b) a next-generation multi-beam sonar system; and
- (c) a highly sophisticated, remotely-operated vehicle (ROV).

These three elements work together seamlessly. The ship's telepresence system delivers live images from the ship's dedicated ROV as well as maps from its multi-beam sonar to support live interactions between the *Okeanos Explorer* and five dedicated command centers located on both coasts of the United States and in Jakarta, Indonesia.

On a traditional research expedition, a small number of specialized principal investigators sail with the ship to direct ROV operations, convey new potential discoveries or findings to others using e-mail or satellite phones, and wait for a response. Connecting the ROV to the telepresence technology allows high-definition images and sensor data to be transmitted directly from the ROV's cameras to shore-based ECCs in near real time, using dedicated high-bandwidth internet communication channels. In the ECCs, scientists can communicate with the ship, direct operations of the ROV, and seek opinions and guidance from hundreds of specialized scientists that have agreed to participate in the program. By adding increased intellectual capital to missions and minimizing the time the ship spends waiting near a potential target for a response from shore, telepresence can increase efficiency as well as the pace and potential for discovery. This is very similar to the way NASA conducts remote exploration of Mars.

The total scientific and technical support function for the *Okeanos Explorer* supports two critical elements and the specialized contract staff associated with each:

- Advanced satellite technology (hardware and software systems) and remote Exploration Command Center (ECC) support required for virtual access to systematic exploration products by the scientific community via telepresence.
- Service, maintenance, and upgrades required to operate the complex remotely-operated vehicle (ROV) that is hardwired to the ship.

The newly requested funds will support the externally competed contracts for the telepresence operations requirement. The telepresence operations requirement will consist of telepresence system consumables, data storage, VSAT bandwidth services, terrestrial network services, hardware warranties, hardware maintenance, spares and upgrades, and software licenses.

Resource requirements are as follows:

- Telepresence capability: \$1 million
  - The land network equipment and services will require \$200,000.
  - The broadband satellite feed and services will require \$800,000.
- Additional days-at-sea: \$0.5 million

**Statement of Need and Economic Benefits:**

NOAA has acquired and outfitted a former Navy ship, the *Okeanos Explorer*, to explore, systematically collect data, and gather foundational information to support subsequent efforts in more in-depth exploration, focused research, and natural resource management. No other Federal agency has the ability to systematically explore the oceans in the manner that NOAA can using its dedicated vessel, unique technologies, and experienced personnel. Systematic exploration products will complement the growing Integrated Ecosystem Approach (IEA) initiative, improve understanding of existing data and information, and identify research gaps.

Previous funding specifically associated with the *Okeanos Explorer* has been allocated to the ship conversion process and the standard OMAO costs for operations and maintenance for T-AGOS class vessels. In concert with base resources, the new funds will develop, operate, and maintain the ROV, the deep-water multi-beam system, the telepresence system, and the ship's scientific sampling equipment. In addition, NOAA will operate and maintain the shore-based ECCs that currently exist in NOAA facilities in Silver Spring, MD; the Pacific Marine Environmental Lab (PMEL) in Seattle, WA; the Joint Hydrographic Center at the University of New Hampshire; the Institute for Exploration in Mystic, CT; and the Inner Space Center at the University of Rhode Island. The new approach to scientific discovery enabled by telepresence removes traditional shipboard constraints and supports broad access and increased participation from scientists and experts.

**Base Resource Assessment:**

All previous funding specifically associated with the *Okeanos Explorer* has been allocated to the ship conversion process and the standard OMAO costs for operations and maintenance for T-AGOS class vessels.

**Schedule and Milestones:**

- The *Okeanos Explorer* was commissioned August 19, 2008, and is currently completing a series of testing and acceptance of ROV systems, shakedown cruises, and shipboard trials.
- In FY 2009, the ship conducted mapping field trials.
- In FY 2009, a stakeholder and NOAA Program workshop identified regional targets for the *Okeanos Explorer's* FY 2010 and FY 2011 Pacific Ocean basin exploration.

- In FY 2010, the ship successfully completed a major joint expedition in partnership with Indonesia to explore deepwater areas of the Coral Triangle, collecting information on new submerged active volcanoes, new habitats, and new species.
- In FY 2011, a stakeholder and NOAA Program workshop will identify regional targets for the Okeanos Explorer's FY 2012 and FY 2013 Atlantic Ocean basin exploration.
- In FY 2012, the *Okeanos Explorer* will be home-ported in Narragansett Bay, RI (October 2011).
- In FY 2012 and FY 2013, the NOAA program will conduct the excursions identified in the FY 2011 stakeholder workshop. A white paper describing the process and methodology used to identify and assign targets for exploration is available upon request.

**Deliverables:**

- Operational telepresence capability
- Increased reach and scope of telepresence activities by virtue of additional days at sea

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of scientists virtually engaged in multidisciplinary discoveries via telepresence through ECC's	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0	55	110	165	220	275
<b>Without Increase</b>	0	0	0	0	0	0
<b>Description:</b> Engagement of scientists via telepresence brings to the ship a wealth of expertise virtually from a widely diverse group of academics, allowing real-time observations, assessments of potential discoveries, gathering of samples, and other foundational data critical for the development of future, targeted research. This is only possible with the combination of the requested funds and the redirection of OER base funds.						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of outreach & education links to classrooms, educators & stakeholders in real time through broadband internet	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	0	110	220	330	440	550
<b>Without Increase</b>	0	0	0	0	0	0
<b>Description:</b> As is well documented, textual teaching coupled with graphical demonstrations have a larger impact on the retention of information in young minds. Adding real-time delivery of information engages students more fully and embeds them into the scientific process in ways not otherwise achievable by traditional teaching methods.						

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Cumulative number of scientists physically on board facilitating discoveries in selected science fields	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	20	40	60	80	100	120
<b>Without Increase</b>	20	40	60	80	100	120

**Description:** The *Okeanos Explorer* has a berthing capacity for 2-4 science crew-members, thus limiting on-board scientific expertise to the 2-4 specialties of the science crew members plus whatever expertise can be obtained through traditional satellite-phone hook-ups and e-mail conversations – which can be time consuming and wasteful of valuable at-sea resources. This performance goal can be met without telepresence.



**PROGRAM CHANGE DETAIL BY OBJECT CLASS**

**(Dollar amounts in thousands)**

Activity: Oceanic & Atmospheric Research  
 Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Object Class</b>		<b>2012 Increase</b>
11	Personnel compensation	
11.1	Full-time permanent	\$0
11.3	Other than full-time permanent	0
11.5	Other personnel compensation	0
11.8	Special personnel services payments	0
11.9	Total personnel compensation	0
12	Civilian personnel benefits	0
13	Benefits for former personnel	0
21	Travel and transportation of persons	0
22	Transportation of things	0
23.1	Rental payments to GSA	0
23.2	Rental Payments to others	0
23.3	Communications, utilities and miscellaneous charges	500
24	Printing and reproduction	0
25.1	Advisory and assistance services	0
25.2	Other services	200
25.3	Purchases of goods & services from Gov't accounts	0
25.4	Operation and maintenance of facilities	0
25.5	Research and development contracts	0
25.6	Medical care	0
25.7	Operation and maintenance of equipment	0
25.8	Subsistence and support of persons	0
26	Supplies and materials	0
31	Equipment	800
32	Lands and structures	0
33	Investments and loans	0
41	Grants, subsidies and contributions	0
42	Insurance claims and indemnities	0
43	Interest and dividends	0
44	Refunds	0
99	Total obligations	1,500

**Integrated Ocean Acidification (Base Funding: 0 FTE and \$5,500,000; Program Change: +3 FTE and +\$6,100,000):** NOAA requests an increase of \$6,100,000 and 3 FTE for a total of \$11,600,000 and 3 FTE to complement, accelerate, and enhance current NOAA Ocean Acidification (OA) activities and provide comprehensive research, dedicated monitoring, and enhanced forecasting capabilities leading to adaptive strategies toward the improved management of living marine resources impacted by OA.

**Proposed Actions:**

Our present understanding of the processes associated with OA and its impacts on large marine ecosystems is not sufficient to derive adaptive management strategies, especially those targeting the management of living marine resources – a mainstay of the economy. This coordinated effort will enable OAR, NMFS, and NOS to build on the current OA funding. This increase will support new technologies and ecosystem monitoring systems, better models, and dedicated research programs as prescribed in the draft NOAA OA Implementation Plan: (1) OA Monitoring, (2) Ecosystem Impacts of OA, (3) Biogeochemistry & Ecosystem Models, (4) Human Dimensions, (5) Data Synthesis & Information Products, and (6) Engagement.

1. Research on Physiological and Ecosystem-level Responses and Development of Ecosystem/ Socioeconomic Models (\$2,500,000) –Assess physiological and ecosystem-level effects of OA on commercial and recreational marine fish stocks and key species critical to NOAA-managed resources to define critical thresholds and adaptive strategies through in-house and competitive research grants. Incorporate these impacts into both existing and newly developed models to predict ecological, trophic level and socioeconomic response in regions where those OA-impacted species reside. (Themes 2, 3 & 4)
2. Develop advanced OA technologies and sensors (\$1,100,000) - Provide advanced carbonate chemistry technologies including sensors deployable on a range of platforms that are cost efficient, operate autonomously over extended periods of time, and provide NOAA with the tools and technological capability to continuously monitor OA across a diverse set of marine environments. (Theme 1 & 2)
3. Ecosystem OA Monitoring Network (\$1,300,000) – Create a Coral Reef OA Observing Network designed to monitor ecosystem response to and feedback from OA to better resolve critical thresholds. The network would comprise discrete biological and chemical observations with advanced observing systems providing real-time information products from selected reef environments. Achieving full capability will require development of advanced ocean acidification technologies (i.e., advanced sensors– funded in #2 above). Biological and biogeochemical surveys and reef process studies are also necessary components of this ecosystem observing network. (Theme 1)
4. Build Carbonate Analytical Capabilities (\$1,200,000) – Leveraging existing marine research facilities to serve as dedicated research foci and support standardized sample analyses will be a significant step towards delivering uniformly calibrated data and products. These dedicated facilities will also serve as training and technology transfer agents for other laboratories expanding their analytical capacity. (Themes 1 & 2)

**Statement of Need and Economic Benefits:**

Increased atmospheric carbon dioxide concentrations result in increased carbon levels in our oceans, causing changes in seawater chemistry that have been labeled ocean acidification. OA generates a unique suite of environmental changes that increasingly affect ocean ecosystems, fisheries, and other marine resources in such profound ways as reducing the ability of many organisms to build their shells and impacting both the carbon and nitrogen cycles that help sustain life on Earth. The economic consequences of these ecosystem-scale impacts of OA could reverberate through the

U.S. and the global economy. The U.S. is the world's third largest seafood consumer with total consumer spending for fish and shellfish of approximately \$60 billion per year. Coastal and marine commercial fishing generates upwards of \$30 billion per year. The shellfish industry throughout the U.S. accounts for approximately half of this amount. In addition to the impact on fisheries, ocean acidification also has potentially devastating implications for coral reef ecosystems which provide coastal communities protection from storms and economic benefit through tourism.

Two legislative acts mandate action by NOAA: (1) The Federal Ocean Acidification Research and Monitoring (FOARAM) Act of 2009 requires NOAA to develop and implement a comprehensive monitoring and research plan for effectively characterizing the consequences of ocean acidification. (2) The Magnuson-Stevens Reauthorization Act requires that conservation and management measures shall account and allow for variations among fisheries, fishery resources, and catches caused by climate-scale processes, such as ocean acidification. Such requirements build upon existing NOAA capabilities and responsibilities, including long-term oceanographic monitoring, model development, and threshold assessments. This OA initiative enhances existing capabilities to help meet NOAA's increased responsibilities.

**Base Resource Assessment:**

In FY 2010, base resources were allocated to NOAA OAR Climate Program Office (\$4.0 million) and NOAA NMFS Science & Technology Office (\$1.5 million) to support OA activities. In FY 2012, these two base funds will be transferred and managed through a single OAR account to form the NOAA Ocean Acidification Program Office (\$5.5 million).

**Schedule and Milestones:**

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
<b>Research &amp; Technology Dev</b>						
ID new/existing platforms for OA instrument deployment (OAR-PMEL, AOML)						
Develop advanced OA technologies and sensors (OAR-OER)						
Competitive physiological and ecosystem-level research on OA impacts (NOS - NCCOS)						
Physiological research on targeted species (NMFS-AKC, NWC, NEC)						
<b>Monitoring &amp; Modeling</b>						
Coral reef OA observing network suite emplacement and maintenance (OAR-AOML, PMEL/ NOS-CRCP/NMFS-PIFSC)						
<b>Forecasting &amp; Management Applications</b>						
OA forecast on marine food web & managed resources (NMFS-AKC)						

Competitive regional ecosystem modeling (NOS-NCCOS)						
OA socioeconomic impacts – forecasts (OAR-Sea Grant)						
<b>Outreach &amp; Product Delivery</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Regional OA assessments (NOS-NCCOS)						
Coordinate national outreach activities (OAR- Sea Grant)						
Develop and implement climate change management tools (OAR-CPO/NOS-CRCP)						
Climate vulnerability assessments and capacity-building workshops (OAR-CPO/NOS-CRCP)						

**Deliverables:**

- FY 2012-2014: Advanced OA monitoring technologies developed; Atlantic coral reef OA observing test-bed established
- FY 2011: National Plan on ocean acidification with regional research priorities delivered to NOAA
- FY 2013: First regional climate vulnerability assessment report delivered to NOAA management
- FY 2013: Species-specific OA impacts research results available for model development and regional management response
- FY 2014-2016: Ecosystem-level OA impacts research results available for regional management response
- FY 2013-2016: Models developed to predict impacts on marine food webs and managed resources
- FY 2015-16: Models developed to predict and manage socio-economic impacts at regional scales

**Performance Goals and Measurement Data**

<b>Performance Goal (Long term):</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Improve confidence of the impacts of ocean acidification for each large marine ecosystem studied (IPCC reports* % Low - High ratings)	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	5%	10%	20%	40%	60%	75%
<b>Without Increase</b>	2%	4%	5%	5%	5%	6%
<b>Description:</b> The uncertainty is a designated level of understanding assessed by a panel of NOAA investigators with regards to the anticipated impacts of ocean acidification on each of the ten Large Marine Ecosystems (LME) based upon the IPCC criteria (including likelihood and confidence). This designation is evaluated on an annual basis and expresses an aggregate of the uncertainties associated with each of the critical LME's facets posited to be impacted by ocean acidification.						

<b>Performance Goal (Long term):</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>	<b>FY</b>
Number of sites with mean annual ocean acidification index (Aragonite Saturation State) determined to be within 0.2 units	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
<b>With Increase</b>	10	15	20	25	30	35
<b>Without Increase</b>	2	3	4	5	5	6

**Description:** Represents an annual inventory of in situ-based fixed and underway observing platforms dedicated to monitoring the rate, magnitude, and dynamics of ocean acidification in response to increasing atmospheric carbon dioxide. These ocean acidification observing platforms are defined by their inherent ability to fully constrain the carbonic acid system and must be capable of resolving decadal changes in ocean chemistry in response to ocean acidification

\* From the IPCC Third Assessment Report: "An explicit uncertainty range is a likely range. Estimates of confidence are: very high (95 %); high (67-94 %); medium (33-66 %); low (5-32 %); very low (< 5 %).

**PROGRAM CHANGE PERSONNEL DETAIL**

Activity: Office of Oceanic & Atmospheric Research

Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Title:</b>	<b>Location</b>	<b>Grade</b>	<b>Number of Positions</b>	<b>Annual Salary</b>	<b>Total Salaries</b>
Program Director	Silver Spring, MD	ZP-V	1	123,758	123,758
Program Deputy Director	Silver Spring, MD	ZP-IV	1	89,033	89,033
Field/Lab Technician	Miami, FL	ZT-III	1	50,204	50,204
Field/Lab Technician	Seattle, WA	ZT-III	1	50,628	50,628
<b>Total</b>			<u>4</u>		<u>313,623</u>
less Lapse		25%	<u>1</u>		<u>78,406</u>
Total full-time permanent (FTE)			3		235,217
2011 Pay Adjustment (0%)					0
2012 Pay Adjustment (0%)					<u>0</u>
TOTAL					235,217

**Personnel Data**

	<u>Number</u>
Full-Time Equivalent Employment	
Full-time permanent	3
Other than full-time permanent	<u>0</u>
Total	3
Authorized Positions:	
Full-time permanent	4
Other than full-time permanent	<u>0</u>
Total	4

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	
11.1 Full-time permanent	\$235
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	<u>235</u>
12 Civilian personnel benefits	71
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	500
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	2,700
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	294
31 Equipment	800
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	1,500
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	<u>6,100</u>

**National Sea Grant College Program Base: Helping Coastal Communities Prepare for and Respond to Natural Hazards and Extreme Events (Base Funding: 0 FTE and \$1,115,000;**

**Program Change: +0 FTE and +\$885,000)**: NOAA requests an increase of 0 FTE and \$885,000 for a total program of 0 FTE and \$2,000,000. In the Consolidated Appropriations Act, 2010, Congress provided an additional \$1,115,000 above the FY 2010 President's Request. With these additional resources NOAA initiated this program. This increase will expand the level of support for regional research, training, and technology transfer to enhance the resiliency of coastal communities to persistent natural hazards such as climate-induced sea-level rise and to extreme events such as coastal storms. The requested funds will enable NOAA to engage an additional three coastal communities beyond the current two communities per year.

**Proposed Actions:**

NOAA Sea Grant research and stakeholders' engagement will be driven by the priorities established in NOAA and interagency planning efforts. This includes: the Ocean Research Priorities Plan (ORPP), the National Sea Grant College Program 2009-2013 Strategic Plan, NOAA's Five-Year Research Plan, and the Regional Research and Information planning effort that is being facilitated by NOAA Sea Grant as an approach to down-scaling the national ORPP.

In FY 2012, NOAA Sea Grant will focus on a regional approach to Theme #2 "Increase Resiliency to Natural Hazards" and the near term priority of "Forecasting the Response of Coastal Ecosystems to Persistent Forcing and Extreme Events," two areas highlighted in the ORPP. NOAA Sea Grant will conduct the research needed to assess hazard-related risks and increase the availability and usefulness of hazard-related information and forecasting for citizens, industries, and decision-makers in coastal communities. NOAA Sea Grant will:

- Conduct risk assessment research in the context of hurricanes, other coastal storms, and climate-related changes;
- Assist public and private decision-makers in creating and adopting policies, plans, and ordinances to reduce risks, manage catastrophic events, and speed recovery;
- Conduct research and communicate information on how the use of natural features and new technologies can help communities prepare for and mitigate the impacts of hazardous events and climate change;
- Make Sea Grant's local knowledge and contacts available to work with Federal, state, regional, and local agencies, non-governmental organizations, and international partners that have hazardous event responsibilities, to facilitate the speed and quality of response to these crises;
- Identify viable strategies and formulate plans to prepare for, mitigate and adapt to climate expected impacts; and
- Consolidate best research-based practices in risk analysis, assessment, mitigation, adaptation and communications, and disseminate risk information to citizens, industries and decision makers in coastal communities.

NOAA Sea Grant will bring together the regional institutional infrastructure represented by the network of state Sea Grant programs to create a powerful regional science and outreach capability. Sea Grant will use a competitive RFP process to fund large-scale regional studies, ensuring that scarce NOAA resources will be targeted at the most tractable approaches, using a process that will be integrated from the start, will be mutually dependent, and will involve management and stakeholder participation.



**Statement of Need and Economic Benefits:**

Sea level rise, the increased number and intensity of coastal storms, the ongoing threat of oil spills, and other natural and human hazards are putting more people and property at risk along the nation's coasts, with major implications for human safety and the economic and environmental health of coastal areas. It is essential that residents of coastal communities understand these risks, adapt and learn what they can do to reduce their vulnerability and respond quickly and effectively when events occur. This issue would benefit from a regional approach involving all coastal programs including NOAA's Coastal Services Center (CSC) and the Ocean and Coastal Resource Management Program (OCRM). NOAA Sea Grant will use its integrated research, training, and technical assistance capabilities, and its presence in coastal communities, in collaboration with CSC and OCRM, to play a major role in helping local citizens, decision-makers, and industries plan for hazardous events and optimize the ability of their communities to respond and rebuild.

**Base Resource Assessment:**

In the Consolidated Appropriations Act, 2010, Congress provided an additional \$1,115,000 above the FY 2010 President's Request. With these additional resources, NOAA initiated this program consistent with the authorities provided to Sea Grant to bring the results of environmental research to decision makers for the purpose of economic improvement & enhanced safety of coastal communities.

**Schedule and Milestones:**

- Regional competitions based on ORPP themes to address regional issues (FY 2012- FY 2016).
- Regional workshops to develop science plans and disseminate research results/products (FY 2012-FY 2016).
- Incorporate research information, tools, and forecasts into regional management plans and IEAs (FY 2016).
- Transfer prototype ecological and predictive forecasts to NOAA laboratories for transition to operations (FY 2016).

**Deliverables:**

Through the funding of integrated regional research efforts, the proposed increase will allow NOAA to:

1. Ensure that coastal residents are aware of and understand the physical processes that produce hazards and climate change and the implications of those events for their communities.
2. Ensure that coastal communities address social and environmental barriers to improve the community's ability to mitigate and respond to natural hazards.
3. Ensure that coastal communities are able to effectively respond to coastal catastrophes.
4. Develop technologies and tools required to increase understanding of ocean, coastal, and Great Lakes ecosystems, facilitate the ecosystem approach to management, and promote responsible and sustainable use of ocean, coastal, and Great Lakes resources;
5. Ensure coastal communities have access to and the ability to utilize data and innovative and adaptive tools and techniques to minimize hazard risks (i.e. planning and construction BMPs, standards, resiliency index, retrofits, flood-zone maps and freeboard).
6. Strengthen stewardship through outreach and education to enhance informed decision making by coastal communities, stakeholders, and users of ocean, coastal and Great Lakes resources, as well as to facilitate the application of new research, technologies, and tools.

**Performance Goals and Measurement Data**

<b>Performance Goal:</b>	<b>FY 2011 Target</b>	<b>FY 2012 Target</b>	<b>FY 2013 Target</b>	<b>FY 2014 Target</b>	<b>FY 2015 Target</b>	<b>FY 2016 Target</b>
Number of coastal communities that have been trained or been provided with hazard resiliency and mitigation tools, techniques, or best practices.						
<b>With Increase</b>	2	5	10	15	20	25
<b>Without Increase</b>	2	4	6	8	10	12
<b>Description:</b> Coastal communities and decision-makers benefit from improved availability and usefulness of hazard-related information and forecasting for citizens, industries, and decision-makers in coastal communities and understand the benefits of coastal hazard risk planning.						

<b>Performance Goal:</b>	<b>FY 2011 Target</b>	<b>FY 2012 Target</b>	<b>FY 2013 Target</b>	<b>FY 2014 Target</b>	<b>FY 2015 Target</b>	<b>FY 2016 Target</b>
Performance Measure: Percentage of U.S. coastal states and territories demonstrating 20% or more annual improvement in resilience capacity to weather and climate hazards (%/yr)* Measure 18e						
<b>With Increase</b>	30%	36%	41%	47%	53%	59%
<b>Without Increase</b>	30%	33%	36%	39%	42%	45%
<b>Description:</b> Measure 18e						

<b>Performance Goal:</b>	<b>FY 2011 Target</b>	<b>FY 2012 Target</b>	<b>FY 2013 Target</b>	<b>FY 2014 Target</b>	<b>FY 2015 Target</b>	<b>FY 2016 Target</b>
Number of regionally-focused climate impacts and adaptation studies, tools, and capacity-building utilized by coastal and emergency management						
<b>With Increase</b>	1	3	5	7	8	10
<b>Without Increase</b>	1	2	3	4	5	6
<b>Description:</b> This measure tracks the number of regionally-focused climate impacts and adaptation studies, tools, and capacity-building utilized by coastal and emergency management. The use of these products will improve management responses to climate change.						

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, and Great Lakes Research

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	885
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	885

**Ocean Exploration & Research (Base Funding: 17 FTE and \$30,923,000; Program Change: -0 FTE and -\$2,900,000):**

NOAA requests a decrease of \$2,900,000 and 0 FTE for a total of \$28,023,000 and 17 FTE. In the Consolidated Appropriations Act, 2010, Congress provided an additional \$2,900,000 to support further ongoing operations in the Pacific and to advance exploration in the Indian Ocean. In FY 2010, NOAA conducted exploration missions in new areas of active hydrothermal venting associated with unique chemosynthetic habitats, though due to piracy concerns affecting the Indian Ocean, the missions were completed in the Black Sea and eastern Mediterranean. These specific missions have been concluded; therefore, no additional funds are needed. In FY 2012, the requested resources will be used to support OER's unique mission as the Federal government's only program dedicated to exploring unknown and poorly known ocean areas and phenomena. For example, these resources will support BOEMRE-NOAA Partnership Joint expeditions to explore and characterize habitats and ecosystems in deep water areas.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-2,900
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-2,900

**Aquatic Invasive Species Program: Sea Grant Aquatic Invasive Species (Base Funding: 3 FTE and \$2,003,000; Program Change: 0 FTE and -\$1,001,000)**: NOAA requests a decrease of 0 FTE and \$1,001,000, for a total remaining program of 3 FTE and \$1,002,000 for the Sea Grant Aquatic Invasive Species Program. In the Consolidated Appropriations Act, 2010, Congress provided additional funds for invasive species research, education, and outreach activities to create tools to help states, communities, fishery commissions, industries and individuals prevent and control invasive species. With these additional funds, NOAA Sea Grant Aquatic Invasive Species Program (AISP) began additional multiyear efforts to study and interdict invasion pathways. These include live bait species that often originate far from where anglers use them, biological supply houses and their academic and other customers, and continuation of successful programs working with recreational boaters to ensure that invasive species are not carried between water bodies on boats. In FY2012, the program will continue at the \$1M level, supporting projects that address serious invasive species issues identified in state, regional or national plans.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, & Great Lakes Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-1,001
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-1,001

**Marine Aquaculture Program: Sea Grant National Marine Aquaculture Initiative (Base Funding: 1 FTE and \$4,801,000; Program Change: 0 FTE and -\$478,000):** NOAA requests a decrease of 0 FTE and \$478,000 for a total program of 0 FTE and \$4,323,000. This national strategic investment will implement a two-pronged approach to address marine aquaculture: competitive extramural research and transfer of research, tools, and technology by Sea Grant Extension. These efforts will complement, accelerate, and enhance current aquaculture activities in the National Marine Fisheries Service (NMFS) and address research gaps identified in the 2008 Governmental Accountability Office (GAO) report “Offshore Marine Aquaculture: Multiple Administrative and Environmental Issues Need to be Addressed in Establishing a U.S. Regulatory Framework” (GAO-08-594, May 9, 2008), with the goal of developing adaptive strategies that improve NOAA’s ability to manage fisheries, end overfishing, and ensure the viability of the multibillion-dollar U.S. seafood industry. Together with the NMFS Aquaculture Program Office, NOAA will address all four aquaculture research areas identified in the 2008 GAO report.

**Proposed Actions:**

By combining competitive research and research delivery via Sea Grant Extension, OAR proposes to address three of the four research needs identified in the 2008 GAO report: 1) best management practices to minimize environmental impacts, 2) data on how escaped aquaculture fish might impact wild fisheries, and 3) strategies to breed and raise fish while effectively managing disease. Alternative fish feeds, the fourth research need, will be addressed by a complementary increase in NMFS.

The proposed funding level will advance sustainable, domestic aquaculture through a competitive research initiative that addresses high priority issues for aquaculture combined with an enhanced aquaculture extension effort for research and technology transfer directly to stakeholders. This Land Grant/Sea Grant research-extension model is based on local extension agents delivering current research findings and technology directly to coastal constituents and serving as conduits to identify knowledge and research gaps to “ground truth” future research priorities. Our present understanding of, and solutions for issues associated with implementing marine aquaculture is limited, hindering our ability to manage living marine resources. Within the proposed funding level, NOAA will sustain capacity to address issues identified by the GAO: program administration; permitting and site selection; environmental management; and research. This FY 2012 coordinated effort will enable the NOAA Aquaculture Program, a matrix program containing offices in OAR, NMFS, NOS, and NESS, to advance sustainable, domestic aquaculture.

Within the funds requested, NOAA will address the following:

1. Research to Support Sustainable Aquaculture (\$2,727,000) – NOAA, through Sea Grant, will leverage its current permanent base of competitive research funding (\$1,627,000) for marine aquaculture with \$1,100,000 from the additional funds provided by Congress in FY 2010 to focus the extramural research community on research gaps addressed in the 2008 GAO report: (1) research on technical aspects of innovative mitigation or “smart design” approaches to sustainable aquaculture, such as integrated multi-trophic aquaculture or other ways to design aquaculture production in an ecosystem management context, which will address impacts of escaped fish and hatchery management issues associated with disease; (2) development of planning tools or approaches to aid site selection for new or expanded aquaculture facilities in the context of coastal and marine spatial planning, including planning and zoning tools for coastal managers, which will aid permitting and site selection; (3) research on the social and economic issues associated with current and new marine aquaculture, which aids the development of best management practices. Research to



develop alternative fish feeds would be addressed by a complementary effort in the NOAA Fisheries Aquaculture Program Office and Science Centers.

2. Aquaculture Extension Enhancement (\$1,600,000) – NOAA, through Sea Grant, will sustain its enhancement of Aquaculture Extension made possible with the additional aquaculture funding provided to Sea Grant in FY 2010 and continued in the FY 2011 Annualized CR. The current emphasis on regional needs for outreach will allow NOAA to deliver research findings directly to coastal constituents. This effort, driven by extension agents who live and work in coastal communities, will provide tangible outcomes after 3 years that clearly lead to impacts within 5 years. Extension activities (including 12 new hires and targeted extension projects) will include: demonstration of increased production and jobs in innovative sustainable aquaculture, especially in coastal communities; alternative or supplemental employment opportunities for fishermen in aquaculture; new or revised aquaculture policy and streamlined permitting; improved management; increased product quality and acceptance; and cooperative training at aquaculture facilities. The Sea Grant model has proven effective in the transfer of technology and information to coastal constituents.
3. Finally, NOAA proposes to terminate \$478,000 of the additional funding that had been provided by Congress in FY 2010. These funds served the useful purpose of funding competitively selected, multi-year projects and regional efforts to develop sustainable marine aquaculture that address critical issues identified in state, regional or national plans. In addition, partnerships with non-federal entities were developed (e.g., industry partners, non-federal matching funds). However, these additional funds are no longer needed because the highest priority projects can continue to be supported within the current funding level.

**Statement of Need and Economic Benefits:**

Many fishing communities are facing severe economic hardships as declining fish stocks and the need to end overfishing have necessitated reduced fish harvests levels. New approaches are therefore required to end overfishing and supply safe and sustainable seafood while maintaining economically vibrant coastal communities. Benefits include: (1) providing working waterfront alternatives for fishing communities; (2) increasing and stabilizing flow of seafood product to markets; (3) stabilizing incomes and jobs; and (4) promoting locally grown, sustainable seafood.

Fishing and aquaculture in the U.S. have not met increased demand for seafood for a variety of reasons, including limits to domestic wild catch and regulatory uncertainties facing the U.S. aquaculture industry. As a result, over 80 percent of our seafood supply is imported, with half of that coming from foreign aquaculture, and tens of thousands of potential jobs have been outsourced overseas. An expanded U.S. aquaculture industry has the potential to supply safe, local seafood grown in the U.S., create jobs in coastal communities, help support fishing communities, and complement existing fishing activities while ending overfishing. This initiative would also help to implement the Magnuson-Stevens Fishery Management Conservation Act (MSA): “Conservation and management measures shall...take into account the importance of fishery resources to fishing communities...and...to the extent practicable, minimize adverse economic impacts on such communities.” One barrier to proper management of fishery resources is a lack of trust and direct information transfer between management agencies and coastal constituents (including citizens, community leaders, and industries). Constituents need more training, information and technical assistance to remain competitive and respond to new fisheries and aquaculture management challenges. The training and neutral facilitation provided by Sea Grant extension agents will help build trust with fishing and aquaculture communities, improving NOAA's ability to manage fisheries, end overfishing, and ensure the viability of the multibillion-dollar U.S. seafood industry.

The 2008 GAO report found that it is important for a regulatory framework to include federally funded research to address gaps in current knowledge on a variety of issues related to offshore aquaculture. Stakeholders identified four research areas as particularly appropriate for Federal funding: the development of alternative fish feeds; the development of best management practices; the investigation of how escaped aquaculture-raised fish might impact wild fish populations; and the development of hatchery technologies to breed and grow fish, while effectively managing disease. This effort would address these issues and transfer research findings to coastal constituents who demand this information.

**Base Resource Assessment:**

The base resources for NOAA’s Marine Aquaculture Program is \$4,801,000, the level provided in the Consolidated Appropriations Act, 2010, and are described in the National Sea Grant College Program, Marine Aquaculture Program base narrative.

**Schedule and Milestones:**

<b>Aquaculture Research &amp; Infrastructure</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Initiate new extension personnel and projects.	X	X				
Select competitive aquaculture research projects.	X	X	X	X	X	X
<b>Outreach &amp; Product Delivery</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Extension outreach to coastal communities.	X	X	X	X	X	X

**Deliverables:**

- Site specific commercial, pilot, or technology transfer projects to establish technical and economic feasibility of innovative mitigation or “smart design” approaches to aquaculture, such as integrated multi-trophic aquaculture or other ways to design aquaculture production in an ecosystem management context.
- Assemble/reaffirm regional advisory group to tackle hurdles and opportunities for aquaculture (e.g., strategic planning, identifying stakeholders).
- Develop/update state and regional plan development (including permitting, policy). Aquaculture plans vary across the country. Extension agents working with the National Sea Grant Law Center and Sea Grant legal programs can determine the status of each state in developing/revising aquaculture plans that cover permitting, disease control, interstate transfer of shellfish, and regional best management practices.
- Bring new aquaculture products/species online, develop innovative marketing approaches, and catalyze new business opportunities (e.g., ecosystem service markets).
- Incorporate aquaculture into Coastal & Marine Spatial Planning efforts.

**Performance Goals and Measurement Data**

<b>Performance Goal:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
Number of coastal communities that have adopted/implement sustainable - economic and environmental - aquaculture development practices and policies as a result of Sea Grant	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>

activities (Cumulative)

<b>With Decrease</b>	4	6	8	10	12	14
<b>Without Decrease</b>	4	6	9	11	14	16

**Description:** This provides technology and information transfer to coastal constituents (including citizens, community leaders, and industries). Armed with this information, coastal constituents can adopt sustainable aquaculture that will contribute to healthy coastal communities, while balancing among multiple social, economic, and environmental uses. New practices and policies will be based on reports from coastal community leaders and aquaculture operations and verified by local Sea Grant extension personnel.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Ocean, Coastal, and Great Lakes Research

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-478
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-478

## **APPROPRIATION ACCOUNT: OPERATIONS, RESEARCH, AND FACILITIES**

### **SUBACTIVITY: INFORMATION TECHNOLOGY RESEARCH & DEVELOPMENT**

The objective of the Information Technology R&D subactivity is to accelerate the adoption of advanced computing, communications, and information technology throughout NOAA. Information Technology R&D supports OAR's High Performance Computing and Communications (HPCC) Initiative. The HPCC program supports OAR through major improvements in weather and climate forecasting, ecosystem and ocean modeling, and environmental information dissemination. These improvements are heavily dependent on major advances in high-end computing power, advanced information technology, and the availability of environmental data and information. These critical investments allow NOAA to meet its mission to deliver vital services and science education.

Through this program, NOAA participates as a mission agency in the National Coordination Office for Networking and Information Technology Research and Development (NITRD). NOAA participates on several of the NITRD interagency coordinating groups including High End Computing, Large Scale Networking, Human Computer Interaction, and Software Design and Productivity.

#### **HIGH PERFORMANCE COMPUTING INITIATIVES**

High Performance Computing and Communications (HPCC) supports a number of objectives in NOAA's Strategic Plan through support of IT research targeted at improving NOAA's mission and services which expands the global understanding of environmental science. The purpose of the HPCC program is to make major improvements in the Nation's ability to forecast the weather and climate, and to disseminate environmental information. At the same time, the program is aimed at stimulating the modernization of NOAA's computationally intensive services through the use of evolving high performance computing and high-speed networking technologies. Improvements in the accuracy and timeliness of NOAA's short-term weather warnings, seasonal forecasts, hurricane forecast improvements, as well as regional and global climate predictions are heavily dependent on major advances. These advances would include high-end computing power, advanced information technology, and the widespread availability of environmental data and information. Timely and responsive dissemination of NOAA's services and information requires full use of modern network and communication technologies. This program provides NOAA's focus for coordinating with external organizations and programs impacting the HPCC Program, through NITRD and its Interagency Coordinating Groups on Information Technology Research and Development (IT R&D), and by establishing agreements with other federal agencies to obtain additional computational cycles to support NOAA's environmental research activities.

The HPCC program provides NOAA with necessary computational and network resources required to support continued advances in environmental modeling capabilities. Benefits of the HPCC program include:

- Improvements in short term warning and weather forecast systems and models,
- Enabling scientists to attack long-lead time problems associated with the physical processes that govern the behavior of the atmosphere and ocean,
- Maintaining NOAA's leadership position in understanding climate with applications towards critical issues such as hurricanes, drought, sea-level rise, and ice-free arctic, and
- Accelerating modeling and simulation activities and providing relevant decision support information on a timely basis for programs such as the multi-agency Climate Change Science Program.

**Schedule & Milestones:**

**FY 2012**

- Award funding to approximately 15-20 HPC and advanced networking R&D projects,
- Implementation of Flow-Following Finite-Volume I cosahedral Model (FIM) global model and updates for operations,
- Develop and utilize the Scalable Modeling System to parallelize, debug and support NOAA Earth System Models on NOAA HPC systems in research and operations (FY 2012 – FY 2016), and
- Develop modeling framework for hydro-climate to provide global seasonal drought forecasts at regional resolution and decadal projections of drought regimes.

**FY 2013**

- Award funding to approximately 15-20 HPC and advanced networking R&D projects, and
- Implementation of FIM global model and updates for operations.

**FY 2014**

- Award funding to approximately 15-20 HPC and advanced networking R&D projects,
- Exercise next 4 year option of the R&D HPC support contract,
- Implementation of FIM global model and updates for operations,
- Develop 1 km non-hydrostatic Atmospheric General Circulation Model (AGCM),
- Develop 1/50° Ocean General Circulation Model (OGCM), and
- Develop high resolution climate/carbon/ice model for Polar Regions for decadal prediction capability for Arctic, assessment of potential for Arctic feedbacks to accelerate global warming, and more accurate estimates of sea level rise rates.

**FY 2015**

- Award funding to approximately 15-20 HPC and advanced networking R&D projects, and
- Implementation of FIM global model and updates for operations.

**FY 2016**

- Award funding to approximately 15-20 HPC and advanced networking R&D projects, and
- Implementation of FIM global model and updates for operations.

**Deliverables/Outputs:**

- HPC System availability – Maximum number of computational hours made available to scientists.

**Performance Goals and Measurement Data**

<b>Performance Measure:</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>
<b>HPCC / R&amp;D System Availability</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>	<b>Target</b>
	97%	97%	97%	97%	97%	97%
<b>Description:</b> On a contractual basis, availability is measured over a six month rolling window. Specifically, the system is contractually required to perform scheduled work 97 percent of the time over a six month period. The system is comprised of several components, including computers, disk storage, tape archive, interconnections, and software.						

**PROGRAM CHANGES FOR FY 2012:**

**Information Technology Research & Development (Base Funding: 13 FTE and \$13,213,000; Program Change: +0 FTE and +\$53,000):** NOAA requests an increase of \$53,000 and 0 FTE for a total of \$13,266,000 and 13 FTE to support existing program requirements within this subactivity but not provided for in the FY 2010 Consolidated Appropriations Act. Specifically, these funds will be used for the HPCC program which supports OAR and other NOAA modelers through computational and network resources required to support continued advances in environmental modeling capabilities. These funds will make it easier to achieve the maximum number of computational hours available to scientists.

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Information Technology Research & Development

<b>Object Class</b>	<b>2012 Increase</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	53
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	0
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	53



**Congressionally Directed Projects (Base Funding: 0 FTE and \$19,500,000; Program Change: -0 FTE and -\$19,500,000)**: NOAA requests a decrease of \$19,500,000 to terminate the funding level that would continue under an annualized FY 2011 continuing resolution associated with the Congressionally directed projects identified in the Conference Report that accompanied the Consolidated Appropriations Act. 2010. (Note: an additional \$5,095,000 is terminated under the Climate Service section. These funds were appropriated to OAR in FY 2010 but are transferred with the base to the Climate Service as part of the proposed reorganization contained herein.)

**PROGRAM CHANGE DETAIL BY OBJECT CLASS**  
**(Dollar amounts in thousands)**

Activity: Office of Oceanic & Atmospheric Research  
Subactivity: Information Technology Research & Development

<b>Object Class</b>	<b>2012 Decrease</b>
11 Personnel compensation	
11.1 Full-time permanent	\$0
11.3 Other than full-time permanent	0
11.5 Other personnel compensation	0
11.8 Special personnel services payments	0
11.9 Total personnel compensation	0
12 Civilian personnel benefits	0
13 Benefits for former personnel	0
21 Travel and transportation of persons	0
22 Transportation of things	0
23.1 Rental payments to GSA	0
23.2 Rental Payments to others	0
23.3 Communications, utilities and miscellaneous charges	0
24 Printing and reproduction	0
25.1 Advisory and assistance services	0
25.2 Other services	0
25.3 Purchases of goods & services from Gov't accounts	0
25.4 Operation and maintenance of facilities	0
25.5 Research and development contracts	0
25.6 Medical care	0
25.7 Operation and maintenance of equipment	0
25.8 Subsistence and support of persons	0
26 Supplies and materials	0
31 Equipment	0
32 Lands and structures	0
33 Investments and loans	0
41 Grants, subsidies and contributions	-19,500
42 Insurance claims and indemnities	0
43 Interest and dividends	0
44 Refunds	0
99 Total obligations	-19,500