



Mike DeLuca, President, National Association of  
Marine Laboratories

Robert Cowen, Chairman, Public Policy  
Committee, National Association of Marine  
Laboratories

# NATIONAL ASSOCIATION OF MARINE LABORATORIES

Annual Public Policy Meeting

March 6 and 7, 2016

1201 New York Avenue NW, Suite 400

Washington, D.C. 20005

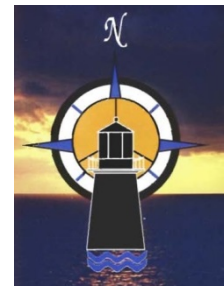


Prepared by Joel Widder and Meg Thompson, Federal Science Partners

- Meeting Agenda
- Speakers' Bios
- Suggested Issues to  
Raise with Speakers
- FY 2017 NAML Public  
Policy Agenda
- Useful Background  
Information –  
Congressional  
Committees,  
OMB/OSTP R&D  
Priorities Memo for  
FY17; FY17 Budget  
Summary Materials,  
National Ocean Council  
FY16 Work Plan, Ad  
Hoc Geoscience  
Community Statement  
on FY17 Budget; Draft  
AMS Priorities  
Statement



**National Association of Marine Laboratories  
Winter Meeting  
1201 New York Avenue NW  
4th floor Ocean Leadership Conference Room  
Washington, D.C.  
March 6 and 7, 2016**



**Sunday -- March 6, 2016**

**Location:** Consortium for Ocean Leadership, 1201 New York Avenue NW, Suite 400  
Conference Rooms A&B

**Housing:** Washington Plaza Hotel, 10 Thomas Circle NW, Washington, D.C. 20005  
<https://www.reservations-page.com/C00519/H11149/be.ashx?pc=G6FY>

**2:00PM** Opening Remarks – Mike DeLuca and Robert Cowen

**2:15PM** Briefing on the Federal Science Budget and Policy Environment and Presentation of FY 2016  
NAML Public Policy Agenda– Joel Widder and Meg Thompson, Partners, Federal Science  
Partners and Consultants to NAML

**2:45PM** Discussion of NAML Public Policy Agenda and Related Activities including the “geosciences”  
debate, and preparing for the next Administration

**3:45PM** NAML Business Meeting  
Committee Reports

Public Policy	Robert Cowen
Treasurer	Jim Sanders/Billie Swalla
Membership	Brett Burk
Education	Jan Hodder
Network Integration	Bob Dickey, Steve Weisberg
Science Communication	Heather Leslie, Karina Nielson
NCCOS	Nancy Rabalais
International	Ivar Babb
Bylaws	Mike DeLuca

**4:15PM** Regional Meetings: WAML; SAML; and NEAMGLL

**5:00PM** Regional Meetings report out

**5:30PM** ACP Conservation Action Agenda, International Plastics  
Albert George, Director, South Carolina Aquarium

**6:00PM** Dinner (on your own)

**Monday – March 7, 2016**

- Location:** Consortium for Ocean Leadership, 1201 New York Avenue NW, Suite 400  
Conference Rooms A &B
- 7:30AM:** Coffee and continental breakfast
- 7:45AM:** Mike DeLuca, President NAML/Robert Cowen, Chair, Public Policy Committee
- 8:00AM:** Speaker: Dr. Craig McLean, Associate Administrator, Office of Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration
- 9:00AM:** Speaker: Ms. Beth Kerttula, National Ocean Council, Office of Science and Technology Policy
- 9:45AM:** Panel: Staff Members from the Senate Appropriations Subcommittee  
Mr. Kolo Rathburn, Majority Staff, Subcommittee on Commerce, Justice, and Science  
Ms. Molly O'Rourke, Minority Staff, Subcommittee on Commerce, Justice and Science  
Mr. Allen Cutler, Majority Staff, Subcommittee on Commerce, Justice, and Science
- 10:30AM:** Break
- 10:45AM:** NSF Program Officer Panel: NSF Initiatives and Marine Laboratories  
Dr. Peter McCartney, Division of Biological Infrastructure, National Science Foundation  
Dr. Lisa Clough, Division of Ocean Sciences, National Science Foundation
- 11:45AM:** Speaker: Amanda Greenwell, Head, NSF Office of Legislative and Public Affairs
- 12:45PM:** Pick Up Lunch outside Ocean Leadership Conference Rooms
- 1:00PM:** Lunch Speaker: Ms. Margaret Davidson, Senior Advisor, National Ocean Service
- 2:15PM:** NOAA Panel –  
Dr. Keelin Kuipers, NOAA Office of Coastal Management  
Dr. Zdenka Willis, Director, Office of Integrated Ocean Observing Program
- 3:30PM:** Dr. Joan Ferrini-Mundy, Assistant Director for Education, National Science Foundation
- 4:30PM:** Break
- 4:45PM:** Panel: NAML -- Working with Like-Minded Organizations:  
Ms. Michelle Wyman, Executive Director, National Council for Science and the Environment  
Dr. Susan Park, Executive Director, Coastal and Estuarine Research Federation  
Ms. Lexie Shultz, Director of Public Affairs, American Geophysical Union  
Ms. Rebecca Roth, National Estuarine Research Reserve Association  
Ms. Josie Quintrell, Executive Director, IOOS Association
- 5:45PM:** Closing Remarks – Mike DeLuca
- 6:00PM:** Adjournment

## **Biographical Sketches of Speakers**

### **NAML Public Policy Meeting**

**Washington, D.C.**

**March 6 and 7, 2016**

**Craig McLean** – In January 2015 Craig McLean was appointed by the NOAA Administrator to be the Assistant Administrator for NOAA's Office of Oceanic and Atmospheric Research (OAR). Prior to this position, Mr. McLean served as deputy assistant administrator for OAR's Programs and Administration, as executive officer of the National Ocean Service, and was the founding director of NOAA's Office of Ocean Exploration. Mr. McLean served in uniform for nearly 25 years, retiring from NOAA's Commissioned Corps in the grade of captain. He served aboard hydrographic, oceanographic, and fisheries research ships. Mr. McLean is also an attorney and has practiced marine resource law for NOAA. He has been awarded the Department of Commerce Silver and Bronze Medals, the NOAA Corps Commendation Medal, and Special Achievement Medal. He is a frequent speaker on ocean related subjects, drawing on his diverse NOAA career experience in fisheries, coastal and marine area management, directing research, law, and both surface and submerged marine operations. He is a fellow of the Explorers Club, and of the Marine Technology Society, and a past-president and chairman of the Sea-Space Symposium.

**Elizabeth (Beth) Kerttula** -- Beth Kerttula is the Director of the National Ocean Council, where she oversees the Council's efforts to implement the National Ocean Policy. In this capacity, she also works closely with stakeholders and with the nine marine regions to facilitate regional marine planning and other ocean management activities. She came to that position from Stanford's Center for Ocean Solutions, where she was a visiting fellow working to bring together policymakers from multiple disciplines to discuss the critical interplay of oceans, climate change, and society. She is a 15-year veteran of the Alaska House of Representatives, where she served as Minority Leader from 2006 to 2013, and has held positions in the State of Alaska Attorney General's Office. Beth was the original sponsor of landmark cruise ship pollution legislation as well as other important environmental bills. She also led efforts to defend and improve the Alaska Coastal Zone Management Program and supported research efforts by the University of Alaska on ocean acidification and community sustainability. Beth was also a member of the State of Alaska's first Arctic Policy Commission, which created Alaska's first Arctic policy recommendations for the state legislature.

**Kolo Rathburn** -- Charles Kolo Rathburn is a Professional Staff Member -- Majority for Senate's Committee on Appropriations on the Commerce, Justice and Science subcommittee under the leadership of Senator Richard Shelby and Ranking Member Senator Barbara A. Mikulski. His account portfolio includes the Department of Commerce and related trade and science agencies including the National Oceanic and Atmospheric Administration (NOAA). Prior to serving on the Appropriations Committee, Mr. Rathburn was a Legislative Assistant to Senator Roger Wicker from 2011 to 2013. In 2010, Mr. Rathburn was a Sea Grant Legislative Fellow in Senator Wicker's office. Mr. Rathburn received an M.S. in Marine Biology from the College of Charleston in 2009.

**Molly O'Rourke** -- Molly O'Rourke McCarthy is a Professional Staff Member on the Senate Appropriations Committee, working for Vice Chairwoman Barbara Mikulski (D-MD). She covers appropriations and oversight for the Department of Commerce, the National Science Foundation, and independent trade agencies. Previously, she has worked for the Transportation and Housing Appropriations Subcommittee under Senator Patty Murray (D-WA) and for the House Committee on Science and Technology under Bart Gordon (D-TN). Molly also worked at OMB's Office of Information and Regulatory Affairs while completing her Master's in Public Policy at the University of Virginia.

**Allen Cutler** -- is a Professional Staff Member on the Senate Appropriations Committee, working for Chairman Shelby (R-AL). He covers appropriations and oversight for the National Aeronautics and Space Administration and the National Science Foundation. Previously he was a professional staff member on the Senate Budget Committee.

**Peter McCartney** -- Peter McCartney has been a program director in the NSF Division of Biological Sciences since 2006, managing the Advances in Biological Informatics and Field Stations and Marine Labs programs. He has also participated in the management of numerous cross-cutting programs related to Cyberinfrastructure including Software Infrastructure for Sustained Innovation (SI2), Data Infrastructure Building Blocks (DIBBS), Cyber-enabled Discovery and Innovation (CDI) and DataNet. Prior to NSF he was Director of Informatics at the Global Institute for Sustainability at Arizona State University where he directed data management and software development projects in ecology, biodiversity, sustainability, and archaeology.

**Lisa Clough** -- Dr. Clough serves as Head, Ocean Section, in the NSF Division of Ocean Sciences, Directorate for Geosciences. Prior to joining the Division of Ocean Sciences, Dr. Clough served as the Program Director for Antarctic Integrated System Science in the Division of Polar Programs at NSF for four years, first as a rotator from 2009-2011 and in a permanent position since 2013. Before coming to NSF, she spent 20 years at East Carolina University, achieving the rank of full Professor of Biology, and serving as the Associate Vice Chancellor for Research for two years. She has numerous publications, most recently focused on Arctic and North Carolina coastal ecosystems. Her outreach activities during this time included three years as the chair of the UNOLS Arctic Icebreaking Coordinating Committee. She is a recipient of both the Arctic and Antarctic Service Medals, and the Distinguished Public Service Award from the U.S. Coast Guard. Her Ph.D. is in Coastal Oceanography, received from the Marine Sciences Research Center at Stony Brook University in 1993. Dr. Clough did her undergraduate degree at Wesleyan University, majoring in Biology and Earth and Environmental Sciences.

**Amanda Greenwell** -- Ms. Greenwell is the director of NSF's Office of Legislative and Public Affairs (OLPA). OLPA communicates information about NSF's activities, programs, research results and policies to a diverse range of audiences. Ms. Greenwell served as director of the National Oceanic and Atmospheric Administration's (NOAA) Office of Legislative and Intergovernmental Affairs before joining NSF in July 2015. At NOAA she was responsible for advising the NOAA Administrator, senior leadership and the Department of Commerce on Congressional activities and for developing legislative strategies. Prior to her current position, Ms. Greenwell served as deputy director of the office for nearly four years. Before joining NOAA, Ms. Greenwell served as professional staff for the U.S. Senate Committee on Commerce, Science and Transportation for the Subcommittee on Oceans, Atmosphere, Fisheries and the Coast Guard. In that role she had oversight of NOAA and the U.S. Coast Guard. Greenwell advised Congressional members on a variety of issues including domestic and international fisheries, marine mammals, coral reefs, aquaculture, seafood safety and the U.S. Coast Guard. Greenwell also served as staff for the Committee's Subcommittee on Trade, Tourism and Economic Development and the Subcommittee of Consumer Affairs, Product Safety and Insurance. She assisted the senior counsel for the subcommittees that oversee the Federal Trade Commission (FTC), the Consumer Product Safety Commission (CPSC), the National Highway Traffic Safety Administration (NHTSA), and the Department of Commerce. Ms. Greenwell earned a Bachelor of Science degree in marine biology from Hawaii Pacific University.

**Margaret Davidson** -- Margaret Davidson, an active participant in coastal resource management since 1978, serves as NOAA's Senior Advisor for Coastal Inundation and Resilience. In May 2014, Holly Bamford, NOAA's National Ocean Service Assistant Administrator, selected Davidson as principal scientific advisor on coastal inundation science, development, and policy. In this role, she has the responsibility for ensuring that all NOAA coastal inundation efforts are based on sound science principles and reflect solid resource management and planning techniques. She works across NOAA to coordinate and execute a research operation plan focused on advancing coastal inundation science and service with connections to social science. Davidson joined NOAA as the director of the NOAA Coastal Services Center in 1995. She also served as the acting assistant administrator for NOAA's National Ocean Service from 2000 to 2002. From 2012 to 2014, Davidson was acting director of the Office of Ocean and Coastal Resource Management (OCRM). In this position, she played a leading role as OCRM and the Coastal Services Center joined forces to bring a greater and better-coordinated level of products and services to their constituents. Before coming to NOAA, Davidson served as special counsel and assistant attorney general for the Louisiana Department of Justice and was the executive director of the South Carolina Sea Grant Consortium. She has served on numerous local, state, and federal committees and has provided leadership for national professional societies. Her professional work has focused on environmentally sustainable aquaculture, mitigation of coastal hazards, and the impacts of climate variability on coastal resources. Davidson holds a faculty appointment at the

University of Charleston and serves on the adjunct faculties of Clemson University and the University of South Carolina. She earned a Juris Doctorate in natural resources law from Louisiana State University and a master's degree in marine policy and resource economics from the University of Rhode Island.

**Keelin Kuipers** -- Keelin Kuipers is chief of the Policy, Planning, and Communications Division for NOAA's Office for Coastal Management. Previously, Dr. Kuipers served as the Policy and Planning Services program manager for NOAA's Coastal Services Center. In 1999, Dr. Kuipers began her NOAA career by working with states to support both the National Coastal Zone Management Program and Coastal Nonpoint Pollution Control Program in the Office for Ocean and Coastal Resource Management. Other NOAA roles include special assistant to the assistant administrator of the National Ocean Service, manager of the NOAA Coastal Storms Program, and resilience lead for NOAA's Coastal Goal. Prior to NOAA, Dr. Kuipers worked for the National Science Foundation for four years on a variety of science policy issues, including biodiversity and endangered species protection. Dr. Kuipers holds a master's degree in conservation biology and environmental policy from the University of Michigan and a bachelor's degree in ecology from the University of Maryland.

**Zdenka Willis** -- Zdenka Willis is the Director of the U.S. Integrated Ocean Observing System (IOOS®) Program. U.S. IOOS which is a coordinated network of people and technology that work together to generate and disseminate continuous data on our coastal waters, Great Lakes, and oceans. Prior to her assignment as Director of U.S. IOOS Program, Ms. Willis served as Director of NOAA's National Oceanographic Data Center and administered the NOAA Central Library, the National Coastal Data Development Center, and the World Data Center of Oceanography, Silver Spring, Maryland. Ms. Willis is a retired Navy Captain with career service as a Meteorology and Oceanography officer in the United States Navy. She has promoted interagency cooperation as the Naval Deputy to NOAA; worldwide sea ice analysis and forecasting as Director of the National Ice Center; and as the satellite and operations officer Naval Polar Oceanography Center. While the Director of the National Ice Center initiated a visiting scientist program which attracted post-doctorate researchers focused on the Arctic and Antarctic. Her meteorological background includes weather forecasting for Naval aircraft as the Officer in Charge of the Naval Oceanography Command Detachment, Oceana Virginia and for Navy vessels as the Naval Eastern Oceanography Center, Norfolk Virginia. Ms. Willis has a background in the collection of oceanographic data onboard the USNS Harkness and USNS Maury survey vessels and in the electronic navigational charting as Deputy Navigator of the Navy. Her other relevant Naval positions are the director of the Strategic Policy Forum (a Congressional and Executive Branch crisis simulation for Members of Congress, senior Executive branch officials, and military leaders) and adjunct professor in the Strategic Leadership Department at the Industrial College for the Armed Forces. Ms Willis received her Bachelor's Degree in Marine Science from the University of South Carolina. She received a Master's degree in Meteorology and Oceanography from the Naval Postgraduate, and a Master's Degree in National Strategy from the Industrial College of the Armed Forces.

**Joan Ferrini-Mundy** -- Dr. Joan Ferrini-Mundy is Assistant Director of the National Science Foundation (NSF) for Education and Human Resources, a position she has held since February 2011, and is responsible for the leadership of the NSF Directorate for Education and Human Resources (EHR). She had served the Foundation in a number of capacities since 2007 including as inaugural director (through an Intergovernmental Personnel Act appointment) of the EHR Directorate's Division of Research on Learning in Formal and Informal Settings. From 2007 through 2009, Ferrini-Mundy was a member of the National Science and Technology Council's (NSTC) Subcommittee on Education, and currently co-chairs the Strategic Plan workgroup of the National Science and Technology Council Committee on STEM Education. She is a member of the Mathematics Expert Group of the Programme for International Student Assessment (PISA), and in 2007-2008, representing NSF; she served as an ex officio member of the President's National Mathematics Advisory Panel, and co-chaired its Instructional Practices Task Group. From 1999 - 2011 Ferrini-Mundy held an appointment at Michigan State University (MSU), where she was a University Distinguished Professor of Mathematics Education in the Departments of Mathematics and Teacher Education, and Associate Dean for Science and Mathematics Education in the College of Natural Science. Her research interests include calculus teaching and learning, mathematics teacher learning, and mathematics and science education policy at the K-12 level. Ferrini-Mundy holds a PhD in mathematics education from the University of New Hampshire. She was elected a fellow of the American Association for the Advancement of Science in 2011.

**Michelle Wyman** – Michelle Wyman is the new Executive Director of the National Council for Science and Environment. Wyman brings over fifteen years of successful leadership experience working on environmental policy, planning and leadership in government, nonprofit, and the private sector to NCSE. Her resume includes serving as Executive Director of Applied Solutions, and ICLEI- Local Governments for Sustainability, and Intergovernmental Affairs Director for the U.S. Department of Energy. Most recently, Wyman served as senior advisor to states working on advanced energy future planning. Wyman has served on a number of boards and provided leadership guidance on energy and the environment to Federal, state and local governments particularly elected officials.

**Susan Park** – Susan Park is the new Executive Director of the Coastal and Estuarine Research Federation (CERF). Dr. Park received her Doctorate in Oceanography from the University of Delaware, and received her Master's in Conservation Biology at the University of Pennsylvania. She has been published most recently in the Journal of Shellfish Research. Dr. Park has more than ten years of experience in supporting organizations in the scientific community, including roles in project and program management, proposal development, budget and financial management, research administration, and program planning and evaluation. Prior to this appointment, Dr. Park held positions with Virginia Sea Grant, and was the Senior Program Officer at The National Academies, Adjunct Professor at Trinity Washington University, and NOAA Coastal Management Fellow at the Massachusetts Office of Coastal Zone Management. She will work closely with CERF's association management company, SBI Management Services, to manage the operations of the organization.

**Alexandra (Lexie) Shultz** – Ms. Shultz joined the American Geophysical Union (AGU) as the organization's director of public affairs. Ms. Shultz is a senior policy specialist with extensive experience in strategic communications and grassroots campaigns as well as a broad knowledge of environmental, climate, and energy policy and science. Ms. Shultz works to develop and implement a public affairs strategy designed to build recognition of and support for the value of the Earth and space sciences, including government advocacy, member engagement, media relations, and building relationships with agencies, the private sector, foundations and other key partners. She previously spent eight years at the Union of Concerned Scientists, where she most recently served as the legislative director for the climate and energy program. While at the Union of Concerned Scientists, Ms. Shultz was part of an effort to restore scientific integrity to the policy making process and then served in several roles within the climate and energy program. As legislative director, she was responsible for directing a team of analysts and outreach and policy experts to convey resonant information about climate change to reporters, policy makers, and the public. She also worked to build and maintain strong congressional and administration relationships, analyze legislation and regulations, and recruit, train, and deploy experts. Prior to her tenure at the Union of Concerned Scientists, Ms. Shultz served as director of legislative and regulatory affairs at the Mineral Policy Center (now Earthworks), and as a staff attorney at the U.S. Public Interest Research Group (now Environment America). She earned her bachelor's degree in chemistry from Vassar and her Juris Doctorate from Pace University Law School, with an emphasis on environmental law.

**Rebecca Roth** -- Rebecca Roth is the executive director of the National Estuarine Research Reserve Association. She advances the mission of the reserve system by advocating for the shared interests of all reserves. She works with Congress and the National Oceanic and Atmospheric Administration to support annual budget appropriations and legislative priorities that enhance the value of all reserves for their many partners and stakeholders. She also works closely with NOAA and other federal agencies to help shape regulations and policies to sustain healthy estuaries nationwide. A land use planner by training, Ms. Roth is a veteran coastal management and public administration professional with more than 25 years of experience. For 18 years, she worked for the California Coastal Commission, where she last served as Federal Programs Manager. She has been involved with the reserves since 1998 through her Coastal Commission work, which facilitated integrated coastal and ocean management among California's reserves, coastal programs, and marine sanctuaries. Ms. Roth earned her Masters of Arts Degree in Public Administration and Policy at San Francisco State University and her Bachelor's degree in Public Administration and City Planning at San Diego State University. Rebecca grew up and lived near the Pacific Ocean in California for most of her life; she now resides in New England where she still finds her connection to the coast to be one of her greatest re-charges.

**Josie Quintrell** -- Josie Quintrell is the Director of the IOOS Association, a non-profit organization dedicated to enhancing coastal observing for the benefit of society. Prior to her work with the IOOS Association, she was C.O.O. for the Gulf of Maine Ocean Observing System (GoMOOS) and a marine policy specialist for the Maine Coastal Program. She has a Masters in Regional Planning from Cornell University and a B.A. in Biology from Colby College. She lives in Maine with her husband and two children.

**Joel Widder** -- Together with business partner, Ms. Meg Thompson, Mr. Widder provides government relations support to the National Association of Marine Laboratories. Mr. Widder has been providing government relations services to research universities and related organizations since he retired from federal service in 2002. Along with his partner, Ms. Meg Thompson, Mr. Widder has represented numerous clients including the University of Chicago, Columbia University, Florida State University, the State University of New York, the South Dakota School of Mines and Technology, the University Corporation for Atmospheric Research, the National Ecological Observatory Network, the National Association of Marine Laboratories, the Sea Grant Association, the Association of Children's Museums, Vaisala, Inc., Quantum Spatial, Inc., and General Atomics. In the past he has also represented the California Institute of Technology, the University of Illinois, the University of Southern California, Georgia Tech, Rutgers University, Arizona State University, and Tulane University. As a result, Mr. Widder has extensive experience in the research and education issues important to major research universities as well as experience in working with major higher education and scientific/engineering associations.

Before his work in the consulting field, Mr. Widder worked from 1982 to 2002 for the National Science Foundation (NSF) where he last served as the Deputy Director for the Office of Legislative and Public Affairs. Before leaving federal service, Mr. Widder also served for two years on the staff of the Senate Appropriations Committee where he had responsibility for issues related to research and education including space and environmental sciences. Mr. Widder was an original member of NOAA's Environmental Information Services Working Group, which reports to the NOAA Science Advisory Board. He serves on the Executive Committee of the Board on Oceans, Atmosphere, and Climate within the Association of Public and Land-Grant Universities; and the American Meteorological Society's (AMS) Weather & Climate Enterprise Commission Steering Committee. Mr. Widder received an undergraduate degree from the University of Maryland in 1975 and completed two years of graduate work at the SUNY College of Environmental Science and Forestry (1975–1977).

**Meg Thompson** -- Together with business partner, Mr. Joel Widder, Ms. Thompson provides government relations support to the National Association of Marine Laboratories. Ms. Thompson has over 20 years of Capitol Hill experience. Ms. Thompson has been professional staff on both the Senate and House Appropriations Committees for both Republican and Democratic majorities. Prior to joining the firm, Ms. Thompson served on the House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies, where she had principle responsibility for all Department of Justice programs. In 2006, Ms. Thompson served on the House Subcommittee on Homeland Security where she had primary responsibility for the Federal Emergency Management Agency (FEMA) and Preparedness Directorate. From 2001-2005, Ms. Thompson served on the House Labor, Health and Human Services, Education, and Related Agencies Subcommittee. Before joining the House Appropriations Committee, Ms. Thompson spent three years as Director of Corporate Communications for the National Fish and Wildlife Foundation, and spent two years as a lobbyist for health and medical research clients. Prior to the private sector, Ms. Thompson served on the Senate Appropriations Committee, Subcommittee on Labor, Health and Human Services, and Education, and Related Agencies from 1992-1997.

Ms. Thompson, in partnership with Mr. Widder has represented numerous clients including the University of Chicago, Columbia University, Florida State University, the State University of New York, the South Dakota School of Mines and Technology, the University Corporation for Atmospheric Research, the National Ecological Observatory Network, the National Association of Marine Laboratories, the Sea Grant Association, the Association of Children's Museums, Vaisala, Inc., Quantum Spatial, Inc., and General Atomics. Ms. Thompson has also represented the Environmental Defense Fund, the National Fish and Wildlife Foundation, the University of New Mexico, and Purdue University.



## Suggested Issues/Questions for NAML Members to Raise with Speakers

### **Craig McLean – NOAA OAR**

- Could you please talk about the interest and willingness of OAR to partner with and support activities at institutions like the laboratories represented around this table. In the past, we have seen NOAA say working with its partners is a high priority only to see major reductions in funding for extramural programs. Is there a role NAML can play to help overall OAR funding issues – as well as support for OAR's various extramural programs?
- The FY17 budget plan for NOAA includes a major increase for the Ocean Acidification program – if Congress goes along the program will literally double in FY17 over its FY16 estimate. As NOAA goes forward in this area, what are NOAA's plans to tap into the expertise and research capabilities of academic marine labs and others in the extramural research community? What about specific funding around such other key coastal topics such as Hypoxia, and Coastal Resilience?
- At the same time OA is increasing, we see reductions in the National Sea Grant College Program, the ocean, coastal and Great Lakes cooperative institutes, and Ocean Exploration and Research? It would seem the Administration has targeted for reduction extramural research related to the coasts and oceans as it developed the OAR budget request for FY 2017. Can you comment on the message being sent to your extramural research partners?
- How can NAML become more involved and more effective as a voice for ocean and coastal research and education? What arguments do you see as important for us to make that will resonate with policy makers both in the Executive Branch and the Hill?
- NOAA had been going through an exercise to re-vision the cooperative institute program. Can you talk about the future for this network of institutes NOAA currently supports? Does NOAA have plans for any new cooperative institutes and if so, in what areas will NOAA been seeking to build expertise?
- NAML is a network of some 100 marine labs located all over the country. What advice do you have for us as to how we might use that network to effectively advocate in support for ocean, coastal and Great Lakes research and education and what advice would you have for NAML members to seek opportunities to serve on advisory committees and other similar agency and interagency working groups?
- One of the key issues in NAML's public policy agenda is to look for ways for the mission agencies to consider co-locating personnel and instrumentation at NAML labs in an effort to avoid duplication of efforts or capabilities. Is that something NAML could work with OAR on in the future? If yes, what are the next steps to foster collaboration on this issue?
- NAML was invited by NCCOS to participate in a session in which views about research priorities were exchanged and discussed. It was a session that essentially took input from NAML members by NCCOS to help focus its future research efforts. Do you see an opportunity for a similar exercise between NAML and OAR?
- NAML members possess the capacity to monitor, sample and assess environmental conditions at significantly enhanced spatial and temporal scales that are relevant for science-based management of coastal resources and ecosystems. NAML also occupies a unique niche in environmental sensing because individual laboratories are co-located among rich ecosystems and vibrant coastal communities. What are the priority issue areas and data needs that NAML can collect and assimilate to assist NOAA/OAR in providing the information and tools that resource managers need to support science-based management and stewardship of coastal systems and communities?

### **Kolo Rathburn/Molly O'Rourke/Allen Cutler – Senate CJS Subcommittee Staff**

- At the outset, we would like to express our appreciation for the support the Subcommittee has provided year in and year out for ocean, coastal, and Great Lakes research and education. We are appreciative of the support you have provided for important programs like Sea Grant, the National Estuarine Research Reserve System, the Prescott program, and ocean education. We are grateful that the committee raised concerns regarding the Administration's plan to consolidate STEM education programs – a proposal that

would have decimated ocean-related education programming. With the budget environment remaining constrained, what efforts can and should NAML undertake to effectively make the case to other policy makers about the importance of these programs? In other words, how do we help you so that you can continue to help us?

- The FY17 NOAA budget contains reductions in the National Sea Grant College Program, the ocean, coastal and Great Lakes cooperative institutes, and Ocean Exploration and Research. These are important extramural programs for NAML members and the Subcommittee has usually protected extramural programs in the past. While the overall budget picture is tight – essentially level with last year – can you give us some sense as to how the Subcommittee is likely to react to these proposed reductions?
- Last year there was an attempt to restrict NSF funding in the geosciences. Your Subcommittee resisted that House proposal and in the end the conference committee adopted the Senate’s position. First – thank you for that support and for prevailing in the end. Do you see the issue coming back in the same or similar fashion in the FY 17 process and do you have some advice for us as what we can do to be more effective advocates for the geosciences and related disciplines?
- Recently the National Academy of Sciences released a decadal survey of the ocean sciences. This report recommends some major shifts in support for ocean sciences research by scaling back on support for major infrastructure. How do you see this decadal survey impacting the mix of support the Subcommittee provides NSF and NOAA via the appropriations process?
- One of NAML’s public policy objectives is to organize ourselves into a virtual network so that we can all take advantage of the data and observations we and other institutions have been collecting on our own for many years. With access to sufficient computing resources and innovative networking as a community we are poised to take advantage of the substantial investment made over the years in the research and education infrastructure of marine labs by integrating our activities more closely. Is this something the Subcommittee is likely to support?
- Can you give us a sense as how the appropriations process for FY 2017 is likely to proceed especially since this is an election year?

**Beth Kerttula, Director, National Ocean Council**

- In what way can marine laboratories participate in the activities of the National Ocean Council?
- NAML’s public policy agenda focuses on research, education and related activities that relate heavily to our coastal environments – on the west coast, gulf coast, east coast and the Great Lakes. How does the administration’s national ocean policy and the activities of the National Ocean Council relate to NAML’s interests?
- In what ways does the National Ocean Council work with and influence the interagency activities related to ocean science and technology?
- In January 2016 the Council released its most recent work plan. Can you talk about the process that led to the establishment of the priorities articulated in this year’s annual plan and in what ways did the Council involve the non-governmental stakeholders in the development of this plan?
- One of the emerging issues in the Council’s most recent work plan is to focus on the development of tools to deal with sea level rise and increasing coastal resiliency. The work plan calls for relevant federal agencies to convene to develop a set of regional sea level rise scenarios and coastal flood hazard tools. How will the Council and the interagency working group include the input and expertise that state, local and regional organizations – such as the marine labs sitting around this table -- bring to this issue on a regional or local basis?
- In terms of outreach to stakeholders, how does the Council use established networks and programs – such as the National Sea Grant College Program and its well known extension and outreach efforts – to reach such audiences?
- In what ways can NAML be helpful in the continued development of the national ocean policy issues?

**Peter McCartney, Program Director, Biological Sciences Directorate, NSF**  
**Lisa Clough, Section Head, Ocean Section, Division of Ocean Sciences, NSF**

- Can you talk about how the FSML program has changed or is changing based on the NAS report on the future of marine labs and field stations?
- Can you talk about the impact NEON operations funding will have on the availability of support for other biological infrastructure activities?
- NSF has put a great deal of emphasis on its INFEWS and Risk and Resilience cross directorate initiatives in the FY17 budget request. To what extent have these cross directorate initiatives impacted so-called “core” research and infrastructure programs in your respective programs? How can marine labs best participate in these major efforts?
- Can you update us on the current scope and direction of the Long Term Ecological Research program and how that relates to NAML and our public policy concerns?
- Can you update us on how the FY17 budget relates to the recommendations contained in the NAS *Sea Change* report?
- What advice would you have for NAML members who may wish to be considered for appointments to NSF’s bio and geo advisory committees?

**Amanda Greenwell, Head, NSF Office of Legislative and Public Affairs**

- How can our marine labs assist NSF in its communication and legislative relations efforts?
- What are the key messages NSF is conveying to policy makers and how well is that message being received?
- Last year NAML and other organizations were very involved in articulating the value of the geosciences to policy makers. We expect to continue to be involved in that on-going education process. How can we coordinate our efforts with those the Foundation will be expending?
- What is NSF’s plan for dealing with the reauthorization of the America COMPETES legislation? Are you actively seeking enactment of this legislation? What can NAML do to be helpful in this regard.
- What reaction have you gotten thus far from the Congress regarding the NSF budget request – particularly on the creative way the Administration has sought to provide increases to the NSF budget and some of the other science agencies?

**Margaret Davidson, Senior Advisor, National Ocean Service, NOAA**

- What advice would you have for NAML in terms of preparing and engaging with the new Administration taking office in January of next year?
- What issues or initiatives should NAML be focused on – not just for the current appropriations cycle but for the foreseeable future?
- What advice would you have for NAML to elevate its visibility and increase its effectiveness as it seeks to influence relevant public policy decisions?
- What do you see as the key research, education and training priorities to advance resilience of coastal communities and ecosystems?
- What role can NAML labs play with federal initiatives to implement green/gray strategies for shoreline management, especially with NOAA and the Army Corps of Engineers?

**Keelin Kuipers, Chief, Policy, Planning, and Communications Division, Office of Coastal Management**

- Last year, NAML was invited to participate in an ongoing discussion with the leadership of the National Centers for Coastal Ocean Science. NAML was used as a bit of sounding board for a discussion of science and programmatic priorities – consistent with the NOAA strategic plan. Would a similar exercise between NAML and the leadership of the Office of Coastal Management be worthwhile for other elements of the National Ocean Service and how would such an activity get underway?

- Can you talk about the status of and the opportunities for participation by NAML labs in the coastal resilience grant program?
- Can you describe the recommendations of the Blue Ribbon Panel for the National Estuarine Research Reserve System, and the implications for restructuring or realigning the geographic and programmatic scope of the National Estuarine Research Reserve System?
- Recently, the National Ocean Service convened a workshop to advance integration of the System-wide Monitoring Program of the NERRS with the ocean observing system of IOOS. What opportunities are there to incorporate the environmental sampling and sensing capacity of NAML labs into this initiative?

**Zdenka Willis, Director, Office of Integrated Ocean Observing Program, NOS/NOAA**

- Last year, NAML engaged with the relevant Congressional committees to register its support for the reauthorization of the IOOS legislation. Was that helpful to the IOOS program from the NOAA perspective and what suggestions or recommendations would have for NAML advocacy going forward?
- Can you talk about how NAML labs and the IOOS program intersect and how our public policy agenda relates to the IOOS program and directions you are trying to take the program?
- Can you talk about how NAML labs can better participate in the IOOS program?

**Joan Ferrini-Mundy, Assistant Director, Education and Human Resources, NSF**

- STEM education is a very important and very active activity at the network of NAML laboratories around the table today. Can you give us some advice as to how NAML labs can take their STEM education activities to the “next level” – given the goals and directions of NSF’s overall interests and priorities with respect to STEM education and the conclusion of NSF’s support for the Centers for Ocean Sciences Education Excellence program (COSEE)?
- In the past the Administration has proposed the consolidation of certain STEM education programs – such as NOAA’s education activities in the Sea Grant program. NAML has been skeptical of such efforts, as have many other organizations for various reasons. What are the Administration’s plans for such consolidation efforts in the FY17 budget?
- At one point the Administration had plans to move all informal science education over to the Smithsonian. Is that proposal still on the table?
- Can you describe where NSF’s own informal science education program is going and is there a role for NAML labs in the program as it continues to evolve?
- How can NAML labs assist NSF in its effort to engender support of its EHR programs? Is there a role for NAML educators on the directorate’s advisory committee?
- Many NAML members have public outreach programs that promote Free-Choice Learning. Are there plans within NSF’s EHR programs to support FCL research and programs?

**Michelle Wyman, Executive Director, National Council for Science and the Environment**

**Susan Park, Executive Director, Coastal and Estuarine Research Federation**

**Lexie Shultz, Director of Public Affairs, American Geophysical Union**

**Rebecca Roth, Executive Director, National Estuarine Research Reserve Association**

**Josie Quintrell, Executive Director, IOOS Association**

- We provided you with a copy of NAML’s FY17 public policy agenda in advance of this meeting. Can you highlight where you think your organization’s public policy interests intersect with NAML’s and how we might work collaboratively to advance each other’s interests?
- Do you have specific legislative or programmatic budgetary issues that intersect with NAML’s and how can NAML be helpful to your organization in that regard?
- Can you discuss whether or not your organization will be active in the geoscience advocacy exercise this year and what activities do you anticipate undertaking to help make the case for the geosciences?

- Can you talk about what your respective organizations might be doing to prepare for the transition process that will begin right after the November Presidential elections? How might NAML collaborate with your organization in such transition efforts?



## National Association of Marine Laboratories -- FY 2017 Public Policy Priorities

In setting NAML's priorities, NAML recognizes the importance of federal investment in the geosciences as it contributes to the Nation's innovation, safety, and security. Drawing from two key reports from the National Academy of Sciences: [Sea Change: 2015-2025 Decadal Survey of Ocean Sciences \(DSOS\)](#); and [Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century](#),

NAML's federal priorities are:

- Enhancing research, education and public engagement at marine labs to foster the continued development of the nation's workforce, expansion of opportunities for active learning and collaborative research, and improved engagement with the public;
- Increasing support for competitive, merit-based ocean, coastal, and Great Lakes research and education from relevant federal agencies to address research priorities and agency mission priorities; and
- Promoting a network of advanced connectivity among Federal and non-Federal laboratories that strengthens the Nation's research and education enterprise – this includes advanced cyber infrastructure and the co-location of federal scientists and infrastructure at NAML facilities.

### The Role of Marine Laboratories in the Nation's Research and Education Enterprise

*"Field stations are national assets formed by the unique merger of natural capital, intellectual capital, social fabric, and infrastructure that leads to the important scientific endeavors required if we are to understand our rapidly changing natural world." Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21<sup>st</sup> Century.*

Ocean, coastal and Great Lakes marine laboratories are vital, place-based "windows on the sea." They connect communities with cutting edge science, while providing students and citizens with meaningful learning experiences. The members of NAML work together to improve the quality and relevance of ocean, coastal and Great Lakes research, education and outreach. NAML seeks support for the following activities:

- Research of the highest quality, making use of the unique capabilities of coastal laboratories in conducting education, outreach and public service;
- Physical and cyber-related infrastructure for research and networking within and among facilities;
- Effective management and conservation of marine and coastal habitats and resources using ecosystem-based management approaches;
- Observing systems that collect data needed to support the management of marine resources for the benefit of environmental and human health needs; and;
- Education and training based on experiential, problem-solving approach.

### Oceans, Coasts and Great Lakes are Vital for Economic Growth and the Well-being of the Nation

Six economic sectors of the U.S. economy depend on the oceans, coasts, and Great Lakes, which provide an important and resilient part of the national economy. According to NOAA, in 2012, the ocean economy accounted for • 147,000 business establishments • 2.9 million employees • \$113 billion in wages • \$343 billion in gross domestic product. In 2012, the ocean economy's contribution to gross domestic product grew by 10.5 percent—more than four times as fast as the U.S. economy as a whole (which grew by 2.5 percent). During the same year, employment in the ocean economy increased 3.8 percent (adding 108,000 jobs). This was twice the national average employment growth of 1.8 percent. Programs such as NOAA's Sea Grant program, NSF's geoscience and biological sciences research programs including the Field Stations and Marine Laboratories program, NOAA's National Estuarine Research Reserve System, ocean observing and education programs at NSF and NOAA, and EPA's national estuaries and other water-related programs all contribute to either the continued economic development

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of our coastal economies and/or the improved management of coastal and marine natural resources.

### Research and Education: Commitment to Innovation

Innovation in the form of new goods, services, or processes builds new knowledge and technology, contributes to national competitiveness, improves living standards, and furthers social welfare. Research and development is a major driver of innovation. R&D expenditures indicate the priority given to advancing science and technology relative to other national goals.

According to the latest federal data, the U.S. science and engineering (S&E) enterprise still leads the world. The United States invests the most in research and development (R&D), produces the most advanced degrees in science and engineering and high-impact scientific publications, and remains the largest provider of information, financial, and business services. However, Southeast, South, and East Asia continue to rapidly ascend in many aspects of S&E. The region now accounts for 40 percent of global R&D, with China as the stand-out as it continues to strengthen its global S&E capacity. The National Science Board's (NSB) [Science and Engineering Indicators 2016](#) (*Indicators*) report highlights that China, South Korea and India are investing heavily in R&D and in developing a well-educated workforce skilled in science and engineering. *Indicators 2016* makes it clear that while the United States continues to lead in a variety of metrics, it exists in an increasingly multi-polar world for S&E that revolves around the creation and use of knowledge and technology.

According to *Indicators 2016*, China is now the second-largest performer of R&D, accounting for 20 percent of global R&D as compared to the United States, which accounts for 27 percent. Between 2003 and 2013, China ramped up its R&D investments at an average of 19.5 percent annually, greatly exceeding that of the U.S. China made its increases despite the Great Recession. China is also playing an increasingly prominent role in knowledge and technology-intensive industries, including high-tech manufacturing and knowledge-intensive services. These industries account for 29 percent of global Gross Domestic Product (GDP) and for nearly 40 percent of U.S. GDP. China ranks second in high-tech manufacturing, where the U.S. maintains a slim lead with a global share of 29 percent to China's 27 percent. While China plays a smaller role in commercial knowledge-intensive services (business, financial, and information), it has now surpassed Japan to move into third place behind the United States and the European Union. China has also made significant strides in S&E education, which is critical to supporting R&D as well as knowledge and technology-intensive industries.

At the same time that China and other Asian nations have continued to increase their R&D investments, the United States' longstanding commitment to federal government-funded R&D is wavering. Federal obligations for the total of R&D and R&D plant were \$129 billion in FY 2008, \$145 billion in FY 2009, and \$147 billion in FY 2010. But the years thereafter have been mostly marked by funding declines: FYs 2011 and 2012 were down \$6–\$7 billion from the FY 2010 peak and then declined further to \$127 billion in FY 2013. In FY 2014, the total increased to \$131 billion. Nonetheless, the drop from the FY 2010 level to that in FY 2014 is a current dollar decline of 11%—and when inflation is factored in, it is steeper still, at 17%. Since the Great Recession, substantial, real R&D growth annually -- ahead of the pace of U.S. GDP -- has not returned. Inflation-adjusted growth in total U.S. R&D averaged only 0.8 percent annually over the 2008-13 period, behind the 1.2 percent annual average for U.S. GDP.

NAML believes the nation is faced with a widening gap between the actual level of federal funding for research and education and what the investment needs to be if the U.S. is to remain the world's innovation leader. NAML believes the nation needs to increase its investments in research and education to develop the ideas, the people, and the innovations that power the nation's economy, create jobs, improve health, and strengthen our national security, ensuring the U.S. maintains its role as a global leader.

### National Science Foundation

NSF's annual budget represents 25 percent of the total federal budget for basic research conducted at U.S. colleges and universities, and this share increases to 60 percent when medical research supported by the National Institutes of Health is excluded. In many fields NSF is the primary source of federal academic support. For example, NSF provides 61% of all federal support for basic research at academic institutions in the environmental sciences and 66% in biology (excluding the biomedical sciences). Although many federal agencies contribute to ocean, coastal, and Great Lakes research and education, NSF provides the broadest base of support, including funding for research in physical, biological, and chemical oceanography and marine geology and geophysics, and the development, implementation, and operational support for ocean, coastal, and Great Lakes research infrastructure. NSF funds vital basic research that enhances the public understanding of the Nation's oceans, coasts and Great Lakes. NSF also supports science, engineering and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being. Research in ocean and coastal areas is supported via a highly competitive, merit-based process through a variety of modes of support at NAML laboratories involving individual investigators, small interdisciplinary teams of researchers and students, and large collaborative efforts integrating several laboratories.

NAML strongly supports robust funding of the geo and biological sciences at the NSF. NAML notes that with respect to the geosciences that since FY 2011 the NSF research and related account has increased by nearly 10%, the geosciences has remained nearly flat. This has exacerbated the budgetary pressures on the core research programs and the support for supporting infrastructure throughout the directorate and as specifically addressed in **DSOS**. The FY 2017 NSF budget request contains a proposed 6% increase for both the geosciences and the biological sciences, with a 6.5% increase for NSF's entire research budget. NAML strongly supports this requested investment in research and and education through NSF.

Research emphases at NSF should reflect the priority science questions contained in **DSOS**. NSF's support for ocean research infrastructure should be realigned with these research priorities. NAML is particularly supportive of the creation of new research networks that connect NAML laboratories and terrestrial field stations in ways that would enhance other ecosystem networks (e.g., LTERs) supported by NSF. NAML embraces this and other recommendations, which stem, in part, from ***Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21<sup>st</sup> Century***.

NAML notes the increasing share of NSF's research funding to support facilities and infrastructure, which now approaches 50% of the total. This is up substantially from the historical 40% share. Advanced infrastructure, while expensive, is essential for the field to move forward. However, the support for infrastructure must be balanced with the need to support individual investigators – particularly young investigators – with the resources needed for high quality research activities. The **DSOS** considers marine laboratories and field stations **critical** for the research priorities related to coastal and estuarine oceans, biodiversity and marine ecosystems, and marine food webs. NAML endorses the recommendations of **DSOS**. NAML particularly calls out the following **DSOS** recommendations:

- In order to sustain a robust ocean science community, holistic fiscal planning is necessary to maintain a balance of investments between core research programs and infrastructure. To maintain a resolute focus on sustaining core research programs during flat or declining budgets, NSF should strive to control operating costs of its major infrastructure programs over the next five years.
- NSF should reconsider whether the current regional class research vessels (RCRV) design is aligned with scientific needs and is cost effective in terms of long-term O&M pressures, and after doing so, should act accordingly.
- NSF should expand its partnership capabilities with other federal agencies and international partners, particularly with regard to shared community research priorities (e.g., climate change, ocean acidification, hypoxia, HABs, etc.).

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### **National Oceanic and Atmospheric Administration**

One of NOAA's key priorities is providing information and services to make communities more resilient. America's coastal communities and shorelines are facing escalating risks from changes in storm intensity, precipitation, flooding, rising sea levels, and ocean ecology, as well as from earthquakes and tsunamis that can result in dramatic human and economic losses. Increasing population density along the coast will further intensify pressures on ecologically and economically important areas, and put more people at risk. Increasing sea level can further escalate the costs and risks of inundation events. A study by the National Institute of Building Sciences on Federal hazard mitigation grants estimated that \$1 spent on hazard mitigation potentially leads to avoidance of \$4 in disaster relief costs and lost Federal tax revenue. Smartly investing in resilience will reduce the economic impacts of these hazards and improve national economic security. Similarly, the Great Lakes region boasts a massive geographic footprint, and is a major driver of the North American economy. With economic output of \$4.7 trillion in 2011, the region accounts for 28% of combined Canadian and U.S. economic activity. By comparison, the region's output ranks ahead of Germany, France, Brazil and the U.K., and it would rank as the fourth largest economy in the world if it were a country, behind only the U.S., China and Japan.

NAML envisions invigorated coastal communities and economies, with increased resiliency and productivity. Comprehensive planning will help protect coastal communities and resources from the effects of hazards and land-based pollution to vulnerable ecosystems by addressing competing uses, improving water quality and fostering integrated management for sustainable uses. Geospatial services will support communities, navigation and economic efficiency with accurate, useful characterizations, charts and maps, and assessment tools and methods. Coastal decision makers will have the capacity to adaptively manage coastal communities and ecosystems with the best natural and social science available. Resilient coastal communities and economies cannot be achieved without strong partnerships. NOAA should increase its outreach to and usage of NAML laboratories by increasing support of *existing programs* before embarking on the establishment of new, potentially duplicative, programs.

NAML strongly supports recommendations made by the NOAA Science Advisory Board (SAB) that calls for priority support for NOAA extramural programs. These include: the National Sea Grant College (NSGC) Program and Coastal Services Center; Aquaculture Initiatives; Prescott Marine Mammal Program; Highly Migratory Shark Fishery Research Program; NOAA Cooperative and Joint Institutes; the Integrated Ocean Observing Systems; NOAA's Center for Sponsored Coastal Ocean Research harmful algal bloom, hypoxia, and ecological forecasting initiatives; the National Estuarine Research Reserve System (NEERS); the National Marine Sanctuary Program; and NOAA's Office of Education. NOAA should also join with NIH and NSF to revitalize its support for the Oceans and Human Health research program. Extramural funding enables NOAA to leverage its R&D and operational investments with the resources of the nation's leading university scientists resulting in greater and faster scientific advances at lower costs. A predictable and reliable partnership with the extramural research community is critical to NOAA's long-term success. As available resources become scarcer and major program reorganizations may be considered, NOAA should expand its efforts to co-locate agency research staff and infrastructure at non-Federal marine laboratories. Such actions will not only result in significant cost savings, but also will achieve a greater return for its investment and increase scientific collaborations and productivity. NAML also continues to express concern with NOAA proposals contained in appropriation language requests that would enable NOAA to compete with non-federal and private entities for private sector support (See proposed Sec 109 on p.219 of the *Appendix to the Budget of the U.S. Government* for FY 2017). NOAA should adhere to its public-private partnership policy, which recognizes the distinct, yet cooperative, roles of the public and private sectors as it relates to environmental information.

The NOAA budget request for FY 2017 includes requested increases for OCM and the Coastal Science and Assessment, including the Competitive Research program that supports harmful algal blooms, hypoxia, and the coastal resilience management grants program which NAML is pleased to support. NAML is concerned, however, with proposed reductions in oceans, coastal, and Great Lakes research - including the National Sea Grant College Program, the Ocean, Coastal, and Great Lakes cooperative institutes and Ocean Exploration and Research.

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### **National Aeronautics and Space Administration**

Part of NASA's mission is to develop an understanding of the total Earth system and the effects of natural and human-induced changes on the global environment. Oceans play a major role in influencing changes in the world's climate and weather. Long-term ocean data from satellites make it possible to employ modeling techniques for global mapping of seasonal changes in ocean surface topography, currents, waves, winds, phytoplankton content, sea-ice extent, rainfall, sunlight reaching the sea, and sea surface temperature. Studying these patterns at a global scale can help forecast and mitigate the effects of floods and drought. Ocean observing satellite images tell us about the most fundamental climate changes. Satellite data have improved forecasting model capabilities to predict events such as El Niño and other global and regional climate cycles. Expanding NASA extramural support will further develop the ability to better predict ocean phenomena, particularly those impacting coastal environments (e.g. harmful algal blooms, hypoxia, ocean acidification).

### **Environmental Protection Agency**

EPA is an important source of support for marine laboratories, and EPA's own laboratories are a critical part of the marine science community. EPA's Office of Research and Development and Office of Water provide essential resources to marine laboratories nationwide, fund research grants in various environmental science and engineering disciplines, and engage the Nation's best scientists and engineers in targeted research complementary to EPA and other federal research activities. Unfortunately, support for research has declined dramatically over the past several years within EPA, and the EPA's Science Advisory Board has called for renewed investments. Enhanced support for extramural research programs at EPA, such as BEACHES, Science to Achieve Results and the National Estuary Program, are essential in helping to mitigate and adapt to environmental change.

### **Department of Interior**

DOI is an important federal player with respect to the ocean and coastal community through the research and other activities supported and conducted by the Bureau of Ocean Energy Management (BOEM), the U.S. Geological Survey (USGS) via the Coastal and Marine Geology program and the National Biological Service, and the U.S. Fish and Wildlife Service (FWS). Greater partnership with NAML laboratories would provide BOEM, USGS, and FWS with improved access to marine science information to support their roles in the management of ocean and coastal resources.

### **National Institutes of Health – National Institute of Environmental Health Sciences (NIEHS)**

NIEHS Centers for Oceans and Human Health fund research on marine-related health issues, such as developing techniques for more accurate and earlier detection of harmful algal blooms with the goal of preventing or reducing exposure, and studying the health effects of eating seafood that harbors toxins produced by harmful algae. NIEHS grantees examine the health effects of consuming seafood containing pollutants such as PCBs and mercury; identify indicators of recreational water contamination and illness, and explore compounds from marine organisms that hold promise as therapies for neurodegenerative disorders, cardiovascular and infectious diseases, certain cancers and other conditions. NIEHS is conducting research on the effects of the *Deepwater Horizon* oil spill on coastal communities with regard to social and human health effects. NAML encourages NIH to reinvigorate its support for the Oceans and Human Health research program, in cooperation with NSF and NOAA.

### **Department of Energy**

DOE's Energy Efficiency and Renewable Energy division has initiated significant efforts to understand and develop sources of renewable marine energy from tidal, wave and current sources. Environmental effects and conflicts with existing ocean uses must be evaluated as U.S. coastal energy sources are developed. The Nation's marine laboratories are uniquely distributed and serve as ideal locations for much of the research needed to rationally develop these energy sources. Opportunities to partner with DOE in these areas are strongly encouraged.

### **U.S. Department of Agriculture**

The vision for USDA's Agriculture Research Service (ARS) aquaculture research and technology transfer is to support a thriving domestic industry based on improved genetic stocks and scientific information on biotechnologies and management practices to ensure a high quality, safe supply of healthful seafood and aquatic products. The mission of the Aquaculture National Program is to conduct high quality, relevant, fundamental, and applied aquaculture research, to improve the systems for raising domesticated aquaculture species, and to transfer technology to enhance the productivity and efficiency of U.S. producers and the quality of seafood and other aquatic animal products. The USDA's National Institute of Food and Agriculture (NIFA) manages the USDA's aquaculture research and extension program and facilitates the coordination of all federal programs in aquaculture through the Joint Subcommittee on Aquaculture, which reports to the National Science and Technology Council in the Office of Science and Technology Policy. NIFA's funding of scientific and technology transfer goals to support development of a globally competitive U.S. aquaculture industry includes: improving the efficiency of U.S. aquaculture production; improving aquaculture production systems; improving the sustainability and environmental compatibility of aquaculture production; ensuring and improving the quality, safety, and variety of aquaculture products for consumers; improving the marketing of U.S. aquaculture products; and improving information dissemination, technology transfer, and access to global information and technology in aquaculture. NAML embraces these goals and encourages more direct USDA extramural funding and co-location of agency research staff and infrastructure at non-Federal marine laboratories.

### **Education, Diversity and an Ocean Literate America**

The U.S. continues to be at risk with respect to student achievement in science, technology, engineering and math among industrialized nations, as well as, emerging industrializing nations. As reported in the National Science Board's *Science and Engineering Indicators 2014* report:

- In mathematics, the percentage of U.S. students reaching the proficient level remained well below half in 2011: 40% of fourth graders and 35% of eighth graders performed at or above this level.
- In science, only 32% of eighth graders performed at or above the proficient level for their grade in 2011.

In comparison with other nations, the U.S. average score on the 2011 Trends in International Mathematics and Science Study (TIMSS) mathematics assessment was substantially lower at grade 4 than those of seven other countries/jurisdictions and those of six countries/jurisdictions at grade 8. The top performing nations each scored at least 50 points higher than the U.S. at grade 4 and at least 77 points higher than the U.S. at grade 8.

NAML continues to believe it is critically important that we improve ocean literacy and workforce development among all sectors of our nation. Marine laboratories play an important role in formal and informal education and workforce development by providing citizens of all ages a place for experiential ocean education. Marine laboratories serve as primary training grounds for students and are committed to enhancing diversity within the field of ocean, coastal and Great Lakes research and education. By fostering relationships with community colleges and minority-serving institutions, marine laboratories provide distinctive learning opportunities for underrepresented groups. Marine laboratories are key to achieving a greater understanding of ocean and coastal ecosystems and promoting stewardship of these ecosystem resources.

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NAML supports the Administration's proposed \$7 billion investment in STEM education across the Federal Government – with its expansion of access to rigorous STEM courses, improving STEM teaching and support for active learning, and expansion of opportunities for all students in STEM education. NAML laboratories believe the mission agencies have a role in helping to educate and train the workforce they will need in the future to carry out their missions. Therefore, NAML strongly supports the continuation of STEM education programs in NOAA, NASA, NIH and other mission agencies. NAML also continues to strongly support partnerships with Federal agencies to address the ocean education needs of the Nation. These include the NSF's Louis Stokes Alliance for Minority Participation, Research Experiences for Undergraduates and Research on Learning in Formal and Informal Settings programs; NOAA's Expanding Partnerships Program in the NOAA Education Office and Sea Grant's fellowships and K-12 STEM education programs; and EPA's Science to Achieve Results (STAR) Fellowship Program. Place-based networks such as NAML offer unique opportunities to provide hands-on training in diverse field settings with advanced sampling and sensing technologies. The importance of marine laboratories in support of coastal states' environmental literacy plans is essential in developing a literate public. Investment is needed today in coastal, ocean and Great Lakes education programs at NAML laboratories that support formal and informal learning at all age levels, in all disciplines and for all Americans.

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March 2016

## House and Senate Appropriations Subcommittees Appropriations for Ocean, Coastal and Great Lakes Issues For 2017

House Appropriations Subcommittee on Commerce, Justice, and Science  
House Appropriations Committee

Rep. John Culberson (R-TX), Chairman	<del>Rep. Chaka Fattah (D-PA)</del>
Rep. Robert Aderholt (R-AL)	Rep. Mike Honda (D-CA)
Rep. John Carter (R-TX)	Rep. Jose Serrano (D-NY)
Rep. Jaime Herrera Beutler (R-WA)	Rep. Derek Kilmer (D-WA)
Rep. Martha Roby (R-AL)	
Rep. David Jolly (R-FL)	
Rep. Evan Jenkins (R-WV)	

Senate Appropriations Subcommittee on Commerce, Justice and Science  
Senate Appropriations Committee

Sen. Richard Shelby (R-AI), Chairman	Sen. Barbara Mikulski (D-MD)
Sen. Lamar Alexander (R-TN)	Sen. Patrick Leahy (D-VT)
Sen. Lisa Murkowski (R-AK)	Sen. Dianne Feinstein (D-CA)
Sen. Susan Collins (R-ME)	Sen. Jack Reed (D-RI)
Sen. Lindsey Graham (R-SC)	Sen. Jeanne Shaheen (D-NH)
Sen. Mark Kirk (R-IL)	Sen. Chris Coons (D-DE)
Sen. John Boozman (R-AR)	Sen. Tammy Baldwin (D-WI)
Sen. Shelly Moore (R-WV)	Sen. Chris Murphy (D-CN)
Sen. James Lankford (R-OK)	

## House and Senate Authorizing Subcommittees For Ocean, Coastal, and Great Lakes Issues For 2017

### House Subcommittee on the Environment House Science, Space, and Technology Committee

Rep. Jim Bridenstine (R-OK) Chairman	Rep. Suzanne Bonamici (D-OR), Ranking Member
Rep. James Sensenbrenner (R-WI)	Rep. Donna Edwards (D-MD)
Rep. Randy Neugebauer (R-TX)	Rep. Alan Grayson (D-F)
Rep. Randy Weber (R-TX)	Rep. Ami Bera (D-CA)
Rep. John Moolenaar (R-MI)	Rep. Don Beyer (D-VA)
Rep. Brian Babin (R-TX)	
Rep. Bruce Westerman (R-AR)	
Rep. Dan Newhouse (R-WA)	
Rep. Gary Palmer (R-AL)	

### House Subcommittee on Water, Power, and Oceans House Natural Resources Committee

Rep. John Fleming (R-LA), Chairman	Rep. Jared Huffman (D-CA) Ranking Member
Rep. Don Young (R-AK)	Rep. Grace Napolitano (D-CA)
Rep. Rob Wittman (R-VA)	Rep. Jim Costa (D-CA)
Rep. Tom McClintock (R-CA)	Rep. Ruben Gallego (D-AZ)
Rep. Cynthia Lummis (R-WY)	Rep. Madeleine Bordallo (D-Guam)
Rep. Jeff Duncan (R-SC)	Rep. Gregorio Sabin (D-Northern Mariana Islands)
Rep. Paul Gosar (R-AZ)	Rep. Raul Ruiz (D-CA)
Rep. Doug LaMalfa (R-CA)	Rep. Alan Lowenthal (D-CA)
Rep. Bradley Byrne (R-AL)	Rep. Norma Torres (D-CA)
Rep. Jeff Denham (R-CA)	Rep. Debbie Dingell (D-MI)
Rep. Dan Newhouse (R-WA)	
Rep. Tom MacArthur (R-NJ)	

### Senate Subcommittee on Oceans, Atmospheric, and Coast Guard Senate Commerce, Science, and Transportation Committee

Sen. Mark Rubio (R-FL), Chairman	Sen. Gary Peters, Rankng Member
Sen. Roger Wicker (R-MS)	Sen. Maria Cantwell (D-WA)
Sen. Kelly Ayotte (R-NH)	Sen. Richard Blumenthal (D-CT)
Sen. Ted Cruz (R-TX)	Sen. Edward J. Markey (D-MA)
Sen. Dan Sullivan (R-AL)	Sen. Brian Schatz (D-HI)
Sen. Ron Johnson (R-WI)	



July 9, 2015

M-15-16

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Shaun Donovan  
Director  
Office of Management and Budget

Dr. John P. Holdren  
Director  
Office of Science and Technology Policy

SUBJECT: Multi-Agency Science and Technology Priorities for the FY 2017 Budget

Scientific discovery, technological breakthroughs, and innovation are the primary engines for expanding the frontiers of human knowledge and are vital for responding to the challenges and opportunities of the 21<sup>st</sup> century. The Nation depends on science, technology, and innovation to promote economic growth and job creation, maintain a safe and sufficient food supply, improve the health of Americans, move toward a clean energy future, address global climate change, manage competing demands on environmental resources, and ensure the Nation's security.

Federal government funding for research and development (R&D) is essential to address societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments. Key among these is basic research—the fundamental, curiosity-driven inquiry that is a hallmark of the American research enterprise and a powerful driver of new technology. Simply supporting research is not sufficient, however, Federal agencies should ensure that the results of that research are made available to other scientists, to the public, and to innovators who can translate them into the businesses and products that will improve all of our lives.

This memorandum outlines the Administration's multi-agency science and technology priorities for formulating FY 2017 Budget submissions to the Office of Management and Budget (OMB). The priorities covered in this memo require investments in R&D; science, technology, engineering, and mathematics (STEM) education; STEM workforce development; technology transfer; R&D infrastructure; and scientific-collection management. The priorities in this

memorandum build on priorities reflected in this Administration's past budgets and priorities directives.

Agencies should label the sections of their budget submissions that address priorities described below. Agencies engaged in complementary activities should consult with each other during the budget planning process to coordinate resources, maximize impact, and avoid inappropriate duplication, and they should include summaries of these discussions in their OMB budget submissions. Agency proposals aligned with multi-agency R&D priorities and demonstrating interagency coordination are more likely to be prioritized in FY 2017 Budget deliberations.

### **Multi-Agency R&D priorities**

In the FY 2017 Budget, agencies should balance priorities to ensure that resources are adequately allocated for agency-specific, mission-driven research, including fundamental research, while focusing resources, where appropriate, on the following multi-agency research activities that cannot be addressed effectively by a single agency.

- Global climate change. Agencies should advance the goals and objectives of the 2012-2021 U.S. Global Change Research Program (USGCRP) Strategic Plan, as well as the complementary science agenda that underpins the President's Climate Action Plan. Agencies should prioritize activities that foster the development and use of actionable data, information, and related tools needed to prepare for and reduce climate-related risks and should prioritize investments that support technical assistance for community climate-preparedness efforts.
- Clean energy. The President has stated a goal for the United States to lead the world in clean energy. His Climate Action Plan outlines several key objectives in this domain that should be given priority in the 2017 Budget, including promoting American leadership in renewable energy (including manufacturing for these technologies and a modernized electric grid); unlocking innovation in other key clean energy technologies; building a clean and efficient 21<sup>st</sup>-century transportation sector; and cutting energy waste in homes, businesses, and factories. In transportation, there is a particular need to support R&D that can advance multiple transportation modes and fill knowledge and technology gaps. As part of this focus, agencies should also support technology development that has the dual benefit of reducing greenhouse gas (GHG) emissions and bolstering the resilience of our communities. For example, agencies might consider technology development that leverages renewable energy to power water desalination or purification – reducing the GHG footprint of drinking water and bolstering the resilience of communities in drought-prone areas.
- Earth observations. Earth-observation data are instrumental to services that protect human life, property, the economy, and national security, and advance understanding the Earth as a system. Federal agencies should advance the goals of the 2014 *National Plan for Civil Earth Observations*. Agencies are encouraged to accelerate the development and demonstration of innovative approaches for observations, including technology for low-cost satellites and disaggregated instrumentation. In addition, space weather observations and R&D are essential to address the growing societal needs for accurate and timely space weather information. Agencies should prioritize investments in space weather science and preparedness according to the 2015 *National Space Weather Strategy and Action Plan*.



- Advanced manufacturing and industries of the future. The Administration is committed to the continued strengthening of America's manufacturing sector. Agencies should prioritize programs that advance the state of the art in manufacturing, as described in the *National Strategic Plan for Advanced Manufacturing*. Agencies should also prioritize investments in enabling technologies that benefit multiple sectors of the economy, such as nanotechnology, robotics, the Materials Genome Initiative, and cyber-physical systems and their application to smart cities.
- Innovation in life sciences, biology, and neuroscience. Agencies should give priority to programs that support fundamental biological discovery research that could generate unexpected, high-impact scientific and technological advances in health, energy, and food security, particularly in the President's BRAIN Initiative, the *National Strategy for Combating Antibiotic Resistance*, and the *National Strategy for Biosurveillance* (e.g., infectious-disease forecasting capabilities). Priority should also be placed on research that seeks fundamental principles that cut across habitats and biological systems, such as those that govern the behaviors of microbiomes in diverse environments. Agencies should prioritize research – guided by the *National Research Action Plan for Improving Access to Mental Health Services for Veterans, Service Members, and Military Families* – to identify and develop effective diagnostic and treatment methodologies and metrics with the aim of improved mental health and reduction in substance-use disorders. In addition, the Administration has committed to launching the Precision Medicine Initiative, aimed at tailoring medical care to the individual patient. Agencies should support investments on improving interoperability of health records, addressing privacy concerns, and launching research that will enable discoveries derived from Big Data.
- National and homeland security. National and Homeland Security and Intelligence mission agencies should invest in science and technology to meet the threats of the future and develop innovative new security capabilities. In order to better understand threats and prioritize investments, agencies should build on recent efforts to integrate and coordinate intelligence gathering and analysis focused on science, technology, and innovation, and assure those efforts are adequately resourced. Priority should be given to investments to develop capabilities in countering weapons of mass destruction, addressing the immediate risks to our national security posed by climate change, handling large data sets for national security mission requirements, advancing hypersonics, and developing accelerated training techniques.
- Information technology and high-performance computing. Agencies should prioritize research guided by the *Trustworthy Cyberspace: Strategic Plan for Cybersecurity R&D Programs* to develop technologies that can protect U.S. systems against cyber-attacks. Agencies should coordinate with each other and with the private sector to promote innovation in high-performance computing; modeling and simulation; and advanced hardware technology to support national security, scientific discovery, and economic competitiveness. Agencies should also give priority to investments that address the challenges and opportunities afforded by the expansion of Big Data to advance agency missions and further scientific discovery and innovation while providing appropriate privacy protections for personal data.
- Ocean and Arctic issues. Member agencies of the National Ocean Council should give priority to investments in science and technology that support the *National Ocean Policy*

*Implementation Plan* and responsible ocean stewardship, including observations, modeling, and data accessibility needed to support ecosystem-based management, as well as to advance understanding and inform responses to current and future climate impacts on oceans, Great Lakes, and surrounding communities. Agencies should also advance the objectives of the *Interagency Arctic Research Policy Committee Arctic Research Plan (FY 2013-2017)* and the newly-created Arctic Executive Steering Committee, which coordinates efforts on Arctic science, resource management, conservation, indigenous peoples, and international engagement through the 2015-17 U.S. Chairmanship of the eight-nation Arctic Council.

- **R&D for informed policy-making and management.** A diverse range of agency missions (e.g. natural resource management protecting health and the environment; global health security needs to prevent, detect, and respond to emerging infectious diseases) benefit from R&D that strengthens the scientific basis for decision-making. In order to maximize the societal benefits of R&D investments, research planning and design should be guided by stakeholder and user engagement. Both mission-centered agencies and R&D agencies should focus on creating user-driven information and tools that enable the translation of scientific observations to decision-making frameworks.

## **R&D Infrastructure**

Agencies should support the R&D infrastructure (e.g. facilities, platform technologies, IT, digital tools) needed to ensure that U.S. science and engineering remain at the leading edge, and leverage resources from other agencies, state and local governments, the private sector, and international partners. Proposals for development, construction, and operations costs for new facilities must be fully justified and balanced against funding for ongoing programs and operations of existing facilities. In addition, agencies should take steps to ensure that underused existing facilities are made available to additional users through transparent and competitive methods.

## **Other R&D Program Guidance**

Transforming research results and technologies to new products and services is a key step in realizing the economic and quality-of-life improvements the taxpayer expects from Federal investments in R&D. Commercialization of Federal R&D is therefore one of the core responsibilities of each R&D supporting agency. Agency budget proposals should prioritize and highlight contributions to the Lab-to-Market Cross-Agency Priority Goal, such as entrepreneurial personnel exchanges, commercialization training, and other programs that have the potential to accelerate and improve the transfer of new technologies from the laboratory to the marketplace.

In accordance with OMB Circular A-11 and the GPRA Modernization Act of 2010, agencies should describe the targeted outcomes of R&D programs using meaningful, measurable, and quantitative metrics where possible and describe how they plan to evaluate the success of those programs. Agencies should consider opportunities for improved measurements of R&D activities and outcomes by linking management and financial information about R&D in their DATA Act implementation plans. Agencies are encouraged to collaborate and identify best practices for linking management information on R&D with budget and financial data.

Agencies are encouraged to use approaches to foster innovation such as Grand Challenges, incentive prizes, citizen science, and collaboration with members of the Maker Movement.

Preserving and improving access to scientific collections, research data, other results of Federally-funded research, open datasets, and open educational resources should be a priority for agencies.

Agencies should ensure that Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards and programs contribute to the above multi-agency science and technology priorities.

Following engagement with stakeholders, agencies should implement policies and prioritize activities to improve the reproducibility of research in the fields they support.

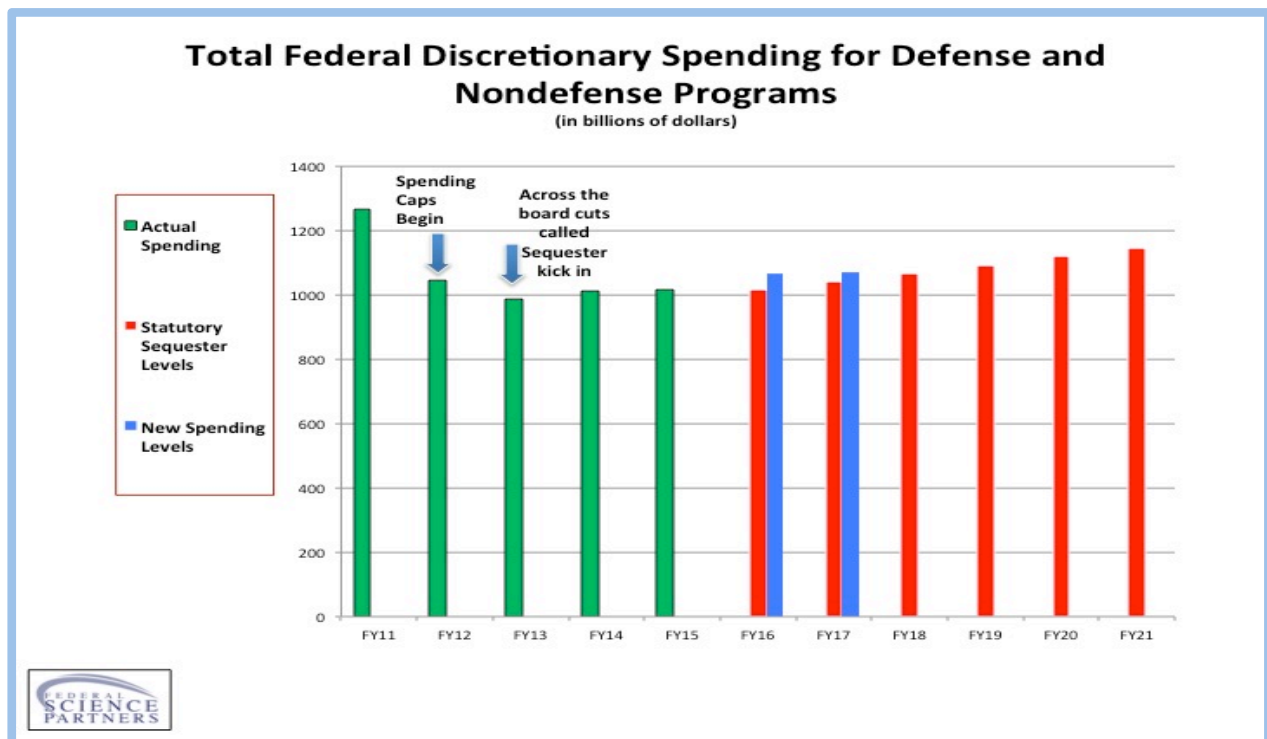
### **STEM Education Guidance**

Investments in STEM education should be guided by the priorities outlined in the *Federal STEM Education 5-Year Strategic Plan* developed by the Committee on STEM Education under the National Science and Technology Council, and should continue to pursue the goals of enhancing program effectiveness and reducing program fragmentation. Priority should be given to programs that use evidence to guide program design and implementation or that build evidence about what works in STEM education, using appropriate metrics and improving the measurement of outcomes. Agencies should give priority to policies and actions identified by research as having the greatest potential to increase inclusion and diversity in STEM education, research, and careers such as changes in STEM instruction; changing the image of STEM education and careers; and reducing explicit, implicit, and structural biases against girls, women, and members of underrepresented minority groups.

## Overview of the Administration’s FY 2017 Budget Request for Research and Development

The Administration has released its [budget request](#) for Fiscal Year 2017 (FY 2017). This is the final budget request for the Obama Administration. The Administration calls for significant new investments in several domestic areas, including research and higher education. The Administration’s budget request stays within the FY 2017 discretionary cap of \$1.070 trillion that is essentially level with the FY 2016 of \$1.067 trillion. Therefore to fund new investments, the Administration is proposing budget increases for several agencies—including the National Institutes of Health (NIH) and the National Science Foundation (NSF)—using mandatory funding in addition to discretionary funding. Past proposals to augment or convert discretionary funding of federal programs with mandatory funding have not been approved by Congress. [Republicans](#) in Congress, who just last October agreed to increase spending in FY 2016 and FY 2017, object to the “unsustainable” [budget request](#).

**Background on Spending Limits:** The Bipartisan Budget Agreement of 2015 increased FY 2016 discretionary spending by \$50 billion to \$1.067 trillion and increased the FY 2017 discretionary spending caps by \$30 billion to \$1.070 trillion. However, the \$3 billion increase (+0.2%) in discretionary spending from FY 2016 to FY 2017 leaves very little room for program increases and new initiatives. The Bipartisan Budget Agreement of 2015, and the underlying law that it amends, the Budget Control Act of 2011, do not cap or limit mandatory funding levels. Rather, reductions in mandatory spending are annually calculated using a formula in the law and applied to available resources.



Among the Administration's announced initiatives are the \$755 million in FY 2017 for a "moonshot" to cure cancer; a doubling, to \$700 million, of the budget for USDA's Agriculture, Food and Research Initiative; a \$4.1 billion effort to promote computer science education in K-12 schools; a major boost in clean energy research and development; and a broad new effort on cybersecurity. For research, the Administration would raise funding, at least modestly, at most science agencies. The exception is the Department of Defense where funding for basic and applied research would be cut.

**RESEARCH AND DEVELOPMENT OVERVIEW** The FY 2017 budget would provide \$152 billion for research and development (R&D) government-wide, an increase of \$6.2 billion, or four percent. Within the overall total, basic research would increase by \$975 million, or three percent, to \$34.5 billion, while applied research would increase by \$2.9 billion, or eight percent, to \$38.4 billion. For FY 2017 research and development, the Administration's overall priorities include the following programmatic areas: global climate change; clean energy; earth observations; advanced manufacturing; innovation in the life sciences, biology, and neurosciences – including the BRAIN initiative, precision medicine, and cancer research; national and homeland security; information technology and high performance computing; ocean and arctic issues; and R&D for informed policy-making and management.

**NATIONAL INSTITUTES OF HEALTH (NIH)** The total program funding level proposed for NIH in FY 2017 is \$33.1 billion. This includes \$31.3 billion in discretionary spending and \$1.8 billion in mandatory funding. Should Congress approve the administration's proposed FY 2017 mandatory funding plan, NIH would receive an additional \$1 billion over FY 2016 appropriated funding. It dedicates \$300 million to the White House's Precision Medicine Initiative, which it launched last year, and \$195 million to the BRAIN Initiative that launched in 2013. The budget also provides an increase of \$755 million for the cancer "moon shot" effort being led by Vice President Joe Biden. The National Cancer Institute, which received a \$264 million boost from in FY 2016, , would receive another \$680 million increases in FY 2017. The Administration says the NIH funding would allow for almost 10,000 new and competing NIH grants. The FY 2016 omnibus spending bill gave NIH an historic funding boost of \$2 billion.

**NATIONAL SCIENCE FOUNDATION (NSF).** The Administration is requesting \$7.96 billion for NSF, an increase of \$500.5 million or 6.7 percent. The request includes \$7.56 billion in discretionary funding and \$400 million in mandatory funding. The Administration says it is requesting the one-year mandatory funding to advance innovation and provide support for early career scientists and engineers. For Research and Related Activities (R&RA), the FY 2017 request is \$6.425 billion, an increase of \$391.7 million, or 6.5 percent. The R&RA budget requests \$6.079 billion in discretionary funding and \$346 million in mandatory funding. Within R&RA, the Geosciences Directorate is proposed to be funded at \$1.4 billion – an increase of \$80 million over FY 2016. Keep in mind, however, \$79 million of the \$80 million proposed increase comes from the "mandatory" budget proposed by the Administration. Without the mandatory budget increase, the Geosciences Directorate is essentially level funded at \$1.3 billion – the same level as FY 2016 and FY 2015.

Within GEO’s division for atmospheric sciences, an increase of \$14.25 million is requested; the entire increase in in mandatory funding. Without the mandatory funding increase, the atmospheric sciences – including the National Center for Atmospheric Research – is at \$254 million - level funded with FY 2016 and very close to the FY2015 level.

For GEO’s division of ocean sciences, a similar story exists – the ocean science division is proposed to grow by \$19.5 or 5.4% over FY 2016, all in mandatory funding. Without the increase proposed by the mandatory budget request, the ocean sciences division in FY 2017 would be level with FY 2016.

**National Science Foundation  
Summary Tables  
FY 2017 Budget Request to Congress  
(Dollars in Millions)**

NSF by Account	FY 2015	FY 2016	FY 2017	FY 2017 Request		FY 2017	FY 2017	FY 2017 Request	
	Actual	Estimate	Request (Discretionary)	Amount	Percent	Request (Mandatory) <sup>1</sup>	Request	Amount	Percent
BIO	\$736.19	\$744.17	\$745.73	\$1.56	0.2%	\$44.79	\$790.52	\$46.35	6.2%
CISE	932.98	935.82	938.43	2.61	0.3%	56.37	994.80	58.98	6.3%
ENG	923.53	916.19	946.41	30.22	3.3%	56.32	1,002.73	86.54	9.4%
<i>Eng Programs</i>	746.42	727.63	744.74	17.11	2.4%	44.73	789.47	61.84	8.5%
<i>SBIR/STTR</i>	177.11	188.56	201.67	13.11	7.0%	11.59	213.26	24.70	13.1%
GEO	1,319.04	1,318.54	1,319.56	1.02	0.1%	79.27	1,398.83	80.30	6.1%
MPS	1,376.32	1,349.15	1,355.06	5.91	0.4%	81.39	1,436.45	87.30	6.5%
SBE	276.19	272.20	272.41	0.21	0.1%	16.36	288.77	16.57	6.1%
OISE	48.46	49.10	49.10	-	-	2.95	52.05	2.95	6.0%
IA	427.46	447.06	451.30	4.24	0.9%	8.56	459.86	12.80	2.9%
U.S. Arctic Research Commission	1.41	1.43	1.43	-	-	-	1.43	-	-
Research & Related Activities	\$6,041.57	\$6,033.65	\$6,079.43	\$45.78	0.8%	\$346.01	\$6,425.44	\$391.79	6.5%
Education & Human Resources	\$886.33	\$880.00	\$898.87	\$18.87	2.1%	\$53.99	\$952.86	\$72.86	8.3%
Major Research Equipment & Facilities Construction	\$144.76	\$200.31	\$193.12	-\$7.19	-3.6%	-	\$193.12	-\$7.19	-3.6%
Agency Operations & Award Management	\$306.56	\$330.00	\$373.02	\$43.02	13.0%	-	\$373.02	\$43.02	13.0%
National Science Board	\$4.15	\$4.37	\$4.38	\$0.01	0.2%	-	\$4.38	\$0.01	0.2%
Office of Inspector General	\$14.60	\$15.16	\$15.20	\$0.04	0.3%	-	\$15.20	\$0.04	0.3%
<b>Total, NSF</b>	<b>\$7,397.97</b>	<b>\$7,463.49</b>	<b>\$7,564.02</b>	<b>\$100.53</b>	<b>1.3%</b>	<b>\$400.00</b>	<b>\$7,964.02</b>	<b>\$500.53</b>	<b>6.7%</b>

Totals may not add due to rounding.

<sup>1</sup> Includes only new mandatory funding. Excludes H1-B Non-Immigrant Petitioner mandatory funds.

The Education and Human Resources (EHR) Directorate request is \$952.9 million, an increase of \$72.86 million, or 8.3 percent. The EHR budget requests \$898.9 in discretionary funding and \$54 million in mandatory funding.

For Major Research Equipment and Facilities Construction (MREFC), the request is \$193.12 million, a cut of 3.6 percent from the FY 2016 level. Within the MREFC account, no new funding is requested for the construction and acquisition of the National Ecological Observatory Network (NEON). Within the Biological Sciences Directorate, \$65M is requested to support NEON operations.

The FY 2017 NSF budget also requests funding for the following cross-government and crossagency initiatives:

- Clean Energy Economy (\$512 million): to support research and education in renewable and alternative energy sources for electricity and fuels.

- Understanding the Brain (\$142 million): to enable scientific understanding of the full complexity of the brain in action and in context.
- Increase Resilience to Disasters (\$43 million): to improve predictability and risk assessment and increase resilience to extreme natural and man-made events.
- Sustaining the Food, Energy, and Water System (\$62 million): to understand, design, and model the interconnected food, energy, and water system through interdisciplinary research.
- Cutting-Edge Manufacturing (\$176 million): for advancing manufacturing. • Commercialization of University Research (\$30 million): for NSF's public-private Innovation Corps (I-Corps) program to further build, utilize, and sustain a national innovation ecosystem.
- Capabilities and Infrastructure for Research and Education (\$139 million): \$33 million for the multi-agency National Strategic Computing Initiative (NSCI) to advance the Nation's computational infrastructure for research. Invests \$106 million in the construction of two Regional Class Research Vessels to meet anticipated ocean science requirements. The FY 2017 budget includes funding for undergraduate and graduate education:
- Improving Undergraduate STEM Education (\$109 million): to accelerate the quality and effectiveness of undergraduate education in all STEM fields.
- NSF Research Traineeships (\$59 million): to identify priority research themes that align with NSF initiatives and have strong potential for the development and testing of innovative practices in graduation education.
- Graduate Research Fellowships (\$332 million): to support students with high potential in STEM research and innovation in pursuit of multidisciplinary research.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) -- For FY 2017, NOAA proposes a budget of \$5.850 billion in discretionary appropriations, an increase of \$77 million or 1.3% above the FY 16 level. For NOAA Research (the Office of Oceanic and Atmospheric Research) the Administration requests \$493.4 million, a net increase of \$24.4 million over FY 2016. Highlights of the NOAA request include:

- \$190 million for climate research – an increase of \$31 million over FY 2016;
- Weather research is reduced by nearly \$6 million. Despite this net reduction, an increase of \$4.6 million is requested for the Airborne Phased Array Radar program;
- Ocean, coastal, and Great Lakes research is reduced by \$11 million, including a reduction of \$4.5 million in the Sea Grant program with \$2.5 million coming from the Sea Grant competitive research program and \$2 million from Sea Grant's aquaculture research program; \$3 million is proposed to be cut from ocean, coastal, and Great Lakes cooperative institutes;
- A new Research Transition Acceleration program is established at \$10 million; and
- Ocean Acidification research would grow by \$11 million.

The COSMIC 2 satellite project is to be funded at \$16.2 million, an increase of just over \$6 million over the FY 2016 level.

DOE OFFICE OF SCIENCE (DOE). The Administration is requesting \$5.672 billion for the DOE Office of Science in FY 2017, including \$100 million in mandatory funding for University

Grants. The DOE budget justification says solicitations for the University Grant program will focus on research in Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics. Within the Office of Science, funding would increase for High Energy Physics (+\$22 million, 2.9 percent), Basic Energy Sciences (+\$87.7 million, 4.7 percent), Biological and Environmental Research (+\$53 million, 8.7 percent), Advanced Scientific Computing Research (+\$42 million, 6.8 percent), Nuclear Physics (+\$18.5 million, 3.0 percent), and Science Laboratory Infrastructure (+\$16 million, 14.4 percent). Fusion Research funding would be reduced to \$398 million (-\$40 million, 9.1 percent). The Advanced Research Projects Agency-Energy (ARPA-E) would receive \$500 million, an increase of \$209 million, or 71.8 percent. This amount includes \$350 million in discretionary funding and \$150 million in mandatory funding.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA). For FY 2017, the Administration is requesting \$19.03 billion for NASA, a cut of \$260 million, or 1.3, percent from FY 2016. Within the \$19 billion, \$18.2 billion is discretionary funding and \$763 million is mandatory funding.

For NASA's Science Mission Directorate (SMD), the Administration is requesting \$5.6 billion, which is \$11 million, or 0.2 percent, above the FY 2016 enacted level of \$5.59 billion. Within SMD, the Administration is requesting the following:

- Earth Science: \$2.03 billion, an increase of \$111 million over FY 2016. The FY 2017 budget request includes \$130.8 million for the Landsat 9 mission, whose expected launch date is 2021. The budget also includes \$6 million for the Global Learning and Observations to Benefit the Environment (GLOBE) science education program.
- Planetary Science: \$1.52 billion, a cut of \$112 million from FY 2016. The FY 2017 budget fully funds the Mars 2020 mission and requests \$49.6 million for the Europa mission. Of note, Congress funded Europa at \$175 million in FY 2016.
- Astrophysics: \$782 million, an increase of \$51 million over FY 2016. The FY 2017 budget fully funds SOFIA, and requests \$90 million for WFIRST, the same as the program's FY 2016 funding. The budget includes \$25 million for STEM Education outreach programs.
- Heliophysics: \$699 million, an increase of \$49 million over FY 16. The FY 2017 budget request includes \$232.5 million for Solar Probe Plus and \$80.7 million for the Solar Orbiter.
- James Webb Space Telescope (JWST): \$569 million, a reduction of \$51 million from FY 2016. This reflects a ramping-down of development for the space telescope and an expected launch date of October 2018.

For the Aeronautics Mission Directorate (ARMD) the Administration is requesting \$790.4 million, an increase of \$150 million above FY 2016. The space agency is increasing its focus on aeronautics research and will be implementing its strategic plan for the Directorate. The FY 2017 budget request for NASA's Space Technology Directorate is \$827 million, or \$140 million above FY 2016. Of note, the Administration is requesting \$130 million for the RESTORE-L mission and \$66.6 million for the Solar Electric Propulsion Mission.





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For Education, the FY 2017 budget includes \$24 million for Space Grant, \$25 million for Education and Public Outreach activities (funded in SMD-Astrophysics), and \$6 million for the GLOBE education program (funded in SMD-Earth Science).

DEPARTMENT OF DEFENSE (DOD). The FY 2017 budget would increase funding for the broad Defense category of research, development, testing & evaluation (RDT&E) to \$71.4 billion, an increase of \$1.6 billion. It proposes to fund Defense science and technology (S&T) at \$12.5 billion, a reduction of \$749.6 million, or 5.7 percent, with the cuts spread across basic research, applied research, and advanced technology development.

Specifically, basic research (6.1) would receive \$2.101 billion, a cut of \$207.6 million, or 9.0 percent; applied research (6.2) would receive \$4.82 billion, a reduction of \$188 million, or 3.8 percent; and advanced technology development (6.3) would receive \$5.58 billion, a cut of \$353.5 million, or 6 percent. The Defense Advanced Research Projects Agency (DARPA) would receive \$2.97 billion, an increase of \$82.4 million, or about 2.8 percent.

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

FOR IMMEDIATE RELEASE

February 9, 2016

**FACT SHEET**

**President's 2017 Budget Invests in American Innovation:  
R&D, Innovation, and STEM Education**

America's economic competitiveness and growth depend on robust investments in: research and development (R&D); innovation; and science, technology, engineering, and mathematics (STEM) education. The President's 2017 Budget invests in American science, technology, and innovation to promote sustainable economic growth and job creation, maintain a safe and sufficient food supply, improve the health of all Americans, move toward a clean energy future and a climate-smart economy, address the challenge of global climate change, manage competing demands on environmental resources, and ensure the Nation's security.

The President's 2017 Budget provides \$152 billion for R&D overall, a \$6 billion or 4 percent increase from 2016 enacted levels. Within the total R&D investment, the Budget provides \$73 billion for basic and applied research (the "R" in R&D), a \$4 billion or 6 percent increase from 2016 enacted levels. \$4 billion of the overall \$152 billion investment in R&D is new mandatory funding. This will ensure that we make adequate R&D investments to create jobs and grow the economy, even as the Budget adheres to the discretionary spending levels set by the Bipartisan Budget Act.

The Budget targets several key priorities:

- **Continuing our commitment to world-class science and research.** The Budget provides the National Science Foundation (NSF) with nearly \$8.0 billion and the Department of Energy's (DOE) Office of Science with nearly \$5.7 billion through a mix of discretionary and mandatory funding. These investments support ground-breaking research and world-leading facilities across all fields of science and engineering, including clean energy, climate science, information technology, and life science. The Budget also provides \$826 million for the National Institute of Standards and Technology (NIST) laboratories. The Budget increases total funding for these three key basic research agencies by more than \$900 million over the 2016 level.
- **Investing in innovation.** The Budget invests in innovative security capabilities. The 2017 Budget proposes \$12.5 billion for the Department of Defense's (DOD) Science & Technology program and \$3.0 billion for the Defense Advanced Research Projects Agency (DARPA). The Budget provides \$318 million for cybersecurity R&D at civilian agencies. To encourage innovation in our space capabilities, the Budget provides \$19.0 billion for NASA to support the President's vision for innovation and scientific discovery on Earth and beyond. The Budget also invests in innovation for the industries of the future, including major investments within DOE (\$285 million) and NSF (\$33 million) to support the National Strategic Computing Initiative.

- **Improving Americans' health.** The Budget provides \$33.1 billion to support biomedical research at the National Institutes of Health (NIH), an increase of \$1 billion over 2016. The Budget provides \$755 million to continue the recently-launched National Cancer Moonshot for new cancer-related research activities at both the NIH and the Food and Drug Administration. The Budget includes \$195 million for NIH's contribution to the multi-agency BRAIN Initiative. The Budget includes \$309 million for Department of Health and Human Services (HHS) agencies to sustain the Precision Medicine Initiative aimed at tailoring medical care to the individual patient.
- **Accelerating the pace of innovation in manufacturing to create jobs.** The 2017 Budget provides \$2 billion for Federal R&D directly supporting advanced manufacturing, consistent with the goals and recommendations of the National Strategic Plan for Advanced Manufacturing. The Budget funds a national network of 45 manufacturing innovation institutes that will position the United States as a global leader in advanced manufacturing technology.
- **Moving toward cleaner American energy.** The 2017 Budget provides \$7.7 billion in clean energy R&D, demonstrating a strong U.S. commitment to the Mission Innovation pledge announced at the Paris climate summit in 2015 to double Federal clean energy R&D investments over five years.
- **Taking action on climate change.** The 13-agency U.S. Global Change Research Program (USGCRP) coordinates Federal research to improve our ability to understand, assess, predict, and respond to the human-induced and natural processes of global change and their related impacts and effects. The Budget includes \$2.8 billion for USGCRP; USGCRP outcomes support the Administration's Climate Action Plan.
- **Growing agriculture research for future generations.** The Budget recognizes the importance of science and technology to meet the challenges and opportunities in agriculture and provides significant investment increases. The Budget funds competitive research grants through the Department of Agriculture's Agriculture and Food Research Initiative at \$700 million, double the funding provided in FY 2016.
- **Preparing students with STEM skills.** Guided by the Federal STEM Education Five-Year Strategic Plan, the Budget invests \$3.0 billion in STEM education programs, maintaining the 2016 enacted funding level. The Budget funds the President's Computer Science for All initiative to give all students across the country the chance to learn computer science in school with \$4 billion in funding for states and \$100 million directly for districts.
- **Supporting private-sector R&D.** The Budget would simplify and expand the Research and Experimentation (R&E) Tax Credit, an important Federal incentive for private-sector R&D that was made permanent in December 2015.

Additional details about the 2017 Budget proposals for R&D, innovation, and STEM education can be found on fact sheets and other resources at <http://www.whitehouse.gov/ostp/rdbudgets>. For more information on OSTP, visit <http://www.whitehouse.gov/ostp>.

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## STEM for All: Ensuring High-Quality STEM Education Opportunities for All Students

*Science, Technology, Engineering, and Mathematics (STEM)  
Education in the 2017 Budget*

*“In the coming years, we should build on that progress, by ... offering every student the hands-on computer science and math classes that make them job-ready on day one.”*

**President Barack Obama**  
2016 State of the Union Address

President Obama believes that every student in the United States should be given the high-quality STEM-education opportunities that allow them to join the innovation economy, have the tools to solve our toughest challenges, and be active citizens in our increasingly technological world. That’s why the President’s 2017 Budget invests \$4 billion in mandatory spending and more than \$3 billion in discretionary spending across the Federal Government on STEM education. The 2017 Budget prioritizes three major areas for investment to support STEM education for all students:

- Expanding access to rigorous STEM courses, with \$4 billion in mandatory funding and \$100 million in discretionary funding for the *Computer Science for All* initiative, which has the goal of giving every student from preschool to high school the opportunity to learn hands-on computer science (CS). Additional investments to support course access include \$80 million for Next-Generation High Schools.
- Improving STEM teaching and supporting active learning with a \$125 million Teacher and Principals Pathways program to support teacher-preparation programs, \$10 million for a newly authorized STEM Master Teacher Corps program, and \$109 million from the National Science Foundation (NSF) to ensure that undergraduate students have the most effective learning experiences. These investments will also advance progress on the President’s 2011 State of the Union call to action to prepare 100,000 excellent STEM teachers over the next 10 years.
- Overcoming stereotypes and expanding opportunities for all students in STEM, including through a comprehensive NSF effort that will invest \$16 million to support alliances and backbone organizations dedicated to increasing diversity and successfully engaging traditionally underrepresented groups in STEM.

### **Expanding Access to Rigorous STEM Courses**

To ensure that all students have access to high-quality and relevant STEM coursework, starting in preschool and progressing through the rest of their formative years, we as a Nation, must increase opportunities for every student to have access to a full suite of advanced STEM courses in high school. For high-school students, access to core and advanced STEM coursework is an essential part of preparing to enter the workforce equipped with relevant skills for a broad range of jobs,

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and to successfully pursue STEM degrees and courses in college. Exposure to STEM education correlates with success in higher education, regardless of major.

Despite the critical importance of access to rigorous STEM courses, the most recent survey from the Department of Education's Office for Civil Rights' Civil Rights Data Collection shows that 50 percent of U.S. high schools do not offer calculus and 27 percent do not offer physics. Between 10 and 25 percent of high schools lack more than one of the core courses in the typical sequence of high-school mathematics and science education, such as algebra I and II, geometry, biology, or chemistry. 25 percent of high schools with the highest proportion of African-American and Latino students do not offer algebra II, and 33 percent of these schools do not offer chemistry.

The Nation must take action to expand the number of schools that offer core and advanced STEM courses. The President's 2017 Budget includes key investments to address the STEM course gap.

### Computer Science for All

By some estimates, just one quarter of all K-12 schools in the United States offer computer-science with programming and coding. The President's 2017 Budget includes a Computer Science for All plan that builds on the momentum at the state and local level to give every P-12 student the opportunity to learn computer science. The 2017 Budget proposes \$4 billion in mandatory funding at the Department of Education (ED), available over three years, for states to increase access to hands-on computer science (CS) in P-12 classrooms. Under the program, all fifty states would be able to submit comprehensive five-year "Computer Science for All" plans, and every state with a well-designed strategy would receive funds. In addition to state-level grants, the 2017 Budget also dedicates \$100 million in competitive grants specifically for leading districts to execute ambitious CS-expansion efforts for all students—with a focus on reaching traditionally underrepresented students—and to serve as models for national replication. The Computer Science for All initiative also includes \$20 million from the National Science Foundation to invest in FY 2017 on the effort. More information on this initiative can be found in the [Computer Science for All](#) fact sheet.

The 2017 Budget also includes additional investments to help narrow STEM course gaps, including:

- [\\$500 million for Student Support and Academic Enrichment Grants](#), a new block grant at ED, authorized by the Every Student Succeeds Act (ESSA), that would provide flexible-formula grant funds to assist school districts in delivering a well-rounded education to their students through a range of locally determined activities, including support for STEM education, the arts, student-support services, and effective use of educational technology in schools. In addition, building on the [STEM Education Act of 2015](#) and the new ESSA, ED will release this year guidance to states, districts and the broader education sector his year on funding opportunities for STEM and CS.
- [Creating Next-Generation High Schools](#). Building on the momentum from the first-ever Summit on Next-Generation High Schools held last year, the 2017 Budget proposes

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establishes a new \$80 million competitive program at ED to help communities across America have the resources to launch Next-Generation High Schools that will be laboratories for cutting-edge STEM teaching and learning. These schools will showcase the tenets of high-school reform that the President has championed: promoting active and personalized learning for students, strengthening relationships with business and post-secondary partners, and linking student work to real-world expectations and experiences that reflect college and careers, in order to better prepare students for their futures. The 2017 Budget also supports a number of complementary investments in high-school reform at ED, including an increase in Title I to support school improvement, \$350 million for charter schools; and \$115 million for magnet schools.

- Identifying and Scaling What Works in STEM education. The 2017 Budget funds \$180 million for ED’s Education Innovation and Research (EIR) program, the successor to the Investing in Innovation (i3) program. The EIR program expands support for evidence-based initiatives to develop, validate, and scale up effective education interventions that will help States and districts meet ESSA requirements emphasizing the use of such interventions wherever possible. A portion of these funds will be reserved for the proposed Advanced Research Projects Agency - Education (ARPA-ED). Complementary investments in building evidence on effective STEM programs include the Administration’s proposal for \$83 million to support NSF’s Discovery Research PreK-12, which invests in research and development on STEM teaching and learning.
- Leveraging the disciplinary expertise of the Federal agencies. The 2017 Budget provides \$17 million for the National Institutes of Health (NIH) to invest in the Science Education Partnership Award (SEPA) program, leveraging the expertise of the biomedical research community to support innovative curricula in K-12 schools, and \$4 million for the Environmental Protection Agency (EPA) to invest in environmental-education grants. In addition, the 2017 Budget calls for the Department of Defense (DoD) to invest \$11 million in expanding STEM opportunities for children of military families. The DoD investments build on a multi-year record of success under the National Math and Science Initiative’s (NMSI) Initiative for Military Families.

### **Improving STEM Teaching and Supporting Active Learning**

Abundant evidence shows that the ways in which STEM subjects are taught matter for learning. Active and hands-on, inquiry-based engagement enhances learning for students of all demographics and has especially beneficial effects on women and other underrepresented groups, likely due to a greater sense of belonging that can be achieved in active classrooms.<sup>1,2,3</sup> In STEM disciplines, use of active-learning techniques by educators—both inside school and informal settings—not only improves learning outcomes, but also helps to retain students in STEM majors.

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<sup>1</sup> For example, see the white paper “Promising Practices in Undergraduate STEM Education” (2008) by J.E. Froyd (available online at: [http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse\\_072616.pdf](http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_072616.pdf)). See also Baldwin, Roger G., ed. (2009). *Improving the Climate for Undergraduate Teaching and Learning in STEM Fields*. San Francisco: Jossey-Bass.

<sup>2</sup> Freeman et al., 2014. “Active learning increases student performance in science, engineering, and mathematics.” *Proc Natl Acad Sci* 111:8410-8415.

<sup>3</sup> National Research Council (U.S.), Donovan, S., & Bransford, J. (2005). *How Students Learn: History, Mathematics, and Science in the Classroom*. Washington, D.C: National Academies Press; *Journal of Educational Psychology*, 93, 579–588; *Cognition and Instruction*, 4, 137-166.

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Active-learning strategies encompass a suite of practices in which students are engaged in thinking or problem solving rather than passively listening to a lecture. These strategies can be as simple as challenging students to try and figure out how solve problems on their own before being taught how to do so, or can require more dramatic changes, such as engaging students in original research or design in introductory-level college courses.

Overall, the 2017 Budget invests \$2.8 billion in discretionary funding at ED for programs to provide broad support for P-12 educators at every phase of their careers, from ensuring that educators have strong preparation before entering the classroom, to pioneering new approaches to help teachers succeed in the classroom, and equipping them with tools and training they need to implement college- and career-ready standards.

In particular, the 2017 Budget supports effective STEM teaching by:

- Making Progress on the President’s Goal of Preparing 100,000 Excellent and New STEM Teachers over a Decade: In his 2011 State of the Union address, the President called for a new effort to prepare 100,000 STEM teachers over the next decade with strong teaching skills and deep content knowledge. Answering the President’s call to action, more than 230 organizations formed a coalition called *100Kin10*. These organizations have made over 350 measurable commitments to increasing the supply of excellent STEM teachers, including recruiting and preparing more than 43,000 teachers in the first five years of the initiative alone. In addition, under this Administration, ED has announced more than \$175 million in STEM-focused five-year grants under the Teacher Quality Partnership Grant program, which will support more than 11,000 new teachers in high-need schools. The 2017 Budget builds on this progress with the \$125 million Teacher and Principals Pathways program to support teacher-preparation programs and nonprofits partnering with school districts to create or expand high quality pathways into the teaching profession, particularly into high-need schools and high-need subjects such as STEM. Finally, the 2017 Budget provides \$61 million for the Robert Noyce Scholarship program to prepare new STEM teachers.
- Creating a STEM Master Teacher Corps. The 2017 Budget includes \$10 million at ED to establish a new program that responds to the President’s July 2012 call to create a national STEM Master Teacher Corps that would enlist America’s best and brightest science and mathematics teachers to improve STEM education. As part of this program, investments in the 2017 Budget will help States create leadership pathways for excellent STEM educators to improve STEM teaching and learning. Corps members will build their capacity to be leaders in the field and enhance the professional learning of other STEM teachers; identify and share promising practices in their schools, districts, and States; and help students excel in STEM subjects while taking on coaching and mentorship roles in their schools and communities.
- Supporting K-12 STEM Teachers by Leveraging Federal STEM Assets: The National Oceanic and Atmospheric Administration (NOAA) will leverage over a billion dollars of STEM assets to provide rigorous STEM education experiences for K-12 teachers. Teachers will be placed on NOAA research vessels to work side-by-side with NOAA scientists as part of their research team. By participating in this opportunity, teachers

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will gain great insight into scientific practices, cross-cutting concepts, and core disciplinary ideas, which they can bring back to their classrooms.

- **Transforming Undergraduate Teaching and Learning:** The 2017 Budget proposes approximately \$109 million at NSF for a comprehensive, NSF-wide effort to improve undergraduate STEM education (IUSE). The effort supports developing and implementing systemic approaches to improve undergraduate teaching, expanding student opportunities for authentic research experiences, addressing the high failure rate for introductory mathematics, leveraging new technologies, and increasing the completion rate for women and underrepresented minorities in STEM. The NSF investments include \$75 million for NSF's Research Experiences for Undergraduates (REU) program to provide early opportunities for college students to conduct research, which can be especially influential in maintaining a student's interest in science, engineering, and mathematics. The 2017 Budget also expands ED's First in the World fund to \$100 million. The fund identifies and expands promising and evidenced-based innovations and practices at colleges and universities across the country to improve graduation rates and other educational outcomes for all students, make college more affordable, and improve undergraduate teaching.

### **Overcoming Stereotypes and Expanding Opportunities for All Students in STEM**

One of the greatest strengths of the American talent pool and workforce is [diversity](#). To engage the diversity of Americans more fully, access the full potential of the STEM talent pool, and provide equitable opportunities, we as a Nation must tackle the growing research on the impact of [implicit barriers and unconscious bias](#) driving interested students away from STEM.

This Administration has taken a range of steps to address these barriers and expand STEM opportunities for all students. These steps include starting the tradition of the [White House Science Fair](#), and launching and growing the [Educate to Innovate](#) initiative, which has catalyzed more than \$1 billion of private-sector investment in STEM education, and includes a number of media organizations committed to overcoming attitudes about who is capable of succeeding in STEM fields. The Administration is also working with the media and entertainment industry to help raise awareness of opportunities to ensure that representation of people working in STEM more accurately represents the diversity of Americans in STEM fields, while offering the public a more realistic image of the broad range of STEM jobs to help inspire students to consider STEM degrees. In addition, the Administration is convening Federal STEM agencies to delineate policies that would enhance training of Federal employees in mitigating the effects of bias on workplace behaviors.

The 2017 Budget builds on these efforts and expands STEM opportunities for all groups through investments including:

- **NSF Investments in Intermediary Organizations.** As part of its "Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science" (NSF INCLUDES) program, NSF, through a comprehensive R&D effort, will invest \$16 million in FY 2017 to support alliances and backbone organizations in developing new solutions to increase diversity and inclusion and successfully engage



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traditionally underrepresented groups in STEM education and workforce development on an impactful scale.

- ED Investments to Expand Higher-Education Opportunities for Underrepresented Groups. ED will invest in a set of programs that have a strong focus on increasing access to STEM education, including \$108 million in the Hispanic-Serving Institutions (HSI) STEM and Articulation program, sustained funding for Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP), and increased funding for ED's Federal TRIO programs.

### **Continued Investments on Priorities in the STEM Strategic Plan**

The 2017 Budget continues to target investment on the five priority areas identified in the Federal STEM Education 5-Year Strategic Plan, building on the inter-agency collaboration that has helped reduce the number of STEM programs by forty percent over the past three years.. In addition to investments focused on improving P-12 instruction, undergraduate education, and broadening participation in STEM education, the Budget includes investments for graduate education and workforce training, education activities that typically take place outside the classroom, and educational innovation.

The 2017 Budget's STEM-workforce and graduate-level STEM-education investments include:

- Strengthening American Cybersecurity. With a \$70 million investment in the "CyberCorps: Scholarship for Service" (SFS) program, NSF will support cybersecurity education at higher-education institutions to prepare and train experts to respond to cybersecurity challenges. Of the \$70 million, \$25 million will be invested in laying the groundwork for SFS alumni to be available over the course of their careers to serve the Federal government, including by helping to respond rapidly to cybersecurity challenges.
- Preparing Graduate Students for Careers in High-Priority STEM Fields. The President's 2017 Budget includes \$10 million for the Computational Sciences Graduate Fellowship (CSGF) at the Department of Energy (DOE) to continue training new graduate students in high-performance computing (HPC), thereby supporting a pipeline of future DOE leaders in HPC and equipping graduate students with the skills to help solve the nation's complex science and engineering problems. The 2017 budget also includes \$66 million for NSF's Advanced Technological Education (ATE) program, which invests in the education of technicians for in-demand high-technology fields, with a focus on partnerships between academic institutions and employers.
- Continuing Support for Major Graduate Training Programs. The 2017 Budget provides \$332 million at NSF for the Graduate Research Fellowships Program and \$59 million for the NSF Research Traineeship Program to support thousands of outstanding graduate-student researchers who will be tomorrow's innovative leaders in a range of careers. Graduate students can access additional STEM opportunities in the Federal agencies under the Graduate Research Internships Program (GRIP), which has a number of Federal agencies and national laboratories as partners. The 2017 Budget also includes \$473 million

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for the National Institutes of Health (NIH)'s Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants (T32 and T35 awards only), which provide funding to prepare individuals for careers in the biomedical, behavioral, and social sciences. In addition, DoD will invest over \$90 million in the Science, Mathematics and Research for Transformation (SMART) Scholarship and the National Defense Science and Engineering Graduate (NDSEG) programs to meet key national-security workforce needs.

### Informal STEM Education

The President believes that we need to give many more boys and girls STEM experiences that engage them and show them the potential to use their STEM skills to have high-wage careers, tackle our world's toughest challenges and be engaged citizens in our increasingly technological world. That's why the President has challenged students to be "makers of things," and hosted the first-ever White House Maker Faire, led by example as the first President to ever write a line of code with students, and called on the Nation's 200,000 Federal scientists and engineers to volunteer in their local communities and think of creative ways to engage students in STEM subjects.

The 2017 Budget builds on the President's leadership with key investments that include:

- Identifying Best Practices to Engage Youth in Hands-on STEM. The 2017 Budget includes \$63 million for NSF's Advancing Informal Science Learning program, focusing on research and model-building contributions of the program to better understand effective means and innovative models for engaging today's young people and adults in science outside of school settings. ED's 21<sup>st</sup> Century Community Learning Centers (21st CCLC) program will also continue to foster interagency partnerships to bring hands-on STEM-learning opportunities to high-need students during after-school and out-of-school time.
- Supporting High-Quality STEM-Education Programs at NASA. The 2017 Budget supports the NASA Office of Education's efforts to enhance coordination with other agencies and use competition to identify and fund the most effective education activities across the agency. The Budget also provides \$25 million to the competed NASA Science Mission Directorate Program which connects NASA science experts and content to learners of all ages.

### Supporting Next-Generation Learning Technologies

Building on the President's *Strategy for American Innovation* and the Administration's commitment to tackle the Grand Challenges of the 21<sup>st</sup> Century, the 2017 Budget provides up to \$30 million for the Advanced Research Projects Agency - Education (ARPA-ED). ARPA-ED will allow the ED to rapidly advance breakthrough innovations in education technology by creating interdisciplinary teams comprised of the nation's top experts in education, technology, and other key disciplines. ARPA-ED will identify promising new approaches being pioneered in the private sector and other Federal agencies in the areas of distance learning, intelligent tutoring systems, and real-time assessment. Applying research and development strategies learned from the Defense Advanced Research Projects Agency (DARPA), these technologies will be rapidly prototyped and

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transitioned to practice, allowing the nation to expand both the quality of and access to STEM coursework for all students.

In addition, the 2017 Budget includes an increase in funding at ED for Competitive Assessment Grants, the successor to the Enhanced Assessment Grants program, which supports projects designed to spur innovation in education-assessment design and delivery and to help States address pressing needs they have identified for developing and implementing next-generation assessment systems.

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# NATIONAL OCEAN POLICY IMPLEMENTATION PLAN

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National Ocean Council

APRIL 2013



# National Ocean Council

Council on Environmental Quality  
Office of Science and Technology Policy  
Department of Agriculture  
Department of Commerce  
Department of Defense  
Department of Energy  
Department of Health and Human Services  
Department of Homeland Security  
Department of the Interior  
Department of Justice  
Department of Labor  
Department of State  
Department of Transportation  
Environmental Protection Agency  
Federal Energy Regulatory Commission  
Joint Chiefs of Staff  
National Aeronautics and Space Administration  
National Oceanic and Atmospheric Administration  
National Science Foundation  
U.S. Army Corps of Engineers\*  
U.S. Coast Guard  
Office of the Director of National Intelligence  
Office of Management and Budget  
Office of the Vice President  
National Security Staff\*\*  
Domestic Policy Council  
National Economic Council

\* *Member of the Deputy-level committee*

\*\* *Includes the National Security Advisor and the Assistant to the President for Homeland Security and Counterterrorism*

NATIONAL OCEAN POLICY IMPLEMENTATION PLAN

EXECUTIVE OFFICE OF THE PRESIDENT  
NATIONAL OCEAN COUNCIL  
WASHINGTON, D.C. 20503

April, 2013

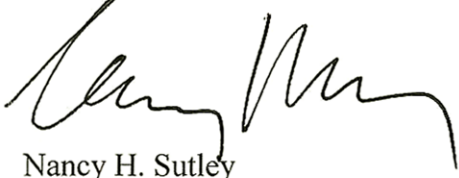
Dear Colleague:

We are pleased to deliver the *National Ocean Policy Implementation Plan* (Plan), a document that translates the National Ocean Policy into on-the-ground actions that will benefit Americans. The Plan presents specific actions Federal agencies will take to bolster our ocean economy, improve ocean health, support local communities, strengthen our security, and provide better science and information to improve decision-making.

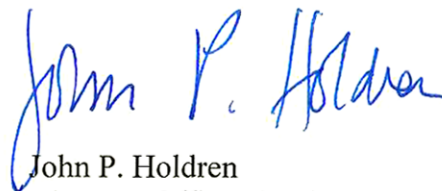
The National Ocean Policy, created by Executive Order 13547 on July 19, 2010, established the National Ocean Council, which consists of 27 Federal agencies, departments, and offices working together to share information and streamline decision-making. The Council developed the Plan over a two-year period with extensive public input from a wide range of stakeholders.

The National Ocean Policy and accompanying Plan will help spur economic growth, empower states and communities, and save taxpayer dollars through better coordination that avoids conflicts. They are examples of common-sense good government that will help Americans sustain and enjoy our ocean resources.

Sincerely,



Nancy H. Sutley  
Chair, Council on Environmental Quality  
Co-Chair, National Ocean Council



John P. Holdren  
Director, Office of Science and Technology Policy  
Co-Chair, National Ocean Council



# Table of Contents

I. Introduction . . . . .	1
Organization of the Document . . . . .	4
II. The Ocean Economy . . . . .	5
Supporting Economic Growth . . . . .	6
Promoting Jobs . . . . .	7
Developing a Skilled Ocean Workforce . . . . .	8
III. Safety and Security . . . . .	10
Improving Maritime Domain Awareness . . . . .	11
Providing Maritime Safety and Security in a Changing Arctic . . . . .	11
Enhancing the Safety and Security of Ports and Waterways . . . . .	12
IV. Coastal and Ocean Resilience . . . . .	14
Reducing Adverse Conditions . . . . .	15
Preparing for Change . . . . .	16
Recovering and Sustaining Ocean Health . . . . .	17
V. Local Choices. . . . .	19
Providing Tools for Regional Action . . . . .	20
Strengthening Regional Partnerships . . . . .	21
Supporting Regional Priorities . . . . .	21
VI. Science and Information . . . . .	24
Enhancing Our Understanding of Ocean and Coastal Systems. . . . .	25
Strengthening Our Ability to Acquire Marine Data and Provide Information . . . . .	26
Improving Science-based Products and Services for Informed Decision-Making. . . . .	27
VII. Conclusion . . . . .	29
Endnotes . . . . .	30



photos (clockwise from top right): MMS; NOAA; Navy; NOAA; NSF; NOAA

## I. Introduction

The ocean, our coasts, and the Great Lakes are among our most treasured resources. They are an integral part of our national identity and our future. A healthy marine environment feeds our Nation, fuels our economy, supports our cultures, provides and creates jobs, gives mobility to our Armed Forces, enables safe movement of goods, and provides places for recreation. Healthy, productive, and resilient oceans, coasts, and Great Lakes contribute significantly to our quality of life.

At the same time, these resources are vulnerable to activities and impacts that diminish their health, productivity, and resilience. Pollution, for example, degrades marine habitats, reduces access to recreational and commercial opportunities, and threatens public health and safety. Habitat loss impacts the stability of marine populations, leading to significant economic and cultural consequences. Overfishing



threatens current and future opportunities for recreational and commercial fishing, compromises our national food security, and reduces the ability of marine ecosystems to recover from disturbances. The impacts of climate change, such as sea-level rise, increase the vulnerability of coastal communities to storm damage. Moreover, these problems interact with one another, collectively amplifying their impact on the health of the ocean.

In addition, a growing population of ocean users is increasingly competing for ocean space both for established uses such as fishing, shipping, military activities, and conventional energy development, and for emerging uses such as renewable energy development and aquaculture. This competition creates conflicts between users and presents new challenges for decision-makers. Inefficient government decision-making can compound the problem, hampering economic opportunities and impeding the entrepreneurial, problem-solving efforts of commercial and conservation interests alike.

At the same time, the Nation is encountering new opportunities to improve our understanding of the ocean, how it works, and how we can expand our use of the ocean while maintaining its health and resilience. Advances in research, science, and technology are necessary to help us better understand how marine environments function, and how they influence and are influenced by human activities. Application of this knowledge will inform locally-driven management practices and will improve and maintain the health of the ocean, support employment and new economic opportunities, enhance the Nation's safety and security, and help preserve the ocean as a valuable resource.

Recognizing these challenges and opportunities, and building on the recommendations of two bipartisan commissions, President Obama established the National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes by Executive Order 13547 on July 19, 2010. The National Ocean Policy (Policy) highlights our responsibility to improve and maintain the health of the ocean, coasts, and Great Lakes and recognizes the importance of working with States,<sup>1</sup> tribes,<sup>2</sup> and other partners to tackle key challenges through common sense, science-based solutions. The Policy aims to ensure that our valuable ocean, coastal, and Great Lakes resources will continue to provide a wealth of benefits that support the Nation's well-being, safety, and prosperity.

Fundamentally, the National Ocean Policy coordinates, through establishment of the National Ocean Council, the ocean-related activities of Federal agencies to achieve greater efficiency and effectiveness, with a focus on reduced bureaucracy, improved coordination and integration, and fiscal responsibility. The Policy does not create new regulations, supersede current regulations, or modify any agency's established mission, jurisdiction, or authority. Rather, it helps coordinate the implementation of existing regulations and authorities by all Federal agencies in the interest of more efficient decision-making. The Policy does not redirect congressionally-appropriated funds, or direct agencies to divert funds from existing programs. Instead, it improves interagency collaboration and prioritization to help focus limited resources and use taxpayer dollars more efficiently.

Developed collaboratively by the agencies of the National Ocean Council and based on the work initiated by the Interagency Ocean Policy Task Force in 2009, this National Ocean Policy Implementation Plan (Plan) provides clear direction to Federal agencies and increased specificity to partners and stakeholders.<sup>3</sup> The Plan reflects a commitment to develop and apply the latest science and information, conduct the business of government more efficiently, and collaborate more effectively with State, tribal, and local

authorities, marine industries, and other stakeholders. This Plan describes specific actions that translate the goals of the National Ocean Policy into on-the-ground change to address key challenges, streamline Federal operations, save taxpayer dollars, and promote economic growth.

A wide range of stakeholders and partners will benefit from these actions to improve the stewardship and health of the ocean, coasts, and Great Lakes. For example:

- States and tribes will benefit from improved coordination with Federal agencies, better information for decision-making, and support for regional priorities and solutions;
- Recreational fishermen and boaters will benefit from actions that advance conservation programs and help ensure continued access to healthy and productive waters;
- Commercial fishermen will be better equipped to meet our Nation's growing demand for healthy seafood through improved science that supports increased sustainable fishing opportunity;
- The commercial shipping and ports industry will have more accurate charts for safe and efficient navigation;
- The Nation's Armed Forces will benefit from improved coordination with maritime interests to ensure their ability to test and train in order to meet current and emerging national security requirements;
- Offshore energy industries will benefit from better data and information to identify potential development sites, more efficient leasing and permitting processes, and planning that facilitates safe access, safe operations, and reduced conflicts with other uses;
- The aquaculture industry will benefit from streamlined Federal permitting and coordinated research efforts to support sustainable aquaculture;
- Coastal communities will build resilience to extreme events and sustain more coastal job opportunities; and
- Beach-goers, birders, conservationists, and others will benefit from healthier coastal and ocean habitats and ecosystems.

This Plan presents a common-sense, science-based approach to achieve these benefits through resource management that considers entire ecosystems. The goal of ecosystem-based management supported by this Plan is to maintain a healthy, productive, and resilient ocean that can continue to provide the benefits and resources humans want and need. Achieving this goal will require both a sound scientific foundation and a commitment to management practices that are adaptable to changing conditions and responsive to new challenges and opportunities that emerge. Working together, resource managers, ocean users, and other stakeholders can develop and apply ecosystem-based management incrementally, by learning and sharing effective practices as knowledge and experience increase.

Importantly, this Plan was informed by thoughtful input from national, regional, and local stakeholders from all marine sectors; tribal, State, and local governments; private sector partners, academic scientists, and the general public. It reflects careful consideration of extensive public comments, particularly those

that relate to the importance of incremental change, pilot projects, support for local and regional capacity and self-determination, and the fundamental need for more and better information.

The Implementation Plan better aligns multiple agency priorities and activities to promote greater synergies and efficiencies in Federal spending. Given today's constrained fiscal climate and recognizing uncertainty in the budget and appropriations processes, completion of every action within the identified timeframes will depend upon the availability of funds and resources.

In that vein, this Plan is intended to be a living document. It is designed to be adaptive to new information or changing conditions, and will be updated periodically as progress is made, lessons are learned, new activities are planned, and as the Nation continually strives to improve the stewardship of the ocean, coasts, and Great Lakes for the benefit of current and future generations.

## Organization of the Document

This Implementation Plan describes, under the following sections, how specific actions to implement the Policy will benefit: (1) The Ocean Economy, (2) Safety and Security, and (3) Coastal and Ocean Resilience by supporting (4) Local Choices, and providing foundational (5) Science and Information. Subsections describe specific outcomes that advance those benefits and the types of actions Federal agencies will take to achieve them. Specific planned actions are described in the appendix containing Implementation Actions. Many of these actions will produce benefits in the short-term that respond to immediate needs of communities, ocean stakeholders, and the public. Others create building blocks to support key outcomes in the medium- to long-term. The actions in this Implementation Plan are grounded in the National Priority Objectives of the Policy. They encompass efforts previously identified under these objectives as those that will move our Nation ahead toward resolving the most pressing challenges facing the ocean, our coasts, and the Great Lakes, and benefitting the people, communities, and businesses that rely on them.

Many of the actions support multiple outcomes, reflecting the common-sense value of focusing and coordinating the work of Federal agencies to provide products and services that benefit all Americans. In particular, a number of science and information-based actions that advance observing systems, mapping and charting, and other information tools benefit many different users at the national, regional, and local level. Those and other actions are therefore discussed in more than one section to explain how they advance each policy objective.



photo: NOAA

## II. The Ocean Economy

The ocean, our coasts, and the Great Lakes are among our Nation's most valuable resources and strongest economic drivers. In 2010, maritime economic activities such as shipping, marine construction, energy development, commercial fishing, recreational fishing and boating, aquaculture, and tourism contributed \$258 billion in GDP to the national economy and supported 2.8 million jobs.<sup>4</sup> Because so many people live near the coast, in 2010, 41 percent of our Nation's Gross Domestic Product (GDP), or \$6 trillion, was generated in the shoreline counties of the United States and territories, including the Great Lakes.<sup>5</sup> These coastal counties supported approximately 44 million jobs and \$2.4 trillion in wages.<sup>6</sup> The value of the ocean to Americans—for commerce, energy, recreation, food, culture, and national security—provides the foundation for our quality of life now and for future generations.

As a maritime Nation, we are challenged to maintain and enhance the economic benefits that a healthy and productive ocean provides. The declining health of ocean, coastal, and Great Lakes ecosystems threatens their ability to provide the products and services on which much of our economy depends. For example, marine and aquatic invasive species cost our economy billions of dollars each year in damage to fisheries, tourism, and coastal infrastructure.<sup>7</sup> Another example indicates that coral bleaching has cost the United States an estimated \$4.8 billion over the past 50 years, affecting tourism and fishing, and increasing the vulnerability of coastal areas to storm damage.<sup>8</sup> The proliferation of marine debris along our coasts has significant economic impacts across a number of marine sectors, including tourism, recreation, and fisheries.<sup>9</sup>

Government inefficiencies can add to these problems. For example, of the seafood consumed in the U.S. in 2011, an estimated 91 percent (by value) was imported with half of that coming from foreign aquaculture.<sup>10</sup> In 2011, the U.S. trade deficit in seafood was \$11.2 billion, a number that grows annually.<sup>11</sup> Government inefficiency in the siting, permitting and approval processes for aquaculture may be hindering the domestic aquaculture industry's growth.<sup>12</sup> Beyond threatening jobs and economic stability, poor coordination and ineffective planning can cause increased delays, conflicts, and costs among the growing number of ocean users.

This Plan responds to such challenges by focusing and coordinating action among Federal agencies under their existing authorizations and budgets, and by providing the tools we need to ensure a robust, sustainable ocean economy. It also promotes better science and information to support economic growth, more efficient permitting and decision-making, and healthier and more resilient marine ecosystems that will continue to support jobs, local economies, and a skilled and diverse ocean workforce.

A healthy marine environment provides significant economic benefits. For example, millions of Americans experience the ocean, coasts, and Great Lakes each year through recreational fishing and boating, which is a major contributor to the national economy. In 2010, marine tourism and recreation accounted for 70 percent of the jobs produced by the total ocean economy—1.9 million American jobs in total.<sup>13</sup> As such, maintaining healthy, productive waters and access to them for recreation and other activities is critically important to sustaining the benefits that so many Americans enjoy. The recreational fishing and boating communities directly contribute to and help fund (through excise taxes and license sales) many marine conservation, State wildlife and fishery programs, and other initiatives that provide further benefits through vehicles such as the Sport Fish Restoration and Boating Trust Fund. These are just some examples of the value provided by healthy marine waters.

The following actions will support existing and new marine industries, maintain and enhance the vitality of coastal communities and regions, and preserve the marine ecosystems that support our quality of life.

## Supporting Economic Growth

Businesses, communities, and governments that rely on ocean resources need high-quality scientific information and data. Greater access to high-quality data and information will enable maritime industries, resource managers, and decision makers at all levels of government to make responsible and effective decisions. Federal agencies will take the following actions that strengthen the national economy through enhanced accessibility to data and information and robust, sustained observing systems.

- **Advance our mapping and charting capabilities and products to support a range of economic activities.** To sustain the flow of the trillions of dollars of goods that pass through our ports and the many businesses that rely on the ocean, our coasts, and Great Lakes, agencies will coordinate to produce better mapping and charting products, which serve to preserve, protect, and expand our Nation's maritime economic activities. Improved mapping, charting, and associated products will enhance the efficiency of maritime commerce through safer navigation and better accident-avoidance, and updated hydrographic charts and seafloor maps will support marine industries such as offshore energy. These products will also provide coastal

communities with better elevation and bathymetric data to plan for and mitigate the adverse economic impacts of disasters.

- **Provide greater accessibility to data and information to support commercial markets and industries, such as commercial fishing, maritime transportation, aquaculture, and offshore energy.** Agencies will take a series of actions to facilitate the availability of relevant ocean data to provide easier access to information for research, planning, and decision support. Further, agencies will utilize public input, local and traditional knowledge, and scientific information to help identify and communicate the economic value of ecosystem services, such as healthy and productive wetlands that support spawning, breeding, and feeding of commercially and recreationally important fish species. This information can help decision makers consider the value of these services when evaluating actions that may impact the economy.
- **Sustain and further develop observing systems for the economic benefit of maritime commerce and marine industry.** Federal agencies will support the development and maintenance of ocean observing systems. Real-time information on waterway conditions from ocean, coastal, and Great Lakes observing systems such as the Physical Oceanographic Real-Time System directly supports the daily operations and efficiency of maritime commerce nationwide, as well as local and regional businesses that rely on the marine environment. Continued development of Federal ocean observing programs will stimulate private sector ocean technology development and provide a rigorous test-bed for new innovations.

## Promoting Jobs

Ocean industries are a major employer. In 2010, U.S. commercial ports supported more than 13 million jobs.<sup>14</sup> Similarly, in 2011, commercial fisheries supported 1.2 million jobs and \$5.3 billion in commercial fish landings, and marine recreational fisheries supported 455,000 jobs.<sup>15</sup> As of March 2012, energy and minerals production from offshore areas accounted for about \$121 billion in economic contributions to the U.S. economy and supported about 734,500 American jobs.<sup>16</sup> Offshore wind energy has the potential to directly support 20.7 jobs for every megawatt-hour generated. Installing 54 gigawatts of offshore wind capacity in U.S. waters would create more than 43,000 permanent operations and maintenance jobs.<sup>17</sup> There is significant potential along the Nation’s shorelines to create a large number of coastal restoration jobs that recover degraded habitats and restore the fisheries and recreational opportunities they provide. For every million dollars invested, coastal restoration creates between 17 and 30 new jobs for coastal regions—regions that provide key habitat for more than 70 percent of the commercial and recreational fish catch.<sup>18</sup> Marine aquaculture in the U.S. has a farm-gate value of \$320 million<sup>19</sup> and supports up to 35,000 jobs.<sup>20</sup> Supporting the growth of sustainable marine aquaculture through the National Shellfish Initiative and building on existing efforts such as the Gulf of Mexico Fishery Management Council’s Aquaculture Plan has the potential to provide additional jobs.

The following actions by Federal agencies will help maintain existing jobs and promote job growth in coastal and marine-related sectors by improving regulatory efficiency, reversing environmental impacts that hinder economic opportunity, and providing information that supports actions to maximize the

economic value of our natural resources. The goal of these actions is to enhance both immediate and long-term potentials for job creation.

- **Increase efficiencies in decision-making by improving permitting processes and coordinating agency participation in planning and approval processes.** A key goal of the Policy is to improve efficiency across Federal agencies, including permitting, planning, and approval processes to save time and money for ocean-based industries and decision makers at all levels of government while protecting health, safety, and the environment. Interagency work already in progress includes more efficient permitting of shellfish aquaculture activities, which will help produce additional domestic seafood and jobs and provide a template for similar action to support other marine commercial sectors. Through pilot projects developed in collaboration with relevant stakeholders, Federal agencies will identify opportunities to streamline processes and reduce duplicative efforts while ensuring appropriate environmental and other required safeguards.
- **Provide jobs and economic value by protecting and restoring coastal wetlands, coral reefs, and other natural systems.** Restoration activities provide direct economic opportunities, and healthy natural systems support jobs in industries such as tourism, recreation, and commercial fishing. Agencies will coordinate to protect, restore, and enhance wetlands, coral reefs, and other high-priority ocean, coastal, and Great Lakes habitats. Agencies will also work through the already established a National Shellfish Initiative with commercial and restoration aquaculture communities to identify ways to both responsibly maximize the commercial value of shellfish aquaculture and achieve environmental benefits such as nutrient filtration and fish habitat.
- **Prevent lost employment opportunities and economic losses associated with environmental degradation.** Hypoxia and harmful algal blooms have significant adverse economic, public health-related, and ecological consequences. Invasive species are a major challenge that results in economic losses to local communities and industries, costing the Nation more than \$120 billion annually.<sup>21</sup> Federal agencies will take steps to prevent and reverse widespread economic impacts caused by hypoxia, harmful algal blooms, invasive species, and other threats to healthy systems. They will take action to strengthen the monitoring, science, data access, modeling, and forecasting of hypoxia and harmful algal blooms to provide decision makers with the necessary information to minimize and mitigate harmful impacts on coastal economies. Federal agencies will take actions to improve our ability to detect and reduce invasive species in coastal and ocean habitats to protect commercial and recreational fish stocks, help sustain the jobs and industries that depend upon healthy coastal aquatic ecosystems, and save millions of dollars in lost revenue and avoided infrastructure damage.

## Developing a Skilled Ocean Workforce

A diverse workforce with interdisciplinary skills and training is needed to maintain the Nation's place as a world leader in ocean science and to ensure informed management and use of ocean, coastal, and Great Lakes resources. Agencies will coordinate to build the science, technology, engineering, and mathematics (STEM) and managerial workforce capacity needed to ensure that management of and research on ocean, coastal, and Great Lakes ecosystems are of the highest quality possible.

- **Develop human capacity and the skilled workforce necessary to conduct ocean research and manage ocean resources.** Agencies will coordinate to ensure that educational programs include diverse student groups and that a highly competent workforce is developed. Agency actions will result in more students, particularly from underrepresented groups at the undergraduate and graduate level, pursuing academic fields related to ocean, coastal, and Great Lakes science and management. This will support the Nation's leadership in ocean research and development and the application of best management practices. For example, agencies will use existing education and training resources to provide scholarship, fellowship, and internship opportunities that leverage existing Federal investments in ocean research, marine laboratories, and natural sciences to provide opportunities for education and training. Agencies will also contribute to periodic ocean-focused academic competitions for middle and high school students that have a positive impact on ocean-related career paths.





### III. Safety and Security

The ocean, our coasts, and Great Lakes are critically important to the Nation’s safety and security. Safe, secure, and productive access to, and use of, our maritime domain are essential to maintaining military strength, a strong economy, and a high quality of life for all Americans. Marine waters comprise the physical boundaries of our Nation, support the mobility and training of our Armed Forces, and provide an economically vital foundation for energy, commerce, tourism and recreation, commercial and recreational fishing and boating, and other industries. For many Native and tribal communities and coastal residents, these waters directly sustain life and cultures. It is fundamentally in our Nation’s best interest to better understand, protect, and sustain these waters.

Industry, government, academia, and the public conduct numerous activities on our coastlines and in the ocean and Great Lakes for a variety of purposes. By improving effective coordination and situational awareness, these comingled activities will take into consideration the safety and security of our people, property, and the health of the marine environment. Federal agencies will work together to improve our overall awareness of the maritime domain, be responsible stewards of the marine environment, and enhance the safety and security of our ports and waterways.

International cooperation is equally important. United States accession to the Convention on the Law of the Sea (Convention) is critical to protecting our navigational rights and freedoms, both for military vessels and for civilian vessels and their cargoes, and to advancing our economic interests in the ocean. The Convention accords to the United States extensive offshore resource rights, including exclusive rights to natural resources such as oil, gas, and fish, out to 200 nautical miles from shore, and additional rights to seabed resources, including oil and gas, beyond 200 nautical miles in several large areas. Accession to

the Convention also means that the United States would have the opportunity to place U.S. nominees/designees on various Convention bodies, including those developing the rules governing mineral resources in the deep seabed, and those making recommendations regarding Parties' submissions on the continental shelf beyond 200 nautical miles. Joining the Convention will advance our national interests by protecting and enhancing our access to the ocean and important natural resources.

## Improving Maritime Domain Awareness

A solid understanding of the wide range of activities, infrastructure, and environmental conditions that occur in the ocean, coastal, and Great Lakes ecosystems enables informed reactions and responses to events that occur in those waters. Maritime domain awareness is achieved by efficiently collecting and sharing information and by improving the Nation's infrastructure for ocean observing and remote sensing systems. It is also important to focus on greater collaboration with the international community to enable better sharing of information, expertise, and knowledge with other nations.

- **Enhance remote sensing systems for ocean observations to support maritime domain awareness.** Federal agencies will optimize use of enhanced remote sensing systems for ocean observations to improve awareness of real-time oceanographic, meteorological, and ecological conditions in the maritime domain. An integrated system of remote sensing assets designed for ocean observations will assist decision-makers by providing a more complete picture of the marine environment.
- **Engage internationally to exchange information, expertise, and knowledge about policy issues in the maritime domain.** The United States will collaborate with international organizations and bodies, such as the International Maritime Organization and Intergovernmental Oceanographic Commission, and with other nations, in exchanging information, expertise, and knowledge to address high-priority ocean policy issues. These efforts will improve awareness of activities in the maritime domain, especially among those nations sharing a maritime border with the United States, and enhance our ability to address high-priority ocean policy issues efficiently and effectively.

## Providing Maritime Safety and Security in a Changing Arctic

The Arctic is rapidly changing. One of the most dramatic changes is the decrease in sea ice, which is likely to increase vessel traffic in the U.S. Arctic. Commercial vessels may capitalize on more expeditious routes, cruise ships and recreational vessels are expected to bring more tourists to the region, fishing grounds are shifting, and oil and gas companies are moving forward with exploration activities and obtaining leases to drill into the Arctic seabed. This brings a need for improvements to our Arctic communication systems and environmental response management capabilities; our ability to observe and forecast sea ice; and the accuracy of maps and charts of the region. Our maritime safety and security in the Arctic hinge upon these actions.

- **Enhance communication systems in the Arctic to improve our capability to prevent and respond to maritime incidents and environmental impacts.** Federal agencies will improve Arctic communication systems by advancing both technical capabilities and partnerships.

Agencies will strengthen existing communication systems to allow vessels, aircraft, and shore stations to effectively communicate with each other and to receive information such as real-time weather and sea ice forecasts that will significantly decrease the risk of loss of life at sea or damage to property or the marine environment. Agencies will partner with each other, Native communities, industry, and other countries as appropriate to identify user needs and existing capabilities prior to building new communication systems.

- **Improve Arctic environmental incident prevention and response to ensure coordinated agency action, minimize the likelihood of disasters, and expedite response activities.** Increased Arctic vessel traffic brings increased risks of collisions, groundings, and other serious marine incidents that can lead to loss of life and property and damage the marine environment. A coordinated and prepared all-hazards response-management system will mitigate the impacts of marine-pollution events on fragile Arctic communities and ecosystems. To improve responses, Federal agencies will conduct joint spill-response workshops and exercises, develop and implement response coordination and decision-support tools like the Arctic Environmental Response Management Application, and improve spill prevention, containment, and response infrastructure, plans, and technology for use in ice-covered waters.
- **Improve Arctic sea ice forecasting to support safety at sea.** Sea ice forecasting is one of the most urgent and timely issues in the Arctic region. To ensure the best tactical and long-term ice forecasts are available for safe operations and planning, Federal agencies will work together to better quantify the rates of sea ice melt and regrowth, understand shifting patterns of distribution of ice, develop better maps of the ice edge, expand participation in the sea ice observation program, and coordinate with international partners to enable better model-based forecasting over larger areas. Improved observations will contribute to improved forecasts, which will better inform Arctic maritime safety and security activities.
- **Improve Arctic mapping and charting for safe navigation and more accurate positioning.** Advancements in hydrographic charting will enhance the safety of navigation in the Arctic region by reducing the risk of damaging maritime incidents. Federal agencies will update nautical charts and establish priorities, in concert with Native communities and stakeholders, for shoreline and hydrographic surveying activities. Further, mapping gravity data over the State of Alaska will help correct meters-level errors in Arctic positioning. Such efforts will support U.S. Navy and U.S. Coast Guard operations and help ensure the safety and security of all mariners in the Arctic.

## Enhancing the Safety and Security of Ports and Waterways

The safety and security of our people, property, and the marine environment and the viability of maritime commerce rely on safe, efficient, and secure navigation and waterways management systems. This includes effective planning for and response to emerging threats to our ports and harbors from illegal human activities, climate change, and extreme weather events or other natural disasters. Federal agencies will conduct several actions that leverage existing resources in a coordinated manner to ensure the

safety and security of all those who make a living from, enjoy through recreation, and rely on the health and vitality of our ports and waterways.

- **Conduct Waterway Analysis and Management System assessments and Port Access Route Studies to support decisions on waterways management and other navigational priorities.** The safe and secure navigation of commercial, recreational, and government vessels in and out of our Nation’s ports depends on accurate and timely assessments of our waterways. Federal agencies will evaluate the performance of our waterways management systems on a consistent basis to identify the improvements needed to ensure the safety and security of our maritime public, the economic vitality of our ports, and the integrity of our marine ecosystems.
- **Assess the vulnerability of our ports and waterways to sea-level rise and extreme weather events or other natural disasters and enable actions that more effectively reduce risks and impacts.** The Nation’s ports and waterways infrastructure support many economic, safety, and security activities. A better understanding of the potential impacts of climate change on our ports and waterways will prepare us to respond and adapt accordingly in order to preserve critical assets. Vulnerability assessments are critical to understanding how extreme weather, sea-level rise, and other manifestations of climate change may affect our coastlines. Federal agencies will conduct such assessments, in collaboration with State, tribal, local, and regional efforts. Federal agencies will develop and disseminate methods, best practices, and standards for assessing the resilience of natural resources, populations, and infrastructure in a changing climate.
- **Advance ocean observing systems to further enhance search and rescue operations and spill response in our ports and waterways.** Ocean observing systems provide real-time and near real-time oceanographic, meteorological, and ecological data, which feed into search and rescue and oil spill trajectory models. The reliability, quality, and resolution of ocean observing system data have a direct impact on the model output, which influences operational decisions for search and rescue and oil and hazardous substance spill response. Advancing the capabilities and reliability of our ocean observing system infrastructure will further protect life, property, and the marine environment in our economically vital ports and waterways.



photo: USFWS

## IV. Coastal and Ocean Resilience

The health and integrity of coastal habitats—such as coral reefs, wetlands, mangroves, salt marshes, and sea grass beds—are key to sustaining our Nation’s valuable coastal and ocean ecosystems and the wealth of benefits they provide to us. Outdoor enthusiasts across the Nation access coastal habitats for fishing, boating, birding, and hiking; communities depend on coastal wetlands as buffers against hurricanes; divers and snorkelers enjoy the beauty of coral reefs; and commercial fishermen provide fresh seafood for our tables. Coastal habitats provide spawning grounds, nurseries, shelter, and food for finfish, shellfish, migratory birds, and waterfowl. They protect coastal communities, homes, infrastructure, and businesses against damage from erosion and flooding, they support hundreds of thousands of jobs, they improve water quality by filtering and detoxifying runoff, they dampen the outbreak of pests and pathogens, they capture and store carbon, and they yield compounds for life-saving medicines. Healthy watersheds and coasts sustain our Nation by providing abundant clean water to coastal communities, residents, businesses, industries, and ecosystems.

Degradation of coastal habitats and ecosystems diminishes their health and their ability to provide environmental, economic, and societal services to the Nation. Our Nation lost nearly 60,000 acres of coastal wetlands each year between 1998 and 2004.<sup>22</sup> Roughly half of the coral reefs under U.S. jurisdiction are in “poor” or “fair” condition because of ocean warming, disease, and human activities.<sup>23</sup> Habitats are being altered by invasive species that threaten native aquatic life and cost billions of dollars per year in natural and infrastructure damage.<sup>24</sup> Trash in the Nation’s waterways injures and kills wildlife, degrades habitats, interferes with navigation, threatens public health and safety, and creates additional costs for shipping, fishing, tourism, and coastal communities. Pollution from a variety of sources affects our

streams, rivers, estuaries, and coasts, and is the leading cause of water quality problems in the United States. Such pollution represents a major cause of rapidly declining ocean and coastal ecosystem health.

These threats are exacerbated by the environmental impacts of climate change and ocean acidification and the resulting shifts in wildlife populations and abundance. Sea-level rise, increased severe storm events, changing ocean temperature, and saltwater intrusion present serious and growing threats to low-lying coastal communities through the destruction of infrastructure, flood inundation, loss of arable land, and the potential displacement of millions of people.<sup>25</sup> Climate change is also predicted to alter water levels of the Great Lakes, thereby changing water cycles and supply, habitats, and economic uses of the Lakes. Ocean acidification, caused by increased levels of carbon dioxide that make marine waters more acidic, can harm the growth of plants and animals, including recreationally and commercially important fish and shellfish. Marine industries such as shellfish aquaculture, and the jobs and communities they support, face increased impacts from the changing chemistry of our marine waters.

Federal agencies will work together to support the various national, State, tribal, and local efforts to prepare for, respond to, and mitigate or avoid the degradation and loss of ocean and coastal habitats, water quality, and ecosystems through improved capabilities, proactive stewardship, strengthened research, and enhanced collaboration. Agencies will also enable and support efforts to understand, minimize, and adapt to the impacts of climate change, ocean acidification, sea-level rise, and extreme weather events, strengthening the resilience of coastal communities.

## Reducing Adverse Conditions

Through National Ocean Policy actions, thousands of acres of wetlands and priority habitat will be protected, restored, or enhanced. Our Nation's coral reefs will be improved by better coordinating existing authorities and implementing projects to prevent or mitigate harmful impacts. Actions to support partnerships and efforts to locate, monitor, control, and eradicate invasive species will protect native aquatic populations and their habitats. Collaborative watershed restoration efforts are important to the overall success of coastal and marine habitat conservation. Restoration efforts in the Gulf Coast, Mississippi River Basin, and Great Lakes, and for Pacific Northwest salmon are excellent examples of collaborative, voluntary upland watershed conservation and restoration.

- **Reduce coastal wetland loss.** Federal agencies will work together and in cooperation with States and tribes to identify the underlying causes of wetland loss in coastal watersheds, and opportunities to more effectively protect and restore the important functions and values they provide. Agencies will conduct pilot studies to identify the most common underlying factors responsible for coastal wetland loss and the most successful tools for addressing it. These actions will complement ongoing State, local, and tribal government projects seeking to protect and restore coastal wetland ecosystems such as the Gulf Coast Ecosystem Restoration Council and the South Florida Ecosystem Restoration Task Force.
- **Protect, conserve and restore coastal and ocean habitats.** Agencies will coordinate to use and provide scientifically sound, ecosystem-based approaches to achieving healthy coastal and ocean habitats. For example, working through the U.S. Coral Reef Task Force, agencies will coordinate to address key threats to coral reef ecosystems, including impacts from land-based

sources of pollution, climate change, ocean acidification, planned activities (authorized activities), and unplanned activities (such as vessel groundings and spills).

- **Locate, control, prevent, and eradicate invasive species populations.** Federal agencies will improve our ability to prevent and reduce impacts from invasive species, focusing on early detection and response, to protect ecologically, commercially, recreationally, and culturally, important marine species and their habitats.
- **Improve and preserve our Nation’s coastal and estuarine water quality to provide clean water for healthier waterways, communities, and ecosystems.** Through more effective use of voluntary programs, partnerships, and pilot projects, agencies will work to reduce excessive nutrients, sediments, and other pollutants. Agencies will also help protect, conserve, and maintain high-quality coastal waters by identifying priority areas for water quality monitoring and assessment and providing financial assistance to private landowners seeking to apply voluntary conservation practices. Other actions will reduce the impacts of hypoxia and harmful algal blooms faced by many coastal and inland States.

## Preparing for Change

Agencies will take a number of actions to improve the resilience of coastal communities and enhance their ability to adapt to the impacts from climate change, extreme weather events, and ocean acidification. Agencies will develop estimates for global mean sea-level rise and make available coastal inundation and sea-level change visualizations and decision-support tools relevant to regional, State, tribal, and local decision-makers. They will offer tools and training courses on how to design and implement vulnerability assessments and develop a national assessment of coastal and ocean vulnerability to both climate change and ocean acidification.

Actions will be conducted in coordination with other Federal climate change and ocean acidification programs and strategies, including the National Action Plan for Managing Freshwater Resources in a Changing Climate, the National Fish, Wildlife and Plants Climate Adaptation Strategy, the Strategic Plan for Federal Research and Monitoring of Ocean Acidification, the U.S. Global Change Research Program, the National Climate Assessment, and the Interagency Climate Change Adaptation Task Force. To the extent appropriate, these actions will also be coordinated with and guide relevant Federal Emergency Management Agency efforts such as national preparedness, disaster response and recovery, and flood hazard map development.

- **Strengthen and integrate observations into a coordinated network of sentinel sites to enhance the Nation’s ability to provide early warnings, risk assessments, and forecasts for impacts.** Federal agencies will strengthen and integrate observations from the Nation’s protected areas, research sites, and observing systems into a coordinated network of climate sentinel sites. This is an efficient and effective way to provide decision-makers with the information they need to reduce risks and increase resilience of ocean and coastal environments and communities in a changing climate.
- **Determine the impacts of interacting stressors on ecological systems, economies, and communities.** Agencies will develop an integrated research agenda to help address gaps in

our current understanding of impacts due to multiple, interacting factors, and build a foundation for the development of models, tools, and services to better inform future planning and decisions and improve implementation of existing policies. This integrated, interdisciplinary agenda will provide information for better forecasts of changes in ecological, economic, and social systems due to climate change and ocean acidification, and improved effectiveness of adaptation actions, with the goal of reducing risks and negative impacts on communities. For example, enhanced sea-level rise projections can inform the development of flood hazard maps.

- **Assess the vulnerability of coastal communities and ocean environments to climate change and ocean acidification and, in partnership with tribes, coastal communities and States, design and implement adaptation strategies to reduce vulnerabilities.** Agencies will develop methods, best practices, and guidance for assessing the vulnerability and resiliency of resources to a changing climate, building off existing efforts such as the National Climate Assessment. These tools will allow decision makers to assess local vulnerability, avoid actions that increase vulnerability of human communities or degrade natural resources, and take actions that increase resilience of both natural systems and communities. Agencies will also strengthen the institutions, mechanisms, and capacities for systematically enhancing resilience to hazards and incorporating adaptation strategies for coastal and ocean species and habitats into future planning, management processes, and infrastructure investments.

## Recovering and Sustaining Ocean Health

Agencies will take a number of actions to significantly improve our Nation’s capacity to address the long-term challenges and impacts of natural and human-caused environmental changes. These actions will strengthen collaboration through scientifically sound ecosystem-based management.

Effective management of activities that affect ocean health requires considering several inter-connected functions of ocean ecosystems, the resources they provide, and how human activities impact both the ecosystems themselves, and the communities that depend on them. Most previous management approaches have focused on a single resource or issue and designed solutions focused on that resource or issue alone. For example, the conventional approach to managing fisheries has been to focus on a single species and work to ensure its availability, primarily by limiting how many of them can be caught. Integrated, ecosystem-based management goes further and supports the goal of having a greater abundance, distribution, and diversity of fish, more jobs, and thriving fishing communities by also addressing the food sources and ecosystems that fish need to grow and the factors that affect them. By understanding those connections, managers can make decisions that support all components of the system, so there can be more fish overall. Federal fishery managers are already applying a more integrated management approach, but it does not include consideration of non-fishery factors, such as water quality, that affect fisheries.

Together, the following actions will provide a lasting foundation for enhancing the many vital benefits our Nation derives from healthy ocean, coastal, and Great Lakes ecosystems.

- **Establish a framework for collaboration and a shared set of goals to promote ecosystem-based management.** Agencies will increase their collaboration with other levels of government,



experts, practitioners, and stakeholders to enhance the efficiency, consistency, and transparency of their development and implementation of ecosystem approaches to management based on existing statutes and regulations. Agencies will develop principles, goals, and performance measures that support the development of integrated ecosystem-based management.

- **Improve coastal and estuarine restoration efforts through better monitoring, coordination, and planning.** Monitoring restoration efforts provides important data and information to improve the science of restoration and track the societal benefits of restoration activities, such as increased fish populations and enhanced protection of coastlines from storms. Federal agencies that fund and implement coastal and estuarine habitat restoration projects will evaluate and track these efforts to ensure that they are efficient and effective.
- **Improve the Nation’s preparedness for, and response to, environmental hazards through better forecasts, increased and more integrated monitoring, and strengthened preparedness.** Agencies will establish a Health Early Warning System that alerts public health officials and managers to marine-related threats to human and ecosystem health from diseases, toxins, and pathogens. To enhance our Nation’s food safety and security, other actions will augment contaminant monitoring and disease surveillance programs in a target region, and develop new, rapid assessment methods to detect contaminants and spoilage in seafood. Further actions will also reduce the negative impacts of trash and marine debris by enhancing non-regulatory prevention, reduction, and removal methods through methods such as community-based grants. In addition, agencies will develop and implement a coordinated response management system to better protect Arctic communities and ecosystems from potential oil spills and other pollution events.
- **Protect significant natural and cultural marine and Great Lakes areas and sufficient habitat to ensure maintenance of ecosystem processes.** Identifying ecologically important and culturally significant areas for focused protection or management supports the long-term sustainability of ocean resources. Several Federal agencies have processes by which to identify important marine areas for management or protection under existing authorities. Agencies will address, with input from State, tribal, regional, local, and stakeholder interests, the protection of essential fish habitat and support reactivation of the National Marine Sanctuary Site Evaluation List. This List is a public process tool for evaluating marine areas that may be considered for national marine sanctuaries in a transparent and public way.



photo: Dawn Standifur

## V. Local Choices

Throughout the U.S., there are myriad tribal, State, regional, and local efforts to support and grow marine economies, protect and conserve the environment that supports quality of life, and sustain unique social and cultural identities. Priorities, however, vary across regions, as do the ways in which different regional actors choose to address them.

All regions share an interest in growing their economies and providing jobs that support strong communities, which they address through a diverse and often unique array of marine uses. For example, their interests range from conventional to renewable energy, they have different commercial and recreational fisheries, and they offer distinct tourism and recreational activities. They also have different priorities for environmental protection and the use of ocean resources. In the Pacific and Caribbean, coral reef ecosystem conservation is a focus area, while in the Pacific Northwest, addressing the impacts of ocean acidification on local shellfish growers is a top priority. In the Gulf of Mexico, efforts are underway to minimize the impacts of harmful algal blooms on human health, while in the Great Lakes, States are working to control invasive species to minimize the damage they cause to commerce, municipal infrastructure, and the Great Lakes ecosystem.

In Arctic communities, adapting to the impacts of climate change is a regional priority, while Chesapeake Bay communities focus on approaches to improve water quality. Regardless of the specific issues being addressed, communities and stakeholders need more and better information and coordinated and responsive Federal agency actions that address locally relevant issues. Actions under the National Ocean Policy provide tools and services that support and build on action at local, State, tribal, and regional scales. These will strengthen partnerships across all levels of government and with regional and local stakeholders and communities.

## Providing Tools for Regional Action

Science and data provide the building blocks for information and tools to support tribal, State, local, and regional action. Efficient access to observations and information is improving our ability to understand and predict ecosystem events—such as a loss or change in habitat or coral bleaching—as well as long-term planning and decision-making. Pilot projects focused on ecosystem-based management allow scientists, managers, and stakeholders to account for and address the many factors that affect how ecosystems work, at a manageable scale and in the context of relevant issues. More efficient discovery of, and access to, information improves the ability of tribal, State, local, and regional planners to understand, predict, and prevent or mitigate events. Assessing vulnerability is yet another crucial step in preparing for and responding to the impacts of climate change, ocean acidification, and extreme weather on ocean environments and coastal communities.

- **Identify and implement pilot projects that use an ecosystem-based approach to partnering in the stewardship of ocean and coastal resources.** In collaboration with local, regional, and tribal practitioners, agencies will identify and conduct pilot projects that incorporate best practices for ecosystem-based management, test on-the-ground effectiveness of decision-support tools, and demonstrate the practical utility of ecosystem-based approaches. Pilot projects will determine what additional data, tools, and training are required, identify how the collaborative and scientific frameworks may need to be altered to be more useful, and enable decision-makers and managers to understand how ecosystem-based management can be most effectively implemented at regional scales relevant to address specific resource management objectives.
- **Assess the vulnerability of communities and ocean environments to climate change and ocean acidification and support and implement adaptation strategies to promote informed decisions.** Agencies will develop best practices and guidance for assessing the vulnerability and resilience of communities, infrastructure, and resources to a changing climate and ocean acidification, and will develop and promote adaptation tools and strategies to help coastal communities address these risks. These tools will enable decision-makers at all levels of government to assess local vulnerability, inform near-term and long-term investments, and avoid actions that increase vulnerability.
- **Expand and improve discovery of and access to non-classified Federal data and decision-support tools, including ocean and coastal mapping products, to support local, tribal, State, and regional decision-making.** Not all existing Federal data are easily accessible or in a useable format for regional decision-making and planning purposes. Agencies will coordinate to make unrestricted Federal data publicly available in a standards-based format through a national data portal (ocean.data.gov). This central portal for planning-related ocean, coastal, and Great Lakes data will allow for easy discovery and access to data and derived products which support the further development of new and/or improved decision-support tools for planners at all levels of government.

## Strengthening Regional Partnerships

Federal agencies will work to strengthen and leverage existing regional partnerships and to build new ones. Agencies will honor the government-to-government relationship, trust obligations, and consultation responsibilities of the Federal government with Federally-recognized tribes and expand partnerships with tribes and Native communities. Agencies will also partner with and assist States in advancing the network of regional alliances to protect ocean, coastal, and Great Lakes health. Partnerships with local governments and private interests are also needed to leverage limited resources.

Existing regional ocean and Great Lakes partnerships are voluntary, usually multi-state forums established by State Governors that identify shared priorities and take critical action on a range of issues relevant to their region. They have different structures and employ varied methods and approaches to enhance the ecological and economic health of the region. These efforts involve non-governmental stakeholders and multiple State and Federal agencies involved in coastal and ocean management. Federal agency actions will increase communication among ocean sectors, streamline processes, leverage resources, and enhance coordination among all levels of government.

- **Support regional priorities and enhance regional partnerships' ability to address issues of regional importance.** Federal agencies will enhance on-the-ground progress by supporting regional priorities such as data collection and analysis, and by improving coordination among Federal offices based in regions. Agencies will identify opportunities to leverage resources and partner on the continued development and organization of regional alliances and existing partnerships. This will include data collection and analysis needed to advance regional efforts, compile resources available to enhance accomplishment of mutual regional goals, and identify and distribute best management practices that are broadly applicable for all regional ocean and coastal entities (for example, how to effectively engage stakeholders, develop partnerships, identify priorities, develop regional action plans, and measure success).
- **Support engagement of interested tribal authorities and use of tribal information.** Agencies will work with interested tribal governments to support tribal involvement in priority-setting and planning for each region, including the integration of traditional ecological knowledge and scientific data collected by indigenous groups. Agency engagement of and coordination with tribes will ensure that tribal interests, lands, treaty and other reserved rights, and co-management agreements are appropriately considered and included in each region.

## Supporting Regional Priorities

Marine planning is a science-based tool that regions can use to address specific ocean management challenges and advance their economic development and conservation objectives. Marine planning will support regional actions and decision-making and address regionally determined priorities, based on the needs, interests, and capacity of a given region. Just as Federal agencies work with States, tribes, local governments, and users of forests and grasslands, among other areas, marine planning will provide a more coordinated and responsive Federal presence and the opportunity for all coastal and ocean interests in a region to share information and coordinate activities. This will promote more efficient and effective decision-making and enhance regional economic, environmental, social, and cultural well-

being. In turn, regional actions will support national objectives to grow the ocean economy, increase regulatory efficiency and consistency, and reduce adverse impacts to environmentally sensitive areas.

The scope, scale, and content of marine planning will be defined by the regions themselves, to solve problems that regions care about in ways that reflect their unique interests, capacity to participate, and ways of doing business. Marine planning should build on and complement existing programs, partnerships, and initiatives. The intent is to ensure that a region can develop an approach that it determines works best.

This approach balances regional and national interests and recognizes that actions commensurate with regional interests and capacities will provide the most immediate regional benefits. Knowledge and experience will build over time and contribute to achieving national objectives.

- **Support marine planning to advance regionally determined economic, social, environmental, and cultural interests.** States, tribes, and Regional Fishery Management Councils may choose to participate on regional planning bodies established in accordance with the National Ocean Policy Executive Order, this Implementation Plan, and guidance to be released by the National Ocean Council. State, tribal, and Fishery Management Council participation on regional planning bodies is voluntary.

Should all States within a region choose not to participate in a regional planning body within their region, a regional planning body will not be established. Instead, Federal agencies will identify and address priority science, information, and ocean management issues associated with marine planning as described in the Executive Order. In doing so, Federal agencies will coordinate with non-Federal partners and authorities, including States, federally-recognized tribes and Fishery Management Councils, and stakeholders, to ensure that Federal actions support and advance both regional and national objectives.

Marine plans produced by regional planning bodies can provide information about specific issues, resources, or areas of interest to better inform existing management measures. Or, they can describe future desired conditions and provide information and guidance that supports regional action moving forward. Each region has flexibility to build the elements of its plans over time in response to what the region wants to accomplish, the resources available to do the work, and the time it will take to learn what works best in that region. Examples of potential focus areas for marine planning could include, but are not limited to:

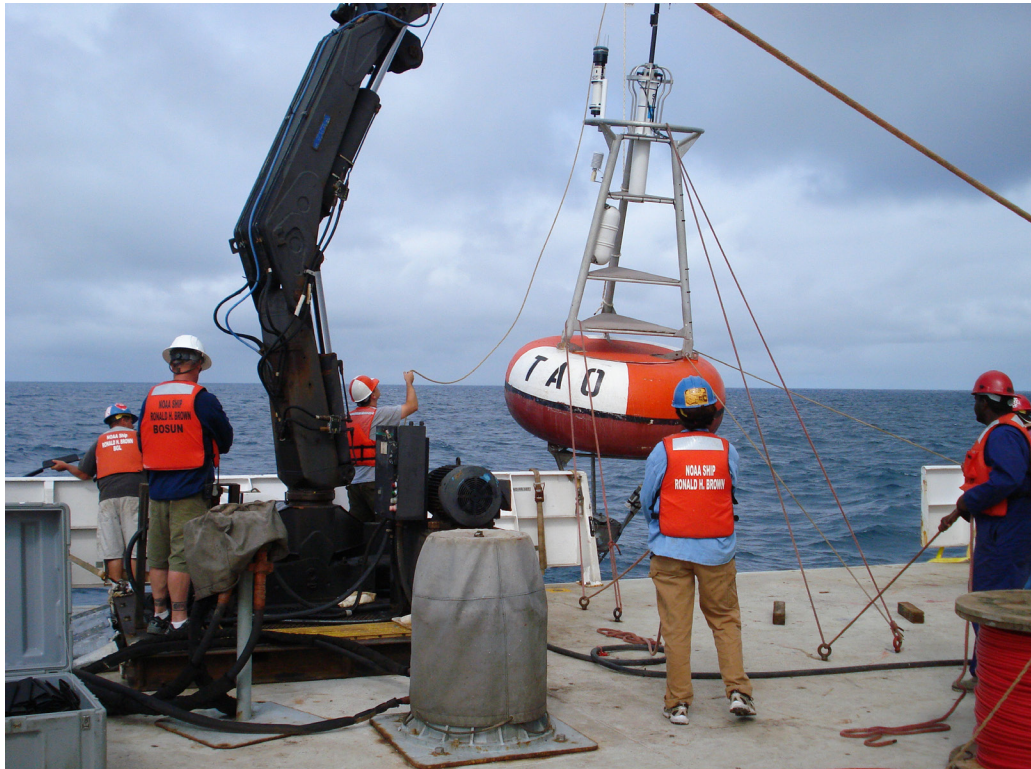
- Developing information that facilitates more effective review and permitting among State, Federal, and tribal authorities for a specific class of activity such as offshore energy infrastructure;
- Characterizing environmental conditions and current and anticipated future uses of marine space to assist in siting offshore renewable energy;
- Developing and implementing a plan to acquire data and information to support more efficient management of activities of particular regional interest, such as remote sensing data to support coastal mapping;
- Identifying a specific geographic area and addressing management challenges that would benefit from multi-government resolution;

- Identifying and developing information that better informs agency or government-to-government consultations under the Endangered Species Act, Marine Mammal Protection Act, and the National Environmental Policy Act that apply to offshore development activities important to the region; or
- Developing maps and information that inform effective co-location of multiple existing and new ocean uses, such as commercial fishing, military training, and new energy infrastructure development.

Robust stakeholder engagement and public participation are essential to ensure that actions are based on a full understanding of the range of interests and interactions that occur in each region. Consultation with scientists, technical experts, the business community, and those with traditional knowledge is a foundation of marine planning.

Regional planning bodies are not regulatory bodies and have no independent legal authority to regulate or otherwise direct Federal, State, tribal, or local government actions. All activities will continue to be regulated under existing authorities. For example, commercial and recreational fishing will continue to be managed exclusively by the relevant State and Federal fisheries managers and Regional Fishery Management Councils or Commissions.

As an initial action, the National Ocean Council will provide additional guidance to support marine planning in the regions that choose to move forward through regional planning bodies as described above.



## VI. Science and Information

Scientific and technological advances allow us to better understand our world. Building our knowledge allows us to respond more appropriately to new challenges, adapt to changing conditions, and take advantage of emerging opportunities for the benefit of our Nation. Strong science, technology, and engineering capabilities and informed people and communities are the foundation for improving our understanding of the marine environment—from the coasts to the deep sea—and informing our decisions about how best to manage the activities that affect the valuable and multiple resources the marine environment provides.

Sustained scientific research and innovative technologies give us the high-quality information we need to maintain or restore ocean resources, guide development and investment opportunities, safeguard lives and property from marine hazards, enhance national security, prepare for and respond to the impacts of climate change and ocean acidification, improve public health, and protect ocean resources. Advancing our scientific, technological, and engineering capabilities also increases the Nation's competitiveness and helps spur the innovation that drives our economy and improves our quality of life. Ultimately, success in improving the ways we use and manage ocean resources depends on building broad public understanding and recognition of the importance of the ocean, coasts, and Great Lakes to our daily lives and the long-term welfare of our Nation.

The actions in this section will engage partners and stakeholders to provide significant, long-term commitments of scientific, technological, and educational support to address existing priorities and

apply new knowledge to improve our approaches to management and inform our responsible pursuit of opportunities. Discoveries and technological advances will provide data and information to improve decision-making and enhance the effectiveness of management actions. A focus on fundamental research and exploration will ensure continued advances in basic scientific understanding. An informed society will enable innovative and effective entrepreneurship and stewardship. Collectively, these actions will provide information and capabilities needed to support economies, improve human well-being, enhance environmental health, and increase safety and security.

## Enhancing Our Understanding of Ocean and Coastal Systems

For the United States to continue to be a global leader in understanding and acting on the connections between our well-being and the health of the natural environment, we need to continue exploring and expanding our knowledge of the ocean, our coasts, and the Great Lakes. Management and policy decisions must be based in the context sound science provides, through the integration of natural and social science data, information, and knowledge. National Ocean Policy actions will contribute to high-quality science and ensure that information based on that science is made available to guide decisions and actions. Insight gained from scientific research, advances in observations, and innovative technologies will further enable evaluation of trade-offs between alternative management scenarios, enhance our ability to balance competing demands on ecosystems, and strengthen our Nation's economic and scientific competitiveness. At the same time, increasing understanding of the ocean, coasts, and Great Lakes among our people and communities will empower better-informed public stewardship of ocean resources.

- **Advance fundamental scientific knowledge through exploration and research.** Through Federal research and exploration activities and partnerships with non-governmental organizations, new ocean discoveries will expand our knowledge and understanding of oceanic and Great Lakes biodiversity, biogeochemical processes, ecosystem services, and climate interactions. Agencies will use the Ocean Research Priorities Plan, a document built with input from the ocean science and technology community, as a reference in determining research directions. They will conduct expeditions in poorly known or unknown regions of the ocean and Great Lakes. They will also work to incorporate natural, social, and behavioral-science information in decision-support tools, which will enable Federal, State, tribal, regional, and local authorities to manage ocean, coastal, and Great Lakes resources more efficiently and effectively.
- **Advance technologies to explore and better understand the complexities of land, ocean, atmosphere, ice, biological, and social interactions on a global scale.** Environmental observation provides the basis for informing decision-making. New technologies, including improved remote sensing systems, and the coordination among agencies needed to develop and implement them, are critical to improving our understanding of the underlying physical and ecological processes driving the ocean, coasts, and Great Lakes, as well as to identifying more efficient means of monitoring these ecosystems. Federal agencies will evaluate how to most effectively integrate observational data, test and develop ocean sensors and communication standards, and implement data and modeling techniques to support a global observational capability to show how observed variables change over time.



- **Increase ocean and coastal literacy.** Increased public understanding of ocean and coastal science and the importance of the ocean in how our planet functions will empower people and communities to be better stewards of ocean resources and increase awareness of opportunities related to these resources. It will also increase interest in activities to address the issues facing the ocean, our coasts, and the Great Lakes. Agencies will contribute to opportunities for systematic inclusion of ocean topics and concepts into mainstream K-12 and informal education systems. Agencies will also develop content that incorporates the latest ocean science for use in schools, aquariums, science centers, National Parks, and other institutions, and conduct demonstration projects that deliver ocean observing data for schools and other educational opportunities.

## Strengthening Our Ability to Acquire Marine Data and Provide Information

Vital to ocean and coastal research and management in the United States is the availability of modern ships, undersea vehicles, moorings, satellites, laboratories, instruments, and observing systems. Our ability to send sensors and scientists to sea through these facilities and infrastructure provides critical information for protecting human lives and property from marine hazards, enhancing safety and security, understanding and projecting global climate change and ocean acidification, improving ocean health, and providing for the protection, sustainable use, and enjoyment of ocean resources. Improved science and technology will help the scientific community forecast changes with greater certainty and provide guidance for communities, resource managers, and commercial interests alike.

- **Assess the status of the Federal Oceanographic Fleet to inform future planning and to ensure a more efficient interagency approach to managing the Fleet.** The Federal Oceanographic Fleet is a critical national infrastructure that supports Federal agency and academic oceanographic operations, surveys, and research across a broad spectrum of needs. Ships provide access to the sea and Great Lakes and enable us to gather critical information that supports our responsible use and management of marine resources. Federal agencies will use the inventory and status report of the Federal Oceanographic Fleet to identify its capacity to support a range of requirements nationwide, including in the Arctic, such as data collection and research, weather and climate, ocean mapping, and the understanding of ocean and seafloor physical, chemical, geological, and biological processes.
- **Advance and sustain ocean, coastal, and Great Lakes observing system infrastructure to support a variety of users.** The hard infrastructure of our ocean observing systems, which include various sensors and instruments affixed to buoys, gliders, piers, sea walls, and other platforms (e.g., satellites), form the foundation for a national, integrated observing system which yields real-time information about the marine environment, including meteorological, oceanographic, and ecological conditions. Such information is of value to many different users—from commercial and recreational interests to government and academia—on a daily basis for multiple purposes. Federal agencies will work to advance and sustain the infrastructure of ocean observing systems, such as the Integrated Ocean Observing System and the Ocean Observatories Initiative, to ensure their capability, reliability, and longevity in providing valuable data and information to a growing community of users. Federal agencies will also develop

a national ocean observation and monitoring plan to address new autonomous underwater vehicle technologies and sustained monitoring of the water column.

- **Develop an integrated ocean and coastal data and information management system to support real-time observations.** Agencies will coordinate to develop a nationally integrated information management system for our ocean observing systems. We need this system—with supporting interagency data management policies—to realize the full potential and benefits of the Nation’s investment in ocean, coastal, and Great Lakes observing systems. This effort will provide easy access to relevant ocean observing data and information for research, planning, and decision support, and will be closely linked with the national marine planning data portal (ocean.data.gov) and other ocean and coastal data portals and services.
- **Implement a distributed biological observatory in the Arctic to monitor changes and improve our understanding of their socioeconomic and ecosystem impacts.** The effects of Arctic changes and human activity on ecosystems and Alaskans who depend on them are poorly understood. Continued observations are needed to form a basis of understanding of the changing processes in the Arctic region. Agencies will continue to develop and deploy a distributed biological observatory, or an array of sites for consistent monitoring of biophysical responses in the Arctic marine environment, as a component of the integrated Arctic Observing Network. Regional collaboration and partnerships will increase our capacity to monitor and assess changing environmental conditions and support improved management of Arctic coastal and ocean resources.

## Improving Science-based Products and Services for Informed Decision-Making

High-quality science and information are the foundation for the development of new and improved products and services, including decision-support tools and information displays, which can help inform the decisions at all levels of government working to protect and sustain our economy and environment. Federal agencies will pursue the following actions to enable all interests and decision-makers to make the best-informed decisions possible.

- **Improve the science framework to support decision-making.** Implementing ecosystem-based management will require support from all available scientific tools and methods (e.g., observing, monitoring, synthesizing, hypothesis testing, modeling, predicting, and reporting). Agencies will identify gaps in the basic natural and socioeconomic data needed to advance development and practice of ecosystem-based management, and develop plans to fill them, and engage partners and stakeholders in development of guidelines and best practices.
- **Provide the high-quality data and tools necessary to support science-based decision-making and ecosystem-based management.** Robust decision-support tools and processes will provide information derived from natural and social sciences and traditional knowledge to support timely and effective decision-making. To the degree practicable, these tools and processes will take advantage of and build upon Federal, State, tribal, regional, and local data

portals and regional data sharing systems, and be coordinated with other Federal data policies and initiatives.

- **Develop and share decision-support tools to identify coastal land protection and restoration priorities.** Developing and sharing decision-support tools will promote better coordination between Federal agencies and local, State, regional, and tribal entities in identifying protection and restoration priorities across the coastal landscape. As a pilot project, Federal agencies will complete the initial build-out of a Chesapeake Bay decision-support tool system and institute collaborative partnerships within the Bay to support coastal land conservation and restoration planning.



photo: Ernest Koe

## VII. Conclusion

This Implementation Plan identifies practical, efficient, and responsible actions that Federal agencies will take to support healthy, productive, and resilient ocean, coastal, and Great Lakes waters, thriving coastal communities, and a robust, safe, and secure marine economy. The Plan will strengthen and build on existing relationships, help forge new partnerships, and enable broad participation from stakeholders and the public in decisions that impact the oceans, coasts, and Great Lakes. Fundamentally, it will provide the science and tools our Nation needs to sustain and enhance the quality of life for all Americans.



# Endnotes

1. Throughout the Implementation Plan, the term “State” includes Puerto Rico, the U.S. Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa.
2. “Tribes” refers to Federally-recognized tribes.
3. The Implementation Plan is intended to be read in conjunction with Executive Order 13547 and the Final Recommendations of the Interagency Ocean Policy Task Force, July 19, 2010.
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UNITED STATES  
NATIONAL  
SCIENCE  
FOUNDATION

FY **2017**  
**BUDGET**  
**REQUEST TO**  
**CONGRESS**

**MISSION:** To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.

—From the National Science Foundation (NSF) Act of 1950 (P.L. 81–507)

**VISION:** A Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education.

—From Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014–2018

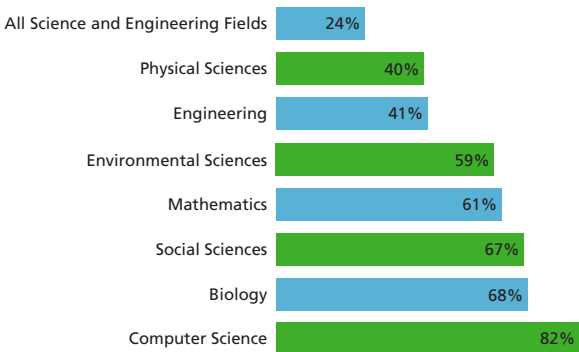


## ABOUT NSF

- Established by Congress in 1950 as an independent federal agency to promote American science and engineering (S&E).
- The only federal agency that funds basic non-biomedical research and education across all fields of S&E and at all levels of education.
- Invests in the basic research and people who make discoveries that transform our future by driving the U.S. economy, enhancing our Nation's security, and giving the United States the competitive edge to remain a global leader.
- Funds advanced instrumentation and facilities, Arctic and Antarctic research and operations, cooperative research between universities and industry, and U.S. participation in international scientific efforts.
- Allocates nearly 90 percent of research funding through a competitive merit review process as grants or cooperative agreements to individual researchers and groups at colleges, universities, academic consortia, nonprofit institutions, and small businesses.
- Has supported 217 Nobel Laureates since its inception.

### NSF Support of Academic Basic Research in Selected Fields

(as a percentage of total federal support)



Note: Biology includes Biological Sciences and Environmental Biology; excludes National Institutes of Health.

Source: NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research & Development, FY 2014

# Investing in Science, Engineering, and Education for the Nation's Future

## FY 2017 BUDGET REQUEST

### NSF Budget by Appropriation (dollars in millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate	
				Amount	Percent
Research and Related Activities	\$6,041.57	\$6,033.65	\$6,425.44	\$391.79	6.5%
Education and Human Resources	\$886.33	\$880.00	\$952.86	\$72.86	8.3%
Major Research Equipment and Facilities Construction	\$144.76	\$200.31	\$193.12	-\$7.19	-3.6%
Agency Operations and Award Management	\$306.56	\$330.00	\$373.02	\$43.02	13.0%
National Science Board	\$4.15	\$4.37	\$4.38	\$0.01	0.2%
Office of Inspector General	\$14.60	\$15.16	\$15.20	\$0.04	0.3%
<b>TOTAL</b>	<b>\$7,397.97</b>	<b>\$7,463.49</b>	<b>\$7,964.02</b>	<b>\$500.53</b>	<b>6.7%</b>

Totals may not add due to rounding.

The FY 2017 Request for NSF is \$7,964.02 million, of which \$7,564.02 million is discretionary funding and \$400.0 million is new mandatory funding. New mandatory funding is \$346.01 million in Research and Related Activities and \$53.99 million in Education and Human Resources.

### FY 2017 CROSS-FOUNDATION INVESTMENTS

- Understanding the Brain (UtB): \$142 million.
- Risk and Resilience: \$43 million.
- Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS): \$62 million.
- Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES): \$16 million.

### ONGOING NSF-WIDE PRIORITIES

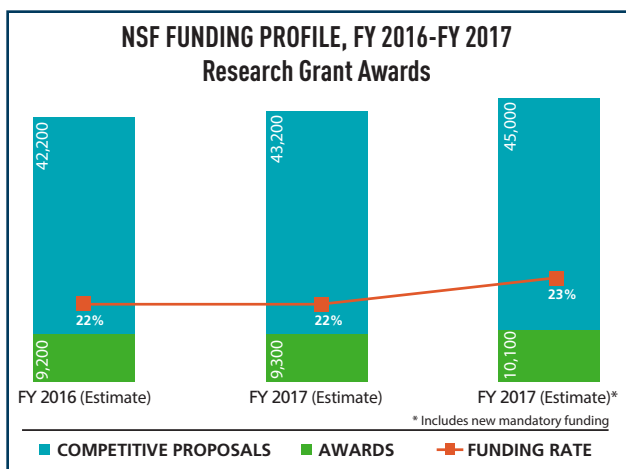
- Clean Energy: \$512 million
- Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS): \$257 million
- Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21): \$100 million
- NSF Innovation Corps (I-Corps™): \$30 million
- Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS): \$30 million
- Science, Engineering, and Education for Sustainability (SEES): \$52 million
- Secure and Trustworthy Cyberspace (SaTC): \$150 million

### NSF by the Numbers

<b>\$8.0 billion</b>	FY 2017 Budget Request
<b>1,859</b>	Colleges, universities, and other institutions receiving NSF funding in FY 2015
<b>49,600</b>	Proposals evaluated in FY 2015 through a competitive merit review process
<b>12,000</b>	Competitive awards funded in FY 2015
<b>231,000</b>	Proposal reviews conducted in FY 2015
<b>350,000</b>	Estimated number of people NSF supported directly in FY 2015 (researchers, postdoctoral fellows, trainees, teachers, and students)
<b>51,800</b>	Students supported by NSF Graduate Research Fellowships since 1952

## ADVANCING INNOVATION AND ENABLING TOMORROW'S DISCOVERIES

- New 1-year mandatory funding of \$400 million will support NSF's core research activities that contribute to the Nation's science and technology enterprise.
- Funding will support more scientists and engineers early in their careers to quicken the pace of discovery and advance the leading edge of research and education.
- Funds will allow for about 800 new research grants, increasing NSF's FY 2017 funding rate to an estimated 23%.
- Funds will impact approximately 20,600 additional people, including senior researchers, postdocs, graduate and undergraduate students, and K-12 students and teachers.



### For More Information:

**NSF FY 2017 Budget Request to Congress**  
[www.nsf.gov/about/budget](http://www.nsf.gov/about/budget)

**Research and Education Results Supported by NSF**  
[www.nsf.gov/discoveries](http://www.nsf.gov/discoveries)

**NSF Budget and Performance**  
[www.nsf.gov/about/performance](http://www.nsf.gov/about/performance)

**Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014–2018**  
[www.nsf.gov](http://www.nsf.gov)

**Driving Federal Performance**  
[www.performance.gov](http://www.performance.gov)

## FY 2017 PERFORMANCE GOALS

For FY 2017, NSF has set nine performance goals that will enable the agency to strategically monitor and oversee progress being made towards its larger aims. NSF also assesses progress through an annual process of strategic reviews of the objectives in its strategic plan. In FY 2017, NSF will perform strategic reviews and monitor the following goals.

Goal	Goal Statement
<b>Agency Priority Goal:</b> Improve Graduate Student Preparedness	Improve STEM graduate student preparedness for entering the workforce.
<b>Agency Priority Goal:</b> Invest Strategically in Public Participation in STEM Research (PPSR)	Build the capacity of the Nation to solve research challenges and improve learning by investing strategically in crowdsourcing and other forms of public participation in science, technology, engineering, and mathematics research.
Ensure that Key Program Investments are on Track	Monitor the progress of four investments using a set of common milestones and indicators: NSF INCLUDES; INFEWS; Risk and Resilience; and UtB.
Ensure that Infrastructure Investments are on Track	Ensure program integrity and responsible stewardship of major research facilities at varying stages of their lifecycle. In FY 2017, this goal involves monitoring the performance of construction projects.
Use Evidence to Guide Decisions	Use evidence-based reviews to guide management investments.
Make Timely Award Decisions	Inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months, of deadline, target, or receipt date, whichever is later.
Foster a Culture of Inclusion	Foster a culture of inclusion through change management efforts resulting in change leadership and accountability.
Evaluate NSF Investments	Enable consistent evaluation of the impact of NSF investments with a high degree of rigor and independence.
Increase the Percentage of Panelists Participating in Merit Review Virtually	Increase the percentage of proposal review panelists that participate virtually while maintaining the quality of the merit review process.

Note: STEM—Science, Technology, Engineering, and Mathematics

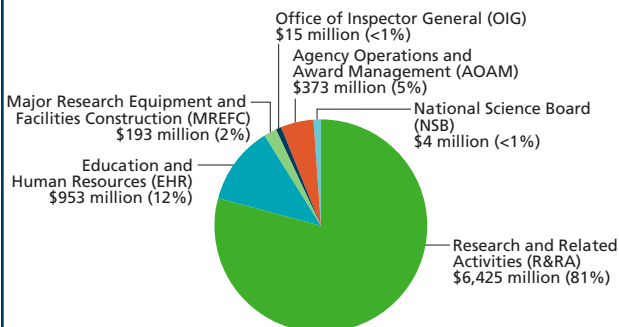


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## FOLLOWING THE MONEY

### WHERE IT COMES FROM

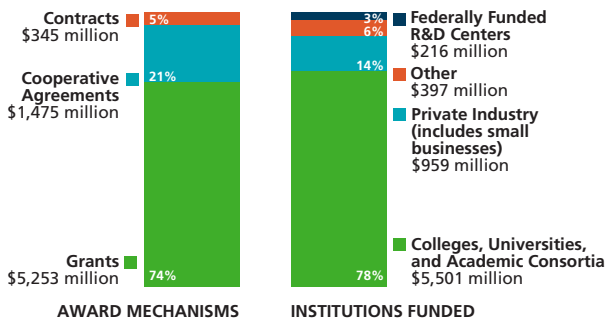
#### FY 2017 NSF Budget Request by Account—\$7,964 million



Note: The FY 2017 Request for NSF is \$7,964 million, of which \$7,564 million is discretionary funding and \$400 million is new mandatory funding. Totals may not add due to rounding.

### WHERE IT GOES AND HOW IT GETS THERE

#### Obligations for Research and Education Programs—\$7,073 million



This chart shows the distribution of NSF's obligations by institution type and funding mechanism. While the data shown are based on FY 2015, the relative shares should provide a good indication of the FY 2017 distribution.

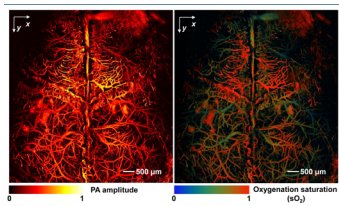
Note: NSF Research and Education Programs include R&RA, EHR, and MREFC appropriations. Other institutions funded include federal, state, and local governments; nonprofit organizations; and international organizations. R&D=Research & Development. Totals may not add due to rounding.

**About the cover:** This cover shows two of the winning images from The Vizzies Visualization Challenge available at [http://www.nsf.gov/news/special\\_reports/scivis/](http://www.nsf.gov/news/special_reports/scivis/). They are (top) a photograph of microscopic crystals found in a sea urchin's tooth and (bottom) an image showing the connectivity of a cognitive computer based on the macaque brain.

**Cover image credits:** Pupa U. P. A. Gilbert and Christopher E. Killian, University of Wisconsin, Madison (top); Emmett McQuinn, Theodore M. Wong, Pallab Datta, Myron D. Flickner, Raghavendra Singh, Steven K. Esser, Rathinakumar Appuswamy, William P. Risk, and Dharmendra S. Modha (bottom).

## RESEARCH AND EDUCATION HIGHLIGHTS

### Imaging the Brain in Real Time



Credit: Junjie Yao and Lihong Wang, WUSTL

NSF-funded researchers at Washington University in St. Louis (WUSTL) use laser light to peer into the brain to unprecedented depths (nearly 3 inches). The approach they pioneered, termed photoacoustic imaging, combines laser light and sound

waves. The technique allows the study of biological material, from cells to tissues and organs, in its natural environment, free of imaging agents. It detects single red blood cells as well as fats and proteins. The researchers are integrating the technique into a system to capture images every 1/1,000th of a second.

### Hunting for Gravitational Waves



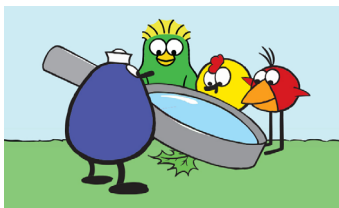
Credit: Cfoellmi via Wikimedia Commons

In May 2015, NSF dedicated the Advanced Laser Interferometer Gravitational-Wave Observatories (LIGO) in Washington state.

Researchers using the facilities seek to observe and record gravitational waves for the first time. The Advanced LIGO

project represents a major upgrade expected to enhance the sensitivity of LIGO's instruments by a factor of at least 10 and can see a volume of space more than 1,000 times greater than the initial LIGO. The existence of gravitational waves is a crucial prediction of the General Theory of Relativity.

### PBS Series Engages Latino Children in Math and Science



Credit: WGBH

*Peep and the Big Wide World*, an NSF-funded Emmy award-winning Public Broadcasting Service (PBS) series, developed an outreach campaign to encourage greater family involvement in children's exploration of math and science. A Spanish-speaking

character was added to the animated cast, and parents, including Spanish speakers, are now featured in the live-action videos. A study found that Spanish-speaking parents who used *Peep* resources with their preschool-age children were better equipped to facilitate science and math exploration. The parents reported feeling more inclined to do math and science activities with their preschoolers and said the resources are easy to understand, fun, and help them learn science alongside their children.



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FY2017

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**NOAA**

Budget Summary



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

# CONTENTS

<b>Chapter 1</b> Introduction	2
<b>Chapter 2</b> National Ocean Service	6
<b>Chapter 3</b> National Marine Fisheries Service	12
<b>Chapter 4</b> Office of Oceanic and Atmospheric Research	20
<b>Chapter 5</b> National Weather Service	26
<b>Chapter 6</b> National Environmental Satellite, Data, and Information Service	32
<b>Chapter 7</b> Mission Support	40
<b>Chapter 8</b> Office of Marine and Aviation Operations	44
<b>Appendix 1</b> Proposed Changes to General Provisions	48
<b>Appendix 2</b> Control Table	49

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Layout and Design: Jacob Kang

## From the Desk of Dr. Sullivan



Dr. Kathryn D. Sullivan, Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator

Dear friends of NOAA,

As America's environmental intelligence agency, NOAA provides timely, reliable, and actionable information - based on sound science - to communities and businesses around the country every day. We've seen demand for our products and services increase, as decision makers look for tools to help them better understand risk and prepare for the future. We're helping people, businesses, communities, and governments make smart decisions that directly impact the future of society, the economy, and the environment.

Since announcing NOAA's priorities, the agency has made tremendous strides toward providing the information and services communities need to build resilience, evolving the National Weather Service, investing in our network of observational platforms, and, achieving organizational excellence.

### Providing Information and Services to Make Communities More Resilient

Communities around the country are struggling with the effects of extreme events like hurricanes, drought, and fisheries collapse. The drought in California - the worst in the state's history - is a paramount example of the environmental and socio-economic devastation that environmental events can wreak on communities, businesses, and the environment. NOAA's FY 2017 budget request takes a major step toward helping communities prepare for, respond to, and recover from the damage that weather-, water-, and climate-related events can cause.

As the only Federal agency charged with water prediction and warning responsibilities, NOAA is uniquely positioned to address water challenges facing the nation. Through targeted investments and an integrated approach to these challenges, NOAA will develop and deliver new and improved products that put critical water forecast information into the hands of local decision makers and the public, including integrated river and stream forecasts for more than 100 million Americans who don't currently receive this information.

The budget request also includes funding for grants to communities to enable them to implement resilience strategies, increased capacity to speed the completion of environmental consultations and remove obstacles to sustainable development, and investments in the baseline scientific research and observations needed to improve understanding and use of ocean and coastal resources and development of coastal infrastructure, all of which will be coordinated efficiently with the efforts of our Federal and state partners. These investments will support our efforts to build resilient communities, economies, businesses, and ecologies.

### Evolving NOAA's National Weather Service

NOAA has made considerable progress in evolving the National Weather Service over the past few years. From technical to organizational changes, including supercomputing upgrades and more efficient budget and administrative structures, we have made positive changes internally and externally. The proposed FY 2017 budget continues these efforts and aims to strengthen the products and services that promote public safety and protect livelihoods. The requested budget enables



NOAA to extend the life of the Next Generation Weather Radar (NEXRAD) infrastructure, which underpins forecast and warning services for severe high-impact weather events, such as tornadoes and thunderstorms. In addition, the budget invests in extending the life of the Automated Surface Observation System (ASOS), the nation's primary surface weather observing system. These upgrades, along with continued integration of NOAA dissemination systems, and expansion of our water prediction capabilities, are vital to ensuring that the NWS becomes second to none and we build a Weather-Ready Nation.

### Investing in Observational Infrastructure

NOAA's observing systems are the foundation of the environmental intelligence we provide. The successful launches of DSCOVR and Jason-3 satellites, and the upcoming launch of GOES-R are major milestones to assuring the continuity of our critical space-based data streams. Ongoing investments in radars, supercomputers, buoys, and other platforms are also critical to sustaining the nation's security against natural hazards, protecting our environment, and providing the information communities and businesses rely upon. The requested FY 2017 budget supports the Polar Follow On (PFO), a program that is vital to ensure the continuity of polar satellite observing systems, which provide the primary data inputs for NOAA's numerical weather prediction models.

NOAA's fleet of research vessels are aging, with half slated to retire within the next decade, including five Regional Class Survey Vessels (RSVs) that are essential to NOAA's fisheries and coastal missions. To prevent this significant erosion of mission capability, this budget invests in development of a new RSV to support fishery surveys, habitat and hydrographic surveys, and disaster response. The long timelines involved in shipbuilding make it imperative to invest in RSV replacement now, in order to avert a decline in stock assessment capacity that would result in more conservative fishery management decisions and lost fishing opportunities.

### Achieving Organizational Excellence

NOAA's employees are the lifeblood of the agency. Twenty-four hours a day, seven days a week, the dedicated men and women of this agency strive to provide excellent science and service to every community in the United States. As public servants, we fully embrace the mantra of "Mission First, People Always." At NOAA, we work hard to uphold a workplace that is welcoming, safe, and professionally challenging. In November 2015, I issued a diversity and inclusion policy statement to articulate how each and every member of our team can contribute toward building a workplace that enhances our people-based skills in concert with the skills we need as a science-based services agency.

Meeting NOAA's mission requires that our dedicated employees have safe and efficient workplaces and up-to-date equipment, technology, and tools that are equal to their mandated tasks. This budget makes targeted investments to remedy critical facility and IT deficiencies that put mission success at risk. Additionally, it proposes to fund a new program designed to accelerate the transition of promising NOAA research into operations and applications--ensuring that the public reaps the benefit of Federal investments in research and development.

### Conclusion

In closing, NOAA's FY 2017 budget supports our unique role within the Federal government. The requested funding is critical as the agency positions itself to meet the growing demand from communities and businesses to help them prepare for, respond to, and overcome vulnerabilities and risk.



Dr. Kathryn Sullivan

Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator

# Terminology

The reader should be aware of the specific meaning of several terms as they are used throughout this budget summary:

### FY 2015 Spend Plan

Fiscal Year (FY) 2015 Consolidated and Further Continuing Appropriations Act, 2015 (PL 113-235).

### FY 2016 Enacted

Fiscal Year (FY) 2016 Consolidated Appropriations Act, 2016 (PL 114-113).

### Adjustments-to-Base

Includes the estimated FY 2017 federal civilian pay raise of 1.6 percent (and the estimated FY 2017 federal military pay raise of 1.6 percent as appropriate). Program totals will provide inflationary increases for non-labor activities, including service contracts, utilities, field office

lease payments, and rent charges from GSA. In addition, ATBs include unique/technical adjustments to the base program, for example transfers of base resources between budget lines.

### FY 2017 Base

FY 2016 Enacted plus Adjustments-To-Base.


### Program Change

Requested increase or decrease over the FY 2017 base.

### FY 2017 Request

FY 2017 Base plus Program Changes.

# CHAPTER 1 INTRODUCTION



DSCOVR, the United States' first operational deep space satellite and a vital piece of our international space weather observing system, successfully launched on February 11, 2015 from Cape Canaveral, Florida.

**I**n its Fiscal Year (FY) 2017 budget request, NOAA continues to position itself as the Nation's premier environmental intelligence agency, supporting U.S. economic growth and job creation, enhancing public safety, and protecting and managing natural resources. NOAA's FY 2017 budget request includes \$5,851 million (\$77 million above the FY 2016 enacted level) to continue targeted investments to: 1) Provide information and services to make communities more resilient; 2) Evolve the National Weather Service (NWS); 3) Invest in observational infrastructure; and 4) Achieve organizational excellence. This budget aligns with the Department of Commerce's Environment, Data, and Operational Excellence priorities, as well as the Administration's priorities related to climate, Earth observations, IT security and high performance computing, ocean conservation and use, and research and development.

Of particular note, NOAA's FY 2017 budget includes a new Integrated Water Prediction initiative to enhance water prediction and public forecasting and warning capabilities to help communities better prepare for and respond to droughts and floods, both of which have grown in frequency and intensity in recent years. The budget also establishes a Research Transition Acceleration Program to accelerate promising NOAA research to operations, applications, and commercialization. In addition, this budget continues critical investments in NOAA's at-sea and space-based observation and monitoring capabilities through continued investments in the NOAA ship fleet and the Polar Follow On, a next generation polar satellite program critical for ensuring future forecasting accuracy and improving forecasting lead times, both of which save lives. For more information about specific FY 2017 initiatives, please consult the individual line office chapters that follow or the tables in Appendix 2.

NOAA appreciates the continued support of Congress, the Administration, and our broad and diverse base of stakeholders and will continue to monitor major milestones and accomplishments to evaluate progress and demonstrate success. Below are some of NOAA's top accomplishments from 2015, which we could not have achieved without our partners in other Federal and state agencies, as well as in the research, industry, and conservation communities:

## Launched Deep Space Climate Observatory Satellite (DSCOVR)

On February 11, 2015, NOAA successfully launched DSCOVR from Cape Canaveral, Florida. DSCOVR, the United States' first operational deep space satellite, is a vital piece of our international space weather observing system. DSCOVR provides NOAA's Space Weather Prediction Center forecasters high-quality measurements of solar wind conditions, improving their ability to monitor and warn of potentially dangerous geomagnetic storms. Early warnings are crucial because solar storms can disrupt public infrastructure, such as transportation systems, power grids, telecommunications, and Geographic Positioning Systems (GPS). Early geomagnetic storm warnings allow infrastructure managers from the commercial airline, electric power, and GPS industries to take appropriate mitigation actions. DSCOVR reached final orbit at Lagrange point 1, a gravity neutral point a million miles away from Earth, on June 8, 2015, and is now hovering continuously between the sun and Earth.

## Continued Progress on Ending Overfishing and Rebuilding Fish Stocks

NOAA's *Status of Stocks 2014: Annual Report to Congress on the Status of U.S. Fisheries*, released in April

2015, reports that the number of fish stocks subject to overfishing or overfished has declined to an all-time low. As a result of the combined efforts of NOAA; the regional fishery management councils; and our partners in industry, research, and conservation communities; stocks subject to overfishing are down from 17 to eight percent and overfished stocks are down from 24 to 16 percent since 2007. The report notes that three stocks, Gulf of Mexico gag grouper, golden tilefish, and butterfish, have been rebuilt to target levels. Two additional stocks, canary rockfish and petrale sole, have been rebuilt since the report was released, bringing the total to 39 stocks rebuilt since 2000 and allowing additional fishing opportunity in those fisheries. Gulf of Mexico red snapper continues to rebuild, enabling a 30 percent increase in the allowable catch for red snapper in 2015.

## Led Effort to Secure Settlement Funds for Gulf of Mexico Ecosystem Restoration

In FY 2015, NOAA led a collaborative effort among four Federal agencies and the five Gulf of Mexico states (Trustees) to advance the Deepwater Horizon oil spill case – the largest marine oil spill in U.S. history – to reach a groundbreaking proposed settlement between British Petroleum (BP) and the Trustees that will promote widespread restoration

in the affected region. NOAA provided extensive science and research (assessing the fish, wildlife, and habitat affected by the spill), supported the litigation actions against BP and other responsible parties, and led development of a comprehensive damage assessment and restoration plan that will direct \$8.8 billion for ecosystem restoration in the Gulf of Mexico in the coming years. This funding will support significant long-term restoration for natural resources injured by the oil spill, including sea turtles, marine mammals, fish, deep sea corals, oysters, and coastal habitats and will provide lasting and significant benefits to the people and environment of the Gulf of Mexico who were most directly impacted by this tragic event.

### Supported Major Recovery Efforts for Endangered Species Act (ESA)-listed Salmonids

NOAA played key roles in two major recovery efforts for ESA-listed Pacific salmon and steelhead in 2015. First, the threatened south-central California Coast steelhead now has unimpeded access to an additional 25 miles of spawning and rearing habitat due to efforts of NOAA, California State Coastal Conservancy, California American Water, and other partners that resulted in removal of the 106-ft. San Clemente Dam on the Carmel River in Monterey, California. Second, for the first time since the 1950s, threatened Central Valley spring-run Chinook salmon began their lives in the waters of the San Joaquin River due to a re-introduction effort led by the San Joaquin River Restoration Program (SJRRP), a multi-agency state and Federal partnership that includes NOAA. This effort allowed for release of approximately 60,000 hatchery-produced juvenile spring-run Chinook into the San Joaquin River in February 2015. Before operation of the Friant Dam in the 1950s, tens to hundreds of thousands of spring-run Chinook salmon returned to the San Joaquin River in California. The SJRRP is using a balanced approach that enables species recovery while maintaining a reliable water supply, critical to California's agriculture industry.

### Increased Supercomputing Capacity for Improved Data Assimilation and Forecasts

In FY 2015, NOAA began a major upgrade of its large scale operational supercomputers to allow for greater data assimilation and faster computation of model data, which will create more realistic conditions in NOAA models and enable more accurate weather forecasts and enhanced public safety. The supercomputing upgrade will help forecasters more accurately predict droughts, floods, winter storms, severe thunderstorms, and hurricanes. It will also enhance NOAA's water science and services for better forecasts of water

flow, soil moisture, evapotranspiration, runoff, and other parameters for 2.7 million stream reaches in the continental U.S. This upgrade has already increased NOAA's supercomputing capacity by nearly four times the previous level, for a total of 5.8 petaflops.

### Expanded Two California National Marine Sanctuaries

On June 9, 2015, NOAA expanded two national marine sanctuaries (NMS) by 2,770 square miles to protect one of the most productive ocean areas in North America. The nutrient rich upwelling zone identified in the Cordell Bank and Gulf of the Farallones NMS supports a vast array of sea life including whales, seals, dolphins, sea lions, and white sharks. New research opportunities in the expansion areas have already provided new findings, including the discovery of large catshark and skate nursery areas and a new species of gorgonian coral. Cordell Bank NMS, located 42 miles north of San Francisco, was expanded from 529 square miles to 1,286 square miles. Gulf of the Farallones NMS (now called the "Greater Farallones NMS"), located in the waters adjoining Cordell Bank NMS, was expanded from 1,282 square miles to 3,295 square miles of ocean and coastal waters. The expansions followed extensive public comment and research by NOAA and its scientific partners.

### Released Climate Resilience Toolkit

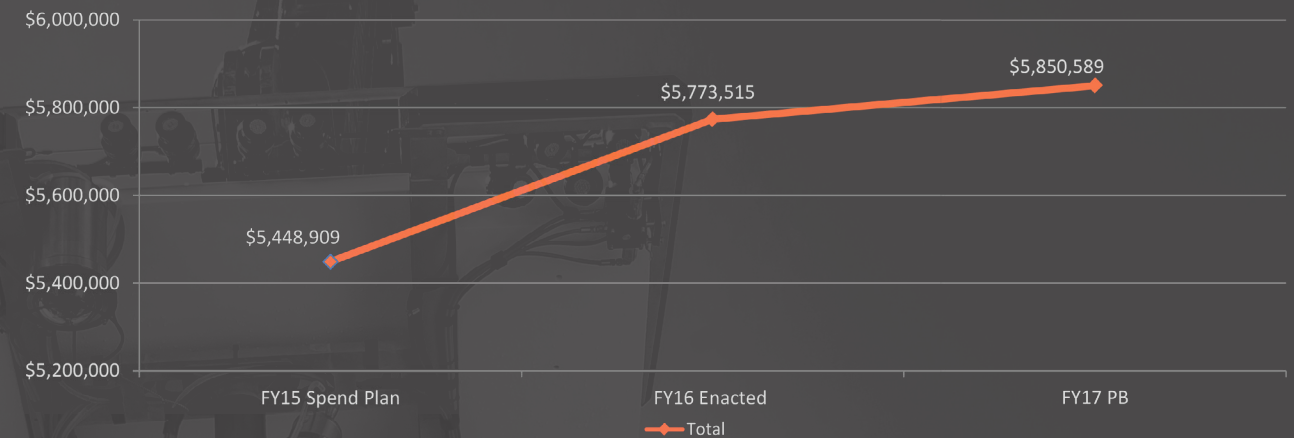
In October 2014, NOAA released version 1.0 of the web-based U.S. Climate Resilience Toolkit, which helps the Nation address challenges related to coastal flooding and other climate-related risks. For instance, the Toolkit includes map generators to illustrate climate-related vulnerabilities that communities face on national and local scales, and summarizes steps communities can take to become more resilient to climate change, such as managing water supply or strengthening infrastructure. The Climate Resilience Toolkit was developed in accordance with the President's Climate Action Plan and is available online at <https://toolkit.climate.gov>.

### Transitioned the Multi-Radar Multi-Sensor System to Operations

In October 2014, in collaboration with University of Oklahoma's Cooperative Institute for Mesoscale Meteorological Studies, NOAA transitioned into operations its Multi-Radar Multi-Sensor (MRMS) system, which helps forecasters manage the high volume of available weather data. The MRMS system generates products every two minutes, streamlining large amounts of data from multiple sources to provide more accurate and complete weather trends than traditional, single-radar

## NOAA Discretionary Appropriation Budget Trends (FY 2015-2017)

(\$ thousands)



systems. With MRMS forecasters are better able to visualize high-impact weather events such as snowstorms and tornadoes. This, in turn, allows NOAA to provide earlier and more accurate weather forecasts.

### Completed Hydrographic and Environmental Surveys in the Arctic

During 2015, NOAA ships collected critical hydrographic, fisheries, and protected species data in the Arctic region, enabling improvements to nautical charts required for safe navigation and providing data on managed species. NOAA Ships Rainier and Fairweather collected nearly 600 nautical miles of hydrographic data. NOAA ships Ronald H. Brown and Oscar Dyson supported a joint NOAA fisheries and research project to study marine ecosystems in the Northern Bering Sea, Chukchi Sea, Beaufort Sea, and Gulf of Alaska. The NOAA ship Reuben Lasker conducted a month-long North Pacific right whale survey off Kodiak Island, AK; this data is critical to assessment and management of this endangered species.

### Upgraded Hurricane Weather Research and Forecasting Model

On June 9, 2015, NOAA improved operational hurricane track and intensity forecasts for the first time for the Western North Pacific, Southern Pacific, and North and South Indian oceans. The Hurricane Weather Research and Forecasting (HWRF) model, which tracks the entire globe to detect tropical cyclones, was upgraded and can now produce forecast guidance out to five days in advance for up to seven separate storms simultaneously. Evaluation of the 2015 HWRF model for the North Atlantic, Eastern North Pacific and Western North Pacific showed a ten percent improvement compared to the model's performance in 2014.

### Issued Volcanic Ash Advisories

On July 31, 2015, using imagery from its Suomi NPP satellite system, NOAA's Washington Volcanic Advisory Center (W-VAAC) helped predict the movement of volcanic ash from the eruption of Manam Volcano off the coast of Papua New Guinea. The Federal Aviation Administration and commercial airlines rely on W-VAAC information to determine if they need to reroute or delay air traffic to avoid volcanic ash, which spreads quickly and can stop airline engines mid-flight. W-VAAC is responsible for monitoring the continental United States, Hawaii, a large part of the Pacific, Central America, northern South America, the Caribbean, and the western Atlantic for volcanic activity. In FY 2015, W-VAAC issued roughly 1,777 volcanic ash advisories to warn about the serious threat of volcanic ash. W-VAAC also provides 6-, 12-, and 18-hour satellite tracking that shows the location and likely dispersal of volcanic ash plumes.

### Released Upgraded nowCoast Tool

NOAA released a major upgrade of nowCOAST in September 2015. The GIS web-based mapping portal provides near real-time coastal intelligence for coastal and marine users on present and future weather, oceanographic, and hydrologic conditions. The new version features an improved map viewer that enables animations of changing conditions and the use of different base maps. The tool now integrates the latest National Weather Service watches, warnings, and advisories for long-duration hazards; water vapor imagery from NOAA geostationary satellites (GOES); forecast guidance from NOAA operational oceanographic forecast modeling systems; and satellite data on lightning activity. This improved functionality better serves needs of users involved in emergency management, homeland security, search and rescue, and marine operations.

# CHAPTER 2 NATIONAL OCEAN SERVICE

Unique geologic formations along the coast provide different textures and habitats for wildlife.  
Credit: Matt McIntosh/NOAA.

**NOAA's** National Ocean Service (NOS) enables safe, sustainable, and efficient use of marine and coastal resources. NOS monitors physical oceanographic features and provides oceanographic data to the public; conducts research for sustainable management, protection, and restoration of ocean and coastal resources; and uses place-based approaches to achieve sound resource management. NOS's science-based products and services support increased coastal economic activity, resilient coastal communities, safe and efficient marine transportation, and enhanced ecosystem services.

## FY 2017 REQUEST \$569,915,000

NOAA requests a total of \$569,915,000 in discretionary and mandatory funds to support enhanced operations and stakeholder support capabilities within NOS. This total includes Operations, Research, and Facilities (ORF); Procurement, Acquisition, and Construction (PAC); and other accounts and includes a net increase of \$33,152,000 in FY 2017 program changes. Funding in 2017 will allow NOS to continue to make critical investments in products, services, and capabilities that strengthen the resilience of the Nation's coasts and coastal communities to immediate hazards and long-term risks.

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$528,411,000 to support the Operations, Research, and Facilities of the NOS. This includes a net increase of \$23,152,000 in program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### NAVIGATION, OBSERVATIONS, AND POSITIONING \$197,906,000

NOAA requests a net program decrease of \$10,000,000 for a total of \$197,906,000 in the Navigation, Observations, and Positioning sub-program. Highlights include:



Two NOAA divers cut a large piece of derelict fishing gear into pieces at the surface.



This PORTS<sup>®</sup> station will provide real-time, 24-hour water level information to mariners, providing safe transport in and out of Port Fourchon, Louisiana.

**Navigation, Observations and Positioning: Hydrographic Research and Technology Development:** NOAA requests a decrease of \$2,000,000 to discontinue single-year cooperative agreements with academic institutions for joint ocean and coastal mapping centers. NOAA will continue to support research and development of survey, geospatial data management, and cartographic technologies through the Joint Hydrographic Center, the Coast Survey Development Laboratory, and other Navigation, Observations, and Positioning programs.

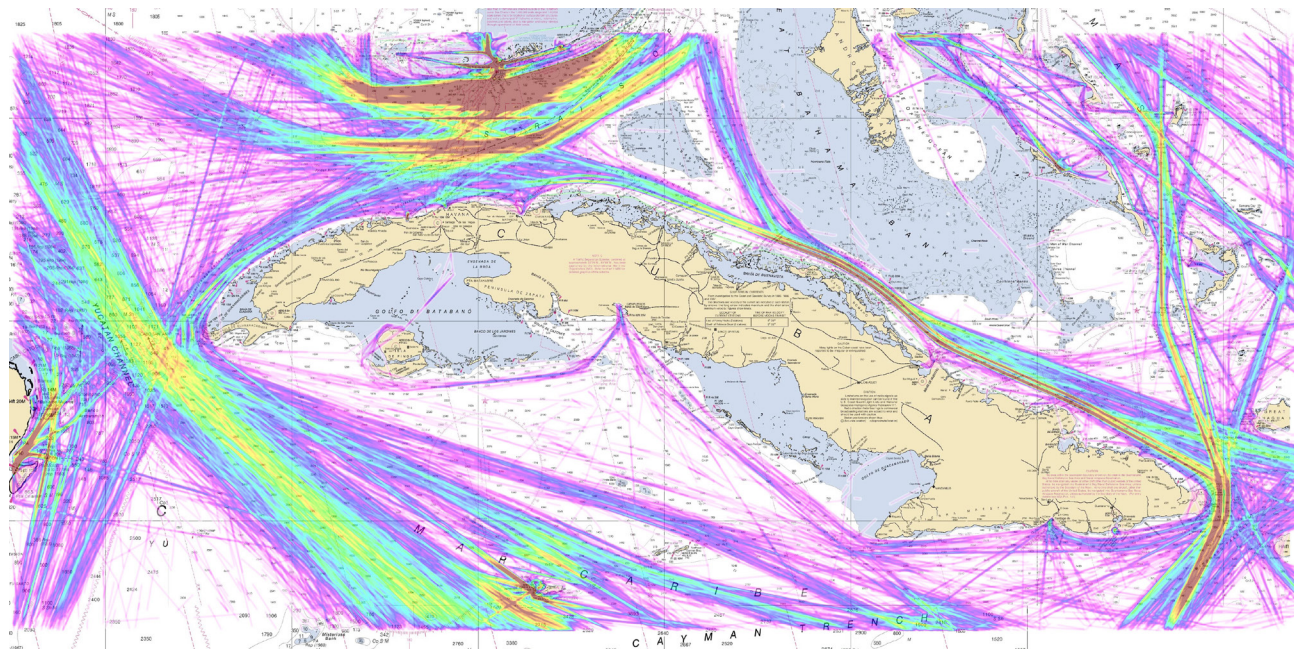


Chart of FL Straits with Automated Identification System (ship traffic) data overlaid that shows the high traffic density in the Straits.

**Navigation, Observations and Positioning: Regional Geospatial Modeling Grants:** NOAA requests a decrease of \$6,000,000 to terminate the Regional Geospatial Modeling Grant program. NOAA will continue to support a range of regional geospatial requirements through NOS's Coastal Zone Management and Services, and Navigation, Observations, and Positioning program activities. These regionally significant activities include height modernization, Continuously Operating Reference Stations, data access, and capacity building.

**Hydrographic Survey Priorities/Contracts: Reduce Acquisition of Hydrographic Surveys Data:** NOAA requests a decrease of \$2,000,000 to reduce acquisition of hydrographic data from contract surveys. NOAA will continue to acquire hydrographic data in support of navigation and other coastal intelligence needs with remaining funds.

#### COASTAL SCIENCE AND ASSESSMENT \$87,112,000

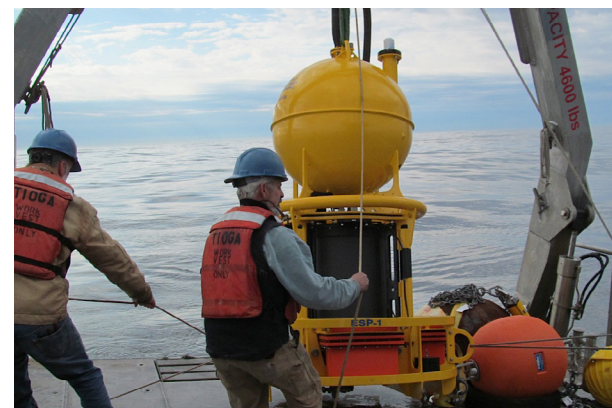
NOAA requests a net program increase of \$4,000,000 for a total of \$87,112,000 in the Coastal Science and Assessment sub-program. Highlights include:

**Competitive Research:** NOAA requests an increase of \$4,000,000 to expand competitive research grants that address coastal ocean issues, including harmful algal blooms, hypoxia, and coastal ecosystem assessment.

#### OCEAN AND COASTAL MANAGEMENT AND SERVICES \$243,393,000

NOAA requests a net program increase of \$29,152,000 for a total of \$243,393,000 in the Ocean and Coastal Management and Services sub-program. Highlights include:

**Coastal Zone Management and Services: Integrated Water Prediction:** NOAA requests an increase of \$2,500,000 to develop and operate the Nation's first Integrated Water Prediction (IWP) capability by developing key atmospheric, terrestrial, and coastal water prediction capabilities across NOAA. IWP will deliver water intelligence products and services to local stakeholders, such as emergency managers and state and municipal officials. Products will include unified, consistent, and



Scientists deploy an Environmental Sample Processor to detect toxic *Alexandrium* blooms in the Gulf of Maine.

high-resolution forecasts for floods and droughts. This cross-line office initiative with the National Weather Service (NWS) begins a multi-year strategy to improve water intelligence services provided to the Nation. NOS will lead the new service delivery model component of the IWP program, bringing together interdisciplinary practitioners to establish common data standards, baseline knowledge, and protocols so that products meet stakeholder needs. For more information on this joint initiative between NOS and NWS, please see p. 27 and p. 29 in Chapter 5.

**Coastal Zone Management and Services: Ecosystem-based Solutions for Coastal Resilience:** NOAA requests an increase of \$5,000,000 for NOS in a joint initiative with the National Marine Fisheries Service (NMFS) to better inform decision-making related to the stewardship of inshore ecosystems. This initiative will complement the NMFS proposal "Ecosystem-based Solutions for Fisheries Management." Increases in coastal population densities and development are reducing the ability of marine and coastal habitat to support species populations and serve as natural barriers against environmental threats, such as severe storms. Agencies, businesses, and communities need additional habitat science to better inform decision-making and enable effective resource management, disaster recovery, and redevelopment planning. Each of these functions is essential to



A pipeline rupture allowed an estimated 21,000 gallons of crude oil to reach the Pacific Ocean, shown here where the oil entered Refugio State Beach in California. NOAA's Office of Response and Restoration provided information on the fate and effects of the crude oil and potential environmental impacts both in the water and on the shore.

support coastal economies. NOS will apply physical and social sciences to deliver actionable information to communities. This will allow green infrastructure and other ecosystem-based solutions to be incorporated into hazard mitigation, coastal development, and post-disaster rebuilding. For more information on this joint initiative between NOS and NMFS, please see p. 13 in Chapter 3.

**Coastal Zone Management and Services: Capacity to Respond to Extreme Events:** NOAA requests an increase of \$4,006,000 to build internal capacity to support community response and resilience to extreme events. This initiative includes continued improvements to inundation monitoring and modeling, social science and risk communication, decision support tools, place-based monitoring, and planning and training for resilient coastal development.

**Coastal Zone Management and Services: AmeriCorps' Resilience Corps Pilot Program Training and Technical Assistance:** NOAA requests an increase of \$2,000,000 to develop and administer a community resilience training and technical assistance program for the AmeriCorps' Resilience Corps Pilot Program. This investment will support communities and Tribes in developing vulnerability assessments, coordinating with Federal resilience efforts, and implementing resilience strategies.

**Coastal Management Grants: Regional Coastal Resilience Grants:** NOAA requests an increase of \$15,000,000 to expand this competitive grant program to more fully address community, ecosystem, fishing community, and economic resilience challenges across the U.S. This



A bicyclist navigates flooded path in Charleston's Battery.

program will assist coastal communities in planning for extreme weather events, coastal inundation, climate hazards, changing ocean conditions, and competing uses; supporting regional approaches that leverage existing collaborative efforts; and protecting, restoring, and enhancing coastal habitat, including fisheries. The solicitations for NOAA's resilience grants in 2015 yielded \$151,000,000 in requests, far exceeding the available funding and demonstrating the significant unmet need for resilience tools and project implementation nationwide.

## FY 2017 PAC BUDGET SUMMARY

NOAA requests a total of \$3,700,000 to support Procurement, Acquisition, and Construction (PAC) activities of the National Ocean Service, unchanged from the FY 2016 enacted level. These funds support the National Estuarine Research Reserve System (NERRS) Construction and Land Acquisition Program and the National Marine Sanctuaries Construction Program.

## DISCRETIONARY FUNDS

### National Oceans and Coastal Security Fund

NOAA requests an increase of \$10,000,000 to establish the National Oceans and Coastal Security Fund, as authorized by Title IX of the Consolidated Appropriations Act, 2016. This Fund will increase the capacity of coastal

states and other entities to conduct projects and initiatives to better understand and utilize the oceans, coasts, and Great Lakes of the United States, and ensure present and future generations will benefit from the full range of ecological, economic, social, and recreational opportunities, security, and services these resources are capable of providing. Broadly, grants will support protection, conservation, and restoration of ocean and coastal resources and coastal infrastructure.

## MANDATORY FUNDS

### Damage Assessment and Restoration Revolving Fund

The Damage Assessment and Restoration Revolving Fund was established in 1990 under Section 1012(a) of the Oil Pollution Act to facilitate (1) natural resources damage assessments and (2) restoration, replacement, or acquisition of injured or lost natural resources, including resources of National Marine Sanctuaries and National Estuarine Research Reserves, tidal wetlands, and other habitats for which NOAA is trustee. The fund receives proceeds from claims against responsible parties as determined through court settlements or agreements.

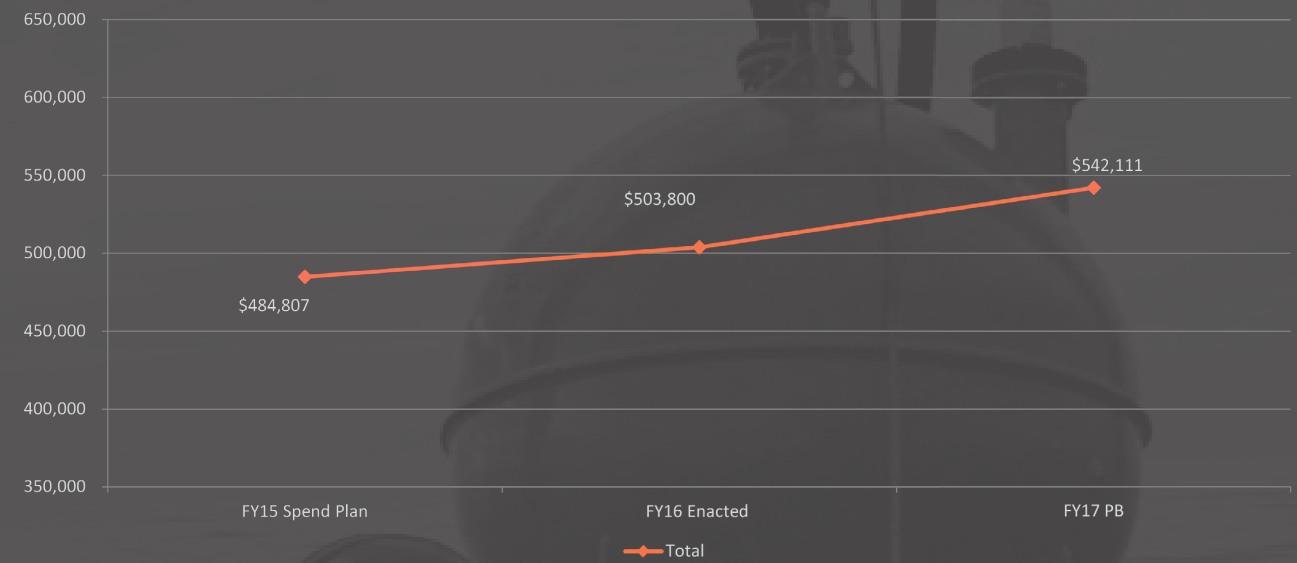
### Sanctuaries Enforcement Asset Forfeiture Fund

The Sanctuaries Enforcement Asset Forfeiture Fund receives proceeds from civil penalties and forfeiture claims against responsible parties, as determined through court settlements or agreements, for violations of NOAA



Taro Lo'i and the Ko'olau Mountains surrounding the the proposed NERR site in He'eia.

## NOS Discretionary Budget Trends (FY 2015-2017) (\$ thousands)



sanctuary regulations. Penalties received are spent on resource protection within a sanctuary in which the violation occurred.

### Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Fund

The Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Fund provides funding for the NOAA RESTORE Act. The purpose of this program is to initiate and sustain an integrative, holistic understanding of the Gulf of Mexico ecosystem and support restoration efforts and the long-term sustainability of the ecosystem.

# CHAPTER 3 NATIONAL MARINE FISHERIES SERVICE

Hawaiian monk seal swims in the Papahānaumokuākea Marine National Monument.

**NOAA's** National Marine Fisheries Service (NMFS) is responsible for the stewardship of the nation's living marine resources and their habitats. NMFS provides vital services for the Nation, including sustainable and safe sources of seafood; the recovery and conservation of at-risk species; and healthy, resilient ecosystems – all backed by sound science and an ecosystem-based approach to management. As of January 2016, NMFS manages 473 marine and anadromous fish stocks within the U.S. Exclusive Economic Zone (EEZ) as well as invertebrates, sea turtles, marine mammals, and other marine and coastal species and their habitats.

## FY 2017 REQUEST \$1,015,930,000

NOAA requests a total of \$1,015,930,000 in discretionary and mandatory funds to support the continued and enhanced operations of NMFS. This includes Operations, Research, and Facilities (ORF) and other accounts, including the Pacific Coastal Salmon Recovery Fund, and represents a net increase of \$51,786,000 in FY 2017 program changes. With this increase, NMFS will expand its permitting and consultation capacity to ensure commercial and other activities can move forward expeditiously in compliance with the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and Magnuson-Stevens Fishery Conservation and Management Act (MSA). NMFS will also be able to expand assistance to some fishing communities with future declared fishery disasters, and strengthen fishery management and enforcement programs, especially those related to illegal, unreported, and unregulated (IUU) fishing. NOAA also requests \$4,557,000 to prepare for the construction of a replacement laboratory in Mukilteo, Washington on Puget Sound. The lab, which is a near-term safety hazard and must be rebuilt, supports Washington State's Puget Sound recovery efforts and northwest commercial and recreational fisheries, which generate \$14.7 billion in sales and 167,000 jobs. NOAA requests these funds within the Mission Support Procurement, Acquisition, and Construction (PAC) account. For more information on the NOAA Fisheries Facilities Initiative, please see p. 42 in Chapter 7.



New England fishing vessels.

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$904,734,000 to support the Operations, Research, and Facilities of NMFS, reflecting a net increase of \$42,786,000 in FY 2017 program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

## PROTECTED RESOURCES SCIENCE AND MANAGEMENT \$216,771,000

NOAA requests a net increase of \$31,802,000 in FY 2017 program changes in the Protected Resources Science and Management sub-program for a total of \$216,771,000. Highlights include:

**Marine Mammals, Sea Turtles and Other Species: Increase Consultation Capacity, ESA Recovery:** NOAA requests an increase of \$13,452,000 to build ESA and MMPA consultation capacity, to address significant growing and emerging permitting needs (e.g., Gulf of Mexico restoration, road and bridge construction, drought projects) and reduce the con-

sultation backlog. With this increased capacity, NOAA will advance species recovery while enabling sustainable economic activity, both of which contribute to community resilience. NMFS will also use \$3,000,000 to advance recovery planning and implementation with partners for ESA listed corals. This request, along with the proposed increase below for essential fish habitat (EFH) consultations in the Habitat Conservation and Restoration sub-program (see p. 15), is part of a broad NOAA initiative to expand capacity needed to expedite review and permitting of public and private development projects that benefit the Nation's economy and create new jobs. NOAA will target some of this increase to support consultations related to Deepwater Horizon and RESTORE Act projects.

**Species Recovery Grants:** NOAA requests an increase of \$16,012,000 for the Species Recovery Grants program, which provides funding to states and Tribes to implement recovery actions for ESA listed species. Recovery actions (e.g., dam removal, bycatch reduction efforts, monitoring programs) improve species populations and habitat so that ESA protections are no longer necessary. Expanding this competitive grants program is critical for our partners to meet management needs for the growing number of listed species and focus on larger scale, ecosystem-level or multi-state projects that have a greater impact on the recovery of listed species. As of January 2016, NMFS had jurisdiction over 129 threatened or endangered species, with an additional 49 species proposed, candidates, or petitioned for listing. NMFS will prioritize funding for grants that address species in the "Species in the Spotlight: Survive to Thrive" initiative, which focuses internal and external resources on preventing the extinction of the most vulnerable species (e.g., white abalone, HI monk seals, southern resident killer whales, Gulf of Maine Atlantic salmon).



Southern Resident killer whales.



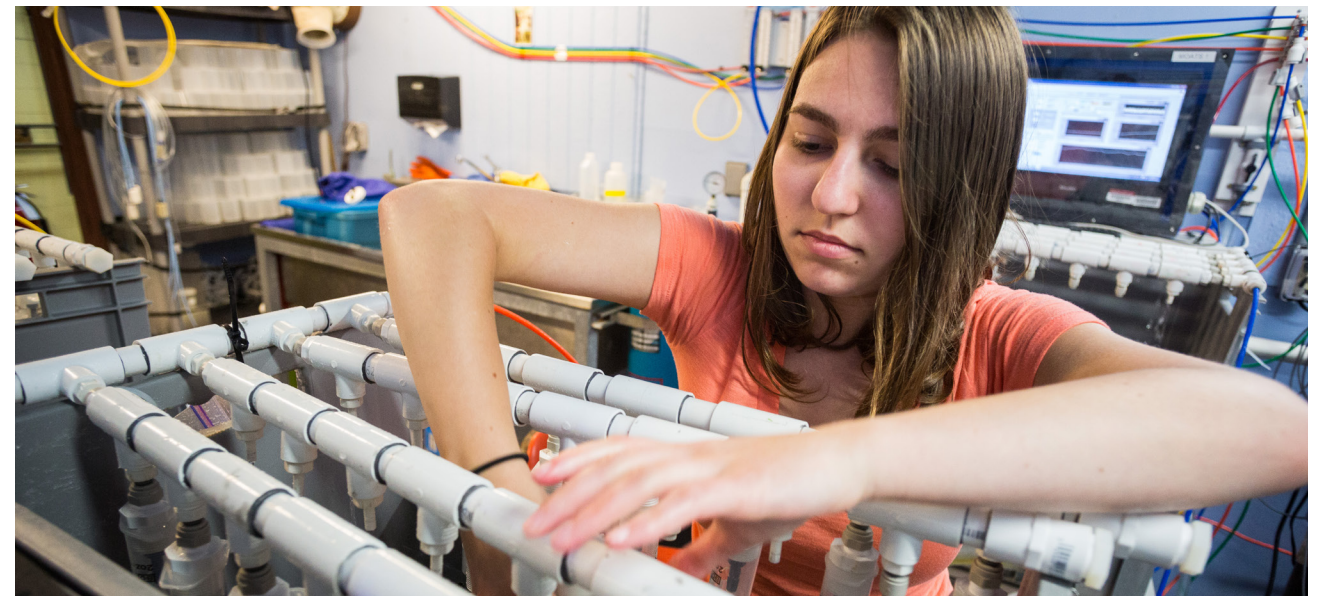
A pair of spawning pink salmon. Credit: John R. McMillan/NOAA.

**Pacific Salmon:** NOAA requests an increase of \$2,338,000 to implement recovery actions and expand consultation capacity to promote Pacific salmonid (salmon and steelhead) recovery. NMFS will focus FY 2017 funds on expediting review of hatchery genetic management plans and improving hatchery practices to reduce their impacts on ESA listed salmonids. Continued hatchery operations are essential to sustaining Pacific salmonid stocks, and hatcheries that are out of compliance are at risk of litigation and potential reduced production. In addition, NMFS will expand monitoring and data collection to enable more precise, targeted, and prioritized recovery strategies, and increased economic opportunity (e.g., harvest).

### FISHERIES SCIENCE AND MANAGEMENT \$558,715,000

NOAA requests a net increase of \$13,489,000 in FY 2017 program changes in the Fisheries Science and Management sub-program for a total of \$558,715,000. Highlights include:

**Fisheries and Ecosystem Science Programs and Services: Ecosystem-based Solutions for Fisheries Management:** NOAA requests an increase of \$5,929,000 for NMFS in a joint initiative with NOS to fill gaps in habitat science needed to improve fisheries and protected species management and community resilience. NMFS will map coastal ecosystems (e.g., marshes, dunes, mangroves) and advance understanding of the value of habitat to fish and protected species populations and as physical defense systems for coastal communities. Rapidly increasing coastal population densities and development are impacting habitat benefits, reducing their ability to support species populations or serve as natural barriers against severe storms and other environmental



The ocean acidification laboratory at the NOAA Mukilteo Research Station is a state-of-the-art facility with which researchers can study the sensitivity of California Current species to ocean acidification, temperature change, and deoxygenation. Here, Jennifer Imm, a NOAA Hollings Scholar, loads a vile containing young Dungeness crab into equipment that exposes them to altered pH and oxygen conditions. Credit: Benjamin Drummond /bdsjs.com.

threats. Additional, targeted, high-quality habitat science will better inform decision-making and trade-offs, enabling effective resource management, disaster recovery, and redevelopment planning, while supporting coastal economies. For more information on this joint initiative between NMFS and NOS, please see p. 8 in Chapter 2.

**Observers & Training:** NOAA requests an increase of \$1,095,000 for observers and training to provide accurate and timely information and analyses on the biological, economic, and social aspects of the Nation's fisheries resources. The scientific data collected by observer programs are critical to population assessments of threatened and endangered species such as sea turtles, seabirds, and marine mammals, and for effective management of the Nation's fish stocks. The requested funding will provide an additional 1,000 sea days of observer coverage in six regional fishery observer programs.

**Fisheries Management Programs and Services: National Catch Share Program:** NOAA requests an increase of \$2,505,000 to develop and implement new catch share programs and support existing programs. Implementation of a new catch share system involves many activities at both national and regional levels, including collecting and analyzing socioeconomic data, establishing accounting databases and reporting systems, and setting up at-sea and dockside monitoring systems. Catch share programs are an important management tool that have demonstrated benefits such as preventing

the dangers associated with the "race for fish," eliminating overfishing, and reducing bycatch. In some fisheries, catch share programs have resulted in more profitable fisheries. For example, the value of the Gulf of Mexico red snapper fishery more than doubled since a catch share program was instituted in 2007 – from \$10.1M in 2007 to \$23.0M in 2014.

**Fisheries Management Programs and Services: Management of Fair Trade:** NOAA requests an increase of \$1,556,000 to combat illegal, unreported, and unregulated (IUU) fishing and fraud by tracking seafood from global harvest to entry in the United States. IUU fishing weakens profitability for legally caught seafood, fuels illegal trafficking operations, and undermines economic opportunity for legitimate fishermen. Global losses attributable to IUU fishing are estimated to be \$10 to \$23 billion annually. Because the U.S. imports more than 90 percent of its seafood, NOAA is working to ensure that high demand for imported seafood does not create incentives for illegal fishing activity. Developing a seafood traceability program will help ensure that products are legally fished, properly labeled, and meet adequate safety and environmental standards. These efforts will create a more level playing field between foreign and U.S. fishermen and secure the Nation's and fishing communities' significant investments in the safety and sustainability of U.S. domestic fisheries. This initiative is complemented by a requested increase in the Enforcement sub-program, described below (see p. 15).





**Aquaculture: Support for Domestic Seafood Production and Jobs through Aquaculture:** NOAA requests an increase of \$1,525,000 to conduct research and regulatory activities that enable safe and sustainable aquaculture development. The U.S. currently imports over 90 percent of its seafood, over half of which is from aquaculture. This funding will be used to develop a coordinated, consistent, and efficient regulatory permitting process for the marine aquaculture sector and to refine science-based tools for sustainable management of marine aquaculture. The funding will increase the U.S.-sourced seafood supply and will create jobs and increase trade opportunities by further developing a robust and sustainable marine aquaculture industry. Failing to make these investments will result in aquaculture companies continuing to invest in operations overseas, drawing expertise, capital, and opportunities away from U.S. communities.

#### ENFORCEMENT \$70,858,000

NOAA requests a net increase of \$1,018,000 in FY 2017 program changes in the Enforcement sub-program for a total of \$70,858,000. Highlights include:

**Enforcement: Expanding NOAA's Cooperative Enforcement Program:** NOAA requests an increase of \$1,018,000 to improve efforts to enforce import restrictions on illegally-harvested and improperly documented seafood and marine resources in collaboration with state and territorial partners through Joint Enforcement Agreements (JEAs). NOAA will use these funds to strengthen and leverage existing partnerships and inspection resources, as well as to add IUU detection and deterrence capabilities in states where NOAA has not had a presence



NOAA enforcement personnel and state partners inspect a shipment for compliance with fisheries regulations.

in the past. The funds will be distributed to existing and new partners at key strategic ports of entry. This initiative is complemented by a requested increase in the Fisheries Science and Management sub-program described above (see p. 14).

#### HABITAT CONSERVATION AND RESTORATION \$58,390,000

NOAA requests a net decrease of \$3,523,000 in FY 2017 program changes in the Habitat Conservation and Restoration sub-program for a total of \$58,390,000. Highlights include:

**Habitat Conservation and Restoration: Increase Consultation and Essential Fish Habitat Implementation Capacity:** NOAA requests an increase of \$6,477,000 to build capacity for MSA Essential Fish Habitat (EFH) consultations to address significant growing and emerging permitting needs due to Gulf of Mexico restoration, road and bridge construction activities, drought projects, and other activities. At current staffing levels, NOAA cannot address the existing EFH consultation demands, impacting NOAA's ability to protect habitats needed to support the nearly \$200 billion U.S. commercial and recreational fishing industry. This request, along with the proposed increase above for ESA and MMPA consultations in the Protected Resources Science and Management sub-program (see p. 12), is part of a broad NOAA initiative to expand capacity needed to expedite review and permitting of public and private development projects that benefit the Nation's economy and create new jobs.

**Habitat Conservation and Restoration: Coastal Ecosystem Resiliency Grants:** NOAA requests a decrease of \$10,000,000 for Coastal Ecosystem Resiliency Grants to consolidate FY 2017 funds with NOS' request for an expanded Regional Coastal Resilience Program (see p. 8, Chapter 2). These funds are being consolidated into the NOS request for a total of \$20,000,000, which will allow NOAA to more comprehensively address ecosystem, fishing, community, and economic resilience challenges across the U.S. due to extreme weather events, coastal inundation, changing ocean conditions, and competing uses. The competitive grants program will expand funding opportunity for resilience planning, coastal habitat protection and restoration, and regional approaches that promote resilience by leveraging existing efforts and collaborations. The solicitations for NOAA's resiliency grants in 2015 yielded \$151 million in requests, far exceeding the available funding. This demonstrates the significant

unmet need for resilience tools and project implementation nationwide.

#### DISCRETIONARY FUNDS

##### FISHERIES DISASTER ASSISTANCE FUND

In FY 2017, NOAA requests \$9,000,000 for a new program to support activities that improve environmental and economic resilience of fisheries designated a fishery disaster by the Secretary. NOAA will use the fund for activities that restore the fishery, increase ecosystem resilience, and reduce the likelihood of future fishery disasters.

##### FISHERMEN'S CONTINGENCY FUND

The Fishermen's Contingency Fund allows NOAA to compensate U.S. commercial fishermen for damage or loss of fishing gear, vessels, or revenues caused by oil and gas-related obstructions in any area of the Outer Continental Shelf (OCS). The funds are derived from fees collected annually by the Secretary of the Interior.

##### FOREIGN FISHING OBSERVER FUND

The Foreign Fishing Observer Fund is financed through fees collected from owners and operators of foreign fishing vessels fishing within the U.S. Exclusive Economic Zone (EEZ) (e.g., such fishing requires a permit issued under the MSA). The fund is used by NOAA to pay salaries, administrative costs, data editing and entry costs, and other costs incurred for these observers.

##### FISHERIES FINANCE PROGRAM ACCOUNT

The Fisheries Finance Program is a national loan program that makes long-term, fixed-rate financing available to U.S. citizens who otherwise qualify for financing or



West coast fishing vessels.



Coral reefs, like this one in Florida's Biscayne Bay, benefit from NOAA's efforts to protect essential fish habitat.

refinancing for the construction, reconstruction, reconditioning, or the purchasing of fishing vessels, shoreside processing, aquaculture, mariculture facilities, or individual fishing quota.

##### MARINE MAMMAL UNUSUAL MORTALITY EVENT FUND

An unusual mortality event is defined under the Marine Mammal Protection Act (MMPA) as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." This fund supports efforts to examine carcasses and live stranded animals allowing understanding of threats and stressors and the ability to determine when a situation is "unusual."

##### PACIFIC COASTAL SALMON RECOVERY FUND

The Pacific Coastal Salmon Recovery Fund was established by Congress in FY 2000 to protect, restore, and conserve Pacific salmonids and their habitats. NMFS provides competitive funding to states and Tribes of the Pacific Coast region. Eligible applicants include the states of Washington, Oregon, California, Idaho, Nevada, and Alaska and federally recognized Tribes of the Columbia River and Pacific Coast (including Alaska). The FY 2017 budget requests \$65,000,000 for this account, which is the same as the FY 2016 enacted level. In FY 2017, NOAA will continue to ensure that riparian buffer protection and restoration receives priority for funding. NOAA will also continue ongoing collaborative work with the U.S. Department of Agriculture and the U.S. Environmental Protection Agency to jointly identify and target the highest priority salmon habitat restoration areas in the region for Federal outreach and funding.





Native shellfish, including geoducks, mussels, and clams, improve water quality and support a vibrant commercial shellfish industry worth over \$180M in Washington State. Credit: NOAA/Su Kim.

## MANDATORY FUNDS

### PROMOTE AND DEVELOP AMERICAN FISHERY PRODUCTS & RESEARCH PERTAINING TO AMERICAN FISHERIES FUND

The American Fisheries Promotion Act (AFPA) of 1980 amended the Saltonstall-Kennedy (S-K) Act to authorize a grants program for fisheries research and development projects to be carried out with the funds in the Promote and Develop account. Funds are derived from a transfer from the Department of Agriculture to NOAA from duties on imported fisheries products. An amount equal to 30 percent of these duties is made available to NOAA and, after transfers, is available to carry out the purposes of the AFPA and the S-K program.

### FISHERIES FINANCE PROGRAM ACCOUNT

The mandatory component of the Fisheries Finance Program Account authority is subject to the Federal Credit Reform Act of 1990 (FCRA) (2 U.S.C. 661). The FCRA requires estimated loan costs to be appropriated in cash when Congress authorizes annual credit ceilings.

### FEDERAL SHIP FINANCING FUND

This account manages the loan guarantee portfolio that existed prior to the enactment of the FCRA.

### ENVIRONMENTAL IMPROVEMENT AND RESTORATION FUND

The Environmental Improvement and Restoration Fund was created by the Department of the Interior and Related Agencies Appropriations Act of 1998 for the purpose of carrying out marine research activities in the North Pacific.

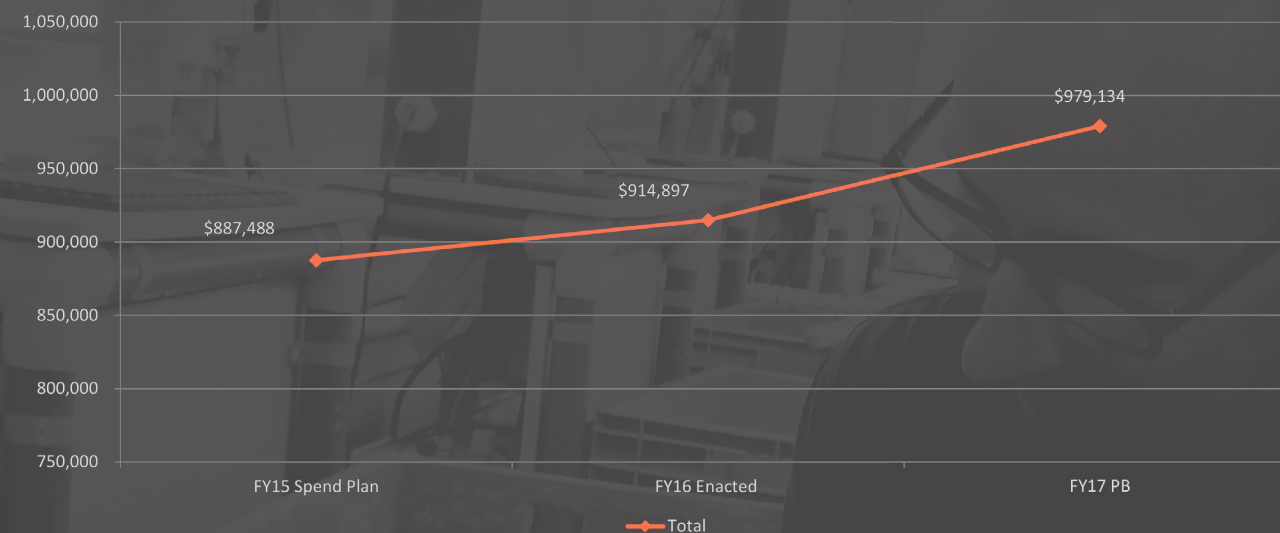
### LIMITED ACCESS SYSTEM ADMINISTRATION FUND

Under the authority of the MSA Section 304(d)(2)(A), NMFS must collect a fee to recover incremental costs of management, data collection, and enforcement of Limited Access Privilege programs. Fees are deposited into the Limited Access System Administration Fund. Fees shall not exceed three percent of the ex-vessel value of fish harvested under any such program.

### WESTERN PACIFIC SUSTAINABLE FISHERIES FUND

Section 204(e) of the 2006 amendments to the MSA authorizes the establishment of the Western Pacific Sustainable Fisheries Fund to allow foreign fishing within the U.S. EEZ in the Western Pacific through a Pacific Insular Area Fishery Agreement.

NMFS Discretionary Budget Trends (FY 2015-2017)  
(\$ thousands)



### FISHERIES ASSET FORFEITURE FUND

Section 311(e)(1) of the MSA authorizes the Secretary of Commerce to pay certain enforcement-related expenses from fines, penalties, and forfeiture proceeds received for violations of the MSA, MMPA, National Marine Sanctuaries Act, or any other marine resource law enforced by the Secretary. NOAA has established a Civil Monetary Penalty/Asset Forfeiture Fund.

### NORTH PACIFIC OBSERVER FUND

The North Pacific Groundfish Observer Program places all vessels and processors in the groundfish and halibut fisheries off Alaska into one of two observer coverage categories: (1) a full coverage category, and (2) a partial coverage category. In the partial coverage category, landings from all vessels will be assessed a 1.25 percent fee on standard ex-vessel prices of the landed weight of groundfish and halibut. Money generated by this fee will pay for observer coverage in the partial coverage category in the following year.



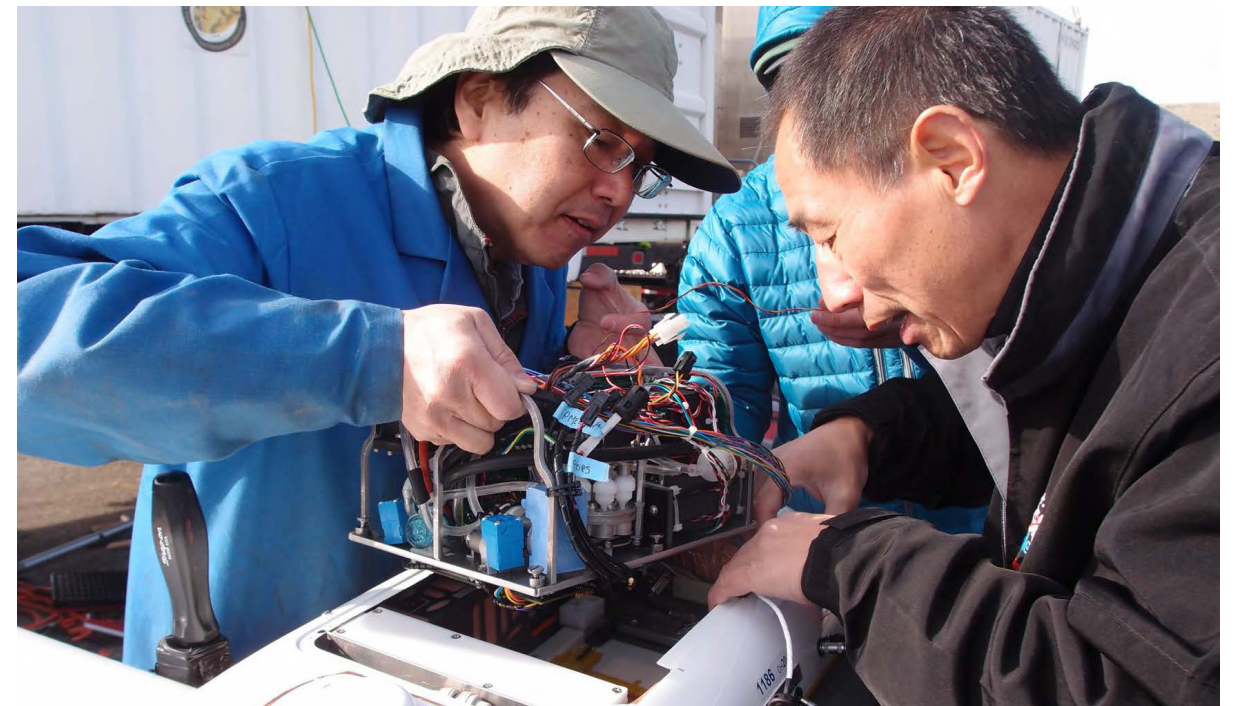
# CHAPTER 4 OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH

MODIS (aqua) satellite image of the 2015 Lake Erie Harmful Algal Bloom. Initial analysis indicates that the 2015 harmful algal bloom was the most severe bloom in terms of biomass this century.

**NOAA's** Office of Oceanic and Atmospheric Research (OAR) is the central research line office that integrates research across NOAA. OAR's science enables NOAA to fulfill its diverse mission, both today and into the future. OAR supports laboratories and programs across the United States and collaborates with external partners, including 16 NOAA-funded Cooperative Institutes and 33 Sea Grant Institutions. OAR research contributes to accurate weather forecasts, enables communities to plan for and respond to climate events such as drought, and enhances the protection and management of the Nation's coastal and ocean resources.

## FY 2017 REQUEST \$519,789,000

In FY 2017, NOAA requests a total of \$519,789,000 to support OAR's continued and enhanced operations. OAR's FY 2017 request supports its activities to accelerate the transition of promising research to operations, provide climate products and information to communities, conduct research to enhance severe weather forecast capability, and develop tools and technologies to monitor ocean acidification. This total includes Operations, Research, and Facilities (ORF) and Procurement, Acquisition, and Construction (PAC) accounts and is composed of a net increase of \$30,758,000 in FY 2017 program changes.



Installing a new aerosol instrument package onboard a Manta unmanned aircraft system platform. When paired with the agile Manta, the compact and lightweight instrument becomes a powerful new tool for NOAA to address climate and air quality issues related to aerosols in remote and hard-to-access regions. Credit: Karen Rosenlof

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$493,410,000 to support the Operations, Research, and Facilities of OAR, reflecting a net increase of \$24,458,000 in FY 2017 program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed

descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### CLIMATE RESEARCH \$189,866,000

NOAA requests a net increase of \$30,760,000 in FY 2017 program changes in the Climate Research sub-program for a total of \$189,866,000. Highlights include:

**Climate Laboratories and Cooperative Institutes: Atmospheric Baseline Observatories:** NOAA requests an increase of \$3,000,000 to return all six

Atmospheric Baseline Observatories (ABOs) to full operations, continuing the more than 50 years of observations collected at these facilities around the world. ABOs record trends and distributions of atmospheric constituents influencing global climate, ozone depletion, and changes in baseline air quality. Due to rising costs at remote sites and a decline in cooperative support, ABOs have experienced deferred maintenance and reduced observation capabilities over time. NOAA's ABOs are located in Barrow, AK; Trinidad Head, CA; Summit, Greenland; Mauna Loa, HI; American Samoa; and South Pole, Antarctica.

**Climate Laboratories and Cooperative Institutes: Greenhouse Gas Monitoring in Support of the President's Climate Action Plan:** NOAA requests an increase of \$2,975,000 to use atmospheric composition data from existing global networks to deliver greenhouse gas emission measurements that help evaluate efforts to reduce greenhouse gases, including carbon dioxide, methane, nitrous oxide, and the full suite of chlorofluorocarbon (CFC) replacements.

**Climate Laboratories and Cooperative Institutes: U.S. Global Change Research Program:** NOAA requests an increase of \$4,518,000 to conduct research and other activities in support of the U.S. Global Change Research Program's priority areas, including extreme weather, water, and climate events such as heat waves, droughts, and floods. Better understanding of these priority research areas will help inform community resilience efforts in the wake of a changing climate.



An Air Resources Laboratory engineer works on a U.S. Climate Reference Network (USCRN) site in Wolf Point, MT. The USCRN is a systematic and sustained network of climate monitoring stations with sites across the conterminous U.S., Alaska, and Hawaii that provide a continuous series of climate observations like temperature, precipitation, wind speed, and soil conditions.

**Regional Climate Data and Information: Assessments:** NOAA requests an increase of \$3,970,000 to help complete the fourth National Climate Assessment in 2018 and support a more robust process for future assessments in compliance with The Global Change Research Act of 1990. The Act requires submission of a regular climate assessment (developed by several Federal agencies including NOAA) to Congress that examines latest climate research, uncertainty, effects of global change, and emerging trends.

**Regional Climate Data and Information: Regional Integrated Sciences and Assessments:** The Regional Integrated Sciences and Assessments program supports research teams that help expand and build the Nation's capacity to prepare for and adapt to climate variability and change. NOAA requests an increase of \$3,912,000 to expand regional research, information services, and competitive grants to manage climate risks and serve one additional region, as well as new communities in existing regions.

**Regional Climate Data and Information: NOAA Arctic Research Program - Arctic Observing Network:** NOAA requests an increase of \$4,255,000 to support further development of its Arctic Observing Network in areas of the Arctic, such as the Chukchi Sea, that are undergoing environmental change and commercial development at an unprecedented pace. The request will also help NOAA develop informational products related to Arctic Ocean changes, sea-ice extent, ecosystem evolution, and Arctic to mid-latitude weather-climate linkages.

**Regional Climate Data and Information: Climate Resilience Toolkit in support of the President's Climate Action Plan via the Climate.gov Portal:** NOAA requests an increase of \$2,300,000 to enhance the Climate Resilience Toolkit (CRT), which provides public online access to actionable climate data, information, and tools to help communities plan for the impacts of climate change. These efforts will make the CRT more intuitive and user-friendly through new features including interactive tools.

**Climate Competitive Research: Impacts of Climate on Fish Stocks:** NOAA requests an increase of \$5,830,000 to award competitive grants for research that improves understanding of the impacts of climate variability and change on fish stocks, prey availability, and habitat. This research will be used to develop decision-support tools and training, and to integrate climate information into fisheries management. Enhancing early-warning

and management strategies for the impacts of climate variability and change will help minimize economic disruption for the fishermen and coastal communities across the Nation whose livelihoods depend on healthy fisheries.

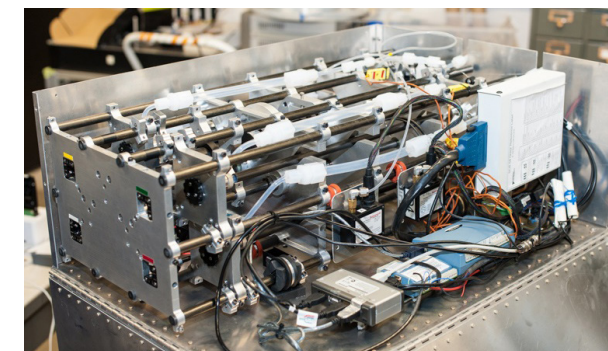
### WEATHER & AIR CHEMISTRY RESEARCH \$101,945,000

NOAA requests a net decrease of \$5,818,000 in FY 2017 program changes in the Weather & Air Chemistry Research sub-program for a total of \$101,945,000. Highlights include:

**Weather and Air Chemistry Laboratories and Cooperative Institutes: Vortex-Southeast:** NOAA requests a decrease of \$5,000,000 to terminate the Vortex-Southeast (SE) project in FY 2017. VORTEX-SE is a research effort that investigates the processes that produce tornadoes (with a focus on the Southeast, U.S. region); the way NWS forecasters anticipate, detect, and warn for tornadoes; and how end users receive and respond to information about tornadic activity. NOAA made considerable progress on Vortex-SE in FY 2015, awarding competitive grants to improve understanding of tornado development and risks, investing in observation systems in the Southeast, and holding a workshop for experts to identify tornado issues of special concern in the southeastern United States. In FY 2016, NOAA will launch a field effort to observe the growth of instability and shear in the atmosphere and the eventual thunderstorm activity associated with tornadoes and other large-scale weather systems.

**Weather and Air Chemistry Laboratories and Cooperative Institutes: Base Research:** NOAA requests a decrease of \$2,985,000 to reduce Cooperative Institute support for planned research projects. With this decrease, NOAA will narrow its research focus to improvements in weather forecasting, advances in near-term modelling, and transitioning research to operations.

**U.S. Weather Research Program: Improving the Airborne Detection and Understanding of Severe Weather:** NOAA requests an increase of \$4,642,000 to research and develop aircraft-based hazardous weather observing systems, such as the Airborne Phased Array Radar (APAR). Further investment in these systems will help NOAA and its partners develop a radar that is capable of doubling the amount of storm detail that can currently be gathered, which in turn will allow NOAA to issue more accurate forecasts and warnings of severe storms.



The NOy-Cavity Ring-Down Spectrometer is a sensitive, compact detector that measures total reactive nitrogen (NOy), as well as NO<sub>2</sub>, NO and O<sub>3</sub> using cavity ring-down spectroscopy. This product is unique in that the small, optical cage system allows measurements of all four trace gases simultaneously and with robust calibration. NOAA is now seeking manufacturers/licensees to deliver its Patent-Pending NOy Cavity Ring-Down Spectrometer to market in the United States and globally. Credit: Derek Parks.

**U.S. Weather Research Program: Research to Improve Mid-Range Operational Weather Outlooks:** NOAA requests an increase of \$3,936,000 to improve the accuracy of weather outlooks out to three to four weeks, where expertise does not currently exist. Increasing capability in developing mid-range outlooks will assist decision-makers in sectors ranging from food security and public health to emergency management and national security.

**Weather and Air Chemistry Research: Joint Technology Transfer Initiative:** NOAA requests to eliminate \$6,000,000 for a Joint Technology Transfer Initiative. NOAA supports an increase in funding to transition the latest scientific and technological advances into operations, but instead requests to expand this concept across NOAA's mission areas in its Research Transfer Acceleration Program in the Innovative Research and Technology sub-program as described below (see p. 23).

### OCEAN, COASTAL, AND GREAT LAKES RESEARCH \$179,455,000

NOAA requests a net decrease of \$10,484,000 in FY 2017 program changes in the Ocean, Coastal & Great Lakes Research sub-program for a total of \$179,455,000. Highlights include:

**Ocean, Coastal, and Great Lakes Research Laboratories and Cooperative Institutes: Autonomous Underwater Vehicle Demonstration:** NOAA requests a decrease of \$2,000,000 to reduce support for an Autonomous Underwater Vehicle demonstration. NOAA will maintain its fleet of autonomous vehicles and other



alternative technologies, but will reduce the funding available for ongoing development, testing, and evaluation activities.

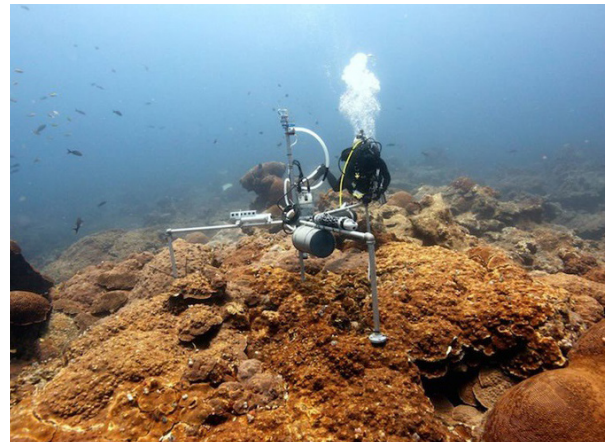
**Ocean, Coastal, and Great Lakes Research Laboratories and Cooperative Institutes: Base Research:** NOAA requests a decrease of \$2,985,000 to reduce Cooperative Institute support for planned research projects. NOAA will decrease funded research across its Cooperative Institute partners, but will continue to make awards to Cooperative Institutes that leverage partnerships to make significant advancements in research.

**National Sea Grant College Program: National Sea Grant College Program Base:** NOAA requests a decrease of \$2,548,000 to fund approximately 30 fewer research projects compared to FY 2016.

**National Sea Grant College Program: Marine Aquaculture Program:** NOAA requests a decrease of \$2,000,000 to eliminate funding for 20 research and extension projects.

**Ocean Exploration and Research Program: Ocean Exploration:** NOAA requests a decrease of \$12,656,000, which will decrease our mapping and exploration of unknown ocean areas and phenomena. NOAA will narrow activities related to Extended Continental Shelf mapping, extramural grants, and Okeanos Explorer missions.

**Integrated Ocean Acidification Program: Integrated Ocean Acidification:** NOAA requests an increase of \$11,705,000 to expand the ocean acidification (OA) observing network to nearshore waters and to aid in the development of tools and OA adaptation strategies for



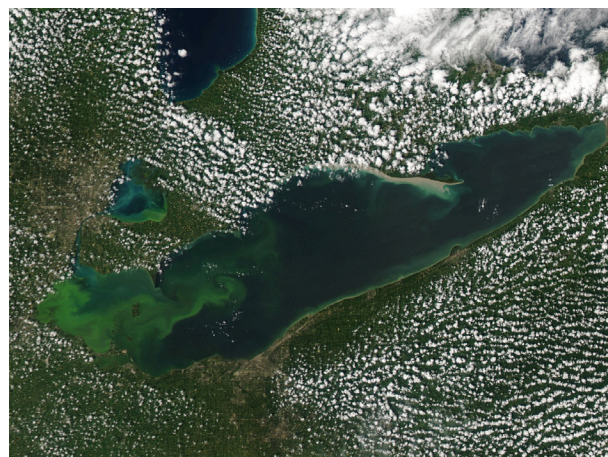
Researcher Lauren Valentino collects data from a Benthic Ecosystem Acidification Monitoring System station in the Flower Garden Banks National Marine Sanctuary to determine the rate and magnitude of climate change and acidification on coral reefs and ecological impacts.

affected industries and stakeholders, including the U.S. shellfish industry. This investment will make substantial advancements in OA observations, greatly expand understanding of the vulnerability of coastal communities, and further investigate OA adaptation options at local and regional scales, by providing data and products for coastal resource managers and other stakeholders.

**INNOVATIVE RESEARCH AND TECHNOLOGY**  
\$22,144,000

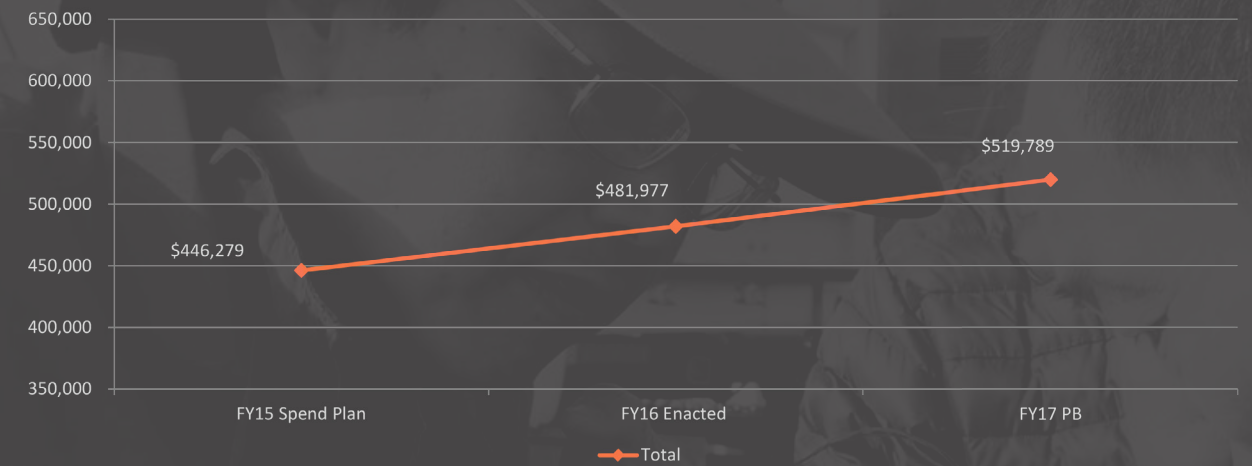
NOAA requests a net increase of \$10,000,000 in FY 2017 program changes in the Innovative Research and Technology sub-program for a total of \$22,144,000. Highlights include:

**Research Transition Acceleration Program: Research Transition Acceleration Program:** NOAA requests an increase of \$10,000,000 to create a new program for identifying, prioritizing, and funding transition of the most promising research into operations, applications, and commercialization. Numerous research projects with significant potential to benefit society are ready for rapid transition to operations. This initiative will ensure that NOAA-funded research projects identified for transition will be evaluated and prioritized for funding based on a common set of criteria, including mission criticality, societal benefit, early stakeholder engagement, and plans for reliable delivery of products and services. Ensuring successful research is transitioned into use ensures that the American public directly realizes the benefit of the previous R&D investments. When appropriate, the Research Transition Acceleration Program (RTAP) initiative will also evaluate project proposals from other government agencies and non-governmental entities.



MODIS (aqua) satellite image of the 2015 Lake Erie Harmful Algal Bloom. Initial analysis indicates that the 2015 harmful algal bloom was the most severe bloom in terms of biomass this century.

**OAR Discretionary Budget Trends (FY 2015-2017)**  
(\$ thousands)



**FY 2017 PAC BUDGET SUMMARY**

NOAA requests a total of \$26,379,000 to support Procurement, Acquisition, and Construction activities for OAR, reflecting a net increase of \$6,300,000 in FY 2017 program changes.

**PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:**

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

**SYSTEMS ACQUISITION \$26,379,000**

NOAA requests a net increase of \$6,300,000 in FY 2017 program changes in the Systems Acquisition sub-program for a total of \$26,379,000. Highlights include:

**Research Supercomputing: Research and Development High Performance Computing Recapitalization:** NOAA requests an increase of \$6,300,000 to continue recapitalization of its research and development (R&D) High Performance Computing (HPC) infrastructure.



GAEA is one of NOAA's high performance computing systems and is located at Oak Ridge National Laboratory in Oak Ridge, Tennessee.

Building on NOAA's FY 2016 request to begin recapitalization of Gaea, this would establish a new funding model to provide regular upgrades to NOAA's computing capacity, the backbone of our weather, climate, and broader environmental modeling efforts. The funding will allow regular refresh and recapitalization of NOAA's R&D HPC via a leasing mechanism, which shifts the burden of future equipment obsolescence to the service provider instead of NOAA continuing to purchase and own infrastructure that quickly becomes outdated.



# CHAPTER 5 NATIONAL WEATHER SERVICE

The Chicago NEXRAD located in Romeoville, IL.

**NOAA's** National Weather Service (NWS) provides weather, water, and climate forecasts and warnings for the protection of life, property, and the national economy. NWS is the official authority for issuing warnings during life-threatening weather events. NWS forecasters issue public, aviation, marine, fire weather, climate, space weather, river and flood forecasts and warnings every day. Each year, NWS collects approximately 76 billion observations and issues approximately 1.5 million forecasts and 50,000 warnings. NWS data and products are publicly available through a national information infrastructure used by the public, other governmental agencies, the private sector, and the global community.

## FY 2017 REQUEST \$1,119,292,000

In FY 2017, NOAA requests a total of \$1,119,292,000 to support NWS' weather, water, and climate products; services; and advancements and to continue to evolve and modernize the NWS. This total includes Operations, Research, and Facilities (ORF) and Procurement, Acquisition, and Construction (PAC) accounts and reflects a net decrease of \$18,551,000 in FY 2017 program changes.

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$976,507,000 to support the Operations, Research, and Facilities of the NWS, reflecting a net decrease of \$26,021,000 in FY 2017 program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

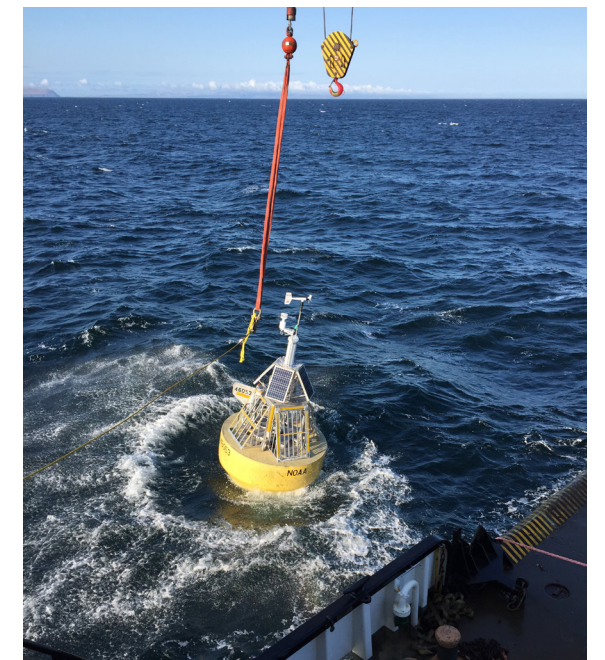
Program changes above \$1,000,000 are highlighted below. A summary of funding by PPA is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### OBSERVATIONS \$222,996,000

NOAA requests a net decrease of \$11,487,000 in FY 2017 program changes for a total of \$222,996,000 in the Observations sub-program. Highlights include:



A Sudbury, MA house under considerable snow after the January 27, 2015 northeast blizzard. Credit: Marc Stern.



The NOAA National Data Buoy Center developed and deployed the Self-Contained Ocean Observation Payload (SCOOP) in the Atlantic and Gulf of Mexico basins. SCOOP aims to significantly increase NOAA's buoy observation system readiness and effectiveness.

**Observations: National Mesonet Program:** NOAA requests a decrease of \$11,487,000 for the National Mesonet Program, a network of automated weather stations that are spaced closely together to provide high-frequency, high-density weather observations. At this level, NOAA will continue to administer the National Mesonet Program. Funding will be provided for lightning data procurements consistent with the Consolidated Appropriations Act, 2016. The lightning data, like other mesonet data, increases NWS' ability to warn for severe weather. NWS is using FY 2016 funding to ingest data from mesonets, which can identify small scale features at the Earth's surface,

such as changes in wind speed/direction, temperature, and pressure, each of which can indicate rapidly deteriorating weather conditions not shown by other observations.

#### CENTRAL PROCESSING \$88,388,000

NOAA requests a net decrease of \$4,969,000 in FY 2017 program changes for a total of \$88,388,000 in the Central Processing sub-program. Highlights include:

**Central Processing: Advanced Weather Interactive Processing System Cyclical Refreshment:** NOAA requests an increase of \$5,131,000 to provide the minimal funding levels required for Advanced Weather Interactive Processing System (AWIPS) information technology (IT) cyclical replacement for AWIPS servers, workstations, monitors, and printers. AWIPS is an interactive computer system that integrates all meteorological and hydrological data, and all satellite and radar data, and enables the forecaster to prepare and issue more accurate and timely forecasts and warnings. Without these funds, NWS will need to delay AWIPS cyclical hardware replacement from the previous replacement period of three-to-five years to six-to-eight years. By deferring cyclical replacement of computer equipment, AWIPS equipment will fail at higher rates and experience more component degradation, which in turn may increase system downtime.

**Central Processing: Establishment of Regional Enterprise Application Development and Integration Teams:** NOAA requests a decrease of \$10,100,000 to reflect efficiencies achieved in the delivery of IT support services to field offices through investments in open source software and implementation of IT best practices. NOAA proposes to continue IT support for the field in the form of Regional Enterprise Application Development and Integration (READI) teams located in each of the six NWS Regions and the National Headquarters. The READI teams will provide cost-effective, sustainable IT delivery operations and allow NOAA to take advantage of significant technological advancements.

#### ANALYZE, FORECAST, AND SUPPORT \$485,931,000

NOAA requests a net decrease of \$4,686,000 in FY 2017 program changes for a total of \$485,931,000 in the Analyze, Forecast, and Support sub-program. Highlights include:

**Analyze, Forecast and Support (and Science and Technology Integration): Integrated Water Prediction:** NOAA requests an increase of \$5,250,000 to develop and



Senator Richard Shelby, Commerce Secretary Penny Pritzker, NOAA Administrator Dr. Kathryn Sullivan and other partners, including USGS and FEMA, were on hand to cut the ribbon at the National Water Center in Tuscaloosa, Alabama, on May 26, 2015. The new building will house the nation's water experts.

operate the Nation's first Integrated Water Prediction (IWP) capability by aligning, integrating, and expanding key atmospheric, terrestrial, and coastal water prediction capabilities across NOAA. IWP will deliver water products to stakeholders such as emergency managers and local decision makers. These will include unified, consistent, and high-resolution forecasts, as well as the corresponding tools and decision support needed to effectively prepare for and respond to challenges such as floods, droughts, and other high-impact events. This request is part of a cross-line office initiative with NOAA's National Ocean Service (NOS) and begins a multi-year strategy to improve water intelligence services provided to the Nation. This work will largely be done at the National Water Center (NWC) in Tuscaloosa, Alabama, where it will benefit from the work of NOAA and other Federal agencies with water expertise. For more information on this joint initiative between NWS and NOS, please see p. 29 and p. 7 in Chapter 3.

**Analyze, Forecast and Support: National Tsunami Hazard Mitigation Program Grants:** NOAA requests a decrease of \$6,000,000 in the National Tsunami Hazard Mitigation Program grants, which would eliminate grant funding to partners for education, outreach, and awareness programs in FY 2017. NOAA will maintain its strong forecast and warning program through the operations of its two Tsunami Warning Centers and continued administration of the TsunamiReady™ Program.

**Analyze, Forecast and Support: Elimination of Redundant Regional Telecommunication Circuits:** NOAA requests a decrease of \$3,000,000 to reflect efficiencies gained by consolidating regional NWS telecommunication circuits into the one-NWS network. As part of the evolution of NWS, NOAA is modernizing its dissemination network with improved bandwidth and reliability.

#### DISSEMINATION \$47,236,000

NOAA requests a net increase of \$2,000,000 in FY 2017 program changes for a total of \$47,236,000 in the Dissemination sub-program. Highlights include:

**Dissemination: NOAA Weather Radio Operations and Maintenance:** NOAA requests an increase of \$2,000,000 for the NOAA Weather Radio (NWR) network. This request increases NWR funding to minimum levels to allow operation of all 1,029 current transmitter stations. NWR infrastructure is a national warning network with a broadcast coverage that currently reaches more than 98 percent of the Nation's population and provides critical weather and other hazard information to U.S. public and media outlets. Without this funding, NWS will be required to decommission approximately 235, or about 23 percent, of the NWR transmitter stations.

#### SCIENCE AND TECHNOLOGY INTEGRATION \$131,956,000

NOAA requests a net decrease of \$6,879,000 in FY 2017 program changes for a total of \$131,956,000 in the Science and Technology Integration sub-program. Highlights include:

**Science and Technology Integration: Shift R2O toward an Integrated Approach:** NOAA requests a decrease of \$3,000,000 to account for efficiencies gained by shifting from separate regional- and event-specific modeling toward more integrated, global modeling approaches. NOAA will integrate projects such as Next Generation Global Prediction System (NGGPS) and Mid-Range Weather Outlooks to improve service delivery. NWS will shift focus away from existing R2O efforts, such as the Hurricane Forecast Improvement Project (HFIP) program, that are highly specialized. However, improvements made from HFIP will be maintained and improvements to hurricane forecasting will continue within other modeling efforts.

**Science and Technology Integration: Consumer Option for an Alternative System to Allocate Losses Act:** NOAA requests a decrease of \$4,629,000 in the FY 2017 budget from the additional funds provided to Science and Technology Integration in the Consolidated Appropriations Act, FY 2016 to advance essential components of the Consumer Option for an Alternative System to Allocate Losses (COASTAL) Act of 2012. The COASTAL Act requires NOAA to produce detailed "post-storm assessments" in the aftermath of a damaging tropical cyclone that strikes the United States or its territories. NWS will



A tornado crosses the road behind the town of Reinbeck, Iowa by Brad Goddard, Orion IL. This photo took third place for professional submissions in NOAA's Weather in Focus 2015 Photo Contest.



further COASTAL Act objectives to the extent possible within our base budget and will continue to make available its observational and model data related to land falling tropical cyclones.

## FY 2017 PAC Budget Summary

NOAA requests a total of \$142,785,000 to support Procurement, Acquisition, and Construction activities of the NWS, reflecting a net increase of \$7,470,000 in FY 2017 program changes.

### PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by PPA is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

#### SYSTEMS ACQUISITION \$134,135,000

NOAA requests a net increase of \$7,470,000 in FY 2017 program changes for a total of \$134,135,000 in the Systems Acquisition sub-program. Highlights include:

**Observations: Automated Surface Observing System Service Life Extension Program:** NOAA requests an increase of \$7,500,000 to begin a Service Life Extension Program (SLEP) for the aging Automated Surface Observing System (ASOS), the Nation's primary surface weather observing network. ASOS data increases accuracy and timeliness of NWS forecasts and warnings, particularly near airports, enhancing aviation safety and efficiency. This request synchronizes NOAA's upgrade process with the Federal Aviation Administration's, yielding efficiencies across the government. Without this investment, ASOS availability will degrade rapidly beginning in 2017, causing data outages and regional gaps in service and undermining NOAA's ability to provide aviation and general forecasts.

**Observations: Next Generation Weather Radar Service Life Extension Program:** NOAA requests a planned increase of \$8,535,000 to continue implementation of the Next Generation Weather Radar (NEXRAD) SLEP to extend the utility of existing infrastructure through 2030. NEXRAD underpins the severe weather forecast and warning services that are critical to maintaining a Weather-Ready Nation during high-impact events. This effort began in FY 2015 and will continue through FY 2022. Without this continued investment, NEXRAD availability

will degrade beginning in 2020, resulting in radar outages and gaps and negatively impacting tornado and flash flood warnings.

### OBSERVATIONS BUDGET AUTHORITY IN THOUSANDS

FY 2017 Request	\$32,755	FY 2020	\$20,999
FY 2018	\$32,953	FY 2021	\$16,944
FY 2019	\$22,909		

#### Central Processing: Integrated Water Prediction:

NOAA requests an increase of \$4,500,000 to procure operational high performance computing (HPC) resources to enable modeling improvements associated with the Integrated Water Prediction (IWP) initiative. IWP will put critical water forecast information into the hands of local decision makers and members of the public. Specifically, these funds will support coupling of the current generation of terrestrial and coastal models and develop the next generation of integrated Earth system coupled models necessary to expand NOAA's water forecast and warning products and services. The HPC supporting IWP will advance both scientific discovery and economic competition by delivering crucial water resource information to decision makers at multiple geographic scales. For more information on this joint initiative between NWS and NOS, please see p. 27 and p. 7 in Chapter 3.

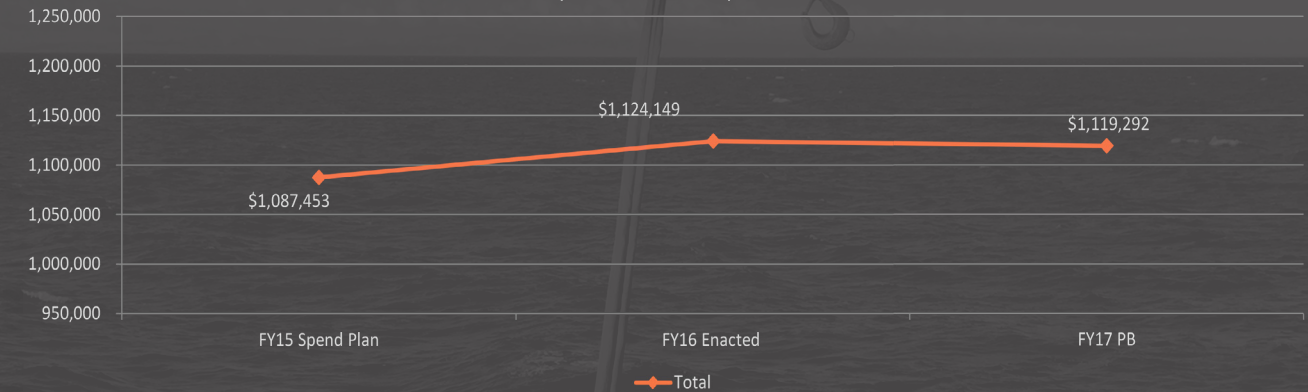
#### Central Processing: Research and Development Supercomputing:

NOAA requests a decrease of \$2,000,000 for High Performance Computing (HPC) resources supporting the Hurricane Forecast Improvement Project (HFIP). NOAA will continue to sustain HFIP HPC at current levels, consistent with recent HFIP scope reductions.

### CENTRAL PROCESSING BUDGET AUTHORITY IN THOUSANDS

FY 2017 Request	\$66,761	FY 2020	\$66,761
FY 2018	\$66,761	FY 2021	\$66,761
FY 2019	\$66,761		

## NWS Discretionary Budget Trends (FY 2015-2017) (\$ thousands)



#### Dissemination: Re-architected NWS Telecommunications Gateway:

NOAA requests a decrease of \$7,604,000 to reflect the completion in FY 2017 of a re-architected National Weather Service Telecommunications Gateway (NWSTG) at the primary and backup sites. The re-architected NWSTG capability enables modern, scalable, and reliable dissemination services – which NWS requires to send out its watches, warnings, and forecasts in a timely manner – using current best practices. It will also ensure NOAA is poised to accommodate future data increases driven by new satellites, increases in environmental model prediction capabilities, and radar data.

#### Dissemination: Ground Readiness Project:

NOAA requests a decrease of \$3,461,000 to reflect the completion of the Ground Readiness Project. In 2017, NOAA will have built the required infrastructure to ensure adequate processing, delivery and exploitation of anticipated data from GOES-R, JPSS, and other recently- or soon-to-be-deployed satellites; radar; and model data. The Ground Readiness Project upgrade will ensure that the full life- and property-saving potential of NOAA's satellite, model, and radar investments is realized.

#### NWS CONSTRUCTION \$8,650,000

NOAA requests a total of \$8,650,000 in the Construction sub-program.

### FACILITIES CONSTRUCTION AND MAJOR REPAIRS BUDGET AUTHORITY IN THOUSANDS

FY 2017 Request	\$8,650	FY 2020	\$8,650
FY 2018	\$8,650	FY 2021	\$8,650
FY 2019	\$8,650		



Maintenance being performed at the Chicago NEXRAD located in Romeoville, IL.

### DISSEMINATION BUDGET AUTHORITY IN THOUSANDS

FY 2017 Request	\$34,619	FY 2020	\$24,919
FY 2018	\$24,919	FY 2021	\$24,919
FY 2019	\$24,919		



# CHAPTER 6 NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE

Hurricane Joaquin Seen From GOES West

**NOAA's** The National Environmental Satellite, Data, and Information Service (NESDIS) provides timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. Along with launching and operating NOAA's satellites, NESDIS manages the product development and distribution of vast amounts of environmental data. NOAA satellites support the weather forecasting enterprise by providing timely, high quality data for model outputs. While providing real-time operations and data services, NESDIS also works to develop the next generation of satellites to meet its primary mission essential functions without incurring gaps in coverage.

## FY 2017 REQUEST \$2,303,687,000

NOAA requests a total of \$2,303,687,000 to support the continued and enhanced operations of NESDIS. This total includes Operations, Research, and Facilities (ORF) and Procurement, Acquisition, and Construction (PAC) accounts and includes a net decrease of \$49,161,000 in FY 2017 program changes. Of particular note, this request includes continued support for development of NOAA's Polar Follow On and Space Weather Follow On satellite systems. In addition, NOAA's FY 2017 budget includes funds to support further evaluation and testing of commercial space-based data for NOAA operations.

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$239,987,000 to support the Operations, Research, and Facilities of NESDIS, reflecting a net increase of \$8,470,000 in FY 2017 program changes.

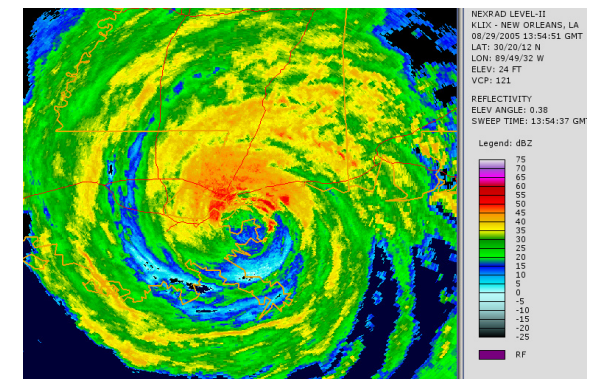
### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by PPA is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### ENVIRONMENTAL SATELLITE OBSERVING SYSTEMS \$176,509,000

NOAA requests a net increase of \$7,209,000 for a total of \$176,509,000 in the Environmental Satellite Observing Systems sub-program. Highlights include:

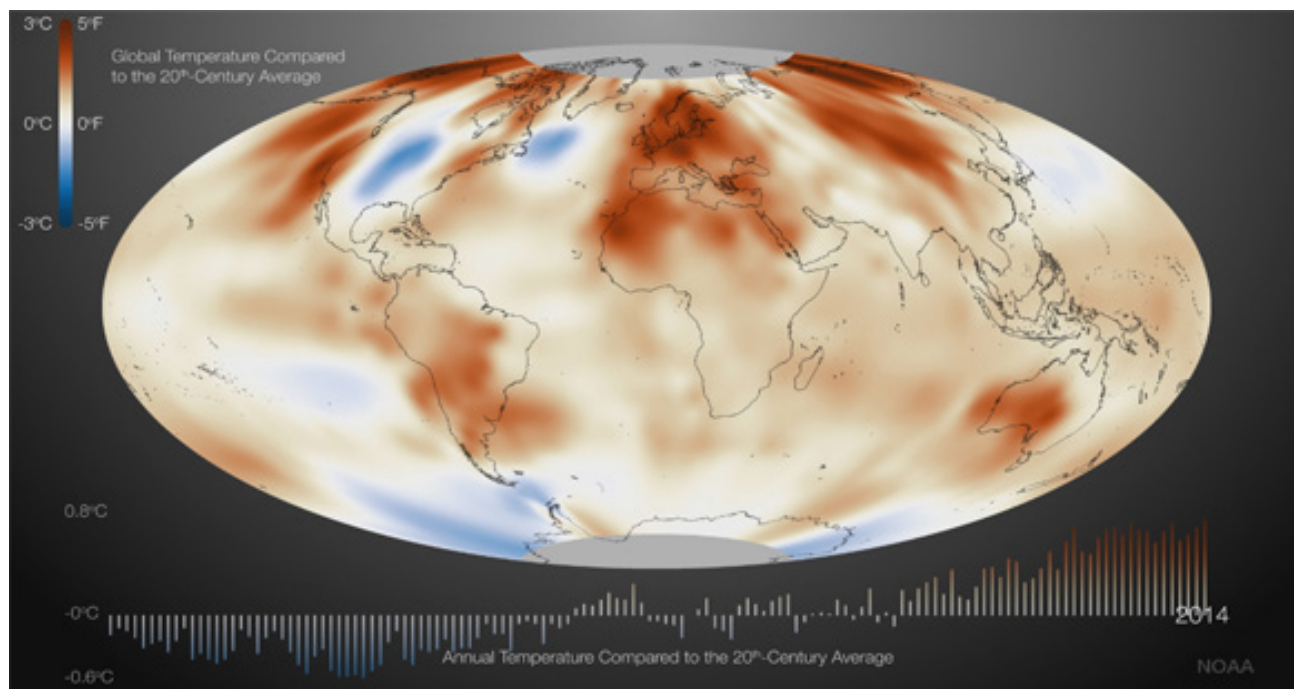
**NESDIS IT Security (Satellite and Product Operations):** NOAA requests an increase of \$3,581,000 to improve data flow resiliency across critical IT systems and infrastructure. Specifically, this request will fund the Office of Satellite and Product Operations' efforts to identify and mitigate vulnerabilities affecting the availability, integrity, security, and delivery of NOAA's data. NOAA will use these funds to migrate NESDIS' Federal Information Security Management Act high impact networks to NOAA Office of Chief Information Officer (OCIO) enterprise services, enabling centralized authentication and automated deployment of security patches. This request is part of a cross-line office initiative with NOAA's OCIO to modernize and



On October 27, 2015, Amazon Web Services announced the public release of NOAA's Next-Generation Weather Radar, (NEXRAD) data for public use. As a part of NOAA's Big Data Project, this effort gives more users equal access to the data and allows them to easily develop comprehensive statistical and probabilistic products while still maintaining NOAA's role as the official archive of the NEXRAD data.

streamline NOAA's IT systems. NOAA uses complex IT systems to produce weather forecasts; issue advisories, watches, and warnings; and disseminate environmental information. IT system failures caused by cyber-attack, equipment malfunctions, or disasters threaten NOAA's ability to collect and process raw meteorological data, analyze and model weather, and disseminate the information and warnings that save lives and preserve property. For more information on this joint initiative between NESDIS and OCIO, please see p. 33 and p. 40 in Chapter 7.

**Commercial Remote Sensing Regulatory Authority (CRSRA):** NOAA requests an increase of \$1,065,000 to increase capacity to support additional compliance oversight responsibilities associated with a recent change in operations allowing the sale of U.S. commercial satellite imagery. This request will allow CRSRA to administer and fulfill its statutory obliga-



In 2014, the most essential indicators of Earth's changing climate continued to reflect trends of a warming planet, rising land and ocean temperature, sea levels, and greenhouse gases set new records. These key findings and others can be found in the "State of the Climate in 2014" report released online by the American Meteorological Society. The report was compiled by NOAA's Center for Weather and Climate at the National Centers for Environmental Information and is based on contributions from 413 scientists from 58 countries around the world.

tion to regulate private remote sensing systems through a licensing regime that allows the licensee to operate its space system consistent with the terms of its particular license. This includes carrying out enforcement activities to address substantial violations of U.S. laws, regulations, and NOAA-issued licenses. CRSRA is the sole U.S. Government entity to develop and administer regulations for any U.S. private remote sensing space system that is capable of sensing the Earth's surface.

**Office of Space Commerce (OSC) (formerly Office of Space Commercialization):** NOAA requests an increase of \$1,400,000 to increase the capacity of OSC to promote a robust and transparent marketplace for commercial space business through evaluation of opportunities for use of commercial data to meet NOAA's space based operational requirements. The NOAA Commercial Space Policy establishes critical components for engaging with the commercial sector, including designating OSC as a single point of entry for commercial providers to streamline the process for easier engagement with NOAA. This request will equip OSC with the resources to serve as NOAA's conduit for commercial vendors.

#### NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION \$63,478,000

NOAA requests a net increase of \$1,261,000 for a total of \$63,478,000 in the National Centers for Environmental Information sub-program. Highlights include:

**IT Security (National Centers for Environmental Information (NCEI)):** NOAA requests an increase of \$1,261,000 to improve data flow resiliency across NOAA's critical IT systems and infrastructure. Specifically, this request will fund NCEI efforts to identify and mitigate vulnerabilities affecting the availability, integrity, security, and delivery of NOAA's data. NOAA will use these funds to migrate NESDIS' Federal Information Security Management Act high impact networks to NOAA OCIO enterprise services, enabling centralized authentication and automated deployment of security patches. This request is part of a cross-line office initiative with NOAA's OCIO to modernize and streamline NOAA's IT systems. Access to reliable and accurate long-term records of environmental data and information is critical to businesses, academic institutions, and government agencies involved in national security, public safety, and economic and environmental issues. For more information on this joint initiative between NESDIS and OCIO, please see p. 32 and p. 40 in Chapter 7.

## FY 2017 PAC BUDGET SUMMARY

NOAA requests a total of \$2,063,700,000 to support the Procurement, Acquisitions, and Construction (PAC) activities of NESDIS, reflecting a net decrease of \$57,631,000 in FY 2017 program changes.

### PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

**SYSTEMS ACQUISITION:** NOAA requests a net decrease of \$57,631,000 for a total of \$2,062,774,000 in the Systems Acquisition sub-program. Highlights include:

**Geostationary Operational Environmental Satellite Systems – R Series:** NOAA requests a planned decrease of \$85,107,000 in the GOES-R Series program. The remaining funding of \$752,784,000 is needed to sustain the instruments, satellite, and launch vehicle activities to ensure the continuity of the GOES-R Series program geostationary observing platforms. The funds will also be used to continue the development activities to maintain the launch schedules for GOES-T and GOES-U. The GOES program, which has provided essential observational data since 1975, supports the National Weather Service (NWS) in forecasting, tracking, and monitoring severe storms. The GOES-R Series constellation will provide observational data continuity through 2036 and significant enhancements to all operational users of geostationary observations. GOES-R Series observations will provide coverage of the western hemisphere from a geostationary orbit, allowing continuous monitoring from the same angle during the detection and tracking of tropical cyclones, volcanic eruptions, fire hot spots, cloud and atmospheric moisture changes, lightning, currents flow dynamics, and atmospheric smoke and dust.

**Jason-3:** NOAA requests a planned decrease of \$170,000 to the Jason-3 program. The Jason-3 satellite was successfully launched from Vandenberg Air Force Base on January 17, 2016. Remaining funding of \$4,357,000 will provide post-launch support and sustainment of the Jason-3 satellite. The satellite will reach its near-polar orbit, 1,336 kilometers (830 miles) above the Earth. Once in orbit and after a six-month commissioning period to test the satellite's instruments, Jason-3 will continue satellite observations of global sea surface height that began in 1992 with the TOPEX/Poseidon mission and continued with Jason-2. Jason-3 will support national and international users of sea surface height measurements and provide data for a variety of other scientific, commercial, and operational applications. This mission will also help NOAA's NWS more accurately forecast the strength of tropical cyclones that threaten U.S. coastal communities. Jason-3 is an international mission in which NOAA is partnering with NASA, the Centre National d'études Spatiales (CNES, the French Space Agency), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).

#### JASON-3 BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$155,464	FY 2020	\$4,648
FY 2017	\$4,357	FY 2021	\$4,648
FY 2018	\$7,651	CTC	\$4,468
FY 2019	\$5,338	Total*	\$186,754

This profile reflects the PAC budget for the Jason-3 program. The total Jason-3 life cycle cost is \$204,340,000. In FY 2017, NOAA requests a technical adjustment to transfer the operational phase requirements budgeted within the PAC account to support operational functions in the ORF account. See the FY 2017 President's Budget for additional details.

**JPSS:** NOAA requests a decrease of \$21,720,000 in the JPSS program. The remaining \$787,246,000 will allow NOAA to operate and sustain the Suomi National Polar-orbiting Partnership satellite (S-NPP); launch and commission JPSS-1; continue development of the instruments and spacecraft for JPSS-2; and continue operations, maintenance and sustainment of the ground system for the JPSS constellation. NOAA remains committed to building a robust polar orbiting weather satellite program as rapidly as practicable. As such, during FY 2017 NOAA will continue to prioritize meeting the JPSS-1 launch commitment date of no later than Q2 FY 2017 and maintain the accelerated JPSS-2 launch readiness date of Q4 FY 2021. JPSS provides meteorological data

#### GOES-R BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$6,952,951	FY 2020	\$214,674
FY 2017	\$752,784	FY 2021	\$148,588
FY 2018	\$518,532	CTC	\$1,226,651
FY 2019	\$335,879	Total*	\$10,150,059

This profile reflects the PAC budget for the GOES-R Series program. The total GOES-R Series life cycle cost is \$10,828,059,000. In FY 2017, NOAA requests a technical adjustment to transfer the operational phase requirements budgeted within the PAC account to support operational functions in the ORF account. See the FY 2017 President's Budget for additional details.



and observations of the atmosphere, ocean, and land for weather forecasting. Data from civilian polar-orbiting satellites are the primary input (approximately 85%) for all Numerical Weather Prediction (NWP) models. JPSS allows for accurate forecasts three to seven days in advance of a severe weather event. These early warnings allow emergency managers and communities to make timely decisions to protect lives and property.

### JPSS BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$7,655,445	FY 2020	\$445,082
FY 2017	\$787,246	FY 2021	\$376,061
FY 2018	\$745,777	CTC	\$740,274
FY 2019	\$572,240	Total	\$11,322,125

**Polar Follow On (PFO):** NOAA requests an increase of \$23,000,000 to continue development activities in support of the PFO/JPSS-3 and PFO/JPSS-4 missions. The \$393,000,000 total request will continue the parts procurement, build, and development of the instruments and complete the detailed design for the PFO/JPSS-3 and PFO/JPSS-4 missions. This request also includes a modest investment in an Earth Observing Nanosatellite-Microwave (EON-MW), a risk reduction mission aimed at mitigating the impact of a potential loss of the most critical microwave sounding observations in the event of a launch or instrument failure on JPSS-1. PFO will extend operations of the NOAA polar satellite system through FY 2038, ensuring that NOAA continues to provide accurate and timely weather forecasts and warnings beyond JPSS-2. Continuing support for the polar satellite system will enable scientists and forecasters to monitor and predict weather patterns with greater accuracy and to study long-term trends. Information from polar satellite constellation supports every area of NOAA's mission, including ensuring a Weather-Ready Nation, healthy coasts, resilient coastal communities, and greater preparedness in the face of climate change.

### POLAR FOLLOW-ON BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$370,000	FY 2020	\$577,000
FY 2017	\$383,000	FY 2021	\$467,000
FY 2018	\$586,000	CTC	TBD
FY 2019	\$576,000	Total	TBD

### EON-MW BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$0	FY 2020	\$2,000
FY 2017	\$10,000	FY 2021	\$2,000
FY 2018	\$8,000	CTC	\$0
FY 2019	\$5,000	Total	\$27,000

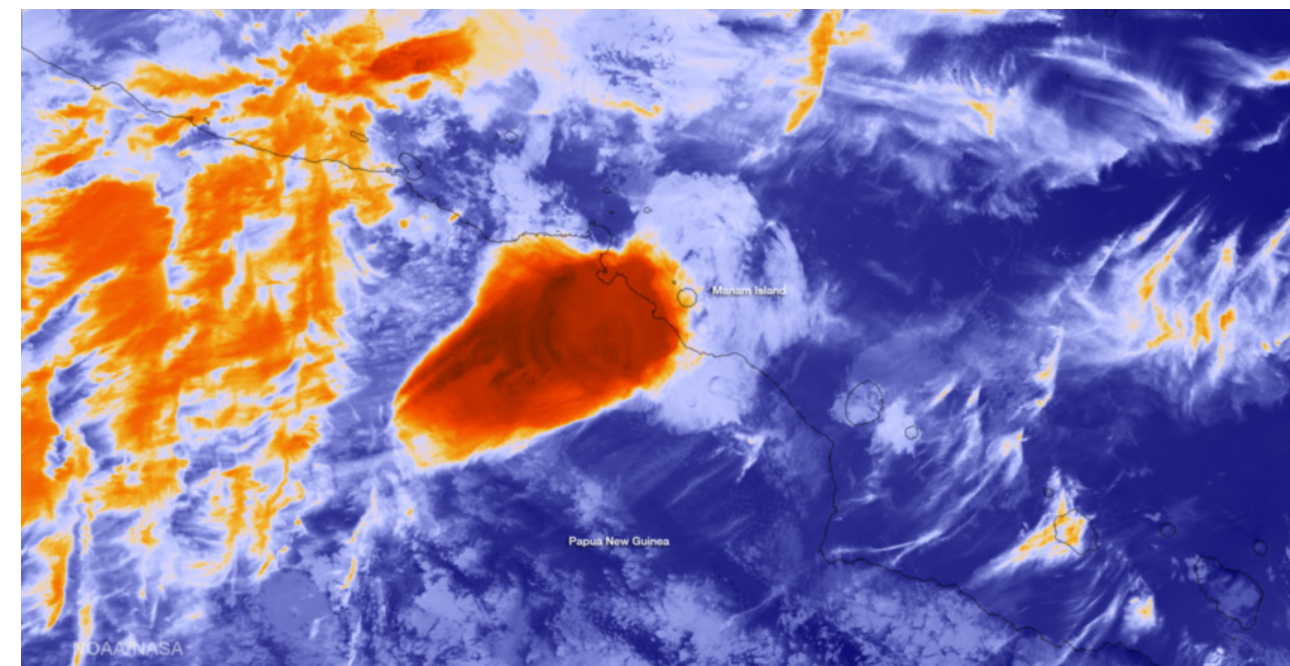
**DSCOVR:** NOAA requests an increase of \$1,453,000 to continue to fund a tech refresh of the NASA-built ground system, anomaly support, and IT security upgrades for the DSCOVR program. The DSCOVR satellite was launched on February 11, 2015. Since its launch, the satellite has had more anomalies than anticipated, which requires additional engineering support from the spacecraft and instrument vendors. Funds requested here will allow NOAA and NASA to respond to anomalies in a timely fashion and return the satellite to operations. Without timely recovery, the NWS Space Weather Prediction Center's ability to provide accurate and early warnings of potentially destructive space weather events will be compromised. These storms can disrupt electrical grids, communications systems, Global Positioning System navigation, air travel, satellite operations, and human spaceflight. This program was developed in partnership with NASA, which refurbished the satellite and developed the ground system, and the U.S. Air Force, which provided the launch services.

### DSCOVR BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$100,294	FY 2020	\$3,838
FY 2017	\$3,745	FY 2021	\$3,838
FY 2018	\$3,860	CTC	\$3,838
FY 2019	\$3,838	Total*	\$123,251

\*This profile reflects the PAC budget for the DSCOVR program. The total DSCOVR life cycle cost is \$136,181,000. In FY 2017, NOAA requests a technical adjustment to transfer the operational phase requirements budgeted within the PAC account to support operational functions in the ORF account. See the FY 2017 President's Budget for additional details.

**Space Weather Follow On:** NOAA requests an increase of \$1,300,000 to continue the development of the Space Weather Follow On program. Based upon the FY 2016 Analysis of Alternatives for critical space weather observations, this request will initiate the projects for solar



This image was taken by the Suomi NPP satellite's VIIRS instrument on July 31, 2015. The Suomi NPP VIIRS instrument provides higher resolution imaging with better spatial resolution. Infrared imagery from VIIRS provides information used for volcanic ash advisories which are a serious threat to aviation.

wind data and Coronal Mass Ejection (CME) imagery. CME imagery is the model input for the 1-4 day warning of geomagnetic storm conditions, while solar wind data are the sole input for short-term warnings (15-45 minutes) of geomagnetic storms. NOAA's space based solar wind detection system is operating as a single string constellation, meaning that a loss of DSCOVR, the Nation's operational space weather satellite, would result in a near-term gap in solar wind observations and impact forecasts. This request allows NOAA to pursue a launch and procurement schedule to ensure a Space Weather Follow On will be in place soon after the DSCOVR satellite reaches the end of its projected mission life in FY 2022. This program will consist of two satellites, two launch vehicles, and two sets of sensors: solar wind instruments and compact coronagraphs for CME imaging.

### SPACE WEATHER FOLLOW ON BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$1,200	FY 2020	\$154,500
FY 2017	\$2,500	FY 2021	\$81,500
FY 2018	\$53,700	CTC	\$278,200
FY 2019	\$186,100	Total	\$757,700

**Constellation Observing System for Meteorology, Ionosphere and Climate -2 (COSMIC-2)/ Global Navigation Satellite System Radio Occultation (GNSS RO): GNSS RO Ground System:** NOAA requests a planned decrease of \$2,000,000 for ground reception and processing of GNSS RO satellite data. The remaining \$8,100,000 will help complete all IT security testing and verification to support the downlink of GNSS RO data at NOAA. Additionally, the request will support the complete operational testing and validation of the Numerical Weather Prediction Models for COSMIC-2.

### GNSS RO GROUND SYSTEM BUDGET AUTHORITY IN THOUSANDS

FY 2016 & Prior	\$18,897	FY 2020	\$8,100
FY 2017	\$8,100	FY 2021	\$8,100
FY 2018	\$8,100	CTC	\$32,400
FY 2019	\$8,100	Total	\$91,797

**COSMIC-2/ GNSSRO: Polar Orbiting Radio Occultation Data Set:** NOAA requests an increase of \$8,100,000 for the acquisition of additional RO data. NOAA will pursue the acquisition of GNSS RO data in the polar orbit, either through purchase and integration of commercial data or development of a second set of COSMIC-2 sensors. The



equatorial and polar orbits of the constellation will work together to provide global coverage of atmospheric and ionospheric soundings. NWS has determined that increasing the number of RO soundings will result in more accurate long-range weather forecasts. Additionally, the polar orbiting GNSS RO sensors will help mitigate the impacts of a potential gap in sounding data in the polar orbit, including the loss of the ATMS or CrIS instruments on JPSS satellites.

### POLAR ORBITING RO DATA SET

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$0	<b>FY 2020</b>	\$700
<b>FY 2017</b>	\$8,100	<b>FY 2021</b>	\$700
<b>FY 2018</b>	\$8,100	<b>CTC</b>	\$2,800
<b>FY 2019</b>	\$8,300	<b>Total</b>	\$28,700

\*This profile represents the estimated cost for procurement of COSMIC-2B sensors and does not include the costs of launch service to place these sensors in the polar orbit. A profile reflecting the purchase of commercial data rather than procuring COSMIC-2B has not yet been developed. See the FY 2017 President's Budget for additional information.

**Satellite Ground Services: Satellite Ground Services (SGS):** NOAA requests an increase of \$4,525,000 to continue the planning and transition of the independent ground services into a unified set of common ground services for NOAA's environmental satellite systems. The funding request will support deployment of the Enterprise Configuration Management Tool, which will provide an inventory of ground system equipment and allow SGS to identify bulk pricing discounts and trend analysis of equipment failures. Funds will also establish a requirements tracking system to identify capability gaps and performance improvement opportunities across the ground enterprise. These activities are critical to consolidating functions, reducing costs, and setting the foundation for an enterprise ground system.

### SATELLITE GROUND SERVICES

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$104,000	<b>FY 2020</b>	\$57,325
<b>FY 2017</b>	\$57,325	<b>FY 2021</b>	\$57,325
<b>FY 2018</b>	\$57,325	<b>CTC</b>	\$N/A
<b>FY 2019</b>	\$57,325	<b>Total*</b>	Recurring

\*In FY 2017, NOAA requests a technical adjustment to transfer SGS funding to operate and maintain the Wallops, VA backup facility for the NSOF Environmental Satellite Processing Center. See the FY 2017 President's Budget for additional details.

**Satellite Ground Services: DSCOVER Technology Refresh:** NOAA requests an increase of \$1,700,000 to provide a technology refresh of the DSCOVER antenna at the Wallops, Virginia Command and Data Acquisition station. The antenna used to collect data from the DSCOVER satellite is well beyond its useful life and requires a technology refresh. The upgrade will greatly lower the risk of equipment failure and ensure NOAA can continue to collect DSCOVER data from this site. If the antenna fails, the Space Weather Prediction Center may not be able to provide advanced warning of an approaching geomagnetic storm, which can have a significant economic impact on customers in every major public infrastructure system.

### DSCOVER TECH REFRESH

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$0	<b>FY 2020</b>	\$0
<b>FY 2017</b>	\$1700	<b>FY 2021</b>	\$0
<b>FY 2018</b>	\$700	<b>CTC</b>	\$0
<b>FY 2019</b>	\$0	<b>Total</b>	\$2,400

**System Architecture and Advanced Planning (SAAP):** NOAA requests an increase of \$1,000,000 to complete the NOAA Satellite Observing System Architecture (NSOSA) study and supporting grant work. The NSOSA study, which started in FY 2016, will allow SAAP to develop the future architecture of satellite observing systems for meeting weather, space weather, and environmental remote sensing requirements beyond FY 2028. This study will be a joint effort between NOAA and NASA, which will provide science and engineering expertise. The increase will also fund the cooperative institute grant for the Space Platforms Requirements Working Group. This grant will complete the working group's assessment of new and existing requirements against the current satellite architecture, which will allow NOAA to prioritize future satellite observational requirements.

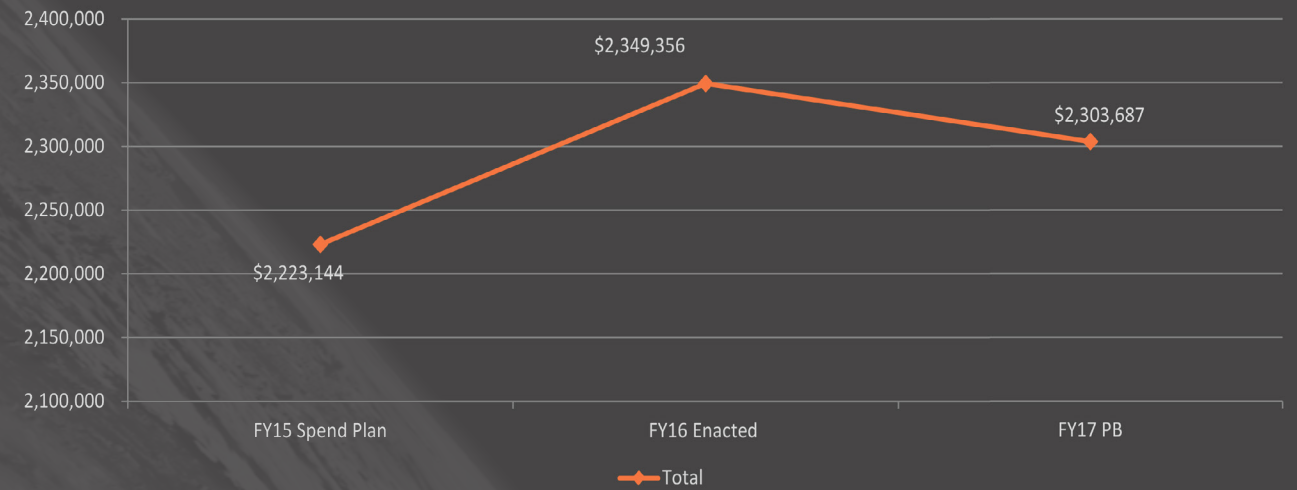
### SAAP

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$6,929	<b>FY 2020</b>	\$4,929
<b>FY 2017</b>	\$4,929	<b>FY 2021</b>	\$4,929
<b>FY 2018</b>	\$4,929	<b>CTC</b>	N/A
<b>FY 2019</b>	\$4,929	<b>Total</b>	Recurring

### NESDIS Discretionary Budget Trends (FY 2015-2017)

(\$ thousands)



**Projects, Planning and Analysis:** NOAA requests an increase of \$8,288,000 to support the accommodation of NOAA instruments on the European satellite MetOp-C for launch in early FY 2019. MetOp-C will provide EUMETSAT and NOAA with polar observations in the mid-morning orbit, similar to the polar observations that JPSS will provide in the afternoon orbit. NOAA is currently preparing three critical instruments for launch on MetOp-C: Advanced Very High Resolution Radiometer; Advanced Microwave Sounding Unit-A; and Space Environment Monitor. FY 2017 funds will allow the Projects, Planning, and Analysis program to evaluate the instrument's performance in the thermal vacuum test, a critical milestone to meeting the MetOp-C launch schedule. This funding request is critical to meeting NOAA obligations to its partnership with EUMETSAT.

**Commercial Weather Data Pilot:** NOAA requests an increase of \$2,000,000 to assess the potential viability of using commercial data in NOAA's weather modeling and forecasting through pilot purchases of commercial data. This request will fund ongoing efforts to evaluate, calibrate and purchase available commercial satellite data, consistent with NOAA's Commercial Space Policy. The Commercial Weather Data Pilot will provide test case examples of commercial providers' ability to deliver data to meet NOAA's observational requirements. NOAA is committed to using commercial space products in its warnings, forecasts, and products, where viable and appropriate, in order to promote a robust commercial space industry and acquire observation data in a cost effective manner.

### PPA

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$50,400	<b>FY 2020</b>	\$33,488
<b>FY 2017</b>	\$33,488	<b>FY 2021</b>	\$33,488
<b>FY 2018</b>	\$33,488	<b>CTC</b>	N/A
<b>FY 2019</b>	\$33,488	<b>Total</b>	Recurring

### COMMERCIAL WEATHER DATA PILOT

BUDGET AUTHORITY IN THOUSANDS

<b>FY 2016 &amp; Prior</b>	\$3,000	<b>FY 2017</b>	\$5,000
Remainder to be provided with FY 2018 President's Budget			



# CHAPTER 7 MISSION SUPPORT

NOAA's Gulfstream IV-SP (front) and Lockheed WP-3D Orions play a major role in tropical cyclone research and forecasting, along with other environmental observation missions.

**NOAA's** Mission Support services (formerly called "Program Support") are the backbone of NOAA's programs and mission. These services provide the planning, administrative, financial, procurement, information technology (IT), human resources, and infrastructure support that are essential to the efficient and effective execution of NOAA's mission. To support the Department of Commerce's Operational Excellence priority, NOAA will begin transitioning its mission services to the shared services model, a new Department-wide customer-focused, service delivery model that will increase efficiencies related to acquisitions, financial management, human resources, and information technology services. Specifically, in FY 2017, following transition of some services in FY 2016, NOAA will continue to develop human resources functions under the shared services model and start to transition acquisitions and information technology services as well. The goal of shared services is to strengthen mission delivery and improve customer service.

## FY 2017 REQUEST \$286,065,000

In FY 2017, NOAA requests a total of \$286,065,000 to position NOAA's Mission Support for more effective execution of NOAA's diverse mission. This total includes Operations, Research, and Facilities (ORF) and Procurement, Acquisition, and Construction (PAC) accounts and reflects a net increase of \$3,494,000 in FY 2017 program changes. In FY 2017, NOAA proposes to rename its Program Support budget program to Mission Support since the functions carried out through these programs are vital to NOAA's environmental stewardship and public safety missions. NOAA proposes a corresponding restructure of the Programs, Projects, and Activities (PPA) within the Mission Support ORF account. This restructure involves simplifying the presentation within the control table and other exhibits by removing line item designations and aligning sub-programs directly with remaining PPAs. The Under Secretary and Associates Office PPA will be renamed Executive Leadership. The NOAA Wide Corporate Services and Agency Management Base, NOAA Facility Management & Construction and Safety, and DOC Accounting System PPAs will be combined into a new Mission Services and Management PPA. As part of this restructure, the Office of Marine and Aviation Operations will become its own budget program and will no longer be part of the Mission Support budget program to reflect its status as an independent line office.

NOAA proposes five sub-programs/PPAs in the restructuring of the ORF account:

- Executive Leadership
- IT Security
- Office of Education
- Mission Services and Management
- Payment to the DOC Working Capital Fund

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$281,508,000 to support the Operations, Research, and Facilities of Mission Support. This includes a net decrease of \$63,000 in FY 2017 program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### EXECUTIVE LEADERSHIP \$27,266,000

NOAA requests a total of \$27,266,000 under the Executive Leadership sub-program. There are no program changes in this sub-program.

## MISSION SERVICES AND MANAGEMENT

### \$155,199,000

NOAA requests a net increase of \$7,842,000 in FY 2017 program changes for a total of \$155,199,000 in the Mission Services and Management sub-program. Highlights include:

**Re-Architecting Data Systems for Mission Resilience:** NOAA requests an increase of \$1,400,000 to improve data flow resiliency across NOAA's critical IT systems and infrastructure. This initiative, which complements the "NESDIS IT Security" proposals described on p. 32 and p. 33 in Chapter 6, will begin modernizing and streamlining NOAA's IT systems. The OCIO component of this request will begin assessment and implementation of robust enterprise architecture to reduce the severity of disruption of the flow of critical NOAA data (e.g., weather forecasts and warnings) in the event that IT systems are compromised or fail. This NOAA-wide re-architecting effort will map specific system linkages, document in-



NOAA's Satellite Operations Facility in Suitland, MD. Home of NOAA's around-the-clock environmental satellite services to provide critical data for weather and climate prediction.

terdependencies, and record configurations for systems that support NOAA's Primary Mission Essential Functions. These efforts are expected to reduce labor and other costs related to NOAA's IT systems over the long term, as well as enhance system resilience and cybersecurity.

**Building Capacity to Provide NOAA-Wide Mission Support:**

NOAA requests an increase of \$4,375,000 to improve oversight, guidance, and administrative operations and services that support NOAA's core mission areas, specifically in human resources and acquisition management. These additional funds are necessary both to support NOAA's retained mission support functions, which have been chronically underfunded for years, as well as to transform from NOAA's current service delivery model to a shared services model whereby a shared service provider will be responsible for transactional tasks (e.g., development of position descriptions and job announcements). This new model will increase efficient delivery of high-quality services; improve performance management and transparency of decision making; and increase NOAA's ability to focus on its mission by freeing bureau employees from routine, transactional tasks. In order to successfully transition the transactional functions to the shared services model, NOAA needs additional funding. The transition will require additional funding for the first few years; costs are expected to decrease in future years.

**Accelerate NOAA Facility Disposal:** NOAA requests an increase of \$2,067,000 to dispose of unneeded facilities and structures in order to reduce the NOAA footprint and optimize the facility portfolio. NOAA operates and manages a large and geographically dispersed facility portfolio with scarce resources, and therefore requires additional funds to transform the portfolio into a modern system of the right type and size in the right places to carry out NOAA's science missions. Disposing of unneeded facilities is a critical step in transforming the portfolio and building the foundation for 21st century science.

**IT SECURITY \$10,050,000**

NOAA requests a total of \$10,050,000 under the IT Security sub-program. There are no program changes in this sub-program.

**PAYMENT TO DOCWORKING CAPITAL FUND \$72,512,000**

NOAA requests a net increase of \$2,295,000 in FY 2017 program changes for a total of \$72,512,000 in the Payment to the DOC Working Capital Fund sub-program.

**Maintaining Capability in the DOC Working Capital Fund:** NOAA requests an increase of \$2,295,000 to cover additional shared service investments within the Departmental Working Capital Fund (WCF). These Departmental requirements include necessary investments in DOC-wide systems, network security initiatives, and replacement of degrading IT infrastructure. A full discussion of all WCF program changes is in the WCF section of the Departmental Management Congressional Submission document.

**OFFICE OF EDUCATION \$16,481,000**

NOAA requests a net decrease of \$10,200,000 in FY 2017 program changes for a total of \$16,481,000 in the Office of Education sub-program. (Within this funding, NOAA will use \$2,050,000 for Office of Education operations and \$14,431,000 to support the Educational Partnership Program.) Highlights include:

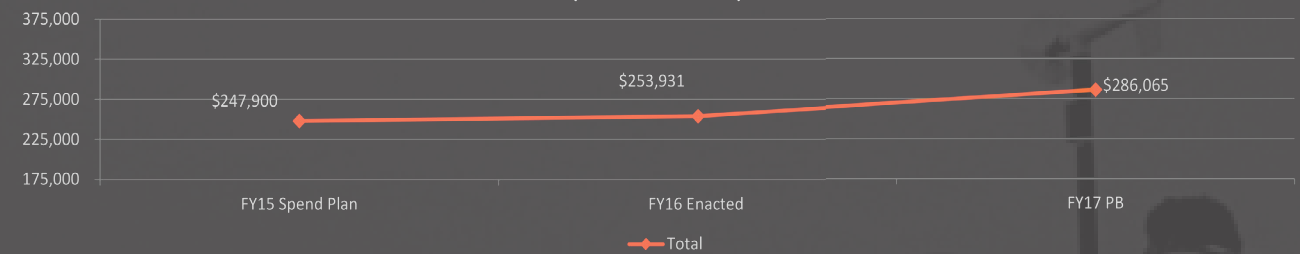
**Office of Education:** NOAA requests a decrease of \$3,000,000 to terminate NOAA's Competitive Education Grants program.

**NOAA Bay-Watershed Education and Training (B-WET) Regional Programs:** NOAA requests a decrease of \$7,200,000 to terminate the Bay-Watershed Education and Training (B-WET) Program. In FY 2017, NOAA will continue to provide watershed educational experiences for students through other programs, including National Marine Sanctuaries and the National Estuarine Research Reserves.

**FY 2017 PAC BUDGET SUMMARY**

NOAA requests a total of \$4,557,000 to support the Procurement, Acquisition, and Construction functions of Mission Support. This includes a net increase of \$3,557,000 in FY 2017 program changes.

**MS Discretionary Budget Trends (FY 2015-2017)**  
(\$ thousands)



In the ocean acidification laboratory at the NOAA Mukilteo Research Station, Dr. Paul McElhany demonstrates the functionality of the equipment that exposes California Current species to ocean acidification, temperature change, and deoxygenation treatments.

**National Marine Fisheries Service Facilities Initiative:** NOAA requests \$4,557,000 to prepare for the replacement of the Northwest Fisheries Science Center facility in Mukilteo, Washington (on Puget Sound), which conducts critical research on marine species and the impacts of ecosystem stressors, such as ocean acidification and marine diseases, that contributes to fisheries management decisions. The structural condition of the facility, which was built in the 1940s and was formerly owned by the Department of Defense, has deteriorated to the point that it poses an imminent safety risk to NOAA personnel, threatening NOAA's mission and operations in the region. Condition assessments confirm that NOAA cannot use the facility in its current state for more than five years.

**NOAA FISHERIES FACILITIES INITIATIVE**  
BUDGET AUTHORITY IN THOUSANDS

FY 2017	\$4,557	FY 2020	\$0
FY 2018	\$28,384	FY 2021	\$0
FY 2019	\$0		

**Naval Station Newport Pier Study:** NOAA requests a decrease of \$1,000,000 for completion of a planning and design study related to the evaluation of the NAVSTA Newport pier as a potential homeport for the fisheries survey vessel (FSV) *Henry B. Bigelow*.

**NAVAL STATION NEWPORT PIER STUDY**  
BUDGET AUTHORITY IN THOUSANDS

FY 2017	\$0	FY 2020	\$0
FY 2018	\$0	FY 2021	\$0
FY 2019	\$0		

**PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2017**

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

**CONSTRUCTION \$3,557,000**

NOAA requests a net increase of \$3,557,000 in FY 2017 program changes for a total of \$4,557,000 in the Construction sub-program. Highlights include:



# CHAPTER 8 OFFICE OF MARINE AND AVIATION OPERATIONS



NOAA Ship Reuben Lasker underway in Alaska. Credit: LCDR Chris Skapin.

**NOAA's** Office of Marine and Aviation Operations (OMAO) supports an array of specialized ships and aircraft that gather oceanographic, atmospheric, hydrographic, and fisheries data in support of NOAA's public safety, environmental stewardship, and scientific missions and vital to the nation's economic security. OMAO includes civilians, mariners, and officers of the NOAA Commissioned Officer Corps, one of the seven uniformed services of the United States. OMAO civilians and NOAA Corps officers operate, manage, and maintain NOAA's active fleet of 16 research and survey ships and nine specialized aircrafts.

## FY 2017 REQUEST \$289,298,000

NOAA requests a total of \$289,298,000 in mandatory and discretionary funds to support the continued and enhanced operations of OMAO, and specifically, to ensure the continuity of NOAA's at-sea data collection capability through continued recapitalization and sustainment of NOAA's ship fleet. This total includes Operations, Research, and Facilities (ORF); Procurement, Acquisition, and Construction (PAC); and other accounts. It also includes a net decrease of \$49,050,000 in FY 2017 program changes. Without these and future investments, the NOAA ship fleet will decline by 50 percent – from 16 to 8 active ships – over the next 10 to 12 years, hampering a number of NOAA missions.



The NOAA aircraft fleet at NOAA's Aircraft Operations Center in Tampa, Florida

## FY 2017 ORF BUDGET SUMMARY

NOAA requests a total of \$217,287,000 to support the Operations, Research, and Facilities activities of OMAO. This includes a net increase of \$2,000,000 in FY 2017 program changes.

### ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### MARINE OPERATIONS & MAINTENANCE \$184,376,000

NOAA requests a net increase of \$2,000,000 for a total of \$184,376,000 in the Marine Operations and Maintenance sub-program. Highlights include:

**Marine Operations & Maintenance: Alternative Crew Models:** NOAA requests an increase of \$2,000,000 to support a pilot program for alternative crewing on NOAA ships. These funds are needed to test alternatives to current ship staffing that will prevent loss of Days at Sea (DAS) due to crewing constraints. NOAA faces a maritime industry-wide problem of high demand and intense competition for a small pool of qualified mariners. Currently, if a qualified replacement engineer is not available when NOAA must conduct an at-sea mission, it can result in lost DAS. With the requested increase, NOAA will expand the rotational staffing program for licensed engineering officers on approximately twelve NOAA ships. NOAA will also begin piloting rotational staffing for unlicensed engine, deck, steward, and survey departments on two ships. Implementing the rotational staffing program will increase the number of DAS available for allocation to NOAA's prioritized mission needs.

## AVIATION OPERATIONS \$32,911,000

NOAA requests a total of \$32,911,000 in the Aviation Operations sub-program. There are no program changes in this sub-program.

## FY 2017 PAC BUDGET SUMMARY

NOAA requests a total of \$24,000,000 to support the Procurement, Acquisition, and Construction functions of OMAO. This includes a net decrease of \$51,050,000 in FY 2017 program changes.

### PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2017:

Program changes above \$1,000,000 are highlighted below. A summary of funding by Program, Project, and Activity (PPA) is located in Appendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2017 Congressional Justification.

### OMAO FLEET REPLACEMENT \$40,700,000

NOAA requests a net decrease of \$51,050,000 in FY 2017 program changes for a total of \$40,700,000 in the OMAO Fleet Replacement sub-program. Highlights include:

#### New Vessel Construction: Fleet Recapitalization:

NOAA requests a net decrease of \$56,050,000 in this PPA in FY 2017. NOAA will use the \$80,050,000 provided in FY 2016 for this program along with the \$24,000,000 remaining in FY 2017 to complete design, acquisition and construction of a Regional Survey Vessel (RSV) as part of a multi-year NOAA ship fleet recapitalization initiative. NOAA's fleet is aging, with half of its vessels scheduled to retire within the next 10-12 years. Both regional-class

vessels and ocean-class survey vessels (OSV) will be decommissioned during this time frame. NOAA's fleet replacement plan previously identified replacing the RSVs as its highest priority, with three regional-class vessels recently retired and two additional ships retiring in the next seven years. Due to an opportunity to leverage Navy's expertise, NOAA decided to develop and build an OSV first. However, cost, schedule, and a reassessment of NOAA's highest priority data collection needs prevented this idea from advancing beyond the design stage. Given these challenges, NOAA, in conjunction with other Federal oceanographic research agencies, re-examined its broad fleet needs, as well as government-wide fleet capacity, and determined that a smarter strategy is to invest in RSVs, which can perform many NOAA mission-critical activities and have lower acquisition and operations and maintenance costs than the OSV. Investment in an OSV has been shifted to a later date.

### NEW VESSEL CONSTRUCTION

BUDGET AUTHORITY IN THOUSANDS

FY 2017	\$24,000	FY 2020	TBD
FY 2018	TBD	FY 2021	TBD
FY 2019	TBD		

**Fleet Capital Improvements and Technology Infusion: Progressive Lifecycle Maintenance:** NOAA requests an increase of \$5,000,000 to support the Progressive Lifecycle Maintenance Program. Funds will stabilize capital investment in regular upgrades and replacements of fleet equipment and technology infusions, such as data processing capacity. This investment will help ensure the continuity and reliability – and extend the service life – of the NOAA fleet to support the agency's diverse at-sea observation and data collection needs.

### FLEET CAPITAL IMPROVEMENTS & TECH INFUSION

BUDGET AUTHORITY IN THOUSANDS

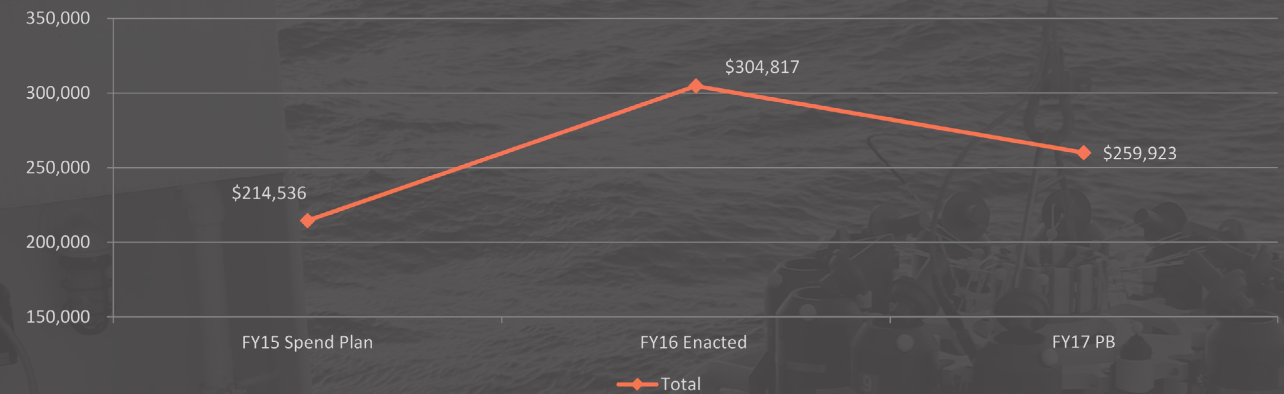
FY 2017	\$16,700	FY 2020	\$16,700
FY 2018	\$16,700	FY 2021	\$16,700
FY 2019	\$16,700		



The crew of NOAA Ship Henry B. Bigelow on the ship's bridge. Credit: David Hall.

## OMAO Discretionary Budget Trends (FY 2015-2017)

(\$ thousands)



## DISCRETIONARY FUNDS

### MEDICARE-ELIGIBLE RETIREE HEALTHCARE FUND CONTRIBUTION

The FY 2003 Department of Defense Authorization Act requires all uniformed services, including NOAA, to participate in an accrual fund for Medicare-eligible retirees. Payments into this accrual fund will cover the future health care benefits of present, active-duty NOAA officers and their dependents and annuitants. FY17 payments to the accrual fund are estimated to be \$1,936,000.

## MANDATORY FUNDS

### NOAA CORPS COMMISSIONED OFFICERS RETIREMENT

The retirement system for the uniformed services provides a measure of financial security after release from active duty for service members and their survivors. It is an important factor in the choice of a career in the uniformed services and is mandated by Federal statutes

under Title 10, United States Code. NOAA transfers retirement pay funds to the Coast Guard, which handles the payment function for retirees and annuitants. Health care funds for non-Medicare-eligible retirees, dependents, and annuitants are transferred to the U.S. Public Health Service, which administers the health care program.

### RECAPITALIZED RESEARCH FLEET

In addition to the aforementioned \$24,000,000 request in discretionary funds for a regional survey vessel (RSV) for OMAO, the Budget includes \$100,000,000 in mandatory funds to begin construction on a second RSV as part of a multi-year NOAA ship fleet recapitalization initiative.





APPENDIX 1  
PROPOSED CHANGES TO  
GENERAL PROVISIONS

NOAA seeks the following changes to the General Provisions in its FY 2017 budget submission. For a more detailed discussion of the justification for these proposed changes, please consult the FY 2017 Congressional Justification.

#### 1. NOAA Cost Recovery Language

SEC. 110. To carry out the responsibilities of the National Oceanic and Atmospheric Administration (NOAA), the Administrator of NOAA is authorized to: (1) enter into grants and cooperative agreements with; (2) use on a non-reimbursable basis land, services, equipment, personnel, and facilities provided by; and (3) receive and expend funds made available on a consensual basis from: a Federal agency, State or subdivision thereof, local government, tribal government, territory, or possession or any subdivisions thereof, foreign government, international or intergovernmental organization, public or private organization, or individual: Provided, That funds received for permitting and related regulatory activities pursuant to this section shall be deposited under the heading “National Oceanic and Atmospheric Administration—Operations, Research, and Facilities” and shall remain available until expended for such purposes: Provided further, That all funds within this section and their corresponding uses are subject to section 505 of this Act.

#### Justification

NOAA proposes to clarify NOAA's ability to receive and expend funds from, and to engage in agreements with, external entities to carry out its responsibilities. These activities include, but are not limited to, scientific data collection and research that informs NOAA's decisions and utilization of land and facilities to support NOAA's research and operational activities.

*Snow Express* by Conrad Stenftenagel, Satin Anthony, IN. This photo took first place for weather, water and climate focused submissions in NOAA's Weather in Focus 2015 Photo Contest.

# APPENDIX 2 CONTROL TABLE

## NATIONAL OCEAN SERVICE All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Navigation, Observations and Positioning</b>						
Navigation, Observations and Positioning	137,961	149,000	2,406	151,406	(8,000)	143,406
Hydrographic Survey Priorities/Contracts	25,000	27,000	0	27,000	(2,000)	25,000
I00S Regional Observations	29,500	29,500	0	29,500	0	29,500
<b>Total, Navigation, Observations and Positioning</b>	<b>192,461</b>	<b>205,500</b>	<b>2,406</b>	<b>207,906</b>	<b>(10,000)</b>	<b>197,906</b>
<b>Coastal Science and Assessment</b>						
Coastal Science, Assessment, Response and Restoration	71,000	72,600	1,512	74,112	0	74,112
Competitive Research	9,000	9,000	0	9,000	4,000	13,000
<b>Total, Coastal Science and Assessment</b>	<b>80,000</b>	<b>81,600</b>	<b>1,512</b>	<b>83,112</b>	<b>4,000</b>	<b>87,112</b>
<b>Ocean and Coastal Management and Services</b>						
Coastal Zone Management and Services	41,700	40,000	341	40,341	13,506	53,847
Coastal Management Grants	71,146	75,000	0	75,000	15,646	90,646
Coral Reef Program	26,000	26,000	100	26,100	0	26,100
National Estuarine Research Reserve System	21,300	23,000	0	23,000	0	23,000
Sanctuaries and Marine Protected Areas	48,500	49,000	800	49,800	0	49,800
<b>Total, Ocean and Coastal Management and Services</b>	<b>208,646</b>	<b>213,000</b>	<b>1,241</b>	<b>214,241</b>	<b>29,152</b>	<b>243,393</b>
<b>Total, National Ocean Service - ORF</b>	<b>481,107</b>	<b>500,100</b>	<b>5,159</b>	<b>505,259</b>	<b>23,152</b>	<b>528,411</b>
<b>Other National Ocean Service Accounts</b>						
Total, National Ocean Service - PAC	3,700	3,700	0	3,700	0	3,700
Total, National Ocean Service - Other	50,931	98,047	(70,243)	27,804	10,000	37,804
<b>GRAND TOTAL NOS</b>	<b>535,738</b>	<b>601,847</b>	<b>(65,084)</b>	<b>536,763</b>	<b>33,152</b>	<b>569,915</b>

## NATIONAL MARINE FISHERIES SERVICE All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Protected Resources Science and Management</b>						
Marine Mammals, Sea Turtles & Other Species	110,219	110,246	1,409	111,655	13,452	125,107
Species Recovery Grants	5,000	6,000	8	6,008	16,012	22,020
Atlantic Salmon	5,500	6,163	61	6,224	0	6,224
Pacific Salmon	60,000	60,000	1,082	61,082	2,338	63,420
<b>Total, Protected Resources Science and Management</b>	<b>180,719</b>	<b>182,409</b>	<b>2,560</b>	<b>184,969</b>	<b>31,802</b>	<b>216,771</b>
<b>Fisheries Science and Management</b>						
Fisheries and Ecosystem Science Programs and Services	132,189	139,489	3,872	143,361	6,808	150,169
Fisheries Data Collections, Surveys and Assessments	158,271	163,271	1,478	164,749	0	164,749
Observers and Training	43,655	43,655	403	44,058	1,095	45,153
Fisheries Management Programs and Services	114,758	115,995	1,839	117,834	4,061	121,895
Aquaculture	5,700	6,300	81	6,381	1,525	7,906
Salmon Management Activities	30,200	31,500	85	31,585	0	31,585
Regional Councils and Fisheries Commissions	32,738	33,470	784	34,254	0	34,254
Interjurisdictional Fisheries Grants	2,500	3,000	4	3,004	0	3,004
<b>Total, Fisheries Science and Management</b>	<b>520,011</b>	<b>536,680</b>	<b>8,546</b>	<b>545,226</b>	<b>13,489</b>	<b>558,715</b>
<b>Enforcement</b>						
Enforcement	65,000	69,000	840	69,840	1,018	70,858
<b>Total, Enforcement</b>	<b>65,000</b>	<b>69,000</b>	<b>840</b>	<b>69,840</b>	<b>1,018</b>	<b>70,858</b>
<b>Habitat Conservation and Restoration</b>						
Habitat Conservation and Restoration	56,408	61,408	505	61,913	(3,523)	58,390
<b>Subtotal, Habitat Conservation &amp; Restoration</b>	<b>56,408</b>	<b>61,408</b>	<b>505</b>	<b>61,913</b>	<b>(3,523)</b>	<b>58,390</b>
<b>Total, National Marine Fisheries Service - ORF</b>	<b>822,138</b>	<b>849,497</b>	<b>12,451</b>	<b>861,948</b>	<b>42,786</b>	<b>904,734</b>
<b>Other National Marine Fisheries Service Accounts</b>						
Total, National Marine Fisheries Service - PAC	0	0	0	0	0	0
Total, National Marine Fisheries Service - Other	136,056	122,206	(20,010)	102,196	9,000	111,196
<b>GRAND TOTAL NMFS</b>	<b>958,194</b>	<b>971,703</b>	<b>(7,559)</b>	<b>964,144</b>	<b>51,786</b>	<b>1,015,930</b>



## OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Climate Research</b>						
<b>Laboratories &amp; Cooperative Institutes</b>						
Laboratories & Cooperative Institutes	60,000	60,000	420	60,420	10,493	70,913
<b>Subtotal, Laboratories &amp; Cooperative Institutes</b>	<b>60,000</b>	<b>60,000</b>	<b>420</b>	<b>60,420</b>	<b>10,493</b>	<b>70,913</b>
<b>Regional Climate Data &amp; Information</b>						
Regional Climate Data & Information	38,000	38,000	266	38,266	14,437	52,703
<b>Subtotal, Regional Climate Data &amp; Information</b>	<b>38,000</b>	<b>38,000</b>	<b>266</b>	<b>38,266</b>	<b>14,437</b>	<b>52,703</b>
<b>Climate Competitive Research</b>						
Climate Competitive Research	60,000	60,000	420	60,420	5,830	66,250
<b>Subtotal, Climate Competitive Research</b>	<b>60,000</b>	<b>60,000</b>	<b>420</b>	<b>60,420</b>	<b>5,830</b>	<b>66,250</b>
<b>Total, Climate Research</b>	<b>158,000</b>	<b>158,000</b>	<b>1,106</b>	<b>159,106</b>	<b>30,760</b>	<b>189,866</b>
<b>Weather &amp; Air Chemistry Research</b>						
<b>Laboratories &amp; Cooperative Institutes</b>						
Laboratories & Cooperative Institutes	70,000	76,000	4,549	80,549	(7,896)	72,653
<b>Subtotal, Laboratories &amp; Cooperative Institutes</b>	<b>70,000</b>	<b>76,000</b>	<b>4,549</b>	<b>80,549</b>	<b>(7,896)</b>	<b>72,653</b>
<b>Weather &amp; Air Chemistry Research Programs</b>						
U.S. Weather Research Program (USWRP)	7,300	8,000	56	8,056	8,078	16,134
Tornado Severe Storm Research / Phased Array Radar	13,500	13,158	0	13,158	0	13,158
Joint Technology Transfer Initiative	0	6,000	0	6,000	(6,000)	0
<b>Subtotal, Weather &amp; Air Chemistry Research Programs</b>	<b>20,800</b>	<b>27,158</b>	<b>56</b>	<b>27,214</b>	<b>2,078</b>	<b>29,292</b>
<b>Total, Weather &amp; Air Chemistry Research</b>	<b>90,800</b>	<b>103,158</b>	<b>4,605</b>	<b>107,763</b>	<b>(5,818)</b>	<b>101,945</b>
<b>Ocean, Coastal, and Great Lakes Research</b>						
<b>Laboratories &amp; Cooperative Institutes</b>						
Laboratories & Cooperative Institutes	27,000	32,000	374	32,374	(4,985)	27,389
<b>Subtotal, Laboratories &amp; Cooperative Institutes</b>	<b>27,000</b>	<b>32,000</b>	<b>374</b>	<b>32,374</b>	<b>(4,985)</b>	<b>27,389</b>
<b>National Sea Grant College Program</b>						
National Sea Grant College Program Base	62,800	64,000	448	64,448	(2,548)	61,900
Marine Aquaculture Program	4,500	9,000	0	9,000	(2,000)	7,000
<b>Subtotal, National Sea Grant College Program</b>	<b>67,300</b>	<b>73,000</b>	<b>448</b>	<b>73,448</b>	<b>(4,548)</b>	<b>68,900</b>

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Ocean Exploration and Research</b>						
Ocean Exploration and Research	28,000	32,000	224	32,224	(12,656)	19,568
<b>Subtotal, Ocean Exploration and Research</b>	<b>28,000</b>	<b>32,000</b>	<b>224</b>	<b>32,224</b>	<b>(12,656)</b>	<b>19,568</b>
<b>Other Ecosystems Programs</b>						
Integrated Ocean Acidification	8,500	10,000	70	10,070	11,705	21,775
<b>Subtotal, Other Ecosystems Programs</b>	<b>8,500</b>	<b>10,000</b>	<b>70</b>	<b>10,070</b>	<b>11,705</b>	<b>21,775</b>
<b>Sustained Ocean Observations and Monitoring</b>						
Sustained Ocean Observations and Monitoring	41,300	41,596	227	41,823	0	41,823
<b>Subtotal, Sustained Ocean Observations and Monitoring</b>	<b>41,300</b>	<b>41,596</b>	<b>227</b>	<b>41,823</b>	<b>0</b>	<b>41,823</b>
<b>Total, Ocean, Coastal, &amp; Great Lakes Research</b>	<b>172,100</b>	<b>188,596</b>	<b>1,343</b>	<b>189,939</b>	<b>(10,484)</b>	<b>179,455</b>
<b>Innovative Research &amp; Technology</b>						
High Performance Computing Initiatives	12,000	12,144	0	12,144	0	12,144
Research Transition Acceleration Program	0	0	0	0	10,000	10,000
<b>Total, Innovative Research &amp; Technology</b>	<b>12,000</b>	<b>12,144</b>	<b>0</b>	<b>12,144</b>	<b>10,000</b>	<b>22,144</b>
<b>Total, Office of Oceanic and Atmospheric Research - ORF</b>	<b>432,900</b>	<b>461,898</b>	<b>7,054</b>	<b>468,952</b>	<b>24,458</b>	<b>493,410</b>
<b>Other Office of Oceanic and Atmospheric Research Accounts</b>						
Total, Office of Ocean and Atmospheric Research - PAC	13,379	20,079	0	20,079	6,300	26,379
Total, Office of Oceanic and Atmospheric Research - Other	0	0	0	0	0	0
<b>GRAND TOTAL OAR</b>	<b>446,279</b>	<b>481,977</b>	<b>7,054</b>	<b>489,031</b>	<b>30,758</b>	<b>519,789</b>



## NATIONAL WEATHER SERVICE All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
Observations	197,977	216,363	18,120	234,483	(11,487)	222,996
Central Processing	96,617	92,871	486	93,357	(4,969)	88,388
Analyze, Forecast and Support	483,060	496,031	(5,414)	490,617	(4,686)	485,931
Dissemination	52,899	44,743	493	45,236	2,000	47,236
Science and Technology Integration	123,600	138,826	9	138,835	(6,879)	131,956
<b>Total, National Weather Service - ORF</b>	<b>954,153</b>	<b>988,834</b>	<b>13,694</b>	<b>1,002,528</b>	<b>(26,021)</b>	<b>976,507</b>
<b>Other National Weather Service Accounts</b>						
Total, National Weather Service - PAC	133,300	135,315	0	135,315	7,470	142,785
Total, National Weather Service - Other	0	0	0	0	0	0
<b>GRAND TOTAL NWS</b>	<b>1,087,453</b>	<b>1,124,149</b>	<b>13,694</b>	<b>1,137,843</b>	<b>(18,551)</b>	<b>1,119,292</b>

## NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Environmental Satellite Observing Systems</b>						
<b>Office of Satellite and Product Operations (OSPO)</b>						
Satellite and Product Operations	84,000	93,000	25,996	118,996	4,428	123,424
NSOF Operations	8,500	9,000	5,250	14,250	0	14,250
<b>Subtotal, Office of Satellite and Product Operations (OSPO)</b>	<b>92,500</b>	<b>102,000</b>	<b>31,246</b>	<b>133,246</b>	<b>4,428</b>	<b>137,674</b>
<b>Product Development, Readiness &amp; Application</b>						
Product Development, Readiness & Application	26,000	26,000	7,954	33,954	316	34,270
<b>Subtotal, Product Development, Readiness &amp; Application</b>	<b>26,000</b>	<b>26,000</b>	<b>7,954</b>	<b>33,954</b>	<b>316</b>	<b>34,270</b>
Commercial Remote Sensing Regulatory Affairs	1,000	1,000	0	1,000	1,065	2,065
Office of Space Commerce	600	600	0	600	1,400	2,000
Group on Earth Observations (GEO)	500	500	0	500	0	500
<b>Total, Environmental Satellite Observing Systems</b>	<b>120,600</b>	<b>130,100</b>	<b>39,200</b>	<b>169,300</b>	<b>7,209</b>	<b>176,509</b>
<b>National Centers for Environmental Information</b>						
National Centers for Environmental Information	68,000	58,986	3,231	62,217	1,261	63,478
<b>Total, National Centers for Environmental Information</b>	<b>68,000</b>	<b>58,986</b>	<b>3,231</b>	<b>62,217</b>	<b>1,261</b>	<b>63,478</b>
<b>Total, NESDIS - ORF</b>	<b>188,600</b>	<b>189,086</b>	<b>42,431</b>	<b>231,517</b>	<b>8,470</b>	<b>239,987</b>
<b>Other NESDIS Accounts</b>						
Total, NESDIS - PAC	2,034,544	2,160,270	(38,939)	2,121,331	(57,631)	2,063,700
Total, NESDIS - Other	0	0	0	0	0	0
<b>GRAND TOTAL NESDIS</b>	<b>2,223,144</b>	<b>2,349,356</b>	<b>3,492</b>	<b>2,352,848</b>	<b>(49,161)</b>	<b>2,303,687</b>



## MISSION SUPPORT All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
Executive Leadership	27,000	27,000	266	27,266	0	27,266
Mission Services and Management	145,000	148,000	(643)	147,357	7,842	155,199
IT Security	8,300	8,300	1,750	10,050	0	10,050
Payment to the DOC Working Capital Fund	40,000	43,000	27,217	70,217	2,295	72,512
Office of Education	27,600	26,631	50	26,681	(10,200)	16,481
<b>Total, Mission Support - ORF</b>	<b>247,900</b>	<b>252,931</b>	<b>28,640</b>	<b>281,571</b>	<b>(63)</b>	<b>281,508</b>
<b>Other Mission Support Accounts</b>						
Total, Mission Support - PAC	0	1,000	0	1,000	3,557	4,557
Total, Mission Support - Other	0	0	0	0	0	0
<b>GRAND TOTAL MS</b>	<b>247,900</b>	<b>253,931</b>	<b>28,640</b>	<b>282,571</b>	<b>3,494</b>	<b>286,065</b>

## OFFICE OF MARINE AND AVIATION OPERATIONS All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Marine Operations &amp; Maintenance</b>						
Marine Operations & Maintenance	175,000	178,838	3,538	182,376	2,000	184,376
<b>Total, Marine Operations &amp; Maintenance</b>	<b>175,000</b>	<b>178,838</b>	<b>3,538</b>	<b>182,376</b>	<b>2,000</b>	<b>184,376</b>
<b>Aviation Operations</b>						
Aircraft Services	31,600	32,293	618	32,911	0	32,911
<b>Total, Aviation Operations</b>	<b>31,600</b>	<b>32,293</b>	<b>618</b>	<b>32,911</b>	<b>0</b>	<b>32,911</b>
<b>Total, OMAO - ORF</b>	<b>206,600</b>	<b>211,131</b>	<b>4,156</b>	<b>215,287</b>	<b>2,000</b>	<b>217,287</b>
<b>Other OMAO Accounts</b>						
Total, OMAO - PAC	6,000	91,750	0	91,750	(51,050)	40,700
Total, OMAO - Other	30,205	31,311	0	31,311	0	31,311
<b>GRAND TOTAL OMAO</b>	<b>242,805</b>	<b>334,192</b>	<b>4,156</b>	<b>338,348</b>	<b>(49,050)</b>	<b>289,298</b>

## ORF SUMMARY LINE OFFICE DIRECT OBLIGATIONS All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
National Ocean Service	481,107	500,100	5,159	505,259	23,152	528,411
National Marine Fisheries Service	822,138	849,497	12,451	861,948	42,786	904,734
Office of Oceanic and Atmospheric Research	432,900	461,898	7,054	468,952	24,458	493,410
National Weather Service	954,153	988,834	13,694	1,002,528	(26,021)	976,507
National Environmental Satellite, Data and Information Service	188,600	189,086	42,431	231,517	8,470	239,987
Mission Support	247,900	252,931	28,640	281,571	(63)	281,508
Office of Marine and Aviation Operations	206,600	211,131	4,156	215,287	2,000	217,287
<b>SUBTOTAL LO DIRECT OBLIGATIONS</b>	<b>3,333,398</b>	<b>3,453,477</b>	<b>113,585</b>	<b>3,567,062</b>	<b>74,782</b>	<b>3,641,844</b>

## ORF ADJUSTMENTS All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>SUBTOTAL LO DIRECT OBLIGATIONS</b>	<b>3,333,398</b>	<b>3,453,477</b>	<b>113,585</b>	<b>3,567,062</b>	<b>74,782</b>	<b>3,641,844</b>
<b>FINANCING</b>						
De-Obligations	(15,000)	(17,500)	0	(17,500)	0	(17,500)
<b>Total ORF Financing</b>	<b>(15,000)</b>	<b>(17,500)</b>	<b>0</b>	<b>(17,500)</b>	<b>0</b>	<b>(17,500)</b>
<b>SUBTOTAL BUDGET AUTHORITY</b>	<b>3,318,398</b>	<b>3,435,977</b>	<b>113,585</b>	<b>3,549,562</b>	<b>74,782</b>	<b>3,624,344</b>
<b>TRANSFERS</b>						
Transfer from P&D to ORF	(116,000)	(130,164)	0	(130,164)	0	(130,164)
<b>Total ORF Transfers</b>	<b>(116,000)</b>	<b>(130,164)</b>	<b>0</b>	<b>(130,164)</b>	<b>0</b>	<b>(130,164)</b>
<b>SUBTOTAL APPROPRIATION</b>	<b>3,202,398</b>	<b>3,305,813</b>	<b>113,585</b>	<b>3,419,398</b>	<b>74,782</b>	<b>3,494,180</b>



## PROCUREMENT, ACQUISITION, AND CONSTRUCTION All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>NOS</b>						
<b>NERRS Construction</b>						
National Estuarine Research Reserve Construction (NERRS)	1,700	1,700	0	1,700	0	1,700
<b>Subtotal, NERRS Construction</b>	<b>1,700</b>	<b>1,700</b>	<b>0</b>	<b>1,700</b>	<b>0</b>	<b>1,700</b>
<b>Marine Sanctuaries Construction</b>						
Marine Sanctuaries Base	2,000	2,000	0	2,000	0	2,000
<b>Subtotal, Marine Sanctuary Construction</b>	<b>2,000</b>	<b>2,000</b>	<b>0</b>	<b>2,000</b>	<b>0</b>	<b>2,000</b>
<b>Subtotal, NOS Construction</b>	<b>3,700</b>	<b>3,700</b>	<b>0</b>	<b>3,700</b>	<b>0</b>	<b>3,700</b>
<b>Total, NOS - PAC</b>	<b>3,700</b>	<b>3,700</b>	<b>0</b>	<b>3,700</b>	<b>0</b>	<b>3,700</b>
<b>Total, NMFS - PAC</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>OAR</b>						
<b>Systems Acquisition</b>						
Research Supercomputing/ CCRI	13,379	20,079	0	20,079	6,300	26,379
<b>Subtotal, OAR Systems Acquisition</b>	<b>13,379</b>	<b>20,079</b>	<b>0</b>	<b>20,079</b>	<b>6,300</b>	<b>26,379</b>
<b>Total, OAR - PAC</b>	<b>13,379</b>	<b>20,079</b>	<b>0</b>	<b>20,079</b>	<b>6,300</b>	<b>26,379</b>
<b>NWS</b>						
<b>Systems Acquisition</b>						
Observations	12,300	16,720	0	16,720	16,035	32,755
Central Processing	64,000	64,261	0	64,261	2,500	66,761
Dissemination	45,000	45,684	0	45,684	(11,065)	34,619
<b>Subtotal, NWS Systems Acquisition</b>	<b>121,300</b>	<b>126,665</b>	<b>0</b>	<b>126,665</b>	<b>7,470</b>	<b>134,135</b>
<b>Construction</b>						
Facilities Construction and Major Repairs	12,000	8,650	0	8,650	0	8,650
<b>Subtotal, NWS Construction</b>	<b>12,000</b>	<b>8,650</b>	<b>0</b>	<b>8,650</b>	<b>0</b>	<b>8,650</b>
<b>Total, NWS - PAC</b>	<b>133,300</b>	<b>135,315</b>	<b>0</b>	<b>135,315</b>	<b>7,470</b>	<b>142,785</b>

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>NESDIS</b>						
<b>Systems Acquisition</b>						
Geostationary Systems - R	980,838	871,791	(33,900)	837,891	(85,107)	752,784
Jason-3	23,175	7,458	(2,931)	4,527	(170)	4,357
Joint Polar Satellite System (JPSS)	916,267	808,966	0	808,966	(21,720)	787,246
Polar Follow On	0	370,000	0	370,000	23,000	393,000
Cooperative Data and Rescue Services (CDARS)	7,300	500	0	500	0	500
DSCOVR	21,100	3,200	(908)	2,292	1,453	3,745
Space Weather Follow On	0	1,200	0	1,200	1,300	2,500
COSMIC 2/GNSS RO	6,800	10,100	0	10,100	6,100	16,200
Satellite Ground Services	50,000	54,000	(1,200)	52,800	6,225	59,025
System Architecture and Advanced Planning	3,000	3,929	0	3,929	1,000	4,929
Projects, Planning and Analysis	25,200	25,200	0	25,200	8,288	33,488
Commerical Weather Data Pilot	0	3,000	0	3,000	2,000	5,000
<b>Subtotal, NESDIS Systems Acquisition</b>	<b>2,033,680</b>	<b>2,159,344</b>	<b>(38,939)</b>	<b>2,120,405</b>	<b>(57,631)</b>	<b>2,062,774</b>
<b>Construction</b>						
Satellite CDA Facility	2,166	2,228	0	2,228	0	2,228
<b>Subtotal, NESDIS Construction</b>	<b>2,166</b>	<b>2,228</b>	<b>0</b>	<b>2,228</b>	<b>0</b>	<b>2,228</b>
<b>Transfer to OIG</b>	<b>(1,302)</b>	<b>(1,302)</b>	<b>0</b>	<b>(1,302)</b>	<b>0</b>	<b>(1,302)</b>
<b>Total, NESDIS - PAC</b>	<b>2,034,544</b>	<b>2,160,270</b>	<b>(38,939)</b>	<b>2,121,331</b>	<b>(57,631)</b>	<b>2,063,700</b>
<b>Mission Support</b>						
<b>Construction</b>						
NOAA Construction	0	1,000	0	1,000	3,557	4,557
<b>Subtotal, Construction</b>	<b>0</b>	<b>1,000</b>	<b>0</b>	<b>1,000</b>	<b>3,557</b>	<b>4,557</b>
<b>Total, Mission Support - PAC</b>	<b>0</b>	<b>1,000</b>	<b>0</b>	<b>1,000</b>	<b>3,557</b>	<b>4,557</b>
<b>OMAO</b>						
<b>OMAO - Fleet Replacement</b>						
Fleet Capital Improvements & Tech Infusion (Vessel Equip & Tech Refresh)	6,000	11,700	0	11,700	5,000	16,700
New Vessel Construction	0	80,050	0	80,050	(56,050)	24,000
<b>Subtotal, OMAO Fleet Replacement</b>	<b>6,000</b>	<b>91,750</b>	<b>0</b>	<b>91,750</b>	<b>(51,050)</b>	<b>40,700</b>
<b>Total, OMAO - PAC</b>	<b>6,000</b>	<b>91,750</b>	<b>0</b>	<b>91,750</b>	<b>(51,050)</b>	<b>40,700</b>
<b>GRAND TOTAL PAC</b>	<b>2,190,923</b>	<b>2,412,114</b>	<b>(38,939)</b>	<b>2,373,175</b>	<b>(91,354)</b>	<b>2,281,821</b>



## PAC ADJUSTMENTS All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>SUBTOTAL DIRECT OBLIGATIONS</b>	<b>2,190,923</b>	<b>2,412,114</b>	<b>(38,939)</b>	<b>2,373,175</b>	<b>(91,354)</b>	<b>2,281,821</b>
<b>FINANCING</b>						
Deobligations	(13,000)	(13,000)	0	(13,000)	0	(13,000)
<b>Total PAC Financing</b>	<b>(13,000)</b>	<b>(13,000)</b>	<b>0</b>	<b>(13,000)</b>	<b>0</b>	<b>(13,000)</b>
<b>SUBTOTAL BUDGET AUTHORITY</b>	<b>2,177,923</b>	<b>2,399,114</b>	<b>(38,939)</b>	<b>2,360,175</b>	<b>(91,354)</b>	<b>2,268,821</b>
<b>TRANSFERS</b>						
Transfer to OIG	1,302	1,302	0	1,302	0	1,302
<b>Total PAC Transfers/Rescissions</b>	<b>1,302</b>	<b>1,302</b>	<b>0</b>	<b>1,302</b>	<b>0</b>	<b>1,302</b>
<b>SUBTOTAL APPROPRIATION</b>	<b>2,179,225</b>	<b>2,400,416</b>	<b>(38,939)</b>	<b>2,361,477</b>	<b>(91,354)</b>	<b>2,270,123</b>

## OTHER ACCOUNTS (DISCRETIONARY) All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>NOS</b>						
National Oceans and Coastal Security Fund Obligations	0	0	0	0	10,000	10,000
National Oceans and Coastal Security Fund Budget Authority	0	0	0	0	10,000	10,000
National Oceans and Coastal Security Fund Appropriation	0	0	0	0	10,000	10,000
<b>Subtotal, NOS Other Discretionary Direct Obligation</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>10,000</b>	<b>10,000</b>
<b>Subtotal, NOS Other Discretionary Budget Authority</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>10,000</b>	<b>10,000</b>
<b>Subtotal, NOS Other Discretionary Appropriation</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>10,000</b>	<b>10,000</b>
<b>NMFS</b>						
Fishermen's Contingency Fund Obligations	350	350	0	350	0	350
Fishermen's Contingency Fund Budget Authority	350	350	0	350	0	350
Fishermen's Contingency Fund Appropriations	350	350	0	350	0	350
Foreign Fishing Observer Fund Obligations	0	0	0	0	0	0
Foreign Fishing Observer Fund Budget Authority	0	0	0	0	0	0
Foreign Fishing Observer Fund Appropriation	0	0	0	0	0	0
Fisheries Finance Program Account Obligations	0	0	0	0	0	0
Fisheries Finance Program Account Budget Authority	0	0	0	0	0	0
Fisheries Finance Program Account Appropriation	0	0	0	0	0	0
Promote and Develop Fisheries Obligations	0	0	0	0	0	0
Promote and Develop Fisheries Budget Authority	(116,000)	(130,164)	0	(130,164)	0	(130,164)
Promote and Develop Fisheries Appropriation	0	0	0	0	0	0
Pacific Coastal Salmon Fund Obligations	65,000	65,000	0	65,000	0	65,000
Pacific Coastal Salmon Fund Budget Authority	65,000	65,000	0	65,000	0	65,000
Pacific Coastal Salmon Fund Appropriation	65,000	65,000	0	65,000	0	65,000
Marine Mammal Unusual Mortality Event Fund Obligations	0	50	0	50	0	50
Marine Mammal Unusual Mortality Event Fund Budget Authority	0	0	0	0	0	0
Marine Mammal Unusual Mortality Event Fund Appropriation	0	0	0	0	0	0
Fisheries Disaster Assistance Fund Obligations	0	0	0	0	9,000	9,000
Fisheries Disaster Assistance Fund Budget Authority	0	0	0	0	9,000	9,000
Fisheries Disaster Assistance Fund Appropriation	0	0	0	0	9,000	9,000

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FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Subtotal, NMFS Other Discretionary Direct Obligation</b>	<b>65,350</b>	<b>65,400</b>	<b>0</b>	<b>65,400</b>	<b>9,000</b>	<b>74,400</b>
<b>Subtotal, NMFS Other Discretionary Budget Authority</b>	<b>(50,650)</b>	<b>(64,814)</b>	<b>0</b>	<b>(64,814)</b>	<b>9,000</b>	<b>(55,814)</b>
<b>Subtotal, NMFS Other Discretionary Appropriation</b>	<b>65,350</b>	<b>65,350</b>	<b>0</b>	<b>65,350</b>	<b>9,000</b>	<b>74,350</b>
<b>OMAO</b>						
Medicare Eligible Retiree Healthcare Fund Acct Obligations	1,936	1,936	0	1,936	0	1,936
Medicare Eligible Retiree Healthcare Fund Acct Budget Authority	1,936	1,936	0	1,936	0	1,936
Medicare Eligible Retiree Healthcare Fund Acct Appropriations	1,936	1,936	0	1,936	0	1,936
<b>Subtotal, OMAO Other Discretionary Direct Obligations</b>	<b>1,936</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>
<b>Subtotal, OMAO Other Discretionary Budget Authority</b>	<b>1,936</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>
<b>Subtotal, OMAO Other Discretionary Appropriation</b>	<b>1,936</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>	<b>0</b>	<b>1,936</b>
<b>TOTAL, OTHER DISCRETIONARY DIRECT OBLIGATIONS</b>	<b>67,286</b>	<b>67,336</b>	<b>0</b>	<b>67,336</b>	<b>19,000</b>	<b>86,336</b>
<b>TOTAL, OTHER DISCRETIONARY BUDGET AUTHORITY</b>	<b>(48,714)</b>	<b>(62,878)</b>	<b>0</b>	<b>(62,878)</b>	<b>19,000</b>	<b>(43,878)</b>
<b>TOTAL, OTHER DISCRETIONARY APPROPRIATION</b>	<b>67,286</b>	<b>67,286</b>	<b>0</b>	<b>67,286</b>	<b>19,000</b>	<b>86,286</b>

## SUMMARY OF DISCRETIONARY RESOURCES All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Discretionary Direct Obligations</b>						
ORF Direct Obligations	3,333,398	3,453,477	113,585	3,567,062	74,782	3,641,844
PAC Direct Obligations	2,190,923	2,412,114	(38,939)	2,373,175	(91,354)	2,281,821
OTHER Direct Obligations	67,286	67,336	0	67,336	19,000	86,336
<b>TOTAL Discretionary Direct Obligations</b>	<b>5,591,607</b>	<b>5,932,927</b>	<b>74,646</b>	<b>6,007,573</b>	<b>2,428</b>	<b>6,010,001</b>
<b>Discretionary Budget Authority</b>						
ORF Budget Authority	3,318,398	3,435,977	113,585	3,549,562	74,782	3,624,344
PAC Budget Authority	2,177,923	2,399,114	(38,939)	2,360,175	(91,354)	2,268,821
OTHER Budget Authority	(48,714)	(62,878)	0	(62,878)	19,000	(43,878)
<b>TOTAL Discretionary Budget Authority</b>	<b>5,447,607</b>	<b>5,772,213</b>	<b>74,646</b>	<b>5,846,859</b>	<b>2,428</b>	<b>5,849,287</b>
<b>Discretionary Appropriations</b>						
ORF Appropriations	3,202,398	3,305,813	113,585	3,419,398	74,782	3,494,180
PAC Appropriations	2,179,225	2,400,416	(38,939)	2,361,477	(91,354)	2,270,123
OTHER Appropriations	67,286	67,286	0	67,286	19,000	86,286
<b>TOTAL Discretionary Appropriation</b>	<b>5,448,909</b>	<b>5,773,515</b>	<b>74,646</b>	<b>5,848,161</b>	<b>2,428</b>	<b>5,850,589</b>



## GRAND TOTAL SUMMARY DISCRETIONARY APPROPRIATIONS All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
Operations, Research and Facilities	3,202,398	3,305,813	113,585	3,419,398	74,782	3,494,180
Procurement, Acquisition and Construction	2,179,225	2,400,416	(38,939)	2,361,477	(91,354)	2,270,123
National Oceans and Coastal Security Fund	0	0	0	0	10,000	10,000
Fisherman's Contingency Fund	350	350	0	350	0	350
Foreign Fishing Observer Fund	0	0	0	0	0	0
Fisheries Financing Program Account	0	0	0	0	0	0
Pacific Coastal Salmon Fund	65,000	65,000	0	65,000	0	65,000
Fisheries Disaster Assistance Fund	0	0	0	0	9,000	9,000
Marine Mammal Unusual Mortality Event Fund	0	0	0	0	0	0
Medicare Eligible Retiree Health Care Fund	1,936	1,936	0	1,936	0	1,936
<b>GRAND TOTAL DISCRETIONARY APPROPRIATION</b>	<b>5,448,909</b>	<b>5,773,515</b>	<b>74,646</b>	<b>5,848,161</b>	<b>2,428</b>	<b>5,850,589</b>

## OTHER ACCOUNTS (MANDATORY) All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>NOS</b>						
Damage Assessment & Restoration Revolving Fund Obligations	48,611	97,568	(75,600)	21,968	0	21,968
Damage Assessment & Restoration Revolving Fund Budget Authority	6,170	5,968	0	5,968	0	5,968
Damage Assessment & Restoration Revolving Fund Appropriation	0	0	0	0	0	0
Sanctuaries Enforcement Asset Forfeiture Fund Obligations	242	125	(5)	120	0	120
Sanctuaries Enforcement Asset Forfeiture Fund Budget Authority	242	125	(5)	120	0	120
Sanctuaries Enforcement Asset Forfeiture Fund Appropriation	183	120	0	120	0	120
Gulf Coast Ecosystem Restoration Fund Obligations	2,078	354	5,362	5,716	0	5,716
Gulf Coast Ecosystem Restoration Fund Budget Authority	2,078	0	0	0	0	0
Gulf Coast Ecosystem Restoration Fund Appropriation	2,078	0	0	0	0	0
<b>Subtotal, NOS Other Mandatory Direct Obligations</b>	<b>50,931</b>	<b>98,047</b>	<b>(70,243)</b>	<b>27,804</b>	<b>0</b>	<b>27,804</b>
<b>Subtotal, NOS Other Mandatory Budget Authority</b>	<b>8,490</b>	<b>6,093</b>	<b>(5)</b>	<b>6,088</b>	<b>0</b>	<b>6,088</b>
<b>Subtotal, NOS Other Mandatory Appropriation</b>	<b>2,261</b>	<b>120</b>	<b>0</b>	<b>120</b>	<b>0</b>	<b>120</b>
<b>NMFS</b>						
Promote and Develop Fisheries Obligations	26,615	16,225	(578)	15,647	0	15,647
Promote and Develop Fisheries Budget Authority	142,615	146,389	(578)	145,811	0	145,811
Promote and Develop Fisheries Appropriation	0	0	0	0	0	0
Fisheries Finance Program Account Obligations	22,757	11,819	(11,819)	0	0	0
Fisheries Finance Program Account Budget Authority	22,757	11,819	(11,819)	0	0	0
Fisheries Finance Program Account Appropriation	22,757	11,819	(11,819)	0	0	0
Federal Ship Financing Obligations	0	0	0	0	0	0
Federal Ship Financing Budget Authority	0	0	0	0	0	0
Federal Ship Financing Appropriation	0	0	0	0	0	0
Environmental Improve & Restoration Fund Obligations	1,311	8,815	(7,671)	1,144	0	1,144
Environmental Improve & Restoration Fund Budget Authority	1,311	9,359	(5,187)	4,172	0	4,172
Environmental Improve & Restoration Fund Appropriation	1,414	10,042	(5,566)	4,476	0	4,476
Limited Access System Administration Fund Obligations	10,893	12,636	106	12,742	0	12,742
Limited Access System Administration Fund Budget Authority	11,710	12,507	72	12,579	0	12,579
Limited Access System Administration Fund Appropriation	11,855	12,492	92	12,584	0	12,584

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FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
Western Pacific Sustainable Fisheries Fund Obligations	322	391	9	400	0	400
Western Pacific Sustainable Fisheries Fund Budget Authority	322	391	9	400	0	400
Western Pacific Sustainable Fisheries Fund Appropriation	250	400	0	400	0	400
Fisheries Enforcement Asset Forfeiture Fund Obligations	4,052	2,870	23	2,893	0	2,893
Fisheries Enforcement Asset Forfeiture Fund Budget Authority	4,068	4,020	(20)	4,000	0	4,000
Fisheries Enforcement Asset Forfeiture Fund Appropriation	4,000	4,000	0	4,000	0	4,000
North Pacific Observer Fund Obligations	4,756	4,050	(80)	3,970	0	3,970
North Pacific Observer Fund Budget Authority	4,756	4,050	(80)	3,970	0	3,970
North Pacific Observer Fund Appropriation	4,800	3,970	0	3,970	0	3,970
<b>Subtotal, NMFS Other Mandatory Direct Obligations</b>	<b>70,706</b>	<b>56,806</b>	<b>(20,010)</b>	<b>36,796</b>	<b>0</b>	<b>36,796</b>
<b>Subtotal, NMFS Other Mandatory Budget Authority</b>	<b>187,539</b>	<b>188,535</b>	<b>(17,603)</b>	<b>170,932</b>	<b>0</b>	<b>170,932</b>
<b>Subtotal, NMFS Other Mandatory Appropriation</b>	<b>45,076</b>	<b>42,723</b>	<b>(17,293)</b>	<b>25,430</b>	<b>0</b>	<b>25,430</b>
<b>OMAO</b>						
NOAA Corp Commissioned Officers Retirement Obligations	28,269	29,375	0	29,375	0	29,375
NOAA Corp Commissioned Officers Retirement Budget Authority	28,269	29,375	0	29,375	0	29,375
NOAA Corp Commissioned Officers Retirement Budget Appropriation	28,269	29,375	0	29,375	0	29,375
Recapitalized Research Fleet Obligations	0	0	0	0	[100,000]	[100,000]
Recapitalized Research Fleet Budget Authority	0	0	0	0	[100,000]	[100,000]
Recapitalized Research Fleet Appropriation	0	0	0	0	[100,000]	[100,000]
<b>Subtotal, OMAO Other Mandatory Direct Obligations</b>	<b>28,269</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>
<b>Subtotal, OMAO Other Mandatory Budget Authority</b>	<b>28,269</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>
<b>Subtotal, OMAO Other Mandatory Appropriation</b>	<b>28,269</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>	<b>0</b>	<b>29,375</b>
<b>TOTAL, OTHER MANDATORY DIRECT OBLIGATIONS</b>	<b>149,906</b>	<b>184,228</b>	<b>(90,253)</b>	<b>93,975</b>	<b>0</b>	<b>93,975</b>
<b>TOTAL, OTHER MANDATORY BUDGET AUTHORITY</b>	<b>224,298</b>	<b>224,003</b>	<b>(17,608)</b>	<b>206,395</b>	<b>0</b>	<b>206,395</b>
<b>TOTAL, OTHER MANDATORY APPROPRIATION</b>	<b>75,606</b>	<b>72,218</b>	<b>(17,293)</b>	<b>54,925</b>	<b>0</b>	<b>54,925</b>

## NOAA SUMMARY All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>TOTAL Direct Obligations (Discretionary &amp; Mandatory)</b>	<b>5,741,513</b>	<b>6,117,155</b>	<b>(15,607)</b>	<b>6,101,548</b>	<b>2,428</b>	<b>6,103,976</b>
<b>TOTAL Budget Authority (Discretionary &amp; Mandatory)</b>	<b>5,671,905</b>	<b>5,996,216</b>	<b>57,038</b>	<b>6,053,254</b>	<b>2,428</b>	<b>6,055,682</b>
<b>TOTAL Appropriation (Discretionary &amp; Mandatory)</b>	<b>5,524,515</b>	<b>5,845,733</b>	<b>57,353</b>	<b>5,903,086</b>	<b>2,428</b>	<b>5,905,514</b>
Reimbursable Financing	406,969	393,089	(151,089)	242,000	0	242,000
<b>TOTAL OBLIGATIONS (Direct &amp; Reimbursable)</b>	<b>6,148,482</b>	<b>6,510,244</b>	<b>(166,696)</b>	<b>6,343,548</b>	<b>2,428</b>	<b>6,345,976</b>
Offsetting Receipts	(5,439)	(3,835)	3,425	(410)	0	(410)
<b>TOTAL OBLIGATIONS (Direct, Reimbursable &amp; Offsetting Receipts)</b>	<b>6,143,043</b>	<b>6,506,409</b>	<b>(163,271)</b>	<b>6,343,138</b>	<b>2,428</b>	<b>6,345,566</b>



## LINE OFFICE SUMMARY All \$ in Thousands

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>National Ocean Service</b>						
ORF	481,107	500,100	5,159	505,259	23,152	528,411
PAC	3,700	3,700	0	3,700	0	3,700
OTHER	50,931	98,047	(70,243)	27,804	10,000	37,804
<b>TOTAL, NOS</b>	<b>535,738</b>	<b>601,847</b>	<b>(65,084)</b>	<b>536,763</b>	<b>33,152</b>	<b>569,915</b>
<b>National Marine Fisheries Service</b>						
ORF	822,138	849,497	12,451	861,948	42,786	904,734
PAC	0	0	0	0	0	0
OTHER	136,056	122,206	(20,010)	102,196	9,000	111,196
<b>TOTAL, NMFS</b>	<b>958,194</b>	<b>971,703</b>	<b>(7,559)</b>	<b>964,144</b>	<b>51,786</b>	<b>1,015,930</b>
<b>Oceanic and Atmospheric Research</b>						
ORF	432,900	461,898	7,054	468,952	24,458	493,410
PAC	13,379	20,079	0	20,079	6,300	26,379
OTHER	0	0	0	0	0	0
<b>TOTAL, OAR</b>	<b>446,279</b>	<b>481,977</b>	<b>7,054</b>	<b>489,031</b>	<b>30,758</b>	<b>519,789</b>
<b>National Weather Service</b>						
ORF	954,153	988,834	13,694	1,002,528	(26,021)	976,507
PAC	133,300	135,315	0	135,315	7,470	142,785
OTHER	0	0	0	0	0	0
<b>TOTAL, NWS</b>	<b>1,087,453</b>	<b>1,124,149</b>	<b>13,694</b>	<b>1,137,843</b>	<b>(18,551)</b>	<b>1,119,292</b>
<b>National Environmental Satellite, Data and Information Service</b>						
ORF	188,600	189,086	42,431	231,517	8,470	239,987
PAC	2,034,544	2,160,270	(38,939)	2,121,331	(57,631)	2,063,700
OTHER	0	0	0	0	0	0
<b>TOTAL, NESDIS</b>	<b>2,223,144</b>	<b>2,349,356</b>	<b>3,492</b>	<b>2,352,848</b>	<b>(49,161)</b>	<b>2,303,687</b>
<b>Mission Support</b>						
ORF	247,900	252,931	28,640	281,571	(63)	281,508
PAC	0	1,000	0	1,000	3,557	4,557
OTHER	0	0	0	0	0	0
<b>SUBTOTAL, Mission Support</b>	<b>247,900</b>	<b>253,931</b>	<b>28,640</b>	<b>282,571</b>	<b>3,494</b>	<b>286,065</b>

FY 2017 PROPOSED OPERATING PLAN	FY 2015 Spend Plan	FY 2016 Enacted	FY 2017 Total ATBs	FY 2017 Base	FY 2017 Program Changes	FY 2017 President's Budget
<b>Office of Marine and Aviation Operations</b>						
ORF	206,600	211,131	4,156	215,287	2,000	217,287
PAC	6,000	91,750	0	91,750	(51,050)	40,700
OTHER	30,205	31,311	0	31,311	0	31,311
<b>TOTAL, OMAO</b>	<b>242,805</b>	<b>334,192</b>	<b>4,156</b>	<b>338,348</b>	<b>(49,050)</b>	<b>289,298</b>
<b>DIRECT OBLIGATIONS</b>						
ORF	3,333,398	3,453,477	113,585	3,567,062	74,782	3,641,844
PAC	2,190,923	2,412,114	(38,939)	2,373,175	(91,354)	2,281,821
OTHER	217,192	251,564	(90,253)	161,311	19,000	180,311
<b>TOTAL, DIRECT OBLIGATIONS</b>	<b>5,741,513</b>	<b>6,117,155</b>	<b>(15,607)</b>	<b>6,101,548</b>	<b>2,428</b>	<b>6,103,976</b>
<b>ORF Adjustments (Deobligations/Rescissions)</b>						
	(15,000)	(17,500)	0	(17,500)	0	(17,500)
<b>ORF Transfers</b>						
	(116,000)	(130,164)	0	(130,164)	0	(130,164)
<b>PAC Adjustments (Deobligations/Rescissions)</b>						
	(13,000)	(13,000)	0	(13,000)	0	(13,000)
<b>PAC Transfers</b>						
	1,302	1,302	0	1,302	0	1,302
<b>OTHER Discretionary Adjustments</b>						
	0	(50)	0	(50)	0	(50)
<b>Mandatory Accounts Excluded</b>						
	(149,906)	(184,228)	90,253	(93,975)	0	(93,975)
<b>TOTAL, DISCRETIONARY APPROPRIATIONS</b>	<b>5,448,909</b>	<b>5,773,515</b>	<b>74,646</b>	<b>5,848,161</b>	<b>2,428</b>	<b>5,850,589</b>





United States Department of Commerce  
National Oceanic and Atmospheric Administration  
[www.noaa.gov](http://www.noaa.gov)

14th and Constitution Avenue, NW  
Washington, DC 20230

National Ocean Service  
[www.nos.noaa.gov](http://www.nos.noaa.gov)

National Marine Fisheries Service  
[www.nmfs.noaa.gov](http://www.nmfs.noaa.gov)

Office of Oceanic and Atmospheric Research  
[www.oar.noaa.gov](http://www.oar.noaa.gov)

National Weather Service  
[www.nws.noaa.gov](http://www.nws.noaa.gov)

National Satellite and Information Service  
[www.nesdis.noaa.gov](http://www.nesdis.noaa.gov)

Office of Marine and Aviation Operations  
[www.oma.noaa.gov](http://www.oma.noaa.gov)

**THE VIEWS AND ESTIMATES**  
**OF THE**  
**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY**  
**U.S. HOUSE OF REPRESENTATIVES**  
**FOR FISCAL YEAR 2017**

In 2016, the House Committee on Science, Space, and Technology will continue to oversee, legislate, and implement a Constitutionally-based Federal focus on open and transparent taxpayer-supported science, basic research in the national interest, and mission-supporting technology development. It is this core focus, coupled with tax and regulatory reform, border security, and a budget on a path to balance, that is required for robust entrepreneurial economic growth, the creation of millions of good-paying, skilled private sector jobs, faster technological innovation, higher productivity gains, and enhanced international competitiveness and security.

During the first session of the 114<sup>th</sup> Congress, fully consistent with the Science Committee's Views and Estimates submitted on February 20, 2015 (which can be found [here](#)), the Science Committee acted to authorize, direct, and constrain programs, projects, and agencies within its jurisdiction for Fiscal Year (FY) 2017. House-passed H.R. 1806, the America COMPETES Reauthorization Act of 2015, covers the National Science Foundation (NSF), the Commerce Department's National Institute of Standards and Technology (NIST), the Department of Energy (DOE), and the White House Office of Science and Technology Policy (OSTP). House-passed H.R. 1561 prioritizes weather research and forecasting innovation in the Commerce Department's National Oceanic and Atmospheric Administration (NOAA). The Science Committee reported H.R. 2039, the NASA Authorization Act for 2016 and 2017. And Committee legislation authorizing Department of Transportation (DOT) surface transportation research and development (R&D) was included in P.L. 114-94, the new highway law.

To build on the Science Committee's FY 2016 funding progress toward Federal prioritization of basic research and fundamental scientific discovery, and in fulfillment of last year's Views and Estimates blueprint and justification, further policy and program changes implementing Science Committee authorizations should be made in FY 2017 Budget and appropriations bills. These are presented below and will be further pursued in additional Committee legislation during the upcoming Congressional session, including DOT Federal Aviation Administration (FAA) R&D reauthorization, EPA science reform, and possible Department of Homeland Security Science and Technology Directorate (DHS S&T) reorganization.

### **National Science Foundation (NSF)**

- Increase NSF Research and Related Activities account funding to the level authorized for Fiscal Year 2017 in House-passed H.R. 1806. This \$6.186 billion, a 2.5% increase of \$153 million, should be allocated as specified in H.R. 1806's legislative language which prioritizes basic research in the Mathematical and Physical Sciences Directorate, the Engineering Directorate, the Computer and Information Science and Engineering Directorate, and the Biological Sciences Directorate. This Budget Function 250 increase can be offset by cuts provided below to DOE in Function 270.
- In addition to requiring NSF Research funding be appropriated at the Directorate level, each and every NSF grant should be required to meet National Interest criteria as prescribed in section 106 of House-passed H.R. 1806.
- Learning disability science, and specifically dyslexia research, should be funded by NSF as directed in House-passed H.R. 3033, the READ Act.

### **National Institute of Standards and Technology (NIST)**

- Increase Function 370 NIST Scientific and Technical Research and Services account generic innovation funding to the level authorized for Fiscal Year 2017 in House-passed H.R. 1806. This \$745 million, a 7.9% increase of \$55 million, can be offset by reducing the NIST Industrial Technology Services account and the NIST Construction of Facilities account to the levels authorized in H.R. 1806, saving \$90 million.
- No further NIST funding should be allocated in Function 370 for the National Network for Manufacturing Innovation (NNMI) in Fiscal Year 2017 since the \$25 million authorized in P.L. 113-235 for NIST in FY 2016-2020 (\$5 million annually) was all appropriated in Fiscal Year 2016. Any further NNMI funding must come by way of transfer from DOE's Energy Efficiency and Renewable Energy account in Function 270 as required by P.L. 113-235.

### **Department of Energy (DOE)**

- Sustain DOE's Fiscal Year 2016 Office of Science account funding level of \$5.35 billion in Function 250, consistent with the Fiscal Year 2017 authorization in House-passed H.R. 1806. As with NSF Directorate-level funding, allocate DOE Science National Laboratories funding by basic research Program as specified in H.R. 1806's legislative language which prioritizes Basic Energy Sciences and Advanced Scientific Computing Research. Increase Fusion Energy Sciences by \$50 million to the \$488 million authorized in H.R. 1806 by reducing Biological and Environmental Research to the authorized level of \$550 million.
- Reduce Energy Efficiency and Renewable Energy R&D funding to the level authorized in House-passed H.R. 1806, \$1.2 billion, saving \$610 million in function 270. Reduce ARPA-E funding to the level authorized in House-passed H.R. 1806, \$140 million, saving \$151 million in function 270.

- Nuclear Energy R&D funding should reflect the research infrastructure priorities and private-sector innovation program blueprint of Committee-reported H.R. 4084, the Nuclear Energy Innovation Capabilities Act. Analytical examination of issues associated with nuclear safety and development of advanced reactor technologies in collaboration with the Nuclear Regulatory Commission is the goal.

#### **Office of Science and Technology Policy (OSTP)**

- Reduce White House Office of Science and Technology Policy funding to \$4.56 million, the authorized level in H.R. 1806, saving \$1 million in Function 800.

#### **National Oceanic and Atmospheric Association (NOAA)**

- Increase priority public safety NOAA Weather Research in the Office of Oceanic and Atmospheric Research to the House-passed Fiscal Year 2017 authorized level in H.R. 1561 of \$120 million, an increase of \$17 million in Function 300. Saving lives and protecting property must be NOAA's primary mission.
- Provide the remaining \$6 million authorized in House-passed H.R. 1561 for the NOAA Commercial Weather Data Pilot project out of existing funding in the NOAA Procurement, Acquisition, and Construction account.
- Make NOAA's Polar Follow-On satellite funding contingent on certification of no feasibility of commercial data or satellite alternatives.

#### **National Aeronautics and Space Administration (NASA)**

- Maintain the overall level of investment for NASA in the Fiscal Year 2016 omnibus funding bill of \$19.3 billion.



- Reduce Fiscal Year 2017 NASA Earth Science funding to \$1.45 billion, the level authorized in Committee-approved H.R. 2039, and reallocate the resulting \$471 million to Planetary Science, Heliophysics, the Orion Space Exploration Multi-purpose Crew Vehicle, and Exploration R&D, and Exploration Ground Systems.
- Reject any proposed cut to the Space Launch System funding that would delay a launch of Exploration Mission 1 (first non-crewed launch to lunar orbit) beyond calendar year 2018 or Exploration Mission 2 (first crewed launch to lunar orbit) beyond calendar year 2021.
- No NASA resources should be provided or permitted for planning and development of technologies unique to an Asteroid Redirect Mission (ARM). Instead, pre-formulation studies should be conducted for a Mars flyby mission. Near Earth Object (NEO) survey, detection, and characterization are not unique to ARM, and additional NASA resources could be used to help NASA meet the long-standing goals of the Congressionally-mandated George E. Brown, Jr. NEO Survey Program.

#### **Federal Aviation Administration (FAA) Research and Development**

- On November 25, 2015, the President signed H.R. 2262, the House Majority Leader's Commercial Space Launch Competitiveness Act, into law as P.L. 114-90. This important Science Committee legislation supports the continued growth of the commercial space launch industry while requiring the Administration to provide important metrics for the development of the industry and to foster an environment of innovation without burdensome regulations. Implementing P.L. 114-90 is not expected to increase the Fiscal Year 2017 activities of the FAA Office of Commercial Space Transportation above those of Fiscal Year 2016.

- The Science Committee will soon reauthorize the FAA's Function 450 Research, Engineering, and Development (RED) account to become part of overall FAA authorization legislation. The Administration has consistently proposed the FAA RED portfolio increase funding on environmental sustainability programs, while neglecting safety, economic competitiveness, and mission support programs. Instead, FAA R&D should be a balance of periodic testing and evaluation, verification and validation, and sustainment of the FAA's full spectrum of aviation systems, and the development of scientific solutions to current and future air transportation safety challenges by conducting applied research and development. FAA R&D must also support FAA certification of new technologies, particularly unmanned aerial systems (UAS), into the national airspace system (NAS).

### **Department of Transportation (DOT) Surface Transportation Research and Development**

- On December 4, 2015, the President signed into law a five-year highway bill, Fixing America's Surface Transportation (FAST) Act, as P.L. 114-94. Among its provisions, the law authorizes funding for two technology deployment programs that cost \$80 million annually to be paid partially from highway research programs that are authorized at \$225 million a year. This will result in a one-third cut to highway R&D, effectively slashing future innovation in exchange for current infrastructure implementation. While not opposing technology deployment, doing so at the expense of R&D funds, without which there will be less transformational technology to deploy, is ill-advised.

### **Environmental Protection Agency (EPA) Science**

- Function 300 EPA funding should be made contingent on the EPA Administrator certifying that all scientific and technical information and data relied on to support a risk, exposure, or hazard assessment; criteria document; standard; limitation; regulation; regulatory impact analysis;

or guidance has been made publicly available. This requirement is fully consistent with and would enforce House-passed H.R. 1030, the EPA Secret Science Reform Act of 2015.

- Given the number of serious allegations concerning inappropriate contact by EPA employees with outside special interest groups, as well as potential violations of anti-lobbying statutes, robust funding of the EPA Inspector General Office of Investigations is warranted.

### **Department of Homeland Security Science and Technology (DHS S&T)**

- R&D plays a critical role in supporting DHS' mission and the DHS S&T Directorate needs to be reorganized and reformed to better and more quickly support DHS component efforts to detect, prevent, mitigate, respond to, and recover from terrorist attacks. The DHS Domestic Nuclear Detection Office combines R&D with acquisition and deployment in effectively carrying out its mission to address nuclear terrorism. That model deserves serious consideration regarding chemical, biological, explosives, cybersecurity, border security, and lone wolf threats.

### **U.S. Global Change Research Program (USGCRP)**

- The United States Global Change Research Program (USGCRP) is an interagency accounting of over \$2 billion of spending on climate change research. Involving NASA, NSF, NOAA, NIST, DOE, EPA, and even the Department of Interior's U.S. Geological Survey, much is duplicative and poorly defined based on the Science Committee's oversight of these agencies under its jurisdiction. Given this fiscal irresponsibility, any funding that is part of the USGCRP should only be available contingent on a finding by the U.S. Government Accountability Office (GAO) that it is not duplicative or wasteful based on a government-wide GAO review of climate change research.

University Corporation for  
Atmospheric Research  
Consortium for Ocean  
Leadership  
Incorporated Research  
Institutions for Seismology  
Lamont Doherty Earth  
Observatory  
Columbia University  
Woods Hole Oceanographic  
Institution  
Scripps Institution of  
Oceanography  
National Association of  
Marine Laboratories  
Association of Public and  
Land-grant Universities  
SRI International  
University of California  
System  
Texas A&M University  
Oregon State University  
University of Colorado  
University of New Hampshire  
University of New Mexico  
University of Connecticut  
University of Wisconsin -  
Madison  
Florida State University  
University of Delaware  
University of Nebraska-  
Lincoln  
University of Massachusetts  
Dartmouth  
Michigan Technological  
University  
University of Hawaii at Manoa  
University of North Carolina  
at Wilmington  
University of Oklahoma  
University of Rhode Island  
University of Georgia  
The University of North  
Carolina at Chapel Hill,  
Institute of Marine Sciences  
Great Lakes WATER Institute,  
University of Wisconsin-  
Milwaukee School of  
Freshwater Sciences  
Humboldt Marine and Coastal  
Science Institute, Humboldt  
State University  
Moss Landing Marine  
Laboratories  
Grice Marine Laboratory,  
College of Charleston  
University of South Florida -  
College of Marine Science  
Center for Marine Sciences  
and Technology - North  
Carolina State University  
Louisiana Universities Marine  
Consortium  
American Anthropological  
Association  
Soil Science Society of  
America  
Bigelow Laboratory for Ocean  
Sciences, Maine  
Friday Harbor Laboratories,  
College of the Environment,  
University of Washington  
American Geosciences  
Institute

Testimony Regarding Fiscal Year 2017 Funding for  
The National Science Foundation  
Submitted to the  
Subcommittee on Commerce, Justice, Science and Related Agencies  
Committee on Appropriations,  
House of Representatives  
**TO BE INSERTED**

Dear Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to present testimony in support of strong and balanced funding for the National Science Foundation. This testimony is submitted on behalf of the organizations listed in the left margin on this and subsequent pages. They all support funding the National Science Foundation at \$8 billion in FY 2017 – including full funding for the geosciences portfolio of research and related national and user facilities within the NSF request.

We strongly believe investing in NSF and the geosciences contributes to the Nation's national security, economic competitiveness, and public safety.

**Geosciences Research and National Security**

On September 15, 2015, a distinguished group of former military and national security leaders said the following:

*"...we urge you to protect funding for NASA Earth science and NSF Geoscience programs. These programs are essential parts of a broader whole of government and whole of society effort to provide essential data about and better scientific understanding of global, regional and local Earth processes. That essential data and better understanding of the underlying science are critical to many strategic planning, strategy, and investment decisions in both the private and public sectors, very much including national security. From better understanding weather, wind patterns and intensity, changing global land cover, snow, ice and glacier melting, and seismic activity, to capturing new insights about ocean-atmosphere dynamics and changing ocean circulation, these...programs represent one of the pillars of our nation's environmental information supply chain. This critical but fragile chain begins with science and data and evolves into decision support products and tools that inform and protect our citizens, property, businesses, and interests around the world. [These programs] directly link to food, water, energy, and economic security, all of which are inherently tied to our national security."*

The national security implications are far reaching as they may exacerbate existing stressors, contributing to poverty, environmental degradation and political instability providing enabling environments for terrorist activity abroad. For example, the impacts of climate change on key economic sectors,

National Association of  
Geoscience Teachers  
American Meteorological  
Society  
Marine Biological  
Laboratory  
Seismological Society of  
America  
College of the Environment,  
University of Washington  
College of Earth and  
Mineral Sciences, Penn  
State University  
Department of Geography  
and Meteorology,  
Valparaiso University  
The College of Arts and  
Sciences, Valparaiso  
University  
Metropolitan State  
University of Denver  
Saint Louis University  
Department of Earth &  
Planetary Sciences, The  
Johns Hopkins University  
Oregon Institute of Marine  
Biology  
University of Oregon  
Annis Water Resources  
Institute – Grand Valley  
State University  
The Institute of Earth,  
Ocean, and Atmospheric  
Sciences at Rutgers  
University  
Whitney Laboratory for  
Marine Bioscience,  
University of Florida  
Seahorse Key Marine  
Laboratory, University of  
Florida  
Marine Science Research  
Institute-Jacksonville  
University  
Galbraith Marine Lab,  
Eckerd College  
Western Washington  
University, Shannon Point  
Marine Center  
Belle Baruch Institute for  
Marine and Coastal  
Sciences, University of  
South Carolina  
University of California,  
Davis  
University of Maine  
Michigan State University  
Dauphin Island Sea Lab,  
Dauphin Island, Alabama  
Desert Research Institute,  
Nevada  
The University of Kansas  
University of Minnesota  
The Institute at Brown for  
Environment and Society,  
Brown University  
The University of Texas at  
Austin  
South Dakota State  
University

such as agriculture and water, can have profound effects on food security, posing threats to overall stability.

On January 14, 2016, Robert Work, the Deputy Secretary of Defense issued DoD Directive 4715.21 that establishes departmental policy and responsibilities within DOD to assess and manage risks associated with the impacts of climate change. The policy statement in this directive says:

*“...The DoD must be able to adapt current and future operations to address the military. Mission planning and execution must include: a) identification and assessment of the effects of climate change on the DoD mission; b) taking those effects into consideration when developing plans and implementing procedures; and c) anticipating and managing any risks that develop as a result of climate change to build resilience...”*

DoD’s ability to implement this new policy directive is dependent on the scientific information that comes out of the geosciences research supported by NSF and other agencies.

### **Geosciences and the Private Sector Commercial Weather Industry**

On June 5, 2015, the Chairman and Executive Officer of the Weather Company said the following about the economic importance of the geosciences and related disciplines:

*“...Research conducted through NSF’s geosciences program, NASA’s Earth Sciences program and NOAA’s weather and climate research programs have enabled us, in partnership with these agencies, to inform citizens and businesses of weather and climate events in a tailored manner that enables them to be weather-ready and climate-smart. Cutting these investments...will have negative consequences on our economy and quality of life in the coming years. They are vital investments to maintain our leadership in environmental information and services.”*

### **Geosciences and the Insurance Industry**

In hearing before the Senate Environment and Public Works Committee in July of 2013 the President of the Reinsurance Association of America said the following about the importance of research in the geosciences to the economic viability of the insurance industry and those they insure:

*“...Our industry [the reinsurance industry] is science based. Blending the actuarial sciences with the natural sciences is critical in order to provide the public with resources to recover from natural events...Developing an understanding about climate and its impact on droughts, heat waves, the frequency and intensity of tropical hurricanes, thunderstorms and convective*

Xcccccccccccccccc

*events, rising sea levels and storm surge, more extreme precipitation events and flooding is critical to our role in translating the interdependencies of weather, climate risk assessment and pricing...”*

### **Geosciences and the Private Sector Aquaculture Industry**

On May 8, 2015 Diane Pleschner-Steele, Executive Director of California Wetfish Producers Association, a major industry aquaculture organization in California said:

*“...NSF’s Geoscience Directorate funds data collecting buoys that provide a long-term signal of increased ocean acidification among other measurements. These forecasts will be critical to maintain for both open-ocean aquaculture and important shellfish fisheries, as these industries are hugely important economically on both west and east coasts. Proposed cuts to the Geoscience Directorate put the data on which the seafood industry depends, and the domestic seafood-producing economy as a whole, at risk...”*

### **Research Underlying Fracking Technology Yields Economic Benefits**

Investment in the geosciences provided the fundamental understanding of geologic structures and processes necessary to utilize hydraulic fracturing (fracking) processes to release oil from shale formations. The ability of U.S. companies to develop these natural resources is built upon decades of fundamental research and technology development in the earth sciences. According to a 2013 report from U.S. Chamber of Commerce’s 21st Century Energy Institute, fracking has created a job boom even in states that don’t actually have shale deposits, with 1.7 million jobs already created and a total of 3.5 million projected by 2035.

### **Geoscience Graduates – Source of Technical Talent for Oil and Gas Industry**

The geosciences research that NSF funds helps educate and train the next generation of geoscientists. According to the Bureau of Labor Statistics (BLS), there were a total of 296,963 geoscience jobs in 2012, and this number is expected to increase by 14% by 2022 to a total of 339,737 jobs. Approximately 143,000 geoscientists are expected to retire by 2022, but over the next decade, approximately 51,000 students will be graduating with their bachelor’s, masters, or doctoral degrees in the geosciences. Therefore, according to the American Geosciences Institute’s (AGI) *Status of the Geoscience Workforce Report 2014*, assuming minimal non-retirement attrition from the geoscience workforce, there is expected to be a deficit of approximately 135,000 geoscientists by 2022. Texas leads the nation in the number of geoscience undergraduates and graduate students enrolled within geoscience departments.

The AGI report, *Status of Recent Geoscience Graduates 2015*, shows a shift in hiring patterns for geoscience industries. For the first time in the report's history, an industry other than oil and gas hired the highest percentage of bachelor's graduates: environmental services. According to the report, approximately 40 percent of bachelor's graduates found a job in the environmental services industry, which includes fields such as environmental consulting and remediation of land assets such as water and soil. Sixteen percent of bachelor's graduates went on to find jobs in the oil and gas industry in 2015, down from 36 percent in 2014. Changing employment dynamics and record low oil prices have led the oil and gas industry to reduce employment opportunities. Nevertheless, 67 percent of master's graduates found jobs in the oil and gas industry, an increase from 59 percent in 2014. Other industries hiring geoscientists include: manufacturing or trade, construction, information technology services, and agriculture. NSF's support for the geosciences contributes significantly to the education and training of these individuals via NSF's programs in research, graduate student support, and undergraduate student support.

### **Conclusion**

It is important to appreciate that the NSF's investments in all fields of science and engineering -- including the geosciences -- have addressed important national and global challenges, spurred new economic sectors, and led to the development and implementation of advanced technologies that save lives, protect property, and support our economy. We appreciate the difficult decisions Congress must make within the constraints of the budget environment. However, we believe the future of the nation is well served by a strong and sustained investment in the full scope of our research enterprise, which includes the geosciences. Thank you for the opportunity to present these views.

1 **American Meteorological Society Policy Statement on Weather, Water, and Climate Priorities**

2  
3 Understanding how the Earth system works and transforming this knowledge into action will  
4 allow the US and the global community to prepare, respond, and adapt to changing weather,  
5 water, and climate conditions. National leadership combined with enhanced partnership across  
6 the public, private, academic and non-governmental organization sectors will make this vision a  
7 reality.

8  
9 **Introduction.** Access to reliable, accurate, timely, and understandable weather, water, and  
10 climate (WWC) information is vital for the safety and well-being of society. Decision makers at  
11 all levels need this information to formulate and implement strategic, tactical, and policy  
12 decisions across all sectors of society, including health, energy, food, water, infrastructure, and  
13 national security, particularly since most of these sectors interact with one another in complex  
14 ways. Extreme weather events like hurricanes, tornados, blizzards, floods, and heat waves, and  
15 longer-term climate changes like droughts, snowpack recharge, and sea level rise impede the  
16 social and economic well-being of society. While these challenges pose serious risks, they also  
17 offer a remarkable national opportunity for enhanced knowledge, leadership, actionable  
18 information, and advanced tools.

19  
20 Support for WWC observations, science, and services are essential for meeting human needs  
21 and have led to technological innovations, trained the next generation of scientists, fueled  
22 economic growth, stimulated social prosperity, and mitigated potential human disasters. AMS  
23 public, private, and academic sector members acknowledge the ongoing commitment to this  
24 support by the American public and its leaders. This support has resulted in significant forecast  
25 improvements that have save hundreds of lives annually and helped our citizens prepare for the  
26 range of disruptive WWC events mentioned above.

27  
28 The value of WWC tools and information to economic growth is increasing and so is the cost of  
29 WWC related disasters<sup>1</sup>. Individuals and business and government leaders are shaping  
30 decisions and actions based on detailed knowledge of meteorological, hydrological,  
31 oceanographic, geophysical, and ecological conditions. As society becomes more vulnerable to  
32 WWC events, it needs and expects ever more reliable and actionable information to deal with  
33 pressing local, regional, national, and global economic and societal challenges that range in  
34 time scales across minutes, decades, and centuries.

35  
36 **Recommendations.** The future belongs to a society that understands, and can prepare,  
37 respond, and adapt to the Earth’s changing WWC conditions. For our nation to lead the world in  
38 the delivery and effective use of WWC information to meet the environmental changes that lie  
39 ahead requires:

- 40  
41 1. **Building the Next Generation of WWC Experts.** To ensure we have a workforce equipped  
42 to communicate uncertainties and inform WWC decisions, investments must continue to: (i)

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<sup>1</sup> <http://www.esa.doc.gov/economic-briefings/value-government-weather-and-climate-data>



- 43 educate and train young students for careers in science, technology, engineering, and  
44 mathematics, and (ii) develop the next generation of WWC researchers that can advance  
45 the science to meet society's evolving information needs.  
46
- 47 **2. Investing in Research Critical to Innovation and Advanced Services.** To ensure that  
48 scientific models and discoveries advance knowledge useful to society and contribute to  
49 economic development, investments must continue to support physical, chemical, and  
50 biological laboratory and field research needed to improve models that can effectively  
51 examine and integrate the human, atmosphere, ocean, land, and ice components of the  
52 Earth system.  
53
- 54 **3. Investing in Critical Observations and Computing Infrastructure.** To ensure timely delivery  
55 of products and decision support at scales useful to decision makers, targeted investments  
56 are required for: (i) atmosphere-ocean-land-ice observational infrastructure and (ii) leading-  
57 edge high-performance computers and software.  
58
- 59 **4. Preparing Informed WWC Information Users.** To ensure we have informed users who can  
60 take full advantage of advanced WWC information and tools, education and communication  
61 programs must continue to focus on enhancing the WWC skills and understanding of both  
62 decision-makers and society at large.  
63
- 64 **5. Creating Services that Harness Scientific Advances for Societal Benefit.** To ensure society's  
65 most pressing needs are met and its capabilities are optimally utilized, mechanisms for  
66 engaging users and moving research into practical applications in a timely and effective  
67 fashion must be encouraged and implemented.  
68
- 69 **6. Building Strong Partnerships Among Public, Private, and Academic Sectors.** The WWC  
70 sectors have always worked together to meet America's WWC challenges. As the job grows  
71 more consequential, urgent, and complex; a coordinated Federal effort is needed to  
72 support and encourage strategic inter-sector partnerships, including efforts to maintain the  
73 global suite of Earth observations, advance long-term stewardship of environmental data,  
74 and improve nationwide community-level resilience to climate change and variability.  
75
- 76 **7. Implementing Effective Leadership and Management.** To ensure that WWC investments  
77 are done in the best interests of the nation, effective leadership and management  
78 approaches will be needed, including: (i) appointing strong and qualified leaders to top  
79 WWC policy positions in the White House and Federal agencies, and (ii) implementing  
80 management structures that support integrated program planning and budgeting across  
81 Federal agencies and the Congress for WWC research and services. These structures should  
82 proactively engage the academic and private sectors.  
83
- 84 **Expected Outcomes and Conclusion.** Implementing these recommendations will enable  
85 citizens, communities, businesses, and the military to manage risks and explore opportunities  
86 associated with changing WWC conditions. Economic and social prosperity will be enhanced

1 February 2016

87 and further progress will be made in saving lives and protecting property. In so doing, America  
88 will advance its leadership in promoting technological innovations that are critical to our  
89 success as a global society.

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