



Nancy Rabalais, President, National Association of
Marine Laboratories

Mike DeLuca, Chairman, Public Policy
Committee, National Association of Marine
Laboratories

NATIONAL ASSOCIATION OF MARINE LABORATORIES

Annual Public Policy Meeting

March 1 and 2, 2015

1201 New York Avenue NW, Suite 400

Washington, D.C. 20005

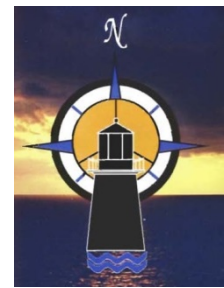


Prepared by Joel Widder and Meg Thompson, Federal Science Partners

- Meeting Agenda
- Speakers' Bios
- Suggested Issues to Raise with Speakers
- FY 2016 NAML Public Policy Agenda
- NAML Resolution in re NAS Reports
- Useful Background Information – Congressional Committees, OMB/OSTP R&D Priorities Memo for FY16; FY16 Budget Overview – NSF, NOAA, etc.: DSOS Executive Summary; FSML Report Executive Summary



**National Association of Marine Laboratories
Winter Meeting
1201 New York Avenue NW
4th floor Ocean Leadership Conference Room
Washington, D.C.
March 1-2, 2015**



Sunday -- March 1, 2015

Location: Hotel W Washington DC; 515 15th Street NW, Washington, D.C. 20004

- 2:00PM Opening Remarks - Nancy Rabalais and Mike DeLuca**
- 2:15PM Briefing on the Federal Science Budget and Policy Environment and
Presentation of FY 2015 NAML Public Policy Agenda- Joel Widder and Meg
Thompson, Partners, Federal Science Partners and Consultants to NAML**
- 2:45PM Discussion and Disposition of NAML Public Policy Agenda and Related
Resolution**
- 3:45PM NAML Business/Board Meeting**
- 4:15PM Regional Meetings: WAML; SAML; and NEAMGLL**
- 5:00PM Regional Meetings report out**
- 5:30PM Reception**
- 6:30PM NAML Dinner**
- 7:30PM Dinner Speaker: Dr. Shirley A. Pomponi, Co-Chair, NAS Decadal Survey of
Ocean Science 2015**
- 8:00PM: Adjourn**

Monday – March 2, 2015

Location: Consortium for Ocean Leadership, 1201 New York Avenue NW, Suite 400

- 8:00AM: Coffee and continental breakfast**
- 8:15AM: Nancy Rabalais, President NAML/Mike DeLuca, Chair Public Policy Committee**
- 8:45AM: Widder/Thompson – Overview of the day’s speakers/issues**
- 9:00AM: Speaker: Dr. Russell Callender, Acting Assistant Administrator, National Ocean Service (confirmed)**
- 9:45AM: Speaker: Kolo Rathburn/Senate Appropriations Subcommittee on Commerce-Justice- Science (Kolo Rathburn – confirmed)**
- 10:30AM: Break**
- 10:45AM: Speaker: Dr. Sarah Oktay, President, OBFS (confirmed)**
- 11:45AM: Speaker: Dr. Richard (Rick) Murray, NEW NSF Division Director for Ocean Sciences (confirmed)**
- 12:45PM: Pick Up Lunch at Credenza outside Ocean Leadership Conference Room**
- 1:00PM: Lunch Speaker: Dr. Rick Spinrad, Chief Scientist, NOAA (confirmed)**
- 2:00PM: Speaker: Dr. Charles D. Liarakos, Senior Advisor, Directorate for Biological Sciences, NSF**
- 3:00PM: Break**
- 3:30PM: Speaker: Ms. Sherri Goodman, President and CEO, Consortium for Ocean Leadership**
- 4:00PM: Speaker: Dr. Libby Jewett, Program Director, Ocean Acidification, Office of Oceanic and Atmospheric Research (confirmed)**
- 4:45PM: Speaker: STEM Education – Dr. Louisa Koch, Director of Education, NOAA (confirmed) and Dr. Jill Karsten, Geoscience Education, National Science Foundation (confirmed)**
- 5:30PM: Mike Deluca/Joel Widder/Meg Thompson – Action/Follow Up Items for NAML**
- 5:45PM: Nancy Rabalais – closing remarks and adjournment**

Biographical Sketches of Speakers
NAML Public Policy Meeting
Washington, D.C.
March 1 and 2, 2015

Dr. Shirley Pomponi

Dr. Shirley Pomponi is Research Professor and Executive Director of the NOAA Cooperative Institute for Ocean Exploration, Research, and Technology at Harbor Branch Oceanographic Institute, Florida Atlantic University, in Fort Pierce, Florida. She received her Ph.D. in Biological Oceanography from the University of Miami. Her research focuses on marine biotechnology, in general, and sponge systematics, cell and molecular biology, in particular. She has authored or co-authored more than 100 peer-reviewed scientific publications and is co-inventor on several patents. She has led numerous research expeditions worldwide and has made more than 300 dives in Harbor Branch's Johnson-Sea-Link submersibles. Dr. Pomponi is immediate Past-President of the Southern Association of Marine Laboratories, and immediate past-Chair of the Florida Institute of Oceanography Council. She is a member of the Florida Oceans and Coastal Council, the U.S. National Committee for the Census of Marine Life, the National Association of Marine Laboratories, and the Southeast Coastal Ocean Observing Regional Association.

Dr. Russell Callendar

Dr. Russell Callendar is the Acting Assistant Administrator for NOAA's National Ocean Service. The National Ocean Service (NOS) is the nation's most comprehensive ocean and coastal agency. Its mission is to provide science-based solutions through collaborative partnerships to address evolving economic, environmental and social pressures on our oceans and coasts. The agency observes, measures, assesses, and manages the nation's coastal, ocean, and Great Lakes areas; provides critical navigation products and services; and conducts response and restoration activities to protect vital coastal resources. As Acting Assistant Administrator, Dr. Callendar provides strategic vision for NOS. He leads the implementation of activities that support NOS's priorities of coastal resilience, coastal intelligence, and place-based conservation. He serves as the focal point for conveying the value of NOS products and services within NOAA and to the Department of Commerce, the Office of Management and Budget, and Congress. Dr. Callendar actively establishes and grows partnerships with other federal agencies, non-governmental organizations, and industry.

Mr. Kolo Rathburn

Charles Kolo Rathburn is a Professional Staff Member -- Majority of the U. S. 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.

Dr. Sarah Oktay

Sarah Oktay, Director of the University of Massachusetts Boston Nantucket Field Station was named, in 2014, to be the president of the Organization of Biological Field Stations, a nonprofit that represents field stations and marine labs from around the world. Dr. Oktay, executive director of Nantucket's field station, was elected by the over 300 members of OBFS. She took office April 1, previously served as a member at large on the executive committee and as secretary for the past year. In addition, she has been the chair of the outreach committee and currently serves as chair for member support. Dr. Oktay will be responsible for representing OBFS at meetings and the person who will talk to other heads of national organizations. Sarah Oktay, is the director of the Nantucket Field Station. This 107-acre field site includes a pristine salt marsh, rolling uplands, and harbor waterfront on Nantucket Island which provides research, education and community service opportunities for participants from the island community, Umass Boston students and scientists from around the country. Sarah is the vice-chairman of Nantucket Island's Conservation Commission and a regular contributor on the science column of Yesterday's Island - a Nantucket newspaper, where she shares her findings from the field.

Dr. Richard Murray

In January 2015, Dr. Richard (Rick) Murray began serving as Director of the Division of Ocean Sciences at the National Science Foundation. Dr. Murray is on leave from Boston University where he is a Professor in the Department of Earth and the Environment. He completed his undergraduate degree at Hamilton College, earned his Ph.D. at the University of California, Berkeley, and is a graduate of the Sea Education Association in Woods Hole, Massachusetts. He has extensive research experience in marine geochemical cycling, geochemical paleoceanography, and climate evolution. Dr. Murray brings to the Division and Foundation his experience as department chair at Boston University, as chief scientist on research cruises, as an elected official (Selectman) in his hometown, and his exemplary record of service on advisory committees for ocean sciences.

Ms. Sherri Goodman

Ms. Sherri Goodman, CEO and President, Consortium for Ocean Leadership began her tenure on February 17, 2015. Ms. Goodman succeeds Bob Gagosian who has served as Ocean Leadership's founding President since 2007 and was named President Emeritus by the Board today. Ms. Goodman has served as Senior Vice President, General Counsel and Corporate Secretary at CNA Corporation, which operates the Center for Naval Analyses and the Institute for Public Research. She is also founder and Executive Director of CNA's Military Advisory Board. CNA is a scientifically based non-profit research organization providing independent analysis and solutions to United States Navy and Marine Corps and other national security leaders and public sector organizations. Previously, Ms. Goodman served as Deputy Under Secretary of Defense (Environmental Security) and on the staff of the Senate Armed Services Committee. She has degrees from Harvard Law School, the Kennedy School of Government, and Amherst College.

Dr. Richard Spinrad

Dr. Richard Spinrad is NOAA's Chief Scientist. An internationally recognized scientist and executive with more than 30 years of experience, Dr. Spinrad is the senior scientist for the agency, driving policy and program direction for science and technology priorities. Until this

appointment, Dr. Spinrad served as vice president for research at Oregon State University (OSU) in Corvallis, Oregon, and from 2005 until 2010, was the head of NOAA's Office of Oceanic and Atmospheric Research and the head of the National Ocean Service. Dr. Spinrad has extensive experience in environmental research, management, and teaching. He was a leader in the development of the nation's first-ever ocean research priorities and established the U.S. Navy's environmental research strategy. He has directed federal research programs and served on the faculty of three major universities. He has been published in pre-eminent peer-reviewed journals and awarded highest honors from three international professional societies.

Dr. Charles D. Liarakos

Dr. Liarakos received a Bachelor of Arts degree in biology from the State University of New York at Buffalo in 1968, and a Ph.D. in biochemistry from Vanderbilt University in 1973. After completing a postdoctoral fellowship in the Department of Pharmacology at Baylor College of Medicine, Dr. Liarakos held medical school faculty appointments at Baylor College of Medicine, Mayo Clinic, the University of Arkansas for Medical Sciences and the University of Tennessee, Memphis, where he taught biochemistry and molecular biology and did research in the field of RNA biochemistry and translational regulation. Since 1994, Dr. Liarakos has served three separate tours of duty in the Biology Directorate at the National Science Foundation as Program Director, Deputy Division Director and Senior Policy Advisor in the Office of the Assistant Director for Biology. Prior to returning to the NSF, Dr. Liarakos held positions as Director of Scientific Review for Autism Speaks (2006 – 2007), and as Chief Scientist and Director of Peer Review (1999 – 2005) for NASA Peer Review Services and NASA Research and Education Support Services, where he managed the independent peer review of ground and flight research proposals in the life and physical sciences for NASA and the National Space Biomedical Research Institute. In 2010 Dr. Liarakos was elected a Fellow of the American Association for the Advancement of Science.

Dr. Libby Jewett

Dr. Libby Jewett became the first Director of the NOAA Ocean Acidification Program in May 2011. A founding member of NOAA's Ocean Acidification Steering Committee, Dr. Jewett led NOAA-wide meetings of scientists and policymakers to conceive and develop NOAA's first comprehensive ocean acidification research plan. She continues to represent NOAA on the ocean acidification interagency working group (under Subcommittee on Ocean Science and Technology) where she helped develop an ocean acidification strategic research plan for the nation. Prior to becoming Director, she directed the only two national competitive hypoxia research funding programs as program manager for the Center for Sponsored Coastal Ocean Research in NOAA's National Ocean Service. In this role, she strived to make the funded science relevant to the management of coastal ecosystems, especially in the Chesapeake Bay and northern Gulf of Mexico. She also has many years of experience working in nongovernmental organizations. Jewett earned a Ph.D. in Biology with a focus on Marine Ecology at the University of Maryland, a Master of Public Policy at Harvard University's Kennedy School of Government, and a B.A. at Yale University.

Ms. Louisa Koch

Louisa Koch is NOAA's Director of Education responsible for enhancing public understanding about the role of the ocean, coasts, Great Lakes and atmosphere in the global environment and

developing the next generation of Science, Technology, Engineering and Math (STEM) professionals capable of understanding and managing those resources. Ms. Koch served as NOAA's Deputy Assistant Administrator for Research in Silver Spring, Maryland from 1998 through 2005. Before joining NOAA, Ms. Koch served as the Commerce Branch Chief at the Office of Management and Budget. She served as a Presidential Management Intern at the Department of Defense and as an economist with the Joint Economic Committee in the U.S. Congress. Ms. Koch earned a Master's in Electrical Engineering from the Massachusetts Institute of Technology (1987), and a Bachelors Degree in Physics from Middlebury College, Middlebury, Vermont (1982).

Dr. Jill Karsten

Dr. Karsten joined the Directorate for Geosciences (GEO) as Program Director for Education and Diversity in November 2005. In addition to program management responsibilities associated with GEO's education and diversity portfolio, Dr. Karsten serves as leader for the GEO Education Team and represents NSF on the U.S. Climate Change Science Program ad-hoc Education Interagency Working Group. She is a member of the NSF-wide Broadening Participation Working Group and was appointed co-Executive Secretary for the National Science Board Committee on Education and Human Resources in 2009. Trained as a marine geologist, Dr. Karsten spent 1 year at Northwestern University and 12 years at the University of Hawaii at Manoa's School of Ocean and Earth Science and Technology as a sea-going research scientist, studying volcanic and tectonic processes occurring at mid-ocean ridges. In conjunction with this research, she participated in 16 research cruises (4 as Chief or Co-Chief Scientist). While at UHM, Dr. Karsten was Chair of the Department of Geology and Geophysics Graduate Admissions Committee and served on the American Geophysical Union's Committee on Education and Human Resources. Before coming to NSF, Dr. Karsten was a Program Officer in the Marine Geology & Geophysics program at the Office of Naval Research (2000-2001), where she helped manage grant programs related to acoustic studies of the seafloor. She subsequently served as Education Manager for the American Geophysical Union (2001-2005). Dr. Karsten earned her B.A. degree in Geochemistry from Wellesley College (1977) and her M.S. (1980) and Ph.D. (1988) degrees in Geological Oceanography from the University of Washington, where she also conducted research focused on water diffusion in magmatic systems.

Mr. 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 is an original member of and served on NOAA's Environmental Information Services Working Group, which reports to the NOAA Science Advisory Board. He also 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).

Ms. 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

Russell Callender

- NAML's key public policy priorities are: support for research and education in the ocean, coastal, and Great Lakes; promotion of a network for data and resource sharing with other marine labs and field stations; pursuit of sustainability and partnerships with other like minded institutions. How do these objectives dovetail with those of NOS?
- Could you please talk about the interest and willingness of NOS 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. For example in NOS, we have seen support for extramural R&D drop from a level of \$21.6M in 2005 to \$13.7M in 2011 while intramural support has grown from a level of \$53M in 2005 to a level of \$58M in 2011. This comes from data provided by NOAA to the NOAA SAB for its recent R&D portfolio study. Is there a role NAML can play to help NOS management address this and larger NOS funding issues?
- 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 Members of Congress?
- What can you tell us about the new coastal resiliency grant program at NOS. We understand that it is slated to grow from \$5 million in FY15 to \$50 million in FY16. Why didn't NOAA use its existing extramural programs – such as Sea Grant and IOOS – for part of the resiliency push NOAA is making? How will this new program fit with existing extramural programs at NOAA?
- 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 NOS on in the future?
- Please talk about the future for the coastal roundtable your predecessor established. Is there a role for NAML in that growing collaboration?

Kolo Rathburn

- At the outset, we would like to express our appreciation for the support the Chair and Ranking Member have 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 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?

- NOAA's FY16 budget request proposes to grow the NOS' coastal resiliency grant program from \$5 million to \$50 million in FY16. To what extent is the subcommittee likely to support that growth? NOAA seems to have omitted its existing extramural programs that already work in the resiliency space – such as Sea Grant and the ocean observing systems. What role do you expect the Subcommittee will play in balancing the needs of existing programs with the resources being targeted for new programs?
- 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 essentially re-invent ourselves into a virtual network so that we can all take advantage of the data and observations we have all 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. There is an NRC report current underdevelopment that will undoubtedly recommend closer collaboration and sharing of resources for both marine labs and field stations. Is this something the Subcommittee is likely to support?

Richard Murray

- Please discuss how you see the new NAS decadal survey report – DSOS – impacting the division of ocean sciences. What do you think of the report's recommendations – especially the recommendations that call for a scaling back on support for infrastructure to protect the core research activities?
- NAML's key public policy priorities are: support for research and education in the ocean, coastal, and Great Lakes; promotion of a network for data and resource sharing with other marine labs and field stations; pursuit of sustainability and partnerships with other like minded institutions. How do these objectives dovetail with those of NSF?
- Please discuss your views with respect to OCE's continued participation with the BIO directorate in the Field Stations and Marine Laboratories (FSML) program? What impact do you expect the NRC report to have in guiding NSF and OCE's decisions with respect to the future for this important initiative?
- How does NAML's public policy priorities fit with the direction you would like to take OCE in the coming years?
- Your predecessor decided to terminate NSF's support for the centers for ocean sciences education (COSI) even though an external review panel gave the program and the centers very high marks. What do you see as OCE's role in ocean and other geoscience education activities?
- 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 Members of Congress?

- 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?

Richard Spinrad

- NAML's key public policy priorities are: support for research and education in the ocean, coastal, and Great Lakes; promotion of a network for data and resource sharing with other marine labs and field stations; pursuit of sustainability and partnerships with other like minded institutions. How do these objectives dovetail with those of NOAA?
- Could you please talk about the interest and willingness of NOAA to partner with and support activities at institutions like the laboratories represented around this table. In the past, we have seen NOAA talk about working with its partners only to see NOAA back track on its extramural funding. For example in OAR, we have seen support for extramural R&D drop by \$60M since 2005 – from \$171.6M to \$107.1M. And the percentage of OAR's research activities to support extramural programs has dropped from just over 50% down to 34% of the total. According to data provided to the NOAA SAB for its recent R&D portfolio study, we see a similar trend in NOS. Is there a role NAML can play to help NOS management reverse this decline in extramural support?
- What can you tell us about the new coastal resiliency grant program at NOS. We understand that it is slated to grow from \$5 million in FY15 to \$50 million in FY16. Why didn't NOAA use its existing extramural programs – such as Sea Grant and IOOS – for part of the resiliency push NOAA is making? How will this new program fit with existing extramural programs at NOAA?
- The new NAS decadal survey report – DSOS – is directed primarily at NSF. How do you see DSOS impacting NOAA. What do you think of the report's recommendations – especially the recommendations that call for a scaling back on support for infrastructure to protect the core research activities?
- 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 Members of Congress?
- 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?

Charles Liarakos

- NAML's key public policy priorities are: support for research and education in the ocean, coastal, and Great Lakes; promotion of a network for data and resource sharing with other marine labs and field stations; pursuit of sustainability and partnerships with other like minded institutions. How do these objectives dovetail with those of NSF?

Libby Jewett

- NAML's key public policy priorities are: support for research and education in the ocean, coastal, and Great Lakes; promotion of a network for data and resource sharing with other marine labs and field stations; pursuit of sustainability and partnerships with other like minded institutions. How do these objectives dovetail with those of the ocean acidification program?
- Could you please talk about the interest and willingness of your program to partner with and support activities at institutions like the laboratories represented around this table. In the past, we have seen NOAA talk about working with its partners only to see the agency back track on its extramural funding. For example in OAR, we have seen support for extramural R&D drop by \$60M since 2005 – from \$171.6M to \$107.1M. And the percentage of OAR's research activities to support extramural programs has dropped from just over 50% down to 34% of the total.

Louisa Koch

- Please comment on future for NOAA education programming; explain the Administration's rationale for cutting NOAA's competitive grant funding for education; how will the Administration's plan for STEM education consolidation impact NOAA's STEM education activities and what can NAML do to support NOAA's STEM education programming

Jill Karsten

- Please comment on future for GEO's education programming; How does the FY16 budget proposal impact GEO's support for STEM education; How will the Administration's plan for STEM education consolidation impact GEO's STEM education activities and what can NAML do to support GEO's STEM education programming.

NATIONAL ASSOCIATION OF MARINE LABORATORIES

FY 2016 PUBLIC POLICY AGENDA

The National Association of Marine Laboratories (NAML) is a nonprofit organization representing the ocean, coastal and Great Lakes interests of member laboratories that employ thousands of scientists, engineers and professionals nationwide. NAML labs conduct high quality research and education in the natural and social sciences and translate that science to improve decision-making on important issues facing our country

NAML's priorities are drawn from and strongly support two important reports from the National Academy of Sciences. They are: ***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***. Specific priorities germane to NAML labs are:

- Enhance science, education and public engagement at marine labs by supporting the continued development of their unique assets and qualities that allow them to prepare the next generation of scientists, expand opportunities for active learning and collaborative research, and explore a wide range of approaches to engage the public. This includes strong sustained support for competitive merit-based ocean, coastal, and Great Lakes research provided by relevant federal agencies to address the research priorities identified in *DSOS*;
- Promote a network for discovery and innovation via Federal and non-Federal support to build and maintain a modern infrastructure for research, education, and networking including advanced internet connectivity and cyber infrastructure;
- Pursue financial sustainability by developing business plans that foster the unique value of marine labs, creating mechanisms to establish reliable based funding, and diversifying approaches to obtain supplemental support – such as a national partnership program to co-locate federal scientists and infrastructure at NAML facilities; and
- Develop metrics for demonstrating the impact of marine labs in research, education, and public engagement.

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 21st 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:

- The conduct of basic and applied research of the highest quality, making use of the unique capabilities of coastal laboratories in conducting education, outreach and public service;
- Balanced support of research with infrastructure with particular emphasis on cost-effective networking of capabilities;
- Encouragement of effective management and conservation of marine and coastal habitats and resources using ecosystem-based management approaches that restore ecosystem health;
- Observing systems that collect data needed to improve predictions of natural and human caused disasters and support the management of marine resources for the benefit of environmental and human health needs; and
- Education and training.

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

More than half of the United States population lives in coastal counties that generate 58% (\$8.3 trillion) of the Nation's gross domestic product (GDP). In 2011, Americans, on average, ate 15 pounds of fish and shellfish per person – 4.7 billion pounds all together – making the U.S. second in the world in total seafood consumption. Offshore oil production in the U. S. Exclusive Economic Zone accounts for 24% of the total U.S. crude oil production. If American coastal watershed counties collectively comprised a single country, that country would have a GDP higher than that of China. The United States has jurisdiction over 3.4 million square miles of oceans – an expanse greater than the land area of all 50 states combined. This is a dynamic area that offers a mosaic of biologically diverse habitats that provide a wealth of environmental resources and economic opportunities, while at the same exposing human and biological communities to hazards such as damaging tsunamis and hurricanes, industrial accidents and outbreaks of water borne pathogens. The 2010 Gulf of Mexico *Deepwater Horizon* oil spill and Sandy in 2012 are vivid reminders that the depth of our understanding of our oceans and coastal areas, and our ability to protect them, is far from complete. Developing sufficient capabilities to sustain ocean-based economies and protect our coasts and coastal communities from natural and man-made hazards requires a sustained, balanced investment in research, infrastructure, education, and training.

NAML's policy priorities reflect and endorse two National Academy of Sciences reports: *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.

Investing in Research

NAML believes America is driven by innovation — advances in ideas, products and processes that transform existing economies, create new industries and jobs, and contribute to our nation’s ecological and economic health and security. It is essential that the nation reaffirms and revitalizes the unique partnership that has existed between the Federal Government, the states, business and the nation’s research and education enterprise. Investing in the nation’s research enterprise has contributed significantly to our long-term prosperity and technological pre-eminence through research spanning a landscape of disciplines, from physics to geology, chemistry to biology, engineering to social sciences, and observing to modeling.

NAML believes that research and education programs at the major federal science agencies with ocean and coastal responsibilities should be viewed as priority investments in the future health and well being of the Nation. Much attention has been focused justifiably on the need for our Nation to continue its support of premier basic research programs. It is also important to maintain strong support for mission-oriented ocean, coastal and Great Lakes research that includes long term observing programs. Research programs that enhance agency missions and support the extramural community in competitive, merit-based research provide highly cost-effective returns on investment and distribute economic and societal benefits over a broad array of communities. Further, NAML believes that developing exchange programs between federal agencies and marine laboratories will further strengthen the communication and capacity of both for the benefit of the ocean science and management enterprise.

Investing in Research Infrastructure

NAML believes that a comprehensive range of ocean and coastal research infrastructure is essential to meet growing demands for scientific information and to ensure that we restore and maintain ecosystem health to support safe, efficient, and environmentally sustainable use of our ocean, coastal and Great Lakes resources. Most marine laboratories operate independently of one another. Greater networking with other marine laboratories, field stations, and other research centers would leverage resources to facilitate discovery and spark innovation. Networking would also allow institutions to share best practices, protocols, and platforms for data archiving and retrieval. Such networking has the potential to open new arenas of scientific inquiry, education, and outreach. It can capture social and intellectual capital to tackle major questions and seize opportunities as no single marine laboratory can, and it enhances creativity and innovation by attracting a wide range of scientists and promoting multidisciplinary collaboration. The most successful and sustainable networks start small and are self-defining; they encourage reciprocity among network members. Networking can facilitate the development and diffusion of knowledge and technology in a way that encourages innovations. It is also important to appreciate that marine laboratories vary in scope, size, infrastructure requirements, and purpose; each contributes to the global portfolio in distinct ways. Internet connectivity and cyberinfrastructure are two neglected and underdeveloped elements of infrastructure. One common element, however, in need of attention is internet connectivity and cyberinfrastructure, which would facilitate data sharing and analysis. Installation of new cyberinfrastructure requires data-management and data-sharing plans and conformity of data with widely used metadata standards. Such infrastructure also requires a long-term funding commitment for repair, upgrades, and technical support.

Investing in Science, Technology, Engineering and Mathematics (STEM) Education

NAML’s education mission is two-fold. First, it is to enhance ocean STEM education to ensure that all citizens recognize the reciprocal effects of the oceans, coasts and Great Lakes on their own lives and the impacts citizens have on these environments. Second, it is to provide formal research and training opportunities at K-12, college, and post-graduate levels to ensure a scientifically savvy, technically qualified, and ethnically diverse workforce capable of solving problems and answering questions related to the protection, restoration and management of coastal and ocean ecosystems, climate variability, and societal needs. An informed and engaged public is essential for the nation to address complex ocean- and coastal-related issues, balance the use and conservation of marine resources, and maximize future benefits from the ocean. Public understanding of human impacts on the marine environment should be balanced with recognition of the benefits to be derived from well-managed ocean resources. Ocean-related education is by its nature interdisciplinary, involving many of the natural sciences and the human connection to natural resources. It can increase overall science literacy and enhance the nation’s health, standing, safety and security. NAML laboratories seek to expand the engagement of individuals from groups that have been historically under-represented in ocean research, education and outreach. This is particularly important in fulfilling the goal of achieving a diversified STEM pipeline to meet future science and ocean workforce needs.

NAML’s policy priorities reflect and endorse two National Academy of Sciences reports: *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.

National Science Foundation

Although many other federal agencies contribute to ocean science and technology, the Division of Ocean Sciences at NSF (OCE) provides the broadest base of support for the field, including funding for research in physical, biological, and chemical oceanography and marine geology and geophysics, and the development, implementation, and operational support for ocean 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 this area as well as in other 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.

Research emphases in NSF should reflect the eight priority science questions contained in *DSOS*. These include: What are the rates, mechanisms, impacts, and geographic variability of sea level change? How are the coastal and estuarine ocean and their ecosystems influenced by the global hydrologic cycle, land use, and upwelling from the deep ocean? How have ocean biogeochemical and physical processes contributed to today's climate and its variability, and how will this system change over the next century? What is the role of biodiversity in the resilience of marine ecosystems and how will it be affected by natural and anthropogenic changes? How different will marine food webs be at mid-century? In the next 100 years? What are the processes that control the formation and evolution of ocean basins? How can risk be better characterized and the ability to forecast geohazards like mega-earthquakes, tsunamis, undersea landslides, and volcanic eruptions be improved? What is the geophysical, chemical, and biological character of the seafloor environment and how does it affect global elemental cycles and understanding of the origin and evolution of life?

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 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 21st Century*.

NAML notes the increasing share of support for 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*, although NAML also expects NSF to implement those recommendations with consideration to NAML's priorities in this document. 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, infrastructure expenses should not be allowed to escalate at the further expense of core research programs.
- NSF Ocean Sciences (OCE) should strive to reduce the O&M costs of its major infrastructure and restore funding to core science programs within the next five years. If budgets remain flat, OCE should adjust its major infrastructure programs (OOI, IODP, and the academic fleet) to comprise no more than 40-50% of the total annual program budget.
- OCE should implement an immediate 10% reduction in the major infrastructure costs with the smallest reduction to the academic research fleet.
- 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.
- OCE should initiate a high level standing committee to evaluate the entire portfolio of OCE-supported infrastructure and facilities in a comprehensive and balanced way and to recommend proposed changes that should include the entire life cycle of construction, O&M, decommissioning, and recapitalization.
- OCE should expand its partnership capabilities with other federal agencies and international partners.

NAML's policy priorities reflect and endorse two National Academy of Sciences reports: *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.

National Oceanic and Atmospheric Administration

One of NOAA's stated key overarching priorities for FY 2016 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, changing sea levels, and changes in ocean ecology that can result in dramatic economic losses. Increasing population density along the coast will further intensify pressures on ecologically and economically important areas, and put more people in the path of coastal storms. Increasing sea level can further escalate the costs and risks of inundation events. NOAA's National Climatic Data Center recorded 14 U.S. weather and climate-related disasters in 2011 with over \$1 billion each in damages, the highest number on record for a single year. A 2011 report by the New York State Energy Research and Development Authority warned that the combination of sea level rise and coastal surge that can accompany a powerful storm could flood much of New York City's major infrastructure, and estimated that the economic losses from a 100-year storm could range from \$58 billion to \$84 billion. The estimated \$65 billion in damages from Sandy, which overwhelmed the city in October 2012, falls directly within that range and the Federal government has invested almost \$10 billion in aid to individuals, and state, local and tribal governments as well as \$450 million in hazard mitigation grants. A 2005 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.

Improved resiliency is not limited to the Nation's ocean coastal areas. 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. The Great Lakes are responsible for nearly 1 million manufacturing jobs; 217,000 jobs in tourism and recreation; over 100,000 in shipping; over 110,000 in agriculture, fishing and food production and about 10,000 related to mining. Understanding the complexity of the Great Lakes is vital for the future health and well being of this region of the country.

NAML envisions invigorated coastal communities and economies, with increased resiliency and productivity. Indeed, resiliency is the basis of high 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* such as the National Sea Grant College Program, cooperative institutes, a strong extramural ocean acidification research effort, the National Estuarine Research Reserve System, the Integrated Ocean Observing Systems program, etc. to help it achieve the coastal resiliency goals in its strategic plan. NOAA should also join with NIH and NSF to revitalize its support for the Oceans and Human Health research program.

NAML strongly supports recommendations made by the NOAA Science Advisory Board (SAB) that calls for priority support for NOAA extramural programs. This recommendation comes on the heels of a significant decline in NOAA extramural research expenditures. For example, according to data provided by NOAA to the SAB's R&D Portfolio Review Task Force, extramural support has declined since 2005 by over \$60M. As a percent of the total NOAA Research budget, extramural support has dropped significantly since 2005. At that time extramural support represented 50.2% of the OAR portfolio. In 2011 the percentage had declined to 34%. NAML also continues to express concern with prior NOAA proposals contained in appropriation language requests that would enable NOAA to compete with non-federal and private entities for private sector support. 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.

Extramural research 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 enhance its partnership with the extramural research community in creative and innovative ways. For example, 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. A robust NOAA budget directly coupled with solid support for extramural partnerships is essential for NOAA to serve national needs.

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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.

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 role in the management of ocean and coastal resources.

FWS' Landscape Conservation Cooperatives (LCCs) are applied conservation science partnerships with two main functions. The first is to provide the science and technical expertise needed to support conservation planning at landscape scales – beyond the reach or resources of any one organization. Through the efforts of in-house staff and science-oriented partners – such as NAML laboratories – LCCs generate the tools, methods and data that managers need to design and deliver conservation using the Strategic Habitat Conservation approach. The second function of LCCs is to promote collaboration among their members in defining shared conservation goals. With these goals in mind, partners can identify where and how they will take action, within their own authorities and organizational priorities, to best contribute to the larger conservation effort. LCCs assist partners to see how their activities can merge with those of other partners to achieve a bigger and more lasting impact. Many LCCs link watershed activities with coastal and Great Lakes water quality issues. NAML encourages the continued engagement of the LCCs with NAML laboratories to help achieve mutual interests.

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—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.

NAML's policy priorities reflect and endorse two National Academy of Sciences reports: *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.

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.

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, Centers for Ocean Science Education Excellence, 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. 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.

For more information about the NAML Public Policy activities, please contact:

Dr. Nancy Rabalais, Ph.D.
 President, NAML
 Executive Director and Professor
 Louisiana Universities Marine Consortium
 8124 Hwy. 56
 Chauvin, Louisiana 70344
 985-851-2801
nralais@lumcon.edu

Mr. Joel Widder
 Consultant, NAML
 Partner, Federal Science Partners
 1201 New York Avenue
 Suite 400
 Washington, D.C. 20005
 (202) 787-1673
jwidder@federalsciencepartners.com

Mr. Michael De Luca
 Chairman, NAML Committee on Public Policy
 Senior Associate Director
 Institute of Marine and Coastal Sciences
 Rutgers University
 71 Dudley Road
 New Brunswick, New Jersey 08901
 732-932-6555 x512
deluca@marine.rutgers.edu

Ms. Meg Thompson
 Consultant, NAML
 Partner, Federal Science Partners
 1201 New York Avenue NW
 Suite 400
 Washington, D.C. 20005
 (202) 787-1672
mthompson@federalsciencepartners.com

NAML’s policy priorities reflect and endorse two National Academy of Sciences reports: *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*.



National Association of Marine Laboratories

PRESIDENT

Dr. Nancy N. Rabalais (2014-2015)
Louisiana Universities Marine Consortium
8124 Hwy. 56
Chauvin, LA 70344
(985) 851-2801; f: 851-2874
nralais@lumcon.edu

PRESIDENT-ELECT

CHAIR, PUBLIC POLICY COMMITTEE

Dr. Michael De Luca
Inst. of Marine & Coastal Sciences
Rutgers University; 71 Dudley Road
New Brunswick, NJ 08901/8521
(732) 932-6555 x508; f: 932-8578
deluca@marine.rutgers.edu

PAST PRESIDENT

Dr. Jo-Ann Leong
Hawaii Institute of Marine Biology
School of Ocean & Earth Science
Technology
University of Hawaii at Manoa
46-007 Lilipuna Road Kane'ohe, HI 96744 P
(808) 236-7401 f 236-7443
joannleo@hawaii.edu

SECRETARY

Dr. Sandra Gilchrist
Pritzker Marine Laboratory
New College of Florida
5800 Bay Shore Road
Sarasota, Florida 34243
(941) 487-4377
gilchrist@ncf.edu

TREASURER

Dr. James Sanders
Skidaway Institute of Oceanography
University of Georgia
10 Ocean Science Circle
Savannah, Georgia 31411
(912) 598-3340
jim.sanders@skio.uga.edu

RESOLUTION ADOPTED BY THE NATIONAL ASSOCIATION OF MARINE LABORATORIES MARCH 2, 2015 WINTER MEMBERSHIP MEETING WASHINGTON, D.C.

Whereas the National Association of Marine Laboratories (NAML) is a nonprofit organization of member institutions representing coastal, marine, and Great Lakes laboratories in every coastal U.S. state and Puerto Rico and Bermuda;

Whereas NAML member laboratories conduct research and provide a variety of academic, education, and public service programs to enable local and regional communities to better understand and manage the ocean, coastal, and Great Lake environments;

Whereas the National Academy of Sciences (NAS) has recently published two important reports that contain recommendations for the National Science Foundation (NSF) that will directly impact the long term health of ocean, coastal, and Great Lakes research and field stations and marine laboratories that undertake such activities;

Whereas those NAS reports, *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*, have been presented to the NAML membership through in-person briefings by the co-chairs of the respective NAS committees responsible for these reports;

Whereas NAML's priorities articulated in the FY 2016 NAML Public Policy Agenda, adopted by the NAML membership via the passage of this resolution, have been informed and influenced by these important reports;

Resolved, that the National Association of Marine Laboratories:

1. Endorses the recommendations of *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences*; and *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*;
2. NAML also expects NSF to implement those recommendations giving consideration to NAML's priorities as described in NAML's FY 2016 Public Policy Agenda
3. The President of NAML shall transmit this resolution and FY 2016 Public Policy Agenda to all appropriate Federal agency decision makers, the membership of NAML, and other interested parties.

**Key Congressional Committees for the Ocean, Coastal and Great Lakes
Research and Education Community**

House Science, Space and Technology Committee

House Subcommittee on Research (NSF)

House Subcommittee on Environment (NOAA, EPA, NASA earth science)

House Subcommittee on Space (NASA, NASA R&D)

House Natural Resources Committee

House Subcommittee on Water, Power, and Oceans (NOAA)

House Commerce-Justice-Science Appropriations Subcommittee (NASA, NSF, NOAA)

House Interior, Environment, and Related Agencies Appropriations Subcommittee (EPA)

Senate Commerce, Science, and Transportation Committee (NASA, NSF, NOAA, NIST)

Subcommittee on Science and Space (NASA, NSF)

Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard (NOAA)

Senate Commerce-Justice-Science Appropriations Subcommittee (NASA, NSF, NOAA)


Senate Interior, Environment, & Related Agencies Appropriations Subcommittee (EPA)




July 18, 2014

M-14-11

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Brian C. Deese 
Acting Director
Office of Management and Budget

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

SUBJECT: Science and Technology Priorities for the FY 2016 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 21st century. The Nation depends on 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 us toward a clean energy future, address global climate change, manage competing demands on environmental resources, and ensure the security of the Nation.

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 the fundamental, curiosity-driven inquiry that has been a hallmark of the American research enterprise and a powerful driver of unexpected, new technology.

This memorandum outlines the Administration's multi-agency science and technology priorities for formulating FY 2016 Budget submissions to the Office of Management and Budget (OMB). The priorities covered in this memo require investments in R&D; support for activities, such as science, technology, engineering, and mathematics (STEM) education, technology transfer, R&D facilities, and scientific data collection and management, that enable a robust science and technology enterprise; and cooperation among multiple Federal agencies. They build on priorities reflected in this Administration's past budgets and documents.

Agencies should explain in their budget submissions how they are redirecting available resources from lower-priority areas to science and technology activities that address the priorities described below. Agency submissions must meet the requirements outlined in OMB's FY 2016 Budget Guidance memorandum M-14-07. Agencies engaged in complementary activities should consult with each other during the budget planning process so that resources are coordinated to maximize their impact and to avoid inappropriate duplication, and include summaries of these discussions in their OMB budget submissions.

Multi-agency R&D priorities

In the FY 2016 Budget, agencies should balance priorities to ensure 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.

- Advanced manufacturing and industries of the future. The Administration is committed to revitalizing America's manufacturing sector, which will require innovation in the products that are manufactured and the manufacturing systems themselves. Agencies should give priority to those programs that advance the state of the art in manufacturing, with particular emphasis on government-industry-university partnerships and enabling technologies for industries of the future (such as nanotechnology, robotics, materials development, and cyber-physical systems) that benefit multiple sectors, as described in the *National Strategic Plan for Advanced Manufacturing*.
- Clean energy. The President's all-of-the-above approach to energy includes a goal 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 2016 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 21st-century transportation sector; and cutting energy waste in homes, businesses, and factories. In transportation, there is a particular need to reduce the current fragmentation of R&D activities and funding and to promote a more cohesive R&D framework that links the capabilities of the Departments of Energy, Defense, and Transportation.
- Earth observations. Earth-observation data serve as the foundation for services that protect human life, property, the economy, and national security, as well as advancing fundamental understanding of the Earth system. Enhanced interagency coordination is required to ensure adequate observational coverage for public services and Earth-system research and to ensure complementarity and integration of the resulting data. Agencies should participate in the coordination efforts of the National Science and Technology Council's (NSTC) Committee on Environment, Natural Resources, and Sustainability (CENRS) and align their R&D investments with the 2014 National Plan for Civil Earth Observations, and comply with the Executive Order on Open and Machine Readable Data.
- 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. In improving the nation's ability to understand, assess, predict and respond to global change, agencies should prioritize

activities that strengthen the scientific basis for, as well as the development and use of, actionable science, information, and related tools needed to prepare for and reduce climate-related risks.

- Information technology and high-performance computing. Agencies should 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. Agencies should also 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, as well as research to advance technologies for more efficient use of spectrum and cyber-physical systems. Agencies should coordinate with each other and with the private sector to promote innovation in high-performance computing to support national security, scientific discovery, and economic competitiveness.
- 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 platform technologies as described in the Administration's 2012 *National Bioeconomy Blueprint* (e.g. technologies for the design of biological systems, understanding systems biology, and high-throughput biology), the President's BRAIN Initiative, and the *National Strategy for Biosurveillance*. Agencies should prioritize research to fulfill the Cross-Agency Priority Goal for Service Members and Veterans Mental Health by supporting research to identify and develop more effective diagnostic and treatment methodologies and metrics to improve mental health and substance use outcomes.

The Administration is committed to combatting the public health and national security challenges associated with the rise in antibiotic-resistant bacteria. Effectively addressing antibiotic resistance will require departments and agencies to support multi-sectoral efforts that promote new and next-generation antibiotic and diagnostics development, strengthen surveillance for resistance in animals and humans, and enhance antimicrobial stewardship practices in clinical medicine and agriculture. Departments and agencies should prioritize funding for the identification and development of new bacterial countermeasures, including engineering the microbiome, use of small molecules as both antibiotics and synergists, novel vaccines, probiotics, and other innovative mechanisms. Agencies should also boost both foundational and translational research and development that leads to rapid, point-of-care diagnostics to determine with certainty whether antibiotics treatment is warranted.

- 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 provide cutting-edge capabilities to meet current and future mission requirements, national security agencies need to support a balanced portfolio of basic and applied research and advanced technology development. In particular, priority should be given to investments to develop capabilities in hypersonics, countering weapons of mass destruction, accelerated training techniques, and handling large data sets for national-security mission requirements.

- R&D for informed policy-making and management. A diverse range of agency missions (e.g. natural resource management protecting health and the environment) benefit from R&D that strengthens the scientific basis for decision-making. Both mission-centered agencies and R&D agencies should focus on user-driven information and tools to ensure science investments more directly support decision-making.

Research Tools and Infrastructure

Agencies should support the research tools and infrastructure needed to ensure that U.S. science and engineering remain at the leading edge of discovery. Proposals for development, construction, and operations costs must be fully justified and balanced against funding for research activities and operations of existing facilities. In supporting tools and infrastructure, agencies should look for opportunities to leverage resources from other agencies and the private sector. OSTP and OMB encourage agencies to consider the best practices for Federal facility partnerships identified in the Science and Technology Policy Institute’s recent report *Best Practices for Federal Research and Development Facility Partnerships*.¹

Other R&D Program Guidance

Within research portfolios, Federal agencies are encouraged to identify and pursue clearly defined “Grand Challenges” – ambitious goals that require advances in science, technology and innovation to achieve – and to support high-risk, high-return research.

Agencies should consider, where appropriate and authorized, supplementing traditional R&D “push” mechanisms (e.g., grants and contracts) with “pull” mechanisms – results-based market incentives designed to overcome market failures, engage a wide range of solvers, and catalyze innovation, such as incentive prizes and advanced market commitments.

International scientific partnerships should be pursued to advance the Administration’s priorities in global health and development, share the financial burden of large research projects, and capitalize on complementary research and technology capabilities. Because of the complexity of international collaborations, agencies should ensure that such activities adhere to the highest management standards.

At its January 31 meeting, the President’s Council of Advisors on Science and Technology discussed concerns about the reproducibility of scientific research². These concerns cut across fields of science. Agencies should engage stakeholders to develop ways to improve the reproducibility of research in the fields they support.

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, quantitative metrics where possible and describe how they plan to evaluate the success of those programs.

The preservation of knowledge is critical to solving current problems and meeting future challenges. Many agencies have collections representing the work of thousands of scientists over

¹ <https://www.ida.org/~media/Corporate/Files/Publications/STPIPubs/2014/ida-p-5148.ashx>

² <http://www.whitehouse.gov/administration/eop/ostp/pcast/meetings/past>

many years. Preserving and providing access to important and often irreplaceable collections should be a priority for agencies with an R&D portfolio. Therefore, agencies are strongly encouraged to work together to implement the March 2014 policy on *Improving the Management of and Access to Scientific Collections* to make the most effective use of these important sources of information.

STEM Education Guidance

Investments in STEM education should adhere to the priorities outlined in the Federal STEM Education 5-Year Strategic Plan, by the Committee on STEM Education (CoSTEM) under the NSTC, and should continue to pursue the goals of reducing program fragmentation and enhancing program effectiveness that were supported in the past two budgets. This includes giving priority 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 also ensure that programs are designed to identify and effectively meet the needs of those we're trying to serve—students, teachers, schools, districts and post-secondary institutions. The 2016 Budget proposals should align STEM education investments with the Strategic Plan, with attention to initiatives presented in the President's Council of Advisors on Science and Technology (PCAST) reports *Prepare and Inspire* and *Engage to Excel* and be coordinated with other Administration priorities.

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

FOR IMMEDIATE RELEASE

February 2, 2015

FACT SHEET

President's 2016 Budget Invests in America's Future: R&D, Innovation, and STEM Education

America's economic competitiveness and growth—including in domestic manufacturing—depend on robust investments in: research and development (R&D); innovation; and science, technology, engineering, and mathematics (STEM) education. Federal funding in these domains has, to date, catalyzed the development of new products, capabilities, and industries; spurred the creation of high-skill, high-wage jobs; and led to an astounding array of insights and services that benefit all Americans.

Science, technology, and innovation resulting from these investments help unlock opportunities in key areas of societal importance: creating jobs; improving the health of all Americans; enhancing access to clean energy, water, and food; addressing global climate change; managing competing demands on environmental resources; and ensuring the security of the Nation.

The President's 2016 Budget provides \$146 billion for R&D overall, an \$8 billion or 6 percent increase from 2015 enacted levels. The Budget targets resources to areas most likely to directly contribute to the creation of transformational knowledge and technologies that can benefit society and create the businesses and jobs of the future. The Budget also provides \$67 billion for basic and applied research (the "R" in R&D), a \$2 billion or 3 percent increase from 2015 enacted levels.

The Budget targets several key priorities:

- **Continuing our commitment to world-class science and research.** To continue the cutting-edge R&D that is essential to U.S. innovation and economic competitiveness, the Budget provides the Department of Energy's (DOE) Office of Science with over \$5.3 billion and the National Science Foundation (NSF) with over \$7.7 billion. The Budget also provides \$755 million for the National Institute of Standards and Technology (NIST) laboratories. The Budget increases total funding for these three key basic research agencies by \$0.7 billion over the 2015 level to \$13.8 billion.
- **Investing in innovation.** The Budget invests in innovative security capabilities. The 2016 Budget proposes \$12.3 billion for the Department of Defense's (DOD) Science & Technology program. The Budget also maintains DOD's critical role in fostering breakthrough approaches for discovering promising technologies with \$3.0 billion for the Defense Advanced Research Projects Agency (DARPA). To encourage innovation in our space capabilities, the Budget provides \$18.5 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 \$1.5 billion for the multi-agency National Nanotechnology Initiative.
- **Improving Americans' health.** The Budget provides \$31.3 billion to support biomedical research at the National Institutes of Health (NIH), an increase of \$1 billion over 2015 enacted. The Budget provides increased resources for Alzheimer's, cancer and other diseases that affect millions of Americans and includes \$135 million for NIH's contribution to the multi-agency BRAIN Initiative that

is helping to revolutionize our understanding of the human brain. The Budget also supports a \$1.2 billion government-wide investment by Department of Health and Human Services (HHS) agencies, DOD, the Department of Veterans Affairs (VA), and the U.S. Department of Agriculture (USDA) on combating antibiotic-resistant bacteria. The Budget also includes \$215 million at three HHS agencies (NIH, FDA, and ONC) to launch a Precision Medicine initiative that will accelerate our ability to develop prevention, diagnostic, and treatment approaches tailored to individual patients.

- **Making America a magnet for jobs.** In the area of manufacturing, the Budget will support the development and scaling of new advanced manufacturing technologies, helping smaller manufacturers adopt new technologies to increase their competitiveness, and accelerating the transfer of new technologies from Federal labs to industry. The 2016 Budget provides \$2.4 billion for Federal R&D directly supporting advanced manufacturing at NSF, DOD, DOE, the Department of Commerce (DOC), and other agencies, 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.
- **Investing in homegrown clean energy.** The Budget provides approximately \$7.4 billion for clean energy technology programs government-wide to accelerate the transition to a clean energy economy and position the United States as the world leader in the energy industries of the 21st Century. In DOE, the 2016 Budget provides \$2.7 billion for the Office of Energy Efficiency and Renewable Energy (EERE) to accelerate research and development, build on ongoing successes, increase the use of critical clean energy technologies, and further reduce costs. The Budget includes \$325 million for the Advanced Research Projects Agency–Energy (ARPA-E), a program that seeks to fund transformative energy research.
- **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 approximately \$2.7 billion for USGCRP; USGCRP outcomes support the Administration's Climate Action Plan.
- **Preparing students with STEM skills.** Our Nation's competitiveness depends on our ability to improve and expand STEM learning in the United States. Guided by the Federal STEM Education Five-Year Strategic Plan and a significant reorganization of programs, agencies are increasing coordination, strengthening partnerships, and identifying ways to leverage existing resources to improve the reach of agency assets. The Budget invests more than \$3 billion in STEM education programs, an increase of 3.6 percent over the 2015 enacted level.
- **Supporting private-sector R&D.** The Budget would reform and make permanent the Research and Experimentation (R&E) Tax Credit, an important Federal incentive for private-sector R&D.

Additional details about the 2016 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>.

###



Fact Sheet

NSF FY16 BUDGET REQUEST

February 2, 2015

The President's 2016 Budget is designed to bring middle class economics into the 21st Century. This Budget shows what we can do if we invest in America's future and commit to an economy that rewards hard work, generates rising incomes, and allows everyone to share in the prosperity of a growing America. It lays out a strategy to strengthen our middle class and help America's hard-working families get ahead in a time of relentless economic and technological change. And it makes the critical investments needed to accelerate and sustain economic growth in the long run, including in research, education, training, and infrastructure.

These proposals will help working families feel more secure with paychecks that go further, help American workers upgrade their skills so they can compete for higher-paying jobs, and help create the conditions for our businesses to keep generating good new jobs for our workers to fill, while also fulfilling our most basic responsibility to keep Americans safe. We will make these investments, and end the harmful spending cuts known as sequestration, by cutting inefficient spending and reforming our broken tax code to make sure everyone pays their fair share. We can do all this while also putting our Nation on a more sustainable fiscal path. The Budget achieves about \$1.8 trillion in deficit reduction, primarily from reforms to health programs, our tax code, and immigration.

The National Science Foundation (NSF) was established in 1950. Its mission is to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense. To support this mission, the Budget provides \$7.7 billion in discretionary funding for NSF. This funding level will continue NSF's longstanding commitment to making investments in learning and discovery that will grow our economy, sustain our competitive advantage, and enable America to remain the world leader in innovation. It embraces the challenge of ensuring that scientific discovery and technological breakthroughs remain engines for expanding the frontiers of human knowledge and responding to the challenges of the 21st century.

Funding Highlights:

- The President's FY 2016 Budget provides \$7.7 billion for the National Science Foundation to expand the frontiers of knowledge and to lay the foundation for long-term economic growth by building an innovation economy and educating a globally competitive workforce. This includes:
 - Building an innovation economy through investments in a broad portfolio of fundamental research, as well as investments in strategic areas such as advanced manufacturing and clean energy; and
 - Preparing a globally competitive workforce by supporting advanced education in

science, technology, engineering, and mathematics.

Reforms:

- Increasing the impact of the Agency's investments and operational efficiency by expanding public access to the results of research and reducing the cost of processing research grant proposals
-

Advances Our Understanding of the Brain.

The Budget provides \$144 million to enable scientific understanding of the full complexity of the brain in action and in context. This encompasses ongoing cognitive science and neuroscience research and includes NSF's contribution of \$72 million to the Administration's Brain Research through Advancing Innovation and Neurotechnologies (BRAIN) Initiative.

Supports Innovations at the Nexus of Food, Energy, and Water Systems.

The Budget provides \$75 million to understand, design, and model the interconnected food, energy, and water system through an interdisciplinary research effort that incorporates all areas of science and engineering and addresses the natural, social, and human-built factors involved.

Invests in Disaster Resilience.

The Budget provides \$58 million to address the Nation's need for resilience in response to disasters both natural and manmade through both core programs and focused activities.

Provides Leading Edge Capabilities and Infrastructure for Research and Education.

The Budget provides \$143 million to support the Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education which will accelerate and transform the process of scientific discovery and innovation by providing advanced cyberinfrastructure and new capabilities in computational and data-enabled science and engineering.

The Budget also invests \$100 million in the Large Synoptic Survey Telescope (LSST), an 8-meter-class wide-field optical telescope designed to carry out surveys of the entire sky. It will open a new era in "time-resolved astronomy" as its 3-billion pixel digital camera and wide field of view enable previously impossible studies of the variable sky. LSST will observe transient events such as exploding stars and the motion of asteroids. Combining these abundant images also traces billions of remote galaxies to provide new insights into dark matter and dark energy. FY 2016 represents the third year of construction funding for this nine year project.

Invests in the Long-Term Competitiveness of American Manufacturing.

The Budget provides \$257 million for Cyber-enabled Materials, Manufacturing, and Smart Systems, which aims to integrate a number of science and engineering activities across the Foundation – breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems. It will address pressing technological challenges facing the Nation and promote U.S. manufacturing competitiveness.

Accelerates the Commercialization of University Research.

The Budget provides \$30 million for Innovation Corps to improve NSF-funded researchers' access to resources that can assist in bridging the gap between discoveries and downstream technological applications.

Supports the Long-Term Development of a Clean Energy Economy.

Clean Energy investments are driven by the fundamental research questions that underlie future energy pathways. The Budget provides \$377 million for clean energy investments to support research and education in alternative energy for electricity (solar, wind, wave, geothermal) and

fuels (chemical and biofuels).

Educates a Globally Competitive American Workforce and Promotes Advanced Education for the Jobs of Tomorrow.

NSF supports a range of investments in developing the workforce for science, technology, engineering, and mathematics (STEM), most notably by injecting new vision and commitment into efforts to broaden participation in STEM fields. The Budget provides a total of \$1.2 billion for STEM education activities, including:

- **NSF Research Traineeships**, which, in its third year, continues to identify priority research themes that both align with NSF priority research activities and have strong potential in areas of national need where innovative practices in graduate education can be developed.
- **CyberCorps: Scholarships for Service** program that supports cybersecurity education and research at higher education institutions. SFS also focuses on workforce development by increasing the number of qualified students entering the fields of information assurance and cybersecurity.
- **Graduate Research Fellowship Program** which recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based Master's and doctoral degrees at accredited United States institutions.
- **Improving Undergraduate STEM Education** to accelerate the improvement of education of undergraduates in all STEM fields by using decades of research on STEM learning and best practices in education to address challenges across fields as well as within specific disciplines.
- **NSF INCLUDES (Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science)**, which aims to develop a scalable, national initiative to increase the preparation, participation, advancement, and potential contributions of those who have been traditionally underserved and/or underrepresented in the STEM enterprise.

Increases Public Access to Research Results

NSF continues to improve public access to NSF-funded research. The agency will build on existing technology to track research products, allow investigators and awardees to make their products known and available, and allow the general public, researchers, and policy makers to locate and use those products.

Reduces Costs Associated with Merit Review Process

In FY 2016, NSF expects to evaluate over 51,700 proposals through a competitive merit review process and make over 12,000 new awards. This will require over 225,000 proposal reviews, engaging on the order of 35,000 members of the science and engineering community participating as panelists and proposal reviewers. Through the use of virtual panels, NSF anticipates saving \$500,000 a year beginning in 2016 as the rate for compensating reviewers participating virtually is reduced by roughly 30 percent.

-NSF-

Media Contacts

Dana Topousis, NSF, (703) 292-7750, dtopousi@nsf.gov

The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. In fiscal year (FY) 2015, its budget is \$7.3 billion. NSF funds reach all 50 states through grants to nearly 2,000 colleges, universities and other institutions. Each year, NSF receives about 48,000 competitive proposals for funding, and makes about 11,000 new funding awards. NSF also awards about \$626

million in professional and service contracts yearly.

 **Get News Updates by Email**

Useful NSF Web Sites:

NSF Home Page: <http://www.nsf.gov>

NSF News: <http://www.nsf.gov/news/>

For the News Media: <http://www.nsf.gov/news/newsroom.jsp>

Science and Engineering Statistics: <http://www.nsf.gov/statistics/>

Awards Searches: <http://www.nsf.gov/awardsearch/>



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UNITED STATES
National Science Foundation

FY 2016

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.

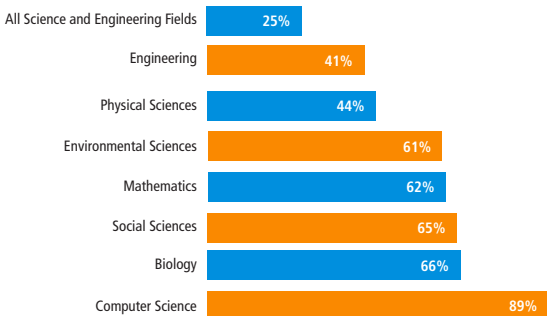
—From "Investing in Science, Engineering, and Education for the Nation's Future" *NSF Strategic Plan for 2014-2018*

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
- NSF serves the national interest, as stated by NSF's mission to promote the progress of science, to advance the national health, prosperity and welfare, and to secure the national defense
- Supports research and workforce development programs that help drive future economic growth, global competitiveness, and the creation of high-wage jobs for American workers
- 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 89 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 214 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 2013

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

FY 2016 BUDGET REQUEST

NSF Budget by Appropriation (dollars in millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	Change Over FY 2015 Estimate	
				Amount	Percent
Research and Related Activities	\$5,775.32	\$5,933.65	\$6,186.30	\$252.66	4.3%
Education and Human Resources	\$832.02	\$866.00	\$962.57	\$96.57	11.2%
Major Research Equipment and Facilities Construction	\$200.00	\$200.76	\$200.31	-\$0.45	-0.2%
Agency Operations and Award Management	\$305.95	\$325.00	\$354.84	\$29.84	9.2%
National Science Board	\$4.25	\$4.37	\$4.37	-	-
Office of Inspector General	\$13.84	\$14.43	\$15.16	\$0.73	5.1%
TOTAL	\$7,131.39	\$7,344.21	\$7,723.55	\$379.34	5.2%

Totals may not add due to rounding.

FY 2016 CROSS-FOUNDATION INVESTMENTS

Understanding the Brain (UtB) — Enable scientific understanding of the full complexity of the brain in action and in context. UtB encompasses NSF's contributions to the Administration's Brain Research through Advancing Innovation and Neurotechnologies (BRAIN) Initiative (\$144 million).

Risk and Resilience — Improve predictability and risk assessment and increase resilience to extreme natural events and man-made events in order to reduce their impact on the Nation's quality of life, society, and economy (\$58 million).

Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS) — Understand, design, and model the interconnected food, energy, and water system through an interdisciplinary research effort that incorporates all areas of science and engineering and addresses the natural, social, and human-built factors involved (\$75 million).

Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (NSF INCLUDES) — Develop a national scalable initiative to increase the preparation, participation, advancement, and potential contributions of those who have been traditionally underserved and/or underrepresented in the STEM enterprise (\$15 million).

NSF by the Numbers

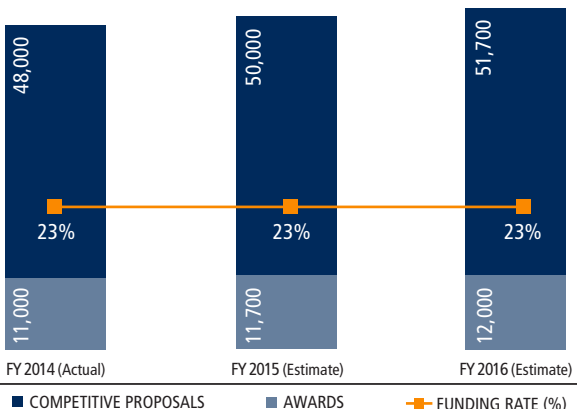
\$7.7 billion	FY 2016 Budget Request
1,826	Colleges, universities, and other institutions receiving NSF funding in FY 2014
48,100	Proposals evaluated in FY 2014 through a competitive merit review process
11,000	Competitive awards funded in FY 2014
225,800	Proposal reviews conducted in FY 2014
320,900	Estimated number of people NSF supported directly in FY 2014 (researchers, postdoctoral fellows, trainees, teachers, and students)
49,800	Students supported by NSF Graduate Research Fellowships since 1952

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

ONGOING NSF-WIDE PRIORITIES

- Clean Energy: \$377 million
- Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS): \$257 million
- Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21): \$143 million
- Innovation Corps (I-Corps™): \$30 million
- NSF Research Traineeship (NRT): \$62 million
- Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS): \$33 million
- Science, Engineering, and Education for Sustainability (SEES): \$81 million
- Secure and Trustworthy Cyberspace (SaTC): \$124 million

NSF Funding Profile, FY 2014–FY 2016



FY 2016 PERFORMANCE GOALS

For FY 2016, NSF has set seven performance goals so that NSF can 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.

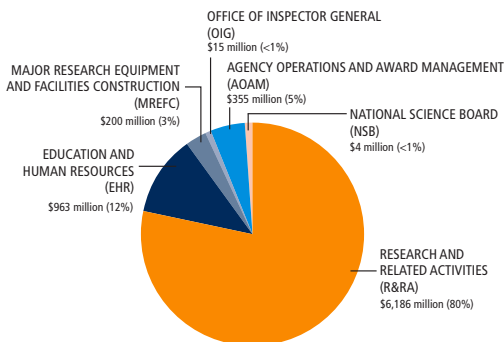
In FY 2016, NSF will perform strategic reviews and monitor the following goals.

Goal	Goal Statement
Ensure that Key Program Investments are on Track	Ensure that key FY 2016 NSF-wide program investments are implemented and on track.
Ensure that Infrastructure Investments are on Track	Ensure program integrity and responsible stewardship of major research facilities and infrastructure.
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 an Environment of Diversity and Inclusion	Foster an environment of diversity and inclusion while ensuring compliance with the agency's equal opportunity and civil rights programs.
Evaluate NSF Investments	Enable consistent evaluation of the impact of NSF investments with a high degree of rigor and independence.
Increase the Percentage of Wholly Virtual Panels	Increase the percentage of proposal review panels that are conducted wholly virtually while maintaining the quality of the merit review process.



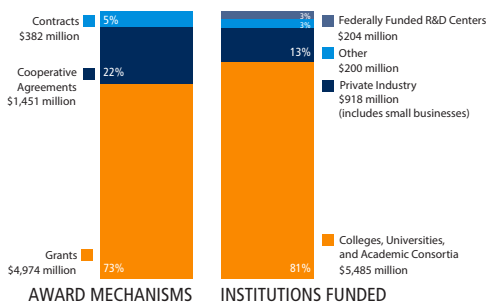
FOLLOWING THE MONEY

WHERE IT COMES FROM FY 2016 NSF Budget Request by Account—\$7,724 million



Note: Totals may not add due to rounding.

WHERE IT GOES AND HOW IT GETS THERE Obligations for Research and Education Programs—\$6,807 million



This chart shows the distribution of NSF's obligations by institution type and funding mechanism. While the data shown are based on FY 2014, the relative shares should provide a good indication of the FY 2016 distribution.

Note: NSF Research and Education Programs include Research and Related Activities, Education and Human Resources, and Major Research Equipment and Facilities Construction appropriations. Other institutions funded include federal, state, and local governments; nonprofit organizations; and international organizations.

For More Information:

NSF FY 2016 Budget Request to Congress

www.nsf.gov/about/budget

Research and Education Results Supported by NSF

www.nsf.gov/discoveries

NSF Budget and Performance

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/publications/pub_summ.jsp?ods_key=nsf14043

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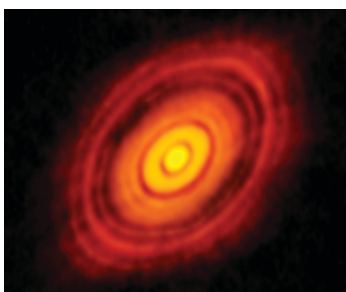
FIRS 800-877-8339 TDD 800-281-8749

www.nsf.gov

RESEARCH AND EDUCATION HIGHLIGHTS

ALMA Image of the Young Star HL Tau and its Protoplanetary Disk

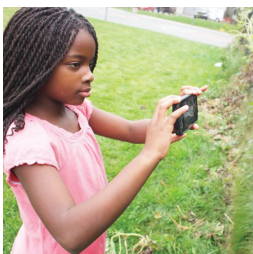
This image, taken recently with the Atacama Large Millimeter/Submillimeter Array (ALMA), shows a planetary system in the process of formation around a nearby young star called HL Tau. The multiple concentric rings are separated by dark gaps that herald the presence of emerging planets as they sweep their orbits clear of dust and gas. The existence of such well-delineated structures so early in the star's life is challenging our theories of star and planet formation. The image was obtained using only a 30-element subset of the full 66-antenna array as part of early science tests. With the relocatable antennas deployed at almost their maximum separation (15km apart) the spatial resolution is 5 au (1 au is the Earth-Sun distance) at the observing wavelength of 1.3mm.



Credit: ALMA (NRAO/ESO/NAOJ); C. Brogan, B. Saxton (NRAO/AUI/NSF)

New Media Model

"Plum Landing," created by WGBH in Boston, uses animations, games, a mobile app, videos, and hands-on activities to increase children's understanding of science and nature. Designed for kids aged 6 to 9, it introduces core science concepts and models key habits of mind scientists use when exploring the natural world. Since its debut last April, the website has garnered 8 million+ page views. Children also are exploring their environments — to date, they've submitted 70,000 photos and drawings.



Credit: Copyright Bill Shribman



Credit: Dr. Cang Ye, University of Arkansas at Little Rock

Seeing-Eye Robot

At the University of Arkansas at Little Rock, researchers prototyped a robotic walking stick for the blind. It has cameras to detect objects in the way such as chairs and stairs, an audio system that communicates to the user, and a computer that remembers recent pathways and objects in them. Developed under the National Robotics Initiative, a multi-agency program that includes NSF.



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



FY 2016
NOAA
Budget Summary

CONTENTS

Chapter 1	
Introduction	2
Chapter 2	
National Ocean Service	6
Chapter 3	
National Marine Fisheries Service	10
Chapter 4	
Office of Oceanic and Atmospheric Research	18
Chapter 5	
National Weather Service	24
Chapter 6	
National Environmental Satellite, Data, and Information Service	30
Chapter 7	
Program Support	38
Appendix 1	
Proposed Changes to General Provisions	44
Appendix 2	
Control Table	46

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Layout and Design: Marc Pulliam

From the Desk of Dr. Sullivan

Dear friends of NOAA,

NOAA is America's environmental intelligence agency. We provide timely, reliable, and actionable information—based on sound science—every day to millions of Americans. NOAA's products and services are used by decision makers around the country to better understand risk and prepare for the future. We're helping people, communities, businesses, and governments make smart decisions that directly impact the future of society, the economy, and the environment. The demand for products and services that NOAA provides continues to increase – from the daily weather forecast to seasonal drought outlooks, to decadal sea level rise projections, and much more.

NOAA's FY 2016 budget request of nearly \$6.0 billion supports critical investments in our priorities, including: 1) community and economic resilience; 2) National Weather Service (NWS) evolution; 3) observational infrastructure; and 4) organizational excellence.

Providing Information and Services to Make Communities More Resilient

The FY 2016 budget request will improve NOAA's ability to provide people, communities, businesses, and governments with information they can understand and use to make smart decisions, assess risk, and minimize losses. With the foresight provided through environmental intelligence, communities can mitigate coastal flooding through natural shorelines, fishery managers can better account for changing ocean temperatures and acidification, and different economic sectors can position themselves to take advantage of our changing climate. The proposed expansion of the Regional Coastal Resilience Grants program will empower states, territories, tribes, local governments, and public/private partners to improve resilience planning efforts, identify and address their shared risks and vulnerabilities, increase their adaptive capacity, and use tools such as "green infrastructure" to mitigate and minimize the risks associated with climate impacts.

Evolving NOAA's National Weather Service

Impacts from severe storms in the United States cost billions of dollars and claim thousands of lives per year. Becoming a Weather-Ready Nation means not just providing timely, accurate, and reliable weather forecasts, but it also means communicating that information in a way that compels people to act to protect themselves and their interests. The FY 2016 budget will continue efforts already underway to evolve the National Weather Service. Major activities in FY 2016 include overhauling the aging Next Generation Weather Radar infrastructure that underpins our weather forecast and warning services for high-impact events, such as tornadoes. In addition, this request builds on the FY 2015 initiative to improve national hydrologic modeling and forecast capabilities at the National Water Center, which are essential to providing communities improved flood forecasts and inundation mapping. The FY 2016 budget also includes an initiative to improve weather outlooks out to weeks three and four—a time period which is currently poorly forecasted and for which many economic sectors are demanding better insight into probable climate and economic conditions.

Investing in Observational Infrastructure

NOAA's global observing systems are the foundation of the environmental intelligence we provide. The FY 2016 budget includes critical investments in weather satellite systems and the NOAA fleet to preserve—and improve—our ability to generate environmental intelligence. The FY 2016 budget begins a Polar Follow On satellite system



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

to ensure data continuity for key sensors as the current generation of satellites reaches their end of service. The FY 2016 budget also initiates construction of an Ocean Survey Vessel (OSV), a multi-use platform designed to conduct surveys throughout the U.S. Exclusive Economic Zone. The OSV will have a more diverse range of capabilities and functions than other vessels in the NOAA fleet. Without continued investment, the NOAA fleet is expected to decline to half its current size by 2028, which would impair NOAA's ability to provide the observations and services that communities depend on.

Achieving Organizational Excellence

Each day, NOAA's employees strive to promote organizational excellence and execute our mission with discipline and consistency. We must recruit, retain, reward, and develop the best talent possible and ensure that our customers receive the best service possible. The FY 2016 budget continues critical investments in organizational excellence by bolstering our internal servicing capability and efficiency and investing in the future of NOAA's facilities. These services and facilities are the cornerstone of NOAA's ability to effectively execute its mission of science, service, and stewardship.

Conclusion

In closing, NOAA's FY 2016 budget submission supports our unique role within the federal government. The investments we make today are critical as we strive to provide the environmental intelligence communities have come to rely upon.

A handwritten signature in blue ink that reads "Kathy". The signature is stylized with a large, sweeping initial "K" and a long, horizontal flourish extending to the right.

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 2014 Spend Plan

Fiscal Year (FY) 2014 Consolidated Appropriations Act, 2014 (P.L. 113-76).

FY 2015 Enacted

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

Adjustments-to-Base

Includes the estimated FY 2016 federal civilian pay raise of 1.3 percent (and the estimated FY 2016 federal military pay raise of 1.3 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 2016 Base

FY 2015 Enacted plus Adjustments-To-Base.

Program Change

Requested increase or decrease over the FY 2016 Base.

FY 2016 Request

FY 2016 Base plus Program Changes.

Chapter 1 | Introduction



Sand dunes and natural vegetation provide critical protection for coastal communities.



In its Fiscal Year (FY) 2016 budget request, the National Oceanic and Atmospheric Administration (NOAA) makes targeted investments in the four agency priorities of Building Community and Economic Resilience, Evolving the National Weather Service (NWS), Improving Observational Infrastructure, and Achieving Organizational Excellence. In particular, this budget requests major initiatives to fortify the NOAA fleet via an Ocean Survey Vessel (OSV) and to advance next-generation polar satellite technology via the Polar Follow On. These investments provide at-sea and spaced-based data that are the foundation upon which the NOAA mission is built. For more information about specific FY 2016 investments, please refer to the following individual line office chapters or the tables in Appendix 2.

NOAA's budget directly aligns with the Environment goal within the Department's "Open for Business Agenda," which reflects Commerce's role as the voice of business and the Administration's focus on economic growth and job creation. Specifically, NOAA helps communities and businesses prepare for and prosper in a changing environment by providing crucial environmental information, products, and services. The budget provides approximately \$6.0 billion for NOAA, which will advance the Nation's ability to understand and anticipate changes in the Earth's environment, improve society's ability to make scientifically informed decisions, deliver vital services to bolster the economy and public safety, and conserve and manage ocean and coastal ecosystems and resources.

NOAA appreciates the support of Congress, the Administration, and its broad base of constituents in FY 2014 and FY 2015 and will continue to monitor major milestones and accomplishments related to its programs and activities in the current and future budget execution years. Below are some of NOAA's top accomplishments from 2014, which could not have been achieved without partners in the research, industry, and conservation communities, and in states and local communities:

Implemented High Resolution Rapid Refresh Model

On September 30, 2014, NOAA transitioned to operations the three kilometer High-Resolution Rapid Refresh (HRRR) severe weather forecast model. The HRRR better pinpoints neighborhood-sized threats such as tornadoes, heavy precipitation that can lead to flash flooding, and heavy snowfall, and provides advanced warnings so that residents can take precautions hours in advance. The HRRR model helps forecasters provide more information – and within a quicker time-

frame – to air traffic managers and pilots about hazards, such as air turbulence and thunderstorms. The model is run every hour out to 15 hours with a domain slightly larger than the Continental United States and has a spatial resolution four times finer than previous numerical models. NOAA's recent increase in super-computing capacity enabled the HRRR to better integrate radar data with traditional observations.

Removed 57 Tons of Marine Debris from World Heritage Site

In September-October 2014, a team of 17 NOAA divers operating from the *Oscar Elton Sette* removed 57 tons of marine debris consisting of derelict fishing nets and plastic litter from the Papahānaumokuākea Marine National Monument, a World Heritage Site and one of the largest marine conservation areas in the world. The divers worked out of small boats launched from the *Sette* systematically surveying coral reefs at Maro Reef, Pearl and Hermes Atoll, and Midway Atoll. NOAA has led this mission every year since 1996 and has removed a total of 904 tons of marine debris, including this year's haul. The nets are an entanglement hazard for monk seals, turtles and seabirds that depend on the shallow coral reef ecosystem for survival. They also break and damage corals as they drift through the currents, catching on anything in their path. Once they have settled, they can smother the corals and prevent growth.

Supported Response to Lake Erie Harmful Algal Bloom

NOAA scientists issued timely forecasts to aid in the response to a bloom of cyanobacteria that contaminated drinking water in Lake Erie on August 2nd, 2014. This event left nearly 400,000 people in Ohio without drinking water for two days. In response to requests from Ohio agencies, NOAA increased the frequency of Lake Erie Harmful Algal Bloom Bulletins from once to twice a week. These bulletins tracked the size and location of blooms and predicted their movement until the bloom season ended in the fall. The August 1st edition of the NOAA bulletin forecasted the intensification of this bloom and enabled Toledo to prepare for a potential hazard.

Continued to End Overfishing and Rebuild Nation's Fish Stocks

In April 2014, in its release of the *Status of U.S. Fisheries, 2013* report, NOAA announced continued progress in ending overfishing and rebuilding fish stocks. The report notes that NOAA removed seven more stocks from the overfishing list and four more stocks from the list of overfished stocks. Additionally, recent

assessments show that two stocks have been rebuilt, bringing the number of stocks rebuilt since 2000 to 34. Published at the same time, *Fisheries Economics of the United States, 2012* showed that the health of commercial and recreational fisheries overall continues to grow, supporting approximately 1.7 million jobs in 2012, up 100,000 from the previous year. This progress demonstrates the strength of the U.S. science-based management model under the Magnuson-Stevens Fishery Conservation and Management Act and underscores the importance of ending overfishing as a key to bolstering the health of the marine environment and coastal economies.

Awarded for Climate.gov Website

In June 2014, NOAA received two Webby wins for the agency's Climate.gov website. The Webby Award is the leading international award honoring excellence on the Internet. The site won in the Government and Green categories and was also selected as the People's Voice Award Winner in the Green category. Climate.gov includes news and information about climate trends, new science results, interactive maps, and learning resources and also supports the Administration's Climate Resilience Toolkit. The goals of the site are to promote public understanding of climate science and climate-related events, make NOAA's data products and services easy to access and use, and provide climate information and tools to local decision-makers.

Revealed Alaska Fisheries at risk from Ocean Acidification

NOAA, in collaboration with the University of Alaska, Bureau of Ocean Energy Management, and other partners, published a study that concluded that Alaska fisheries and communities in certain regions are at high risk from the effects of ocean acidification (OA). The study, "Ocean acidification risk assessment for Alaska's fishery sector," published on July 29, 2014 in *Progress in Oceanography*, showed that many of Alaska's economically valuable marine fisheries, such as red king crab and tanner crab, are located in waters with increasing OA. The economy and livelihood of communities in southeast and southwest Alaska are expected to be particularly vulnerable to these impacts due to their reliance on fisheries. The study recommends stakeholders develop response strategies to address this increasingly widespread environmental challenge.

Listed Threatened Coral Species under the Endangered Species Act

In August 2014, NOAA listed 20 species of coral as

threatened under the Endangered Species Act (ESA) to provide additional protections and enable the recovery of corals throughout the Pacific and Caribbean regions. To make these listing determinations, NOAA collected and analyzed an unprecedented amount of scientific data, including information on threats to coral ecosystems, such as climate change (e.g., rising ocean temperatures, ocean acidification, and disease), effects from fishing, and land-based sources of pollution (e.g., sedimentation and nutrient enrichment). NOAA is working with states, territories, and other partners on conservation measures and recovery strategies for the newly listed corals.

Provided Advanced Warnings for Record Cold during Winter "Polar Vortex" Incursion

NOAA accurately predicted the unusual jet stream pattern that occurred in January 2014, known as the "Polar Vortex," more than eight days in advance. The "Polar Vortex" produced the coldest and most persistent frigid temperatures across the central and eastern United States in 20 years. Nearly 180 million people across 20 states experienced dangerous wind chill levels. Along with the extreme cold, heavy snow and ice plagued much of the Midwest, with up to a foot of wind-driven snow falling from Missouri to Michigan. The effective advanced warnings enabled federal, state, local and commercial decision makers to take action. NOAA's weather warnings highlighted dangers from exposure, frozen pipes and indoor fire/carbon monoxide hazards in an attempt to educate the public and mitigate health and property risks from the cold. Although at least 10 people died as a direct result of the cold, NOAA warnings prevented greater calamity by ensuring that communities had the information they needed to take appropriate precautions.

Saved Lives with Cospas-Sarsat System

The international Cospas-Sarsat rescue network was inducted into the Space Foundation's Space Technology Hall of Fame in May 2014 at the 30th Space Symposium. The Search and Rescue Satellite Aided Tracking (SARSAT) system uses NOAA satellites in low-earth and geostationary orbits to detect and locate aviators, mariners, and land-based users in distress. The honor recognizes technologies originally developed for space applications that now improve life on Earth. In FY 2014, 203 people were rescued in the U.S. with the aid of the Cospas-Sarsat system.

Completed World Ocean Atlas

In February 2014, NOAA released the World Ocean Atlas (WOA) 2013. The WOA is a data product of NOAA's Ocean Climate Laboratory. First produced in 1994,



the WOA is a set of objectively analyzed climatological fields of in situ temperature, salinity, dissolved oxygen, Apparent Oxygen Utilization (AOU), percent oxygen saturation, phosphate, silicate, and nitrate at standard depth levels for annual, seasonal and monthly compositing periods for the World Ocean. After the sun, the ocean is the most important driver of weather and climate on the planet. The WOA is an indispensable tool that establishes a crucial baseline of comparison for scientists in their pursuit of understanding the impact of the ocean on the Earth's climate and environment.

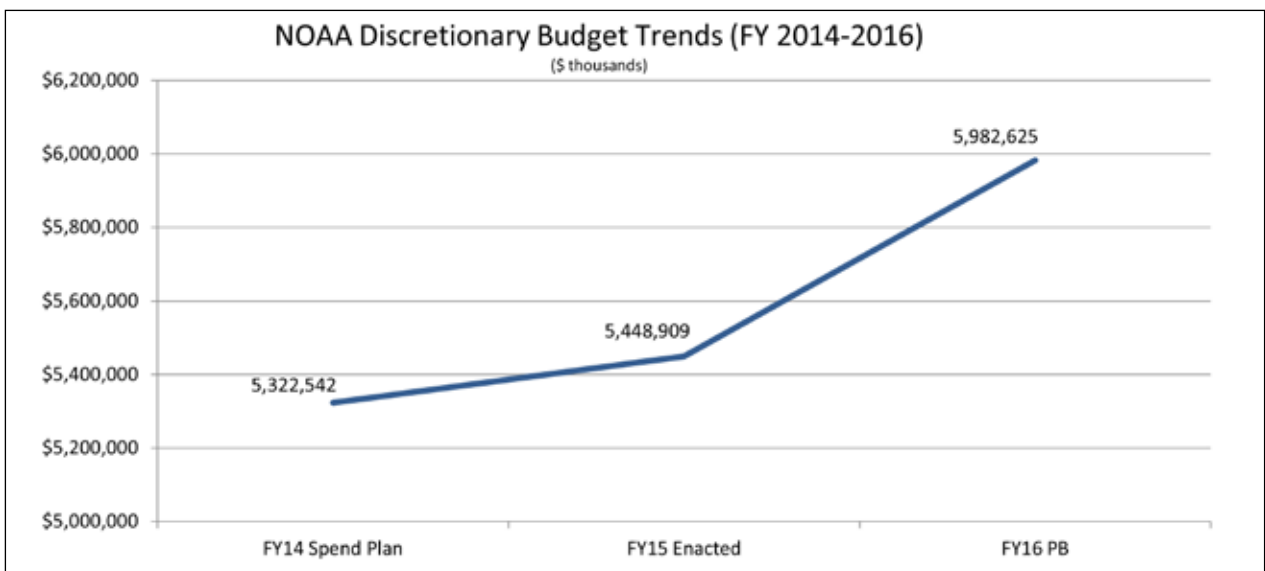
Launched First Unmanned Aircraft Directly into the Eye of a Hurricane

In September 2014, a NOAA WP-3D aircraft launched the first-ever successful release of the Coyote, an unmanned aircraft system (UAS), directly into the eye of Hurricane Edouard. Once deployed, the UAS proceeded into the highest wind region of the storm, known as the "eyewall." At an approximate altitude of 2,900 feet, the UAS penetrated Edouard's western eyewall and documented record-breaking winds of 100 kt. as it orbited this high wind region during its historic 28 minute mission. Such deployments of UAS provide unique and groundbreaking insights into a critical region of the storm environment that is typically difficult to observe in sufficient detail since they are too dangerous for manned aircraft. Because the Coyote can fly near the surface of the ocean where warm ocean water fuels a hurri-

cane, it will help provide vital information needed to better understand and predict hurricane intensity.

Opened the Inouye Regional Center in Oahu, Hawaii

From January-March 2014, NOAA moved into the \$158 million LEED Gold Inouye Regional Center facility and campus in Hawaii (official occupancy occurred on October 8th, 2014). This effort consolidated nearly all NOAA programs across Oahu (650 employees and equipment at 12 locations) into a government owned multi-building. NOAA initiated disposal actions for the former leased and owned properties and awarded a \$15 million design build contract for the Child Development Center, which is scheduled for completion in September 2015. This project has won two national awards for architecture and design, as well as a Hawaii historical society award.



FY 2014 Spend Plan includes \$75 million in Fisheries Disaster Assistance Funding.

Chapter 2 | National Ocean Service



Surveying the Arctic. In 2014, NOAA issued a new chart for the DeLong terminal serving Red Dog Mine in Alaska.



NOAA's National Ocean Service (NOS) observes, measures, assesses, and manages the Nation's coastal, ocean and Great Lakes areas; protects marine and coastal areas; provides critical navigation products and services (e.g., real time observations, nautical charts); and prepares for and responds to natural disasters and emergencies. The benefits of NOS' products and services include increased coastal economic activity, resilient coastal communities, and enhanced ecosystem services. In FY 2016 NOS is preparing for a future of higher intensity coastal storms, increased demands on the marine transportation system, changing sea levels leading to coastal flooding, and heightened offshore and coastal development.

FY 2016 REQUEST \$573,960,000

NOAA requests a total of \$573,960,000 in mandatory and discretionary funds to support the continued and enhanced operations of the NOS. This total includes Operations, Research, and Facilities (ORF); Procurement, Acquisition, and Construction (PAC); and other accounts and includes a net increase of \$59,419,000 in FY 2016 program changes. In FY 2016, NOS continues to make critical investments in products, services and capabilities that will improve the resilience of the Nation's coasts to immediate hazards and long-term risks.

FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$547,090,000 to support the Operations, Research, and Facilities of the NOS. This includes a net increase of \$59,419,000 in FY 2016 program changes.

ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

NAVIGATION, OBSERVATIONS, AND POSITIONING \$195,500,000

NOAA requests a total of \$195,500,000 under the Navigation, Observations, and Positioning sub-program. There are no program changes in this sub-program.

COASTAL SCIENCE AND ASSESSMENT \$85,600,000

NOAA requests a net increase of \$4,000,000 for a total of \$85,600,000 under the Coastal Science and Assessment sub-program. Highlights include:



Robert Mowery, a survey technician on research vessel Bay Hydro II, views the wreck of the (documented) schooner Herbert D. Maxwell, which was discovered by NOAA Coast Survey in the Chesapeake Bay.

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

Coastal Science, Assessment, Response, and Restoration: Arctic Spill Preparedness: NOAA requests an increase of \$1,300,000 to improve oil spill response capacity in the Arctic. Among other activities, this investment will enable: improvement of models to predict oil movement and weathering in ice-covered waters, identification of sensitive ecological resources, better coordination with and preparedness of local communities, and increased research to fill science gaps.

Coastal Science, Assessment, Response, and Restoration: Scientific Support and Emergency Preparedness: NOAA requests a decrease of \$1,300,000 to reflect the conclusion of training and preparedness activities at its Gulf of Mexico Disaster Response Center. NOAA will continue to maintain science support for response and restoration in the Gulf region.

OCEAN AND COASTAL MANAGEMENT AND SERVICES \$265,990,000

NOAA requests a net increase of \$55,419,000 for a total of \$265,990,000 under the Ocean and Coastal Management and Services sub-program. Highlights include:



Monohansett Shipwreck in Thunder Bay Sanctuary.

Coastal Management Grants: Regional Coastal Resilience Grants: NOAA requests an increase of \$45,000,000 to significantly expand the Regional Coastal Resilience Grant Program. This will allow NOAA to more fully address a broad suite of resilience challenges facing all U.S. coastal regions—including community, ecosystem, and economic resilience. The objectives of this enhanced Regional Coastal Resilience competitive grant program are twofold: 1) to increase the resilience of coastal communities and ecosystems by assisting with planning for and addressing extreme weather events, coastal inundation, climate hazards, changing ocean conditions, and competing uses; and 2) to support regional approaches that leverage existing re-

sources and efforts and promote collaboration across jurisdictions and sectors.

Coastal Zone Management and Services: Ecosystem-based Solutions for Coastal Resilience: NOAA requests an increase of \$5,000,000 to assist coastal communities with incorporating green infrastructure into hazard mitigation, resilient coastal development, and post-event rebuilding decisions. In this joint initiative with the National Marine Fisheries Service (NMFS), NOS will deliver practical actionable information to support regional- and community-level planning that incorporates both the technical ingenuity of built infrastructure and the sustainable, protective capacity of ecosystem-based infrastructure solutions. Activities will include economic valuation of ecosystem services, natural resource characterizations and decision support products that depict long-term benefits and tradeoffs of natural vs. built infrastructure solutions. (For more information on this joint initiative between NOS and NMFS, see p. 14 of Chapter 3).

Coastal Zone Management and Services: Capacity to Respond to Extreme Events: NOAA requests an increase of \$4,780,000 to provide products and services that help coastal communities prepare for, respond to, and recover more quickly from, natural disasters. Building off recovery efforts in communities impacted by recent major disasters, NOAA will extend its products and services to provide: enhanced real-time inundation observations; improved inundation modeling; targeted technical assistance; and training on risk communication strategies. This funding will mitigate inundation risk to coastal resources, and accelerate recovery from and adaptation to the impacts of extreme events and changing conditions.



Shoreline cleanup of thick surface and subsurface oil residue at Galveston Bay in April following the March 2014 Texas "Y" oil spill.



Coastal Zone Management and Services: AmeriCorps’ Resilience Corps Pilot Program Training and Technical Assistance: NOAA requests \$2,000,000 to develop and administer a training program for an AmeriCorps’ Resilience Corps Pilot Program, which will be managed by the Corporation for National and Community Service, a Federal agency that engages American citizens in service through its core programs, such as AmeriCorps, and is the Nation’s largest grant maker for service and volunteering. With this investment, NOAA will train this new AmeriCorps unit to support communities and tribes in: developing vulnerability assessments, coordinating with Federal resilience efforts, and implementing resilience strategies.

Sanctuaries and Marine Protected Areas: NOAA requests a decrease of \$1,361,000 to sanctuary operations, including reductions to scalable activities such as vessel operations within the National Marine Sanctuary System. At this level, NOAA will continue to fund mission critical functions and support continued implementation of management plans across the Sanctuary System.

FY 2016 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 2015 Enacted level. These funds support the National Estuarine Research Reserve System (NERRS) Construction and Land Acquisition Program and the National Marine Sanctuaries Construction Program.

MANDATORY FUNDS

Damage Assessment and Restoration Revolving Fund

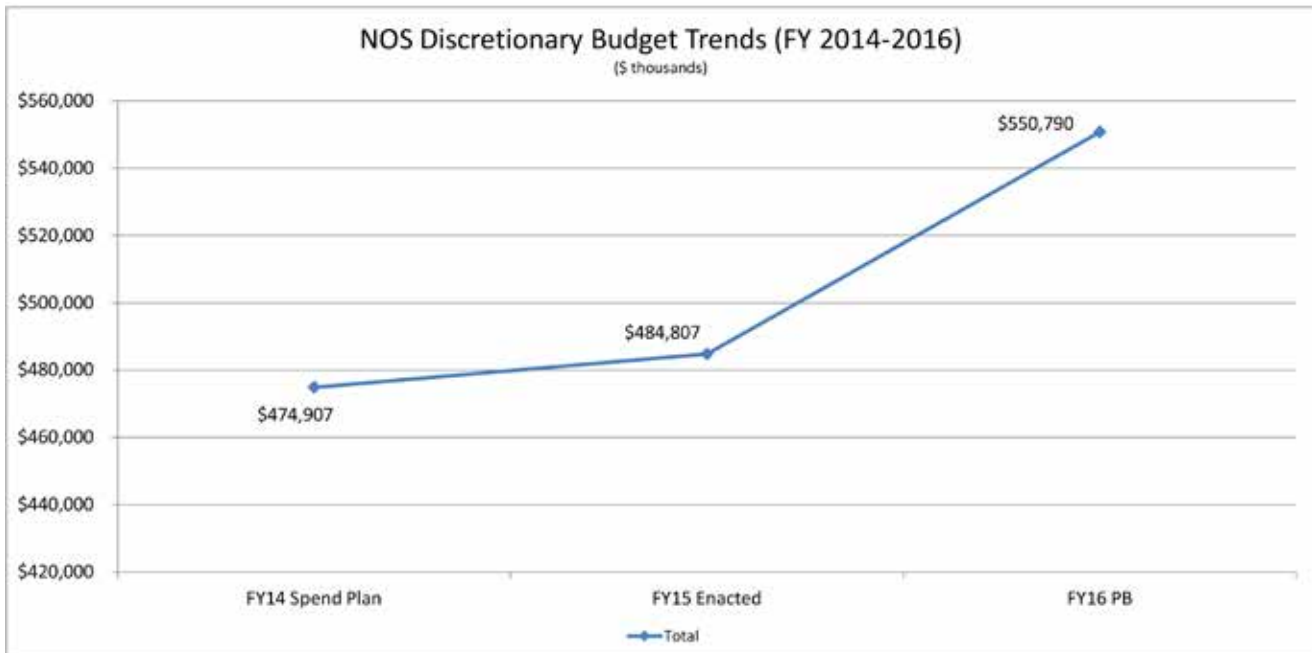
The Damage Assessment and Restoration Revolving Fund was established in 1990 under Section 1012(a) of the Oil Pollution Act to facilitate (1) natural resources damage assessments, and (2) restoration, replacement, or acquisition of injured or lost natural resources, including resources of National Marine 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 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



Killer whales travel in their family group for most of their lives. This family group includes a two-year-old calf (second from top), and a young-of-the-year (middle). Photo Credit: NOAA, Vancouver Aquarium.



NOAA's National Marine Fisheries Service (NMFS) serves the Nation through a science-based approach to the conservation and management of living marine resources and the promotion of sustainable commercial fisheries and healthy coastal and marine ecosystems. As of December 31, 2014, NMFS manages 469 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 2016 REQUEST \$990,121,000

NOAA requests a total of \$990,121,000 in mandatory and discretionary funds to support the continued and enhanced operations of NMFS. This total includes Op-

erations, Research, and Facilities (ORF) and other accounts, including the Pacific Coastal Salmon Recovery Fund, and is composed of a net increase of \$54,987,000 in FY 2016 program changes.

In addition to a number of program-related changes, NMFS proposes to restructure its ORF budget Programs, Projects and Activities (PPA) in FY 2016 to improve the coordination and collaboration among activities that service its interwoven missions and mandates. This restructure will better align NMFS' budget to its programmatic and organizational needs, and will provide increased transparency and accountability. Please see the chart below for a detailed crosswalk of the budget line restructure.

Proposed NMFS Budget Restructure (ORF)

CURRENT SUB-PROGRAM	CURRENT PPA	PROPOSED SUB-PROGRAM	PROPOSED PPA
Protected Species Research and Management	Protected Species Research and Management Programs	Protected Resources Science and Management	Marine Mammals, Sea Turtles and Other Species
Protected Species Research and Management	Species Recovery Grants	Protected Resources Science and Management	Marine Mammals, Sea Turtles and Other Species
Protected Species Research and Management	Marine Mammals	Protected Resources Science and Management	Marine Mammals, Sea Turtles and Other Species
Protected Species Research and Management	Marine Turtles	Protected Resources Science and Management	Marine Mammals, Sea Turtles and Other Species
Protected Species Research and Management	Other Protected Species (Marine Fish, Plants, and Invertebrates)	Protected Resources Science and Management	Marine Mammals, Sea Turtles and Other Species
Protected Species Research and Management	Atlantic Salmon	Protected Resources Science and Management	ESA Salmon
Protected Species Research and Management	Pacific Salmon	Protected Resources Science and Management	ESA Salmon
Fisheries Research and Management	Fisheries Research and Management Programs	Protected Resources Science and Management/Fisheries Science and Management/Habitat Conservation and Restoration	Marine Mammals, Sea Turtles and Other Species; Fisheries and Ecosystem Science Programs and Services; Fisheries Management Programs and Services; Habitat Management and Restoration
Fisheries Research and Management	National Catch Share Program	Fisheries Science and Management	Fisheries Management Programs and Services
Fisheries Research and Management	Expand Annual Stock Assessments - Improve Data Collection	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments
Fisheries Research and Management	Economics & Social Sciences Research	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Fisheries Research and Management	Salmon Management Activities	Fisheries Science and Management	Salmon Management Activities
Fisheries Research and Management	Regional Councils and Fisheries Commissions	Fisheries Science and Management	Regional Councils and Fisheries Commissions

continued on next page

Proposed NMFS Budget Restructure (ORF)

CURRENT SUB-PROGRAM	CURRENT PPA	PROPOSED SUB-PROGRAM	PROPOSED PPA
Fisheries Research and Management	Fisheries Statistics	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments
Fisheries Research and Management	Fish Information Networks	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments
Fisheries Research and Management	Survey and Monitoring Projects	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments; Habitat Management and Restoration
Fisheries Research and Management	Fisheries Oceanography	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Fisheries Research and Management	American Fisheries Act	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments; Fisheries Management Programs and Services
Fisheries Research and Management	Interjurisdictional Fisheries Grants	Fisheries Science and Management	Regional Councils and Fisheries Commissions
Fisheries Research and Management	National Standard 8	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Fisheries Research and Management	Reducing Bycatch	Fisheries Science and Management	Observers and Training; Fisheries Management Programs and Services
Fisheries Research and Management	Product Quality and Safety	Fisheries Science and Management	Fisheries Management Programs and Services
Enforcement & Observers/Training	Enforcement	Enforcement	Enforcement
Enforcement & Observers/Training	Observers/Training	Fisheries Science and Management	Observers and Training
Habitat Conservation & Restoration	Sustainable Habitat Management	Habitat Conservation and Restoration	Habitat Management and Restoration
Habitat Conservation & Restoration	Fisheries Habitat Restoration	Habitat Conservation and Restoration	Habitat Management and Restoration
Other Activities Supporting Fisheries	Antarctic Research	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Other Activities Supporting Fisheries	Aquaculture	Fisheries Science and Management	Fisheries Management Programs and Services
Other Activities Supporting Fisheries	Climate Regimes & Ecosystem Productivity	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Other Activities Supporting Fisheries	Computer Hardware and Software	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Other Activities Supporting Fisheries	Cooperative Research	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments
Other Activities Supporting Fisheries	Information Analyses & Dissemination	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Other Activities Supporting Fisheries	Marine Resources Monitoring, Assessment & Prediction Program	Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments
Other Activities Supporting Fisheries	National Environmental Policy Act (NEPA)	Protected Resources Science and Management; Fisheries Science and Management	Marine Mammals, Sea Turtles and Other Species; Fisheries Management Programs and Services
Other Activities Supporting Fisheries	NMFS Facilities Maintenance	Fisheries Science and Management	Fisheries and Ecosystem Science Programs and Services
Other Activities Supporting Fisheries	Regional Studies	Protected Resources Science and Management; Fisheries Science and Management	Fisheries Data Collections, Surveys, and Assessments; Habitat Management and Restoration



FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$888,236,000 to support the Operations, Research, and Facilities of NMFS, composed of a net increase of \$51,687,000 in FY 2016 program changes.

ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

PROTECTED RESOURCES SCIENCE AND MANAGEMENT \$214,211,000

NOAA requests a net increase of \$29,622,000 in FY 2016 program changes in the Protected Resources Science and Management sub-program for a total of \$214,211,000. Highlights include:

Marine Mammals, Sea Turtles and Other Species: Increase Consultation Capacity, ESA recovery: NOAA requests an increase of \$13,230,000 to build consultation and permitting capacity mandated by sections 7 and 10 of the Endangered Species Act (ESA) and sections 104 and 101(a)(5) of the Marine Mammal Protection Act (MMPA). With this increased capacity, NOAA will promote species recovery while enabling sustainable economic activity, both of which contribute to community resilience. Specifically, this increase will enable NMFS to reduce the current consultation backlog and expedite permitting and review of public and private development projects that benefit the Nation's economy and create new jobs. NMFS will use \$3,230,000 of the total increase amount to work with private, state, territorial and other governmental entities to ensure that their actions can be conducted in a manner that enables the recovery of ESA listed corals.

Marine Mammals, Sea Turtles and Other Species: Species Recovery Grants: NOAA requests an increase of \$17,000,000 for the Species Recovery Grants Program, which provides funding to states and tribes to conduct recovery actions for species listed under the ESA. Expanding this competitive grants program will help our partners meet management needs for the growing number of listed species and focus on larger scale, ecosystem-level or multi-state/region projects that have a greater impact on the recovery of listed species. Past recovery actions include assessing and monitoring species status and trends, minimizing bycatch of listed species, conserving habitat, and educating and engaging the public in conservation actions.



Atlantic sturgeon research funded by a Species Recovery Grant under Section 6 of the ESA. Photo Credit: University of Georgia

Marine Mammals, Sea Turtles and Other Species: Prescott Grants: NOAA requests a decrease of \$1,909,000 for the John H. Prescott Marine Mammal Rescue Assistance Grant Program. NOAA will continue to award competitive grants to stranding network organizations for the rescue, rehabilitation, or investigation of sick, injured, or distressed live marine mammals and for determining the cause of death or disease in dead marine mammals. NOAA will continue to coordinate technical and veterinary assistance and guidance to the stranding network.

ESA Salmon: Atlantic and Pacific Salmon: NOAA requests an increase of \$1,301,000 for ESA salmon recovery. Under this proposal, NOAA will enhance support for a number of activities related to the Maine Department of Marine Resources Atlantic salmon research and management program, such as monitoring changes following dam removals and improving fish passage engineering. NOAA will also expand Pacific salmon monitoring capabilities and increase ESA Section 7 consultation capacity on the West Coast to improve our on-time consultation completion rate in support of the regional economy.

FISHERIES SCIENCE AND MANAGEMENT

\$546,122,000

NOAA requests a net increase of \$17,544,000 in FY 2016 program changes in the Fisheries Science and Management sub-program for a total of \$546,122,000. Highlights include:

Fisheries and Ecosystem Science Programs and Services: Electronic Monitoring and Reporting: NOAA requests an increase of \$5,596,000 for Electronic Monitoring and Reporting. This increase will support the development, testing, and installation of electronic monitoring and reporting technologies across the country. The goal is to deliver cost-effective and sustainable electronic data collection solutions that enhance monitoring of catch and bycatch in U.S. fisheries.

Fisheries and Ecosystem Science Programs and Services: Ecosystem-based Solutions for Fisheries Management: NOAA requests an increase of \$5,000,000 for the NMFS component of this integrated, cross-disciplinary, and cross-line office scientific initiative that will promote understanding of the importance of inshore and offshore habitat to the productivity and recovery of fisheries and protected species. Working through the NOAA Habitat Conservation Team, NMFS and NOS will implement this program jointly. For more information on this joint initiative, please see p. 8, Chapter 2.

Fisheries Data Collections, Surveys, and Assessments: Expand Annual Stock Assessments: NOAA requests an increase of \$2,815,000 to address critical gaps in its stock assessment program and strengthen its stock assessment capacity in each region. This funding will also enable NMFS to expand implementation of the Next Generation Stock Assessment framework, which incorporates ecosystem factors affecting key fish stocks (e.g., climate, habitat) into stock assessments wherever

needed and uses advanced technologies to better inform fishery management.

Fisheries Management Programs and Services: Management and Regulatory Support for Electronic Technologies: NOAA requests an increase of \$1,450,000 to establish the regulatory framework needed to integrate electronic technologies into fishery-dependent data collection. As electronic monitoring pilot projects are completed, NOAA and the Fishery Management Councils will have a clearer picture of how the increased use of these technologies will work in practice, and what steps are needed to implement changes in the fishery management regulations. The final step of integrating successful pilot project results into the management framework is necessary for electronic monitoring solutions to provide timely and cost efficient data.

Fisheries Management Programs and Services: National Catch Share Program: NOAA requests an increase of \$2,216,000 to develop and implement new catch share programs. The implementation of catch share programs can yield efficiencies that lower fisheries management costs and increase the profitability of fisheries over time.

Fisheries Management Programs and Services: Support for Domestic Seafood Production and Jobs through Aquaculture: NOAA requests an increase of \$2,000,000 to conduct research and regulatory activities that support safe and sustainable aquaculture development. This funding will increase the U.S. seafood supply and will create jobs and increase trade opportunities by further developing a robust and sustainable U.S. marine aquaculture industry. This effort is in cooperation with the Office of Oceanic and Atmospheric Research (OAR) and their aquaculture programs and proposed budget initiative (see p. 21, Chapter 4).



Finfish aquaculture has high potential to contribute to the domestic supply of safe and sustainable seafood.



NOAA's efforts to restore marshland and set back dikes on the Skagit River, WA are helping to protect neighboring farmland and roads from flooding while also improving fish access to new and existing habitat. Photo Credit: Marlin Greene/One Earth Images

Salmon Management Activities: NOAA requests a decrease of \$2,896,000. At the requested level, NOAA will provide \$15,922,000 to continue support of Mitchell Act hatchery reforms to bring the programs into compliance and consistency with the Endangered Species Act. NMFS will continue to meet its obligations under the Mitchell Act by supporting the operations and maintenance of Columbia River hatcheries.

ENFORCEMENT \$70,018,000

NOAA requests a net increase of \$3,850,000 in FY 2016 program changes in the Enforcement sub-program for a total of \$70,018,000. Highlights include:

Enforcement: Leveling the Playing Field for U.S. Fisherman – Combating Illegal, Unreported and Unregulated Fishing and Seafood Fraud: NOAA requests an increase of \$3,000,000 to strengthen efforts to detect and deter Illegal, Unreported and Unregulated (IUU) fishing and enforce restrictions on imports of illegally-harvested and improperly-documented seafood. These efforts will enhance international cooperation and help block the entry of IUU-caught fish into the stream of commerce and, ultimately, into the U.S. market.

HABITAT CONSERVATION AND RESTORATION \$57,885,000

NOAA requests a net increase of \$671,000 in FY 2016 program changes in the Habitat Conservation and Restoration sub-program for a total of \$57,885,000. Highlights include:

Habitat Management and Restoration: Increase Consultation and Essential Fish Habitat Implementation Capacity: NOAA requests an increase of \$5,671,000

to build capacity for Magnuson-Stevens Act (MSA) Essential Fish Habitat (EFH) consultations. With increased capacity, NOAA will reduce delays and streamline permitting and review timeframes for public and private development projects that benefit the Nation's economy and create new jobs.

Habitat Management and Restoration: Coastal Resiliency Ecosystem Grants: NOAA requests a decrease of \$5,000,000 for coastal resiliency ecosystem grants funded under this budget line to consolidate funds for this activity in FY 2016 with the National Ocean Service's request for an expanded Regional Coastal Resilience Program (see p. 8, Chapter 2). NOS is requesting a total of \$50,000,000 to expand the Regional Coastal Resilience grants program, which will allow NOAA to more fully address a broad suite of resilience challenges facing all U.S. coastal regions—including community, ecosystem, and economic resilience. The objectives of this enhanced Regional Coastal Resilience competitive grant program are twofold: 1) to increase the resilience of coastal communities and ecosystems by assisting with planning for and addressing extreme weather events, coastal inundation, climate hazards, changing ocean conditions, and competing uses; and 2) to support regional approaches that leverage existing resources and efforts and promote collaboration across jurisdictions and sectors.

DISCRETIONARY FUNDS

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



North Pacific Long Line electronic monitoring (EM) is a tool to monitor bycatch on Pacific halibut longline vessels on standard Alaska Fisheries Science Center Observer sampling trips.

Continental Shelf. 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. EEZ (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 re-financing for the construction, reconstruction, reconditioning, or the purchasing of fishing vessels, shoreside processing, aquaculture, mariculture facilities, or individual fishing quota. The FY 2016 President's Request includes up to \$24,000,000 in obligations for Individual Fishing Quota direct loans and up to \$100,000,000 in obligations of traditional direct loans. Additionally, as required under Section 3095 of the 2015 National Defense Authorization Act and section 504(b) of the Federal Credit Reform Act (FCRA), the Budget requests \$10,000,000 to cover the estimated loss to the government from the reduced payments received under the new loan terms compared with the current payments for the Pacific Coast Groundfish Fishing Capacity Reduction Loan. The Budget also requests \$300,000 for the subsidy cost to refinance the loan of up to \$30,000,000 for a total of \$10,300,000 in FY 2016.

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 2016 President's Request includes \$58,000,000 for this account which is \$7,000,000 below the enacted level in FY 2015. In 2016 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.

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."



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 ENFORCEMENT 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.

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

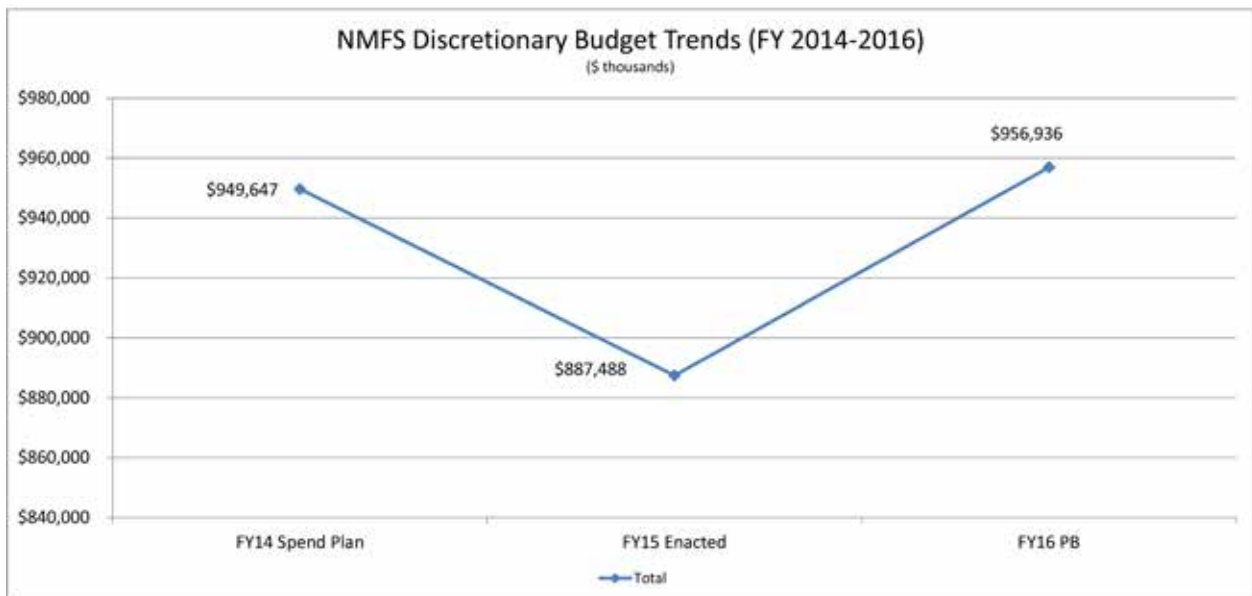
Under the authority of the MSA Section 304(d)(2)(A), NMFS must collect a fee to recover incremental costs of management, data collection, and enforcement of Limited Access Privilege programs. Fees are deposited into the Limited Access System Administration Fund. Fees shall not exceed three percent of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

NORTH PACIFIC OBSERVER FUND

The restructured 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.



FY 2014 Spend Plan includes \$75 million in Fisheries Disaster Assistance Funding.

Chapter 4 | Office of Oceanic and Atmospheric Research



Increasing acidity in the oceans might increase the growth of harmful algal species such as *Pseudo-nitzschia* and *Alexandrium*.



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 2016 REQUEST \$507,035,000

In FY 2016, NOAA requests a total of \$507,035,000 to support the continued and enhanced operations of OAR. OAR's FY 2016 request supports its activities to 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 \$ 54,126,000 in FY 2016 program changes.

FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$484,656,000 to support the Operations, Research and Facilities for OAR, composed of a net increase of \$45,126,000 in FY 2016 program changes.

ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

CLIMATE RESEARCH \$188,760,000

NOAA requests a net increase of \$29,231,000 in FY 2016 program changes in the Climate Research sub-program for a total of \$188,760,000. Highlights include:

Climate Laboratories and Cooperative Institutes: U.S. Global Change Research Program: NOAA requests an increase of \$3,440,000 to implement 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; and marine ecosystem "tipping points." Improved observations and understanding associated with these priority research areas are critical to promoting community resilience in a changing climate.

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 build upon its Atmospheric Baseline Observatories, Global Reference Networks for atmospheric composition, and the North American Carbon Observation and Analysis System to deliver policy-relevant information on the full suite of greenhouse gas emissions, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and the full suite of chlorofluorocarbon (CFC) replacements.

Climate Laboratories and Cooperative Institutes: Atmospheric Baseline Observatories: NOAA requests an increase of \$3,000,000 to continue data records collected at Atmospheric Baseline Observatories (ABOs). ABOs document trends and distributions of atmospheric constituents influencing global climate, ozone depletion, and changes in baseline air quality. With this proposed investment, NOAA will be able to continue full operations at all six ABOs, which are at risk due to the



The South Pole Observatory is one of six Atmospheric Baseline Observatories (ABOs) that are stationed from north to south, covering the hemispheric scale. The ABOs are critical to documenting trends and distributions of atmospheric constituents including global climate, ozone depletion, and changes in baseline air quality.

combination of rising costs at remote sites and a decline in support from the National Science Foundation.

Regional Climate Data and Information: Assessments: NOAA requests an increase of \$3,970,000 to support climate assessments at national and regional scales in compliance with The Global Change Research Act of 1990. The Act requires the President (through a federal interagency body) to prepare and submit to Congress regular climate assessments that examine the latest climate research, uncertainty, effects of global change, and emerging trends.

Regional Climate Data and Information: Regional Integrated Sciences and Assessments: NOAA requests an increase of \$5,852,000 to expand its regional research and information services and competitive grants to manage climate risks in two additional regions – the Mid-Atlantic and the Midwest. For example, a Regional Integrated Sciences and Assessment (RISA) team could help Mid-Atlantic coastal communities prepare for and respond to coastal flooding from storms, such as Hurricane Sandy. A Midwest RISA could help farmers cope with the effects of drought and flooding in the Missouri River basin.

Regional Climate Data and Information: NOAA Arctic Research Program - Arctic Observing Network: NOAA requests an increase of \$2,190,000 to support further development of NOAA's Arctic Observing Network and 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 support continued development of a Climate Resilience Toolkit (CRT), which will provide public online access to actionable climate data, information, and tools to help communities plan for impacts of climate change. Specifically, NOAA will work with relevant agencies to improve the CRT, which will include a more intuitive and user-friendly interface for access to climate data, information and tools across the federal government, as well as a climate literacy learning center for formal and informal educators.

Climate Competitive Research: Impacts of Climate on Fish Stocks: NOAA requests an increase of \$5,504,000 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 investment will develop valuable information, decision-support tools, and training to build



Eric Moglia, of NOAA's Cooperative Institute for Research in Environmental Sciences, pumps air from sampling flasks to test them for leaks before preparing them for shipment to some 80 sites around the world. Photo Credit: Willfred von Dauster, NOAA

capacity for the integration of climate information into fisheries management. Enhancing early-warning and management of the impacts of climate variability and change will help minimize economic disruption for the many communities, citizens, and livelihoods across the Nation that depend on healthy fisheries.

WEATHER & AIR CHEMISTRY RESEARCH \$97,340,000

NOAA requests a net increase of \$4,612,000 in FY 2016 program changes in the Weather & Air Chemistry Research sub-program for a total of \$97,340,000. Highlights include:

U.S. Weather Research Program: Improving the Airborne Detection and Understanding of Severe Weather: NOAA requests an increase of \$5,000,000 to research and develop aircraft-based hazardous weather observing systems to generate improved information about severe storms (e.g., hurricanes) for more accurate public warnings and forecasts in order to help strengthen the Nation's climate resiliency. Specifically, this investment will help NOAA and its partners develop an aircraft-based dual-polarization phased array radar system capable of doubling the amount of storm detail that can currently be gathered.

U.S. Weather Research Program: Research to Improve Mid-Range Operational Weather Outlooks: NOAA requests \$3,936,000 to begin a collaborative effort between OAR and NWS to improve the accuracy of weather outlooks out to three to four weeks (i.e., in the



Tending oyster aquaculture longlines in New England. NOAA is partnering on pilot projects to train commercial fishermen on aquaculture techniques.

“mid-range”), 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. Addressing this challenge will require a sustained scientific research and research-to-operations effort. For more information on this joint initiative between OAR and NWS, see p. 26 in Chapter 5.

Weather and Air Chemistry Laboratories and Cooperative Institutes: Warn-On Forecast: NOAA requests an increase of \$1,730,000 to accelerate implementation of forecasting capabilities to improve the accuracy of warnings, extend lead times, and enhance decision support services for high impact weather, like tornados and flash floods, critical for building a Weather-Ready Nation. The requested funding will accelerate the research, development, and transition into operations of a prototype Warn-on-Forecast modeling system for high-impact weather. This is intended to help NOAA extend average tornado warning lead times beyond current targets.

Weather and Air Chemistry Laboratories and Cooperative Institutes: Vortex-Southeast: NOAA requests a decrease of \$5,542,000 to terminate the Vortex-SE project in FY 2016. NOAA was provided funding in the Consolidated and Further Continuing Appropriations Act, 2015 to initiate this project to understand how environmental factors that are characteristic of the south-eastern United States affect the formation, intensity,

and storm path of tornadoes in this region.

OCEAN, COASTAL, AND GREAT LAKES RESEARCH \$186,412,000

NOAA requests a net increase of \$11,180,000 in FY 2016 program changes in the Ocean, Coastal, & Great Lakes sub-program for a total of \$186,412,000. 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, while continuing to support a competitive process open to NOAA laboratories and Cooperative Institutes, but will reduce the funding available for ongoing development, testing, and evaluation activities.

National Sea Grant College Program: National Sea Grant College Program Base: NOAA requests a decrease of \$1,431,000 to reduce the amount of research funding available for competitively awarded projects.

National Sea Grant College Program: Marine Aquaculture Program: NOAA requests an increase of \$2,500,000 to provide competitive grants to support aquaculture research, extension activities, and tech-

nology transfer to develop a sustainable aquaculture industry. Domestic marine aquaculture is poised to emerge as a significant provider of seafood and coastal jobs over the next several years. This initiative dovetails with NMFS' increase of \$2,000,000 to facilitate efficient and effective permitting in support of a sustainable aquaculture industry. For more information on this joint initiative between OAR and NMFS, see p. 14 in Chapter 3.

Ocean Exploration and Research Program: Ocean Exploration: NOAA requests a decrease of \$8,780,000 to reduce the number of days for the Extended Continental Shelf mapping effort and decrease the number of missions for the *EV Nautilus* program and the *Okeanos Explorer*.

Integrated Ocean Acidification Program: Integrated Ocean Acidification: NOAA requests an increase of \$21,422,000 to improve understanding of the impacts of ocean and coastal acidification and to develop tools and adaptive strategies for affected industries and stakeholders, such as the U.S. shellfish industry. This investment will allow NOAA to develop advanced technologies, enhance the U.S. Ocean Acidification Observing System, develop models to better understand carbonate chemistry dynamics and impacts, and provide valuable data and products for coastal resource managers and other stakeholders.

FY 2016 PAC Budget Summary

NOAA requests a total of \$22,379,000 to support Procurement, Acquisition, and Construction activities of

the Office of Oceanic and Atmospheric Research, composed of a net increase of \$9,000,000 in FY 2016 program changes.

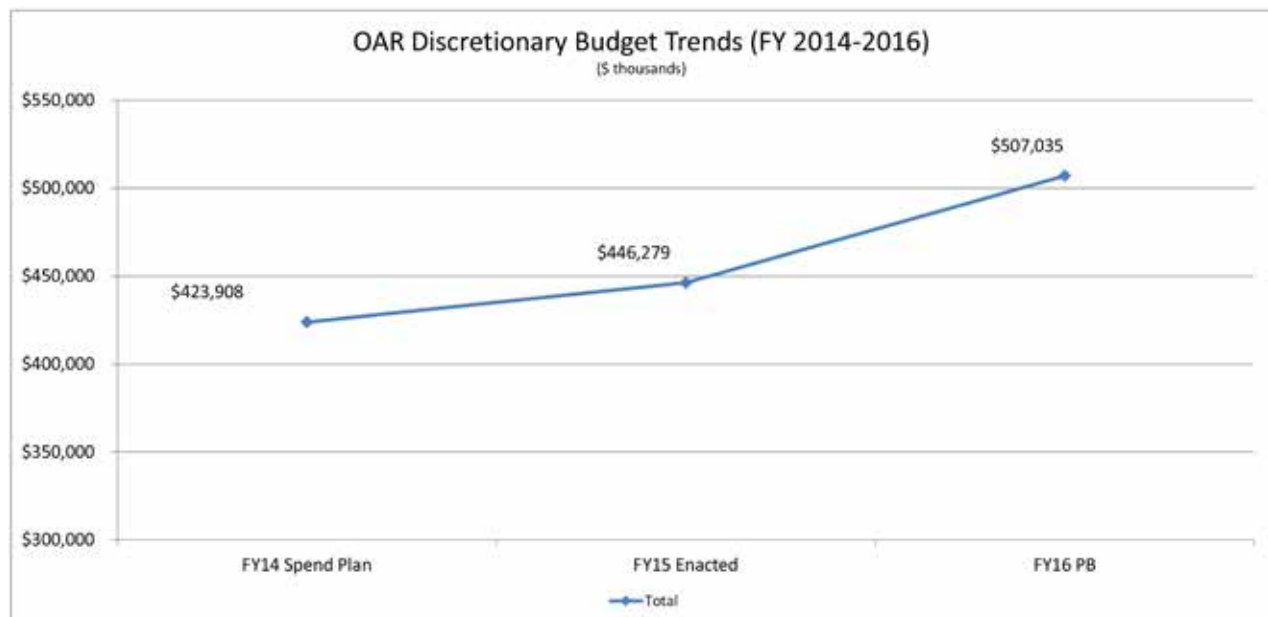
PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

SYSTEMS ACQUISITION \$22,379,000

NOAA requests a net increase of \$9,000,000 in FY 2016 program changes in the Systems Acquisition sub-program for a total of \$22,379,000. Highlights include:

Research Supercomputing: High Performance Computing Software Engineering: NOAA requests an increase of \$9,000,000 to begin recapitalization of the Research and Development High-Performance Computing (HPC) systems (i.e., Gaea) located at Oak Ridge National Laboratory in Oak Ridge, Tennessee and to establish a permanent source of funding that would allow NOAA to maintain regular refresh and recapitalization of supercomputing resources. A portion of the increase would be used to provide additional HPC capacity to support regional sea level rise modeling.





Remotely Operated Vehicle being deployed from NOAA Ship *Reuben Lasker*. Photo Credit: Paul Hillman.

Chapter 5 | National Weather Service



This image taken by the GOES-12 satellite on Saturday, October 17, 2009 shows Hurricane Rick as a Category Five hurricane with maximum sustained winds of 180 mph. With these winds Rick became the second most powerful hurricane on record in the Eastern Pacific behind Hurricane Linda in 1997.



NOAA's National Weather Service (NWS) provides weather, water, and climate forecasts and warnings for the protection of life and property and enhancement of the national economy. NWS is the official and authoritative U.S. voice for issuing warnings during life-threatening weather situations. 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 database.

FY 2016 REQUEST \$1,098,878,000

In FY 2016, NOAA requests a total of \$1,098,878,000 to support NWS' advancements to weather, water, and climate products and services 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 is composed of a net decrease of \$7,918,000 in FY 2016 program changes.

FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$963,563,000 to support ORF activities of the NWS, composed of a net decrease of \$12,933,000 in FY 2016 program changes.

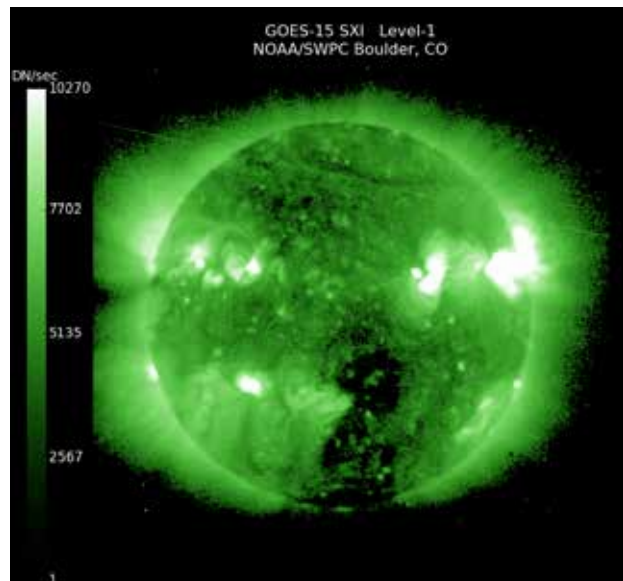
ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

OBSERVATIONS \$204,876,000

NOAA requests a net decrease of \$7,633,000 in FY 2016 program changes for a total of \$204,876,000 in the Observations sub-program. Highlights include:

Observations: Radiosonde Supply: NOAA requests an increase of \$1,014,000 to fully fund the acquisition cost of radiosondes for twice daily launches at all 102 NWS Upper Air observing stations. Radiosondes provide atmospheric profiles of pressure, temperature, relative humidity, and winds. These data are critical inputs for weather prediction models and NWS forecaster operations supporting severe storm, aviation and marine forecasts; and climate and other research uses. In ad-



An X-ray image of the Sun captured by a NOAA satellite. Three successive coronal mass ejections (CMEs) exploded from a bright region near the far right.

dition to these requested funds, in FY 2016, NWS proposes to transfer the Radiosonde Replacement System from PAC to ORF to consolidate all radiosonde acquisition within the ORF Observations PPA.

Observations: Space Weather Observations: NOAA requests an increase of \$1,000,000 to support annual operating costs associated with the use of the Global Oscillations Network Group (GONG) data for space weather prediction. Data from the GONG's six ground based observatories are a critical input to NOAA's Space Weather Prediction Center (SWPC) solar wind models, which provide advanced warning of earth directed Coronal Mass Ejections that cause geomagnetic storms.

Observations: National Mesonet Program: NOAA requests a decrease of \$10,500,000 for the National Mesonet Program to restore funding to the amount included in the FY 2015 President's Budget. NOAA will continue to administer the National Mesonet Program and is using FY 2015 funding to continue to ingest data from mesonets, which can identify small scale features at the 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 \$87,902,000

NOAA requests a net decrease of \$10,100,000 in FY 2016 program changes for a total of \$87,902,000 in the Central Processing sub-program. Highlights include:



NWS Incident Meteorologist supporting New York City emergency services.

Central Processing: Establishment of Regional Enterprise Application Development and Integration Teams:

NOAA requests a decrease of \$10,100,000 to reflect efficiencies achieved by transitioning to a new information technology (IT) service delivery model for forecast offices through remote software support. 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. This consolidation is part of the NWS evolution, as establishing the READI teams will provide sustainable IT delivery operations and allow NOAA to take advantage of significant technological advancements.

ANALYZE, FORECAST, AND SUPPORT \$489,845,000

NOAA requests a net decrease of \$3,700,000 in FY 2016 program changes for a total of \$489,845,000 in the Analyze, Forecast, and Support sub-program. Highlights include:

Analyze, Forecast and Support: National Water Center Operations and Maintenance: NOAA requests an increase of \$2,000,000 to support National Water Center (NWC) operations and maintenance (O&M). The NWC, located in Tuscaloosa, Alabama, does not have a sustained line of O&M to support its current and growing operations. NWS' Hydrological Services and Warnings program is headquartered at the NWC and provides state-of-the-science hydrologic analysis, forecast information, and decision support services to address the Nation's growing water resources challenges. The NWC also serves as a cornerstone for Integrated Water Resources Science and Services and as a central hub to

integrate and advance national and regional hydrologic field operations and services.

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 2016. 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.

DISSEMINATION \$46,743,000

NOAA requests a total of \$46,743,000 in the Dissemination sub-program. There are no program changes in this sub-program.

SCIENCE AND TECHNOLOGY INTEGRATION \$134,197,000

NOAA requests a net increase of \$8,500,000 in FY 2016 program changes for a total of \$134,197,000 in the Science and Technology Integration sub-program. Highlights include:

Science and Technology Integration: Mid-Range Weather Outlooks: NOAA requests an increase of \$5,000,000 to begin efforts to extend weather and water skill beyond current limits (i.e., 10-14 days). Multiple sectors, ranging from food security and public health, to emergency management and national security, need skilled weather and water outlooks out to weeks three and four, or in the "mid-range." This increase will help



NOAA, through collaborative efforts between NWS and OAR, cultivate critical expertise in creating mid-range outlooks; this expertise does not currently exist. Addressing this challenge will require sustained scientific research and research-to-operations (R2O) efforts. Funding for this initiative, along with the corresponding and complementary increase requested in OAR (see p. 20 of Chapter 4), will ultimately allow for 30-day operational weather outlooks and longer lead severe storm outlooks.

Science and Technology Integration: Enhanced Water Prediction Capability: NOAA requests an increase of \$2,000,000 to expand hydrologic forecast services to provide improved flood forecasts and inundation mapping. This initiative builds on work started in FY 2015 by expanding centralized modeling science and technology to enable seamless and consistent prediction of flash floods and urban flood inundation mapping. Ultimately, NWS flood modeling outputs will be linked with FEMA’s Hazus database, allowing for estimation of economic impacts associated with flash floods and urban flood inundation. These capabilities are key to providing nationally consistent flash flood services and dynamic flood inundation maps that illustrate the predicted locations and depths of urban flooding.

Science and Technology Integration: Space Weather Numerical Model Transition to Operations: NOAA requests an increase of \$1,500,000 to augment R2O activities for critical space weather numerical model development and related operations and maintenance. This investment will advance the Sun to Earth suite of numerical models to improve operational forecasts of space weather. These numerical models will either be updated or transitioned to operations with this investment, providing an upgraded Sun to Earth Suite. NOAA will accomplish these activities with assistance from other federal agencies, academia, and private industry. This will ensure that a continuous stream of advancements is made to the existing space weather modeling suite.

FY 2016 PAC Budget Summary

NOAA requests a total of \$135,315,000 to support Procurement, Acquisition, and Construction activities of the NWS, composed of a net increase of \$5,015,000 in FY 2016 program changes.

PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

Program changes above \$1,000,000 are highlighted below. A summary of funding by PPA is located in Ap-



The Medford OR NEXRAD is located on Mount Ashland alongside the Ski Resort with the same name.

pendix 2. Detailed descriptions of all program changes by PPA are located in the NOAA FY 2016 Congressional Justification.

SYSTEMS ACQUISITION \$126,665,000

NOAA requests a net increase of \$8,365,000 in FY 2016 program changes for a total of \$126,665,000 in the Systems Acquisition sub-program. Highlights include:

Observations: Next Generation Weather Radar Service Life Extension Program: NOAA requests a planned increase of \$7,420,000 to continue implementation of a Service Life Extension Program, which will extend the utility of existing Next Generation Weather Radar (NEXRAD) infrastructure through 2030. NEXRAD underpins the severe weather forecast and warning services for high-impact events that are critical to maintaining a Weather-Ready Nation. 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 2016 REQUEST	\$16,720
FY 2017	\$25,255
FY 2018	\$22,953
FY 2019	\$12,909
FY 2020	\$12,199



Iowa Flooding.

Central Processing: Sustain Supercomputing: NOAA requests an increase of \$1,761,000 for the continued procurement, operations and maintenance of NOAA's Weather and Climate Operational Supercomputing System. In 2015, NOAA announced plans to boost its computing power by more than tenfold by 2016. The requested funding provides 24/7, 365 day operational support resources for current weather and climate forecasting capabilities, numerical environmental prediction model products, and dissemination of operational products as required by the NWS mission. Operational products from this system are distributed to other government agencies, the military, and the general public and include national and global weather, water, climate and space weather guidance; forecasts; warnings; and analyses.

Central Processing: Slow Advanced Weather Interactive Processing System II Extended: NOAA requests a decrease of \$1,500,000 to slow implementation of new Advanced Weather Interactive Processing System (AWIPS) II Extended tools and capabilities. AWIPS II Extended will add new tools and capabilities for data delivery; improve collaboration capabilities to support collaboration among NWS operational units and NOAA

trusted partners; improve means to generate information to support decision makers; and improve ways for forecasters to access and visualize meteorological information. The proposed reduction will not affect the planned deployment schedule for AWIPS II to the Weather Forecast Offices (WFOs). Rather it will slow development work for the applications and tools that will work in the AWIPS II environment.

Dissemination: Improve Dissemination Reliability: NOAA requests an increase of \$9,700,000, by reinvesting the planned decrease for the Re-architected NWS Telecommunications Gateway, to reduce single points of failure and increase website capacity to NWS Field Offices. Recent events have shown vulnerabilities in NWS dissemination infrastructure. This investment will help NOAA build second entries into many Forecast Offices and Centers to eliminate single points of failure, making facilities less vulnerable to network outages. Additionally, this investment will provide centralized, high capacity websites with 100 percent backup capabilities to keep up with growing requirements and increased demand during severe weather events.

Dissemination: Ground Readiness Project: NOAA requests an increase of \$1,400,000 to continue to build the necessary infrastructure required to ensure utilization of the substantial increase in environmental satellite, radar, and model data that will improve weather warnings and forecasts. The expected increase in critical environmental data far exceeds the capacity of the organization's current IT infrastructure. The Ground Readiness Project upgrades will help ensure that the full life- and property-saving potential of NOAA's satellite, model and radar investments are realized.

Dissemination: Re-architected NWS Telecommunications Gateway: NOAA requests a planned decrease of \$10,416,000 to reflect the completion in FY 2016 of a re-architected National Weather Service Telecommunications Gateway (NWSTG) at the primary and backup site. The re-architected NWSTG capability will enable modern, scalable, extensible, and reliable dissemination

Central Processing (Budget Authority in Thousands)	
FY 2016 REQUEST	\$64,261
FY 2017	\$64,261
FY 2018	\$64,261
FY 2019	\$64,261
FY 2020	\$64,261

Dissemination (Budget Authority in Thousands)	
FY 2016 REQUEST	\$45,684
FY 2017	\$34,619
FY 2018	\$24,919
FY 2019	\$24,919
FY 2020	\$24,919



NWS Weather Forecast Office in Norman, OK.

and infrastructure services 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.

NWS CONSTRUCTION \$8,650,000

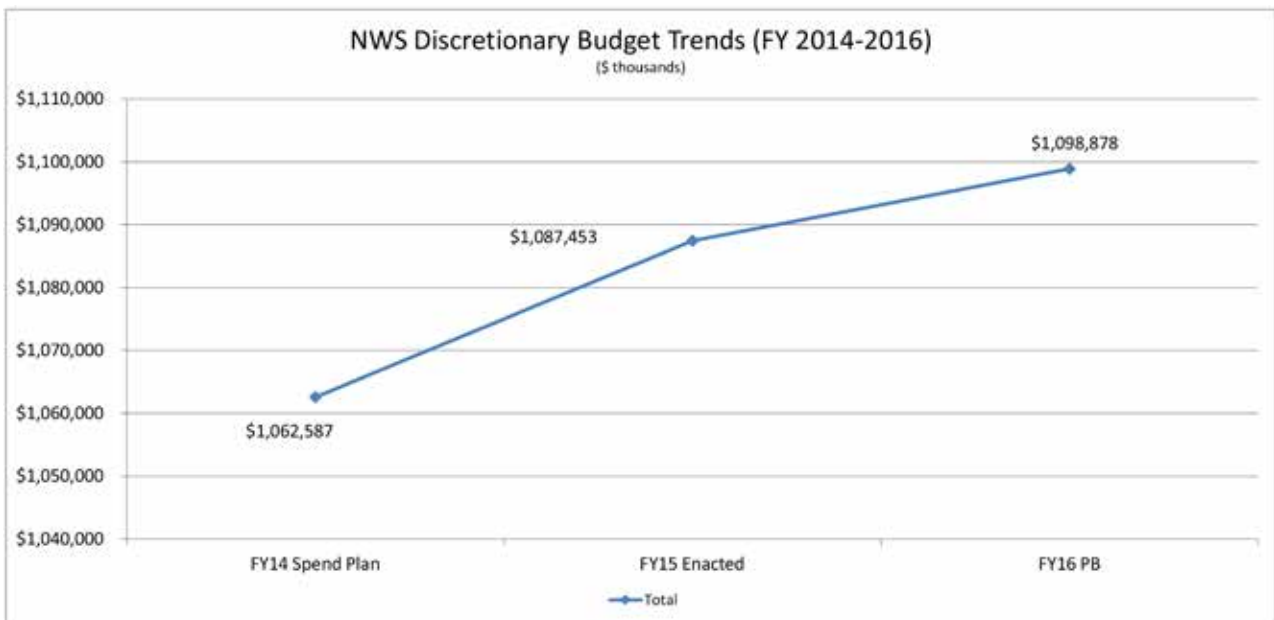
NOAA requests a net decrease of \$3,350,000 in FY 2016 program changes for a total of \$8,650,000 in the NWS Construction sub-program. Highlights include:

Facilities Construction and Major Repairs: Weather Forecast Office and River Forecast Center Relocations: NOAA requests an increase of \$4,710,000, to continue tenant improvements and support costs associated with WFO and River Forecast Center (RFC) relocations as well as structural repairs to improve conditions at WFOs and RFCs.

Facilities Construction and Major Repairs: Relocation of the National Logistics Supply Center/National Reconditioning Center: NOAA requests a decrease of \$8,060,000 to reflect the completion of the National Logistics Supply Center/National Reconditioning Center relocation from the Bannister Federal Complex in Kansas City, Missouri. FY 2015 funds were used for this one-time relocation, which will be complete in 2016.

Facilities Construction and Major Repairs
(Budget Authority in Thousands)

FY 2016 REQUEST	\$8,650
FY 2017	\$3,159
FY 2018	\$3,159
FY 2019	\$3,159
FY 2020	\$3,159



Chapter 6 | National Environmental Satellite Data, and Information Service



This January 8, 2015 image from the Suomi NPP satellite's Day/Night Band shows the eastern part of the U.S. clearly for the most part, highlighting the snow on the ground from a storm system.



The National Environmental Satellite, Data, and Information Service (NESDIS) is responsible for providing 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 the corresponding data. NOAA satellites support the weather forecasting enterprise by providing the timely, high quality data upon which model outputs are based. While providing real-time operations and data services, NESDIS also works to develop the next generation of satellites in order to continue meeting its primary mission essential functions without incurring gaps in coverage.

FY 2016 REQUEST \$2,379,627,000

NOAA requests a total of \$2,379,627,000 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 increase of \$154,838,000 in FY 2016 program changes. The FY 2016 President's Budget Request for NESDIS supports continued development of the Geostationary Environmental Operational Satellite – R Series (GOES-R) and the Joint Polar Satellite System (JPSS), as well as a significant investment in the subsequent mission to JPSS-2, the Polar Follow On (PFO). A FY 2016 start for PFO is critical to maintain continuity of polar observations and puts NOAA on a path toward a robust polar constellation.

FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$190,344,000 to support the Operations, Research, and Facilities of NESDIS, composed of a net increase of \$6,249,000 in FY 2016 program changes.

ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

ENVIRONMENTAL SATELLITE OBSERVING SYSTEMS \$131,097,000

NOAA requests a net increase of \$5,182,000 in FY 2016 program changes for a total of \$131,097,000 under the Environmental Satellite Observing Systems sub-program. Highlights include:



A rendering of the GOES-R satellite.

Data Center Operations: NOAA requests an increase of \$4,582,000 to operate and maintain the Comprehensive Large Array-Data Stewardship System (CLASS). Requested funds provide operations and maintenance (O&M) for the core capabilities of CLASS. This request funds the transition of the CLASS system from the current test and development environment to full operations. CLASS provides NOAA with long-term safe archival storage capacity and provides the general public with access to the preserved data. CLASS data volumes have increased by 380% from FY 2012 to FY 2016. CLASS begins the transition from development to Full Operational Capability (FOC) in FY 2016 and completes the transition in FY 2017. Full funding of the core operational capabilities is essential to ensure that NESDIS can expand the archive of data, supporting the increasing user demand.

NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION \$59,247,000

NOAA requests a net increase of \$1,067,000 in FY 2016 program changes for a total of \$59,247,000 under the National Centers for Environmental Information sub-program. Highlights include:

Big Earth Data Initiative: NOAA requests an increase of \$1,067,000 to make its environmental data holdings more easily accessible to other U.S. agencies and the

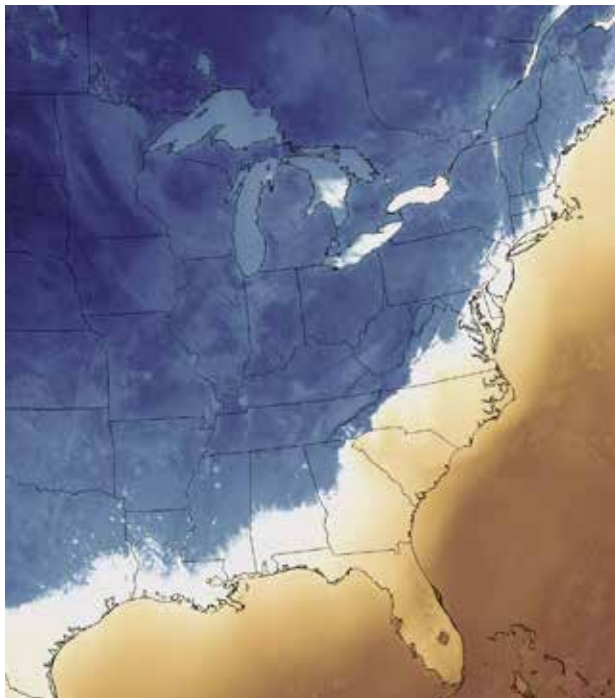
Nation. Requested funding in the FY 2016 President's Budget would further enable easy, open, and transparent access to NOAA's weather, climate, oceanographic and geophysical data and derived environmental information and would improve the usability of NOAA's data, consistent with other data initiatives across the government. These data and information directly contribute to the Nation's management of its environmental resources and support a broad range of environmental intelligence applications. Funding will directly contribute to modernizing search, discovery and access methods; providing descriptive information for all data and information products; and supporting the services necessary to transform NOAA's data into machine readable information.

FY 2016 PAC BUDGET SUMMARY

NOAA requests a total of \$2,189,283 to support the Procurement, Acquisitions, and Construction activities of NESDIS, composed of a net increase of \$148,589,000 in FY 2016 program changes.

PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.



This image from the High Resolution Rapid Refresh model shows the minimum surface air temperature expected from November 13 - 14, 2014. Areas shaded blue are at or below freezing.

SYSTEMS ACQUISITION

\$2,188,357,000

NOAA requests a net increase of \$148,527,000 in FY 2016 program changes for a total of \$2,188,357,000 in the Systems Acquisition sub-program. Highlights include:

Geostationary Operational Environmental Satellite Systems-R Series (GOES-R):

NOAA requests a decrease of \$109,047,000 to the GOES-R program. The remaining \$871,791,000 will allow NOAA to continue satellite engineering development, production, integration, and launch activities associated with the four-satellite GOES-R program to meet required operational capabilities through 2036. The reduction includes \$94,047,000 in a planned reduction according to the established budget profile. Additionally, the FY 2016 request is further decreased by \$15,000,000 achieved by a one week reduction in carryover available to the GOES-R program from FY 2016 into FY 2017. The reduction remains within the bounds of the NASA best practices for six to eight weeks of carryover and does not change the program's content or baseline life cycle cost. The remaining GOES-R funding is needed to maintain instruments, satellite, and ground system developments that are all currently under contract to keep the GOES-R program on schedule to meet the launch commitment dates (LCD) of the 2nd Quarter FY 2016 for GOES-R and 3rd Quarter FY 2017 for GOES-S. Remaining funding will also be used to continue development activities necessary to maintain GOES-T and GOES-U launch schedules.

GOES-R

(Budget Authority in Thousands)

FY 2015 & PRIOR	\$6,087,084
FY 2016	\$871,791
FY 2017	\$786,684
FY 2018	\$523,049
FY 2019	\$364,032
FY 2020	\$266,865
CTC	\$1,928,554
TOTAL	\$10,828,059

Jason-3: NOAA requests a planned decrease of \$15,717,000 to the Jason-3 program. This level of funding allows NOAA to continue post launch operations of the Jason-3 satellite in partnership with European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and Centre National d'Etudes Spatiales (CNES), NOAA's European and French partners. This



funding will support routine post-launch operations of the Jason-3 satellite to include ingestion, processing and distribution of the data, and essential engineering services to sustain operations in the event of space or ground based anomalies. Remaining funding of \$7,458,000 will be used to complete the evaluation of the Jason-3 satellite and instrument performance during the calibration and validation of all satellite data and will support continued Jason-3 satellite operations per our international commitments with EUMETSAT and CNES. The Jason-3 mission provides continuity of precise measurement of sea surface heights. Future ocean altimetry missions will be the responsibility of NASA as part of a new framework for Earth-observing satellite responsibilities in which NOAA will be responsible only for satellite missions that contribute directly to its ability to issue weather and space weather forecasts and warnings to protect life and property.

Jason-3 (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$148,006
FY 2016	\$7,458
FY 2017	\$7,288
FY 2018	\$7,265
FY 2019	\$7,196
FY 2020	\$0
CTC	\$0
TOTAL	\$177,213

Joint Polar Satellite System (JPSS): NOAA requests a decrease of \$107,301,000 to JPSS. The remaining \$808,966,000 allows NOAA to operate and sustain the Suomi National Polar-orbiting Partnership satellite (SNPP) Program and continue development of the in-

JPSS (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$6,852,002
FY 2016	\$808,966
FY 2017	\$797,246
FY 2018	\$735,777
FY 2019	\$558,803
FY 2020	\$439,506
CTC	\$1,129,825
TOTAL	\$11,322,125



The JPSS-1 satellite.

struments, ground system, and spacecraft for JPSS-1 and JPSS-2. The reduction includes \$82,301,000 in a planned reduction consistent with the 2013 Program baseline. The FY 2016 request is further decreased by \$25,000,000, achieved by reducing the amount of carryover available to the JPSS program from FY 2016 into FY 2017 by one week. This reduction remains within the bounds of the NASA best practice of six to eight weeks of carryover, and does not change the program’s content or baselined life cycle cost. The remaining funding will keep JPSS on schedule to meet the LCD of no later than Q2 FY 2017 for JPSS-1 and to meet the LCD of Q1 FY 2022 for JPSS-2.

Polar Follow On (PFO): NOAA requests an increase of \$380,000,000 to initiate the PFO. PFO is critical to continuing NOAA’s polar weather satellite observations after JPSS-2. PFO will achieve robustness in the polar weather constellation as early as FY 2023 and minimize the potential for gaps in polar weather data. The PFO implements a strategic procurement and management plan that will allow NOAA to move the polar satellite mission toward robustness as expeditiously as possible while realizing significant efficiencies and cost savings. The PFO consists of two primary missions: JPSS-3 and JPSS-4. The request also invests in an Earth Observing



The DSCOVR satellite.

Nanosatellite-Microwave (EON-MW), which is a miniature microwave sounder that approximates the atmospheric profiling capabilities of the Advanced Technology Microwave Sounder (ATMS) instrument, and provides some mitigation in the event of a launch or instrument failure on JPSS-1. Polar orbiting satellites provide the primary input (up to 85%) of the data needed for NOAA's Numerical Weather Prediction models, the underpinnings of high impact weather forecasts. These data are increasingly important to emergency managers in the public and private sectors and are key inputs to critical decisions related to protection of life and property, such as evacuations and the staging of resources.

Solar Irradiance, Data, and Rescue (SIDAR): NOAA requests a decrease of \$6,800,000 with \$500,000 remaining to plan the accommodation of the Argos Advanced Data Collection System (A-DCS) and Search and Rescue Satellite-Aided Tracking (SARSAT) instruments for launch in FY 2019. A-DCS is part of the Argos data collection and location system. Argos has the ability to geographically locate a source of data from anywhere on Earth. NOAA relies on the Argos system to collect worldwide ocean data from moored and drifting buoys and submerged floats. Argos transmitters are also deployed on a large number of marine mammals and sea turtles to track their migrations. SARSAT provides satellite search and rescue services to detect and locate mariners, aviators, and recreational enthusiasts in distress almost anywhere in the world. SARSAT is credited with saving over 35,000 people worldwide, including more than 7,400 people in the U.S., from the time of its

Polar Follow-On*

(Budget Authority in Thousands)

FY 2015 & PRIOR

FY 2016 \$370,000

FY 2017 \$430,000

FY 2018 \$589,000

FY 2019 \$579,000

FY 2020 \$577,000

CTC TBD

TOTAL TBD

EON-MW

(Budget Authority in Thousands)

FY 2015 & PRIOR

FY 2016 \$10,000

FY 2017 \$8,000

FY 2018 \$5,000

FY 2019 \$2,000

FY 2020 \$2,000

CTC \$0

TOTAL \$27,000

*The preliminary phasing of funds provided in the budget profile is based on an Initial Formulation Estimate, and is subject to change.



inception in 1982. The Solar Irradiance measurements initially conceived as a part of SIDAR have been taken up by NASA, including the transfer of TSIS-1 to NASA beginning in FY 2016.

SIDAR (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$7,300
FY 2016	\$500
FY 2017	TBD
FY 2018	TBD
FY 2019	TBD
FY 2020	TBD
CTC	TBD
TOTAL	\$7,800

Deep Space Climate Observatory (DSCOVR): NOAA requests a planned decrease of \$17,900,000 with \$3,200,000 remaining to support routine post-launch maintenance and operations of the refurbished DSCOVR satellite. NOAA proposes the FY 2016 reduction according to the established DSCOVR budget profile. The funding request will sustain engineering support and provide mission operations, ground systems maintenance, data processing, data archiving, on-orbit support, and enhancements to the ground system. The DSCOVR satellite maintains the Nation's real-time solar wind monitoring capabilities that are critical to the detection of space weather events such as geomagnetic storms, which can disrupt public infrastructure systems (e.g., power grids, telecommunications, aviation). Solar wind observations are the only data source to support 15- to 45-minute lead time for geomagnetic storm warnings.

DSCOVR (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$97,094
FY 2016	\$3,200
FY 2017	\$2,400
FY 2018	\$2,069
FY 2019	\$0
FY 2020	\$0
CTC	\$0
TOTAL	\$104,763

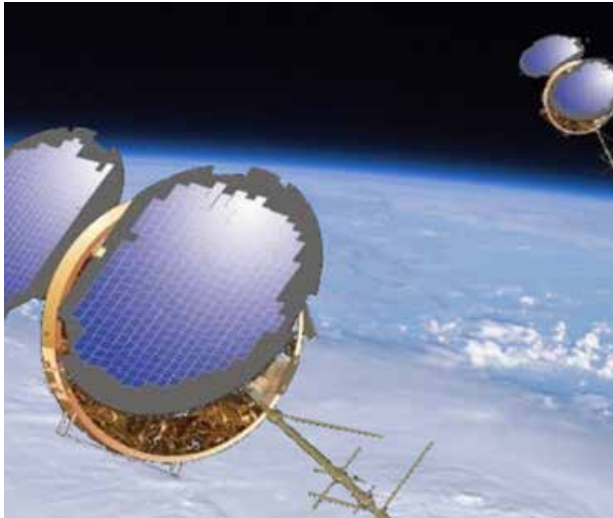
Space Weather Follow On: NOAA requests an increase of \$2,500,000 to analyze options from the Analysis of Alternatives (AoA) for critical space weather observations and to initiate development of the Space Weather Follow On program. The mission design life for the DSCOVR spacecraft ends in FY 2019. Thus, NOAA will initiate plans and studies in FY 2016 to ensure data continuity for solar wind data. The lack of a DSCOVR replacement will diminish NOAA's ability to provide timely and accurate geomagnetic storm warnings and other space weather services, leaving the U.S public infrastructure more vulnerable to impending space weather storms.

Space Weather FO (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$0
FY 2016	\$2,500
FY 2017	*
FY 2018	*
FY 2019	*
FY 2020	*
CTC	*
TOTAL	*

To Be Provided with FY 2017 President's Budget

COSMIC 2/Global Navigation Satellite System Radio Occultation (GNSS RO): GNSS RO Ground System: NOAA requests an increase of \$3,300,000 for ground reception and processing of GNSS RO satellite data. This request will help NOAA complete all IT security testing and verification in preparation for the COSMIC-2 launches. All University Corporation for Atmospheric Research (UCAR) processing functions will be tested and certified for operations by National Centers for Environmental Prediction (NCEP) in advance of the FY 2016 and FY

GNSS RO Ground System (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$8,797
FY 2016	\$10,100
FY 2017	\$8,100
FY 2018	\$8,100
FY 2019	\$8,100
FY 2020	\$8,100
CTC	\$23,200
TOTAL	\$74,497



COSMIC is the first constellation of satellites to use radio occultation.

2019 launches. Additionally, the increase will support the complete operational testing and validation of the Numerical Weather Prediction Models (NWP) for COSMIC-2. This testing requires up to 12 months of joint operations between NCEP and UCAR before the system can be deemed operational at NWS in support of the first COSMIC-2 launch. The COSMIC-2 ground system allows NOAA flexibility to acquire RO data from sources including other governmental organizations and commercial operators.

COSMIC-2/Global Navigation Satellite System Radio Occultation (GNSS RO): COSMIC-2 Sensors: NOAA requests an increase of \$9,900,000 for the procurement of the second set of six COSMIC-2 radio occultation (RO) sensors to be launched in FY 2019. The COSMIC-2 constellation will consist of 12 total RO sensors. The first six satellites will be placed in a low earth equatorial orbit in FY 2016, and are currently in production. This funding request will support the acquisition of the second set of six satellites, which will be placed in a low earth

GNSS RO/COSMIC-2: RO SENSORS (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$0
FY 2016	\$9,900
FY 2017	\$8,100
FY 2018	\$700
FY 2019	\$700
FY 2020	\$700
CTC	\$2,200
TOTAL	\$22,300

polar orbit in FY 2019. These two different orbits of the COSMIC-2 constellation work together to provide global coverage of atmospheric and ionospheric observations, which improves the overall accuracy of NOAA's operational weather models. NWS has determined that the COSMIC mission provides the highest quality and most timely RO data available. Additionally, the acquisition and launch of the polar orbiting COSMIC-2 sensors will help to mitigate the impacts of a potential gap in sounding data in the polar orbit as COSMIC-2 RO data provides unique advantages that can be leveraged to improve data collected from existing NOAA sensors such as ATMS and CrIS (Cross-track Infrared Sounder).

Satellite Ground Services (SGS): NOAA requests an increase of \$2,717,000 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. This funding will sustain SGS program activities implemented within the FY 2015 Congressional approval of the NOAA reorganization. The goal of the SGS program is to leverage existing ground systems to provide new products and services and to develop a future set of common ground services that can be executed across NOAA's satellites. The funding request is needed to accelerate prototyping of software elements that can be used by multiple applications and to evaluate hardware options for technology refresh action. These activities are a critical step toward setting the foundation for an enterprise ground system that will ultimately generate cost savings and interface efficiencies across NOAA.

SGS (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$55,808
FY 2016	\$58,525
FY 2017	\$58,525
FY 2018	\$58,525
FY 2019	\$58,525
FY 2020	\$58,525
CTC	N/A
TOTAL	RECURRING

System Architecture and Advanced Planning (SAAP): NOAA requests an increase of \$1,587,000 to establish and lead the system engineering processes necessary to meet NESDIS' mission assurance needs. The funding increase is needed to provide adequate end-to-end validation of the GOES-R and JPSS-1 mission requirements to ensure the NESDIS' systems and products meet the



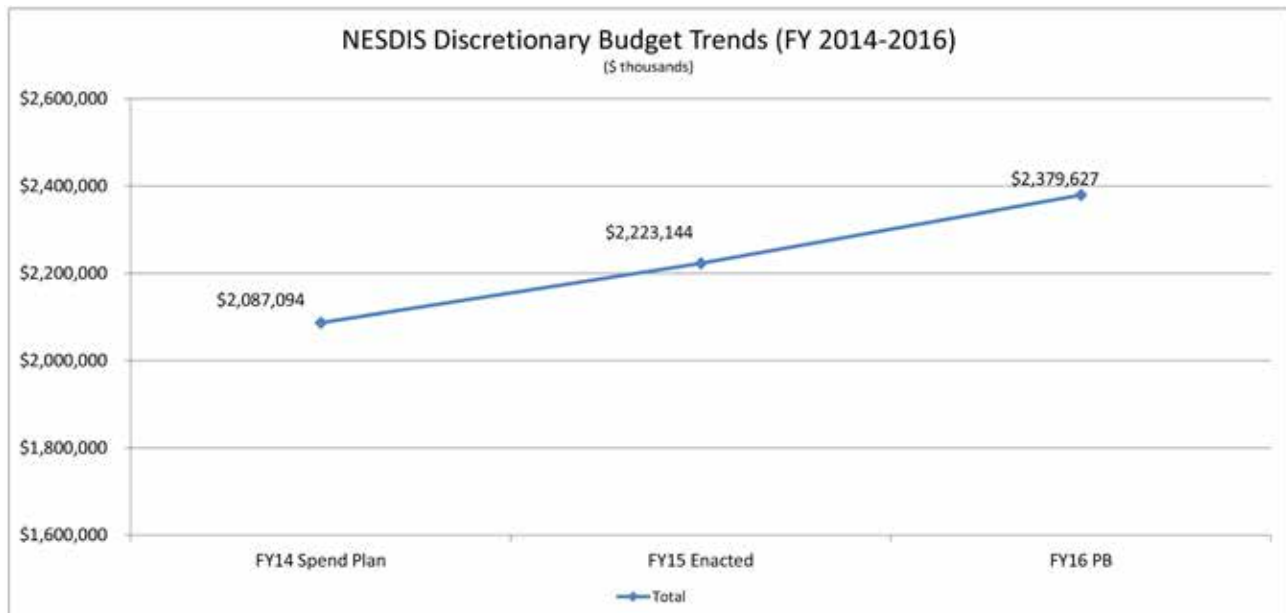
operational needs identified by the user community. Funding this activity in FY 2016 is critical for GOES-R to complete development activities and to certify end-to-end validation of the GOES-R products and ground system prior to launch. Remaining funding will be used to support planning for the full development of next generation satellite and ground architectures. NESDIS architecture planning is integral to the long-term continuity of satellite products used for environmental monitoring and prediction at an affordable cost.

vanced Very High Resolution Radiometer (AVHRR); Advanced Microwave Sounding Unit (AMSU-A); and Space Environment Monitor (SEM). This funding request will allow NOAA to calibrate the SEM instrument on schedule for shipping to Europe for satellite Dynamics and Electro-Magnetic Compatibility Testing. Without this funding request, NOAA will be unable to meet schedule obligations to ensure the accommodation of the SEM instrument on MetOp C in Q1 FY 2019.

SAAP (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$3,000
FY 2016	\$4,929
FY 2017	\$4,929
FY 2018	\$4,929
FY 2019	\$4,929
FY 2020	\$4,929
CTC	N/A
TOTAL	RECURRING

PPA (Budget Authority in Thousands)	
FY 2015 & PRIOR	\$25,200
FY 2016	\$30,488
FY 2017	\$33,488
FY 2018	\$33,488
FY 2019	\$33,488
FY 2020	\$33,488
CTC	N/A
TOTAL	RECURRING

Projects, Planning and Analysis (PPA): NOAA requests an increase of \$5,288,000 to continue project management, on-orbit anomaly support and sustainment of existing operational systems, and to integrate science planning and operational science product development for NOAA satellite missions. NOAA is currently preparing three critical instruments for launch on the EUMETSAT satellite, Metop-C, including the Ad-



Chapter 7 | Program Support



NOAA Ship *Nancy Foster*. Photo Credit: ENS Conor Maginn



NOAA's Program Support services are the backbone of NOAA's programs and mission. These offices – including Corporate Services, Office of Education, and Office of Marine and Aviation Operations (OMAO) – provide the planning, administrative, financial, procurement, information technology, human resources, acquisitions and grants, and infrastructure services that are essential to safe, timely, and effective execution of the NOAA mission. NOAA Corporate Services provides centralized executive management, as well as policy formulation and direction, to all of NOAA's Staff and Line Offices. NOAA's Office of Education provides advice and counsel to the Under Secretary of Commerce for Oceans and Atmosphere in matters pertaining to education. The NOAA Facility Program is the focal point for facility planning, project planning formulation and development, and project management oversight to support critical NOAA mission requirements. OMAO supports an array of specialized ships and aircraft that play a critical role in the in-situ collection of oceanographic, atmospheric, hydrographic, and fisheries data in support of NOAA's environmental and scientific missions. OMAO also administers the NOAA-wide Diving Program and Small Boat Program and is composed of civilians and the NOAA Commissioned Corps uniformed officers.

FY 2016 REQUEST \$677,040,000

In FY 2016, NOAA requests a total of \$677,040,000 to position NOAA's Program 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 is composed of a net increase of \$148,841,000 in FY 2016 program changes.

The FY 2016 request supports critical investments in NOAA's Corporate Services and fleet. NOAA's Program Support requires additional funds to ensure sound execution of programs and activities related to NOAA's diverse mission. NOAA's FY 2016 request seeks to strengthen NOAA Corporate Services by integrating new Departmental business systems at NOAA and improving performance in the human resources and acquisitions business lines. The NOAA ship fleet will decline by 50 percent – from 16 to 8 active ships between FY 2016 and FY 2028 – without additional investment, leaving it unable to successfully support NOAA's at-sea data collection activities, which serve as the basis for management decisions and products and services on which communities depend. To ensure the continuity of NOAA's at-sea data collection capacity into the future, the FY 2016 request makes critical investments in capital improvements for the entire ship fleet and in one Ocean Survey Vessel (OSV).

FY 2016 ORF BUDGET SUMMARY

NOAA requests a total of \$487,135,000 to support the Operations, Research, and Facilities of the Program Support functions. This includes a net decrease of \$4,859,000 in FY 2016 program changes.



The Inouye Regional Center (IRC) is located on historic Ford Island, Naval Station Pearl Harbor, Honolulu, Hawaii. The IRC combines new facilities with the historic preservation of four historic buildings culminating into a campus which is environmentally sustainable, state of the art and Leadership in Environmental and Energy Design (LEED) Gold Certified.



NOAA WP-3D N43RF USAF.

ORF PROGRAM CHANGE HIGHLIGHTS FOR FY 2016:

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 2016 Congressional Justification.

CORPORATE SERVICES \$234,506,000

NOAA requests a net increase of \$4,341,000 in FY 2016 program changes for a total of \$234,506,000 in the Corporate Services sub-program. Highlights include:

NOAA-Wide Corporate Services and Agency Management Base: NOAA requests an increase of \$4,341,000 for a total of \$118,973,000 for the implementation of the new Departmental business systems and to improve performance of the Corporate Services functions across NOAA. This request will support NOAA Corporate Services to improve performance in the human resources and acquisition and grants business lines.

OFFICE OF EDUCATION \$16,431,000

NOAA requests a net decrease of \$11,200,000 in FY 2016 program changes for a total of \$16,431,000 in the Office of Education sub-program. Within this funding, NOAA will use \$2,031,000 for Office of Education operations and \$14,400,000 to support the Educational Partnership Program. Highlights include:

NOAA Bay-Watershed Education and Training (B-WET) Regional Programs: NOAA requests a decrease of \$7,200,000 for B-WET. In FY 2016, NOAA will continue to provide watershed educational experience for students through other programs including those within National Marine Sanctuaries and National Estuarine Research Reserves.

Office of Education: NOAA requests a decrease of \$4,000,000 to the Office of Education to terminate NOAA's Competitive Education Grant Program.

FACILITIES \$25,067,000

NOAA requests a net increase of \$2,000,000 in FY 2016 program changes for a total of \$25,067,000 in the Facilities sub-program. Highlights include:

NOAA Facilities Management & Construction and Safety: NOAA requests an increase of \$2,000,000 to excess surplus facilities and address deferred maintenance needs at corporate campuses to ensure safe and sustainable facilities for future mission success. Addressing deferred maintenance allows NOAA to reduce the financial impact of inefficient buildings and building systems while potentially reducing energy costs and mitigating the financial and safety risk from the effects of climate change. With these funds, NOAA will begin to identify excess and dispose of surplus facilities, eliminating arrangements that are not cost effective and disposing of excess and underutilized assets. NOAA will work closely with the General Services Administration to ensure excessing is done effectively and in accordance with regulations.

MARINE OPERATIONS & MAINTENANCE \$178,838,000

NOAA requests a total of \$178,838,000 in the Marine Operations and Maintenance sub-program. There are no program changes in this sub-program. This program funds centralized management for NOAA's 16 active research and survey ships. In FY 2016, funding will provide approximately 3,220 Days at Sea (DAS) to support NOAA's highest-priority programs.



AVIATION OPERATIONS \$32,293,000

NOAA requests a total of \$32,293,000 in the Aviation Operations sub-program. There are no program changes in this sub-program. This program funds centralized management for NOAA’s research and survey aircraft. In FY 2016, funding will provide approximately 4,063 flight hours to support NOAA’s highest-priority programs.

FY 2016 PAC BUDGET SUMMARY

NOAA requests a total of \$159,700,000 to support the Procurement, Acquisition, and Construction (PAC) functions of Program Support. This includes an increase of \$153,700,000 in FY 2016 program changes.

PAC PROGRAM CHANGE HIGHLIGHTS FOR FY 2016

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 2016 Congressional Justification.

CONSTRUCTION \$1,000,000

NOAA requests a net increase of \$1,000,000 in FY 2016 program changes for a total of \$1,000,000 in the Construction sub-program.

NOAA Construction: NOAA requests an increase of \$1,000,000 to conduct a Planning and Design study that will evaluate the feasibility of extending the temporary berth of the fisheries survey vessel *Henry B. Bigelow* at the Naval Station Newport pier.

NOAA Construction (Budget Authority in Thousands)	
FY 2016 REQUEST	\$1,000
FY 2017	\$0
FY 2018	\$0
FY 2019	\$0
FY 2020	\$0

OMAO FLEET REPLACEMENT \$158,700,000

NOAA requests a net increase of \$152,700,000 in FY 2016 program changes for a total of \$158,700,000 in the OMAO Fleet Replacement sub-program. Highlights include:

New Vessel Construction: NOAA requests an increase of \$147,000,000 to begin development of one Ocean Survey Vessel (OSV), a multi-use platform designed to conduct surveys throughout the U.S. Exclusive Economic Zone, which is the area extending 200 nautical miles offshore where the U.S. has jurisdiction over natural resources. The OSV has a more diverse range of capabilities and functions than other vessels in the NOAA fleet and is capable of meeting a variety of NOAA’s missions, such as:

- surveying marine mammal populations;
- collecting samples and observations to support ecosystem-based management activities;
- conducting oceanographic and climate research;
- mapping the ocean floor to update nautical charts; and
- servicing National Weather Service’s buoys.

With this investment, NOAA will leverage the Navy’s existing Auxiliary General Oceanographic Research Vessel system specifications, which will reduce design risk, provide cost savings and increase the ability for cross-government research opportunities.

New Vessel Construction (Budget Authority in Thousands)	
FY 2016 REQUEST	\$147,000
FY 2017	\$0
FY 2018	\$6,200
FY 2019	\$0
FY 2020	\$0

Fleet Capital Improvements and Technology Infusion: NOAA requests an increase of \$5,700,000 to support the Progressive Lifecycle Maintenance Program. Funds will continue to improve the material condition

Fleet Capital Improvements and Tech Infusion (Budget Authority in Thousands)	
FY 2016 REQUEST	\$11,700
FY 2017	\$11,700
FY 2018	\$11,700
FY 2019	\$11,700
FY 2020	\$11,700



NOAA Flight Director Rich Henning at his station aboard N42RF. Photo Credit: David Hall.

and maximize the service life of the NOAA ship fleet by stabilizing capital investment in regular upgrades and replacements of mission support equipment and technology infusions, such as data processing capacity. This investment will help ensure the continuity and reliability of the NOAA fleet to support the agency’s diverse at-sea observation and data collection needs.

DISCRETIONARY FUNDS

MEDICARE-ELIGIBLE RETIREE HEALTHCARE FUND CONTRIBUTION

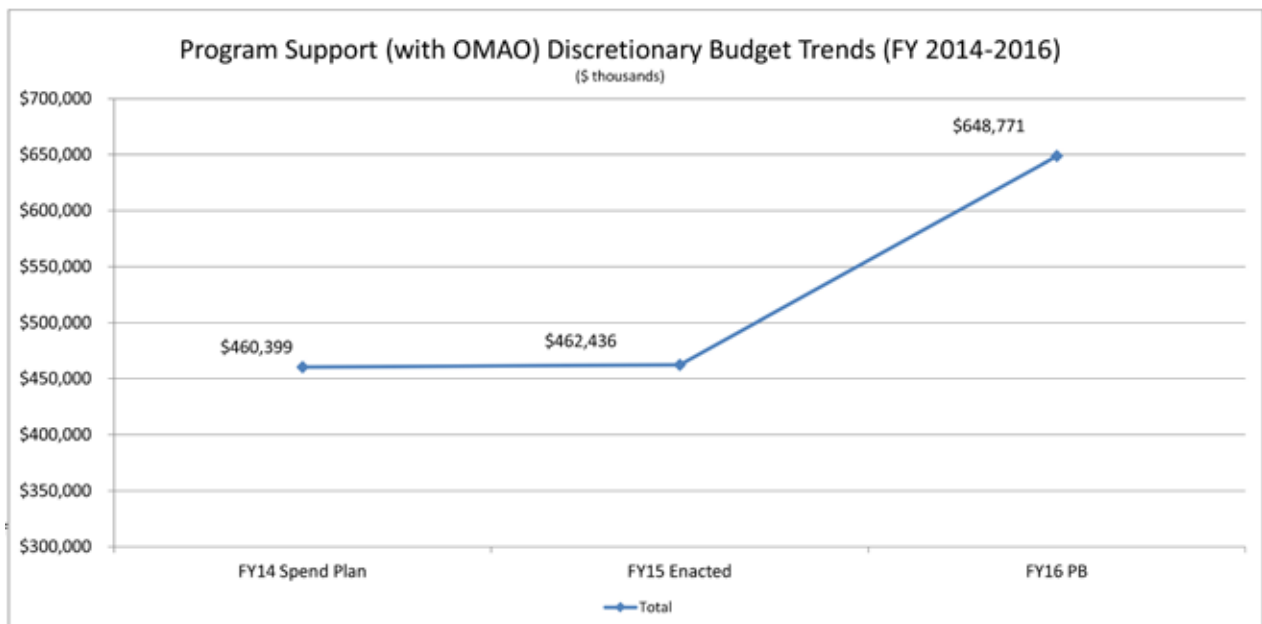
The FY 2003 Department of Defense Authorization Act requires all uniformed services, including NOAA, to participate in an accrual fund for Medicare-eligible retirees. Payments into this accrual fund will cover the future health care benefits of present, active-duty NOAA officers and their dependents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

2016, 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.





Flags flying from mast of NOAA Ship *Nancy Foster*. Photo Credit: ENS Conor Maginn

Appendix 1 | Proposed Changes to General Provisions





NOAA seeks the following changes to the General Provisions in its FY 2016 budget submission. For a more detailed discussion of the justification for these proposed changes, please consult the FY 2016 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 related to permitting and other regulatory activities.

2. Availability for New Vessel Construction funds (under Procurement, Acquisition and Construction)

For procurement, acquisition and construction of capital assets, including alteration and modification costs, of the National Oceanic and Atmospheric Administration, \$2,498,679,000, to remain available until September 30, 2018, except that funds provided for the acquisition and construction of vessels and that funds provided for construction of facilities shall remain available until expended.

Justification

NOAA proposes language that would extend the period of availability of Procurement, Acquisition and Construction funds for vessel acquisition and construction from three fiscal years until expended.

Appendix 2 | Control Table

NATIONAL OCEAN SERVICE

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Navigation, Observations and Positioning						
Navigation, Observations and Positioning	135,789	137,961	3,039	141,000	0	141,000
Hydrographic Survey Priorities/Contracts	24,961	25,000	0	25,000	0	25,000
IOOS Regional Observations	28,456	29,500	0	29,500	0	29,500
Total, Navigation, Observations and Positioning	189,206	192,461	3,039	195,500	0	195,500
Coastal Science and Assessment						
Coastal Science, Assessment, Response and Restoration	70,390	71,000	1,600	72,600	0	72,600
Competitive Research	8,986	9,000	0	9,000	4,000	13,000
Total, Coastal Science and Assessment	79,376	80,000	1,600	81,600	4,000	85,600
Ocean and Coastal Management and Services						
Coastal Zone Management and Services	40,936	41,700	664	42,364	11,780	54,144
Coastal Management Grants	66,043	71,146	0	71,146	45,000	116,146
Coral Reef Program	25,960	26,000	100	26,100	0	26,100
National Estuarine Research Reserve System	21,267	21,300	0	21,300	0	21,300
Sanctuaries and Marine Protected Areas	48,425	48,500	1,161	49,661	(1,361)	48,300
Total, Ocean and Coastal Management and Services	202,631	208,646	1,925	210,571	55,419	265,990
Total, National Ocean Service - ORF	471,213	481,107	6,564	487,671	59,419	547,090
Other National Ocean Service Accounts						
Total, National Ocean Service - PAC	3,694	3,700	0	3,700	0	3,700
Total, National Ocean Service - Other	23,259	50,931	(27,761)	23,170	0	23,170
GRAND TOTAL NOS	498,166	535,738	(21,197)	514,541	59,419	573,960



NATIONAL MARINE FISHERIES SERVICE

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Protected Resources Science and Management						
Marine Mammals, Sea Turtles & Other Species	114,104	115,219	2,170	117,389	28,321	145,710
ESA Salmon	64,400	65,500	1,700	67,200	1,301	68,501
Total, Protected Resources Science and Management	178,504	180,719	3,870	184,589	29,622	214,211
Fisheries Science and Management						
Fisheries and Ecosystem Science Programs and Services	131,134	132,189	2,653	134,842	11,475	146,317
Fisheries Data Collections, Surveys and Assessments	156,990	158,271	2,165	160,436	2,815	163,251
Observers and Training	43,586	43,655	611	44,266	484	44,750
Fisheries Management Programs and Services	120,548	120,458	2,243	122,701	5,666	128,367
Salmon Management Activities	30,153	30,200	158	30,358	(2,896)	27,462
Regional Councils and Fisheries Commissions	34,446	35,238	737	35,975	0	35,975
Total, Fisheries Science and Management	516,857	520,011	8,567	528,578	17,544	546,122
Enforcement						
Enforcement	62,899	65,000	1,168	66,168	3,850	70,018
Total, Enforcement	62,899	65,000	1,168	66,168	3,850	70,018
Habitat Conservation & Restoration						
Habitat Management and Restoration	51,037	56,408	806	57,214	671	57,885
Subtotal, Habitat Conservation & Restoration	51,037	56,408	806	57,214	671	57,885
Total, National Marine Fisheries Service - ORF	809,297	822,138	14,411	836,549	51,687	888,236
Other National Marine Fisheries Service Accounts						
Total, National Marine Fisheries Service - PAC	0	0	0	0	0	0
Total, National Marine Fisheries Service - Other	193,476	136,056	(37,471)	98,585	3,300	101,885
GRAND TOTAL NMFS	1,002,773	958,194	(23,060)	935,134	54,987	990,121

OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Climate Research						
Laboratories & Cooperative Institutes						
Laboratories & Cooperative Institutes	58,858	60,000	1,078	61,078	9,415	70,493
Subtotal, Laboratories & Cooperative Institutions	58,858	60,000	1,078	61,078	9,415	70,493
Regional Climate Data & Information						
Regional Climate Data & Information	36,943	38,000	125	38,125	14,312	52,437
Subtotal, Regional Climate Data & Information	36,943	38,000	125	38,125	14,312	52,437
Climate Competitive Research						
Climate Competitive Research	58,407	60,000	326	60,326	5,504	65,830
Subtotal, Climate Competitive Research	58,407	60,000	326	60,326	5,504	65,830
Total, Climate Research	154,208	158,000	1,529	159,529	29,231	188,760
Weather & Air Chemistry Research						
Laboratories & Cooperative Institutes						
Laboratories & Cooperative Institutes	63,900	70,000	2,086	72,086	(3,982)	68,104
Subtotal, Laboratories & Cooperative Institutes	63,900	70,000	2,086	72,086	(3,982)	68,104
Weather & Air Chemistry Research Programs						
U.S. Weather Research Program (USWRP)	4,193	7,300	(158)	7,142	8,936	16,078
Tornado Severe Storm Research / Phased Array Radar	12,980	13,500	0	13,500	(342)	13,158
Subtotal, Weather & Air Chemistry Research Programs	17,173	20,800	(158)	20,642	8,594	29,236
Total, Weather & Air Chemistry Research	81,073	90,800	1,928	92,728	4,612	97,340
Ocean, Coastal, and Great Lakes Research						
Laboratories & Cooperative Institutes						
Laboratories & Cooperative Institutes	26,201	27,000	2,546	29,546	(2,531)	27,015
Subtotal, Laboratories & Cooperative Institutes	26,201	27,000	2,546	29,546	(2,531)	27,015
National Sea Grant College Program						
National Sea Grant College Program Base	62,702	62,800	83	62,883	(1,431)	61,452
Marine Aquaculture Program	4,493	4,500	0	4,500	2,500	7,000
Subtotal, National Sea Grant College Program	67,195	67,300	83	67,383	1,069	68,452

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Ocean Exploration and Research						
Ocean Exploration and Research	25,960	28,000	124	28,124	(8,780)	19,344
Subtotal, Ocean Exploration and Research	25,960	28,000	124	28,124	(8,780)	19,344
Other Ecosystems Programs						
Integrated Ocean Acidification	5,991	8,500	83	8,583	21,422	30,005
Cross-NOAA Science and Technology	0	0	0	0	0	0
Subtotal, Other Ecosystems Programs	5,991	8,500	83	8,583	21,422	30,005
Sustained Ocean Observations and Monitoring						
Sustained Ocean Observations and Monitoring	40,936	41,300	296	41,596	0	41,596
Subtotal, Sustained Ocean Observations and Monitoring	40,936	41,300	296	41,596	0	41,596
Total, Ocean, Coastal, & Great Lakes Research	166,283	172,100	3,132	175,232	11,180	186,412
Innovative Research & Technology						
High Performance Computing Initiatives	11,981	12,000	41	12,041	103	12,144
Total, Innovative Research & Technology	11,981	12,000	41	12,041	103	12,144
Total, Office of Oceanic and Atmospheric Research - ORF	413,545	432,900	6,630	439,530	45,126	484,656
Other Office of Oceanic and Atmospheric Research Accounts						
Total, Office of Ocean and Atmospheric Research - PAC	10,363	13,379	0	13,379	9,000	22,379
Total, Office of Oceanic and Atmospheric Research - Other	0	0	0	0	0	0
GRAND TOTAL OAR	423,908	446,279	6,630	452,909	54,126	507,035

NATIONAL WEATHER SERVICE

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Observations	205,022	210,777	1,732	212,509	(7,633)	204,876
Central Processing	100,069	96,617	1,385	98,002	(10,100)	87,902
Analyze, Forecast and Support	474,729	483,060	10,485	493,545	(3,700)	489,845
Dissemination	46,259	40,099	6,644	46,743	0	46,743
Science and Technology Integration	123,066	123,600	2,097	125,697	8,500	134,197
Total, National Weather Service - ORF	949,145	954,153	22,343	976,496	(12,933)	963,563
Other National Weather Service Accounts						
Total, National Weather Service - PAC	113,442	133,300	(3,000)	130,300	5,015	135,315
Total, National Weather Service - Other	0	0	0	0	0	0
GRAND TOTAL NWS	1,062,587	1,087,453	19,343	1,106,796	(7,918)	1,098,878



NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Environmental Satellite Observing Systems						
Office of Satellite and Product Operations (OSPO)						
Satellite and Product Operations	83,869	84,000	4,499	88,499	4,582	93,081
NSOF Operations	7,988	8,500	500	9,000	0	9,000
Subtotal, Office of Satellite and Product Op- erations (OSPO)	91,857	92,500	4,999	97,499	4,582	102,081
Product Development, Readiness & Application						
Product Development, Readiness & Application	24,459	26,000	316	26,316	0	26,316
Subtotal, Product Development, Readiness & Application	24,459	26,000	316	26,316	0	26,316
Commercial Remote Sensing Regulatory Affairs	998	1,000	0	1,000	200	1,200
Office of Space Commercialization	599	600	0	600	400	1,000
Group on Earth Observations (GEO)	499	500	0	500	0	500
Total, Environmental Satellite Observing Systems	118,412	120,600	5,315	125,915	5,182	131,097
National Centers for Environmental Information						
National Centers for Environmental Information	66,463	68,000	(9,820)	58,180	1,067	59,247
Total, National Centers for Environmental Information	66,463	68,000	(9,820)	58,180	1,067	59,247
Total, NESDIS - ORF	184,875	188,600	(4,505)	184,095	6,249	190,344
Other NESDIS Accounts						
Total, NESDIS - PAC	1,902,219	2,034,544	6,150	2,040,694	148,589	2,189,283
Total, NESDIS - Other	0	0	0	0	0	0
GRAND TOTAL NESDIS	2,087,094	2,223,144	1,645	2,224,789	154,838	2,379,627

PROGRAM SUPPORT

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Corporate Services						
Under Secretary and Associate Offices						
Under Secretary and Associate Offices Base	26,958	27,000	188	27,188	0	27,188
Subtotal, Under Secretary and Associate Offices	26,958	27,000	188	27,188	0	27,188
NOAA Wide Corporate Services & Agency Management						
NOAA Wide Corporate Services & Agency Management Base	110,828	112,000	2,632	114,632	4,341	118,973
DOC Accounting System	9,984	10,000	223	10,223	0	10,223
Payment to the DOC Working Capital Fund	46,204	40,000	29,822	69,822	0	69,822
Subtotal, NOAA Wide Corporate Services & Agency Management	167,016	162,000	32,677	194,677	4,341	199,018
IT Security						
IT Security	8,287	8,300	0	8,300	0	8,300
Subtotal, IT Security	8,287	8,300	0	8,300	0	8,300
Total, Corporate Services	202,261	197,300	32,865	230,165	4,341	234,506
Office of Education						
BWET Regional Programs	7,189	7,200	0	7,200	(7,200)	0
Education Partnership Program/Minority Serving Institutions (EPP/MSI)	14,378	14,400	(14,400)	0	0	0
Office of Education	5,591	6,000	14,431	20,431	(4,000)	16,431
Total, Office of Education	27,158	27,600	31	27,631	(11,200)	16,431
Facilities						
NOAA Facilities Management & Construction and Safety	22,964	23,000	67	23,067	2,000	25,067
Subtotal, NOAA Facilities Management, Construction & Maintenance	22,964	23,000	67	23,067	2,000	25,067
Total, Facilities	22,964	23,000	67	23,067	2,000	25,067
Total, Program Support - ORF	252,383	247,900	32,963	280,863	(4,859)	276,004
Total, Program Support - PAC	0	0	0	0	1,000	1,000
Total, Program Support - ORF and PAC	252,383	247,900	32,963	280,863	(3,859)	277,004
Marine Operations & Maintenance						

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Marine Operations & Maintenance	169,736	175,000	3,838	178,838	0	178,838
Total, Marine Operations & Maintenance	169,736	175,000	3,838	178,838	0	178,838
Aviation Operations						
Aircraft Services	31,152	31,600	693	32,293	0	32,293
Total, Aviation Operations	31,152	31,600	693	32,293	0	32,293
Total, OMAO - ORF	200,888	206,600	4,531	211,131	0	211,131
Total, OMAO - PAC	5,192	6,000	0	6,000	152,700	158,700
Total, OMAO - Other	30,205	30,205	0	30,205	0	30,205
Total, OMAO - ORF, PAC and Other	236,285	242,805	4,531	247,336	152,700	400,036
Total, Program Support and OMAO - ORF	453,271	454,500	37,494	491,994	(4,859)	487,135
Other Program Support and OMAO Accounts						
Total, Program Support - PAC	5,192	6,000	0	6,000	153,700	159,700
Total, Program Support - Other	30,205	30,205	0	30,205	0	30,205
GRAND TOTAL PS	488,668	490,705	37,494	528,199	148,841	677,040

ORF SUMMARY LINE OFFICE DIRECT OBLIGATIONS

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
National Ocean Service	471,213	481,107	6,564	487,671	59,419	547,090
National Marine Fisheries Service	809,297	822,138	14,411	836,549	51,687	888,236
Office of Oceanic and Atmospheric Research	413,545	432,900	6,630	439,530	45,126	484,656
National Weather Service	949,145	954,153	22,343	976,496	(12,933)	963,563
National Environmental Satellite, Data and Information Service	184,875	188,600	(4,505)	184,095	6,249	190,344
Program Support	453,271	454,500	37,494	491,994	(4,859)	487,135
SUBTOTAL LO DIRECT OBLIGATIONS	3,281,346	3,333,398	82,937	3,416,335	144,689	3,561,024



ORF ADJUSTMENTS

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
SUBTOTAL LO DIRECT OBLIGATIONS	3,281,346	3,333,398	82,937	3,416,335	144,689	3,561,024
FINANCING						
De-Obligations	(15,000)	(15,000)	(2,500)	(17,500)	0	(17,500)
Unobligated Balance, SOY	0	0	0	0	0	0
Rescission	0	0	0	0	0	0
Total ORF Financing	(15,000)	(15,000)	(2,500)	(17,500)	0	(17,500)
SUBTOTAL BUDGET AUTHORITY	3,266,346	3,318,398	80,437	3,398,835	144,689	3,543,524
TRANSFERS						
Transfer from P&D to ORF	(115,000)	(116,000)	(14,164)	(130,164)	0	(130,164)
Total ORF Transfers	(108,954)	(116,000)		(130,164)	0	(130,164)
SUBTOTAL APPROPRIATION	3,157,392	3,202,398	66,273	3,268,671	144,689	3,413,360

PROCUREMENT, ACQUISITION, AND CONSTRUCTION

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
NOS						
NERRS Construction						
National Estuarine Research Reserve Construction (NERRS)	1,697	1,700	0	1,700	0	1,700
Subtotal, NERRS Construction	1,697	1,700	0	1,700	0	1,700
Marine Sanctuaries Construction						
Marine Sanctuaries Base	1,997	2,000	0	2,000	0	2,000
Subtotal, Marine Sanctuary Construction	1,997	2,000	0	2,000	0	2,000
Subtotal, NOS Construction	3,694	3,700	0	3,700	0	3,700
Total, NOS - PAC	3,694	3,700	0	3,700	0	3,700
Total, NMFS - PAC	0	0	0	0	0	0
OAR						
Systems Acquisition						
Research Supercomputing/ CCRI	10,363	13,379	0	13,379	9,000	22,379
Subtotal, OAR Systems Acquisition	10,363	13,379	0	13,379	9,000	22,379
Total, OAR - PAC	10,363	13,379	0	13,379	9,000	22,379
NWS						
Systems Acquisition						
Observations	5,640	12,300	(3,000)	9,300	7,420	16,720
Central Processing	65,658	64,000	0	64,000	261	64,261
Dissemination	34,156	45,000	0	45,000	684	45,684
Subtotal, NWS Systems Acquisition	105,454	121,300	(3,000)	118,300	8,365	126,665
Construction						
Facilities Construction and Major Repairs	7,988	12,000	0	12,000	(3,350)	8,650
Subtotal, NWS Construction	7,988	12,000	0	12,000	(3,350)	8,650
Total, NWS - PAC	113,442	133,300	(3,000)	130,300	5,015	135,315

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
NESDIS						
Systems Acquisition						
Geostationary Systems - R	940,416	980,838	0	980,838	(109,047)	871,791
Jason-3	35,171	23,175	0	23,175	(15,717)	7,458
Joint Polar Satellite System (JPSS)	819,575	916,267	0	916,267	(107,301)	808,966
Polar Follow-on	0	0	0	0	380,000	380,000
Solar Irradiance, Data and Rescue (SIDAR)	0	7,300	0	7,300	(6,800)	500
DSCOVR	23,638	21,100	0	21,100	(17,900)	3,200
Space Weather Follow-on	0	0	0	0	2,500	2,500
COSMIC 2/GNSS RO	1,997	6,800	0	6,800	13,200	20,000
Satellite Ground Services	49,708	50,000	5,808	55,808	2,717	58,525
System Architecture and Advanced Planning	4,587	3,000	342	3,342	1,587	4,929
Projects, Planning and Analysis	26,402	25,200	0	25,200	5,288	30,488
Subtotal, NESDIS Systems Acquisition	1,901,494	2,033,680	6,150	2,039,830	148,527	2,188,357
Construction						
Satellite CDA Facility	1,725	2,166	0	2,166	62	2,228
Subtotal, NESDIS Construction	1,725	2,166	0	2,166	62	2,228
Transfer to OIG	(1,000)	(1,302)	0	(1,302)	0	(1,302)
Total, NESDIS - PAC	1,902,219	2,034,544	6,150	2,040,694	148,589	2,189,283
Program Support						
Construction						
NOAA Construction	0	0	0	0	1,000	1,000
Subtotal, Construction	0	0	0	0	1,000	1,000
Total, Program Support - PAC	0	0	0	0	1,000	1,000
OMAO						
OMAO - Fleet Replacement						
Fleet Capital Improvements & Tech Infusion (Vessel Equip & Tech Refresh)	5,192	6,000	0	6,000	5,700	11,700
New Vessel Construction	0	0	0	0	147,000	147,000
Subtotal, OMAO Fleet Replacement	5,192	6,000	0	6,000	152,700	158,700
Total, OMAO - PAC	5,192	6,000	0	6,000	152,700	158,700
GRAND TOTAL PAC	2,034,910	2,190,923	3,150	2,194,073	316,304	2,510,377

PAC ADJUSTMENTS

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
SUBTOTAL DIRECT OBLIGATIONS	2,034,910	2,190,923	3,150	2,194,073	316,304	2,510,377
FINANCING						
Deobligations	(7,000)	(13,000)	0	(13,000)	0	(13,000)
Unobligated Balance Adj. SOY (start of year)	0	0	0	0	0	0
Unobligated Balance End of Year	0	0	0	0	0	0
Total PAC Financing	(7,000)	(13,000)	0	(13,000)	0	(13,000)
SUBTOTAL BUDGET AUTHORITY	2,027,910	2,177,923	3,150	2,181,073	316,304	2,497,377
TRANSFERS						
Transfer from ORF to PAC	(6,046)	0	0	0	0	0
Transfer to OIG	1,000	1,302	0	1,302	0	1,302
Total PAC Transfers/Rescissions	(5,046)	1,302	0	1,302	0	1,302
SUBTOTAL APPROPRIATION	2,022,864	2,179,225	3,150	2,182,375	316,304	2,498,679



OTHER ACCOUNTS (DISCRETIONARY)

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
NMFS						
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	10,300	10,300
Fisheries Finance Program Account Budget Authority	0	0	0	0	10,300	10,300
Fisheries Finance Program Account Appropriation	0	0	0	0	10,300	10,300
Promote and Develop Fisheries Obligations	0	0	0	0	0	0
Promote and Develop Fisheries Budget Authority	(115,000)	(116,000)	(14,164)	(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	(7,000)	58,000
Pacific Coastal Salmon Fund Budget Authority	65,000	65,000	0	65,000	(7,000)	58,000
Pacific Coastal Salmon Fund Appropriation	65,000	65,000	0	65,000	(7,000)	58,000
Marine Mammal Unusual Mortality Event Fund Obligations	0	0	50	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	75,000	0	0	0	0	0
Fisheries Disaster Assistance Fund Budget Authority	75,000	0	0	0	0	0
Fisheries Disaster Assistance Fund Appropriation	75,000	0	0	0	0	0
Subtotal, NMFS Other Discretionary Direct Obligation	140,350	65,350	50	65,400	3,300	68,700
Subtotal, NMFS Other Discretionary Budget Authority	25,350	(50,650)	(14,164)	(64,814)	3,300	(61,514)
Subtotal, NMFS Other Discretionary Appropriation	140,350	65,350	0	65,350	3,300	68,650
OMAO						
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

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Medicare Eligible Retiree Healthcare Fund Acct Ap- propriations	1,936	1,936	0	1,936	0	1,936
Subtotal, OMAO Other Discretionary Direct Obligations	1,936	1,936	0	1,936	0	1,936
Subtotal, OMAO Other Discretionary Budget Authority	1,936	1,936	0	1,936	0	1,936
Subtotal, OMAO Other Discretionary Appropriation	1,936	1,936	0	1,936	0	1,936
TOTAL, OTHER DISCRETIONARY DIRECT OBLIGATIONS	142,286	67,286	50	67,336	3,300	70,636
TOTAL, OTHER DISCRETIONARY BUDGET AUTHORITY	27,286	(48,714)	(14,164)	(62,878)	3,300	(59,578)
TOTAL, OTHER DISCRETIONARY APPROPRIATION	142,286	67,286	0	67,286	3,300	70,586



GRAND TOTAL SUMMARY DISCRETIONARY APPROPRIATIONS

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Operations, Research and Facilities	3,157,392	3,202,398	66,273	3,268,671	144,689	3,413,360
Procurement, Acquisition and Construction	2,022,864	2,179,225	3,150	2,182,375	316,304	2,498,679
Coastal Zone Management Fund	0	0	0	0	0	0
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	10,300	10,300
Pacific Coastal Salmon Fund	65,000	65,000	0	65,000	(7,000)	58,000
Fisheries Disaster Assistance Fund	75,000	0	0	0	0	0
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
GRAND TOTAL DISCRETIONARY APPROPRIATION	5,322,542	5,448,909	69,423	5,518,332	464,293	5,982,625

SUMMARY OF DISCRETIONARY RESOURCES

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Discretionary Direct Obligations						
ORF Direct Obligations	3,281,346	3,333,398	82,937	3,416,335	144,689	3,561,024
PAC Direct Obligations	2,034,910	2,190,923	3,150	2,194,073	316,304	2,510,377
OTHER Direct Obligations	142,286	67,286	50	67,336	3,300	70,636
TOTAL Discretionary Direct Obligations	5,458,542	5,591,607	86,137	5,677,744	464,293	6,142,037
Discretionary Budget Authority						
ORF Budget Authority	3,266,346	3,318,398	80,437	3,398,835	144,689	3,543,524
PAC Budget Authority	2,027,910	2,177,923	3,150	2,181,073	316,304	2,497,377
OTHER Budget Authority	27,286	(48,714)	(14,164)	(62,878)	3,300	(59,578)
TOTAL Discretionary Budget Authority	5,321,542	5,447,607	69,423	5,517,030	464,293	5,981,323
Discretionary Appropriations						
ORF Appropriations	3,157,392	3,202,398	66,273	3,268,671	144,689	3,413,360
PAC Appropriations	2,022,864	2,179,225	3,150	2,182,375	316,304	2,498,679
OTHER Appropriations	142,286	67,286	0	67,286	3,300	70,586
TOTAL Discretionary Appropriation	5,322,542	5,448,909	69,423	5,518,332	464,293	5,982,625



OTHER ACCOUNTS (MANDATORY)

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
NOS						
Damage Assessment & Restoration Revolving Fund Obligations	20,633	48,611	(27,643)	20,968	0	20,968
Damage Assessment & Restoration Revolving Fund Budget Authority	5,424	6,170	(202)	5,968	0	5,968
Damage Assessment & Restoration Revolving Fund Appropriation	0	0	0	0	0	0
Sanctuaries Enforcement Asset Forfeiture Fund Obligations	929	242	(118)	124	0	124
Sanctuaries Enforcement Asset Forfeiture Fund Budget Authority	928	242	(118)	124	0	124
Sanctuaries Enforcement Asset Forfeiture Fund Appropriation	1,000	183	(63)	120	0	120
Gulf Coast Ecosystem Restoration Fund Obligations	1,697	2,078	0	2,078	0	2,078
Gulf Coast Ecosystem Restoration Fund Budget Authority	1,697	2,078	0	2,078	0	2,078
Gulf Coast Ecosystem Restoration Fund Appropriation	1,819	2,078	0	2,078	0	2,078
Subtotal, NOS Other Mandatory Direct Obligations	23,259	50,931	(27,761)	23,170	0	23,170
Subtotal, NOS Other Mandatory Budget Authority	8,049	8,490	(320)	8,170	0	8,170
Subtotal, NOS Other Mandatory Appropriation	2,819	2,261	(63)	2,198	0	2,198
NMFS						
Promote and Develop Fisheries Obligations	12,187	26,615	(13,041)	13,574	0	13,574
Promote and Develop Fisheries Budget Authority	120,774	142,615	1,123	143,738	0	143,738
Promote and Develop Fisheries Appropriation	0	0	0	0	0	0
Fisheries Finance Program Account Obligations	14,629	22,757	(22,757)	0	0	0
Fisheries Finance Program Account Budget Authority	14,629	22,757	(22,757)	0	0	0
Fisheries Finance Program Account Appropriation	14,629	22,757	(22,757)	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
Environmental Improve & Restoration Fund Obligations	9,087	1,311	(977)	334	0	334
Environmental Improve & Restoration Fund Budget Authority	9,087	1,311	1,910	3,221	0	3,221
Environmental Improve & Restoration Fund Appropriation	9,792	1,414	2,057	3,471	0	3,471

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
Limited Access System Administration Fund Obligations	9,338	10,893	632	11,525	0	11,525
Limited Access System Administration Fund Budget Authority	8,998	11,710	(1,437)	10,273	0	10,273
Limited Access System Administration Fund Appropriation	9,718	11,855	(1,706)	10,149	0	10,149
Western Pacific Sustainable Fisheries Fund Obligations	218	322	(72)	250	0	250
Western Pacific Sustainable Fisheries Fund Budget Authority	160	322	(72)	250	0	250
Western Pacific Sustainable Fisheries Fund Appropriation	250	250	0	250	0	250
Fisheries Enforcement Asset Forfeiture Fund Obligations	3,769	4,052	(52)	4,000	0	4,000
Fisheries Enforcement Asset Forfeiture Fund Budget Authority	3,712	4,068	(68)	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	3,898	4,756	(1,254)	3,502	0	3,502
North Pacific Observer Fund Budget Authority	3,898	4,756	(1,254)	3,502	0	3,502
North Pacific Observer Fund Appropriation	4,200	4,800	(1,400)	3,400	0	3,400
Subtotal, NMFS Other Mandatory Direct Obligations	53,126	70,706	(37,521)	33,185	0	33,185
Subtotal, NMFS Other Mandatory Budget Authority	161,258	187,539	(22,555)	164,984	0	164,984
Subtotal, NMFS Other Mandatory Appropriation	42,589	45,076	(23,806)	21,270	0	21,270
OMAO						
NOAA Corp Commissioned Officers Retirement Obligations	28,269	28,269	0	28,269	0	28,269
NOAA Corp Commissioned Officers Retirement Budget Authority	28,269	28,269	0	28,269	0	28,269
NOAA Corp Commissioned Officers Retirement Budget Appropriation	28,269	28,269	0	28,269	0	28,269
Subtotal, OMAO Other Mandatory Direct Obligations	28,269	28,269	0	28,269	0	28,269
Subtotal, OMAO Other Mandatory Budget Authority	28,269	28,269	0	28,269	0	28,269
Subtotal, OMAO Other Mandatory Appropriation	28,269	28,269	0	28,269	0	28,269
TOTAL, OTHER MANDATORY DIRECT OBLIGATIONS	104,654	149,906	(65,282)	84,624	0	84,624
TOTAL, OTHER MANDATORY BUDGET AUTHORITY	197,576	224,298	(22,875)	201,423	0	201,423
TOTAL, OTHER MANDATORY APPROPRIATION	73,677	75,606	(23,869)	51,737	0	51,737

*Obligations and Budget Authority for mandatory accounts have been updated in FY14 to reflect the Pop up of FY13 sequestered funds and in FY15 to reflect FY15 sequestration and the Pop up of FY14 sequestered funds.



NOAA SUMMARY

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
TOTAL Direct Obligations (Discretionary & Mandatory)	5,563,196	5,741,513	20,855	5,762,368	464,293	6,226,661
TOTAL Budget Authority (Discretionary & Mandatory)	5,519,118	5,671,905	46,548	5,718,453	464,293	6,182,746
TOTAL Appropriation (Discretionary & Mandatory)	5,396,219	5,524,515	45,554	5,570,069	464,293	6,034,362
Reimbursable Financing	416,687	406,969	(164,969)	242,000	0	242,000
TOTAL OBLIGATIONS (Direct & Reimbursable)	5,979,883	6,148,482	(144,114)	6,004,368	464,293	6,468,661
Offsetting Receipts	(6,000)	(5,439)	1,604	(3,835)	0	(3,835)
TOTAL OBLIGATIONS (Direct, Reimbursable & Offsetting Receipts)	5,973,883	6,143,043	(142,510)	6,000,533	464,293	6,464,826

LINE OFFICE SUMMARY

FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
National Ocean Service						
ORF	471,213	481,107	6,564	487,671	59,419	547,090
PAC	3,694	3,700	0	3,700	0	3,700
OTHER	23,259	50,931	(27,761)	23,170	0	23,170
TOTAL, NOS	498,166	535,738		514,541	59,419	573,960
National Marine Fisheries Service						
ORF	809,297	822,138	14,411	836,549	51,687	888,236
PAC	0	0	0	0	0	0
OTHER	193,476	136,056	(37,471)	98,585	3,300	101,885
TOTAL, NMFS	1,002,773	958,194		935,134	54,987	990,121
Oceanic and Atmospheric Research						
ORF	413,545	432,900	6,630	439,530	45,126	484,656
PAC	10,363	13,379	0	13,379	9,000	22,379
OTHER	0	0	0	0	0	0
TOTAL, OAR	423,908	446,279	6,630	452,909	54,126	507,035
National Weather Service						
ORF	949,145	954,153	22,343	976,496	(12,933)	963,563
PAC	113,442	133,300	(3,000)	130,300	5,015	135,315
OTHER	0	0	0	0	0	0
TOTAL, NWS	1,062,587	1,087,453	19,343	1,106,796	(7,918)	1,098,878
National Environmental Satellite, Data and Information Service						
ORF	184,875	188,600	(4,505)	184,095	6,249	190,344
PAC	1,902,219	2,034,544	6,150	2,040,694	148,589	2,189,283
OTHER	0	0	0	0	0	0
TOTAL, NESDIS	2,087,094	2,223,144	1,645	2,224,789	154,838	2,379,627
Program Support / Corporate Services						
ORF	202,261	197,300	32,865	230,165	4,341	234,506
PAC	0	0	0	0	0	0
OTHER	0	0	0	0	0	0
SUBTOTAL, PS / Corporate Services	202,261	197,300	32,865	230,165	4,341	234,506
Program Support / NOAA Education Program						
ORF	27,158	27,600	31	27,631	(11,200)	16,431
PAC	0	0	0	0	0	0

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FY 2016 PROPOSED OPERATING PLAN (\$ IN THOUSANDS)	FY 2014 Spend Plan	FY 2015 Enacted	FY 2016 Total ATBs	FY 2016 Base	FY 2016 Program Changes	FY 2016 Estimate
OTHER	0	0	0	0	0	0
SUBTOTAL, PS / NOAA Education Program	27,158	27,600	31	27,631	(11,200)	16,431
Program Support / Facilities						
ORF	22,964	23,000	67	23,067	2,000	25,067
PAC	0	0	0	0	1,000	1,000
OTHER	0	0	0	0	0	0
SUBTOTAL, PS / Facilities	22,964	23,000	67	23,067	3,000	26,067
Program Support / Corp Srv, Edu, Fac						
ORF	252,383	247,900	32,963	280,863	(4,859)	276,004
PAC	0	0	0	0	1,000	1,000
OTHER	0	0	0	0	0	0
TOTAL, PS / Corp Srv, Edu, Fac	252,383	247,900	32,963	280,863	(3,859)	277,004
Program Support / Office of Marine and Aviation Operations						
ORF	200,888	206,600	4,531	211,131	0	211,131
PAC	5,192	6,000	0	6,000	152,700	158,700
OTHER	30,205	30,205	0	30,205	0	30,205
TOTAL, PS / OMAO	236,285	242,805	4,531	247,336	152,700	400,036
Total PS ORF	453,271	454,500	37,494	491,994	(4,859)	487,135
Total PS PAC	5,192	6,000	0	6,000	153,700	159,700
Total PS Other	30,205	30,205	0	30,205	0	30,205
TOTAL, PS	488,668	490,705	37,494	528,199	148,841	677,040
DIRECT OBLIGATIONS						
ORF	3,281,346	3,333,398	82,937	3,416,335	144,689	3,561,024
PAC	2,034,910	2,190,923	3,150	2,194,073	316,304	2,510,377
OTHER	246,940	217,192	(65,232)	151,960	3,300	155,260
TOTAL, DIRECT OBLIGATIONS	5,563,196	5,741,513	20,855	5,762,368	464,293	6,226,661
ORF Adjustments (Deobligations/Rescissions)	(15,000)	(15,000)	(2,500)	(17,500)	0	(17,500)
ORF Transfers	(108,954)	(116,000)		(130,164)	0	(130,164)
PAC Adjustments (Deobligations/Rescissions)	(7,000)	(13,000)	0	(13,000)	0	(13,000)
PAC Transfers	(5,046)	1,302	0	1,302	0	1,302
OTHER Discretionary Adjustments	0	0	(50)	(50)	0	(50)
Mandatory Accounts Excluded	(104,654)	(149,906)	65,282	(84,624)	0	(84,624)
TOTAL, DISCRETIONARY APPROPRIATIONS	5,322,542	5,448,909	69,423	5,518,332	464,293	5,982,625



United States Department of Commerce
National Oceanic and Atmospheric Administration
14th and Constitution Avenue, NW
Washington, DC 20230
www.noaa.gov

National Ocean Service
www.nos.noaa.gov

National Marine Fisheries Service
www.nmfs.noaa.gov

Office of Oceanic and Atmospheric Research
www.oar.noaa.gov

National Weather Service
www.nws.noaa.gov

National Satellite and Information Service
www.nesdis.noaa.gov

Office of Marine and Aviation Operations
www.oma.noaa.gov

Report Summary

Sea Change



2015–2025 Decadal Survey of Ocean Sciences

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

New observational and computational technologies are transforming the ability of scientists to study the global ocean with a more integrated and dynamic approach. This enhanced understanding of the ocean is becoming ever more important in our economically and geopolitically connected world, enabling informed decisions on vital ocean policy matters.

In the United States, the National Science Foundation (NSF) is the primary funder of the basic research that underlies advances in our understanding of the ocean. This study addresses the strategic investments necessary at NSF to ensure a robust ocean scientific enterprise over the next decade.

Scientific Advances from Ocean Research

The ocean science community has undertaken the challenge of exploring the ocean domain and over the past few decades has produced a remarkable surge in understanding the physics, biology, and chemistry of the ocean, and the geology and geophysics at and beneath the seafloor. Technological advances have fueled much of the increase in knowledge, as ocean scientists have rapidly adopted, developed, and employed new computational and modeling capabilities, robotics, and technological innovations such as genomics. Satellites and autonomous sensor systems have revealed a dynamic global ocean system on unprecedented temporal and spatial



Beach erosion near homes in North Carolina.
Credit: iStock

scales; chemists have detected significant declines in ocean pH, and biologists have studied the impact of this change in ocean chemistry on marine species and ecosystems. Geologists have documented eruptions on the deep seafloor and discovered microbial communities beneath the

seafloor. Also, ocean research has improved scientific understanding of global climate change, one of the defining issues of the twenty-first century.

These exciting developments in ocean science have been made possible by investments in a portfolio of funds for research, development and application of new technologies, and oceanographic infrastructure such as ships, gliders, and submersibles; in situ and remote observing systems; and other facilities such as marine laboratories, cyberinfrastructure, and sample and data repositories. In addition, substantial advances have arisen from programs that cut across traditional disciplinary boundaries, bringing together scientists from many fields, federal agencies, and other countries. Such programs have yielded insights into the global ocean and have informed policymakers, the private sector, and the general public about both the future opportunities, and limits, of the ocean as a resource.

Ocean Sciences at the National Science Foundation

Although many other federal agencies contribute to ocean science and technology, the Division of Ocean Sciences at NSF (OCE) provides the broadest base of support for the field, including funding for research in physical, biological, and chemical oceanography and marine geology and geophysics, and the development, implementation, and operational support for ocean research infrastructure. Within NSF, OCE encompasses a broad portfolio of diverse interests and

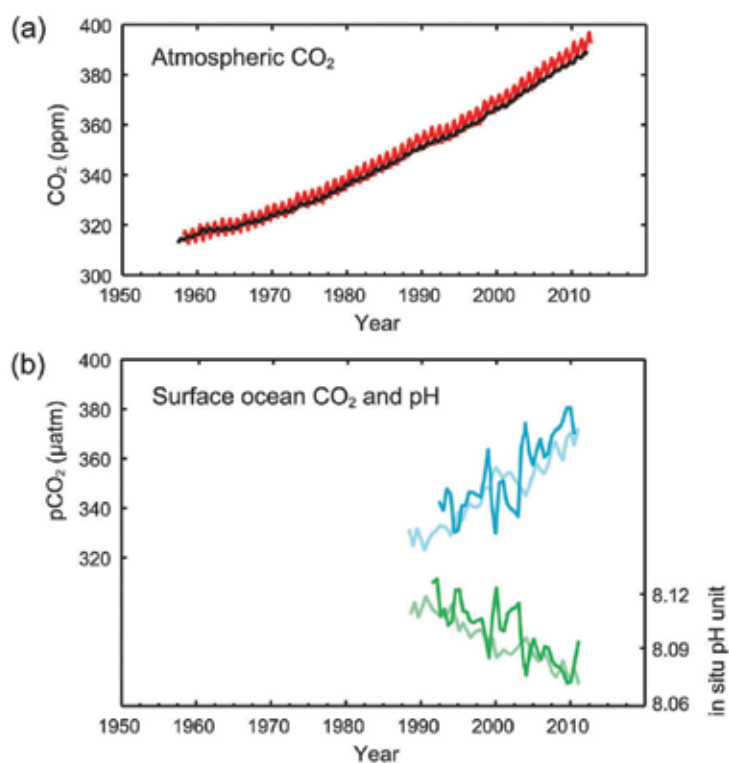


Figure S-1. Observations of increasing CO₂ in the atmosphere (Mauna Loa 19°32'N 155°34'W- red and South Pole Station - black) and surface ocean (BATS 31°40'N 64°10'W - blue and green, and HOT 22°45'N 158°00'W - light blue and light green) and decreasing surface pH (ocean acidification). The oceanic stations have been occupied at monthly intervals since the late 1980s/early 1990s, and include a host of physical and biogeochemical measurements. SOURCE: IPCC5 and references therein; Dore et al., 2008.

activities. Managing this enterprise has been made more challenging with the continued increase in operations and maintenance costs for the ocean research facilities, especially the academic research fleet, scientific ocean drilling through the International Ocean Discovery Program (IODP), and the launch of the Ocean Observatories Initiative (OOI). Infrastructure expenses have risen over the past decade (about 18% in 2014 dollars), even as the total NSF OCE budget fell by more than 10%. With no significant budget increases anticipated by NSF in the near future, strategic decisions are required to ensure that key programmatic elements are supported to maintain the overall health of the ocean sciences community.

Traditionally, NSF seeks community input on long-range research priorities and strategies to optimize scientific investments. A decadal

survey process that establishes research priorities, and then identifies the investments necessary to achieve those priorities, has been used by several scientific disciplines and science agencies to develop community-based plans. In 2013, OCE asked the National Research Council's Ocean Studies Board to undertake a decadal survey of ocean sciences to provide guidance from the ocean sciences community on research and facilities priorities for the coming decade. OCE requested this guidance to address the community's priorities in the context of funding constraints imposed by the current trend of flat or declining budgets. The research portfolio includes investments in infrastructure, individual investigator-based science, multi-investigator large research programs, and cross-directorate initiatives like NSF's Science, Engineering, and Education for Sustainability. The study committee was asked to place NSF's ocean science activities in the context of activities undertaken by other federal

ocean agencies. The committee also examined the role of international cooperation and collaboration in advancing ocean science.

Priority Science Questions and Infrastructure for the Next Decade of Ocean Research

Selection of Priority Science Questions

The committee was asked to select no more than ten ocean science priorities with the goal "to identify areas of strategic investment with the highest potential payoff" for the coming decade (2015-2025). NSF, the Ocean Studies Board, and this committee viewed community involvement as an essential element in the process of identifying priorities. To encourage participation, the committee held town hall meetings at the 2013

American Geophysical Union Fall Meeting (San Francisco, CA) and the 2014 Ocean Sciences Meeting (Honolulu, HI). In addition, the committee solicited input through a web-based virtual town hall that collected over 400 responses from November 2013 to March 2014. The community responses were supplemented with research topics identified in more than 30 reports and publications, presentations by scientists from both academic and government institutions, letters from institutions, and discussions with colleagues. Additionally, the committee actively sought out opinions from early career scientists whose futures will be influenced by decisions made over the next decade.

The committee devoted a major effort to distill the many topics gathered through these sources down to 10 or fewer priorities. The process began with sorting the input into three dozen diverse, high-level, disciplinary and interdisciplinary scientific questions. Similar questions were then clustered to yield high-level scientific questions, to which four criteria—transformative research potential, societal impact, readiness, and partnership potential—were applied, listed in order of relative importance. These criteria were derived from previous NRC and interagency reports related to ocean science research priorities, and from suggestions by NSF program managers.

Eight priority science questions emerged from this process, each representing an integrative and strategic research area. The questions cover topics appropriate for OCE core programs,

cross-cutting NSF programs, or in partnership with other federal agencies or international programs. A synopsis of the eight priorities is provided below, ordered from the ocean surface, through the water column, to the seafloor:

- 1. *What are the rates, mechanisms, impacts, and geographic variability of sea level change?***
- 2. *How are the coastal and estuarine ocean and their ecosystems influenced by the global hydrologic cycle, land use, and upwelling from the deep ocean?***
- 3. *How have ocean biogeochemical and physical processes contributed to today's climate and its variability, and how will this system change over the next century?***
- 4. *What is the role of biodiversity in the resilience of marine ecosystems and how will it be affected by natural and anthropogenic changes?***
- 5. *How different will marine food webs be at mid-century? In the next 100 years?***
- 6. *What are the processes that control the formation and evolution of ocean basins?***
- 7. *How can risk be better characterized and the ability to forecast geohazards like mega-earthquakes, tsunamis, undersea landslides, and volcanic eruptions be improved?***
- 8. *What is the geophysical, chemical, and biological character of the subseafloor environment and how does it affect global elemental cycles and understanding of the origin and evolution of life?***

Each of these high level questions encompasses many sub-topics that are described in much greater detail in the report. Most of the questions will require interdisciplinary research across the sub-disciplines of ocean science as they are managed within OCE, within the disciplines of the Geosciences Directorate (GEO), and across Directorates. Because interdisciplinary research across the subfields of ocean science will be essential to achieve many of the decadal science priorities, it is particularly important that the ocean science community does not encounter or perceive barriers to obtaining funding for interdisciplinary research.



Credit: NOAA

The OCE core programs will likely address many aspects of the scientific priorities identified above, but the committee recognizes that it would be counterproductive to constrain the core programs to fund only those proposals directly related to these priorities. To advance ocean science and technology, the core programs require a high degree of flexibility to fund basic research and promising new ideas and approaches, respond to infrequent events that present opportunities to understand key phenomena, incorporate advances from other areas of science and technology, and encourage the training and professional development of the next generation of scientists.

Because the eight priority questions have broad relevance to societal issues, other federal agencies may also be interested in devoting resources to addressing these research topics. Collaborations between U.S. basic research and mission agencies could hasten both research advancements and transition to operational products by taking advantage of complementary skills, resources, and expertise among organizations. Industry, foundations, international organizations, and non-governmental organizations could also be engaged to assist in addressing these questions, due to their global reach.

Alignment of Infrastructure to the Priority Science Questions

One purpose of identifying priorities in this report is to ensure alignment between the next decade’s foremost topics in ocean science and the National Science Foundation’s (NSF) investments in ocean research infrastructure. The committee assessed how well the current portfolio of NSF-supported ocean research infrastructure matched the decadal science priorities and focused on three major infrastructure assets—the academic research fleet, IODP, and OOI—which together

comprise over 50% of the total OCE budget and over 90% of the infrastructure budget. In addition, the committee evaluated a few smaller facilities and programs supported by OCE, such as the National Deep Submergence Facility and field stations.

The committee identified categories of alignment between infrastructure and each decadal science question. Critical refers to infrastructure assets without which the science priority question cannot be addressed effectively and important infrastructure is useful but not essential to address the question.

Academic Research Fleet

The strongest match between current infrastructure and the decadal science priorities is the academic research fleet. Research vessels, especially Global class ships, support a broad swath of oceanographic activities and are essential to achieve all of the science priorities. Global class ships have greater deck loading, berthing, and sea state capacities, and are critical to or important for the multidisciplinary, multi-investigator types of research identified in all of the science priorities. Regional class ships strongly contribute

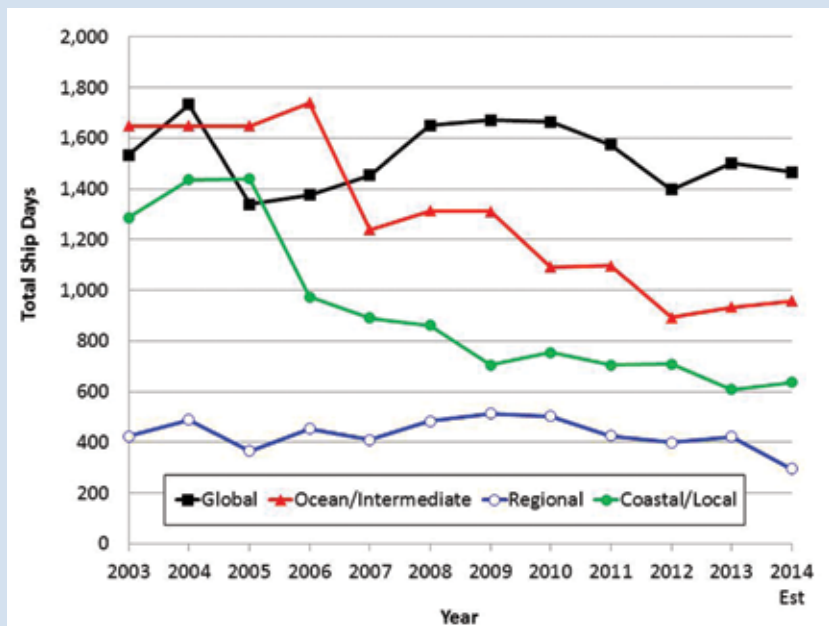


Figure S-2. Ship usage for the UNOLS fleet, broken out by class. Data from NSF and UNOLS, October 2014.

to societally relevant questions in coastal environments, being critical to or important for topics such as sea level rise and biodiversity of marine ecosystems. Ice-capable ships are requisite for answering a number of questions related to understanding climate change, ocean-ice interactions, and polar marine food webs.

NSF is currently considering the acquisition of up to three new Regional class research vessels (RCRVs). Under current plans, the new RCRVs will have a length and berthing capacity comparable to the larger Intermediate class and are expected to have day rates that are substantially higher than the regional ships that are being replaced. This expansion in capability and cost, combined with the restricted geographical range and days at sea associated with the RCRV's regional status, raises the question of whether the current design and estimated day rates of the RCRVs are well matched for expected future use.

Scientific Ocean Drilling

Based on the committee's analysis, scientific ocean drilling facilities and analysis of core collections are critical for the decadal science priorities related to subseafloor exploration, geohazards, and formation and evolution of the ocean basins. They are also important for issues related to



JOIDES Resolution drill ship.

Credit: William Crawford and IODP

climate and sea level variability. Scientific ocean drilling has also proven to be an effective vehicle for science diplomacy through building long-term international partnerships.

NSF has supported an ocean drilling program for over 45 years and, as part of IODP (2013–2018), currently covers the majority of costs for the JOIDES Resolution drill ship. Although scientific ocean drilling is necessarily an “infrastructure-heavy” undertaking, requiring a high proportion of funding for operations relative to research, IODP has implemented many cost-savings measures in recent years to decrease operating costs and improve efficiency. Nevertheless, the United States still carries a heavier financial burden than many of the other contributing countries to cover scientific ocean drilling facilities and operations costs. Moreover, the international community as a whole appears overextended in scientific ocean drilling facilities. NSF has the ability to renegotiate its contribution to the IODP consortium and is strongly urged to pursue a more cost-effective partnership. If additional revenue cannot be found, one budget solution could include a reduction in the total number of platforms operated by members of the consortium, which would allow more efficient utilization of the remaining assets. NSF plans to fund IODP (2013–2018) at a total of \$250 million over the next five years, providing for four JOIDES Resolution expeditions annually.

Ocean Observatories Initiative

The different OOI components—global moorings, coastal arrays, and the regional cabled observatory—are not all at the same level of alignment with the science priorities. The coastal arrays are important for sea level rise, coastal processes, and climate variability; the global moorings are important for climate variability. The regional cabled observatory is important for solid earth and subseafloor biosphere questions.

Because OOI has not yet entered full operation, it lacks both a robust user community and a record of research accomplishments. Therefore, the committee determined that it was premature to make strong statements about potential success, failure, or the possibility



Ocean Observatories Initiative. SOURCE: OOI Cabled Array program and the Center for Environmental Visualization, University of Washington.

for transformational research. However, comments from the virtual town hall and additional discussions with both early-career and established scientists suggest a lack of broad community support for this initiative, exacerbated by an apparent absence of scientific oversight during the construction process. OOI is an expensive new piece of infrastructure; estimated operational costs are at least \$55-to-\$59 million per year for the next five years.

Course Corrections

NSF asked the committee to “recommend a strategy to optimize investments that will advance knowledge in the most critical and/or opportune areas of investigation while also continuing to support core disciplinary science and infrastructure,” and provide “guidance on the most effective portfolio of investments achievable at the current funding level that will support both the research infrastructure and programmatic science necessary to address the most significant priorities.”

The committee undertook this assignment by first developing a vision for the ocean sciences in the next decade:

The ocean science community will undertake research and pursue discoveries that advance our understanding of the oceans, seafloor, coasts, and their ecosystems; foster stewardship of the ocean; reduce society’s vulnerability to ocean hazards; and nurture and exploit the integration of the disciplines. A diverse and talented community of researchers will develop new technologies to study the ocean in novel and cost-effective ways and create innovative educational programs that will engage and inspire the next generation. Partnerships will be fostered across funding agencies, national borders, and the private sector to provide the greatest value for the nation’s investment in ocean science.

With this vision in mind, the committee considered the balance of investments in

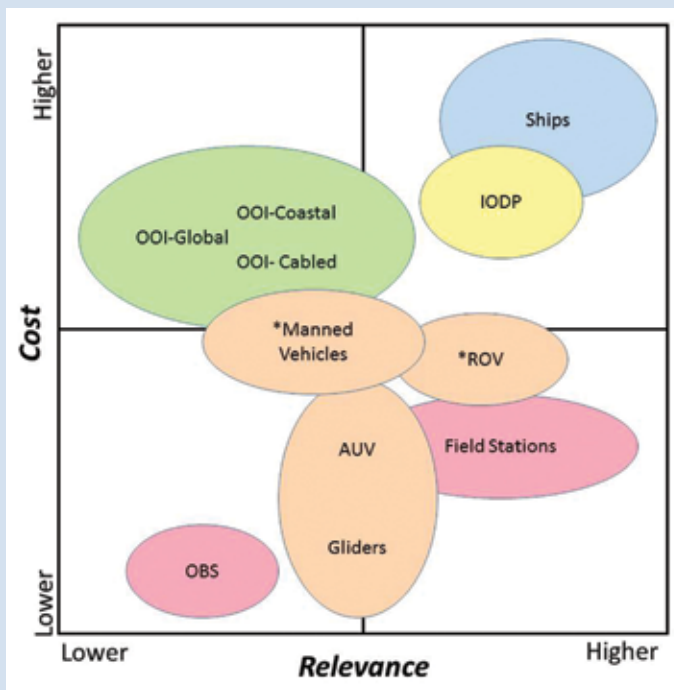


Figure S-3. Relative cost versus relevance of the infrastructure—fleet and other ships (blue), IODP (yellow), OOI (green), vehicles (orange), other (pink). The asterisk next to manned vehicles and ROVs indicates that costs increase if the costs of necessary support vessels are included.

ocean science funding and the research infrastructure. Since 1970, the total budget at OCE has seen an annual growth rate of roughly \$3 million per year (2014 dollars), punctuated by spurts of growth and shrinkage in spending power. Over the past decade the OCE budget has declined by more than 10% (inflation-adjusted¹). During times of budget increases, OCE was able to initiate new technologies and sustain research facilities in addition to maintaining a diverse research portfolio that took advantage of the new capabilities.

From 2000 through 2014, there has been a shift in investment from the core research programs to the operations and maintenance costs of infrastructure. In the last four years the overall budget has not grown; as a consequence, the continued increase in infrastructure costs (more than 16% in 2014 dollars) has resulted in a substantial decline (about 26% in 2014 dollars) in the amount of funding available for the core research programs and therefore less support for investigator proposals. The funding for Oceanographic Technology and Interdisciplinary Coordination (OTIC), the main source of support for technology development within OCE, has been particularly hard hit by this decline.

Since the committee was asked to assume that the OCE budget is unlikely to grow significantly over the next decade, and given that cost inflation will continue at recent historical rates (~2%/year), the only way to recover funding for core science and OTIC is to reduce the amount of money spent on infrastructure. Such reductions are not easy and will cause disruptions for parts of the ocean science community. However, restoring the core science budget and investing prudently in new technology will promote the vision presented above—a diverse community of scientists able to undertake research and pursue discoveries that will advance ocean science. During the next five years, the goal is to carry out necessary programmatic changes to prepare for full implementation of the vision during the second half of the decade.

¹ Inflation adjustments were based on the U.S. Bureau of Labor Statistics Consumer Price Index annual average, with the exception of 2014. 2014 was based on an average of January–November values.

Recommendation 1: 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, infrastructure expenses should not be allowed to escalate at the expense of core research programs.

The committee identified two models to achieve balance—(1) maintaining a fixed ratio for infrastructure costs relative to the total budget and (2) maintaining a consistent long-term funding trajectory for core science. The applicability of these two approaches depends on the fiscal outlook. In periods of flat or declining budgets, using a fixed ratio as a target for guiding expenditures would ensure that one part of the budget does not increase at the expense of the other. In times of increasing budgets, maintaining a consistent long-term funding trajectory for core science, rather than a fixed ratio, may provide a better approach to achieve balance. This approach accommodates adjustments in the budget fraction dedicated to infrastructure costs to reflect short-term needs or long-term changes in the use of existing infrastructure assets, as well as development of new technologies and facilities.

The committee developed a strategy for improving the balance of the OCE budget over the next decade. To restore core science funding during these lean budget times, the immediate goal is to reverse the trend of increasing infrastructure spending at the expense of core science in the OCE budget. Assuming that OCE has a flat budget over the next 10 years, roughly 20% (about \$40 million in 2014 dollars) of the infrastructure O&M budget would need to be reallocated to core science (including OTIC) to meet this goal. This would return core science funding to approximately the budget level in 2011, the last year before funding for core science began to decrease.

Recommendation 2: OCE should strive to reduce the O&M costs of its major infrastructure (OOI, IODP, and the academic research fleet) and restore

funding to core science and OTIC within the next five years. If budgets remain flat or have only inflationary increases, OCE should adjust its major infrastructure programs to comprise no more than 40–50% of the total annual program budget.

Recommendation 3: *To implement Recommendation 2, OCE should initiate an immediate 10% reduction in major infrastructure costs in their next budget, followed by an additional 10–20% decrease over the following five years. Cost savings should be applied directly to strengthening the core science programs, investing in technology development, and funding substantive partnerships to address the decadal science priorities, with the ultimate goal of achieving a rebalancing of major infrastructure costs to core science funding within the next five years.*

There are several options available to reduce infrastructure costs while sustaining research capabilities. These options include: de-scoping or terminating activities; lengthening the time horizon of programs; delaying the start of new or planned programs or facilities; and finding ways to lower costs. Based on the analysis of the infrastructure investment alignments with the scientific priorities, costs of operation, efficiencies that could be gained, and likelihood of community support, the committee determined that the distribution of initial cost reductions between OOI, IODP (2013–2018), and the academic research fleet should be as follows:

Recommendation 4: *The immediate initial 10% cost reduction in major infrastructure should be distributed, with the greatest reduction applied to OOI, a moderate reduction to IODP (2013–2108), and the smallest reduction to the academic research fleet.*

A suggested weighting is to initially and immediately reduce OOI by 20%, IODP by 10%, and the UNOLS fleet by 5%. OOI is recommended for the greatest cost reduction because fewer of its components align strongly with the science priorities, operation of the program can be scaled to fit the available budget, and because the separate components of the OOI structure provide flexibility to retain those components that align more strongly with the decadal science priorities and broad

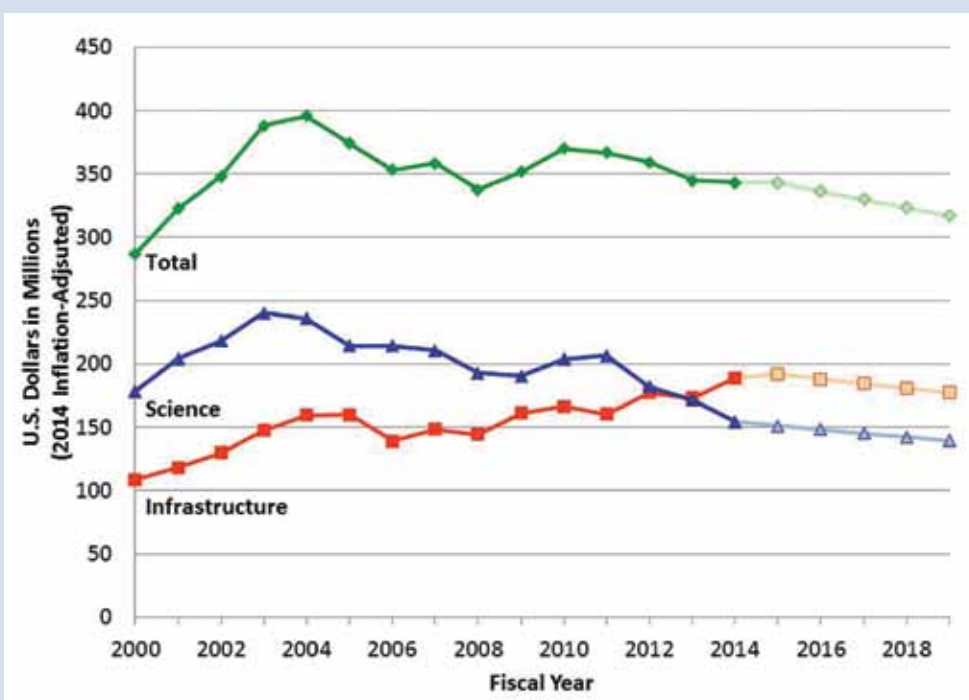


Figure S–4. NSF investments in core ocean science (blue) and infrastructure (orange) since 2000, shown in inflation-adjusted 2014 dollars. Total funding for OCE is shown in green. Projections for FY2015–2019 (lighter colors) are based on the following assumptions provided by OCE—total future budgets are flat with no inflationary increases and ship operations, IODP, and OOI costs are held constant. OCE defines “infrastructure” as the academic research fleet, OOI, IODP, field stations and marine laboratories, the accelerator mass spectrometer facility, and miscellaneous smaller facilities. Facilities held in the core programs are included in core science, not in infrastructure. Data from NSF, December 2014.

OCE research goals. For example, OOI might focus attention on one or two of the four global sites to minimize logistic costs and to demonstrate proof of concept. A moderate weighted cut recommended for the NSF-supported portion of IODP (2013–2018) reflects that IODP is important or critical for over half of the decadal science priorities. However, the JOIDES Resolution is an expensive facility and cost-sharing agreements within the consortium are not evenly distributed. The smallest cost reduction is recommended for the academic research fleet, because essentially all of the science priorities require ship-based access to the sea. Even a modest cut will require finding efficiencies to reduce the costs of the current fleet and to prevent an increase in overall O&M expenses with future ship acquisitions.

Recommendation 5: NSF should reconsider whether the current RCRV design is aligned with scientific needs and is cost-effective in terms of long-term O&M, and should plan to build no more than two RCRVs.

Decision Rules for the Future

The committee established the following strategic principles, to guide decision-making in an uncertain budget climate, which when combined with

open communication and consistent actions will assist NSF in maintaining a balanced portfolio:

Promote a Decadal Budget Planning Outlook

A 10-year budget planning outlook can take into account both inflation and anticipated increased costs of doing business, while accounting for risks associated with unexpected costs.

Maintain Conservative Infrastructure Investment Strategies

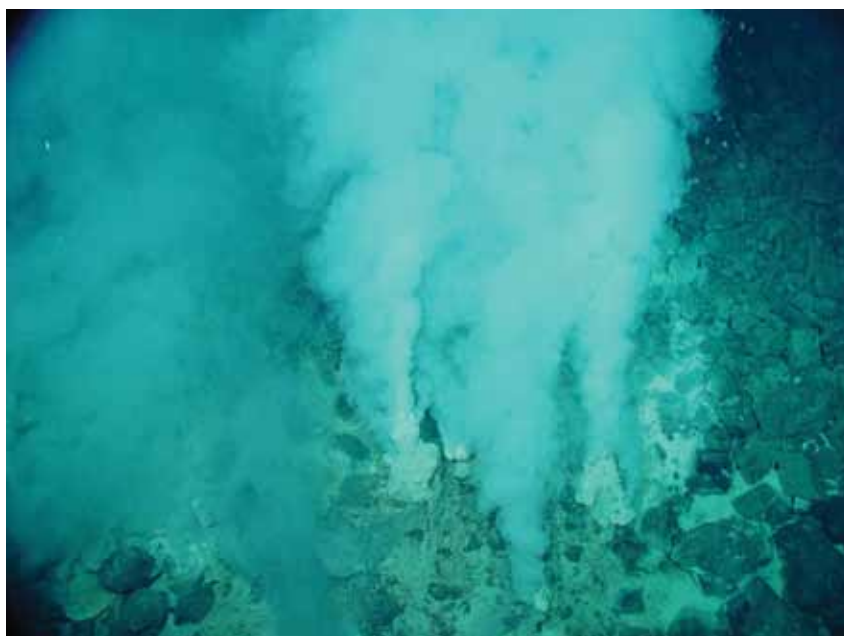
Given the uncertain budget environment, it is prudent to assume budget cuts are permanent and increases are temporary. Strategies for controlling the overall costs of infrastructure have to be identified prior to the addition of any new asset. Assumptions that prove to be too conservative can be corrected in future budget cycles.

Involve the Community in Setting Goals

Involving the scientific community in the development of strategic goals and objectives provides a broad base for identifying priorities and building community support for the enterprise into the future. The NSF Advisory Committee for Geosciences (AC-GEO) could serve as a link with the broader community. Involvement of AC-GEO could bolster support for difficult decisions that need to be made by OCE to adhere to the strategic plans.

Although NSF has undertaken reviews of individual programs and has established committees advising OOI, IODP, the fleet, and NDSF, at present there is no advisory body with broad oversight of major OCE infrastructure that can provide advice on the construction, maintenance, and operations of facilities in relation to the science priorities.

Recommendation 6: Program reviews for OOI, IODP, the academic research fleet, and NDSF should occur periodically (nominally every three to five years, with a 10-year outlook) and should be considered within the context of the broader OCE budget environment, rather than



Hydrothermal vent chimneys at the NW Eifuku volcano in the Mariana Arc. Credit: NOAA

independently. OCE should consider exit strategies for major acquisitions if funding is insufficient. OCE should seek periodic community input to help ensure infrastructure investments align with the science priorities.

Recommendation 7: OCE should initiate a high-level standing infrastructure oversight committee to evaluate the entire portfolio of OCE-supported infrastructure and facilities and to recommend proposed changes. The outlook should be for at least 10 years and should include discussion of the entire lifecycle of construction, operations and maintenance, decommissioning, and recapitalization. Committee membership should include professionals experienced in long-range budgeting and strategic planning.

Ocean research inevitably transcends national boundaries, with numerous opportunities for interagency and international collaboration. Such partnerships can leverage resources and maximize progress, and are expected to play an increasingly strong role for support of large, multi-disciplinary programs to address complex, high-priority, ocean science questions.

Recommendation 8: The committee encourages OCE to expand its partnership capabilities with other federal agencies, international programs, and other sectors. Such partnerships can maximize the value of both research and infrastructure investments and may help spread the costs of major ocean research infrastructure beyond OCE.

Although the contributions of the ocean sciences community have been invaluable in guiding the work of the committee, the conclusions represent the deliberations of its members, who recognize the difficulty of the task and the reality that resolving current budget issues will impact existing programs. The committee focused on the long-term health of the ocean sciences with the goal of restoring a healthy balance among OCE's funding profiles and portfolios, while preserving the essential elements to sustain the research enterprise into the next decade. These strategic issues need to be examined regularly to make continued course corrections as necessary to steer ocean sciences toward a vibrant future.



Credit: kakisky/morgueFile

Committee for the Decadal Survey of Ocean Sciences 2015: **Shirley A. Pomponi** (*Co-Chair*), Harbor Branch Oceanographic Institution–Florida Atlantic University; **David W. Titley** (*Co-Chair*), Pennsylvania State University; **Edward Boyle** (NAS), Massachusetts Institute of Technology; **Melbourne Briscoe**, OceanGeeks, LLC, Alexandria, VA; **Russ E. Davis** (NAS), Scripps Institution of Oceanography; **Margo Edwards**, University of Hawaii at Manoa; **Mary (Missy) H. Feeley**, ExxonMobil Exploration Company (*retired*), Houston; **Donald Forsyth** (NAS), Brown University; **Peter Liss** (FRS), University of East Anglia, United Kingdom and Texas A&M University; **Susan Lozier**, Duke University; **Roberta Marinelli**, University of Southern California, Los Angeles; **James J. McCarthy**, Harvard University; **Alan Mix**, Oregon State University; **Steven A. Murawski**, University of South Florida, St. Petersburg; **Robert T. Paine** (NAS), University of Washington; **Charles Paull**, Monterey Bay Aquarium Research Institute, Moss Landing, CA; **Don Walsh** (NAE), International Maritime Incorporated, Myrtle Point, OR; **Bess B. Ward**, Princeton University; **James A. Yoder**, Woods Hole Oceanographic Institution; **William R. Young** (NAS), Scripps Institution of Oceanography; **Deborah Glickson** (*Study Director*), **Susan Roberts** (*Director*), **Payton Kalina** (*Senior Program Assistant*), **Stacey Karras** (*Research Associate*), National Research Council.

The National Academies appointed the above committee of experts to address the specific task requested by the National Science Foundation. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. For more information, contact the Ocean Studies Board at (202) 334-2714 or visit <http://dels.nas.edu/osb>. Copies of *Sea Change: 2015–2025 Decadal Survey of Ocean Sciences* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

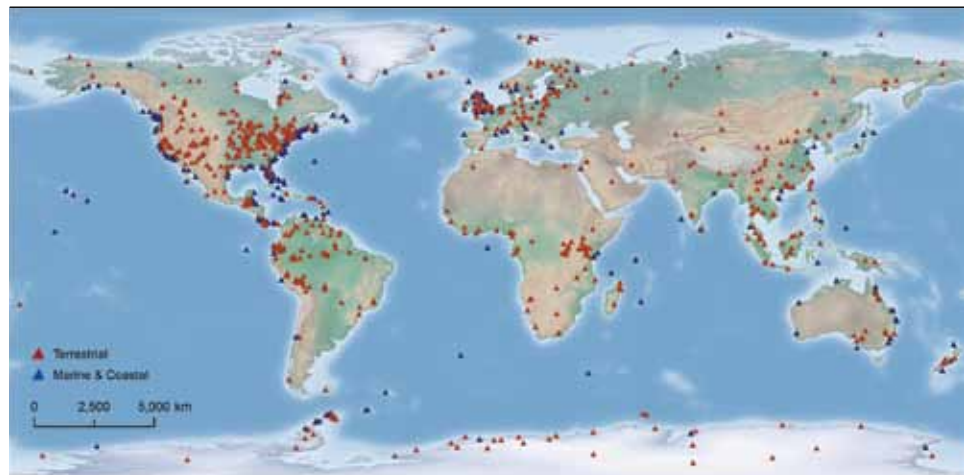
Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century

AMID RAPID ENVIRONMENTAL CHANGE, a strong understanding of the natural world is more important than ever. Field stations and marine laboratories place scientists on the front lines of the changing Earth so they can better understand shifting climate and ecosystems and make robust projections of future conditions. Field stations are a critical part of the scientific infrastructure that bring the basic tools of science into the field and connect scientists, educators, and communities to their environments. But to fulfill their vital roles, field stations and their leadership must continue to evolve. This report explores strategies to harness the power and potential of field stations to address complex challenges, by developing stronger networks, establishing more entrepreneurial leadership and planning, and documenting their impacts in science and society.

To understand the workings of our planet—from how a forest responds to wildfire to how climate change is affecting biodiversity—there is no substitute for directly observing the natural world. Field stations and marine laboratories provide the tools to help make those observations possible in almost every environment, from city to mountain, prairie to desert, to forest, river, and ocean.

Although they range in size, scope, and complexity, all field stations are windows into ecosystems that provide unique educational and research opportunities. Field stations engage local communities in observing the natural world and help connect their observations with decision making.

Away from the hustle and bustle of everyday life, field stations foster collaborations among scientists from different disciplines. But the separation that enables focused research and allows creativity to flourish can also mean that field stations are overlooked by their parent institutions and other funding organizations. In challenging economic times, some field stations—especially remote or small ones—are vulnerable to budget cuts and even closure.



There are more than 900 field stations and marine labs worldwide.

If field stations are to thrive in the 21st century and beyond, they will need to become better able to adapt to changing technologies, economic situations, and societal and scientific needs. At the request of the National Science Foundation, the National Research Council convened an expert committee to review and assess the roles field stations play in supporting research, education, and public outreach; and to identify strategies to help enhance those vital roles in sustainable ways.

SCIENCE FOR AN UNPREDICTABLE WORLD

In an era of rapid climate change, overexploitation of natural resources, and instabilities in food production, field stations provide vital links to the environment

Box 1 An Unexpected Research Opportunity

Native to South America, red fire ants are invasive pests that cost the United States an estimated \$8 billion each year in control, damage mitigation and medical treatment. In 1981, red fire ants invaded the Brackenridge Field Laboratory in Austin, Texas, and inadvertently giving researchers the opportunity to launch an invasive species research program. Today, the Brackenridge Field Laboratory is an international hub for fire ant research that has generated more than \$10 million in research funds and more than 80 publications over 20 years.



Photo credit: John & Kendra Abbott/Abbott Nature Photography

through research, education and community engagement. These connections are more important than ever in understanding, predicting, and modifying the changing relationship of humans with Earth to make them more resilient.

The long-term environmental data gathered at field stations help scientists better understand current changes in ecosystems and climate. Over many years, observations on the timing of leaf budding or the arrival of migratory species allow researchers to document shifting conditions and identify the environmental drivers of change. This historical record allows more robust projections of future change and that can inform policy decisions.

Field stations also foster cross-disciplinary research communities. Field stations stimulate convergence among the various branches of science as well as engineering, humanities, and arts that can help tackle pressing scientific and societal challenges.

PREPARING THE NEXT GENERATION OF SCIENTISTS

Field stations enable hands-on, discovery-based learning for students of all ages and backgrounds. Early research experiences in the field help students build skills such as learning how to develop research questions and gathering data to answer them. Research experiences early in life promote a lifelong interest in science, technology, engineering, and mathematics (STEM) and have been shown influence career choices. Active learning has been shown to help students retain, recall, and apply information. Universities should seek to expand opportunities for student participation in research and active learning programs at field stations, which could boost student interest in science and the environment, and encourage their persistence in STEM fields.

EMPOWERMENT THROUGH PUBLIC ENGAGEMENT

Many field stations have programs that engage the public in science, for example through lectures, workshops, science cafes, citizen science, volunteer opportunities. These engagement activities help

connect local communities with their environment and promote stewardship of the natural world.

Technological advances allow citizen scientists to collect field data in unprecedented ways, from relatively simple observational programs, such as eBird or iNaturalist, to coordinated, training-intensive water quality monitoring programs. As well as helping to strengthen public understanding, appreciation, and support of science, citizen science initiatives also contribute much-needed data to researchers. Advances in mobile technologies and geographic information tools allow citizens across the globe to pool data to reveal patterns of change.

Each field station should continue to explore and expand a range of approaches to engage the public in science, tailoring its programs to reflect its unique assets and environmental and societal challenges. Each station should take advantage of empirical knowledge of science communication and informal education research to develop effective public engagement programs. New technologies and networking initiatives provide opportunities to recruit and engage the public in the nation's scientific enterprise as citizen scientists.

NETWORKING FOR DISCOVERY AND INNOVATION

Linking field stations and other organizations to enable data pooling could greatly enhance our understanding of the impacts of a regional drought, an extreme storm, or longer-term environmental change resulting from human activities. More expansive and robust networks would make it easier to share these data in a timely way and transform them into information and knowledge that could aid decision-making. In a time of budget constraints, networking could help field stations share resources to make investments in expensive infrastructure such as tools for data storage and analysis. Networking also promotes the coordination of research and education programs to enhance effectiveness and reduce redundancies.

By providing incentives for networking, universities and funding organizations could encourage collaborations that make scientific, educational, and business

sense. For example, funding agencies could state in program announcements and in requests for proposals that they will give preference to proposals that link multiple field stations.

Networking of field stations can also help build convergence among scholars from different scientific disciplines to foster creativity and innovation, and to fuel more rapid scientific and societal advances. Field-station leaders can facilitate this convergence by organizing research around common scientific and societal challenges, and by embracing the social sciences, the arts and the humanities.

MEASURING PERFORMANCE AND IMPACT

The value of field stations is documented unevenly and, for the most part, anecdotally. There is a dearth of empirical evidence on the contributions that field stations make to research, education, and community engagement. In the absence of aggregated and empirical documentation of their value, field stations are vulnerable to budget cuts. Field stations need to document the roles they play in science and society with better metrics individually and as a community. One way of doing this could be to track the

publications based on research from a particular field station using a field-station-specific digital object identifier, or DOI. A digital object identifier is a character string (a “digital identifier”) that is used to uniquely identify content and provide a persistent link to its location on the Web. If each future publication based on research at a particular field station cited this DOI, publications from the field station could be easily tracked. In times of shrinking budgets and increased demands for accountability, demonstrating outputs and outcomes is essential to securing long-term funding.

Field stations should work together to develop a common set of metrics of performance and impact that can be aggregated across regions and the entire nation. New mechanisms and funding are needed to collect, aggregate, and synthesize these data.

MODERN INFRASTRUCTURE FOR A NETWORKED WORLD

Maintaining and upgrading field station infrastructure—from laboratory space to scientific equipment—is essential to ensuring field stations are equipped to provide scientists with the tools needed for research and education in the 21st century.

Field stations vary greatly in size, scope, complexity, and mission, and therefore each field station needs to assess and define its own infrastructure needs. However the infrastructure needed for data management and internet connectivity, known as cyber-infrastructure, is essential to allow all field stations to build networks and more easily share data. In particular, the process of archiving “dark data”—data that are not currently stored in digitally accessible formats—is critical.

FINANCIAL SECURITY FOR A MODERN INFRASTRUCTURE

Aging infrastructure, the need for current technology and cyber-infrastructure, and evolving safety regulations place increased financial demands on field stations. To be sustainable, many field stations will need to place greater emphasis on good business practices. A business plan that includes a clear, compelling, and comprehensive value proposition is crucial both to secure continuing support from host institutions

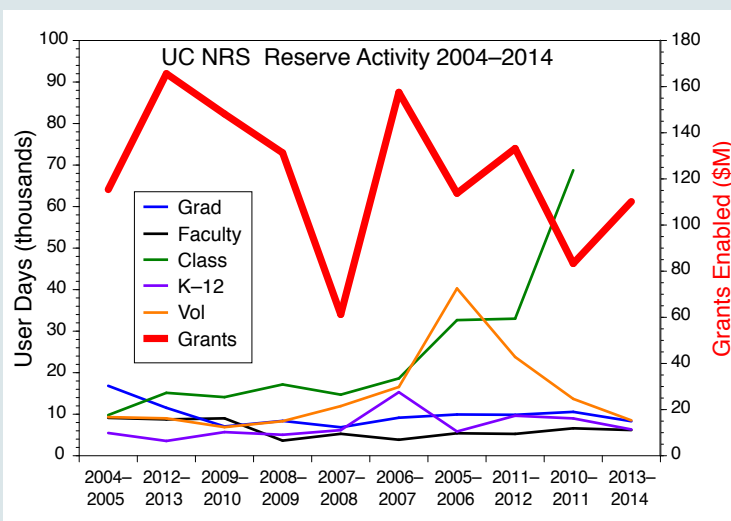
Box 2 A Network to Study the “Dead Zone” in the Gulf of Mexico



In the Gulf of Mexico there lurks a “dead zone”—an area of water so low in oxygen that it is lethal to many of the organisms that live on or beneath the ocean floor. This dead zone is caused by excess nutrients from agricultural lands that runoff into the Mississippi River and are carried to the Gulf, where they cause algal blooms. As the algae decompose, they remove oxygen from the water column. Runoff from agricultural land is exacerbated by the loss of forests and wetlands that help retain sediments and absorb nutrients. Building a network among the many field stations located in the Mississippi River Basin and along the coast could help scientists gather and share data to better understand the connections between the region’s freshwater and marine systems.

Box 3 University of California Natural Reserve System: Gathering Metrics

Created in 2000, the Reserve Application Management System (RAMS) helps track the use of the University of California Natural Reserve System's 39 field stations for easier reporting to funders such as campus administrators, and private sector, state, and federal agencies. Before they are granted access to the reserves, researchers are asked to provide information such as the project, an abstract, and funding amounts. Data from the RAMS system show that from January 2010 to January 2013, 26,600 people used the reserves, generating 683 peer-reviewed journal articles, books, and book chapters and \$386.4 million in research grants. These metrics could, when combined with outcome metrics, more effectively demonstrate field stations' contribution to research and education.



and to develop new and diverse sources of funding. Furthermore, station leaders should be recruited and evaluated not only for their scientific credentials, but also for their leadership, management and entrepreneurial skills. Mentoring of field-station leaders would help them develop and hone management, business planning, and fundraising skills.

LOOKING FORWARD

Field stations play a critical role in science and society by connecting researchers, students, and communities

with each other and with the environment. These valuable resources are poised to help scientists better understand the shifting climate and nature's responses, and to create the information and knowledge we need to conserve our ecosystems and quality of life. But in an era of budget constraints, reaching these goals will take business acumen as well as scientific expertise. Through networking, incorporating more entrepreneurial leadership and developing new metrics of performance and impacts, field stations can meet the challenges of a rapidly changing world.

Locate additional information, including related reports, at <http://dels.nas.edu/bls>

Read, purchase, or download a free PDF of this report at <http://www.nap.edu>

Committee on Value and Sustainability of Biological Field Stations, Marine Laboratories, and Nature Reserves in 21st Century Science, Education, and Public Outreach: **Jerry R. Schubel** (*Chair*), Aquarium of the Pacific, Long Beach, CA; **Felicia C. Coleman**, Florida State University Coastal and Marine Laboratory, St. Teresa; **Cathy Conrad**, Saint Mary's University, Halifax, Nova Scotia, Canada; **Diane Debinski**, Iowa State University, Ames; **Peter M. Kareiva**, The Nature Conservancy, Seattle, WA; **George I. Matsumoto**, Monterey Bay Aquarium Research Institute, Moss Landing, CA; **Diane M. McKnight**, University of Colorado Boulder; **Camille Parmesan**, Plymouth University, Plymouth, UK, and University of Texas, Austin; **Robert Plowes**, University of Texas Brackenridge Field Laboratory, Austin; **Alison G. Power**, Cornell University, Ithaca, NY; **Mary E. Power**, Angelo Coast Range Reserve, University of California, Berkeley; **Mark R. Stromberg**, University of California Natural Reserve System (*retired*), Sonora, AZ; **Keegan Sawyer** (*Study Director and Program Officer*), **Claudia Mengelt** (*Senior Program Officer*), **Laurence Yeung** (*Christine Mirzayan Science & Technology Policy Fellow, until April 2014*), **Lauren Soni** (*Senior Program Assistant*), **Norman Grossblatt** (*Senior Editor*), National Research Council

The National Academies appointed the above committee of experts to address the specific task requested by the National Science Foundation. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.

For more information, contact the Board on Life Sciences at (202) 334-3514 or visit <http://dels.nas.edu/bls>. Copies of *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu.

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