

COMMERCE, JUSTICE, SCIENCE, AND RELATED AGENCIES APPROPRIATIONS FOR FISCAL YEAR 2018

U.S. SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS,
Washington, DC.

NONDEPARTMENTAL WITNESSES

[CLERK'S NOTE.—The subcommittee was unable to hold hearings on nondepartmental witnesses. The statements and letters of those submitting written testimony are as follows:]

PREPARED STATEMENT OF THE ALAMEDA COUNTY BAR ASSOCIATION, OAKLAND
CALIFORNIA

DEAR SENATORS:

We are a local bar association representing 1400 attorneys in Alameda County, California, and we are writing to urge you to reject the proposed elimination of funding for the Legal Services Corporation (LSC). Our association is made up of attorneys from large and small corporate law firms, prosecutors, and city attorneys, among others. We are Republicans, Democrats and Independents, but what we have in common is a belief that Legal Aid plays a critical role in the justice system and in our society.

As you no doubt know, the LSC provides funding (through a carefully monitored grant and review process) to Legal Aid organizations across the country. Last year, Legal Aid organizations provided assistance to more than 1.9 million Americans, helping them with issues like obtaining a domestic violence restraining order, dealing with consumer fraud, and struggling with problems in housing conditions. They provide help to veterans in a wide variety of areas. One in five people nationwide qualifies for legal services from the organizations. There are other nonprofits that provide legal services to low-income communities—but the lions' share of the work is done by the one organization in each region that is funded by LSC.

Without Legal Aid, homelessness, domestic violence, and poverty will increase. Not only would such increases be terrible from a moral and democratic standpoint—they would also significantly decrease the quality of life for all of us living in these communities. Further, having more people trying to represent themselves in courts will create court congestion. Dealing with litigants who are representing themselves takes much more time than dealing with cases with attorneys. Those of us representing America's corporations and small businesses will be forced to recommend that they pay a private judge in order to get their cases heard in a timely manner.

Some have suggested that if the Federal Government defunds Legal Aid, private lawyers will step in and cover the gap with pro bono work. In fact, just the opposite is true. As more than 150 law firms stated in a letter to the Office of Management and Budget, "Eliminating the Legal Services Corporation will not only imperil the ability of civil legal aid organizations to serve Americans in need, it will also vastly diminish the private bar's capacity to help these individuals The pro bono activity facilitated by LSC funding is exactly the kind of public-private partnership the government should encourage, not eliminate."

This is not a partisan issue. The LSC has long enjoyed bipartisan support in both the House and the Senate. Legal Aid is a critical part of the justice system, and if that piece is broken, the entire system will virtually cease to function. And the justice system, in turn, is one of the key elements keeping the wheels of American

commerce rolling. LSC's budget for the entire country is only \$385 million—that's .00009 percent of the Federal budget. Yet the \$40 million that California alone stands to lose makes all the difference.

We urge you to stand firm, and insist that the LSC budget remain uncut.

Sincerely,

TIELA CHALMERS,
CEO and General Counsel.
ERIC HANDLER,
President.

PREPARED STATEMENT OF THE AMERICAN SOCIETY OF PLANT BIOLOGISTS

On behalf of the American Society of Plant Biologists (ASPB), I submit this testimony for the official record to support \$8 billion for the National Science Foundation (NSF) for fiscal year 2018. ASPB recognizes the difficult fiscal environment our Nation faces, but we believe that sustained investments in scientific research will be a critical step toward economic recovery and continued global competitiveness for our Nation.

ASPB would like to thank the subcommittee for its consideration of this testimony and for its strong support for the research mission of NSF.

ASPB is an organization of professional plant biology researchers, educators, graduate students, and postdoctoral scientists with members across the Nation and throughout the world. A strong voice for the global plant science community, our mission—achieved through work in the realms of research, education, and public policy—is to promote the growth and development of plant biology, to encourage and communicate research in plant biology, and to promote the interests and growth of plant scientists in general.

FOOD, FUEL, ENVIRONMENT, AND HEALTH: PLANT BIOLOGY RESEARCH AND AMERICA'S FUTURE

Plants are vital to our very existence. They harvest sunlight, converting it to chemical energy for food and feed; they absorb carbon dioxide and produce oxygen; and they are the primary producers on which most life depends. Indeed, plant biology research is making many fundamental contributions in the areas of energy security and environmental stewardship; the continued and sustainable development of better foods, fabrics, and building materials; and in the understanding of biological principles that underpin improvements in the health and nutrition of all Americans.

Plant science has become that backbone of agricultural innovation, and a thriving agricultural sector has become a cornerstone for American economic success. Agriculture and agriculture related industries comprise 5.7 percent of the U.S. GDP, contributing \$985 billion and 17.3 million jobs to the economy.¹ In fact, despite persistent US trade deficits, there has been a surplus in agricultural trade since 1960 with a \$21.5 billion surplus expected in 2017.² To maintain and increase agricultural productivity, critical investments in basic biological sciences, such as plant biology, are needed.

In particular, plant biology is at the interface of numerous scientific breakthroughs. For example, with high throughput experimental approaches facilitating extraordinary syntheses of information that are NSF-supported, plant biologists are using computer science applications to make tremendous strides in our understanding of complex biological systems, ranging from single cells to entire ecosystems. Understanding how plants function ultimately will result in better and more productive crops, new sources of fuel, and the development of better medicines to treat diseases like cancer.

Despite the significant positive impact plants have on our Nation's economy and in addressing some of our most urgent challenges, including food and energy security, Federal investments in fundamental plant biology research are modest. Still scientists have maximized and leveraged this funding in order to understand the basic function and mechanisms of plants, providing a foundation for vital advances in practical applications in agriculture, health, energy, and the environment.

To address future societal challenges that might be mitigated through investments in plant biology research and to prioritize community research efforts, ASPB organized a two-phase Plant Science Research Summit with funding from NSF, the U.S. Department of Agriculture, the Department of Energy, and the Howard

¹ <https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/>.

² <https://www.ers.usda.gov/topics/international-markets-trade/us-agricultural-trade/>.

Hughes Medical Institute that resulted in the development of a community agenda document: “Unleashing a Decade of Innovation in Plant Science: A Vision for 2015–2025” (plantsummit.files.wordpress.com/2013/07/plantsciencedecadalvision10-18-13.pdf). The report, part of an ongoing and iterative process, puts forth a 10-year consensus agenda to fill critical gaps in our understanding of plant biology in order to address the grand challenges we face. As a research community, our vision is to create plant systems that are flexible and adaptable to new and existing challenges by increasing the predictive and synthetic abilities of plant biology. In achieving these goals, the plant science research community will make significant contributions to:

- exploring, conserving and utilizing our natural resources;
- protecting, maintaining and improving crop productivity; and
- creating new plant-inspired industries.

Since the report’s release, the community has launched the Plant Science Research Network to work on the next iteration and begun working on the development of specific recommendations in the areas of cyberinfrastructure, training, and broadening participation.

ROBUST FUNDING FOR THE NATIONAL SCIENCE FOUNDATION

ASPB encourages strong support for the Directorate of Biological Sciences (BIO) and proportional funding increases across all of the scientific disciplines NSF supports. As scientific research becomes increasingly interdisciplinary with permeable boundaries, a diverse portfolio at NSF is needed to maintain transformational research and innovation.

NSF funding for plant biology specifically enables the scientific community to address cross-cutting research questions that could ultimately solve grand challenges related to a sustainable food supply, energy security, and improved health and nutrition. This notion is reflected in the National Research Council’s report “A New Biology for the 21st Century.”

NSF BIO is a critical source of funding for scientific research, providing the majority of the Federal support for non-medical basic life sciences research at U.S. academic institutions and beyond. BIO supports research ranging from the molecular and cellular levels to the organismal, ecosystem, and even biosphere levels. These investments continue to have significant pay offs, both in terms of the knowledge directly generated and in deepening collaborations and fostering innovation among communities of scientists. This increase is needed as BIO received only a 1 percent increase in fiscal year 2016, and a 2 percent increase in fiscal year 2015, which when adjusted for inflation, actually represents a loss in purchasing power.

The Biological Sciences Directorate’s Plant Genome Research Program (PGRP) is an excellent example of a high impact program that has laid a strong scientific research foundation for understanding plant genomics as it relates to energy (biofuels), health (nutrition and functional foods), agriculture (impact of changing climates on agronomic ecosystems), and the environment (plants’ roles as primary producers in ecosystems). *ASPB asks that the PGRP be funded at the highest possible level and have sustained funding growth to address 21st century challenges.* Furthermore, in light of the need to create cyberinfrastructure across a wide range of scientific disciplines, ASPB supports efforts to homogenize metadata formats and enhance data sharing.

ASPB also supports the “Understanding the Rules of Life: Predicting Phenotype” initiative, part of NSF’s 10 big ideas for future investment. The proposed initiative focuses on expanding current knowledge of plant genetics, the environment, and phenotypes, or an organism’s observable characteristics. “Understanding the Rules of Life” takes a multidisciplinary approach to understanding plant genetics, incorporating computer science, biology, mathematics, engineering, and behavioral science to conduct foundational research in genotype to phenotype studies, plant science, microbiome, and synthetic biology. Research supported by “Rules of Life” will encourage using quantitative approaches to advance biological research, increasing the use of innovative new methods and interdisciplinary approaches to complex research questions.

Without significant and increased support for BIO and NSF as a whole, promising fundamental research discoveries will be delayed and vital collaborations around the edges of scientific disciplines will be postponed, thus limiting the ability to respond to the pressing scientific problems that exist today and the new challenges on the horizon. Addressing these scientific priorities also helps improve the competitive position of the United States in a global marketplace.

CONTINUED SUPPORT FOR NSF EDUCATION AND WORKFORCE DEVELOPMENT PROGRAMS

The National Science Foundation is a major source of funding for the education and training of the American scientific workforce and for understanding how educational innovations can be most effectively implemented. NSF's education portfolio impacts students at all levels, including K–12, undergraduate, graduate, and post-graduate, as well as the general public.

ASPB urges the subcommittee to support expanding NSF's fellowship and career development programs—such as the Postdoctoral Research Fellowships in Biology, the Graduate Research Fellowship (GRF) and the Faculty Early Career Development (CAREER) programs—thereby providing continuity in funding opportunities for the country's most promising early career scientists.

Furthermore, the nearly 7-year median for a life-science PhD in the United States contrasts with other Nations where students specialize earlier, thus entering doctoral programs with more uniform and advanced scientific foundations. To focus more attention on new types of skills, such as private-sector experience and data-science training, NSF may wish to consider encouraging universities to tailor undergraduate curricula to allow committed students to enter PhD programs without needing a significant amount of textbook-style coursework. One way to do so would be to offer a seamless, 7-year curriculum that combines bachelor's and doctoral education, thereby making the career path more attractive and reducing costs to investigators, institutions, and funding bodies. NSF may wish to fund exploration and development of this kind of program or curriculum.

ASPB urges support for NSF to further develop programs aimed at increasing the diversity of the scientific workforce by leveraging professional scientific societies' commitment to provide a professional home for scientists throughout their education and careers and to help promote and sustain broad participation in the sciences. Discrete focused training and infrastructure support programs for Hispanic Serving Institutions, Historically Black Colleges and Universities, and Tribal Colleges and Universities remain vitally important, because they foster a scientific workforce that reflects the U.S. population.

ASPB urges support for education research that enhances our understanding of how educational innovations can be sustainably and most effectively implemented in a variety of settings. NSF Education and Human Resources programs provide opportunities to expand NSF's research and evaluation efforts to address scale-up and sustainability. *ASPB encourages continued support for education research programs within NSF's Education and Human Resources portfolio with a focus on understanding how previous investments in educational strategies can be made most effective.*

Grand research challenges will not be resolved in a year, an administration, or a generation, but will take continued attention and investment at Federal research agencies, such as the National Science Foundation, over decades.

Thank you for your consideration of ASPB's testimony. For more information about ASPB, please visit us at www.aspb.org.

[This statement was submitted by Tyrone C. Spady, PhD, Director of Legislative and Public Affairs.]

PREPARED STATEMENT OF THE ARCTIC RESEARCH CONSORTIUM OF THE UNITED STATES

On behalf of the Arctic Research Consortium of the United States (ARCUS), I appreciate the opportunity to discuss fiscal year 2018 Federal science funding of the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and at the National Aeronautics and Space Administration (NASA). ARCUS represents the leading Arctic research organizations and has been dedicated to supporting and connecting Arctic research across the boundaries of discipline, institution, and sector since 1988.

Arctic research strengthens our understanding of the current rapid change in the region, which is affecting the lives of Americans everywhere. It has important effects on our national and homeland security, economic growth regionally and nationwide, human health, and coastal and community resilience. Through better knowledge of the Arctic, Americans can make more informed decisions in each of these areas.

Aligning with like-minded science organizations and coalitions, we respectfully request the subcommittee provide no less than \$8 billion for NSF (including funding parity for all directorates or at least \$1.4 billion for the Geosciences Directorate); \$5.9 billion for NASA's Science Mission (including at least \$2.03 billion for the

Earth Science Division); and \$6.1 billion for NOAA (including research, extramural grant programs, and education). Additionally, the Arctic research community is deeply concerned by the President's fiscal year 2018 budget request to drastically reduce non-defense discretionary funding (–\$54 billion) with draconian cuts and outright program eliminations in the geosciences, education, and extramural grants. Specifically, we oppose any reductions to NSF's geosciences or education programs, especially in the Office of Polar Programs; the proposed zeroing out of over \$250 million in targeted NOAA grants and programs supporting Arctic coastal and marine management, research, and education, including its Arctic Research Program (which improves sea ice modeling and prediction) and Sea Grant (and its Knauss Fellowship program); and reducing NASA's Earth science portfolio by \$102 million (slashing funding for Earth science research grants and terminating four Earth science missions).

ARCTIC RESEARCH: VITAL TO THE NATION

Arctic Change Affects All of Us

The U.S. is one of eight Arctic nations in the world, and our leadership in the region is a point of national pride. The Arctic is tightly connected to the rest of the U.S. through land, sea, air, and migratory species. Our daily weather, what we eat, and coastal flooding are all tied to Arctic changes. The Arctic region is rapidly and dramatically changing, redefining life for people and communities, animals and plants, ecosystem functions, and landscapes. Higher air temperatures, rapid retreat of sea ice, thawing permafrost, larger and more frequent forest fires, increasing ocean acidity, and other significant conditions demonstrate the altered state of the Arctic and have ramifications far beyond the region's borders. Examples include a pronounced impact on sea level rise, weakening of the jet stream and much more unpredictable weather in the mid-latitudes (where most of the U.S. is located).

As we learn more, Arctic researchers are able to provide answers to the key questions of what changes we will be experiencing in weather, as coastal residents, in global atmospheric impacts, and as stewards of natural resources. Arctic research plays a key role underlying community resilience and the ability to adapt to change.

Arctic Research Supports National and Homeland Security

As sea ice retreats, there is more mobility available through the Arctic Ocean, opening both new opportunities and new risks. Arctic research supports maritime domain awareness in this new open-water as well as situational and threat awareness in the changing region. Federal investment in Arctic research at NSF, NASA, and NOAA is required to meet the endstate goals of the U.S. Navy's Task Force Ocean, specifically enabling "increased permeability between the Navy and government, academia, and the private sector." Criminal and terrorist networks have also discovered the Arctic, so the ability to monitor and limit their activities depends upon research and understanding. Department of Homeland Security efforts to develop and implement its national strategy for the Arctic strongly draw upon the Arctic research conducted with NSF, NOAA, and NASA support.

Arctic Research Supports Economic Growth Regionally and Nationwide

A majority of our seafood industry is tied to Arctic and sub-Arctic fisheries, which depend upon environmental knowledge to manage and sustain these critical food resources. Billions of dollars of agriculture depend upon reliable and accurate weather forecasts, which Arctic research is improving through the understanding of Arctic-mid latitude connections. Opening Arctic sea routes are creating new economic opportunities for regional and global trade, and the research community is laying the foundations for how to achieve this safely and sustainably. Within Alaska, Arctic research guides countless management decisions about land use, economic development, human and social services, and much more.

Arctic Research Promotes Human Health

Studies of unique Arctic organisms are supporting innovative approaches to battlefield medicine, stroke treatment, and developing cures for many other ailments. Studies of animals and plants with unique adaptations to cold Arctic environments can be mined to support a wide range of medical treatments. Residents of the Arctic (including Alaska) experience high rates of suicide, substance abuse, and domestic violence. Arctic social science research, integrated with broader studies of the Arctic system and context, enables quantifiable progress in addressing these issues regionally and nationally.

Arctic Research Enables Community Planning and Resilience

As coastal communities nationwide plan for increased flooding and manage risks to lives, property, and infrastructure, Arctic research is helping to answer the key questions of “how much?” and “how soon?” Studies of the Greenland ice sheet and glaciers throughout the Polar regions are enabling more accurate predictions of local and global sea level rise. Within the region, research is enabling Alaskan communities to understand how thawing permafrost and related coastal erosion will affect vital infrastructure and community survival. As Arctic ecosystems change, with global ripple effects (since plants and animals are interconnected far beyond the region), research allows for foresight and planning that will enable communities nationwide to adapt.

The Arctic is a sentinel site providing early indications of ongoing changes that are propagating around the Nation and around the globe. Understanding and adaptation in the Arctic will inform U.S. community planning and policies for decades.

Arctic Research Supports Better Decision-Making at All Levels of Government and in the Private Sector

ARCUS members adhere to the principle that decisionmaking at national, State, and local levels is benefited by an understanding of the environmental, geological, biological, cultural, and social factors. Arctic research enables better decisions, whether considering where to invest, how to defend our Nation’s interests, or where to develop. In this time of rapid change, we need to empower decision-makers with the best possible information about the Arctic.

CONCLUSION

Arctic research impacts every American. Across the Nation, across research disciplines, and across the Federal family, it is clear that robust and sustained Federal investments in Arctic research is key to addressing global and national challenges, underpinning new and growing economies while maintaining and supporting existing ones, and improving people’s lives. As the subcommittee drafts the fiscal year 2018 spending bill, we hope that you reflect on the fact that the bulk of the intellectual capacity regarding the Arctic research resides within the academic research community. Peer-reviewed extramural research is the most efficient and effective vehicle for providing our policy makers and our commercial partners with the expertise, information, and data necessary to address the emerging challenges facing our Nation. I respectfully reiterate the geoscience community’s recommendation that the subcommittee provide no less than \$8 billion for NSF (including funding parity for all directorates or at least \$1.4 billion for the Geoscience Directorate); \$5.9 billion for NASA’s Science Mission (including at least \$2.03 billion for the Earth Science Division); and \$6.1 billion for NOAA (including research, extramural grant programs, and education). Additionally, the Arctic research community opposes the President’s proposal to reduce NSF’s geosciences and education programs; to zero out over \$250 million in targeted NOAA grants and programs supporting Arctic coastal and marine management, research, and education, including its Arctic Research Program and Sea Grant; and to reduce NASA’s Earth science portfolio through cuts to funding for Earth science research grants and terminating four Earth science missions.

Adequate and sustained investment in research is the bedrock upon which this Nation’s global science primacy and innovation economy are built. Only through the subcommittee’s continued dedication to our Nation’s science and education enterprise will this be possible.

Mr. Chairman and Members of the subcommittee, we greatly appreciate the opportunity to share our recommendations, and I encourage bipartisan support for geoscience funding, including Arctic and Polar research, in the fiscal year 2018 appropriations process and into the future.

Below is a list of the institutions that are members of the Arctic Research Consortium of the United States:

ALASKA

Alaska Biological Research, Inc.
Fairweather Science, LLC
North Slope Science Initiative
Ukpeagvik Iñupiat Corporation (UIC)
Science
University of Alaska, Anchorage
University of Alaska, Fairbanks

ARIZONA

Arizona State University

COLORADO

University of Colorado, Boulder

IDAHO

Ecoanalysts, Inc.

MAINE	Texas A&M University
Bates College	
MASSACHUSETTS	VIRGINIA
Tufts University, Fletcher School of	U.S. Arctic Research Commission
Law & Diplomacy	University of Virginia
Woods Hole Oceanographic Institution	WASHINGTON
Woods Hole Research Center	University of Washington
MICHIGAN	WASHINGTON, DC
Michigan Tech Research Institute	Consortium for Ocean Leadership
NEW HAMPSHIRE	The George Washington University
Dartmouth College	CANADA
NEW JERSEY	University of Northern British
Rutgers, The State University of New	Columbia
Jersey	FINLAND
NEW MEXICO	University of the Arctic
Sandia National Laboratories	GERMANY
NEW YORK	Alfred Wegener Institute, Helmholtz
Lamont-Doherty Earth Observatory,	Centre for Polar and Marine
Columbia University	Research
OHIO	NORWAY
The Ohio State University	Norwegian Polar Institute
PENNSYLVANIA	UIT: The Arctic University of Norway
The Pennsylvania State University,	RUSSIA
The Polar Center	Russian State Hydrometeorological
TENNESSEE	University
Oak Ridge National Laboratory	INDIVIDUALS
TEXAS	There are also 97 individual members
	from 31 States.

[This statement was submitted by Robert H. Rich, Ph.D., CAE, Executive Director.]

PREPARED STATEMENT OF THE INSTITUTE OF MAKERS OF EXPLOSIVES

INTEREST OF THE IME

The Institute of Makers of Explosives (IME) is a nonprofit association founded over a century ago to provide accurate information and comprehensive recommendations concerning the safety and security of commercial explosive materials. Our mission is to safeguard employees, users, the public and the environment, and to encourage the adoption of uniform safety and security rules and regulations in the manufacture, transportation, storage, handling, use and disposal of the explosive materials used in blasting and other essential operations. IME represents U.S. manufacturers, distributors and transporters of commercial explosive materials and oxidizers as well as other companies that provide related services. The majority of IME members are "small businesses" as determined by the U.S. Small Business Administration.

Millions of metric tons of high explosives, blasting agents, and oxidizers are consumed annually in the United States. These materials are essential to the U.S. economy. Energy production, construction, mining, quarrying, demolition, and other specialized applications begin with the use of commercial explosives. IME member companies and their affiliates produce nearly all of the explosives used in these industries. Commercial explosives are used in every State and are distributed worldwide. The ability to manufacture, distribute, and use these products safely and securely is critical to our industry.

Commercial explosives are pervasively regulated by a myriad of Federal and State agencies. The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) plays a predominant role in ensuring that explosives are manufactured, identified, tracked,

and stored in a safe and secure manner and received/possessed only by authorized persons. IME shares ATF's focus on safety and security, and it is from that perspective that we offer the following comments on the fiscal year 2018 budget submission.

ATF'S EXPLOSIVES REGULATORY PROGRAM

IME understands the difficult decisions that ATF and the Federal government face when allocating scarce resources. We also understand the other important work and responsibilities that ATF is assigned. Nevertheless, the members of IME, their employees and customers rely on a properly funded regulatory program. The success of ATF's explosives programs in preventing the misappropriation of commercial explosives should not be seen as an opportunity to reallocate funding, but, rather, as confirmation that a base level of funding is necessary for ATF to fulfill its mission. ATF must retain a cadre of trained personnel to perform these vital services. The commerce of explosives is so closely regulated that failure to provide adequate personnel and resources can be detrimental to our industry, our customers, our employees, and the industrial sector of the U.S. economy.

ATF is the primary Federal law enforcement agency that regulates the explosives industry—licensing and permitting businesses and individuals to engage in manufacturing, importing, or dealing in explosives, or receiving or transporting explosives materials.¹ By law, ATF must inspect an estimated 10,000 explosives licensees and permittees at least once every 3 years. ATF's workload also involves completing background checks of employee possessors of explosives and responsible persons.

The workforce challenges facing the Bureau are not new, but changes in consumer behaviors are presenting staffing challenges. Specifically, the “[m]arket demand for National Firearm Act (NFA) services continues to set annual records, which has resulted in a dramatic increase in workload over the past several years.”² The NFA requirements, combined with the Bureau's requirement to inspect 100 percent of the explosive licensees and permittees within their 3-year license/permit cycle, clearly indicates that the demand for resources is going up. While the 2018 budget proposal protects the NFA program in recognition of the growing workload, the proposal would eliminate 21 full time equivalents (FTEs) from ATF's Investigative Support Services. We are concerned that such action could compromise safety and security. IME would like to draw the attention of the committee to the staffing and retention challenges faced by the Bureau. Knowing that it “typically takes 3–5 years of close mentoring and on-the-job training for a new special agent [including Certified Explosive Experts] to acquire the skills necessary to achieve full productivity levels,”³ we encourage the subcommittee to continue monitoring the ATF to ensure it is implementing the plan to deal with the attrition of its special agent workforce. Additionally, IME will communicate with this subcommittee if ATF's efforts to service the regulated community fall short.

In past years, IME has recommended that ATF harmonize its vetting and clearance procedures with those used by other Federal programs. Doing so would allow ATF's vetting program to be reciprocally recognized by these programs and save time and resources of the agency and the individuals being vetted. In 2015, the Department of Homeland Security moved to accept ATF's vetting program. However, concerns remain about the equivalency of the ATF program with other Federal vetting programs because the Bureau's program lacks recurrent vetting and fails to disqualify individuals on the Terrorist Watchlist. We strongly encourage efforts to harmonize ATF's vetting standards and procedures with those used by other agencies and to improve the timeliness of vetting programs.

ATF-INDUSTRY PARTNERSHIP

United States Bomb Data Center

The U.S. Bomb Data Center (USBDC) is responsible for collecting and storing explosives-related incident data, to include information on thousands of explosives incidents investigated by ATF and other Federal, State, and local law enforcement agencies. While this data helps government entities perform trend analysis and compare incidents for similarities and crime methodologies, USBDC data also helps the industry in efforts to identify any potential weaknesses or reaffirm the effectiveness of safety and security practices, and to update industry standards accordingly.

In 2013, USBDC reinstated the issuance of the Explosives Incident Report (EIR) for calendar years 2010–2013, including valuable information on fillers of improvised explosives devices and on thefts, losses, and recoveries categorized by the type

¹ Fiscal Year 2018 ATF Congressional Budget Submission, page 6.

² *IBID*, 26.

³ *IBID*, 14.

and amount of explosives involved. IME commends ATF for continuing to share the report as the data helps confirm the success of industry best practices and the effectiveness of ATF regulations. Recently, IME reviewed 20 years of available ATF Explosives Incident Reports, and the use of commercial explosives used in domestic criminal events has remained around or below 2 percent. In 2015, that number was .7 percent. In 2015, thefts of commercial explosives dipped to a historic low of 8 total reported thefts. To put this in context, in the same year, the industry consumed over 5 billion pounds of explosives. This is clearly evidence of the success of IME safety and security best practices coupled with a sound regulatory structure.

National Center for Explosives Training and Research

IME would like to commend ATF for its work at the National Center for Explosives Training and Research (NCETR), including training, testing and research, which is critically important for the safety and security of explosive materials. IME and its member companies employ recognized subject matter experts in the safe and secure development, manufacture, handling and use of commercial explosives. IME welcomes continued opportunities to partner with NCETR on research and testing initiatives related to commercial explosives and encourages the subcommittee to ensure that NCETR receives sufficient funding and resources to continue its critical work.

IMESAFR

IME has spent over a decade developing a credible alternative to the 100-year-old quantity distance tables used to determine safe setback distances from explosives. The result is a scientifically-based computer model for assessing the risk from a variety of commercial explosives activities called IMESAFR.⁴ ATF and other regulatory agencies are recognizing the value of IMESAFR. In April 2015, we were pleased to see ATF approve the first variance from the American Table of Distances (ATD) based on risk assessment using IMESAFR. Since that time, an additional variance has been issued by ATF using the IMESAFR program, indicating that the Bureau is becoming more confident with the program the more they work with it. NCETR has partnered with IME on efforts to further validate IMESAFR data and ensure transparency of the scientific process by participating in testing and supporting an IMESAFR Science Panel. We welcome and strongly encourage ATF's continued support and leadership related to IMESAFR. Towards this end, IME urges the subcommittee to direct ATF to take a leadership role to validate an acceptable tolerable risk criteria. The establishment of a tolerable risk standard will provide a definitive level of risk that industry and other Federal entities will be able to understand and be able to use as a bright-line when developing projects. Additionally, IME urges the subcommittee to provide additional resources to ATF to allow them to conduct additional validation and testing in order to develop policies that allow the use of such models to meet regulatory mandates.

INTERNATIONAL ENGAGEMENT

Marking Harmonization Efforts

Explosive manufactures and importers are required to mark products with codes to aide law enforcement agencies in the U.S. and foreign countries in tracing lost or stolen materials. Additionally, others in the global supply chain also cooperate in these tracing efforts. However, more and more government entities are imposing their own unique system of identification marks without recognizing each other's marks. These redundant and competing marks create non-tariff barriers to trade and hampers successful tracing and investigation. We are pleased to inform you that IME's effort to obtain global harmonization of explosives security markings gained the approval of the United Nations Sub-committee on the Transport of Dangerous Goods (TDG) in December 2016. The success of the proposal is the culmination of an effort begun by IME in June 2013, with assistance and support of JIDO, JIEDAC (United Kingdom's Joint IED Analysis Center), ATF, DOT/PHMSA (as the U.S. delegation to the TDG), the United Kingdom, the European Commission, and the Federal of European Explosives Manufacturers. IME would like the sub-

⁴IMESAFR was built on the Department of Defense Explosives Safety Board's software model, SAFER. The DDESB currently uses SAFER and table-of-distances methods to approve or disapprove Department of Defense explosives activities. Not only can IMESAFR determine the amount of risk presented, but it can also determine what factors drive the overall risk and what actions would lower risk, if necessary. The probability of events for the activities were based on the last 20 years of experience in the U.S. and Canada and can be adjusted to account for different explosive sensitivities, additional security threats, and other factors that increase or decrease the base value.

committee to know that the ATF's involvement was instrumental in the success of the proposal.

INDUSTRY STANDARDS

IME holds in high regard the statutory obligation that ATF take into account industry's standards of safety when issuing rules and requirements. We continue to fulfill this obligation through our development of industry best practices for safety and security, membership in relevant standard-setting organizations, and active participation in forums for training. We have offered to ATF recommendations that we believe will enhance safety and security through our participation in the rule-making process, in the Bureau's important research efforts, and in other standard-setting activities.

CONCLUSION

ATF plays a critical role in helping the explosives industry achieve and maintain a strong safety and security record. Even though explosives may be dangerous materials when in the wrong hands, the manufacture and distribution of explosives is accomplished with a remarkable degree of safety and security. The use of explosives is essential to sustain the economy, and the explosives industry and the general public are dependent on ATF. The Bureau must have adequate resources to fulfill its mission and keep the American public safe. It is up to Congress to ensure that ATF has the resources it needs. IME strongly recommends full funding for ATF's explosives programs.

[This statement was submitted by John Boling, Vice President of Government Affairs.]

PREPARED STATEMENT OF THE MONTEREY BAY AQUARIUM, MONTEREY, CALIFORNIA

The Monterey Bay Aquarium is pleased to submit this statement on ocean conservation and related science issues for the subcommittee's consideration as it develops the fiscal year 2018 Commerce-Justice-Science Appropriations Act.

The mission of the Monterey Bay Aquarium is to inspire conservation of the ocean. We carry out this mission by providing an unparalleled educational experience that connects over 2 million visitors per year to some of the most dramatic species and ecosystems on our planet. The Aquarium uses innovative exhibits and educational programs to demonstrate the connection between the ocean and our human existence—from the air we breathe to weather patterns and resources that drive our multi-billion dollar blue economy.

The Monterey Bay Aquarium is also a leading policy advocate for ocean conservation and science. Given the significance of our ocean, we identified strategic conservation priorities to address some of the most pressing challenges, including plastic pollution, protecting wildlife and ecosystems, sustainable fisheries and aquaculture, climate change and partnerships. All of these initiatives are based on sound science and encourage partnerships with the private sector and other stakeholders to expand their impact.

The Federal Government is an important partner in many of these initiatives, and plays a key role in supporting fundamental science and regulatory functions. The Aquarium has identified several high-impact and strategic investments within the National Oceanic and Atmospheric Administration (NOAA) that underpin efforts to better understand and manage ocean resources. We urge the subcommittee to fully support these programs as it develops the fiscal year 2018 appropriations bill:

Illegal, Unreported, and Unregulated (IUU) Fishing/Seafood Traceability.—Global losses attributable to IUU fishing are estimated to be between \$10 and \$23 billion annually, and has links to other forms of criminal activity, as well as slavery and human rights abuses. It and undermines economic opportunities for legitimate fishermen in the U.S. and has global implications for national security and food security. Congress acted in 2015 and 2016 to pass bipartisan legislation to improve the U.S. response to IUU fishing. Similarly, the fiscal year 2017 budget specifically identified the urgent need to address IUU fishing through enhanced enforcement and import restrictions on illegally harvested and improperly-documented seafood.

The Aquarium urges the subcommittee to provide at least \$4 million specifically for activities to address IUU fishing in fiscal year 2018 to ensure strong implementation of the Seafood Import Monitoring Program and improved international enforcement and port security responsibilities under the SAFE Ports Act. These funds will improve the ability of the Federal government to identify, inspect and enforce

against imported IUU products coming into U.S. commerce and will enhance efforts to incentivize foreign compliance with international laws.

Bycatch Reduction and Highly Migratory Species.—NOAA Fisheries (NMFS) supports research on technologies that reduce bycatch and bycatch mortality. Reducing bycatch can save fishing jobs by preventing fishery closures due to interactions with endangered species or attainment of strict bycatch quotas. This funding supports the Bycatch Reduction Engineering Program (BREP) external competitive grants program, which supports innovative gear designs and fishing techniques to minimize bycatch. We recommend the subcommittee include at least \$2.5 million for bycatch reduction competitive grants to non-Federal researchers for the development and implementation of practical bypass solutions through research and working with U.S. fishermen on the development of improved fishing practices and innovative gear technologies.

In addition, we note that the House report that accompanied the fiscal year 2017 Commerce-Justice-Science Appropriations bill included language on highly migratory fish species that only included the Atlantic Ocean and Gulf Coast. We urge the subcommittee to include the Pacific Ocean in this year's appropriation since there are several valuable highly migratory fish species, particularly Pacific bluefin tuna, that are adversely impacted by international fisheries practices in the Pacific.

Marine Aquaculture.—The U.S. imports over 90 percent of its seafood, about half of which is farmed. While aquaculture globally has grown dramatically over the past 30 years, U.S. production remains low. As demand for seafood continues to rise, aquaculture presents an opportunity to meet this demand, create jobs and support sustainable development that can achieve a high environmental standard. We request that the subcommittee to fully fund NOAA's marine aquaculture program within NOAA Fisheries and in the Office of Oceanic and Atmospheric Research (OAR) through the Sea Grant program.

Marine Debris.—Our ocean is at increasing risk from growing levels of plastic pollution. Studies estimate that an average of eight million metric tons of plastic enter the global ocean each year. Unless we curb the flow, scientists estimate that there could be one ton of plastic for every three tons of fish in the ocean by 2025, posing a risk to water quality, wildlife and human health. Ocean plastic pollution is an issue that is especially relevant to our millions of visitors—and to Californians in general, many of whom have cleaned up local beaches and reduced the use of plastic bags in grocery stores. For these reasons, we recommend funding support strengthening the NOAA Marine Debris Program at \$8 million in fiscal year 2018. The Marine Debris program offers competitive grants for aquariums and others to work with Federal, State, and local partners on marine debris education and reduction projects. The Monterey Bay Aquarium has received \$52,306 from this program for our Ocean Plastic Pollution Summit for Teachers. Over 100 pre-K to 12th grade teachers from throughout California have participated in the Summit and follow-up activities, learning how to use the issue of ocean plastic pollution to engage their students in marine conservation and science.

National Marine Sanctuaries and National Monuments.—NOAA's Office of National Marine Sanctuaries serves as the trustee for a network of underwater parks encompassing more than 600,000 square miles of marine and Great Lakes waters. The network includes a system of 13 national marine sanctuaries and Papahānaumokuākea and Rose Atoll marine national monuments. Few places on the planet can compete with the diversity of the National Marine Sanctuary System, which protects America's most iconic natural and cultural marine resources. The system works with diverse partners and stakeholders to promote responsible, sustainable ocean uses that ensure the health of our most valued ocean places.

America's underwater national treasures conserve some of the Nation's most critical natural, historic and cultural resources such as the USS Monitor, Midway Island, sacred heritage sites for Native Americans, and some of the largest and oldest corals in the world. They are home to millions of species, preserve more than 300 shipwrecks and our Nation's maritime heritage, and promote public access for exploration and world-class outdoor recreation and enjoyment for future generations. They generate \$8 billion annually in local economies and support numerous jobs and businesses in the fishing, tourism, recreation, and scientific research sectors. Sanctuary visitor centers, vessels, and facilities are key assets for communities; stimulate public-private partnerships on emerging technologies, cutting edge science, and hands on education; and attract millions of visitors to the coasts each year. We request the subcommittee fund the National Marine Sanctuaries program with sufficient funding to support the current national marine sanctuaries and

Papahānaumokuākea, Rose Atoll and New England Coral Canyonsarine national monuments.

NOAA Office of Education.—The Aquarium provides a wide variety of educational experiences for students, teachers, and families all designed to inspire ocean conservation. We support local schools by hosting field trips and hands-on learning experiences for students, as well as offering professional development activities for teachers. NOAA's education programs are an integral part of the national effort to educate and train our workforce for the future—a workforce knowledgeable about the world around us and therefore able to participate in decisionmaking as it relates to our ocean and coastal resources. We urge the subcommittee to reject the administration's plan to terminate NOAA education programs and support them at the following levels: \$8,000,000 for the Environmental Literacy Grants Program, including ocean education grants and \$12,000,000 for the Bay, Watershed, Education and Training Program.

Conclusion.—The Aquarium fully appreciates the extreme budget constraints confronting the Congress and the Executive Branch and the intense scrutiny that must be applied to all Federal programs. Nevertheless, we believe ocean conservation and science programs are an investment in the future health, well-being, and economic competitiveness of our Nation. Thank you for the opportunity to provide the Aquarium's views on these ocean conservation and science issues.

[This statement was submitted by Ms. Margaret Spring, Vice President of Conservation & Science and Chief Conservation Officer.]

PREPARED STATEMENT OF THE NATIONAL ASSOCIATION OF MARINE LABORATORIES

The National Association of Marine Laboratories (NAML) is pleased to submit this testimony to the subcommittee for consideration in the fiscal year 2018 Commerce-Justice-Science Appropriations Act. In this statement, we provide our recommendations for the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), and the National Aeronautics and Space Administration (NASA) that we believe would strengthen the Nation's research and education enterprise. The network of the Nation's marine laboratories is cost effective, highly relevant, and the vehicle that brings science to those who depend on research results to protect lives and support livelihoods.

NAML'S MESSAGE

This subcommittee is uniquely responsible for the health of our Nation's research and education enterprise. Much of the Federal extramural nondefense, non-bio-medical support for research and education is provided by this subcommittee. Thus, this subcommittee is in a unique position to impact the Nation's long term economic growth, national security, and public safety through its investments in the agencies under its jurisdiction.

The value of research investments is borne out by history. According to economists Charles Jones and John Williams of Stanford University, the National Bureau of Economic Research, and the Federal Reserve Bank of San Francisco, the return on investment for publicly funded scientific research and development is somewhere between 30 percent and 100 percent.¹ Given the importance of the research investment to the economic health of the country, NAML is disappointed by the administration's fiscal year 2017 Supplemental and the fiscal year 2018 budget requests which seek to reduce programs that are critical to the sustainability and creation of jobs and associated economic benefits. This includes funding for NSF research and education; eliminate over \$250 million in targeted NOAA grants and programs supporting coastal and marine research, education, and management, including Sea Grant and Knauss Fellowship program; and reductions in earth science research at NASA by over \$100 million including major reductions for Earth science research grants.

¹ Charles Jones and John Williams, "Measuring the Social Return to R&D" (1997), available at <http://ssrn.com/abstract=2155>.

NAML PRIORITIES AND RECOMMENDATIONS FOR FISCAL YEAR 2018

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 the decisionmaking by policy officials on important issues facing our country and fostering economic development. 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."

A recent report from the Center for the Blue Economy² reported that the ocean economy generated a larger share of U.S. economic activity than farming, food products, oil and gas extraction, and forest products. Employment supported by the ocean economy is almost as large as the employment of these industries combined. The Great Lakes alone generate nearly \$5 trillion in economic activity or about 30 percent of combined U.S. and Canadian economic output. Finally, the U.S. marine transportation system is an essential driver of the U.S. economy and its impact is felt well beyond the coast and reaches into the heartland of the Nation. America's seaports are crucial generators of economic development and well-paying jobs, both regionally and nationally, that is felt throughout all supply chains that use the ports.

The ocean, coastal, and Great Lakes network of NAML laboratories, is a vital part of the Nation's research and education enterprise. That enterprise is a critical contributor to the economic and environmental health of the Nation. The Nation is faced with a widening gap between the actual level of Federal funding for research and education and the required investment to sustain the U.S. as the world's leader in innovation. Accordingly, NAML's priorities are:

- The Nation should build on its investment in research to develop the knowledge, people, and technologies that power the ocean and coastal economies, create jobs, improve health, strengthen our national security, and support the U.S. as the global innovation leader. The key programs that support this goal include:
 - NSF funding for research, training, infrastructure, and education much of which is supported by the Directorates for Geosciences and Biological Sciences;
 - Extramural funding provided by NOAA Research (OAR) including funding the National Sea Grant College Program at \$80 million and marine aquaculture;
 - NOAA National Estuarine Research Reserves at \$27 million in fiscal year 2018 and National Centers for Coastal Ocean Science; and
 - NASA Earth Sciences.
- This investment should include ocean observations, data integration, and related cyber and physical infrastructure; monitoring, research, and response to changing environmental conditions such as:
 - NSF's Field Stations and Marine Laboratories (FSML) at \$6 million;
 - NOAA Integrated Ocean Observing System program at \$43 million;
 - Research and Monitoring for Ocean Acidification; and
 - NSF's Long Term Ecological Research program and HBCU Research Infrastructure for Science and Engineering (RISE)
- Renew the commitment to improve the quality of STEM education and re-energize efforts to attract, recruit, support, and retain women, minorities and others not currently well represented in the science and technology workforce through the following programs:
 - NSF's Research Experiences for Undergraduates (REU), its Alliances for Minority Participation, the graduate and post graduate fellowship programs at NSF, NOAA, and NASA; and
 - Reject the Administration's proposal to terminate the NOAA and NASA Offices of Education

² State of the U.S. Ocean and Coastal Economies—2016 Update, Middlebury Institute of International Studies at Monterey, Center for the Blue Economy.

NAML is concerned by the administration's recommendations for reductions to NSF, NASA and NOAA as part of the fiscal year 2017 Security Supplemental and the fiscal year 2018 budget requests which seek to reduce support for the National Science Foundation (especially in the Geosciences and for education); eliminate over \$250 million in targeted National Oceanic and Atmospheric Administration (NOAA) grants and time-tested programs in coastal and marine management, research, and education such as Sea Grant and Knauss Fellowship program; and a reduction in earth science research at NASA by over \$100 million including major reductions for Earth science research grants.

The time-tested programs, that support the extramural research and education community via competitive, merit-based research, provide cost-effective and impressive returns on investment, leverage additional resources to meet science and management priorities, distribute economic and societal benefits over a broad array of communities, and provide the agency with valuable flexibility. Yet, in fiscal year 2017 and fiscal year 2018 the Administration is proposing steep reductions in these extramural programs. Additionally, past Administrations have sought authority for NOAA to "receive and expend funds made available by, any . . . private organization, or individual (i.e. proposed Section 108 of the General Provisions in the NOAA Section of the Appendix to the fiscal year 2016 Budget, page 218)." NAML is concerned that this could result in the Federal Government competing with non-Federal and private entities for limited private sector support.

NAML requests the subcommittee to reject the Administration's proposed reductions for research, infrastructure, and education and training. Instead, NAML urges the subcommittee to invest in the future of the Nation by supporting the ocean, coastal, and Great Lakes research and education enterprise represented in part by the NAML priorities articulated in this statement. NAML also requests the subcommittee to continue its vigilance regarding proposals that would result in unfair competition with the private sector.

THE VALUE OF THE NATION'S COASTAL AND OCEAN ECONOMY

More than half of the United States population lives in coastal counties that generate 58 percent (\$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 altogether—making the U.S. second in the world in total seafood consumption. The United States is the leading global importer of fish and fishery products, with 91 percent of the seafood we eat originating abroad—half of which is from aquaculture. Driven by imports, the U.S. seafood trade deficit has grown to over \$11.2 billion annually. Federal aquaculture programs, working in partnership with marine laboratories, offer the opportunity to advance U.S. aquaculture to reduce the seafood trade deficit. Tourism is a major economic driver in coastal States. The U.S. 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 with biologically diverse habitats that provide a wealth of natural resources and economic opportunities, while at the same time exposing human and biological communities to coastal hazards such as storms and hurricanes, shifting shorelines, outbreaks of harmful algal blooms, and water-borne pathogens.

Research conducted by people educated and trained, in part, at the Nation's network of marine laboratories has uncovered the linkage between changes in ocean temperature and its impact on the lobster industry; the role science can play to maximize the return on shoreline restoration; and the impact of ocean acidification on the oyster industry. Training and research centered in the Nation's network of marine laboratories should:

- develop vital, lifesaving adaptive and mitigation strategies to enhance coastal resiliency with forthcoming environmental challenges facing the Nation;
- develop a deeper fundamental understanding of earth system science so that we can more accurately predict severe weather and climate changes on local, regional, national, and global scales;
- develop technologies that will increase the competitiveness of the U.S. aquaculture industry, and contribute to sound fishery management practices, which enhance food security and by access to safe, sustainable, and healthy seafood; and
- lead to the discovery of new marine biological agents that may prove valuable in the treatment of diseases and other ailments.

To develop the knowledge and technologies needed to meet these and other challenges in the ocean, coastal, and Great Lakes environment, it will take the continued education and training of people in science, technology, engineering, and mathematics (STEM). This calls for a renewed commitment to improve the quality of STEM education at the pre-K levels and continuing on through the undergraduate and graduate levels that will attract and retain women, minorities, and others not currently well represented in our scientific and technical workforce.

CONCLUSION

This subcommittee is uniquely responsible for the health of our Nation's research and education enterprise. Over 50 percent of the extramural nondefense, non-bio-medical Federal support for research and education is provided by this subcommittee. Thus, the subcommittee is in a unique position to impact the Nation's long term economic growth, national security, and public safety through its investments in the agencies under its jurisdiction. The economic value of research investments is borne out by history. While we appreciate the difficult constraints facing the Nation and this subcommittee we hope the subcommittee will continue to be a leading and influential voice in the health of the Nation's research enterprise via the decisions it makes in developing the fiscal year 2018 Commerce-Justice-Science Appropriations Act.

NAML is grateful for the opportunity to provide the subcommittee with our members' priorities and recommendations.

[This statement was submitted by Mr. Michael De Luca, President.]

PREPARED STATEMENT OF THE OCEAN CONSERVANCY

Thank you for this opportunity to provide Ocean Conservancy's recommendations for fiscal year 2018 funding for NOAA. Ocean Conservancy has worked for over 40 years to address threats to the ocean through sound, practical policies that protect our ocean and improve our lives. We support funding for NOAA at or above fiscal year 2016 funding levels.

NOAA's mission to understand, protect, restore, and manage our ocean, coasts, and Great Lakes is vitally important to sustain these resources and our economy. The U.S. ocean and coastal economy contributes \$359 billion annually to the Nation's GDP and supports 3 million jobs. There is a good reason that NOAA is in the Department of Commerce, and adequate funding is vital to support a healthy and resilient ocean that can maintain and grow our coastal economies and communities. For example, our Nation's fisheries and seafood sector is a \$214 billion dollar industry and fishermen rely on information from NOAA to make the most informed decisions on where to fish, how to fish and when to fish. Coastal wetland buffer zones in the U.S. are estimated to provide \$23.2 billion per year in storm protection, and NOAA works to build resilient coasts that are more storm-ready and prepared for threats like sea level rise and ocean acidification.

Much of the U.S. ocean is under Federal jurisdiction, and yet many of NOAA's programs focus on pushing resources and decisionmaking power out to regions, States and communities. From region-by-region fishery management, to region-specific programs in places like the Arctic, to extramural funding that supports State agencies and universities, to place-based conservation in our estuaries and oceans, NOAA is providing leverage for hardworking people on the coast and on the water who are fighting for a stronger economy and a healthier ocean.

We ask that you also consider the balance between NOAA's oceanic and atmospheric missions, and the nexus between the two. Americans should not have to choose between weather satellites and ocean and coastal resources like coral reefs and marine mammals. We need both. NOAA's ocean programs support many other Federal agencies and missions that will also suffer if NOAA funding is cut. For example, ocean observations and monitoring provide critical information for severe storm tracking and weather forecasting. And ocean programs facilitate homeland security and national defense functions, including U.S. Navy operations and U.S. Coast Guard search and rescue.

In particular, we recommend the following NOAA programs be funded at or above fiscal year 2016 funding levels. See below for further explanation.

Account, Program or Activity	Fiscal year 2016 enacted (\$ millions)
Operations Research and Facilities	
National Ocean Service:	
Coastal Science, Assessment, Response and Restoration: Marine Debris	6
Coastal Management Grants	75
National Marine Fisheries Service:	
Marine Mammals, Sea Turtles, & Other Species	110.246
Fisheries Data Collections, Surveys and Assessments	163.271
Habitat Conservation and Restoration	61.408
Office of Oceanic and Atmospheric Research:	
National Sea Grant College Program	73
Integrated Ocean Acidification	10
Office of Marine and Aviation Operations:	
Marine Operations & Maintenance	178.838

MARINE DEBRIS: RECOMMEND INCREASE TO \$10 MILLION

Marine debris, particularly plastic waste pollution, has become one of the most widespread pollution problems facing the world's oceans and waterways. An estimated 150 million metric tons of plastic waste are in the ocean today, and every year an estimated 8 million metric tons more are being added. With oil prices at an all-time low, coupled with growing population levels and economic prosperity, plastic production and consumption are predicted to double over the coming decade. Without immediate intervention, 250 million metric tons of plastic waste could be in the ocean in fewer than 10 years. Marine debris has serious effects on the marine environment and the economy, causing impacts from wildlife entanglement, ingestion and ghost fishing to navigational hazards and vessel damage.

The program is authorized at \$10 million, but has been flat-funded at \$6 million since fiscal year 2014. Given the magnitude of the problem, there is an urgent need for the NOAA Marine Debris Program to do more to counter the growing threat to ocean health. Fundamental knowledge gaps exist in four critical areas: the sources of plastic waste in the ocean, how the waste distributes within the marine environment, the fates of those materials, as well as their impacts. More scientific research into these key areas will support data-driven policy solutions to prevent plastic from entering the environment and impacting ocean health. Additional funding will enable NOAA MDP to support this additional research.

COASTAL MANAGEMENT GRANTS

The Coastal Zone Management Program achieves multiple goals for coastal communities including economic development, enhancement of public access and recreation, and protection of coastal resources. The CZM program provides Federal support for these State programs to ensure that as a Nation, all coastal States and territories can enable their coastal communities to achieve both State and national priorities. This State-Federal partnership also enables States to leverage Federal funds to improve permitting processes, provide grants to communities, and ensure Federal actions are consistent with State laws. Moreover, the CZMA requires a dollar-for-dollar State match for almost all Federal funding, with States matching over \$59 million fiscal year 2016.

In addition, Regional Coastal Resilience Grants are producing on-the-ground results through regional ocean partnerships, with grants going out to every region over the last 2 years. The resilience of our coastal communities is a critical mission for NOAA. Resilient means more than just storm-ready. Truly resilient communities are able to effectively adapt to changing economic, social, and environmental conditions over time and effectively respond to new challenges and threats to infrastructure, community well-being, and ecosystem health.

We support funding at or above fiscal year 2016 levels to continue the success of the CZM program and to meet significant demand for RCRG, as demonstrated by more than \$150 million in grant applications last year.

MARINE MAMMALS, SEA TURTLES AND OTHER SPECIES

NOAA's work to protect living marine resources is important nationwide, but is especially critical in the Gulf of Mexico region. We were disappointed that last year's requested \$13.452 million increase for Marine Mammals has not yet been

funded, in particular because it would have supported increased capacity for restoration efforts in the Gulf region. This year we support continued funding at or above fiscal year 2016 funding levels, including for the John H. Prescott Marine Mammal Rescue Assistance Grant Program, which funds the first responders for sick or dying marine mammals.

FISHERIES DATA COLLECTIONS, SURVEYS AND ASSESSMENTS

We support funding for programs that implement the *Magnuson-Stevens Fishery Conservation and Management Act*. As we review the Act for reauthorization, it is important to note that the Act is working—NOAA has made great strides towards ending overfishing and continued investments in these programs are needed.

This recently consolidated budget line supports a host of activities critical to MSA implementation. For example, it provides resources for fisheries managers to assess priority fish stocks, implement the requirement for annual catch limits (ACLs), and ensure the successful recovery of overfished populations. Stock assessments give fishery managers greater confidence that their ACLs will avoid overfishing while providing optimal fishing opportunities. We also support funding for the Marine Recreational Information Program. Despite their often sizeable economic and biological impacts, much less data are collected from recreational saltwater fisheries than commercial fisheries due to the sheer number of participants and limited sampling of anglers' catches. The low level of data collection and lack of timely reporting of data in these fisheries is a large source of uncertainty and has become a flashpoint for controversy in regions where catch restrictions have been adopted to rebuild overfished stocks, particularly in the Southeast. By all accounts, improved sampling and timelier reporting of catch data are needed for successful management of marine recreational fisheries.

We support funding for electronic monitoring and reporting for nationwide efforts. In particular we support funding that goes to the Gulf of Mexico region, where managers need electronic monitoring to keep track of catch and prevent overruns in the red snapper fishery, there is significant need for additional funding. Based on the findings of the November 2014 "Technical Subcommittee Report to the South Atlantic and Gulf of Mexico Fishery Management Councils: Recommendations for Electronic Logbook Reporting" NOAA's requested increases are only a portion of what is needed to support effective electronic monitoring. The Gulf of Mexico region alone will require more than \$5 million annually to support electronic monitoring.

HABITAT CONSERVATION AND RESTORATION

Restoration of the Gulf of Mexico in the wake of the BP *Deepwater Horizon* oil disaster and years of environmental stressors is only in its early stages. It is critical that NOAA's expertise be deployed effectively to support and carry out restoration efforts. In particular, NOAA's Restoration Center is providing key coordination and expertise to government-wide restoration efforts. For example, it is clear that the Restoration Center will serve as a center of gravity for the Open Ocean Trustee Implementation Group. In order to effectively lead this effort, the Restoration Center must be sufficiently resourced and it must also have the support and services needed from other parts of NOAA.

NATIONAL SEA GRANT COLLEGE PROGRAM

Sea Grant is a joint Federal-State investment that supports the health and resilience of the Nation's coastal communities, yielding quantifiable economic, social, and environmental benefits at the national, regional, State, and local levels. In 2015–2016 the Sea Grant program helped generate an estimated \$575 million in economic impacts; created or sustained nearly 21,000 jobs; provided 33 State-level programs and 534 communities with technical assistance on sustainable development practices; worked with about 1300 industry, local, State and regional partners; and supported the education and training of almost 2000 undergraduate and graduate students. The Sea Grant program achieved this with a Congressional appropriation in fiscal year 2016 of \$73 million, which is leveraged with matching funds provided by States, universities, and other sources.

INTEGRATED OCEAN ACIDIFICATION: INCREASE TO \$21.775 MILLION

The Integrated Ocean Acidification line-item funds NOAA's ocean acidification program (OAP), which was established and mandated by the Federal Ocean Acidification Research and Monitoring (FOARAM) Act of 2009. Under FOARAM, OAP is directed to "provide grants for critical research projects that explore the effects of ocean acidification on ecosystems and the socioeconomic impacts of increased ocean

acidification,” establish long-term monitoring, identify adaptation strategies, and conduct public outreach.

Ocean acidification (OA) is the rise in acidity of the earth’s ocean caused by uptake of CO₂ from the atmosphere. This rising acidity makes it harder for shell-forming species such as oysters and crabs to grow, and fundamentally alters many other processes (e.g., reproduction, risk avoidance) necessary for healthy ecosystems and the coastal industries that depend on them. Prior Federal investments in OAP, such as FOARAM, have greatly expanded our knowledge of OA and its risks to coastal communities and industries, but current funding levels are not at the scale needed to understand this global problem and its full impacts.

We recommend a funding level of at least \$21.775 million for this program, which is the amount requested by the program in fiscal year 2017.

MARINE OPERATIONS AND MAINTENANCE

Marine Operations and Maintenance should be funded at or above the fiscal year 2016 level. Days at sea funded by this line are functionally tied to fishery stock assessments, and the two programs must be viewed together.

[This statement was submitted by Jeff Watters, Director, Government Relations.]

PREPARED STATEMENT OF ORGANIZATIONS AND INSTITUTIONS REGARDING FISCAL YEAR 2018 FUNDING FOR NSF, NASA, AND NOAA

Dear Mr. Chairman and Members of the subcommittee: Thank you for the opportunity to present testimony from the organizations and institutions listed in the left-hand margins recommending strong and balanced funding for the research programs of NSF, NASA, and NOAA. A strong and balanced research portfolio should include support for the geosciences—by which we mean the earth sciences, the ocean sciences, and the atmospheric sciences.

These disciplines are vital contributors to this Nation’s national security, economic competitiveness, and public safety.

While an estimated \$60 billion in losses were attributed to Superstorm Sandy, the accurate forecast enabled evacuations and other actions that saved an enormous number of lives. Hundreds of thousands of people lived on land flooded catastrophically by the storm, but the total number of deaths was less than 150, due to timely warnings and evacuations. The impact would have been much worse if Sandy had hit just 15 years ago, when hurricane forecasts extended only 3 days into the future, as opposed to 5 days in 2012. Over the last several decades, forecasts have improved steadily in accuracy, due to continuous improvements in both observations from satellites and aircraft, in the weather prediction models, and in the data assimilation methods used to combine models and observations to produce forecasts. Without these advances—all built on the foundation of broad and deep research programs at NOAA, NASA, and NSF—forecasters would never have seen Sandy’s last minute westward turn into New Jersey, but with them they were able to see it 5 days ahead of time. The resulting accurate and timely forecasts by our academic-government-commercial weather enterprise allowed nearly a week of preparations by governments (local, State, and Federal), businesses, institutions, and families, and undoubtedly made a life or death difference for many thousands of people?

How did we acquire this life-saving weather forecasting system? The short answer is that consistent funding for research, observations, infrastructure, and training by the Federal research agencies, thanks to this subcommittee, the Congress, and ultimately the taxpayers—in science, technology, engineering, mathematics, and education—produced that capability. These investments supported everything from basic research in mathematics and the physical sciences, the computer sciences, and the geosciences to the development of sophisticated models, satellites, radar, and parachute-borne instrument packages that could make the key observations. Those investments also allowed us to develop an understanding of how the Earth, the oceans, and the atmosphere collectively impact our weather and the environmental conditions that ensued. They enabled us to develop and run forecast models on advanced computing systems that turned huge amounts of raw observations into “actionable advice” for businesses, local and State governments, and our citizens. These advances were coupled with investments in education and training that created the talented and dedicated workforce needed to put it all together. Finally, a host of innovative technologies and the application of social science-informed best practices in communications allowed all this information to be presented in a manner that people could understand and on which they could act.

THE GEOSCIENCES AND NATIONAL SECURITY

In September 2016, the Center for Climate and Security released a report entitled, “Military Expert Panel Report—Sea Level Rise and the U.S. Military’s Mission.” The panel included retired flag officers from all the Armed Services: General Ronald Keys, USAF (ret); Lieutenant General John Castellaw, USMC (ret); Vice Admiral Robert Parker, USCG (ret); Rear Admiral Jonathan White, USN (ret); and Brigadier General Gerald Galloway, USA (ret). The expert panel concluded that risks of sea level rise to coastal military installations and supporting civil infrastructure will present serious threats to military readiness, operations, and strategy. The panel concluded that policies and plans for addressing climate change risks must go beyond infrastructure resilience, and into the realm of operations and strategy.

The authors recommend that policy-makers support comprehensive and preventive measures to address increasing risks from sea level rise. Recommendations included: building capacity to address infrastructural, operational, and strategic risks; gaming out catastrophic climate scenarios in planning; tracking trends in climate impacts; and collaborating with adjacent civilian communities. To get ahead of the risks, policy makers will need the research and the educated and trained workforce that comes from the geosciences community. They will need the basic research, computing, and modeling that comes from the support NSF provides the academic research community. They will also need the data, observational capabilities, computing, and modeling that NASA and NOAA can provide.

THE GEOSCIENCES—PRODUCING A WORKFORCE FOR U.S. INDUSTRY

The geosciences research that NSF, NASA, and NOAA fund helps educate and train the next generation of geoscientists. Using data provided by the Bureau of Labor Statistics, the American Geosciences Institute calculated a total of 324,411 geoscience jobs in 2014, and this number is expected to increase by 10 percent by 2024 to a total of 355,862 jobs. Approximately 156,000 geoscientists are expected to retire by 2024, but over the next decade, approximately 58,000 students will be graduating with their bachelor’s, master’s, or doctoral degrees in the geosciences. According to the American Geosciences Institute’s (AGI) “Status of the Geoscience Workforce 2016,” given minimal non-retirement attrition from the geoscience workforce, there is expected to be a deficit of approximately 90,000 geoscientists by 2024.

Industry hiring of geoscience graduates fluctuates between sectors, with the oil and gas sector taking on some 60 percent of recent Master’s graduates who gained employment in the geosciences, and the environmental services sector hiring the largest share (31 percent) of recent Bachelors graduates who stayed in the geosciences, according to the American Geosciences Institute’s “Status of Recent Geoscience Graduates 2016” report. Other industries hiring geoscientists include mining, construction, agriculture, transportation, and information technology services, all of which contribute to our national infrastructure. NSF, NASA, and NOAA support for the geosciences contributes significantly to the education and training of these individuals via programs in research, graduate and undergraduate student support.

THE GEOSCIENCES AND ECONOMIC COMPETITIVENESS—RESEARCH YIELDING ECONOMIC BENEFITS

The Federal investment in the geosciences provided the fundamental understanding of geologic structures and processes necessary to utilize hydraulic fracturing (fracking) processes to release oil from shale formations. The ability of U.S. companies to develop these natural resources is built upon decades of fundamental research and technology development in the earth sciences. According to a 2013 report from U.S. Chamber of Commerce’s 21st Century Energy Institute, fracking has created a job boom even in States that don’t have shale deposits, with 1.7 million jobs already created and a total of 3.5 million projected by 2035.

Research on hot-spring-dwelling microbes in Yellowstone National Park resulted in development of the polymerase chain reaction (PCR), a technology that made the molecular biology revolution possible. Scientists discovered that hot spring microbes utilize enzymes that are resistant to the high temperatures required for PCR. PCR is the process by which scientists can generate copies of a single strand or piece of DNA and is indispensable for the multi-billion-dollar biotechnology industry.

Moreover, private enterprise—ranging from insurance companies and large engineering firms to the marine and overland shipping sectors and to small farmers—increasingly relies on the results of the long-term weather, climate, and other natural hazards research enabled by government and university scientists to make

strategic management decisions. The Nation's private sector needs to incorporate weather and climate risks into its risk-management portfolios to remain globally competitive. Industries that rely on global supply chains and distribution centers, such as the major overnight shipping companies, are beginning to use the results of fundamental geoscience research in their day-to-day decisionmaking as well as long-term strategic planning.

THE GEOSCIENCES AND PUBLIC SAFETY

The benefit of the investment in public weather forecasts and warnings is substantial: the estimated annualized benefit is about \$31.5 billion, compared with the \$5.1 billion cost of generating the information (Lazo et al., 2009). In 2016, there were 15 weather and climate disaster events with losses exceeding \$1 billion each across the United States. These events included a drought event, four flooding events, eight severe storm events, a tropical cyclone event, and a wildfire event. Overall, these events resulted in the deaths of 138 people and had significant economic effects on the areas impacted.

We continue to experience extreme weather events in nearly every region of the country. Tornadoes in Oklahoma, Kansas, and Missouri; floods in Louisiana; droughts in Texas; and blizzards in New England. According to the NAS Report, *When Weather Matters*, the annual impacts of adverse weather on the national highway system and roads are staggering: 1.5 million weather-related crashes with 7,400 deaths, more than 700,000 injuries, and \$42 billion in economic losses (BTS, 2007) and \$4.2 billion is lost each year because of weather-related air traffic delays (NOAA, 2010). The death, destruction, and economic harm communities and businesses experience from these and other weather events could be further reduced with continued research and training in the geosciences.

Technologies and observing systems developed to examine the fundamental earth structure have also provided data and enabled models necessary for forecasting and estimating the impact resulting from major earthquakes, tsunamis, volcanic eruptions, and landslides. Understanding of disaster events enables business and government to engage in informed risk management and mitigation and to develop response strategies. When an event does occur, early warnings for evacuation based on timely forecasts and characterization of these disasters has the potential to save billions of dollars and countless lives. For example, EarthScope is a NSF program that has deployed thousands of seismic, GPS, and other geophysical techniques to explore the structure and evolution of the North American continent and to understand the processes controlling earthquakes and volcanoes. Thousands of geophysical instruments create a dense grid covering the continental United States. Scientists from multiple disciplines have joined together to conduct research using the large influx of freely accessible data being produced. The data collected through EarthScope and other NSF research investments are critical for the development of an earthquake early warning system. As the data is collected and disseminated in real-time, computers, communications technology, and alarms are devised to notify the public when an earthquake is in progress. Just ten seconds of warning that an earthquake is occurring is enough to halt trains, shut off gas lines, and open emergency bay doors for first responders.

CONCLUDING THOUGHTS

We appreciate the difficult decisions Congress must make within the constraints of the budget environment. We have provided several examples where the geosciences contribute to the Nation's national security, economic competitiveness, and public safety. We believe that the future of this Nation is well served by a strong and sustained investment in the full scope of our research enterprise—including the geosciences programs sponsored by NSF, NASA, and NOAA. This subcommittee has consistently been a strong champion for the Nation's research enterprise and, despite the budget challenges that it must confront, we urge you to maintain the high priority the subcommittee has long placed on research and training in all fields of science and engineering.

This statement was submitted by the following organizations and institutions:

Lamont-Doherty Earth Observatory,	Consortium for Ocean Leadership
Earth Institute, Columbia University	Incorporated Research Institutions for
University Corporation for Atmospheric	Seismology
Research	American Geophysical Union
National Association of Marine	American Meteorological Society
Laboratories	

Association of Public and Land-grant Universities
 Aerospace Industries Association
 The Weather Company, an IBM Business
 Vaisala, Inc.
 Atmospheric and Environmental Research, Inc.
 Cleantech San Diego
 Aquaai Corporation
 Highwave Ocean Energy
 MRV SYSTEMS LLC (Marine Robotic Vehicles)
 Ocean Innovations
 RBR USA
 American Wave Machines, Inc.
 Reinsurance Association of America
 American Energy Society
 Catalina Offshore Products Inc.
 Analytics Ventures
 Grassy Bar Oyster Company, Inc.
 Teledyne RDI Instruments
 Assure Controls, Inc.
 BMT Group
 Deep Ocean Engineering, Inc.
 OceanGate, Inc.
 FlyWire Cameras
 National Instruments
 Ocean Aero, Inc.
 Del Mar Oceanographic
 Woods Hole Oceanographic Institution
 UC San Diego's Scripps Institution of Oceanography
 The Geological Society of America
 American Geosciences Institute
 University of California System
 Penn State University
 University of Oklahoma
 University of Wisconsin-Madison
 University of Massachusetts Dartmouth
 University of California, Irvine
 University of Georgia
 University of Arizona
 University of Washington
 The University of Texas at Austin
 Texas A&M University
 University of Colorado Boulder
 Oregon State University
 University of New Hampshire
 University of Delaware
 Colorado School of Mines
 University of California, Davis
 Iowa State University
 Michigan Technological University
 School of Ocean and Earth Science and Technology, University of Hawaii at Manoa
 Rutgers University—New Brunswick
 Hubbs-SeaWorld Research Institute
 Institute at Brown for Environment and Society, Brown University
 The University of Texas at Austin Marine Science Institute
 Annis Water Resources Institute, Grand Valley State University
 National Snow and Ice Data Center, University of Colorado
 The School for Marine Science and Technology at the University of Massachusetts Dartmouth
 Sitka Sound Science Center, Alaska
 Large Lakes Observatory, University of Minnesota Duluth
 Savannah State University
 Grice Marine Laboratory, College of Charleston
 Belle W. Baruch Institute for Marine and Coastal Sciences, University of South Carolina
 Patuxent Environmental and Aquatic Research Laboratory, Morgan State University
 National Ground Water Association
 National Estuarine Research Reserve Association
 North Carolina A&T State University Division of Research and Economic Development
 Metropolitan State University of Denver
 Earth & Planetary Sciences, The Johns Hopkins University
 Romberg Tiburon Center for Environmental Studies, San Francisco State University
 National Weather Service Employees Organization
 Institute for Global Environmental Strategies
 School of the Earth, Ocean, and Environment, University of South Carolina, Columbia
 Bermuda Institute of Ocean Sciences (Bermuda and New York)
 The Oceanography Society
 Jacksonville University Marine Science Research Institute
 The Ocean Foundation
 Council on Undergraduate Research
 UNAVCO, Inc.
 The Coastal and Estuarine Research Federation
 Jacques Cousteau National Estuarine Research Reserve
 Department of Marine Outreach, Rutgers University
 University of Maryland Center for Environmental Science
 Skidaway Institute of Oceanography, University of Georgia
 School of Freshwater Sciences, University of Wisconsin-Milwaukee
 National Association of Geoscience Teachers
 American Association of Geographers
 Soil Science Society of America
 Hatfield Marine Science Center, Newport Oregon
 University of California Santa Cruz
 College of Fisheries and Ocean Sciences at the University of Alaska Fairbanks
 North Carolina State University, Center for Marine Sciences & Technology
 Institute for Water and Environment, Florida International University

Association of Ecosystem Research Centers	School of Earth, Energy, and Environmental Sciences at Stanford University
Stony Brook University	Lyndon State College
Desert Research Institute	Department of Atmospheric Sciences, University of Utah
George Mason University	University of Oregon
University of South Florida—College of Marine Science	Oregon Institute of Marine Biology
Utah State University	University of Connecticut
The Weather Coalition	The University of Alaska Fairbanks
Boston University	University of Maine Darling Marine Center
Florida State University	University of Louisiana at Lafayette and the Louisiana Immersive Technologies Enterprise
San Francisco State University	University of Pittsburgh
The University of North Carolina at Chapel Hill, Institute of Marine Sciences	FAU Harbor Branch Oceanographic Institute
University of Miami	Bigelow Laboratory for Ocean Sciences
Washington State University	Duke University Marine Laboratory
University of Denver	California State University Council on Ocean Affairs, Science & Technology
St. Cloud State University	
Earth2Ocean, Inc.	
Virginia Institute of Marine Science	

PREPARED STATEMENT OF THE UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

On behalf of the University Corporation for Atmospheric Research (UCAR), I am pleased to submit this testimony to the Senate Appropriations Subcommittee on Commerce, Justice, Science and Related Agencies and we ask for the subcommittee's continued strong support for the Federal investment in the academic atmospheric, Earth, and Related Sciences. These agencies support vital atmospheric, Earth, and related research in hundreds of universities across the country, benefitting from the knowledge, expertise and innovation of our academic institutions.

UCAR is a consortium of over 100 research institutions, including 77 doctoral degree granting universities, which manages and operates the National Center for Atmospheric Research (NCAR) on behalf of the National Science Foundation (NSF). UCAR is proud to collaborate with and enhance the capabilities of our member universities and Federal partners so that they can carry out important research and meet mission responsibilities on behalf of the American public. UCAR respectfully submits a set of research priorities for the academic atmospheric, Earth, and related sciences for this subcommittee and the 115th Congress. A focused investment of Federal resources in the atmospheric, Earth, and related sciences will make significant contributions towards meeting societal concerns including: protection of American lives and property; expansion of new economic opportunities; enhancement of national security; and strengthening the U.S. leadership in research and development. UCAR's subject matter research and education priorities are:

- Weather*: Accurate weather forecasts are critical in providing important information for short term and longer term forecasts as well as early warnings of impending severe weather. The goal of weather prediction is to provide timely and accurate information that will serve to reduce weather-related losses, protect life and property, improve public health and safety, support economic prosperity and national security, and improve the quality of life for all citizens.
- Water*: Water challenges are facing communities and regions across the United States and the world, impacting billions of lives and costing billions of dollars in damages. These challenges are particularly problematic in predominantly poor, minority, or rural communities. Weather and climate models are fundamental for understanding the earth's water cycle and issues related to availability, quality, water resource management, energy production, flooding, and drought.
- Climate*: Understanding climate change is critical to the world's welfare. Fundamental use-inspired research, made possible by cutting-edge tools for collecting and analyzing data, can provide the knowledge that governments, businesses, and communities need as they address the climate-related changes that pose growing risks to life, property, natural resources, and the economy. Such research depends on sustained programmatic investments in multidisciplinary observations, process studies, and modeling.

- Air Quality*: Air quality affects broad sectors of society, from human health to crop yields to enjoyment of our national parks. Particulate matter, in addition to ozone, triggers most air quality alerts and health effects. Scientists are improving pollutant tracking and developing detailed air quality predictions. Research is also focused on developing detailed air quality forecasts days in advance. Improved forecasts offer the promise of significant benefits to society.
- Space Weather*: Space weather can disrupt vital technology that forms the backbone of this country's economic vitality and national security, including satellite and airline operations, communications networks, navigation systems, and the electric power grid. Research and observations will help drive advances in modeling capability and improve the quality of space-weather products and services. Transition of the latest scientific and technological advances into space weather operations centers will enable an improved rate of forecast improvement.
- Education*: The success of the research challenges above is dependent on a science, technology, engineering and mathematics (STEM) education system that produces a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry that have access to the ideas and tools of science and engineering.

The recommendations are consistent with the recently enacted legislation including the American Innovation and Competitiveness Act, the Weather Research and Forecasting Innovation Act of 2017, and the pending Space Weather Research and Forecasting Act.

THE IMPORTANCE OF OUR RESEARCH INVESTMENTS

UCAR has worked to elevate the understanding of, and support for, the atmospheric, Earth, and related sciences nationwide. The atmospheric science departments at our member institutions are drivers of innovation and the fundamental scientific research that has pushed our understanding of weather, water, climate, air quality, space weather, and education and training atmosphere into exciting and groundbreaking new areas. These advances have improved our ability to predict and understand some of the most dangerous phenomena that occur on our planet every day. Protection of life and property are the central drivers of this scientific innovation and discovery. However, more broadly, these innovations play a significant role in protecting our national security, our homeland, our businesses, our infrastructure and most importantly, our families and communities. As demand for information, prediction, and mitigation increase nationally and across the globe, it is the collaborative and exhaustive research being conducted in our universities and research laboratories that will answer this call and make our families, communities, businesses, and infrastructure better equipped and prepared to meet the challenges and dangers of living inside Earth's dynamic atmosphere.

The return on investments in the atmospheric sciences exemplifies how Federal R&D drives economic growth. The commercial weather industry leverages U.S. investments in weather observation, atmospheric research, and computer modeling to produce tailored products for a wide variety of clients, including the general public. There are now more than 350 commercial weather companies in the U.S., generating nearly \$3 billion in annual revenues. The growth rate of this industry is estimated to be about 10 percent per year. The vast majority of these innovations and technological advances are products of our academic institutions. Researchers, graduate students, and investigators at our universities are an astounding and innovative resource that, in light of the linkage between innovation and our economy, should be seen for what they are—our most valuable national asset. Across the country there is groundbreaking atmospheric science being done that will power our economy, save lives, protect our citizens, and impact every single American in a profound way.

KEY PROGRAMS AT NSF, NOAA, AND NASA

UCAR calls out the importance of these agencies supporting extramural research, particularly with respect NOAA and NASA. Both agencies place a high value on the partnerships that develop via collaborative extramural research. This includes such activities as NOAA's Cooperative Institutes and NASA's research opportunities in space and earth sciences. Maintaining the extramural portion of these programs while fostering new extramural efforts in emerging areas will help these agencies meet their stewardship responsibilities as they relate to their particular missions. UCAR supports the April 2013 NOAA Science Advisory Board's report from its Research and Development Portfolio Review Task Force (PRTF), which said:

NOAA's success in fulfilling its mandate and mission to the Nation depends upon a well-configured and appropriately balanced and funded portfolio of research, both intramural and extramural. The balance is dynamic and will change over time. The internal investment is required to fulfill the agency's mandates and to ensure long-term stable funding of key research and observational programs. The extramural investment allows greater flexibility and agility in the selection of problems and problem-solvers and takes on added importance during periods of severe budgetary constraints. Both the intramural and extramural components require stability and predictability in funding levels . . . The PRTF recommends that NOAA capitalize on the support and skills of the extramural research community by developing carefully targeted initiatives that meet the needs of the Next Generation Strategic plan, that are stable and consistent over time to enable year to year planning, and that ensure the results are integrated into NOAA's R&D operations . . ."

Within NSF, NOAA, and NASA, there are a number of specific initiatives we call to the subcommittee's attention and ask for your strong support for these initiatives:

- NSF's geoscience directorate, its division of atmospheric and geospace sciences; and the National Center for Atmospheric Research (NCAR);
- Key NOAA programs including the Cooperative Institutes, the Airborne Phased Array Radar program (APAR), and the Constellation Observing System for Meteorology, Ionosphere, and Climate—2 (COSMIC) and its ground station; and
- NASA earth sciences and heliophysics research programs.

National Center for Atmospheric Research (NCAR).—NCAR, NSF's only federally Funded Research and Development Center in the geosciences, has an exceptional record of leadership, scientific achievement and effective translation of scientific advances into useful knowledge for a nation that is highly impacted by atmospheric events that are sometimes catastrophic. The current Administration has proposed a \$350 million reduction in fiscal year 2017 for NSF research activities. Even greater reductions are expected to be proposed for fiscal year 2018. There is real and growing concern by the UCAR Board of Trustees that with these proposed reductions, NCAR will be unable to sufficiently support its user community by maintaining existing national scientific capabilities; such as the expanded computing facility operating in Wyoming or the High-performance Instrumented Airborne Platform for Environmental Research (HIAPER). These are examples of newly established capabilities resulting from prior appropriations provided by this subcommittee now under stress. NCAR is an essential part of the research capabilities needed by the atmospheric, Earth, and related sciences community.

NOAA Cooperative Institutes (CI).—The National Oceanic and Atmospheric Administration's CI program helps to provide the research and development necessary to improve the agency's weather, ocean, and climate services, living marine resource management and stewardship, and many more mission responsibilities. These activities provide the scientific basis for national policy decisions in key environmental disciplines, such as climate and weather, disaster risk reduction, and air quality management. CIs provide NOAA with access to a wide diversity of programs, disciplines, and expertise. Within the last 15 years alone, CIs have enabled NOAA scientists to collaborate with dozens of universities and thousands of academic scientists, including multiple Nobel laureates. Additionally, a large number of students and early-career researchers have gained exposure to NOAA laboratories and programs through CIs, and some formed long-lasting collaborations with NOAA or even became NOAA employees. The diversity of the CI program also extends to the management structure, communications capacity, and the types of products delivered, reflecting and respecting the cultures and styles of particular institutions and programs, and the communities in which they are situated.

Airborne Phased Array Radar (APAR).—Continued support for NOAA's investment of in the APAR program will enable research and development of advanced methods of aircraft-based hazardous weather observation, which provide critical information about severe, tropical and heavy precipitation storms, for more accurate public warnings and forecasts. Airborne Doppler radar measurements provide critical location and intensity information about these storms, especially over open ocean or rugged terrain, where other radar information does not exist. Forecasters around the world utilize these radar observations, combined with satellite data and other environmental observations, to study storms and generate predictions of storm intensity and direction. The investment will focus on the research and development of an airborne radar system which can be utilized on a NOAA aircraft, and will provide more data, more accurately. Funding will be used to examine the potential benefits of APAR for providing the real-time data needed for National Weather Service (NWS) forecasts and warnings and to determine how APAR's additional, advanced

capabilities can improve forecasts in the future. NOAA Research will work with the research community to initially develop and demonstrate APAR's feasibility for collecting airborne radar measurements in hazardous weather environments, including hurricanes and severe local storms. Additionally, NOAA and its partners will use these measurements to conduct research to understand severe storms and improve NOAA's predictions and warnings for the public. Through this effort, future opportunities to develop and test other airborne observing systems, besides radar, will emerge and ensure that NOAA has the best airborne observing platform for hazardous weather events.

Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC).—COSMIC is a six-satellite constellation that was launched to the polar orbit in 2006 in a joint collaboration between Taiwan, National Science Foundation, NASA, United States Air Force (USAF), and University Corporation for Atmospheric Research (UCAR). COSMIC-2 is a continuation of the partnership between the United States (NOAA and USAF) and Taiwan to produce an operational constellation of GNSS RO satellites. The USAF is providing six RO sensors to be launched in low-inclination (equatorial) orbit, known as COSMIC-2A. Taiwan will procure and operate the spacecraft for the GNSS RO satellites. NOAA will provide the ground reception system for processing data from the GNSS RO satellites. NOAA intends to leverage this ground system to acquire other RO data where possible whether from other governmental organizations or commercial operators. UCAR strongly supports the COSMIC-2 program. With sufficient funding NOAA intends to complete all information technology security testing and verification in preparation for COSMIC-2 launches. UCAR processing functions will be tested and certified by the National Centers for Environmental Prediction. Funding will support the operational testing and validation of the Numerical Weather Prediction models for COSMIC-2.

NASA Earth Science.—UCAR requests full funding of the Earth Science Division and opposes the Administration's proposals to reduce Earth Science research in fiscal year 2017 and fiscal year 2018. Adequate funding ensures exciting projects such as the Surface Water and Ocean Topography (SWOT) mission, which will conduct the first-ever global survey of Earth's surface water. Data from the satellite has promising uses for flood and drought management at local, regional, and national levels; improved risk assessments by the insurance industry; harnessing ocean energy opportunities; and optimizing the efficiency and effectiveness of both military and commercial marine operations. Strong funding for NASA Earth Sciences will also support the launch of Landsat 9 and 10 in a timely manner, which will provide manifest benefits to municipalities, corporations, and the general public in land-use planning.

NASA Heliophysics.—UCAR strongly supports NASA's Heliophysics Science Division which supports research in the study of the sun and its impact on the Earth. In 1859, a large Coronal Mass Ejection (CME)—known as the Carrington Event—sent charged plasma to the Earth from the sun, causing widespread failure of the telegraph system. Recently smaller events caused localized disruptions in telecommunications and electricity grid systems, which negatively impacted industry and military activities, as well as the daily lives of American citizens. Because of societal reliance on space-based assets, as well as the electricity grid, and a number of other systems vulnerable to extreme space weather, the economic impact of another Carrington Event to the United States alone is \$2.6 trillion. As such, we must improve our ability to understand and predict space weather to mitigate the risks and costs associated with future threats. Strong funding for the Heliophysics Division would enable NASA to fully participate in the cross-agency Space Weather Action Plan that will enable the United States to better understand, prepare for, and respond to space weather.

CONCLUDING THOUGHTS

We recognize the constraints the subcommittee must confront in developing its fiscal year 2018 appropriations bill. We hope you will see the investment in the research programs of NSF, NOAA, and NASA as essential priority investments that will contribute to the Nation's economic and national security as well as public safety. Thank you for the opportunity to submit these views.

[This statement was submitted by Dr. Antonio Busalacchi, President.]