October 16, 2020

Honorable Eddie Bernice Johnson   Honorable Frank Lucas
Chair   Ranking Member
Committee on Science, Space, and   Committee on Science, Space, and
Technology   Technology
House of Representatives   House of Representatives
Washington, D.C. 20515   Washington, D.C. 20515

Dear Chair Johnson and Ranking Member Lukas:

As your Committee considers its legislative options with respect to the reauthorization of the National Science Foundation (NSF), we would like to urge the Committee to include language that directs NSF, in coordination with other relevant Federal agencies, to regularly develop and submit to the Congress a multi-year strategic plan. In our view that plan should have NSF identify its role in and resource requirements for supporting the earth, ocean, coastal, and Great Lakes research and education enterprise to achieve the kind of capabilities envisioned in the National Academies' *Sustaining Ocean Observations to Understand Future Changes in Earth's Climate.* We believe it is essential that we develop a focused set of strategic and sustained investments in earth, ocean, coastal, and Great Lakes observations that will drive science, lead to the quantification of key climate and weather processes, and the improvement of models and predictions needed by policy and decision makers at all levels – local, state, regional, national and international.

By observations, we include not only the infrastructure and technology necessary for the actual capture of data, but the synthesis and processing of data and its integration into models to advance our prediction and forecasting capabilities. It is ships, buoys, and satellites, and the shore-based infrastructure and marine and freshwater laboratories to support them. It includes high performance computing, data management, and support for the education and training of people who will conduct the research with this infrastructure as well as develop it, maintain it, and operate it. It includes novel and innovative technological developments, including battery development and miniaturization and underwater autonomous vehicle development. It includes artificial intelligence and machine learning. It includes expanded broadband internet access on our fleet to more quickly connect science at sea to shoreline, revolutionizing ocean research and education capabilities. It includes everything that other sectors are addressing, only it is being done in the vast and unforgiving environment of the ocean.

Society will face increasingly complex decisions about how to adapt to and mitigate the impacts of more severe droughts, sea-level rise, ocean acidification, harmful algal blooms, hypoxia, species loss, changes to growing seasons, and stronger and possibly more frequent storms and wildfires. To make informed decisions that will improve coastal, economic, and national security resilience, policy makers will need information that depends on understanding the dynamics of the planet's system. Because these dynamics will evolve the ability to anticipate and predict the future will depend on ongoing observations of key parameters to tune and

enhance models. Sustained collection of ocean observations over years, decades, and centuries monitoring the Earth's main reservoirs of heat, carbon dioxide, and water will provide a critical record of long-term change and variability over multiple timescales. Sustained observations of many environmental parameters are thus essential to advance understanding of the state of the earth system now and in the future.

The National Academies' *Sustaining Ocean Observations to Understand Future Changes in Earth's Climate* (2017) made the following findings:

- The current ocean observing system has made significant contributions to better understanding the ocean's role in the Earth system, including its heat, carbon, and freshwater budgets, and to better understanding global and regional sea-level change. Sustaining, optimizing, and increasing ocean observing capability will further improve understanding of the ocean's role in climate.
- The ocean observing system contributes not only to our understanding of climate variability and change, but also to a wide variety of other services including weather and seasonal-to-interannual forecasting, living marine resource management, and marine navigation. This understanding of climate variability and change and other services underpins national defense, economic, and social policy decisions.
- Direct scientific involvement in sustained observing programs, from design to implementation to analysis, synthesis, and publication, ensures that the ocean observing system will be robust in terms of data quality, incorporation of new methods and technologies, and scientific analyses; all are essential elements for realizing the value of long-term, sustained observations.
- The continuity of ocean observations is essential for gaining an accurate understanding of the climate. Funding mechanisms that rely on annual budget approval or short-term grants may result in discontinuity of ocean climate measurements, reducing the value of the observations made to date and in the future.
- To avoid data gaps and ensure the required data quality and the accessibility of the data for monitoring climate over decades, ocean observing initiatives will need to plan for the end-to-end scope of expenses associated with observing programs, including appropriate logistical planning.
- The absence of an overarching long-term national plan with associated resource commitments and lack of strong leadership presents a challenge for sustaining U.S. contributions to ocean observing, by inhibiting effective coordination and multiyear investments in the many components of the observing system.

The need for this investment is consonant with the ongoing commitment of the NSF to support partnerships that harvest critical observations in order to provide decision support to the public and private sectors. Improved ocean observations will narrow the range of uncertainties in the climate and weather forecasts used by a multitude of enterprises at all levels of government and in all sectors of private enterprise.

This Committee has held numerous hearings highlighting the importance and need for improved observations. This Committee has also been instrumental in highlighting the indisputable role of the oceans and its impact on climate and weather and has been developing a number of ocean-related legislative initiatives. We suggest the Committee can build on those efforts in forthcoming NSF legislation with the inclusion of language that would direct NSF, in coordination with other relevant Federal agencies, to regularly develop a multi-year strategic plan that would have NSF identify its role in and resource requirements for supporting the earth, ocean, coastal, and Great Lakes research and education enterprise to achieve the kind of capabilities envisioned in *Sustaining Ocean Observations to Understand Future Changes in Earth's Climate*.

We would recommend that such an exercise consider a variety of sources of advice including: the National Academies; international climate and related analyses; recent interagency reports on ocean science and technology priorities and the state of the academic and federal fleet; advanced marine technology developments and data needs; input from the research community via proposals, workshops, advisory committees and other similar forums; and information regarding future workforce challenges. We believe that such a plan could enhance NSF's role in earth system science as well as in its partnership and relationships with other relevant federal agencies.

We appreciate the opportunity to provide this information to the Committee. We have provided similar comments to the Senate Commerce, Science, and Transportation Committee. We stand ready to work with the Committee in whatever capacity would be most helpful.

Sincerely,

Lamont-Doherty Earth Observatory of Columbia University
The Earth Institute, Columbia University
National Association of Marine Laboratories
Woods Hole Oceanographic Institution
Scripps Institution of Oceanography
Consortium for Ocean Leadership
University Corporation for Atmospheric Research
College of Earth, Ocean and Atmospheric Sciences, Oregon State University
Hatfield Marine Science Center, Oregon State University
Graduate School of Oceanography, University of Rhode Island
Marine Science Institute, University of Texas
College of the Environment, University of Washington
College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
School of Ocean and Earth Science and Technology, University of Hawaii
Jacksonville University Marine Science Research Institute
University of Wisconsin-Milwaukee, School of Freshwater Sciences
Moss Landing Marine Laboratories
The Hawaii Institute of Marine Biology, University of Hawaii

Friday Harbor Laboratories, University of Washington
Kewalo Marine Laboratory, University of Hawaii
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Horn Point Laboratory, University of Maryland Center for Environmental Science
Grice Marine Lab, College of Charleston
Florida Atlantic University, Harbor Branch Oceanographic Institute
University of Guam Marine Laboratory
R.B. Annis Water Resources Institute, Grand Valley State University
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NC State University, Center for Marine Sciences and Technology
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Telonicher Marine Laboratory,
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Institute of Marine Sciences, University of North Carolina at Chapel Hill
University of Guam Marine Laboratory
Research & Collections Branch of the Natural History Museum of Los Angeles County
Estuary & Ocean Science Center, San Francisco State University
College of Science & Engineering, San Francisco State University
Dauphin Island Sea Lab
Duke University Marine Laboratory
Coastal Studies Institute, East Carolina University
Whitney Lab for Marine Bioscience, University of Florida
IOOS Association
Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science
Sanibel-Captiva Conservation Foundation Marine Laboratory
Jacques Cousteau National Estuarine Research Reserve at Rutgers University
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