UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary of Commerce
for Oceans and Atmosphere
Washington, D.C. 20230

June 20, 2023

Mr. Scott Rayder
Chair
U.S. Integrated Ocean Observing
System Advisory Committee
555 Yuma Circle
Boulder, CO 80303

Dear Mr. Rayder:

In February 2023, the U.S. Integrated Ocean Observing System (IOOS) Advisory Committee submitted a report on their recommendations to the National Oceanic and Atmospheric Administration (NOAA) and the Interagency Ocean Observation Committee. The recommendations focus on climate change, diversity, equity and inclusion, and the new blue economy. These recommendations align with NOAA's strategic priorities, which include building a climate-ready Nation, integrating equity into core operations, and advancing the new blue economy. NOAA recognizes the critical role of the U.S. IOOS Enterprise in all of these endeavors.

I am pleased to report that the U.S. IOOS Office has already begun to implement many of the recommendations included in the Committee's report, and NOAA intends to continue making progress on many more as well. Please see the attached NOAA response to the report for more details on how we are implementing these recommendations. I am grateful for the time and talents of this Committee and your dedication to furthering NOAA's strategic priorities and the IOOS mission.

Sincerely,

Dr. Richard W. Spinrad
Under Secretary of Commerce
for Oceans and Atmosphere
and NOAA Administrator

THE ADMINISTRATOR

NOAA Response to:

February 2023 U.S. IOOS Advisory Committee Work Plan Recommendations

A Report to the
U.S. Integrated Ocean Observing System Advisory Committee
May 2023

Submitted by:
Richard W. Spinrad, Ph.D.
Under Secretary of Commerce for Oceans and Atmosphere
and National Oceanic and Atmospheric Administration Administrator
May 2023

Fostering Growth of the New Blue Economy

1. **Recommendation:** *NOAA should invest in technology advancement by leveraging the IOOS network of government agencies, academia, and industry.*
    - Technology is rapidly evolving in the ocean domain, with the creation of new sensor technology, dramatic increases in remotely-sensed data, new modeling techniques, and the use of AI/ML.
    - Active engagement with the growing number of technology startups in the blue economy, and coordination of joint projects across sectors would be impactful.
    - IOOS should continue to use the Ocean Technology Transition (OTT) program and explore collaboration with IOOC and NOPP on Notice of Funding Opportunity's (NOFO) related to research to operations.
    - NOAA should evaluate options for a new funding model, including Other Transaction Agreements (OTAs), that allows for rapid funding and evaluation of new technologies that are agile and can move quickly to start and stop projects.

    NOAA Response: NOAA concurs with this statement. The IOOS network of Regional Associations (RAs), academic, private sector, and non-governmental partners are already proving crucial to NOAA successfully accelerating technology development. Enabling maximum use and usefulness of ocean information from the IOOS RAs and other members of the IOOS observing networks is a primary goal.
    What we have done: The IOOS Office issues competitive funding opportunities to enable adoption of new technology in the ocean observing, data, and modeling science and technology areas. The IOOS Office utilizes NOPP well for marine life program funding opportunities, enabling interagency collaboration and funding. The IOOS enterprise is working closely with NOAA, other agencies, and external partners to understand ocean observation data needs to support operational oceanography activities and unlock the potential of ocean data using technologies like AI/ML.
    What we will do: The IOOS Office will leverage new funds from the Bipartisan Infrastructure Law (BIL) and new FY23 funding to accelerate new technological opportunities for the IOOS network of RAs as well as private sector entrepreneurs and small businesses. This will take at least five years to implement, as this is a new line of effort that will evolve and mature over time. At the same time this new investment will enable us to improve our ongoing processes and partnerships to meet these recommendations. For upcoming funding opportunities, the IOOS Office will do more to cross-pollinate requirements needs and R&D trends across the federal government.

2. **Recommendation:** *NOAA should review and evaluate the current Data Management & Cyberinfrastructure (DMAC) structure to meet the exponential growth in data being created from sensors, models, analysis, and AI.*
    - The accomplishments of IOOS and the RAs in the area of data management have been remarkable, and are made possible through community effort and promotion of data standards and use of open-source technologies. As the volume of data

increases and demands on the system increase, it is important that the system continues to scale to meet these demands.
- The review should evaluate a number of areas, including security, redundancy, technology components, scalability, hybrid-centralization, and Cloud-readiness.

NOAA Response: NOAA concurs with this statement. A robust DMAC system is required in order to meet the increasing need to steward a growing and diversifying observational ecosystem, as well as ensuring that data is available to partners and customers in a timely, reliable, and standardized way.
What we have done: In 2022, the IOOS Office hired a DMAC coordinator to analyze and realign DMAC projects. Using BIL and new FY23 funding, the IOOS Office is bringing on additional personnel support, including software engineering support, to work with the DMAC Architect and the DMAC team to further refine and evolve the IOOS DMAC infrastructure.
What we will do: Over the next couple of years, the IOOS Office plans to conduct an analysis of operational oceanography gaps and evolving needs within NOAA, and design a data system that addresses these issues. One of the many challenges before us is how to balance standardization and innovation—creating a uniform system of data assembly and data services that honors and includes the best practices developed by the RAs, as well as creating opportunities to develop new capabilities. Our intent is not to supersede or replace existing RA systems, but to build scalable, operationally reliable systems for the Federal DMAC system that incorporate the innovations and customer-driven services of the RAs and their partners. From a broader NOAA perspective, the NOAA Cloud Services contract, the NESDIS Common Cloud Framework, and the NOAA Open Data Dissemination program all present opportunities in the next several years for cross line office collaboration to ensure less duplication and more knowledge sharing across the agency. The coordination levels required to succeed are high and will require ongoing engagement and convening of experts to achieve these goals.

3. **Recommendation:** *NOAA should review and evaluate the data buy agreements currently in place for the ocean domain.*
    - NOAA has entered into agreements to purchase data, especially in the weather and satellite enterprise, and current technologies are expanding beyond the air-sea interface. Future opportunities for the data-purchase model in the ocean domain should be evaluated further.
    - Potential data buys could include hydrographic surveys, platforms such as Saildrone and Wave Gliders should be evaluated
    - It would be valuable to learn about successes and challenges from the weather enterprise such as GPSRO and the NWS National Mesonet Program.
    - NOAA should consider increased coordination of data buys across offices and define “best practices for data buys” in order to ascertain if they can be used to support the IOOS, NOS, and NOAA missions, and if so, ensure equitable agreements between federal and private entities in these agreements across the agency.

NOAA Response: NOAA concurs with this statement. A robust IOOS enterprise DMAC system, utilizing in-house and external data management capabilities (i.e., data buys), is required in order to meet the increasing need to steward a growing and diversifying observational ecosystem, as well as ensuring that data are available to partners and customers in a timely, reliable, and standardized way.
What we have done: The IOOS Office currently supports 11 externally funded RAs. All 11 RAs are certified as Regional Coastal Observing System (RCOS), which means they are non-federal observing organizations recognized as meeting federal standards for data gathering and management. Similar in concept to a data buy, the IOOS Office uses data provided by the RAs to inform and build NOAA products and services. IOOS has the authority to directly procure data through the Integrated Coastal and Ocean Observation System Act, Section 4(c)(3)(D), as amended by the Coordinated Ocean Observations and Research Act of 2020, which states that the IOOS Office has “the authority to enter into and oversee contracts, leases, grants, or cooperative agreements with non-Federal assets, including regional coastal observing systems, to support the purposes of this chapter on such terms as the Administrator deems appropriate". This authority includes entering into agreements with the private sector.
What we will do: NOAA is currently establishing a Commercial Data Buys Task Team, sponsored by the NOAA Chief Data Officer, to develop policy and guidance for NOAA’s data buy activities, ensuring that NOAA can fully utilize commercial data to meet its mission needs in a cost-effective manner. NOS will contribute to this Task Team, ensuring that NOAA’s observational needs for ocean information are considered. The IOOS Office will monitor the work of this task team over the next two years, and evaluate the role of data buys in accomplishing the IOOS mission. Additionally, the IOOS Office will utilize funding available in FY23-FY26 to stimulate private sector engagement in the data enterprise and support small businesses working on new technologies and methods for collecting and providing these critical data needs.

4. **Recommendation:** *IOOS should evaluate its role in coordination of data collection and data management for the Offshore Wind sector.*
    - The growth of offshore wind is transformational for the U.S in terms of its climate and energy strategies, and is also a tremendous opportunity to leverage these projects as ocean observing assets and to expand ocean observing capabilities in the U.S. EEZ. Data collected during planning, permitting, and operations includes extensive site characterization (geological, geophysical and archeological seafloor and subsurface data, metocean observations) and baseline environmental data (marine species, habitats, baseline monitoring for fish, avian, and marine mammal species).
    - NOAA/IOOS should coordinate with BOEM to frame a data sharing agreement between the offshore wind developers and government, leveraging IOOS’s experience and data infrastructure to manage disparate data required by regulatory processes. There are a number of data sharing agreements that could be

considered as templates for such an agreement, including the IOOS data sharing agreement with Orsted[1] and the MOU between NOAA and BOEM[2].

- IOOS should also consider partnerships and work closely with regional entities such as the Regional Wildlife Science Collaborative (https://rwsc.org/) and Responsible Offshore Science Alliance (https://www.rosascience.org/).
- There is a need for a data backbone to support these types of regional efforts and IOOS should consider expanding its data infrastructure to include more ecosystem and marine life data.
- NOAA should promote coordination of oceanographic data collection on offshore structures, supported by and in partnership with the offshore wind industry. IOOS and its RAs are ideally positioned to advise on what types and where these measurements are most valuable, and can provide guidance and standards on instrument configuration and data management for integration of sensors on offshore wind structures.

NOAA Response: NOAA concurs with this statement. NOAA is committed to enabling sustainable, safe, and informed Offshore Wind (OSW) development through environmental reviews, data collection and science, ocean intelligence, improved climate forecasts and projections, and an essential blue economy workforce.
What we have done: The IOOS Office is supporting several efforts related to expanding our observational backbone, particularly around marine life observations, including: a small grants program to develop Marine Life capabilities regionally; communities of practice and training opportunities to develop and test data management best practices; centralized data assembly centers to organize and disseminate Marine Life data. However, financial support for sustained monitoring of the marine life and ecosystem aspects of the coastal oceans is insufficient. The IOOS RAs are actively engaging with the OSW industry to partner on data collection and sharing.
What we will do: The IOOS Office is working to develop a standardized approach with BOEM over the next year that would require ocean surface current and wave observing system infrastructure to be provided and properly maintained within and around the periphery of new wind farms, to mitigate the interference OSW turbines cause to the high-frequency radar (HFR) systems presently measuring these variables. To date, the IOOS Office has worked with BOEM on a lease-by-lease basis, successfully including this requirement for lessee-provided sensors to telemeter their data to IOOS into the public domain throughout the life of the wind farm in a number of BOEM Terms & Conditions of Construction & Operations Plan approval. However, this piecemeal approach is effectively “reinventing the wheel” each time to advocate for and institute this same requirement, which is time consuming for all parties including lessees, and introduces uncertainty in the process for the OSW industry. Standardizing HFR

[1] NOAA signs data-share agreement with offshore wind energy company (2021 March 29). (https://www.noaa.gov/media-release/noaa-signs-data-share-agreement-with-offshore-wind-energy-company)

[2] NOAA and BOEM announce interagency collaboration to advance offshore wind energy (12 January 2022). (https://www.noaa.gov/news-release/noaa-and-boem-announce-interagency-collaboration-to-advance-offshore-wind-energy)

interference mitigation in a way that includes a coordinated approach between BOEM, NOAA, and the IOOS RAs will assist the OSW industry's advance planning with more effective and efficient agency input.

The Regional Ocean Partnerships (ROPs) are an additional avenue to support this recommendation. The IOOS Office and NOAA Office for Coastal Management are building a collaboration between ROPs and RAs in relevant regions to support the regional ocean data portals and OSW data needs over the upcoming years as OSW is deployed. This collaboration around OSW is just beginning and is being funded through BIL and new FY23 funding. The RAs and the ROPs have the opportunity to leverage the initial work that they are both doing in OSW. For example, the Mid-Atlantic Regional Council on the Ocean (MARCO) and Northeast Regional Ocean Council (NROC) are currently creating plans that identify research, monitoring, and data management priorities for marine wildlife on the Atlantic coast as it relates to the development of offshore wind (as part of a larger Regional Wildlife Science Collaborative for Offshore Wind). The outcomes from these plans will support the RAs as they investigate the best ways to coordinate data collection and data management for Offshore Wind.

5. **Recommendation:** *NOAA should promote IOOS to support STEM education in ocean sciences.*
    - IOOS is uniquely positioned to be the leader in providing data and content for our next generation of STEM students, and become a platform to support student and citizen science.
    - NOAA should promote IOOS tools and data for use in high school and college courses – consider an IOOS Education led position to coordinate with NOAA Office of Education, National Sea Grant and the RAs, and actively engage with institutions.
    - NOAA should support programs that provide simple tools (e.g., XLS, Python notebooks) that can be used to leverage IOOS data and teach relevant technical skills and support workforce development.
    - Using a number of channels including partnerships and co-branding, IOOS should engage universities with ocean science/engineering and data science programs to develop internships and co-ops with government, academic, and business entities performing data science with NOAA/IOOS ocean data.

NOAA Response: NOAA concurs with this statement. Developing a data literate workforce is an important goal.
What we have done: The IOOS Office is currently working with the NOAA Office of Education and the National Science Foundation (NSF) on growing the New Blue Economy workforce through partnerships with accelerators and universities, developing programs that help students develop ocean data science skills and find career opportunities at NOAA and in the IOOS community. In addition, the IOOS Office leads and supports Data Science workshops and training opportunities, such as Code Sprints, Hackathons, Ocean Hack Week, and the Google Summer of Code. The results from

these events are made available in the IOOS Github https://github.com/ioos, an open source repository of data science tools, including Python code and Jupyter Notebooks, that are free for use and open for contribution.
What we will do: The IOOS Office will continue to identify ways to increase students' exposure to careers in ocean data science and ocean observations, to increase and diversify the pipeline of ocean experts required to sustain ocean observing and service delivery in the future. These pipelines will take years to develop and mature and additional resources are needed to accelerate these efforts. The IOOS Office is also working with the NOAA Office of Education to coordinate with a cross NOAA team who is working with NSF to co-develop workshops and conferences to mutually support this arena over the next few years.

Climate Impacts at the Oceans and Coasts

1. **Recommendation:** *NOAA should develop a national integrated coastal climate capability with IOOS as the national leader to collect-collate-synthesize continental shelf data.* NOAA should designate and provide the resources to support IOOS as that leader, including appointing a full-time coastal climate program manager to manage and guide aspects of collecting, integrating and disseminating data working with NOAA's climate programs and the IOOC agencies.

   NOAA Response: NOAA is supportive of a national integrated coastal climate capability. The IOOS Office is well positioned to serve as a national leader to collect, collate, and synthesize continental shelf data. Owning responsibility for the recommendation in its entirety would require substantial additional resources for the IOOS Office.
   What we have done: The IOOS Office is contributing to NOAA's climate goals through data sharing, data archiving and contributing coastal and ocean domain expertise. The IOOS Regional Associations are collecting data on the continental shelf and coasts, documenting changing ocean conditions through time. IOOS observations provide a backbone of observations to build off of in order to better observe and detect the coastal climate signal.
   What we will do: With additional resources, the IOOS Office will provide more dedicated staff support to improve coordination within NOAA and across agencies, working to optimize the observations collected to fulfill identified oceanic continental shelf climate data needs. Importantly, additional resources would augment the spatial and temporal coverage provided by regionally operated observing systems. The IOOS Office will also serve as a national convener, coordinating across government and NOAA programs (see page 4) on how ocean and coastal data support this mission area. Over the next five years, the IOOS Office will continue to seek cross-line office and cross-program opportunities to leverage funding and engage existing science, observing, modeling and management structures and partners to advance coastal climate understanding toward a climate-ready nation.

2. **Recommendation:** *NOAA should fund recapitalization and modernization of existing infrastructure and fill existing gaps in the current ocean observing network.* This should include funding for the national network of moorings, profiling gliders, high frequency radar and shore stations, updating sensors, and expanding to comprehensive nationally standardized physical, chemical and biological data in order to detect change. While some progress has been made towards modernizing infrastructure, funding of existing infrastructure remains the most urgent need as collecting sustained time series is required for detecting the impacts of a shifting climate and informing adaptation and mitigation strategies.

   NOAA Response: NOAA concurs with this recommendation, and a rigorous requirements assessment may be necessary to determine and prioritize which observing infrastructures are most needed to address stakeholder needs. Climate change science and research need a long-time series of observations to detect the impacts and develop adaptation and mitigation strategies. As acknowledged, some strides have been made in modernizing infrastructure through “Fill the Gaps” funding, however, new resources will be needed to continue modernization of the infrastructure to keep providing the essential data and information to deal with climate change complex challenges. While BIL funding has provided RAs with some resources to address infrastructure needs, the regional stakeholder requests for data and the underlying observation infrastructure surpass BIL funding.
   What we have done: NOAA has conducted a Consolidated Unfunded Requirements List analysis, which will be updated periodically. NOAA is providing BIL funding to each RA to address recapitalization needs. Both the sensors IOOS RAs use to observe the ocean and the staff that maintain them are highly leveraged (e.g., NSF, ONR, NASA, BOEM grants, state funds, internal university research funding). The IOOS Office has made inroads towards funding the recapitalization of select of those sensors, but does not have the budget to fund the replacement of the full constellation of instruments needed as those sensors reach the end of their rated service lives.
   What we will do: NOAA and the IOOS Office will utilize BIL funds and new FY23 funding to implement this recommendation over the next five years. The IOOS Office will continue to document the existing gaps and request funds to fill them through the budget formulation process.

3. **Recommendation:** *NOAA should expand coastal observations and support regional-scale models that collectively can be used to monitor trends, detect changes, provide forecasts, and deliver tailored information products to users for improving coastal resilience.* A first step is to fully fund the recently approved IOOS Regional Associations’ five-year cooperative proposals, which were developed with significant regional stakeholder input.

   NOAA Response: NOAA partially concurs with this statement. Models across varying spatial and regional scales are needed to monitor trends, detect climate signals, improve model and forecast accuracy and meet the users needs. However, the greater need

within existing funding levels is to integrate data, information, and models across regions for pan-regional and national-scale approaches and data for status/trends, changes detection, and forecasting. Additionally, NOAA does not concur with the need to fully fund the IOOS Regional Associations' five-year cooperative proposals as a first step. The IOOS Office funding levels are insufficient to do so.
What we have done: The National Ocean Service has developed a Modeling Strategy, providing a unified vision for improving the simulation and prediction of coastal and ocean phenomena and for working with community partners across NOAA, the federal government, academia, and the private sector to build and advance models to issue reliable ocean predictions and address the needs of the public. Models like the West Coast Operational Forecast System (WCOFS) are assimilating IOOS observations to deliver operational regional forecasts. IOOS is working with partners on elements of the design, development and evaluation of a prototype East Coast Community Ocean Forecast System (ECCOFS) that implements data-assimilation of real-time observations in a Regional Ocean Modeling System (ROMS) model of the western North Atlantic Ocean and U.S. coastal and shelf waters.
What we will do: NOAA continues to develop new and, where appropriate, upgrade existing Operational Forecast System models to include data assimilation of relevant IOOS core variables. Over a span of time (~5 years) to match BIL funding, NOAA will develop a prototype data assimilative regional model spanning the entire Eastern seaboard and Gulf of Mexico. This is a challenging and ambitious undertaking. NOAA is utilizing new FY23 funding to establish pan-regional and national data products and services to accelerate service delivery improvements across regions.

4. **Recommendation:** *NOAA should invest in technological innovation for new types of observing tools, sensors, and delivery mechanisms to improve coastal observations and regional scale models, reduce costs and improve the understanding, delivery, and communication of information.*

   NOAA Response: NOAA concurs with this recommendation. Cost-effective observing tools and sensors have advanced recently. Deployment of these cost-effective technologies will certainly augment data holding and improve coastal observations and regional scale models.
   What we have done: The IOOS Office and RAs are actively engaged with the community and stakeholders to develop requirements for innovative observing technologies transition to operations through the IOOS Ocean Technology Transition (OTT) Program and the Coastal Ocean Modeling Testbed (COMT). At the regional level new cost-effective observing systems such as low cost water level sensors and the Backyard Buoys Project are good examples of innovative cost-effective technologies that will improve ocean observations coverage. The IOOS Office is also actively engaged in new ventures to expand our innovation and service delivery, including developing a cloud computing sandbox, harvesting HFR wave data from the HFR network, and HFR surface current velocity data assimilation.

What we will do: The IOOS Office will implement this recommendation through its existing programs, in partnership with RAs and other NOAA offices (e.g., OAR), utilizing competitive funding opportunities over the next five years. The timelines of those vary, with some already established on a 3-yr award cycle (e.g., OTT, COMT). The IOOS Office will use new resources in FY23 to build upon and expand these activities and to enable new partnerships with the private sector in new and exciting ways to accelerate technology innovations and information services over the next five years.

5. **Recommendation:** *NOAA should expand regional data integration services to better integrate IOOS with other coastal and global climate programs and to better provide products and services for communities.* This can be achieved by supporting advanced platforms that can more rapidly communicate information, alerts and warnings to users, thereby building synergies, filling critical gaps, and developing cost-effective solutions.

   NOAA Response: NOAA concurs with this recommendation. Data integration is one of the priorities for the IOOS Office. The IOOS DMAC and IOOS Regional Data Assembly Centers have advanced significantly in recent years to integrate national coastal and ocean observing data, and sustaining and modernizing this national infrastructure is critical to improving the accuracy of the models and improve the understanding, delivery, and communication of information.
   What we have done: The IOOS Office continues to engage coastal and global climate programs to integrate data through DMAC workshops and meetings to develop advanced community platforms to innovate and improve data sharing tools, and build synergies to meet the users needs. NOAA has various NWS alerts; InteractiveNWS mobile alerts; in partnership with FEMA, Wireless Emergency Alerts; HAB forecasts; the Common Alerting Protocol XML-based information standard used to facilitate emergency information sharing; a host of NOS mobile apps, some of which communicate alerts and warnings; and R&D efforts including tsunami and meteotsunami detection with HFR and warnings. These tools utilize IOOS observations directly or indirectly to varying extents and the IOOS Office continuously works with partners throughout government to improve products and services with IOOS data.
   What we will do: The IOOS Office will implement this recommendation through its existing programs, in partnership with RAs and other NOAA offices (e.g., OAR). The timelines of those vary, with some already established on an annual cycle (e.g., OTT). The plans underway to grow the Ocean Enterprise and the Blue Economy will also be an opportunity to accelerate technology innovations and information services over the next five years.

6. **Recommendation:** *NOAA should increase engagement with historically underrepresented communities that are often disproportionately affected by climate impacts and take action to co-producing observation systems and tailored products to ensure all have access to the information and tools needed to fully prepare for and respond to coastal change.*

NOAA Response: NOAA concurs with this recommendation. Equitable service delivery will require reaching out beyond existing engagement avenues. NOAA seeks to improve its engagement, co-design, and co-creation of observations, data, models, and products to assist communities most affected by coastal change, which have been historically marginalized.
What we have done: NOAA has created its Regional Collaboration network, which has convened a series of Climate and Equity Roundtables across the country to gather feedback from community partners to inform how NOAA provides climate services, engages with underserved and vulnerable communities, and strengthens internal processes to respond to expressed needs. NOAA has also directed offices throughout the organization, including the IOOS Office, to incorporate DEIA into their planning and funding opportunities. Programs like NOAA Sea Grant provide opportunities for students from underrepresented communities to learn and work with NOAA. NOAA also has a Tribal Relations Team and works to improve its use of indigenous knowledge, and the incorporation of CARE principles (Collective Benefit, Authority to Control, Responsibility, and Ethics) in NOAA's use of data. The Backyard Buoys project is one example of partnerships with indigenous communities. This initiative brings together a geographically and culturally diverse group of partners that include three regional associations of the U.S. Integrated Ocean Observing System (NANOOS in the Pacific Northwest, AOOS in Alaska, and PacIOOS in the Pacific Islands); indigenous and education partners from each region; and a wave buoy and sensor company known as Sofar Ocean. Together, they are collectively working to close the gap in access to coastal and ocean data, especially for indigenous communities in remote coastal areas.
What we will do: The IOOS Office will both continue its current actions to maintain engagement with historically underrepresented communities and emphasize equitable service delivery, engagement, co-design, and co-creation with underrepresented, underserved, and vulnerable communities in future funding opportunities and fund activities that will address and report on this area of need. With new FY23 funding, the IOOS Office will be hiring a partnerships and service delivery lead that will focus, in part, on expanding partnerships to include underserved and underrepresented communities, and defining new service delivery outlets to expand IOOS' reach. These are early efforts that will mature over time to revamp how the IOOS enterprise delivers information and services to a broader constituency.

Diversity, Equity, Inclusion, and Accessibility (DEIA)

1. **Recommendation:** *The IOOS Program Office, working with the IOOS Association, the RAs, the IOOC and others (e.g., NOS) should develop common DEIA vision and mission statements for the IOOS enterprise.*
    - The vision statement should identify the key outcomes of the DEIA work to be undertaken by the IOOS enterprise.
    - The mission statement should identify key audiences with whom the IOOS enterprise will work, how the work will be conducted (e.g., principles of engagement) and the benefits they will receive as a result of this DEIA work.

NOAA Response: NOAA concurs with this recommendation. The DEIA space is very broad. Establishing common DEIA vision and mission statements is part of a broader need to establish clear goals and focus for the IOOS enterprise.
What we have done: The IOOS Office is part of the DEIA IOOS Association working group, which has drafted initial vision and mission statements for the IOOS enterprise. The IOOS Office is also actively engaged with NOS DEIA efforts and contributed to NOAA, NOS, and Department of Commerce strategic planning efforts to expand DEIA efforts within the broader organization.
What we will do: With new FY23 funding, the IOOS Office is hiring a partnerships and service delivery lead that will focus, in part, on developing a collaborative and comprehensive strategic and implementation plan to advance DEIA within the IOOS enterprise. This nascent effort will take years to fully mature as the IOOS enterprise refines business practices and broadens the audiences that utilize IOOS information and services.

2. **Recommendation:** *NOAA should expand support for and/or develop new programs for DEIA activities within NOAA, leveraging the broader IOOS community.* This could include:
    - Competitive grants and funding opportunities that advance DEIA activities. These may include the development of workforce programs and programs specifically for minority serving institutions, including leveraging STEM expertise, expanding internships and opportunities for sabbaticals and IPAs at NOAA or the IOOC agencies.
    - A permanent IOOS DEIA fellowship program to work with the RAs, IOOS program office and stakeholders to identify and assess issues, identify opportunities, recommend improvements, and recommend new or expanded partnerships. We endorse the current IOOS RA's DEIA Fellow's work, including tracking and maintaining close contact throughout the Fellowship, and encourage this Fellowship to be made permanent to allow that work to continue.
    - An IOOS DEIA Strategic Plan and follow on Implementation Plan for execution by the U.S. IOOS Office, developed in collaboration with the Regional Associations.

    NOAA Response: NOAA concurs with this recommendation. NOAA is promoting DEIA as an integral part of our workforce and workflows, to ensure the needs of America's underserved and vulnerable populations are met through delivery of services, education and training to prepare all communities for increasing extreme weather and climate hazards. The IOOS Office has a unique role to play as a funding entity, requiring and motivating new partnerships with minority serving institutions.
    What we have done: The IOOS Association and the IOOS Office created a DEIA Fellowship in 2021. This position is the first of its kind for IOOS, establishing dedicated capacity to coordinate across the regions, establish dialogs, and assess DEIA work across all 11 regions. The IOOS Association has also created a DEIA working group with RA and IOOS Office membership, to continue the work started by the fellowship.

What we will do: The IOOS Office will coordinate with the RAs to develop an IOOS DEIA Strategic Plan and an Implementation Plan to be executed by the IOOS Office. The IOOS Office is hiring a partnerships and service delivery lead to continue and build upon the valuable work completed by the first IOOSA DEIA Fellow and provide dedicated capacity within the IOOS Office to coordinate with other NOS and NOAA DEIA efforts. The IOOS Office will coordinate with the RAs to expand outreach programs with HBCUs and increase engagement with the SACNAS, where we have submitted a session proposal about harmful algal blooms in Alaska, the Pacific Northwest, and the Pacific Islands, with a goal of showcasing how relevant and timely HAB information for diverse audiences requires interdisciplinary scientific expertise and diverse service delivery approaches.

3. **Recommendation:** *NOAA and the IOOC should develop and execute strategies in DEIA activities that will strengthen the IOOS Program, IOOC observing community, and the new blue economy.* This could include:
    - Conduct, assess, and publish publicly a baseline data assessment of DEIA workforce across IOOC agencies. Update the baseline assessment every two to three years to monitor areas of need and progress for follow up action as appropriate.
    - Conduct an assessment of barriers to and opportunities for DEIA, including workforce development and access to funding. Assessment should include how data sources, metrics and analytical methods can be used in decision making for investments in DEIA programs.
    - Develop and implement an investment strategy that could have the greatest impacts for DEIA elements with a focus on underserved communities, operational observation systems, information access, research and development and technological innovation.
    - Where appropriate develop, expand, and implement partnerships with stakeholders and minority serving communities to foster technological innovation and inclusivity, including the IOOC agencies, academia, NGOs and the private sector.
    - In coordination with the U.S. IOOS community, develop a plan for incorporating the new White House Council on Environmental Quality (CEQ) Indigenous Knowledge Guidance for Federal Agencies into IOOS operations.
    - Explore the creation of an internship/fellowship program designed to increase agency connections with underserved communities. Such internships might be well served by including a position guarantee (e.g., service agreement equal to, or greater than time spent as an intern) within that agency or the intern's home state equivalent.

NOAA Response: NOAA concurs with this recommendation. Strategies and dedicated DEIA activities are needed to enhance the accessibility of NOAA's services and information by underserved and vulnerable communities, in order to increase their resilience in the face of climate and coastal hazards.

What we have done: The IOOS Office has been working to improve diversity in our hiring by ensuring we have diverse interview panels, incorporating redacted/blind resume reviews to limit unconscious bias, and holding quarterly discussion groups to highlight topics that focus on inclusion and diversity (e.g., the use of personal pronouns, CARE and FAIR data principles).
What we will do: With new FY23 funding, the IOOS Office will be hiring a partnerships and service delivery lead that will focus, in part, on developing a collaborative and comprehensive strategic and implementation plan to advance DEIA within the IOOS enterprise. The IOOS Office will work closely with the IOOC to begin exploring an interagency assessment of DEIA workforce. This will be challenging within existing resources and will likely take several years to implement.

4. **Recommendation:** *NOAA should gather knowledge and enhance access to information to increase diversity, equity, inclusivity, and accessibility in coastal ocean communities and programs.* This could include:
    - Incorporate principles of collaborative science by expanding stakeholder engagement and information gathering sessions with diverse and underserved groups and communities that rely on access to information and data from the ocean and exchange critical local and traditional knowledge.
    - Reinforce IOOS as a key regional integrator to facilitate connections among existing networks that link communities, in order to provide information and ensure access for communities that rely on knowledge from the ocean to guide decision making and sharing knowledge from and for the local and regional environment.
    - Find and connect to a centralized repository of knowledge that includes information on best practices, technology, observing systems, and training materials for DEIA, with a focus on underserved and underrepresented communities.

    NOAA Response: NOAA concurs with this recommendation. Growing our connections with DEIA expertise is needed in order to share best practices, expand training materials, and broaden audiences that need ocean data products and services.
    What we have done: The IOOS Association and the IOOS Office created a DEIA Fellowship in 2021. This position is the first of its kind for IOOS, establishing dedicated capacity to coordinate across the regions, establish dialogs, and assess DEIA work across all 11 regions. The IOOS Association has also created a DEIA working group with RA and IOOS Office membership, to continue the work started by the fellowship.
    What we will do: The IOOS Office is hiring a partnerships and service delivery lead that will focus, in part, on enhancing connections to broader NOS and NOAA priorities around improved service delivery for more equitable access to IOOS data and information. The IOOS Office will continue to encourage the IOOS RAs to serve as regional integrators among all communities, articulating expectations through our competitive funding announcements wherever possible. This will take at least several years to implement.

5. **Recommendation:** *NOAA should ensure coordination of DEIA activities across NOAA and the broader IOOC community.* The U.S. IOOS Office could:
    - Work with other NOAA Line Offices and the IOOC to ensure coordination of DEIA initiatives, to avoid duplication, provide an agency focus, and maximize investments and best practices.
    - Continue to ensure that resources are available for IOOS staff to participate in NOAA diversity initiatives and to work to transfer knowledge and experience gained to Regional Association partners.
    - In coordination with other entities, convene a workshop on DEIA with representation from diverse groups, including scientists and technologists from diverse fields (including social scientists and students) from academia, government, industry.

    NOAA Response: NOAA concurs with this recommendation. There is tremendous energy around DEIA across NOAA and it's an opportunity to align interest and activities in order to maximize our collective impact.
    What we have done: The IOOS Association has created a DEIA working group with RA and IOOS Office membership, in order to leverage the efforts being conducted in each region, share best practices, and identify collective needs that can be addressed at the IOOS Office and nationally.
    What we will do: The IOOS Office is hiring a partnerships and service delivery lead that will focus, in part, on enhancing connections to broader NOS and NOAA priorities around improved service delivery for more equitable access to IOOS data and information. This position will serve to liaise with the broader NOAA efforts, in order to better leverage and coordinate with those efforts. The IOOS Office is targeting this hire to happen within the next 6 months.