# U.S. IOOS Advisory Committee
# Report of Recommendations to NOAA and the IOOC
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## Executive Summary

The IOOS Advisory committee is established under law by the Coordinated Ocean Observation and Research Act (COORA) of 2020. During the drafting of this report, the committee was still operating under the authorization of the original Integrated Coastal Ocean Observation System (ICOOS) Act of 2009. The ICOOS Act states the purpose of this committee is to advise the NOAA Administrator and the Interagency Ocean Observing Committee (IOOC) on:

> (A) administration, operation, management, and maintenance of the System, including integration of Federal and non-Federal assets and data management and communication aspects of the System, and fulfillment of the purposes set forth in section 12302;
>
> (B) expansion and periodic modernization and upgrade of technology components of the System;
>
> (C) identification of end-user communities, their needs for information provided by the System, and the System's effectiveness in disseminating information to end-user communities and the general public; and
>
> (D) any other purpose identified by the Administrator or the Interagency Ocean Observing Committee.

At the beginning of their current term, the IOOS Advisory Committee chose to pursue three priority areas to focus their recommendations based on a survey of IOOS Enterprise members and stakeholders that identified strengths, weaknesses, opportunities, and challenges. Those three priority areas are (1) Vision and Strategy for the Future, (2) Requirements Management for Success and Growth, and (3) Creating and Sustaining Strategic Partnerships. During the term, a fourth priority emerged to focus more specifically on the work of the IOOC. This report synthesizes the Committee's recommendations, which are the result of three public meetings, briefings to the committee by NOAA and the IOOC, and independent analyses conducted by working groups of the committee.

## Introduction

The U.S. IOOS Enterprise is a national integrated system of ocean, coastal, and Great Lakes observing systems, comprised of Federal and non-Federal components that includes in situ, remote, and other coastal and ocean observation and modeling capabilities, technologies, data management systems, communication systems, and product development systems. It is designed to address regional and national needs for ocean and coastal information, to gather specific data on key ocean, coastal, and

Great Lakes variables, and to ensure timely and sustained dissemination and availability of these data to the public.

The observations collected, and the products developed by U.S. IOOS support climate science and coastal resilience, national defense, search and rescue operations, marine commerce, navigation safety, weather and marine forecasting, energy siting and production, economic development, ecosystem-based marine, coastal, and Great Lakes resource management, and public safety. U.S. IOOS is mandated to monitor and model changes in the oceans and Great Lakes, including with respect to water chemistry, harmful algal blooms, hypoxia, water levels, and other phenomena; and to improve the Nation's capability to measure, track, observe, understand, and predict events related directly and indirectly to weather and climate, natural climate variability, and interactions between the oceanic and atmospheric environments, including the Great Lakes.

U.S. IOOS is also has a mandate to promote basic and applied research to develop, test, and deploy innovations and improvements in coastal and ocean observation technologies, including advanced observing technologies such as unmanned maritime systems needed to address critical data gaps, modeling systems, other scientific and technological capabilities to improve the understanding of weather and climate, ocean-atmosphere dynamics, global climate change, and the physical, chemical, and biological dynamics of the ocean, coastal, and Great Lakes environments.

The components of the U.S. IOOS Enterprise are both federal and non-federal. The federal components include the Lead Federal Agency, NOAA, which has established an IOOS Program Office within the National Ocean Service; and the Interagency Ocean Observation Committee (IOOC), a subgroup of the Ocean Policy Committee's (OPC) Subcommittee on Ocean Science and Technology (SOST). The IOOC is comprised of 17 federal agencies that all contribute to our nation's ocean observing capabilities. The non-federal components of the system are the 11 federally-certified IOOS Regional Associations, which cover the complete geographic span of the U.S. EEZ and manage the regional coastal observing systems. The Regional Associations work with their local communities to provide specific products and services tailored to meet regional stakeholder needs.

## Vision and Strategy for the Future

While the IOOS Enterprise has a current (2018-2021) Strategic Plan, the Advisory Committee deliberated in areas that will help define the roadmap to move the IOOS Enterprise will move into the future. This includes how specifically it develops and mature; how the various components (local, regional, national) fit into a broader framework; and how to align with national priorities. Below are recommendations on how to move forward.

***Develop a clear and concise plan for a Smart Coastal Ocean***

Marine technology is evolving rapidly and a 5 (or 10) year plan needs to be developed to systematically replace aging infrastructure with newer, advanced, and often cheaper and better technologies. To complement the hardware, the plan should also include the transfer of older data tools to modern tools such as Cloud Storage, Machine Learning, and Artificial Intelligence to address the needs of the Regional Associations, extending from estuaries to the EEZ. This would reflect NOAA's overall technology initiatives to weave in omics, unmanned systems, AI etc.

***Ensure Sustained Observations***

Long-term data are invaluable in establishing baselines and must be maintained in all regions. The data collected through the Regional Associations quantify coastal climate variability in addition to other changes that occur in the nexus between land and the deeper ocean. Sustained observations are also assimilated into climate and weather models and are needed to advance linkages between near-shore and global ocean models.

**DETAILED RECOMMENDATIONS:**

| # | Action | Point | Status |
|---|---|---|---|
| 1.1 | Support Development of a White House Science and Technology Presidential Memorandum. | IOOS AC | Complete |
| 1.2 | Advance linkages between near-shore and global ocean models. | IOOS RAs | Underway |
| 1.3 | Enhanced integration of ocean teams with Unified Forecast System at NOAA. | NOAA | Underway |
| 1.4 | Leverage diverse STEM expertise to enhance future workforce. Identify ways that NOAA can be more inclusive in outreach efforts, specifically in coastal and rural areas and communities. | IOOS AC | Ready |
| 1.5 | Coordinate Ocean Data Assimilation (research and operational) with EMC to address more ocean expertise with modelers and ocean data assimilation experts. | ? | Ready |
| 1.6 | Reestablish Climate as an emerging issue that needs attention. | IOOS | Underway |
| 1.7 | Explore new programs associated with Smart Coastal Ocean in conjunction with recapitalization plans to replace aging technology with modernized technology to address emerging issues. | SOST | Ready |
| 1.8 | Draft a vision of the ocean infrastructure plan going forward (10-15year time horizon aligned with the Ocean Study Board's Ocean Infrastructure 2030 Report). | NOAA | Ready |
| 1.9 | Utilize 11 regional data centers and consider further data aggregation. | NOAA | Ongoing |
| 1.10 | Develop a central hub for Ocean Acidification and Harmful Algal Bloom to operationalize data and information. | IOOS | Ready |
| 1.11 | Advocate for incorporating IOOS into other interagency planning processes including the Ocean Policy Committee. | IOOS | Ready |
| 1.12 | Continue to undertake economic valuation processes of observing systems to help better quantify benefits and enhance messaging. | IOOS | Ongoing |

## Requirements Management for Success and Growth

The national-regional construct of the IOOS Enterprise makes requirements management particularly difficult, as a comprehensive process would involve managing national-level requirements across the 17 federal agencies in the IOOC, including the IOOS Office within NOAA, as well as regional-level requirements across the 11 IOOS Regional Associations. This was indeed the lofty vision of the original ICOOS Act of 2009, but has yet to be fully realized and implemented.

The IOOS Advisory Committee investigated the requirements management processes of the Enterprise, beginning with NOAA's process for managing observing requirements across the agency as well as the IOOS Office approach for managing regional requirements. NOAA currently manages all observing system requirements through the NOAA Observing System Council (NOSC), with the NESDIS Technology, Planning, and Integration for Observation (TPIO) Office providing a catalogue of observing system components, their connections to NOAA mission areas, and a value tree. That system is not currently set up to ingest and manage the numerous regional requirements identified by IOOS Regional Associations through their regular stakeholder outreach and engagement activities. Furthermore, those regional requirements are not analyzed annually through a process to produce an unfunded requirements list, which makes it difficult for the national IOOS Office to adequately manage growth across the nation.

***Tie Requirements Management to the annual Budget Process***

Both NOAA and the IOOC should be ready to quickly and easily answer the following questions when asked by Congress:

- Who conducts ocean observing (in NOAA and across the federal government)?
- What activities do those entities conduct?
- What is their funding level?
- What are their unfunded requirements?

Presently, neither are properly organized to provide those answers. The IOOS Advisory Committee strongly encourages both entities to consider immediate steps to organize in a manner that allows these questions to be answered on an annual basis. There is no successful, sustainable mechanism to grow annual base budgets absent a holistic process to manage requirements across the IOOS Enterprise. For NOAA, that includes reorganizing the ocean observing elements of various line offices and at minimum, producing an ocean observation budget roll-up across line offices. NOAA Programs routinely use research dollars to fund operational products; the committee recommends that IOOS be the centralized operational integrator for all NOAA ocean observing products. For the IOOC, the committee recommends conducting the federal budget cross-cut mandated in both the ICOOS Act of 2009 and the Coordinated Ocean Observation and Research Act (COORA) of 2020, and ensuring their membership has the expertise, resources, and influence in their agencies to accomplish this task.

**DETAILED RECOMMENDATIONS:**

| # | Action | Point | Status |
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| 2.1 | Per the Coordinated Ocean Observation and Research Act, the IOOC should conduct an annual budget cross-cut for ocean observing across the federal government | IOOC | Ready |
| 2.2 | Create an Ocean Observation budget roll-up within NOAA | NOAA | Ready |
| 2.3 | Reorganize/Consolidate Ocean Observing Programs within NOAA Line Offices to be more efficient | NOAA | Ready |
| 2.4 | Position IOOS as the oceanographic operational integrator at NOAA | NOAA | Ready |
| 2.5 | IOOS Office should create an unfunded requirements list with a priority on regional requirements | IOOS | Ready |
| 2.6 | NOS should set up PAC budget lines, including for IOOS, for infrastructure refreshes and equipment servicing | NOS/IOOS | Ready |

## Creating and Sustaining Strategic Partnerships

The IOOS Advisory Committee investigated relationships across federal agencies, as well as with non-federal partners, and provided recommendations to strengthen and enhance those relationships. These include outreach activities (by IOOS AC members) to provide informational briefings about the Enterprise and explore ways to tighten collaborative efforts. In addition to strengthening existing partnerships, the committee investigated where the IOOS Enterprise can forge strategic alignments with new and unfamiliar communities; and will provide those recommendations to the appropriate bodies. .

IOOS is a distributed system pulling together federal, academic and commercial partners to provide an integrated national ocean observing capability for continental shelves. This partnership model is a strength of IOOS and should be strengthened. Recommendations for enhancing and building new partnerships include:

***Maintain/Build on existing partnership models***

It is critical to maintain and build on existing partnerships. Aging infrastructure provides an ongoing struggle for IOOS as backbone infrastructure ages out. Exploration of different partnership models to leverage infrastructure from other federal, private and academic partners is critical. Partnerships span from within NOAA and as well as with other agencies (DoD, NASA) and build around themes of interest with a range of proprietary agreements and targeted IOOS investments. Additionally, enhancing academic and private sector partnerships are critical for providing infrastructure and expertise which is core to the evolving IOOS enterprise.

***Use partnerships to accelerate innovation***

There are private and academic entities that are performing well and available to partner with IOOS. IOOS provides a distributed system well suited to benefit from external partners. Frameworks such as

those from National Ocean Partnership Program (NOPP), Ocean Technology Transfer (OTT) program and interagency agreements should be fostered by IOOS.

***Leverage non-IOOS data initiatives***

IOOS can partner to leverage usage of and development with non-IOOS (big) data initiatives spanning operational (i.e. storm intensity forecasting) to innovation (ie. eco-forecasting) initiatives. Partnerships with entities within NOAA, other agencies (i.e. DoD, NASA) and universities should enhance interactions and integrations with other data initiatives of interest to IOOS functions. These partnerships may complement or supplement themes of interest with a range of agreements and targeted IOOS investments.

**DETAILED RECOMMENDATIONS:**

| # | Action | Point | Status |
|---|---|---|---|
| 3.1 | Develop best practices document and/or policy guide for data and product buys (e.g. buying hydro data vs. a nautical chart) that encompass all programs and advances successful private partnerships. | NOAA | Complete |
| 3.2 | Analyze NOAA initiatives with established partnership models to ensure alignment with IOOS. | IOOS | Ready |
| 3.3 | Engage private industries through potential proprietary partnerships to replace aging infrastructure as a potential way to bolster recapitalization efforts. | IOOS AC | Ready |
| 3.4 | Execute Ocean Technology Transfer through the National Ocean Partnership Program as a way to leverage support from other agencies and private sources. | NOPP | Ready |
| 3.5 | Collaborate with NOAA Big Data Project regarding IOOS contributions to Ecological Forecasting | IOOS, NOAA | Underway |

## Recommendations specific to the IOOC

In general, the IOOS Advisory Committee supports the Interagency Ocean Observation Committee (IOOC) as a leader in interagency ocean activities. The IOOC should look beyond immediate agency commitments and missions to develop consensus strategies laying groundwork for future ocean priorities. IOOC members and staff can also help the IOOS AC connect programmatic initiatives to executive requirements, legislative directives, and community recommendations. The IOOC Co-Chairs continue to be a valuable resource with its committee members that play a pivotal role executing the ocean observing initiatives and can leverage them bringing greater attention to their particular agency-based goals. We encourage the IOOC to work closely with other Interagency Working Groups (IWGs) in other thematic areas including Ocean Partnerships, Facilities and Infrastructure, Ocean and Coastal Mapping, Ocean Acidification, and others.

**DETAILED RECOMMENDATIONS:**

| # | Action | Point | Status |
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| 4.1 | Consider broader topics beyond the task teams to address critical U.S. government-wide priorities. | IOOC | Ready |
| 4.2 | Examine alignment of all the different efforts coming out of OceanObs'19 and how it will align with the UN Decade goals. | IOOC | Ready |
| 4.3 | Establish a Societal Indicators Task Team with collaboration from NOAA's Sea Grant, NOAA's RISA Program, NOAA's Office of Coastal Management, NOAA's Climate Program Office, and NSF's Arctic Programs. | IOOC | Ready |
| 4.4 | Incorporate genomics into the scope of both the corals and marine mammals subgroups of the IOOC Biological Integration and Observation Task Team's efforts. | IOOC | Ready |

## Conclusion: Charge from Chair, Scott Rayder and Vice Chair, Sara Graves