Enhancing Coastal and Ocean Observing and Innovation: OAR and IOOS

Oceanic and Atmospheric Research (OAR) and Integrated Ocean Observing System (IOOS)[1] held three regional workshops in 2020 focused on supporting the evolving needs of stakeholders and improving access to actionable ocean, coastal, and Great Lakes information by: 1) identifying key issues and critical gaps in observations to address those issues; 2) aligning efforts and resources; 3) increasing efficiency in the development and implementation of new strategies and technologies; 4) reducing redundancy; and 5) enhancing the integration and dissemination of information.[2]

WHY NOW?

Improving stakeholder access to actionable ocean, coastal, and Great Lakes information directly supports the National Oceanic and Atmospheric Administration's (NOAA) mission to protect life and property from extreme events and to create and strengthen resilience in ecosystems, communities, and economies.

OAR AND IOOS TOGETHER

IOOS and OAR collaborate to improve stakeholder access to streamlined oceans, coasts, and Great Lakes observational information and decision-making by:

- Addressing critical gaps in observational needs.
- Enhancing the application of new science and technology toward the provision of end-to-end Oceans/Coasts/Great Lakes information.
- Enhancing the integration of information to maximize resources.
- Furthering scientific understanding.
- Improving the impact of operational decision-support products and services.

Enhancing OAR and IOOS collaborations will serve to:

- Support NOAA's ocean observing and forecasting imperatives to understand and predict changes in climate, weather, oceans and coasts.
- Leverage NOAA's transformative advancements in uncrewed systems[3], artificial intelligence[4], adoption and utilization of cloud services[5], artificial intelligence[6], 'omics[7], and data[8].
- Improve service delivery and decision support to save lives and property.
- Support the National and Blue Economy.

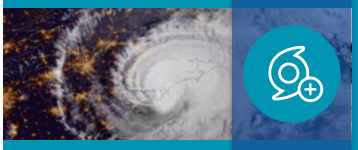
DECISION-MAKER QUESTIONS:

- How are oceans and Great Lakes changing?
- How will climate affect the oceans and Great Lakes?
- How do we respond to current and future ocean and Great Lakes conditions?
- How is NOAA coordinating its approach to answer these questions?

Cloud Computing and Artificial Intelligence. Cloud services and artificial intelligence are transformative technologies that will improve OAR and IOOS functions across the entire value chain to better serve the public.

Biology. The diversity of life in our ocean and Great Lakes is fundamental to our Nation's culture, heritage, and prosperity.

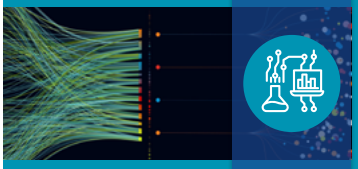
Observations of Great Lakes Multiple Stressors. Threats to Great Lakes' ecosystems come from multiple sources including excess nutrients, harmful algal blooms, hypoxia, high water levels, and invasive species.



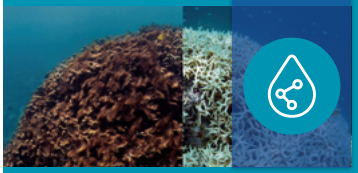
Hurricane-Intensity Forecasting. Track forecasts have greatly improved since 1970, yet similar progress in hurricane intensity prediction has lagged.

Marine Heatwaves (MHW). Marine heatwaves (MHW) have profound economic and ecological impacts to marine ecosystems, fishing and aquaculture industries, and coastal communities.

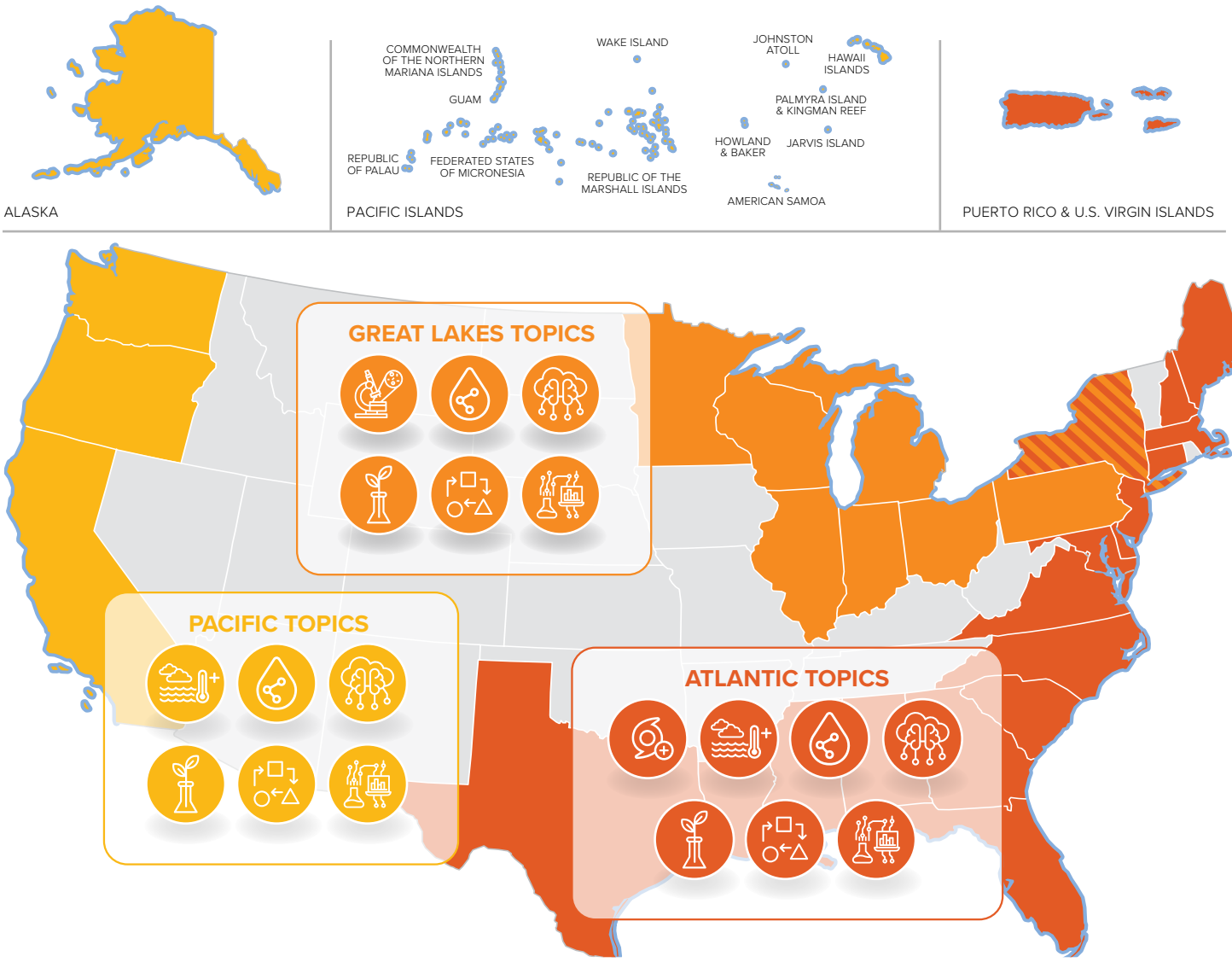
Technology Development and Transition. The development of modern tools and technology has established new data streams that require innovative approaches to more effectively transition new or improved technology to stakeholders.



Data Integration in Decision-Support Tools. Great Lakes, ocean, and coastal observation data is stored and shared across multiple pathways for specific purposes.



Ocean Acidification. Ocean Acidification (OA) is resulting in pole-to-pole change in ocean carbonate chemistry that is impacting a range of biological processes and ecosystems as well as the Blue Economy.



IOOS and OAR Collaborations Span the Nation

Hurricane-Intensity Forecasting. Track forecasts have greatly improved since 1970, yet similar progress in hurricane intensity prediction has lagged. Changes in intensity are difficult to assess because of the complex physical mechanisms of tropical cyclone dynamics and the interaction of the upper-ocean and atmosphere. Enhancing OAR and IOOS observational, research, and operational efforts, and the coordination thereof, will improve hurricane intensity forecasting by: supporting current and implementing improved targeted and sustained ocean observations to provide a better understanding of the key oceanic processes; better responding to changing operational needs; supporting development and use of improved current or new technology in sensors and observing platforms; developing a robust data assimilation process to efficiently incorporate more and better ocean observations into numerical models; solidifying current or new regional collaborations and partnerships. For more information, see Hurricane Intensity Forecasting: OAR and IOOS.

Marine Heatwaves (MHW). Marine heatwaves (MHW) have profound economic and ecological impacts to marine ecosystems, fishing and aquaculture industries, and coastal communities. Ocean warming is causing MHW events to occur more frequently and the frequency, size, intensity, and duration of these events are projected to increase as the climate continues to warm. Improving MWH forecasts requires a better understanding of “normal” and “event” ocean features to ensure that ocean observing systems and models are designed and deployed strategically to provide informative, actionable data. A focused OAR and IOOS effort on improving MHW forecasting will result in: improvement in understanding of the oceanic processes responsible for the development of these events; identification of the key oceanic observations needed to improve forecasts related to the frequency, size, intensity, duration, thermal displacement of MHW events; and development of services targeted to address stakeholder needs. For more information, see Marine Heatwaves: OAR and IOOS.

Observations of Great Lakes Multiple Stressors. Threats to Great Lakes' ecosystems come from multiple sources including excess nutrients, harmful algal blooms, hypoxia, high water levels, and invasive species. Accurate determination of the impacts the Great Lakes suffer from these stressors requires a year-round observing system that addresses the need to simultaneously observe the interactions of these multiple stressors at relevant spatial and temporal resolution along with a data management and delivery system. A Lake Erie test bed focused on understanding the ecosystem stressors will provide a focused forum for improving the coordination of current IOOS-OAR efforts; optimizing, formalizing, and systematizing collaborative processes; improving workflows; and coordinating work plans. Given the ongoing, collaborative observational efforts across Lake Erie, this lake is an ideal test bed for applying lessons learned to the other Great Lakes. For more information, see Observations of Great Lakes Multiple Stressors: OAR & IOOS.

Ocean Acidification. Ocean Acidification (OA) is resulting in pole-to-pole change in ocean carbonate chemistry that is impacting a range of biological processes and ecosystems as well as the Blue Economy. IOOS and OAR's Ocean Acidification Program have built a strong OA community of practice and have collaborated on ocean observing, technology development and modeling. Enhancing these collaborative efforts would provide better understanding of the impacts of OA and the vulnerability of communities and stakeholders; improve the understanding of the response and adaptive capacity of marine species, ecosystems, and communities; and generate products and services that support stakeholder needs, including adaptation and resilience plans. For more, see Ocean Acidification: OAR and IOOS.

Cloud Computing and Artificial Intelligence. Cloud services and artificial intelligence (AI) are transformative technologies that will improve OAR and IOOS functions across the entire value chain to better serve the public. Reflective of OAR's and IOOS' diverse missions, the available ocean and Great Lakes data is vast, complex, non-standardized, and distributed, and the systems and infrastructure that process, store, and disseminate these data can be just as complex. Implementing cloud services and AI strategies will better unlock the full utility and potential of current and future NOAA, OAR, and IOOS' massive and diverse data by allowing the seamless development and implementation of data strategies that will scale the infrastructure and services to support this growth; drive innovation and guide transformative advancements in science, products and services; and, accelerate the implementation of the most effective science and technology applications. For more, see Cloud Computing and Artificial Intelligence: OAR and IOOS.

Biology. The diversity of life in our ocean and Great Lakes is fundamental to our Nation's culture, heritage, and prosperity. Changes in seasonal and longer-term variations in physical and chemical ocean conditions are affecting the distribution and timing of biodiversity in the ocean. While these physical and chemical conditions are often well-documented, there are significant gaps in the understanding of and ability to observe life in the ocean and Great Lakes. Enhanced IOOS-OAR efforts around biological observing will advance the co-development of new technologies and best practices from data collection to data sharing; improve the integration of technologies and data across topical areas and platforms to address multiple stakeholder concerns; incorporate species observations into models, and support stakeholder response to changing ocean conditions that impact critical living resources and ecosystem services. For more, see Biology: OAR and IOOS.

Technology Development and Transition. The development of modern tools and technology has established new data streams that require innovative approaches to more effectively transition new or improved technology to stakeholders. OAR and IOOS can enhance collaborative efforts to more effectively and efficiently develop and transition technology that captures the rapidly changing oceanic ecosystem, climate, and atmospheric conditions to meet key user needs. Improving technology transition efforts will benefit the understanding of the climate, weather, ocean, and coasts as well as also enhance our Nation's Blue Economy. For more, see the Technology Development and Transition: OAR and IOOS.

Data Integration in Decision-Support Tools. Great Lakes, ocean, and coastal observation data is stored and shared across multiple pathways for specific purposes. Opportunities exist to increase collaboration and communication about how these data are provided to users. Sharing strategies reduces duplication of effort in terms of ensuring data access and benefits from services and tools. Synchronizing data standardization between OAR and IOOS will ensure different data sets are interoperable across systems and disciplines to enhance the development of tailored portals and products, prevent unnecessary duplicative efforts, and enhance data integration into decision-support tools to better provide stakeholders with actionable information. For more, see Data Integration in Decision-Support Tools: OAR and IOOS.

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1 2020 Enhancing Coastal and Ocean Observing and Innovation: OAR and IOOS Workshops

2 In response to FY2018 Senate Appropriation Report language

3 https://nrc.noaa.gov/LinkClick.aspx?fileticket=0tHu8KI8DBs%3D&tabid=93&portalid=0

4 https://nrc.noaa.gov/LinkClick.aspx?fileticket=0I2p2-Gu3rA%3D&tabid=91&portalid=0

5 https://nrc.noaa.gov/Portals/0/Final%20Cloud%20Strategy.pdf?ver=2020-07-02-122459-813

6 https://nrc.noaa.gov/LinkClick.aspx?fileticket=0I2p2-Gu3rA%3D&tabid=91&portalid=0

7 https://nrc.noaa.gov/Portals/0/2020%20Omics%20Strategy.pdf?ver=2020-09-17-150026-760

8 https://nrc.noaa.gov/Portals/0/Final%20Data%20Strategy.pdf?ver=2020-07-02-122524-377

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