

**Atlantic Oceanographic and  
Meteorological Laboratory  
2025 Science Review  
February 25-27, 2025**

**AOML Response to Panel Review Recommendations**

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## Review panel

Co-Chair Dr. Avichal Mehra, NOAA/NWS

Co-Chair Dr. Scott Braun, NASA/Goddard Space Flight Center

Dr. Heather Benway, Woods Hole Oceanographic Institution

Dr. Gokhan Danabasoglu, NSF National Center for Atmospheric Research

Dr. Isabela Le Bras, Woods Hole Oceanographic Institution

Dr. Frank Muller-Karger, University of South Florida

## Summary

On February 25-27, 2025, NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) conducted an independent review of its divisions' activities, as required every five years, to assess the quality and relevance of its scientific research and the performance of those activities in service to NOAA's strategic plan, the scientific research community, and to society more broadly. The three divisions include the Physical Oceanography Division, the Hurricane Research Division, and the Ocean Chemistry and Ecosystems Division. The review consisted of presentations on laboratory activities, laboratory tours, and discussion sessions with laboratory stakeholders in the outside research and operational communities.

The review panel recognized the hard work and critical role of the laboratory in collecting vital observations of the ocean and atmosphere in the Atlantic region. AOML has *unique expertise* for the collection, calibration, and analysis of various ocean observing technologies (e.g., Argo floats, Saildrones, environmental DNA (eDNA), etc.), and delivering products to users. AOML leads and contributes significantly in the collection and interpretation of coastal, estuarine, open, and deep ocean observations that support multiple other federal agencies' operations in coral, seagrass, and pelagic habitats. AOML collects critical airborne, marine boundary layer, and subsurface ocean observations of hurricanes that are needed for improved understanding of storms, improved model physics and data assimilation methods, and essential information for hurricane forecasters. With the above portfolios, AOML is NOAA's *primary laboratory* for collecting oceanographic and meteorological observations in the Atlantic basin.

The panel also recognized some of the unique challenges facing the organization and developed a set of recommendations to address those challenges and to ensure the continued success of the laboratory. These recommendations fall within the following themes:

1. Prioritizing, streamlining, and communicating the value of AOML activities;

2. Exploring or enhancing public-private partnerships;
3. Using and advancing modeling, assimilation, and artificial intelligence - machine learning tools for improved analysis and prediction;
4. Long-term planning and risk mitigation for key observing systems;
5. Prioritizing and streamlining efforts for transitioning research at AOML and elsewhere to operations within NOAA and other agencies;
6. Clarifying and improving connectivity between and interactions with cooperative institutes (CIMAS<sup>1</sup> and NGI<sup>2</sup>) and improving mentoring and professional development for early career personnel; and
7. Developing or documenting specific plans for hurricane observations (both in the atmosphere and ocean) and for sustained ecological monitoring activities.

<sup>1</sup> Cooperative Institute for Marine and Atmospheric Studies

<sup>2</sup> Northern Gulf Institute

This report responds to the reviewers' recommendations and provides an action plan to address these recommendations.

## 1. Introduction

On February 25-27, 2025, NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) conducted an independent peer review of each of its divisions. The purpose of the review was:

- to evaluate the quality, relevance, and performance of the research conducted and sponsored by the laboratory and its partners;
- to develop recommendations to improve the quality, relevance, and performance of research conducted at the laboratory; and
- to recommend how AOML can strategically position the laboratory and its partners for success in its planning for future research and development.

The criteria for the review are quality, relevance, and performance, as defined below:

- **Quality** is a measure of the novelty, soundness, accuracy, and reproducibility of a specific body of research. Indicators include publications, technology development, data contributions, and awards.
- **Relevance** is a measure of how well a specific body of research supports NOAA's mission and the needs of users and the broader society.
- **Performance** is a measure of effectiveness and efficiency. It includes an assessment of the organization's leadership, management, organizational culture, workforce development, strategic planning, progress towards performance targets and milestones, efficiency in resource utilization, and transition of research to operations.

The scope of the review covers the research and activities conducted or sponsored by the laboratory over the last five years. The panel was charged to provide recommendations for the following **questions**; What should AOML's role be in:

1. Collecting foundational observations and improving understanding of climate mean state and variability and associated impacts? How has our recent science contributed to achieving these objectives?
2. Improving our monitoring, understanding, and prediction of tropical cyclones and ocean phenomena as well as their broader impacts on extreme events and associated hazards? How has our recent science contributed to achieving these objectives?
3. Understanding the distribution and impact of multiple stressors on marine ecosystems? How has our recent science contributed to achieving these objectives?
4. Developing its work environment for the continued pursuit of world-class science, and building strong connections with communities and stakeholders to ensure broad access to science results?

## **2. FMC's Strategy**

Based upon the valuable input from this review, AOML will be implementing a more focused and disciplined strategic approach that prioritizes activities with the greatest scientific, operational, and societal impact. This approach emphasizes streamlining efforts to concentrate on areas of unique capability, strengthening communication of AOML's value to NOAA and external stakeholders, and more intentionally leveraging public-private partnerships to extend capacity under constrained resources. AOML will also accelerate the use of advanced modeling, data assimilation, and artificial intelligence and machine-learning tools to improve analysis and prediction, while instituting longer-term planning and explicit risk mitigation for mission-critical observing systems.

In parallel, AOML will tighten pathways for transitioning research to operations by emphasizing co-design, readiness, and sustainment from the outset. The laboratory is clarifying roles, expectations, and connectivity with its cooperative institutes (CIMAS and NCI), and formalizing mentoring and professional development—particularly for early-career personnel—to strengthen workforce continuity. These actions are reinforced by the development and documentation of targeted plans for hurricane observations across atmospheric and ocean domains, as well as for sustained ecological monitoring, ensuring that AOML's research and observing investments are coordinated, resilient, and aligned with NOAA's evolving mission needs.

### 3. Response to Recommendations

#### General Recommendations

##### **Recommendation 1:** Prioritize, streamline, and communicate about AOML efforts

*AOML should establish and communicate clear priorities across its entire science portfolio and focus resources on its unique strengths and most critical contributions to the U.S. science enterprise. Such a prioritization will help establish clear pathways to obtain and allocate the necessary resources to advance science. Furthermore, continued emphasis on successful partnerships built upon trustworthy and mutually beneficial relationships with groups inside and outside of NOAA can expand and bolster AOML's funding infrastructure and enhance its science and operational outcomes.*

*AOML has a talented communication and outreach team with continuous infusion of fresh ideas and skill sets from interns. The benefits of the communication group's efforts are rather evident in both increasing the visibility and uniqueness of AOML's research, as well as connecting with various stakeholders, including on social media. These activities should continue as one of the highest priority efforts, especially during these challenging times, stressing economic impacts and benefits of AOML's work to the nation. This would also provide a broader set of AOML metrics (beyond publications, which were a focus of the review) that demonstrate value and impact.*

##### **Response 1:**

AOML agrees with the panel's recommendation to prioritize and clearly communicate laboratory-wide efforts, particularly in the context of constrained resources and increasing demands for actionable science. AOML recognizes the importance of focusing on unique strengths, leveraging partnerships, and improving how scientific impacts and benefits—especially societal and economic value—are communicated internally and externally.

To address these, AOML proposes the following actions:

**Action 1a:** AOML will use the 2025 Science Priorities from NOAA's Office of Ocean and Atmospheric Research (OAR) to focus near to mid-term lab priorities and align with more consistent OAR messaging on these areas.

**Action 1b:** AOML will develop a communications plan that prioritizes highlighting successful partnerships and our impacts and benefits to the nation, including detailed websites, timely news stories, dynamic social media posts, and a more efficient process to share accomplishments internally and throughout NOAA and DOC.

## **Recommendation 2:** Expand and enhance public-private partnerships

*AOML's expertise, datasets, and products are extensively used by the private sector and various stakeholders. In the presence of funding challenges and uncertainties, we recommend exploring funding options with these groups. A focus on public-private partnership at AOML in its data collection, monitoring, technology, and product development efforts would have the following benefits:*

- *Leverage use of foundational, precious, and limited NOAA resources (both human and financial) for advancing commercial technologies;*
- *Enable cost sharing and reduced financial risk since some of the risk is transferred away from expectations of sustained government funding;*
- *Open pathways for new business models and broader engagement of AOML observations, technologies, and intellectual capital;*
- *Lower the total cost of data and products through competition among multiple commercial providers; and*
- *Help establish a pipeline for future employment in the private sector for well-trained students and interns at AOML.*

*There were calls for such partnerships in the March 2024 [NOAA Science Advisory Board \(SAB\) report on public-private partnerships](#). AOML has advanced in establishing such partnerships. Additional key partnerships can be sought for advancing and exploring innovative observing systems that are specific to the needs of AOML's mission for coastal, ocean, and atmospheric research. They can be extended to marine ecosystems for enhanced environmental intelligence to support the needs of ongoing Ocean Chemistry & Ecosystems Division (OCED) and Physical Oceanography Division (PhOD) research projects at the Laboratory and for significant societal and economic benefit.*

## **Response 2:**

AOML agrees that public-private partnerships provide opportunities to leverage limited NOAA resources, reduce financial risk, support innovation, and enhance workforce development. AOML recognizes the potential for such partnerships to advance observing systems, technologies, and applications that deliver societal and economic benefits aligned with the NOAA mission.

NOAA has several offices, housed in OAR, which exist to directly support these initiatives. The Technology Partnership Office (TPO) includes the Small Business Innovation Research (SBIR) program, as well as technology transfer resources for both within and outside of the agency. AOML will identify projects/areas where Cooperative Research and Development Agreements (CRADAs) or other agreements could be used to advance the AOML mission. AOML will also use TPO resources to connect with other labs who have success with CRADAs, SBIRs, and Memoranda of Understanding to learn best practices. A critical part of using these existing programs is to ensure our scientists and financial experts have training to learn what is available, and how to proceed in using it.

AOML will address these recommendations in the following ways:

**Action 2a:** Examine which technologies developed by AOML and used by commercial entities could be leveraged to provide financial support to AOML.

**Action 2b:** Engage in evaluating and expanding public-private partnerships that could save AOML and taxpayers money particularly for lowering the costs for observing systems.

**Action 2c:** Provide training for scientists and financial staff on available partnership mechanisms and processes to ensure effective and appropriate implementation.

**Recommendation 3:** Use of Artificial Intelligence-Machine Learning (AI-ML)-based methodologies and advancing deep learning algorithms

*With its impressive and vast observation portfolio, AOML is uniquely positioned to exploit AI-ML-based methods for its research focus areas. For many applications of numerical weather prediction (NWP), ML-based systems are rapidly eclipsing the skill of their full-physics counterparts and at a fraction of the cost. However, there remains a strong need for creating state-of-the-art datasets for training AI-ML systems. This implies using all available curated observations for producing long-term reanalyses which are the best possible representations of “truth” (or nature). Further, these datasets can then be used for generating best possible forecasts (or reforecasts). There are other focus areas in which AOML researchers can exploit advantages of utilizing AI tools. These algorithms can be used to effectively analyze and process large amounts of data efficiently. Deep learning (DL), a sub-field of ML, is an effective technique for processing and analyzing complex datasets with multiple relationships. It uses neural networks with specialized layers to extract deeper levels of information at each layer (Haupt et al. 2022). Deep learning algorithms can comprehend information collected simultaneously by different observing system sensors. These algorithms can then assist with advancements in data processing techniques for environmental research, including weather, long-term forecasting and scenario planning, energy conservation, decision-making, and much more. ML models can assist in decision-making processes for creating improved management zones and implementing measures to conserve and enhance local biodiversity (Da Silveira et al. 2021).*

**Response 3:**

Decades of historical data collected by AOML are a treasure trove for AI/ML-based models and applications on predictions and resource management. AOML scientists will strive to prioritize the following four areas by applying AI/ML technology: data quality control and mining, AI/ML infrastructure development, AI-based prediction system development, and adopting AI/ML for innovations and applications.

AOML is well positioned to provide state-of-the-art datasets for training AI/ML systems with a wealth of high-quality data from sustained operations. AOML will continue development of data quality control packages for key datasets, such as Tail Doppler Radar, hurricane and ocean observations from Hurricane Field Program, uncrewed

systems, Argo, 'omics, and corals.

AI-based NWP models have become efficient tools for weather forecast, data assimilation, and reanalysis. In order to take advantage of the capabilities of the fundamental models for NWP and align with NOAA's efforts, AOML is investing in AI/ML to improve foundational capabilities by leveraging internal and external funds.

AOML will take these actions in response to this recommendation:

**Action 3a:** AOML and our collaborators will develop quality control software using AI/ML technology to improve data including some of AOML's most widely accessed and valued datasets, such as Tail Doppler Radar, hurricane and ocean observations, uncrewed systems, Argo, drifters, omics, coral datasets, etc.

**Action 3b:** AOML and partners will develop AI/ML prediction systems to enhance hurricane prediction addressing track, intensity, physics, and long-range genesis.

**Action 3c:** AOML will leverage ML to generate forecasts of ecosystem health through integration of biological, environmental, and remote-sensing datasets.

#### **Recommendation 4: Adopt modeling innovations**

*Adopt and deploy all modeling and data assimilation innovations in the Unified Forecast System (UFS) and the Joint Effort for Data assimilation Integration (JEDI) frameworks. The UFS is a community-based, coupled, comprehensive numerical Earth modeling system that is a paradigm adopted formally by NOAA for developing all future operational forecast applications. UFS-based applications span local to global domains and predictive time scales from sub-hourly analyses to seasonal predictions. UFS is designed to support the Weather Enterprise and to be the source system for NOAA's operational numerical weather prediction applications. In parallel, the JEDI effort is being developed to become the backbone for performing data assimilation across the UFS applications and will be critical for realizing a unified data assimilation system for any coupled application of the UFS. All divisions need to adopt the above frameworks to advance NOAA modeling and data assimilation capabilities. They can promote harmonization with the NOAA UFS and JEDI frameworks as part of the NOAA Climate Ecosystems, and Fisheries Initiative (CEFI). This would also allow for consolidation of resources within the laboratory and foster collaboration with the UFS community at large and the Consortium for Advanced Data Assimilation Research and Education (CADRE) consortium for data assimilation research and development. Transitioning to JEDI will also accelerate innovations and science development across a whole range of data assimilation issues being worked on at the laboratory.*

#### **Response 4:**

AOML is actively adopting and deploying the UFS and JEDI to advance NOAA modeling and data assimilation. One major accomplishment is AOML's substantial contribution to the Hurricane Analysis and Forecast System (HAFS), the first regional UFS application to achieve operational transition. AOML is also making advancements in predicting both

the atmosphere and ocean *together*. This includes leading the integration of a high-resolution regional ocean model into HAFS. Further, AOML leverages critical airborne and ocean observations collected by AOML's field programs to improve how this data is assimilated into the UFS-HAFS and tuning physical parameters, thereby aiding our forecasts. Complementing this, AOML is using the Marine JEDI framework to integrate observational data into the regional ocean model for HAFS in collaboration with NOAA's National Weather Service (NWS) to mitigate risk on the path to operations.

We agree that the adoption and deployment of UFS and JEDI also promotes harmonization with the NOAA modelling community and facilitates external collaboration with partners such as the Consortium for Advanced Data Assimilation Research and Education. . More broadly, AOML is well-positioned to contribute to NOAA operations by transitioning research, including machine learning tools for observation quality control. AOML will foster better internal UFS collaboration, addressing gaps, for example, by extending predictions beyond weather timescales (days) to sub-seasonal (weeks) and longer (months) and exploring coupling UFS with biogeochemical models for a lab-wide system. Migrating all modeling groups to these frameworks requires adequate resources and readiness assessment. A noted challenge is conducting research within UFS/HAFS due to yearly version changes and lack of maintenance for older versions.

In summary, AOML will undertake these actions:

**Action 4a** AOML will finalize and build upon a modular transition plan for HAFS to guide developments, evaluations, and operationalization of forecast-improving upgrades. Since the review, AOML has drafted a transition plan that is currently under NWS leadership review.

**Action 4b** AOML will develop the use of JEDI for HAFS. Since the review, AOML successfully tested weakly coupled data assimilation using the latest version of the marine JEDI system in the next generation of HAFS for a realistic Hurricane Fiona test case. Transition to EMC is planned for December 2026.

**Recommendation 5:** Strike the right balance for transitioning research to operations

*AOML is a nationwide leader in stakeholder engagement and transitioning research to operations (R2O) conducted by other branches of NOAA, State and Federal agencies, or the private sector. This is a laudable and important goal, as it quickly puts new technologies and research findings into the hands of users for decision making and other applications and also frees up AOML staff and resources to focus on future innovation and technology development. However, it was evident that the readiness levels of prospective recipients of new AOML products can be somewhat of a bottleneck. Among several issues, some technologies that have high benefits and impact are either costly, hard to operate, or require high technical and scientific skills that are not present or easily transitioned in the receiving stakeholder group. If transitioning is to be a focus for AOML moving forward, resources to train up prospective users are essential for closing the loop on R2O. Otherwise it's a large investment of time and energy and a continual struggle for AOML to transition these capabilities. Caution is especially advised*

*in transitioning its sustained ocean observation programs [e.g., US Atlantic and Gulf of America coastal and oceanographic surveys, regional meteorological research, Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP) and Biological (Bio)-GO-SHIP, South Atlantic Meridional Overturning Circulation (SAMOC), Argo, Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) Northeast extension, Western Boundary Time Series (WBTS), etc.], given the level of knowledge and experience required to make these uniquely valuable, science-quality measurements. Ensuring sustained quality and consistency of these datasets should be the highest priority.*

## **Response 5:**

AOML thanks the panel for the compliment and agrees with the panel that effective transition of research to operations is critical, but must be balanced with the need to maintain long-term, high-quality research datasets and capabilities across the entire NOAA enterprise. AOML recognizes that not all research products are appropriate for transition and that sustained observing and research activities require careful stewardship. AOML excels in engaging stakeholders and transitioning research, including advanced, highly technical and specialized products that are inherently difficult to transition without training or funding of our intended recipients to fully operate. At risk is the ‘sustained quality and consistency’ of high value data sets.

To maintain research and development (R&D) expertise and scientific integrity for long-term programs, , while simultaneously allowing for hand-off of proven technologies to operational partners requires funding and staff which are both in low supply as we write this response. What is needed is investment in training for the recipient of the new technology to seamlessly transfer the technology to another group without loss of data quality or information content. The receiving organization also might need funding or new specialized staff to operate that research product. Any transition that protects the gold standard of data quality must proceed with caution and not be prescribed by artificial timelines in the absence of staffing or funding. In the absence of additional funding, AOML will focus on its core strengths of collecting observations and advancing hurricane models.

To address these, AOML proposes the following actions/deliverables.

**Action 5a:** Develop and deploy a dynamic, interactive transition plan platform. AOML will continue to prioritize intentional co-design of research with stakeholders from the proposal stage to align outcomes with a viable transition path and increase engagement with key offices to find committed partners and potential resources for projects lacking identified operational partners or funding. AOML will develop a dynamic, interactive transition plan platform (moving from the current static, rigid documents) that fosters engagement with all stakeholders, provides transparency, and allows for easier updating of project maturity, budget information, and project progress.

**Action 5b:** Develop and implement transition training activities (seminars, web tools,

etc.) to build capacity both internally and externally. AOML will lead transition training to build capacity both internally and externally. Specifically, AOML will work to bridge the R2O divide by re-invigorating AOML transition training activities (seminars, web tools, etc.) and committing efforts to train and engage with prospective users at receiving agencies to ameliorate the R2O bottleneck. As part of this training, we will share with the AOML community best practices for preparing the operational party (prospective users) to receive our research advancements.

**Action 5c:** AOML will develop an AOML-GOMO Umbrella Transition Plan that encompasses all sustained observations that emphasizes the transfer of **data and knowledge** (e.g. Argo, Ships Of Opportunity, Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP), eXpendable BathyThermograph (XBT), tropical Atlantic buoy array (PIRATA), etc.). By reframing transition plans for sustained observing programs as the transfer of **data/knowledge** and will formalize and socialize the notion that some R&D efforts can be "operationally utilized" while remaining in R&D for continued improvement.

**Recommendation 6:** Strengthening the consortium network and AOML's interactions with the Cooperative Institute for Marine and Atmospheric Studies (CIMAS) and the Northern Gulf Institute (NGI)

*The value that AOML brings to the Cooperative Institutes (CIs) was very apparent during the review. While the CIs are critical to advancing NOAA's oceanographic and meteorological research goals, AOML needs to continually evaluate the role of the CIs, set priorities and research directions, and implement strategies to strengthen the partnerships with all members of the CI consortia.*

*There are many synergistic research efforts between AOML and CIMAS and the NGI. Of particular concern by the review panel was the need to continually guide the CIs so that NOAA obtains the added value that is required and maximize the return on its investment. The panel was able to observe more of the activities highlighted by CIMAS than those of the NGI, perhaps in part because of the larger physical presence of CIMAS at AOML. The panel's impression was that AOML seems too hands-off about how CIMAS prioritizes and spends NOAA resources. In the case of CIMAS, the University of Miami seems to dominate the CI consortium and other CIMAS consortium member institutions seem less able to be involved in the cooperation. This may represent important lost opportunities for research and partnerships for NOAA, and a loss to AOML in particular. Notably, the contributions of other consortium members were not highlighted in the CIMAS video and were not discussed during the review.*

*The panel has the following questions for the AOML leadership to help clarify its relationship with the CIs:*

- *How much of the CI budget supports CIMAS activities outside the University of Miami?*
- *How many CIMAS and NGI consortium members have the opportunity to contribute to AOML needs?*
- *How many opportunities for partnerships are offered in a way that engages the*

- expertise available among all members of the CIMAS and the NGI consortia?*
- *Are the staff roles, opportunities, and budget management responsibilities with respect to the CIMAS and NGI consortia members clear to all parties involved and are consortia members satisfied that the participation in the consortia is beneficial for all parties involved and for the people of the region?*

*As mentioned above, the review panel had less information about the relationship between AOML and NGI. The panel met with several staff members from the NGI and, while not as acute, there may be similar concerns to address as with CIMAS.*

## **Response 6:**

AOML appreciates both the benefit and challenge of partnering closely with cooperative institutes. For CIMAS in particular, NOAA's mission has been advanced through a decades-long collaboration with the University of Miami's CIMAS. That long standing relationship can have the effect of not encouraging participation with the full consortia members. CIMAS has a similar science review conducted in 2024 where the review panel raised similar concerns about consortia participation, NOAA alignment and oversight. The reviewers report submitted to the NOAA Science Advisory Board can be accessed [here](#). Many of the questions the reviewers are asking are firmly within the Cooperative Institute partners responsibility to answer, perhaps through a 'recommendation response document' such as this one. Responses to the Science Advisory Board are currently not required or tracked to assess improvements. However, AOML has regular meetings with CIMAS and NGI leadership to discuss strategic research priorities and issues related to both consortia, including tracking recommendations from reviews.

In general CIMAS has a well-defined science plan and annual work plans are provided to AOML with objectives that align closely with NOAA research priorities and mission needs across OAR, National Marine Fisheries Service (NMFS,) National Weather Service (NWS), National Ocean Service (NOS), National Environmental Satellite, Data, and Information Service (NESDIS), and Office of Marine and Aviation Operations (OMAO), with particular relevance to AOML and the Southeast Fisheries Science Center. Its four research themes—tropical weather observations, ocean and climate analysis and prediction, ecosystem monitoring and management, and marine resource protection and restoration—directly support NOAA's core missions. CIMAS also provides access to novel techniques (e.g., AI/ML and DNA analysis), regional ship assets (e.g., R/V *Walton Smith*), and unique facilities, while its university partnership supports workforce development by engaging early-career scientists. AOML's relationship to CIMAS is collaborative and delivers value to AOML.

While AOML cannot provide definitive answers to the reviewers' questions about another organization, asking our CI partners generated the following answers:

- 6.2% of the CI budget supports CIMAS activities outside the University of Miami (see their review [report](#)).
- There are approximately 84 CIMAS and 10 NGI employees affiliated with

AOML, 99% are formally employed with the main CI partner. However, many more university staff receive funding through CIs without a formal affiliation with AOML. We have no way to report on those numbers.

- All CIMAS consortium members have the opportunity to contribute to AOML needs (by definition as a member of the formal consortium). While the majority of CIMAS projects are led by University of Miami scientists, one example of a non-UM project is *"Developing next generation surveys to improve and automate detection of red snapper across diverse water column conditions using acoustic technologies,"* led by Florida International University. FIU provides expertise and leadership for this project.
- All six member institutions of the NGI consortium have the opportunity to contribute to the needs of AOML. In addition to the eDNA and microbiome research contributed to AOML by Mississippi State University researchers, the University of Southern Mississippi operates autonomous systems and gliders, Florida State University conducts hurricane intensity modeling, Louisiana State University performs hypoxia and ecosystem modeling, the University of Alabama in Huntsville makes severe weather and landfall observations, and the Dauphin Island Sea Laboratory studies links between coastal heatwaves and fisheries, all in collaboration with AOML.
- AOML doesn't publish 'partnership opportunities.' This function is held by the program offices in OAR. Funding from CIs comes largely from joint proposals from funding opportunities published by program offices such as the Climate Program Office, etc.
  - Job opportunities with CIMAS at AOML are shared among consortium members. CIMAS is currently compiling a database of expertise across the consortium members to enhance networking capabilities.
  - NGI's four primary research themes are designed to engage the collective expertise of all six member institutions: Climate Change and Climate Variability Effects on Regional Ecosystems, Coastal Hazards, Ecosystem Management, and Effective and Efficient Data Management Systems Supporting a Data-driven Economy. These themes are structured to integrate the strengths of the various universities—ranging from Mississippi State's lead in data management to the Dauphin Island Sea Laboratory's focus on coastal ecosystems—to address NOAA's mission in the Gulf of America. While not every opportunity is relevant to the expertise available at each member institution, each member institution can contribute to one or more of the research themes through partnership opportunities with AOML.
- AOML cannot comment on the clarity or satisfaction of the CI relationship with their consortia members, however AOML has already engaged with our CI partners who provided this response:
  - CIMAS's cooperative agreement, led by the University of Miami, provides centralized budget oversight and supports NOAA's science mission and operations through coordination across the consortium. All consortium

members have access to federal research funds, while specialized activities are supported and distributed according to expertise across partner institutions, including areas such as fisheries stock assessments and coastal inundation. In this way, the cooperative agreement enables shared access to resources while ensuring that targeted scientific capabilities are effectively leveraged across the consortium.

- NCI maintains clarity and satisfaction through its structured cooperative agreements led by Mississippi State University, which centralizes budget management and aligns academic research with NOAA's operational needs. This partnership is mutually beneficial, providing all consortium members with access to federal research funds, fleets, and data while offering NOAA specialized expertise to address critical regional challenges. This collaboration serves the public by improving hurricane forecasting, supporting sustainable fisheries, and fostering a local STEM workforce, ensuring the "science-to-service" model effectively protects both the economy and the people of the Gulf region.

As noted above, the Science Advisory board requires CI reviews every two years. CIs are renewed every 5 years and re-competed every 10 years. For many details on how NOAA administers Cooperative Institutes, NOAA has published a [handbook](#). AOML gains alignment with our CI partners through annual work plans and joint proposals with defined milestones. We remain committed to expanding our partnerships with our CIs and leveraging their expertise.

#### **Action 6:**

AOML will continue to meet with CI lead institutions and NOAA Cooperative Institute Administrative Office to share concerns regarding lack of funds distributed to consortia members and discuss ways CIs could better engage with consortia members. Additionally, we will be more deliberate in our engagement with the CI lead institutions to reinforce that the original selection of their proposal was based on the strength of the consortium. We will revisit that intent and ensure CIMAS is appropriately leveraging and supporting consortium partners based on their respective areas of expertise.

**Question 1:** What should AOML's role be in collecting foundational observations and improving understanding of climate mean state and variability and associated impacts? How has our recent science contributed to achieving these objectives?

#### **Recommendation 7: Prioritization of observations**

*The breadth and quality of research presented by AOML staff was impressive. AOML is renowned for their observational products and is one of just very few centers in the country (and in fact in the world) with the capacity to carry out ocean observations at the scale and high standard that they do and this should continue to be a priority.*

*We were surprised that the review was not more focused on potential issues and identifying solutions with research vessels and maintaining the Florida Cable observations. Further, access to small coastal vessels that allow frequent and sustained access to coastal zones in the Gulf and U.S. East Coast is critical to the collection of data that help us understand the nation's resources.*

*The Florida Cable observations seem to be in danger of being discontinued, which would be a devastating loss to the oceanographic community and society as a whole. The Florida Cable time series is the longest running record of western boundary current transport globally (since 1982) and is regularly used as a benchmark for high-impact studies on AMOC decline (e.g., Caesar et al. 2018; Piecuch 2020). Backup plans are needed for all programs in case of any major observational cuts such as reductions in ship time.*

*Thus, it may be useful for AOML to define priorities for observing efforts to help minimize staff burn-out, keep morale high, maintain and retain the best talent, and to continue to deliver trusted, high-quality datasets.*

## **Response 7:**

We appreciate the review panel's assessment that the breadth and quality of research presented by AOML staff was impressive. AOML recognizes the unique value of our ocean observing capacity and is actively addressing the issues raised by the reviewers concerning the continuity of key time series and making our observing systems more resilient. While efforts to reestablish the Florida Current cable measurements were not the focus of discussions during the lab review, AOML has undertaken a coordinated effort to ensure minimal disruption to the Florida Cable time series. Specifically, we have been initiating mitigation measures such as adding a second voltage monitoring system in West Palm Beach, Florida, and implementing new methodologies utilizing pressure gauges and satellite altimetry for backup transport measurements ([Volkov et al. 2025](#)). Longer term, we are exploring new technologies, such as the use of fiber optic cables and autonomous vehicles, to measure and supplement Florida Current observations, along with deploying low-cost sea level sensors.

AOML acknowledges the extreme challenges related to reduced access to regional and global-class research vessels over the past decade, which poses a great risk to the sustainability of AOML's ocean observing efforts. These challenges were exacerbated by reduced shiptime allotments, decreased capacity of ships, elimination of charter funds, and most recently by the unavailability of the NOAA Ronald H. Brown after almost two years in dry-dock repairs and the unfortunate fire incident in October 2025.

The scope of AOML's ocean observing enterprise has expanded, e.g. into the use of autonomous vehicles to reduce reliance on large 'white hull' ship time, but funding and staff capacity have not kept pace with that growth. For example the work conducted by AOML through the use of supplemental funding rapidly allowed AOML to demonstrate the value of uncrewed and unmanned atmospheric and ocean observing platforms to improve the accuracy of hurricane intensity forecasts and increase situational awareness. Observing systems developed in this way, become

valuable quickly even when the supplemental funding runs out and continued support becomes challenging. This is a perfect example of a high-priority ocean observing capability that reduces our reliance upon shiptime that should continue to be developed by AOML.

In the face of these challenges, AOML acknowledges the importance of the recommendation to prioritize observational efforts to ensure sustained, high-quality data collection, minimize staff burnout, and retain talent. AOML's prioritization process involves continually assessing feasibility and impact. AOML takes into account key factors such as strategic priorities, societal and economic impact, uniqueness/irreplaceable nature of the observations, research vessel and infrastructure requirements, funding and cost, staffing levels, and intangibles such as leveraging national and international partner resources. Within the constraints of funding and staff capability, AOML will continue to collect ocean observations, maintain valuable data sets, develop data products, and conduct research to better understand and better predict changes in the ocean, and the ocean's impact on society, but must prioritize the enterprise.

**Action 7a:** AOML's Director will continue to meet with NOAA leadership in preparation for NOAA Fleet Council meetings to advocate for global class ship time.

**Action 7b:** AOML will pursue testing of interim solutions to reduce dependency on ship time. Specifically for FY2026, AOML plans to 1) test using USVs for collecting air-sea and subsurface data (through the use of portable CTDs/LADCPs) in hurricanes, and to support western boundary moored arrays (e.g., WBTS and SAM) and to 2) deploy experimental datapod shuttle systems in 2026-2027 (pending ship availability) in the Southwest Atlantic to improve the data return rates and reduce the need for shiptime for our western boundary moored arrays.

**Action 7c:** AOML will develop backup plans for the Florida Current cable observations to mitigate the possible interruption of this benchmark observation whose loss would devastate the oceanographic community.

#### **Recommendation 8:** Prioritization of co-design to facilitate transition

*Acknowledging that transitioning from research to operations is important and that AOML has a manager to guide this process, AOML may improve efforts to co-design research efforts together with specific stakeholders that require specific observations, technologies, and knowledge. As in the previous recommendation (number 5 above), we suggest prioritization of the selection of stakeholders so that the required research can follow through to a transition to research or operational applications. If it is not already being done, this action may involve an a priori assessment of marketability of products; support and maintenance costs in terms of staff time; and opportunity / innovation cost, that is, what these transitions are coming at the expense of.*

*Similar to the above recommendation number 5, some research and observing programs cannot be transitioned to other groups without transferring the entire capacity now at AOML. This*

*includes high-quality ocean observations collected for the purpose of research of phenomena that include slow changes over large areas of the ocean and that are being conducted and curated by researchers at AOML (e.g., Florida Cable measurements, Global Drifter Program, XBT program, contributions to the SAMOC observing system). It is critical that these observations not be transitioned as they could be disrupted and rendered irrecoverable. Research questions will evolve, and AOML should explore efforts to streamline these observation programs to maximize efficiency and cost-effectiveness (such as data pods for PIES observations). However, to maintain the quality of these observations, they should continue to be housed at AOML. These are unique, high-accuracy, long-term observations that need to be coordinated and scrutinized by experts to maintain their high level of accuracy and value to the economy and society.*

### **Response 8:**

We agree with the review panel's recommendations that echo their recommendation #5, with a stronger recommendation to resist transitioning 'Gold Standard' observing programs. To address these, AOML proposes the following actions/deliverables. AOML will be more intentional in our efforts to co-design research through engagement with a prioritized list of stakeholders, especially those aligned with OAR and NOAA priorities, who have clear needs for and actively utilize AOML's observations, technologies, and scientific expertise. Given the breadth of our research and observational activities, reduced staff levels, and the risk of staff burn-out, we propose a series of actions that can be reasonably achieved over the next five-years, including actions taken in response to Recommendations 5 and 7.

AOML will review and update the list of AOML's stakeholders and private partners and prioritize the list by phenomena / region / process / economic sector supported. AOML will develop a better understanding of stakeholders' requirements in phenomena / region / process / economic sector subgroups, to discuss use-cases and future needs, possibly through a stakeholder workshop, conversations with program offices that have conducted stakeholder surveys (e.g., Global Ocean Monitoring and Observing program is conducting such a review in FY26), and other stakeholder and private sector engagement activities to better understand how they use our data, and how they could use it in the future (more efficiently for different applications). This could open up partnering opportunities which would benefit both NOAA and industry, spark innovation, and potentially reduce burnout. AOML will hold a stakeholders workshop and document uses and new requirements of AOML's data and products.

AOML will reapproach new observing system efforts to involve co-design, transition planning with AOML's transition manager, and stakeholder engagement from the outset. AOML will organize training on connecting with, and building, stakeholder communities, demonstrating value beyond publications, and providing examples of successful transitions and public-private partnerships (**Action 5b**). AOML will continue to cultivate champions of our work so that end-users and stakeholders can clearly articulate the value of observations collected by their program. AOML will also build upon efforts to create messaging on the economic and societal impacts of our research with the AOML communications team.

We appreciate the panel's recognition of the value of the high-accuracy observations that AOML collects, coordinates, curates, and maintains. We agree with the reviewers that while some of AOML's research and observing programs could be operationalized and transitioned, there are many programs at AOML with "operationally utilized" data that cannot be transitioned to other groups without transitioning the entire capacity now at AOML. As mentioned in **Response 5**, these observational programs that should remain housed at AOML, knowledge derived from our high-quality, long-term data *is* and should be considered the transition. As mentioned in **Response 7**, AOML is working on several efforts to make the existing ocean observing programs more resilient, efficient, and cost-effective, through modernization and innovation.

**Action 8a:** AOML will review and update the list of AOML's stakeholders and private partners in order to document uses and new requirements of AOML's data and products.

**Action 8b:** Build upon efforts to create messaging on the economic and societal impacts of our research with the AOML communications team.

**Question 2:** What should AOML's role be in improving our monitoring, understanding, and prediction of tropical cyclones and ocean phenomena as well as their broader impacts on extreme events and associated hazards? How has our recent science contributed to achieving these objectives?

**Recommendation 9:** Radar technical and cost assessment, risk management

*With the cancellation of the Advanced Phased Array Radar by the National Science Foundation, one of the leading candidate radar systems for the eventual C-130 aircraft fleet (replacing the current P-3 Orions near the end of the decade) has been eliminated as an option. It is unclear whether the current P-3 TDRs can be installed on the C-130s while alternative radar options, particularly given expected limited resources for HRD, are also unclear. It is recommended that HRD, with its partners, perform a thorough assessment of radar options for the C-130s, including technical risks and costs, as well as likely impacts on forecast operations and skill. Once viable options are identified, use of a likelihood-consequence risk matrix tool may be an important means of tracking progress and communicating risks and issues to NOAA management to ensure that every effort is being taken to achieve a viable solution by the time of the retirement of the P-3 aircraft.*

**Response 9:**

We appreciate this timely recommendation regarding the challenges and uncertainties surrounding radar options for the transition from NOAA's two WP-3D (P-3) aircraft to a new suite of four C-130s expected in 2030. As the Tail Doppler Radar (TDR) is not compatible with C-130 aircraft, one of AOML's top priorities is to preserve and advance current radar capabilities on NOAA's next-generation aircraft. Radar recommendations

for the first two C-130s were shaped by urgent timelines and cost constraints. To that end, the C-130 prime contractor has already delivered an Analysis of Alternatives (AoA) on 05/2025 to identify technically and financially feasible options. The AoA and a subsequent study requested by NOAA informed a radar recommendation for the first two C-130s, reflecting what is achievable within the constraints of budget and timeline before the P-3s retire in 2030. For the latter two C-130s, NOAA is able to take a more forward-looking approach.

**Action 9a:** For NOAA's 1st and 2nd C-130 aircraft, conducting Observing System Simulation Experiments (OSSE) will help evaluate design tradeoffs during development and quantify how design changes may affect radar data quality, forecast skill, and operational situational awareness. As NOAA begins planning for NOAA's 3rd and 4th C-130 aircraft, OSSEs will continue to be an important tool for evaluating the impacts of future design and for evaluating tradeoffs in beamwidth, panel configuration, and scan strategy to ensure that decisions are guided by quantitative assessments of forecast impact. To conduct these OSSEs, AOML will actively pursue funding opportunities.

**Action 9b:** AOML expects that a likelihood-consequence risk matrix tool will be required as part of the NOAA radar sub-contract award. AOML will advocate and advise on all progress, tracking elements, especially those related to radar performance and processing software development.

**Action 9c:** The existing method to quality control TDR observations is tailored to the present TDR system. AOML has already developed an adaptable, ML-based method for quality controlling radar observations, which will be used both for the existing TDR system through P-3 retirement as well as for future radar systems on the C-130s. While aircraft-integration plans for the new quality control method were in progress, staffing constraints have delayed its implementation. AOML will continue to advocate for its inclusion. Additionally, we have a WPO-funded effort that will quantify the impact of this new method on TC forecasts compared to the one currently used.

**Recommendation 10:** Mitigation of SFMR data issues

*HRD should work with the Stepped Frequency Microwave Radiometer (SFMR) instrument vendor to solve issues with the measurements going forward, particularly focusing on understanding the sources of errors and assessing and fixing calibration issues. HRD should also explore approaches (perhaps based on ML) to correct the past record through collection of coincident active measurements (like the Imaging Wind and Rain Airborne Profiler or analogous sensors) and SFMR measurements.*

**Response 10:**

We appreciate this recommendation and fully recognize the importance of addressing the identified issues with SFMR data. AOML has prioritized this work and is already actively engaged in several initiatives including: 1) diagnosing the root causes of SFMR measurement errors, 2) exploring innovative solutions to correct the real-time and

historical SFMR records, and 3) investigating the potential of ML techniques to generate real-time surface wind measurements from a variety of sources.

**Action 10a:** As part of AOML's ongoing efforts, NOAA's Aircraft Operations Center (AOC) has entered into a contract (*circa August 2025*) with ProSensing, the SFMR vendor, to conduct rigorous lab testing of the NOAA-owned SFMR units. This testing focuses on identifying and understanding sources of errors in SFMR data and assessing potential calibration issues. AOML will continue to participate in this effort in collaboration with partners, ensuring that all aspects that could contribute to SFMR errors are thoroughly investigated.

**Action 10b:** Following the completion of lab testing of NOAA-owned SFMR units, subject to available funding, AOML will contribute to developing corrective measures for any identified errors. More specifically, AOML will use knowledge gained from lab testing to develop and implement corrections to the historical SFMR archive and address the inconsistency between SFMR units and stability of each unit. These improvements will be crucial for improving the quality of SFMR data both for current operational retrievals and for the historical archive.

**Action 10c:** After characterizing the errors and developing corrections for them, AOML will explore retraining the SFMR retrieval algorithm with ML techniques, using IWRAP data as training data. As this effort is contingent upon securing the necessary funding, AOML plans to actively pursue funding opportunities to support this initiative.

**Action 10d:** In parallel, AOML has been, and will continue to, actively pursue funding to explore how to leverage ML in generating real-time surface wind estimates from a variety of instruments, thus extending beyond the current capabilities of the SFMR. Doing so would supplement and fill gaps in SFMR data as well as enhance our situational awareness and improve the accuracy of our models (note: AOML's progress has been limited due to funding constraints). For example, AOML is currently working on a project that will use ML to enhance surface wind analyses of tropical cyclones, and will continue advocating for additional funding for future projects.

**Recommendation 11:** Develop a Hurricane Research Observations Plan (HROP)

*The HRD and PhOD at AOML have developed an extensive portfolio of observing capabilities that target both atmospheric and oceanic states in the Atlantic basin during and ahead of tropical systems. There is an immediate need for these divisions to develop a joint HROP. Analogous to the National Hurricane Operations Plan (NHOP), which is published annually prior to the hurricane season, HROP should also be published annually and document AOML's and its partners' collaborative efforts to develop a comprehensive plan for collecting observations for research reconnaissance missions aboard Office of Marine and Aviation Operations (OMAO) Aircraft Operations Center's (AOC) flights, or with deployment of in-situ platforms and/or data collected from operational and experimental satellite missions for conducting research. These plans should be developed in close coordination with NWS/NHC and OMAO/AOC.*

*HROP should consist of:*

1. *Tropical Weather Reconnaissance Measurements (Atmosphere, Ocean, Land);*
2. *Buoy and Ocean In-situ Measurements including those via uncrewed platforms; and*
3. *Environmental Satellite Measurements.*

*Partner participants of HROP could be from:*

1. *Federal agencies;*
2. *Academic partners; and*
3. *Private industry.*

*The panel also identified a few notable challenges:*

- *Ten people provide about 80% of the support for airborne missions. Supporting flights in a busy hurricane season can lead to significant fatigue with the potential for burnout. Efforts to transition some of the work to NWS may be countered by the addition of new aircraft.*
- *Expertise in key activities is often one person deep, i.e., the loss of that one person could have significant impacts on the ability of the organization to continue the work. Flat budgets, retirements, and the current hiring freeze could impair AOML's ability to maintain the high quality and scope of their work. **It is critical that all personnel involved in key activities at HRD should be retained at the laboratory.***
- *Data from the Stepped Frequency Microwave Radiometer (SFMR) were recently flagged as having significant issues with large errors, possibly poor calibration, and different performances across the several copies of the instrument. This dataset provides a key basis for assessing storm intensity, feeding into real-time assessments of storm intensity, the hurricane best-track dataset, and a long list of research publications over the past couple of decades.*

## **Response 11:**

We appreciate the reviewers for recognizing the challenges AOML faces with dwindling staff expertise in the face of constrained resources. We agree that collecting coordinated hurricane observations spanning atmospheric and marine observations will be increasingly important as models improve and AI demands for more data increases. Retaining staff and building a deeper bench would mitigate risks for AOML delivering the high quality of AOML's work. AOML currently produces an annual Hurricane Field Program plan (HFP) that is published online each year (<https://www.aoml.noaa.gov/2025-hurricane-field-program/>) that addresses some of the concerns of the reviewers regarding coordination and is sometimes leveraged to advance the National Hurricane Operations Plan (NHOP). We believe that the annual plan could be improved by more explicitly aligning with priorities within the annual National Hurricane Operations Plan (NHOP) and more clearly emphasizing evolving hurricane research priorities as defined by NOAA and its various government, academic, and private industry partners, including observations.

We believe that there are multiple potential benefits to the proposed Hurricane Research Observations Plan (HROP). First, there is not currently a formal mechanism for

integrating hurricane-ocean observational research efforts into the annual Hurricane Field Program plan. As the proliferation of ocean assets expands, such as gliders, uncrewed surface vehicles, aircraft-deployed expendables, floats, and drifters, as well as more advanced uncrewed aircraft systems (UASs), it would be prudent to improve planning and coordination before each hurricane season. The challenge for a NOAA-wide and community-wide plan is the role of programs in setting priorities and tactical directions through short-term funding. For example there are at least four distinct Program Offices in NOAA that fund marine, atmospheric and satellite observations of hurricanes: the Global Ocean Monitoring and Observing Program (within OAR), the Uncrewed Aircraft Operations Center (within OMAO), the Weather Program Office and NESDIS. A strategic role exists for AOML to lead the scientific priorities to address gaps, setting forward recommendations that all these programs should address. Expanding AOML's already existing Hurricane Field Program Plan to include Ocean Observations is within AOML's core capabilities.

AOML proposes the following actions/deliverables:

**Action 11:** AOML will add marine observations to AOML's Hurricane Field Program Plan to broaden into an AOML Hurricane Research Observations Plan (AOML - HROP).

**Question 3:** What should AOML's role be in understanding the distribution and impact of multiple stressors on marine ecosystems? How has our recent science contributed to achieving these objectives?

**Recommendation 12:** Preserve access to small vessels for ecosystem monitoring

*One of the highest priorities for NOAA is to facilitate continued access to the ocean by AOML staff and partners to enable the collection of data and the generation of the knowledge needed to make management decisions and to understand the biology and chemistry of the Atlantic Ocean so that forecasts can be developed. There is now uncertainty in access to sustained support from other NOAA offices, including OMAO, for charter ships. This is a critical ocean observing infrastructure. NOAA needs to work with AOML to provide sustained, long-term access to small ships, which may be procured from the private sector and universities in the region for frequent observing of coastal shallow marine waters by AOML. These areas require frequent sampling because of the rapid scales of change of essential ocean variables there: resources that affect coastal resiliency, biodiversity and marine life, multiple stressors, and long-term impacts. People living in coastal communities are the most impacted. Specifically, a key example is the NOAA SFER program. There may be an opportunity here to work more closely with the state of Florida for ship support.*

**Response 12:**

Preserving and formalizing access to small and medium vessels (up to Class III) is paramount to sustaining AOML's mandated research, particularly for shallow marine

waters critical to coastal resiliency, coral reef monitoring, and the South Florida Ecosystem Restoration (SFER) program. AOML's coastal and near-shore programs directly support regional monitoring and restoration activities, including Everglades and coral reef restoration interventions, changes in hydrographic conditions, water quality, ocean chemistry, harmful algal blooms, and the associated impacts on marine habitats and marine life, from microbes to vertebrates. Our goal is to secure reliable, sustained, and flexible access to small and medium vessels to enable frequent, responsive monitoring of rapidly changing coastal Essential Ocean Variables.

AOML will take these actions in response to these recommendations:

**Action 12a:** AOML will analyze the current needs of projects in comparison to available resources and alternatives through a requirements and gap analysis. This will assess annual days-at-sea requirements for coastal activities and capabilities of vessel classes. This analysis will also compare the cost-effectiveness of sustained charters against reliance on NOAA-owned vessels and additional field expenses.

**Action 12b:** AOML will continue to articulate to NOAA the sustained need for dedicated vessel funding to support the long-term SFER time series. AOML needs will be communicated to the OMAO Fleet Council via the OAR Fleet Liaison.

**Action 12c:** AOML will work with external partners in the State of Florida, universities, foundations, and the private sector to identify additional ship/boat resources that could support AOML programs in coastal and near-shore waters.

**Recommendation 13:** Prioritize and communicate research goals to sustain ecological monitoring activities

*AOML's ecological monitoring programs would especially benefit from a cohesive research plan and vision for the future to help focus and prioritize resources, which would help NOAA support the ongoing access to small coastal oceanographic ships and small boats that are critical to the AOML operational research mission. It would also ensure that the information needed by stakeholders is delivered in a timely manner. To elevate AOML visibility and relevance to a wide range of stakeholders, we recommend integrating OCED's numerous ecological monitoring and assessment activities into a single product such as an Atlantic ecosystem report card that can tell a more cohesive story of ecosystem changes and associated human impacts.*

*NOAA AOML research can make substantial contributions and also gain by engaging with global networks like the MBON, Ocean Biomolecular Observing Network, Ocean Carbon & Biogeochemistry, and other NOAA CIs to augment the scope and value of AOML research.*

**Response 13:**

We agree that a cohesive research plan and communication strategy is essential to demonstrate the return on investment for our critical ecological monitoring programs and secure long-term funding/vessel access. We will engage with partners and stakeholders, and utilize OAR's Science Priorities, to develop a research plan to strategically focus ecological monitoring efforts and prioritize existing resources. We also aim to elevate the visibility and impact of AOML's ecological monitoring programs by integrating both existing and potentially new activities into visible and digestible products, and leveraging global scientific networks. Rather than attempting to integrate all of AOML's ecosystem data into publication of a single Atlantic Ecosystem Report Card, which would place a significant burden on an already overextended team, we will focus on improving and expanding the data page on AOML's website (<https://www.aoml.noaa.gov/data-products/>), including use of a dynamic map prototype developed by PhOD to showcase all of AOML's ecological monitoring activities. We believe that this approach will adequately present data-driven ecosystem stories from across AOML and the associated human impacts that impact a wide range of stakeholders.

To maximize the scope, value, and global interoperability of AOML's ecological research, we are committed to formalizing and strengthening our engagement with key national and international networks. We will formalize relationships with United Nations Decade of Ocean Science for Sustainable Development programs, such as the Ocean Biomolecular Observing Network. Furthermore, we will actively strengthen AOML's leadership roles in the U.S. National Oceanographic Partnership Program, Marine Biodiversity Observation Network, and the Ocean Carbon and Biogeochemistry program. We will also significantly strengthen ties with both U.S. and international coral reef organizations to ensure our data and expertise directly support global conservation and management efforts.

AOML will take these actions in response to these recommendations:

**Action 13a:** AOML will prioritize and refine future research directions and focus ecological monitoring efforts, in alignment with OAR's Science Priorities, stakeholder needs, and available resources.

**Action 13b:** Integrate AOML's ecological monitoring activities into a dynamic map and high-impact data products to elevate visibility to stakeholders.

**Action 13c:** Since the review, AOML will apply for a formal endorsement of Bio-GO-SHIP and the Marine Biodiversity Observation Network (MBON) by the Ocean Biomolecular Observing Network (OBON), a UN Ocean Decade-endorsed program. The value to AOML of having Bio-GO-SHIP and MBON formally endorsed by OBON is that it will maximize the scope, value, and global interoperability of AOML's ecological research by strengthening engagement with key international networks, specifically a UN Ocean Decade-endorsed program.

**Recommendation 14:** Help advance FAIR and CARE tools and initiatives for ecological data sets

*Adhering to Findable; Accessible; Interoperable; Reusable (FAIR) and Collective benefit; Authority to control; Responsibility; Ethics (CARE) data principles will increase return on investment for AOML-collected datasets. AOML's cross-division coordination on data management, along with user interfaces that support data access in multiple formats (ERDDAP) and data visualization tools ensures that the data are accessible and usable by a wide range of stakeholders.*

*AOML should continue to leverage and contribute to NOAA's leadership and advancing ecological data management strategies for biodiversity (e.g., stock assessments, habitat surveys, eDNA, imaging), acoustics, and biogeochemistry datasets. Coordinating across the agency and more broadly with federal and state government and academic partners will ensure more interoperable datasets for long-term ecosystem monitoring and assessment. Intercalibration and standardization efforts are also needed for novel biological datasets such as eDNA. Given its expertise and leadership in this area, AOML should engage with and promote these efforts whenever possible.*

#### **Response 14:**

AOML is committed to increasing the long-term value, interoperability, and ethical use of its ecological data by strictly adhering to FAIR and CARE principles through a series of collaborative standardization efforts. To achieve this, the lab is modernizing the way biological observations are handled by developing sophisticated standardization frameworks and software tools that mobilize complex data into global biodiversity repositories.

By deploying centralized data servers (e.g., ERDDAP), AOML will streamline access for government, academic, and private-sector partners, facilitating the integration of diverse datasets and the calibration of scientific methods across organizations. The development of interactive dashboards and visualization platforms will bridge the gap between raw data and actionable insights, enhancing transparency and fostering deeper engagement with stakeholders who rely on this information for environmental management and decision-making.

AOML proposes the following actions/deliverables:

**Action 14a:** AOML will develop standards and software tools for mobilizing eDNA observations and associated data to the Ocean Biodiversity Information System (OBIS).

**Action 14b:** AOML will develop an ERDDAP server for biodiversity and associated methodological data from OBIS, which will enable access to NOAA, government, and academic users, facilitating data integration and methods intercalibration.

**Action 14c:** Create data dashboards to enhance data accessibility and stakeholder engagement. Ecosystem data products increasingly support decision-making and

restoration efforts. To begin, we are integrating a dashboard on our website to display near-realtime environmental data collected as part of the Port Everglades environmental monitoring project.

**Question 4:** What should AOML's role be in developing its work environment for the continued pursuit of world-class science, and building strong connections with communities and stakeholders to ensure broad access to science results?

**Recommendation 15:** Coordinate formalized mentoring and professional development

*Throughout the review, we received mixed messages from AOML and affiliate staff about access to mentoring and professional development. This is a critical investment in AOML's overall team morale and workplace culture, as well as capacity building and succession planning. It seems that there are many ongoing programs and activities with varying degrees of accessibility depending on employee status, including contractors (e.g., federal employees and some contractors may be informed and have access to some programs that may not be made accessible to CI or other affiliates). While not all professional development should necessarily be available to all staff, there could be a more coherent mentoring strategy that is designed to address long-term agency goals. As part of a strategic planning session, staff working across divisions and members of CIs need to be part of a planning conversation around mentoring and professional development to ensure the same level of awareness and understanding. These opportunities need to be formalized (e.g., mentoring plans for staff members) and documented and then the information must be continually communicated to current and incoming staff to ensure equitable access to these opportunities. With the loss of groups like the Early Career Researcher group, there also seems to be a concern about ensuring early career hires maintain a communication path to upper leadership and management to ensure they have a voice in AOML strategic planning.*

**Response 15:**

The people and the culture of AOML are our most valuable assets. Investing in our team through mentoring and professional development opportunities is a critical strategic investment that will contribute to higher team morale, foster a healthier workplace culture, restore institutional capacity, and help with succession planning necessary for AOML to continue to achieve its long-term goals. To address the specific reviewer recommendations, AOML proposes the following actions/deliverables.

To address the concerns regarding equitable access to mentoring and professional development, AOML plans to adopt a more coherent and formalized strategy of disseminating information about mentoring and professional development opportunities that encompasses federal, affiliate, and contractor staff. While there are formalized mentoring programs available to some employees, such as the [CIMAS Mentoring Program](#) (open to affiliates like CIMAS and the Northern Gulf Institute) and the [NOAA Mentoring](#) (federal employees only, but has been discontinued), and AOML Ambassadors program (open to federal and affiliate employees), there is not a specific mentoring program for the NGI and other affiliate employees. There is a lack of uniform

awareness about the mentoring and professional development opportunities that are available, as well as inconsistent communication channels for sharing information. Some great information was assembled from self-organized groups within AOML (“Promoting Peer Mentorship Across the AOML Workforce”, “Promoting Peer Mentorship Across the CIMAS Workforce”) that AOML will revisit and build upon. There is a need to consolidate information about all existing opportunities and ensure this is continuously and broadly communicated. AOML will implement the following actions to address this recommendation:

**Action 15a:** Develop a coordinated communication strategy for disseminating information about mentoring and professional development opportunities through a mentoring/professional development page on the AOML Central Internal google site, AOML All Hands meetings, and announcements in "This Week at AOML." Share this information with new employees when they are onboarded.

**Action 15b:** AOML will involve Early Career personnel in the processes of developing a more coherent and formalized strategy of disseminating information about mentoring and professional development opportunities. Since the review for example, AOML held a “Navigating USA Jobs” training session.

**Recommendation 16:** Build more connectivity across AOML divisions and with CI partners

*This laboratory review was designed to present AOML’s science and technology, transition to operations, communication, and stakeholder engagement efforts in a holistic manner that showcased cross-division contributions and partnerships, as well as collaborations with the CIs CIMAS and the NGL. More regular cross-division activities, especially around AOML strategic planning, prioritization, and innovation, would provide a greater sense of unity among AOML employees and provide more opportunities to coordinate and streamline operations, avoid duplication of effort, build new collaborations, and leverage external resources.*

### **Response 16:**

Creating a united community here at AOML is one of our highest priorities. We appreciate this recommendation and will strive for increasing laboratory unity through enhancing communication, networking, and cross-divisional collaboration. To address the reviewer recommendations, AOML proposes the following actions/deliverables.

**Action 16a:** Continue to host foundational events like the annual AOML Awards ceremony, quarterly AOML All-Hands meetings, and weekly AOML seminars, and establish a new cross-divisional science event such as a poster session, biennial scientific retreat to showcase science across the lab, or cross-divisional workshops to highlight capabilities across all divisions.

**Action 16b:** Foster informal interactions between divisions, such as hosting coffee breaks before meetings and seminars, creating lab-wide shadowing opportunities, facilitating casual, non-technical seminars (e.g., "lightning talks"), and possibly re-establishing the Virginia Key early career networking group.

## **References**

Volkov, D. L., Smith, R. H., & Garcia, R.F. (2025). Pressure gauges and satellite altimetry ensure the continuity of Florida Current transport observations. *Geophysical Research Letters*, 52, e2025GL115897. <https://doi.org/10.1029/2025GL115897>

## AOML Science Review Action Sheet

Recommendation	Action	Champion	Start Date	Completion Date	Status/Notes
<b>General Recommendations</b>					
<b>1a.</b> Prioritization	Use the 2025 OAR Science Priorities to focus near to mid-term lab priorities	Molly Baringer (AOML Deputy Director)	09/2025	09/2026	Immediate action has already been taken to review and incorporate the OAR priorities in key messaging. For example, the AOML FY25 accomplishments report has been structured to align with the four OAR Foundational Capabilities.
<b>1b.</b> Communications and outreach	Develop a communications plan that prioritizes highlighting successful partnerships and impacts	Laura Chaibongsai (AOML Comms Lead)	09/2025	04/2026, updated annually	Updating the AOML communications plan to focus on priorities, partnerships, and impacts. A new website shares resources that highlight <a href="#">our impact</a> .
<b>2a.</b> Public-private partnerships	Examine which technologies developed by AOML and used by commercial entities could be leveraged to provide financial support to AOML	Molly Baringer (AOML Deputy Director)	09/2025	09/2026	
<b>2b.</b> Public-private partnerships	Engage in evaluating and expanding public-private partnerships that could save AOML and taxpayers money particularly for lowering the costs for observing systems	Molly Baringer (AOML Deputy Director)	09/2025	09/2026	
<b>2c.</b> Public-private partnerships	Provide training for scientists and financial staff on available partnership mechanisms and processes to ensure effective and appropriate implementation.	Molly Baringer (AOML Deputy Director)	09/2025	09/2026	
<b>3a.</b> AI/ML	Develop quality control software using AI/ML technology to improve data including some of AOML's most widely accessed and valued datasets	Matthieu LeHenaff (AOML Physical Oceanographer)	2/2025	9/2027	AOML's Global Drifter Program Data Assembly Center is implementing Machine Learning to detect the time of a drifter's drogue loss.
<b>3b.</b> AI/ML	Develop AI/ML prediction systems to enhance hurricane prediction addressing track, intensity, physics, and long-range genesis	Xuejin Zhang (AOML meteorologist), Ghassan Alaka (HRD Director)	02/2026	09/2027	

<b>3c. AI/ML</b>	Leverage ML to generate forecasts of ecosystem health through integration of biological, environmental, and remote-sensing datasets	Jasmin John (OCED Deputy Director), Luke Thompson (NGI Research Professor)	10/2026	09/2028	
<b>4a. Modeling innovations</b>	Finalize and build upon a modular transition plan for HAFS to guide developments, evaluations, and operationalization of forecast-improving upgrades	Ghassan Alaka (HRD Director)	09/2025	06/2026, updated annually	
<b>4b. Modeling innovations</b>	AOML will develop the use of JEDI for HAFS.	Ghassan Alaka (HRD Director), Renellys Perez (PhOD Deputy Director)	09/2025	12/2026	
<b>5a. Transitioning research to operations</b>	Develop and deploy a dynamic, interactive transition plan platform	Annette Hollingshead (AOML Transition Manager)	09/2025	09/2026	
<b>5b. Transitioning research to operations</b>	Develop and implement transition training activities (seminars, web tools, etc.) to build capacity both internally and externally	Annette Hollingshead (AOML Transition Manager)	09/2026	09/2027	
<b>5c. Transitioning research to operations</b>	AOML will develop an AOML-GOMO Umbrella Transition Plan that encompasses all sustained observations	Annette Hollingshead (AOML Transition Manager)	03/2026	09/2027	
<b>6a. Cooperative Institutes</b>	Meet with CI lead institutions and NOAA Cooperative Institute Administrative Office to discuss ways CIs could better engage with consortia members and possibly require follow-on responses when undergoing formal reviews	Molly Baringer (AOML Deputy Director)	01/2026	09/2026	

**Question 1**

<b>7a.</b> Prioritization of observations	Meet with NOAA leadership to advocate for global class ship time and pursue interim solutions to continue fieldwork	Molly Baringer (AOML Director), Renellys Perez (PhOD Deputy Director), Jasmin John (OCED Deputy Director)	09/2025	08/2027	AOML plans to deploy experimental datapod shuttle systems in 2026-2027 (pending ship availability) in the Southwest Atlantic to improve the data return rates and reduce the need for shiptime for our western boundary moored arrays
<b>7b.</b> Prioritization of observations	Reduce dependency on ships to collect ocean observations	Renellys Perez (PhOD Deputy Director), Pedro Pena (AOML Engineer), Matthieu LeHenaff (AOML Oceanographer)	09/2025	08/2027	
<b>7c.</b> Prioritization of observations	Develop a backup plan for Florida Current cable observations	Renellys Perez (PhOD Deputy Director), Pena (AOML Engineer)	09/2025	08/2028	
<b>8a.</b> Prioritizing stakeholders	Review and update the list of <a href="#">AOML's stakeholders</a> to document uses and new requirements of AOML's data and products	Annette Hollingshead (AOML Transition Manager)	09/2025	09/2027	
<b>8b.</b> Prioritizing stakeholders	Create messaging on the economic and societal impacts of our research	Laura Chaibongsai (AOML Comms Lead), Annette Hollingshead (AOML Transition Manager)	09/2028	09/2030	

**Question 2**

<b>9a.</b> Radar risk assessment	Pursue funding opportunities to conduct OSSEs to evaluate design tradeoffs during development, contingent on funding	Jason Sippel (AOML Meteorologist)	09/2025	08/2029	End date is through estimated P-3 retirement.
<b>9b.</b> Radar risk assessment	Advise on all tracking elements, especially those related to radar performance and processing software development	Paul Reasor (AOML Meteorologist)	09/2025	08/2029	End date is through estimated P-3 retirement.

<b>9c.</b> Radar risk assessment	Quantify the impact of a new ML method on TC forecasts compared to the one currently used	Jason Sippel (AOML Meteorologist), Sarah Ditchek (CIMAS Assoc. Scientist)	02/2026	01/2027	
<b>10a.</b> Mitigating SFMR errors	Oversee rigorous lab testing of the SFMR units to identify and understand sources of errors and assess potential calibration issues	Ghassan Alaka (HRD Director), Heather Holbach (NGI Associate in Research)	09/2025	06/2026	
<b>10b.</b> Mitigating SFMR errors	Develop and implement corrections to the historical SFMR archive and address inconsistency between SFMR units and stability of each unit	Ghassan Alaka (HRD Director), Heather Holbach (NGI Associate in Research)	10/2022	07/2027	
<b>10c.</b> Mitigating SFMR errors	Actively pursue funding opportunities to explore retraining the SFMR retrieval algorithm with ML techniques, using IWRAP data as training data, contingent on funding	Ghassan Alaka (HRD Director), Heather Holbach (NGI Associate in Research)	09/2025	08/2030	
<b>10d.</b> Mitigating SFMR errors	Use ML to enhance surface wind analyses of tropical cyclones using NOAA Hurricane Hunter data	Jason Sippel (AOML Meteorologist)	08/2025	08/2026	
<b>11a.</b> NROP	Explore development of a Hurricane Research Operations Plan	Ghassan Alaka (HRD Director), Jason Sippel (AOML Meteorologist)	01/2026	06/2027	
<b>Question 3</b>					
<b>12a.</b> Preserving small vessel access	Analyze the current needs of projects in comparison to available resources and alternatives through a requirements and gap analysis	LTJG Anna Gaskill (AOML Vessel Operations Coordinator)	02/2025	09/2026	
<b>12b.</b> Preserving small vessel access	Communicate to the OMAO Fleet Council via the OAR Fleet Liaison the sustained need for dedicated vessel funding to support the long-term SFER time series	Molly Baringer (AOML Deputy Director)	02/2025	09/2026	

<b>12c.</b> Preserving small vessel access	Meet with State of Florida officials to discuss ship/boat resources that could support joint efforts in coastal and near-shore waters	Jasmin John (OCED Deputy Director), Enrique Montes (CIMAS Assistant Scientist)	01/2026	12/2026	Conversations are ongoing with the Florida Fish and Wildlife Conservation Commission.
<b>13a.</b> Sustaining ecological monitoring	Prioritize and refine future research directions and focus ecological monitoring efforts	Molly Baringer (AOML Deputy Director), Jasmin John (OCED Deputy Director), Enrique Montes (CIMAS Assistant Scientist)	03/2026	03/2027	
<b>13b</b> Sustaining ecological monitoring	Integrate AOML's ecological monitoring activities into a dynamic map and high-impact data products to elevate visibility to stakeholders	Jasmin John (OCED Deputy Director), Luke Thompson (NGI Research Professor)	03/2026	09/2028	A dynamic map prototype has been developed by PHOD to showcase all of AOML's observing systems. An environmental DNA data portal (beta version) has been developed by OCED.
<b>13c.</b> Sustaining ecological monitoring	Apply for formal endorsement of Bio-GO-SHIP and the Marine Biodiversity Observation Network (MBON) by the Ocean Biomolecular Observing Network, a UN Ocean Decade-endorsed program	Jasmin John (OCED Deputy Director), Luke Thompson (NGI Research Professor)	09/2025	01/2026	Application for Bio-GO-SHIP submitted Nov 2025, and MBON submitted Jan 2026.
<b>14a:</b> Ecological data management	Develop standards and software tools for mobilizing eDNA observations and associated data to the Ocean Biodiversity Information System (OBIS)	Jasmin John (OCED Deputy Director), Luke Thompson (NGI Research Professor)	01/2026	12/2026	The FAIR eDNA metadata standard has been published, and the BeBOP protocol standard has been submitted for publication. An OBIS eDNA publishing toolkit is being developed.
<b>14b.</b> Ecological data management	Develop an ERDDAP server for biodiversity and associated methodological data from OBIS	Jasmin John (OCED Deputy Director), Luke Thompson (NGI Research Professor)	01/2026	12/2028	ERDDAP servers are being developed and tested, including for eDNA data from <a href="#">OBIS</a> .
<b>14c.</b> Ecological data management	Create data dashboards to enhance data accessibility and stakeholder engagement	Jasmin John (OCED Deputy Director), Enrique Montes (CIMAS Assistant Scientist)	01/2026	09/2028	We are in the process of integrating a Port Everglades dashboard on AOML project page as one example of this effort.

**Question 4**

<b>15a.</b> Mentoring	Develop a coordinated communication strategy for disseminating information about mentoring and professional development opportunities	Laura Chaibongsai (AOML Comms Lead)	<i>01/2026</i>	<i>12/2026</i>	
<b>15b.</b> Early career opportunities	Involve early career personnel in the processes of developing a more coherent and formalized strategy of disseminating information about mentoring and professional development opportunities	Molly Baringer (AOML Deputy Director), Renellys Perez (PhOD Deputy Director)	<i>01/2026</i>	<i>12/2026</i>	
<b>16a.</b> AOML connectivity	Host formal AOML-wide events to share research, celebrate accomplishments, and learn from each other	Molly Baringer (AOML Deputy Director)	<i>01/2026</i>	<i>12/2026</i>	
<b>16b.</b> AOML connectivity	Foster informal AOML-wide interactions to increase a sense of unity	Molly Baringer (AOML Deputy Director)	<i>01/2026</i>	<i>12/2026</i>	