U.S. IOOS FY23

National Harmful Algal Bloom Observing Network Awards

New Awards

California

Moss Landing Marine Lab/San Jose State University Research Foundation, PI: Holly Bowers
FY 23 Funded amount: $630,043
New Ocean Technology Transition award

Validating the Aqusens imaging platform to expand networked cell detection capabilities
This project aims to compare and validate a new low-cost digital holography based cell imaging platform (Aqusens) against the Imaging Flow CytoBot (IFCB) towards increasing capacity building for harmful algal bloom (HAB) cell detection within the context of routine monitoring and targeted deployments. This project aims to assess direct performance comparison between the Aqusens and IFCB through three objectives:

1. Laboratory experiments with a variety of cultured HAB and non-HAB species to provide foundational platform comparisons.
2. Deployments throughout the year at the Santa Cruz Wharf monitoring site to test performance during varied conditions (e.g. algal blooms, upwelling).
3. In underway cruise operations aboard established USGS transects in San Francisco Bay targeting seasonal (3 cruises across winter, spring, autumn), and within season (3 cruises across June, July, August) succession of phytoplankton populations.

Washington

University of Washington, PI: John Mickett
FY 23 Funded amount: $1,199,542
New Ocean Technology Transition award

Institutionalizing Long-term Offshore ESP Monitoring in the Pacific Northwest
The overarching goal of this project is to produce and institutionalize a flexible and dependable Environmental Sample Processor (ESP) mooring program in the Pacific Northwest for sustained monitoring of domoic acid, eDNA, and other contextual oceanographic parameters. Specific objectives are to:

1. Transition the ESP mooring program operations to NANOOS for sustained monitoring.
2. Bring infrastructure and equipment inventory to sustainable levels and carry out system upgrades to allow the ESP mooring to be deployed in new locations and collect new types of information about food webs and ecosystems using eDNA.
3. Identify and prioritize end user data needs to inform the timing and location of the ESP mooring deployments.
4. Conduct back-to-back, spring-to-fall ESP mooring deployments to provide early warning of domoic acid events and inform ecosystem assessments.

For more information, please contact Kate Culpepper, U.S. IOOS, kate.culpepper@noaa.gov

Oregon

Oregon State University; PI: Jessica Garwood
FY 23 Funded amount: $1,200,000
New Ocean Technology Transition award

Fishing for Hypoxia: An Academic-Industry-Tribal Partnership to Observe the Coastal Ocean
This project aims to enhance the ability of coastal ocean observing systems to support the climate-readying of fisheries threatened by ocean deoxygenation. New low-cost dissolved oxygen (DO) sensors deployed in crab pots will yield expanded near real-time data, allowing the fishing community and managers to monitor low-oxygen conditions in order to identify when to pull crab pots or the best areas to place them. Readily available in-water observations of dissolved oxygen can be used to define and monitor climate vulnerability to hypoxia exposure to help National Marine Sanctuary managers and other state and local managers responsible for spatial planning. This work will benefit coastal ocean observing systems by expanding their capabilities to serve and maximize the potential of fleet-based (citizen science) observations, significantly increasing the number of available dissolved oxygen measurements to verify and improve coastal ocean model predictions. This project has three primary goals:

1. Refine a recently developed dissolved oxygen (DO) sensing package that is currently being deployed by commercial, tribal, and recreational fisherfolks and state managers to cost-effectively detect and track the progression of seasonal hypoxia; transform this DO sensing package into operational elements of the U.S. Integrated Ocean Observing System (IOOS), National Marine Sanctuaries, Fisheries and coastal ocean forecasting.
2. Streamline, expand, and automate the data and knowledge delivery system for use by fisherfolks, the scientific community, fisheries managers and policy makers. The project will use existing linkages with the IOOS's Northwest Association of Networked Ocean Observing Systems (NANOOS) to build flexible data-serving capacity to meet the rapid growth in collaborative ocean observing, and augment the currently sparse data available for validation of coastal biogeochemical models.
3. Grow the community of users and observations to enhance partnerships and support for an operational regional-scale hypoxia observing system across the Pacific Northwest.

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Continuing Awards

Alaska Ocean Observing System (AOOS)

FY 23 Funded amount: $350,000
Continuing from FY 2020

Alaska Harmful Algal Bloom Network; monitoring for Alexandrinum
The presence of harmful algal blooms and their biotoxins in Alaska's waters threatens the availability and safety of important commercial and subsistence shellfish resources, as well as the wild populations of fish, birds, marine mammals, and other species foraging in the marine environment. Climatic changes in Arctic Alaska are increasing the likelihood HABs, signaling a growing potential threat to human and ecosystem health.

The Alaska Harmful Algal Bloom network, formed in 2017, seeks to improve the effectiveness of HAB monitoring and event response across the state. This award supports the nascent network, continuing to support a full-time AHAB coordinator and statewide action plan; ensures that data are collected, synthesized, and accessible through a central portal; and incorporates proven, cost-effective technologies, such as microscopy and qPCR testing for Alexandrium (the cause of paralytic shellfish poisoning) and testing for paralytic shellfish toxins through in-state labs.

Additionally, the funding will support the purchase of an Imaging FlowCytobot (IFCB) to better understand the dynamics of harmful phytoplankton (specifically Alexandrium) in the changing conditions of Alaska's oceans. The project will also help test and develop a plane-based hyperspectral camera system in Alaska to determine whether it can detect blooms of Alexandrium. This project led by NOAA PMEL will coordinate with ship-based surveys to calibrate hyperspectral cameras to describe large Alexandrium blooms. The project will also support more travel for in-person meetings in communities where HABs are a concern; increase data management and visualization capacity; increase the amount of toxin testing offered to communities; provide more support to purchase sampling and lab equipment; and test out other innovative technologies in Alaska (such as the field microscopes with AI-based cell identification, and qPCR-based toxic gene detection).

Caribbean Coastal Ocean Observing System (CARICOOS)

FY 23 Funded amount: $100,000
Continuing from FY 2022

Monitoring, tracking, and predicting Sargassum blooms
The Caribbean region has been experiencing severe and disruptive Sargassum blooms. The Caribbean Coastal Ocean Observing System has developed a project to improve the current capacity to monitor, track, and predict Sargassum trajectory by combining high-resolution satellite data and customized numerical models as well as information technology. There are four specific objectives:

1. Develop algorithms and data products to map Sargassum from high-resolution (10 m or better) satellite measurements over coastal and nearshore waters of selected portions of Regional Association domains of SECOORA, GCOOS and CARICOOS.

2. Implement the near real-time data downloading, processing, and data sharing infrastructure to incorporate the algorithms and data products.
3. Combine remotely sensed Sargassum maps with numerical models to track and forecast Sargassum transport.
4. Make the combined data products available in user-friendly formats through an online data portal.

Central and Northern California Ocean Observing System (CeNCOOS) & Southern California Coastal Ocean Observing System (SCCOOS)

FY 23 Funded amount: $300,000
Continuing from FY 2020

HAB monitoring off the California coast
Identifying and quantifying phytoplankton community composition and structure in the waters off of the California coast is vital for monitoring, understanding, and predicting Harmful Algal Blooms (HABs). Recreational and commercial fisheries and shellfish are monitored by the California Department of Public Health for biotoxins produced by HAB species, and advisories are issued for recreational fisheries when levels of toxins exceed the regulatory threshold for seafood. In an effort to create a more robust early warning for HABs, the State of California and NOAA have partnered with the California Ocean Observing Systems (Central & Northern California (CeNCOOS) and Southern California (SCCOOS)) and their networks of public-private monitoring partners to deploy Imaging FlowCytobots (IFCBs) along California's coastline. Developed at Woods Hole Oceanographic Institution and manufactured by McLane Research Laboratories Inc., the IFCBs take images of each particle in a small sample (~15 mL) of water every hour. Machine-learning models are then applied to the imagery to identify the phytoplankton taxa and generate abundance estimates of each HAB group for managers to consult on a daily basis.

This award supports the operation and maintenance of a large fleet of these autonomous robotic microscopes (i.e., IFCBs) to identify HAB species in real-time at critical land-based and offshore locations throughout California. This project, with additional funding from other NOAA resources, the California Ocean Protection Council, and the Orange County Sanitation District, provides an efficient way to quickly and consistently monitor for HAB species. Biotoxins are additionally sampled on a weekly basis at many of the same sites.

Gulf of Mexico Coastal Ocean Observing System (GCOOS)

FY 23 Funded amount: $200,000
Continuing from FY 2020

HABscope; Gulf of Mexico sargassum bulletin; Gulf of Mexico HAB testbed
Commonly called red tide, Karenia brevis blooms along the Gulf of Mexico coast can cause respiratory illness and eye irritation in humans. It can also kill marine life and lead to shellfish closures. Blooms are often patchy, so impacts vary by beach and throughout the day. The HABscope, an innovative K. brevis sampling tool developed by the Gulf of Mexico Coastal Ocean Observing System and NOAA's National Centers for Coastal Ocean Science, empowers citizen science to manage and mitigate red tide. Trained citizens and scientists can collect water samples, take a video of the sample using a low-cost microscope and iPod, and connect to the GCOOS image recognition software to calculate a cell count. Funds will

continue to support the HABscope/Every Beach/Every Day project. Additionally, the project will support two IFCBs operated and the IFCB Gulf of Mexico dashboard that will display data from two Texas locations, one Alabama location, and 4-5 Florida locations. In response to the increasing Sargassum impacts in the Gulf of Mexico and the Caribbean, the project will also fund the development of a sargassum bulletin for the Gulf of Mexico.

In addition, GCOOS will continue a testbed pilot project initiated in 2021 to improve detection and forecasting of harmful algal blooms in the Gulf of Mexico. Researchers will acquire and deploy a small suite of autonomous instruments to test their suitability in the turbid waters of the gulf and build both the instrument and personal capacity to operate, maintain and interpret the data from the systems. The project was funded with $947,000 divided over three years, and results will inform future investments to support HAB forecasting and management through a Gulf of Mexico HAB observing system.

Great Lakes Observing System (GLOS)

FY 23 Funded amount: $320,000
Continuing from FY 2020

Monitoring of Harmful Algal Blooms in the Great Lakes
Cyanobacterial harmful algal blooms (HABs) are a growing problem in the Great Lakes. These blooms, which can produce different cyanotoxins, in particular the liver toxin micocystin, pose a risk to human and wildlife health, threaten the safety of recreational activities, impact the sustainability of drinking water production, and disrupt the region's vital summer tourism economy. The Great Lakes Observing System has partnered with a broad group of stakeholders to develop and operationalize an early warning system to support decision making to take steps for public safety when facing these blooms.

Lake Erie serves as the main source of drinking water for approximately 11 million people and experiences cyanobacterial HABs annually. It is important to track and monitor the shifts in bloom locations and toxin concentrations in (near) real-time to provide timely information to stakeholders. The use of uncrewed surface vehicles, such as the SeaTrac ASV, integrated with an environmental sample processor (3G ESP), which can assess algal populations and transmit data quickly, can assist in monitoring cyanobacterial HABs in shallow, coastal systems. However, the deployment and operation of these observing platforms require the collaborative efforts of engineers and ecologists, making it a labor-intensive process. Funds will be allocated to support an engineer at NOAA Great Lakes Environmental Research Lab to continue studying and mapping bloom movement in Lake Erie's western basin.

Support will also be provided for the deployment of the AUTOHOLO in western Lake Erie. This is a submersible holographic system that aids in determining the abundance of cyanoHABs and other planktonic species. This initiative also helps in building a database of holograms specifically for freshwater plankton. Furthermore, research will be carried out to understand the interactions between cyanobacterial community composition, cyanotoxins, and buoy data in lower Green Bay at Bay Beach in Lake Michigan, as well as in Mawikwe Bay in the Apostle Islands National Park on Lake Superior.

Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS)

Funded amount: $200,000
Continuing from FY 2022

Integration of state-level data; Chesapeake Bay monitoring; regional stakeholder engagement
The Mid-Atlantic Regional Coastal Ocean Observing System is developing harmful algal bloom prediction and response capabilities focused on the particular needs of the Mid-Atlantic region where blooms can kill fish and shellfish and have severe impacts on fisheries and aquaculture. Funding this year will focus on 4 primary areas:

1. Integration of Mid-Atlantic states' HAB data and NOAA NCCOS satellite images into OceansMap, MARACOOS' dynamic data visualization tool.
2. Development of a tool that would combine satellite imagery, tides, wind, dissolved oxygen, and HAB data into one easily accessible location, in real time. This would be an invaluable asset to a host of end users including fishing and ecotourism charter boat captains and commercial crabbing companies.
3. Support for a HAB liaison in the Mid-Atlantic region to serve as the link between stakeholder needs, research efforts, and product development. This liaison is critical in ensuring that efforts are coordinated and stakeholder needs are not only addressed in the early stages of research and product development but also shared throughout the region.
4. Development of new capabilities in the Chesapeake Bay Environmental Forecast System. This project will generate hindcasts and forecasts of primary variables (including temperature, salinity, O2, pH, aragonite saturate state (AR), nutrients, total chlorophyll and water clarity). It will also use habitat suitability models for multiple secondary variables including sea nettles, pathogens such as vibrios and HABs.

Northwest Association of Networked Ocean Observing Systems (NANOOS)

Funded amount: $460,000
Continuing from FY 2020

Pacific Northwest HAB Bulletin; SoundToxins; tribal engagement
Harmful algal blooms have made a sizable impact on the economic and human health of the Pacific Northwest region, prompting frequent fishery closures and disrupting jobs, tourism, and food supply chains. The Pacific Northwest Harmful Algal Bloom Bulletin — a forecast based on field observations and modeling output — has been providing critical, timely information to state and tribal managers in both Washington and Oregon since 2017. Data, information, and forecasts in the bulletin support decision-making for opening or closing shellfisheries, including delayed openings; selective harvests at "safe" beaches; and harvest limits, protecting the health of tens of thousands of harvesters and consumers in the region. This award will be used for a combination of salary support, LiveOcean ocean circulation modeling, offshore sampling, beach sampling, and sample analysis. Funding this year will:

1. Support the PNW Bulletin, working with partners throughout the region to reach diverse stakeholders, continue technical development of the bulletin, and engage new partners from the fishing industry in HAB monitoring efforts.

2. Support SoundToxins, a diverse partnership of trained monitors from Native tribes, shellfish producers, environmental learning centers, environmental groups, and Puget Sound partners coordinated by King (UW), providing early warning of harmful algal bloom events in order to minimize both human health risks and economic losses to Puget Sound fisheries.
3. Invest in expanded capabilities for HAB monitoring throughout the PNW, including from the four Coastal Treaty Tribe partners to sample offshore waters for HABs and other HAB related needs. The Olympic Natural Resources Center staff have compiled equipment, supply, and operation support needs in consultation with each tribe to support their capacity to collect, process, and analyze nearshore samples.

Northeastern Regional Association for Coastal Ocean Observing Systems (NERACOOS)

FY 23 Funded amount: $420,000
Continuing from 2021

Testing of new HAB monitoring technology; HAB monitoring off the northeast coast; integration of new datasets
Historically the only harmful algal bloom in the northeast region was the toxic dinoflagellate Alexandrium catenella, a globally widespread cause of paralytic shellfish poisoning. In recent years, however, other biotoxin threats have emerged with blooms of Pseudo-nitzschia diatoms and Dinophysis dinoflagellates causing shellfish closures for amnesic shellfish poisoning and diarrhetic shellfish poisoning. This project is working to demonstrate an alternative approach to Imaging FlowCytobot deployment and sampling that would offer capacity for mobility and reduce the overall costs of deployments. This year's funding will:

1. Allow for the expansion of short-term HAB monitoring deployment off the northeast coast to two months to cover more of the period of greatest HAB risk and a larger area.
2. Integration of IFCB data from the Damariscotta River into HABON-NE. This includes data quality control, an update to the IFCB itself to allow for real-time image sharing, and development of compatible image classification models and annotation workflows.
3. Continued research into potential sensor deployment locations based on ecological and oceanographic factors, user value, and practical considerations. Funding will also support computing system upgrades to maintain system integrity alongside the integration of new coastal stations.

Pacific Islands Ocean Observing System (PacIOOS)

FY 23 Funded amount: $400,000
Continuing from 2022

Ciguatera monitoring in Hawaii and the U.S. Affiliated Pacific Islands
Ciguatera poisoning (CP), an illness caused by toxins produced by the microalga Gambierdiscus, can lead to diarrhea, paralysis, and, in worst cases, death. It occurs globally and poses significant risk to fisheries and human health. Supporting a research coordinator and providing the opportunity to build relationships with collaborators within and outside of the U.S. Affiliated Pacific Islands (USAPI) is a critical first step in managing the threat of CP in this region.

This Pacific Islands Ocean Observing System program will help establish partnerships between ongoing research and monitoring efforts in other regions with the needs and issues faced by communities in the USAPI and other Pacific nations. A part-time research and network coordinator will help establish these working relationships and foster collaborations in the USAPI and in other parts of the United States, and a series of working group meetings will bring together stakeholders and experts who are actively involved in research addressing CP. An additional component of the proposed work will focus on developing pilot projects to collect preliminary data on Gambierdiscus distribution and abundance, as well as ciguatoxin concentrations in environmental and fish tissue samples.

PacIOOS will also seek to learn from other IOOS Regional Associations, such as the Alaska Ocean Observing System, to address challenges associated with developing data-limited monitoring programs in areas with vast geographic scope.

Southeast Coastal Ocean Observing Regional Association (SECOORA)

FY 23 funded amount: $100,000
Continuing from 2021

West Florida HAB monitoring, tracking, and forecasting efforts; Sargassum forecasting
Impacts from harmful algal blooms are increasing throughout the southeast, with significant incidences of red tide on the Florida west coast and Sargassum blooms throughout southeast Florida and the Keys. This funding will build on previous west Florida HAB monitoring, tracking, and forecasting efforts, including Sargassum forecasting. With this project, SECOORA intends to improve the current capacity to monitor, track, and predict Sargassum trajectory by combining high-resolution satellite data and customized numerical models as well as information technology. There are four specific objectives:

1. Develop algorithms and data products to map Sargassum from high-resolution (10 m or better) satellite measurements over coastal and nearshore waters of selected portions of Regional Association domains of SECOORA as well as portions of neighboring RAs in the Gulf of Mexico (GCOOS) and Caribbean (CARICOOS).
2. Implement the near real-time data downloading, processing, and data sharing infrastructure to incorporate the algorithms and data products.
3. Combine remotely sensed Sargassum maps with numerical models to track and forecast Sargassum transport.
4. Make the combined data products available in user-friendly formats through an online data portal.