U.S. IOOS FY21

National Harmful Algal Bloom Observing Network Awards

Alaska Ocean Observing System (AOOS)

Funded amount: $270,000
Funding period: June 2021–June 2022
Continuing from FY 2020

Alaska, especially in the U.S. Arctic, is emerging as a new at-risk region for HAB-related events. 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 qPCR testing for Alexandrium cell abundance (the cause of paralytic shellfish poisoning) and domoic acid field test kits into operational monitoring across Alaska. With added FY 2021 funding, AOOS and AHAB will build upon existing community sampling programs to develop a statewide assessment; fully implement qPCR assays in multiple regions; fully operationalize use of domoic acid field kits; collaborate with partners in testing the potential use of Imaging FlowCytobots and Environmental Sample Processors in Alaska; develop prototype risk assessments; and develop training programs and protocols for HAB sampling and event response.

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

Funded amount: $275,000
Funding period: June 2021–June 2022
Continuing from FY 2020

Identifying and quantifying the diversity of phytoplankton in the waters off of the California coast is vital for monitoring and understanding harmful algal blooms. Nearly every year, recreational and commercial fisheries are closed due to excessive amounts of biotoxins found in shellfish and crustaceans that are produced by harmful algae. This award supports the operation and maintenance of a suite of autonomous water samplers, Imaging FlowCytobots, to identify HAB species in real-time at critical land-based and offshore locations throughout California. Developed at Woods Hole Oceanographic Institution and manufactured by McLane Labs, the IFCB continuously takes images of each particle in a small sample (~15 mL) of water every hour. An onboard computer then uses image recognition processes and a machine-learning model to estimate both the identity and the volume of the phytoplankton.

This project, with additional funding from other NOAA resources and the CA Ocean Protection Council, provides an efficient way to quickly and consistently test for HAB toxins off the California coast. NOAA's National Centers for Coastal Ocean Science/PCMHAB program is funding a complementary project to develop a data infrastructure for this network. FY 2021 funding will support operations and maintenance as well as data management funds for the California network of eleven IFCBs.

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

Gulf of Mexico Coastal Ocean Observing System (GCOOS)

Funded amount: $947,000
Funding period: June 2021–June 2022
New Award

The project will develop capacity in the Gulf of Mexico to improve detection and forecasting of harmful algal bloom species such as Karenia brevis, and potential unidentified HAB species. Over the course of this three-year testbed pilot project, researchers will 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 will purchase two Imaging FlowCytobots; support the personnel to deploy, operate, and maintain the instruments; and support the data interpretation and dissemination. The testbed will operate for three years to allow time for purchasing (anticipating 6-9 months from ordering to delivery), deployment and testing. Results will inform future investments to support HAB forecasting and management through a GoMEX HAB observing system.

Funded amount: $150,000
Funding period: June 2021–June 2022
Continuing from FY 2020

Florida's "red tide," a harmful algal bloom caused by Karenia brevis, takes a devastating toll on the Gulf Coast. When a bloom occurs, it can kill marine animals as well as birds, shutter fisheries, and release air borne toxins that can cause respiratory and neurological symptoms in humans along the shore. The HABscope, an innovative K. brevis sampling tool developed by GCOOS and NOAA's National Centers for Coastal Ocean Science, brings citizen science to the effort to manage and mitigate red tide. Trained citizen scientists can collect water samples, take a video of the sample using a low-cost microscope and iPod, and connect to the GCOOS RA image recognition software to calculate a cell count. Expanding the HABscope user group allows for increased sampling with broader coverage, improving red tide forecasting and better illustrating the status of any given bloom. This award will support recruitment, retention, and training of citizen scientists, as well as allowing GCOOS to maintain the image recognition software, and acquire necessary supplies like microscopes, iPods, and disposable items.

Great Lakes Observing System (GLOS)

Funded amount: $200,000
Funding period: June 2021–June 2022
Continuing from FY 2020

Lake Erie is a vital resource for the U.S. It supports jobs, tourism, and — critically — drinking water for more than 11 million people. Harmful algal blooms have been on the rise in Lake Erie, once contaminating the Toledo, Ohio water supply to such an extent that the city was cut off from fresh water for three days. GLOS has partnered with a broad group of stakeholders to develop and operationalize an early warning system for Lake Erie to support decision making to take steps for public safety when facing these blooms. FY 2021 funding will support testing of integration of HAB observations from hyperspectral imagery and real-time microcystin concentration and chlorophyll data. Crewed and uncrewed airborne systems will provide sen-

tinel observations directing the path of an Environmental Sample Processor deployed on an autonomous surface vessel. The combination of both — potentially autonomous — observational systems will help to better discern the distribution, composition, and behavior of western Lake Erie HABs.

In addition, this project will enhance and expand the near real-time monitoring network in other areas of the Great Lakes, such as Green Bay, Wisconsin, to better understand the response of HABs to nutrient loads and flooding, which are two primary risks in this area. Wisconsin's Fox-Wolf basin is one of the four EPA-designated algae bloom hotspots in the Great Lakes and the Lower Green Bay is one of the International Joint Commission-designated Areas of Concern. This project will instrument the two existing buoys in the lower Green Bay, which currently measure real-time water quality conditions related to seasonal HABs and hypoxia, to gather near real-time measurements of nutrients as well.

Northeastern Regional Association for Coastal Ocean Observing Systems (NERACOOS)

Funded amount: $200,000
Funding period: June 2021–June 2022
New Award

Historically the only HAB 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 will demonstrate an alternative approach to Imaging FlowCytobot deployment and sampling that would offer capacity for mobility and reduce the overall costs of deployments. Funds will support the purchase of an SP-48 autonomous solar vehicle from SeaTrac Systems, Inc. and a dedicated conductivity-temperature sonde with complementary fluorescence sensors made by AML Oceanographic. These will be supplemented with a suite of upgrades that tailor an existing IFCB for optimal performance aboard the SP-48 platform. Crucially, these upgrades will enable on-board classification of IFCB images, an essential capability for deployments to high-need regions of the NERACOOS domain that are not served by cellular data coverage.

Ongoing NCCOS/MERHAB support will be leveraged to demonstrate the SeaTrac-IFCB system within major HAB development and transport paths within the eastern and western regions of the Gulf of Maine. Additionally, the project partners will work with NCCOS project partners to facilitate rapid assimilation of SeaTrac-IFCB data for use in assessments of NOAA HAB forecast products for the NERACOOS region.

Northwest Association of Networked Ocean Observing Systems (NANOOS)

Funded amount: $250,000
Funding period: June 2021–June 2022
Continuing from FY 2020

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.

FY 2021 funding will support key elements needed to produce the popular bulletin including offshore and ESP sampling, beach sampling by tribes, analysis, and circulation modeling. The project complements an FY20 U.S. IOOS Ocean Technology Transition project to support HAB sampling using the Ocean Aero Triton, an autonomous surface vehicle; a NOAA National Centers for Coastal Ocean Science/MERHAB five-year regional project, developing improvements to the bulletin; and another MERHAB project that is funding deployment of the Environmental Sample Processor for the next three years.

Funded amount: $48,000
Funding period: June 2021–June 2022

Imaging FlowCytobots are an invaluable tool in early detection and monitoring of harmful algal blooms which continue to evolve to meet emerging needs. NANOOS will work to to increase the utility of the observational capacity of IFCBs in Washington and Oregon by 1) improving and assessing a regional classifier for automated taxonomic classification of phytoplankton observed by the network of IFCBs; and 2) creating a spatiotemporally explicit taxonomic dashboard for NANOOS by building upon existing software developed by the Woods Hole Oceanographic Institution. The project will inform observations, modeling, and forecasts for the Pacific Northwest Harmful Algal Bloom Bulletin and allow for increased use of IFCBs in the region that also would contribute to the National HAB Observing Network.

Southeast Coastal Ocean Observing Regional Association (SECOORA)

Funded amount: $150,000
Funding period: June 2021–June 2022
New Award

HABs are increasing throughout the southeast with incidences of red tide on the Florida west coast and sargassum blooms throughout southeast Florida and the Keys being the most significant impacts. This funding will build on previous west Florida HAB monitoring, tracking, and forecasting, which includes sargassum forecasting. A number of predictive tools are in development to investigate this natural phenomenon, which has both biological and physical dimensions. This project — a collaborative effort between SECOORA, NOAA's Atlantic Oceanographic and Meteorological Laboratory, Florida Fish and Wildlife Research Institute, the University of South Florida, Mote Marine Laboratory and others — will enable enhanced tracking, modeling, and forecasting of HABs by SECOORA and their partners.

Additionally, this project will help SECOORA to continue providing HAB resources to stakeholders, such as the Red Tide Data Resources for Florida website, ongoing monthly water sampling, and AUV deployments.