Annual Report on the National Oceanographic Partnership Program Fiscal Year 2022

Prepared by the

Interagency Working Group

on the National Oceanographic Partnership Program

of the

Ocean Science and Technology Subcommittee

of the

Ocean Policy Committee

August 2023

About the Ocean Policy Committee

The Ocean Policy Committee (OPC) was codified by the National Defense Authorization Act for Fiscal Year 2021 to coordinate Federal actions on ocean-related matters. The OPC traces its roots to the National Ocean Council created by Executive Order 13547 and the Ocean Policy Committee established by Executive Order 13840. The OPC is co-chaired by the Director of the Office of Science and Technology Policy (OSTP) and the Chair of the Council on Environmental Quality (CEQ) and is directed to engage and collaborate with the ocean community on ocean-related matters, facilitate coordination and integration of Federal activities in ocean and coastal waters to inform ocean policy, identify priority ocean science and technology needs, and to leverage resources and expertise to maximize the effectiveness of Federal investments in ocean research. For more information about the work of the OPC, please see https://www.noaa.gov/interagency-ocean-policy.

About the Office of Science and Technology Policy

The Office of Science & Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976 to provide the President and others within the Executive Office of the President with advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. As a Cabinet- level office in the Biden-Harris Administration, OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget with an annual review and analysis of Federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government. More information is available at http://www.whitehouse.gov/ostp.

About the Ocean Science and Technology Subcommittee

The purpose of the Subcommittee on Ocean Science and Technology (SOST) is to advise and assist on national issues of ocean science and technology. The SOST contributes to the goals for Federal ocean science and technology, including developing coordinated interagency strategies and fostering national ocean science and technology priorities. The SOST reports to both the NSTC Committee on Environment and the Ocean Policy Committee.

About the National Oceanographic Partnership Program

The National Oceanographic Partnership Program (NOPP) was established by Congress in 1997 and reauthorized in 2021 to promote the national goals of advancing economic development, protecting quality of life, strengthening science education and communication, and assuring national security by improving knowledge of the ocean. These goals are achieved through partnerships among Federal agencies, academia, industry, and non-governmental organizations that advance interagency initiatives and Federal science and technology priorities and cut across agency missions and multiple disciplines. Through NOPP, public and private sectors across the ocean science community coordinate to support larger, comprehensive projects, promote sharing of resources, and foster community-wide innovative advances in ocean science, data, technology development, resources, education, and communication.

About this Document

Under the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 (Public Law 116–283, §1055(b)(2)(A)), the OPC is required to report to Congress annually on NOPP activities. This report details activities in fiscal year 2022.

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Executive Summary

The National Oceanographic Partnership Program (NOPP) marked its 24th year in Fiscal Year (FY) 2022. Since its establishment through the FY 1997 Defense Act (Public Law 104-201, 10 U.S. Code §7901-7903), NOPP has forged interagency and multi-sector cooperation through cross-cutting ocean science and technology research and education projects. NOPP is an effective forum for developing new interagency activities that advance ocean knowledge and augment marine stewardship by transcending single-agency research and education missions.

NOPP focuses on two strategic goals:

- Facilitate and promote interagency ocean research partnerships, and
- Catalyze and support scientific and technological research on critical and emerging issues.

In FY 2022, NOPP partner agencies funded thirteen new projects spanning a number of Administration and Agency priority focus areas, including: internal wave, energy, mixing, and interactions in the ocean; high resolution ocean modeling and earth system prediction; marine biodiversity observing and monitoring; marine carbon sequestration and ocean acidification; sedimentation impacts on offshore safety and marine archaeology. These thirteen projects bring the total number of active awards to 82 and the total number of awards funded since the inception of NOPP to 266. The funding dedicated to new FY 2022 projects totaled $13.9M. An additional $5.35M was provided in FY 2022 for ongoing multi-year NOPP projects bringing the total FY 2022 investment in all NOPP-solicited activities, both new and continuing, to $19.25M. NOPP partner agencies also provided continued oversight of 69 ongoing projects funded in FY 2021 and earlier.

Introduction

The National Oceanographic Partnership Program (NOPP) was established by Congress in Fiscal Year (FY) 1997 to promote the goals of ensuring national security, advancing economic development, protecting quality of life, and strengthening science education and communication by improving knowledge of the ocean (Public Law 104-201, 10 U.S. Code §7901-7903 and more recently, Public Law 116–283, §1055(b)(2)(A)). These goals are accomplished through partnerships among Federal agencies, academia, industry, and non-governmental organizations. The program is an effective forum for the advancement of national goals through the development of interagency initiatives and projects that span agency missions, research sectors, and scientific and technological disciplines.

NOPP Interagency and External Interactions

Interagency and external partnerships are a central tenet of NOPP. Agency participation in NOPP includes sponsoring research through partnership funding opportunities and prize competitions.

Within the U.S. Government, collaboration is accomplished largely through an Interagency Working Group (IWG) that aims to develop, plan, and oversee NOPP ocean research and technology projects and to address topics of mutual and emerging interest. The IWG NOPP meets monthly to advance projects that benefit from the collaboration of more than one agency, require government-private-academic partnerships, and work toward fulfilling the missions of multiple agencies.

Mechanisms for external input include the Ocean Research Advisory Panel (ORAP), which is in the process of being reconstituted as a Federal Advisory Committee Act Panel under the interagency Ocean Policy Committee.

Fiscal Year 2022 NOPP Activities

Annual Solicitation and New Partnership Projects

Each year, NOPP partner agencies identify ocean research and technology topics of mutual interest that would benefit from cross-agency and cross-sector partnerships leading to an agency-issued formal Broad Agency Announcement (BAA), Request For Proposal, or Federal Funding Opportunity. Proposals are received, usually in the Fall, and funded projects are then selected through a formal merit review process developed with the guidance and approval of the participating Federal agencies. Details of the procedure for developing these funding opportunities are described in Appendix 1.

The IWG NOPP developed topics and language for a FY 2022 BAA, published on October 6th, 2021. The solicitation was intended to provide up to $23M over five years and was focused on two topics: 1) *A Global Multi-agency Experiment on Internal Wave Energy, Mixing, and Interactions in the Ocean and Their Representation in Global Ocean Models and Operational Forecasts* and 2) *High Resolution Ocean Models for Coupled Earth System Prediction across Space and Time Scales.* Proposals were received, reviewed, and selected for funding in FY 2022.

In FY 2022, thirteen new NOPP projects (selected from the FY 2022 BAA) were funded, totaling $13.9M:

1. *Diagnosis and validation of the time and spatial variability of remotely generated internal waves in global ocean simulations,*
2. *Improving the representation of internal waves in the Navy and NOAA data assimilative forecasting systems*,
3. *A global distributed observing program for shear, energy flux, and mixing by internal waves*,
4. *The Internal Wave Spectrum and Boundary Mixing in the Sub-Tropical South Atlantic*,
5. *A distributed network of internal wave resolving moored arrays for assessing tide-resolving model fields and improving forecasts in the coastal ocean,*
6. *Enhancing the Realism of MOM6-SIS2 Simulations with Ocean Tides*,
7. *The CeNCOOS MBON: Marine biodiversity information in support of a healthy Blue Economy in the central California Current,*
8. *Quantifying marine biodiversity through movements and feeding: Assessing coastal marine ecosystem dynamics near estuary mouths,*
9. *Louisiana Deltaic Estuaries MBON: Sea Level Rise Sentinels,*
10. *AMBON (Arctic MBON) - linking biodiversity observations in the Arctic,*
11. *The Southeast US Marine Biodiversity Observation Network (MBON): Toward Operational Marine Life Data for Conservation and Sustainability,*
12. *Electrochemical Acid Sequestration to Ease Ocean Acidification (EASE-OA),* and
13. *Offshore Analysis of Seafloor Instability and Sediments (OASIS Partnership) with Applications to Offshore Safety and Marine Archaeology*.

Further information and abstracts for these thirteen projects can be found in Appendix 2.

Prior Year Project Continuations

NOPP partner agencies also continue to provide oversight for 69 additional ongoing NOPP projects. FY 2022 funding totaling $3.88M was provided to support a subset of these projects. The partnering agencies for these efforts are: NOAA, Naval Research Laboratory (NRL), Bureau of Ocean Energy Management (BOEM), Federal Highway Administration, National Aeronautics and Space Administration (NASA), Environmental Protection Agency (EPA), and National Science Foundation (NSF). Further information for these additional projects, along with the new FY 2022 projects, can be found in Appendix 2.

Additionally, the U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) and the Integrated Ocean Observing System (IOOS®) program at the National Oceanic and Atmospheric Administration (NOAA), continue to support the U.S. Ocean Observing Prize. FY 2022 activities under this competition continue support for the DEVELOP Competition component whose theme is "Buoys and Autonomous Systems" and challenges competitors to advance ideas that could use marine energy to increase platform longevity, energy availability, or other similar performance characteristics. Experimental design and testing for projects in the DEVELOP Competition takes place at the Naval Surface Warfare Center's facility in Carderock, Maryland.

FY 2023 Plans and Partnership Priorities

In FY 2023, the IWG NOPP will continue to identify, facilitate, and foster collaboration on priority interagency ocean research projects through engagement with representatives from Federal ocean agencies and other appropriate avenues. The IWG NOPP is supporting proposal solicitation efforts led

by NOAA's Ocean Acidification Program (OAP) focused on expanding understanding of various aspects of marine Carbon Dioxide Removal (mCDR) to reduce uncertainty about the extent and durability of carbon removal, associated co-benefits/risks, and contribute to regulatory frameworks needed for both testing and implementation of approaches. The agencies and entities participating in this multi-agency request for proposals include: the NOAA (OAP, Global Ocean Monitoring and Observing Program (GOMO), U.S. Integrated Ocean Observing System (IOOS)), the Department of Energy (Fossil Energy and Carbon Management, Water Power Technologies Office), the Department of Navy (Office of Naval Research), the National Science Foundation (Chemical Oceanography Program), and philanthropies including ClimateWorks.

The IWG NOPP is also defining topics for future funding focused on fostering NOPP ocean science and technology partnership projects that are supportive of Federal marine science and technology priorities, including those identified in the recently released Ocean Climate Action Plan (OCAP).

National Oceanographic Partnership Program Office

The William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 authorized the secretary of the Navy and NOAA to jointly establish the partnership program office for NOPP. During FY 2022, the NOAA Office of Oceanic and Atmospheric Research (NOAA OAR), through NOAA Ocean Exploration, awarded a $3.5 million, five-year contract to Integrated Systems Solutions, Inc. (ISS) to establish the NOPP Program Office to support NOAA and the Department of Navy's Office of Naval Research (ONR) in their role in jointly co-chairing IWG NOPP. The cost of the NOPP Program Office will be equally shared through a new interagency agreement between ONR and NOAA OAR.

The NOPP Program Office facilitates communication across ocean science sectors to expand the scope of public/private partnerships; plans and facilitates fora and workshops; provides administrative support to IWG NOPP; supports the NOPP peer review grant process; facilitates the annual NOPP Excellence in Partnership (EiP) Award; supports drafting the NOPP annual report to Congress; and coordinates NOPP outreach and education activities including the www.nopp.org website. The award was made through NOAA's Professional, Scientific, and Technical Services Program (ProTech) Oceans Domain as a small business set-aside. ISS has provided support services to NOAA for 16 years.

Summary of NOPP Investments

FY 2022 funding for new and ongoing projects under NOPP totaled $19.25M. From FY 1997 through FY 2022 the total expenditures on NOPP are $519M. Figure 1 shows a sand chart of recent NOPP funding by agency and year. The same data are presented as a table in Appendix 3. Appendix 4 provides a list of the 82 active NOPP projects. All historical projects supported by NOPP can be found at www.nopp.org.

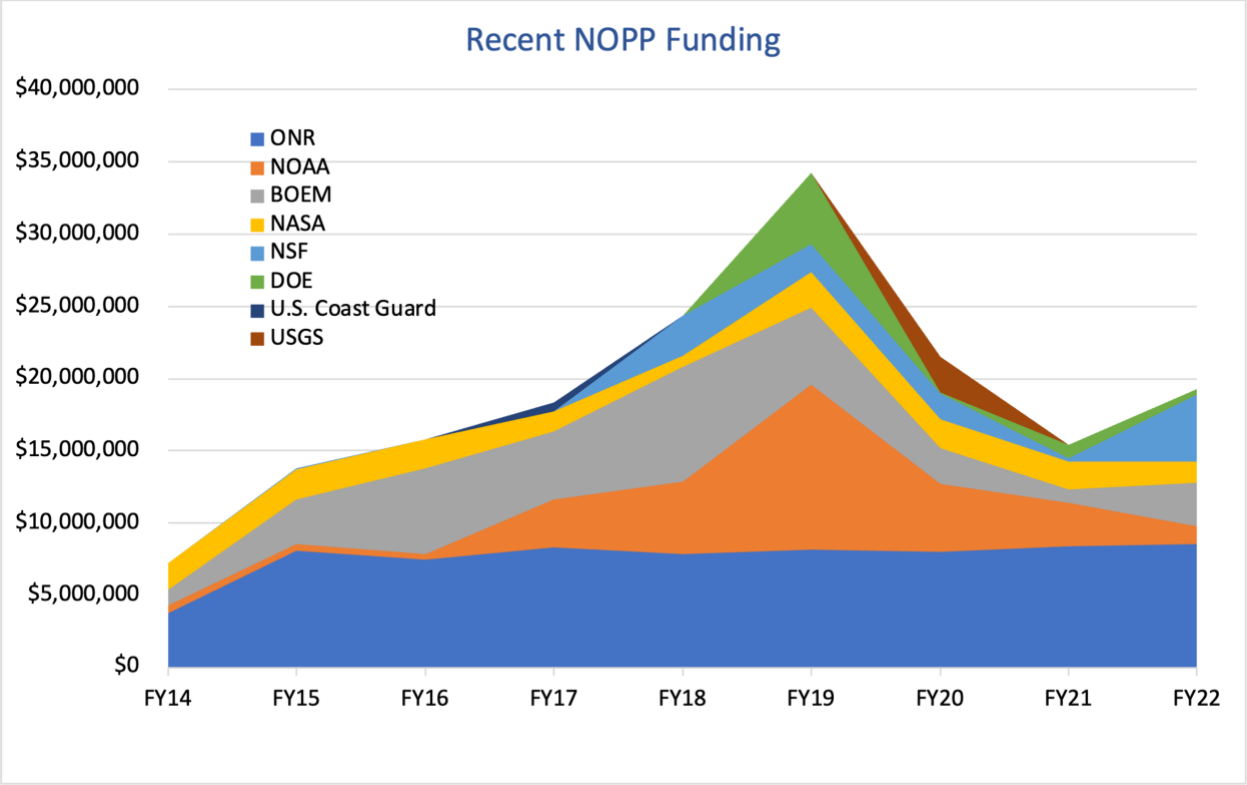

Figure 1. Reported agency contributions to National Oceanographic Partnership Program projects from Fiscal Year 2014 to Fiscal Year 2022.

Conclusion

In FY 2022, NOPP launched 13 new projects and supported the U.S. Ocean Observing Prize competition while continuing successful projects from previous years. NOPP's FY 2021 BAA announcing the possible award of $23M over five years is the largest in recent years. Going forward, NOPP will draw upon its 24 years of experience and lessons learned to serve as an efficient mechanism for implementing productive ocean partnerships among Federal agencies, industry, academia, and other sectors; supporting interagency working groups focused on key ocean research and facilities issues; and supporting Federal ocean science priorities.

Appendix 1. Development and Process for NOPP Solicitations

To be a funded NOPP project requires multi-sector partnerships among academia, industry (including non-government organizations), and government (including Federal, Tribal, state, and local entities).

Research topics funded through NOPP are initiated via interactions among agency program officers and managers, most often at IWG-NOPP meetings. Partner agencies then discuss the research topic with other agencies through NOPP. At this point, a follow-up meeting is conducted where interagency partnerships are formed, and tentative levels of support are pledged on an as-available basis. The research goals, partner resources, solicitation mechanisms, and language are then proposed, and the lead agency and agency project coordinator is identified.

Once the solicitation is approved by the lead agency and its partners, NOPP then reviews the funding announcement language, which is then presented as either a broad agency announcement, request for proposals, or Federal funding opportunity by the lead agency on behalf of NOPP.

Once a funding opportunity is announced, submitted proposals undergo a review process which fulfills the review standards of all agencies sponsoring that topic. For instance, when the National Science Foundation is a co-sponsor, this may be some combination of mail and panel peer review. Proposals are reviewed based on:

- Relevance of the proposed research to NOPP objectives and Federal science and technology priorities,
- Overall scientific and technical merits of the proposal,
- Level of support of critical research objectives or operational goals,
- Quality of proposed partnerships,
- The offeror's capabilities, related experience, and access to facilities that are critical to the proposal objectives,
- The long-term commitment of the partners to the proposed objectives,
- The qualifications and experience of the proposed principal investigator and key personnel, and
- Rationale of proposed cost.

At the conclusion of the review process, agency program officers or managers make a recommendation for funding. After NOPP discussions and receipt of appropriations, the awarded research projects are announced.

Appendix 2. New NOPP-Solicited Activities in Fiscal Year 2022

NOPP BAA: A Global Multi-agency Experiment on Internal Wave Energy, Mixing and Interactions in the Ocean and Their Representation in Global Ocean Models and Operational Forecasts (5 projects, $8.3M total funding over 3 years)

Project Website: NOPP BAA FY2022

Diagnosis and validation of the time and spatial variability of remotely generated internal waves in global ocean simulations

PI: Maarten Buijsman, University of Southern Mississippi

Partners: National Research Laboratory, University of Michigan

This University of Southern Mississippi/University of Michigan/National Research Laboratory proposal and the Scripps Institute of Oceanography/Woods Hole Oceanographic Institution/Jet Propulsion Laboratory proposal "A Distributed Network of Internal Wave Resolving Moored Arrays for Assessing Tide-Resolving Model Fields and Improving Forecasts in the Coastal Ocean" are two synergistic pieces of a two-piece puzzle; both have been submitted to this NOPP call. In the SIO/WHOI/JPL proposal a full water column Internal Wave Resolving (IWR) Array is designed and deployed in the Calibration/Validation area off the U.S. West Coast to resolve unidirectional near-inertial, diurnal, and semidiurnal internal waves from remote and local sources, and their continuum. In this proposal, which is in front of you, we will use several data sets to verify and improve the internal wave predictability in the far field in global HYbrid Coordinate Ocean Model (HYCOM) simulations with tides, data assimilation, and realistic atmospheric forcing. While near-field internal waves are reasonably well simulated in HYCOM, the model performance in the far field is not-well studied and understood. We will validate HYCOM using the IWR Array and SWOT data collected during the fast-sampling and science orbit phases. We will apply directional filtering techniques to separate unidirectional waves, allowing us to study the wave energy decay along a beam. Moreover, we will prepare SWOT data to be ingested in HYCOM's data-assimilative system to further improve predictability of internal waves, whose phase and amplitude in the far field are affected by the location of mesoscale eddies. Finally, we will perform ensemble HYCOM simulations with perturbed eddy fields to quantify uncertainty in model internal wave fields.

Improving the representation of internal waves in the Navy and NOAA data assimilative forecasting systems

PI: Eric Chassignet, Florida State University

Partners: Naval Research Laboratory NOAA/NCEP, U. of Southern Mississippi, U. of Michigan, Tendral, LLC.

The Global Ocean Forecast System (GOFS) is the U.S. Navy's operational global ocean prediction system that runs daily at U.S. Navy production centers. The system depicts the location of mesoscale features

such as oceanic eddies and fronts, i.e., the "ocean weather", and provides accurate 3- dimensional ocean temperature, salinity, and current structure to the Fleet. In the last decades, GOFS has improved its predictive capabilities for ocean circulation over a wide range of frequencies and wave numbers. The assimilation of observational data using NCODA-3DVAR, a three-dimensional variational data assimilation (DA) technique, has significantly lowered the forecast errors of subtidal fields (Chassignet et al., 2009; Cummings and Smedstad, 2014; Luecke et al, 2017). A major step forward in the HYCOM system was achieved with the introduction of tidal forcing (Arbic et al., 2010, 2012, 2018). The current implementation of NCODA-3DVAR data assimilation of observational data is, however, not without drawbacks. It causes shocks in the positioning of mesoscale fields and these shocks can result in high-frequency internal gravity waves, which appear as "noise" in the tidal bands and inertial bands in regions with strong mesoscale activity. These spurious internal waves cause an excess of energy when compared to observations (drifters) and/or to simulations without data assimilation. The main objective of this proposal is to have more accurate internal tide predictions in GOFS by reducing the generation of high-frequency noise introduced by the data assimilation and by taking advantage of the new observational datasets. To minimize the noise introduced by the DA, we propose to evaluate several data assimilation techniques and to quantify their impact on the representation of high-frequency motions. The data assimilation methods are NCODA-3DVAR (default configuration; Cummings, 2005), TSIS (Srinivasan et al., 2021), 4DVAR (Ngodock and Carrier, 2014), and LETKF (Penny, 2014). The evaluations will be performed in idealized, regional, and global HYCOM configurations.

A global distributed observing program for shear, energy flux, and mixing by internal waves

PI: James Girton, Woods Hole Oceanographic Institution

Partners: University of Washington, NOAA, Teledyne Webb Research

Mixing rates in the ocean of the future will be determined to a large extent by the distribution of internal waves. Changes in the forcing of these waves by winds and tides, and modifications of the currents and density stratification that modulate internal wave propagation, evolution, and eventual dissipation into turbulence, are likely to be simulated with some skill by numerical coupled climate models. But the waves themselves and their impacts on the climate system through diffusive transport of heat, chemicals, and other tracers are a more difficult challenge. We propose a global sampling program for internal waves using profiling floats—measuring temperature, salinity, velocity, and turbulence—that will yield new insights into internal wave regimes and parameterizations, and that will provide direct and derived data products tailored for use by modeling groups for comparison and validation.

The Internal Wave Spectrum and Boundary Mixing in the Sub-Tropical South Atlantic

PI: Kurt Polzin, Woods Hole Oceanographic Institution

Partners: University of Delaware, University of Maryland, Georgia Institute of Technology, and National Research Laboratory

This proposal represents an intersection between the expanding capability of global scale Ocean Circulation Models (OCMs) to represent internal gravity waves, their dynamics and mixing with characterizing the oceanic internal wavefield at regional scales through a targeted field campaign and numerical investigations. Such characterization will be obtained using observationally based metrics

of ocean mixing and theoretical treatments of nonlinear wave-wave interactions. The wavefield will be linked to the structure of the ocean's bottom boundary layer and their coupling resolved. A moored array will be deployed in the Brazil Basin to quantify near boundary flow distortions due to finite amplitude topography, near boundary internal wave breaking, and momentum and buoyancy fluxes in both turbulent and internal wavebands (i.e. drag and mixing). Extant data obtained as part of a Tracer Release Experiment in the same domain and data from the Global Drifter Program will be used to create a regional statistical characterization of the oceanic internal wavefield in the Sub-Tropical South Atlantic. This characterization will be compared to a hierarchy of five models: an operational forecast model (HYCOM), Order (1-3) km horizontal resolution ROMS-CROCO, nonhydrostatic ROMS-CROCO 'mountain scale' simulations with 50 m resolution and 1:1 grid aspect ratio, realistic Large Eddy Simulations (LES), and a quasi-analytic spectral representation of the internal wave energy spectrum. The proposed work I synergistic: the field characterization represents ground truth, the quasi-analytic model is constrained by those highly resolved data and can be modified to critique how a numerical model's truncation of topographic variability impacts the mid-water column internal wavefield, the global models assist assessment of non-local generation and propagation not represented in the quasi-analytic model, quantification of nonlinear wave-wave interactions in the 'mountain scale' simulations provides insight into theoretical treatments. Observed data and LES permit investigation of interactions between boundary layer dynamics, wave generation and the forward cascade to turbulence.

A distributed network of internal wave resolving moored arrays for assessing tide-resolving model fields and improving forecasts in the coastal ocean

PI: Amy Waterhouse, University of California, San Diego, SCRIPPS

Partners: Scripps Institution of Oceanography University of California San Diego, Woods Hole Oceanographic Institution, Jet Propulsion Laboratory Pasadena

We propose to collect high-frequency in situ measurements that can resolve the energy flux associated with internal waves propagating through the deep ocean by combining high vertical- resolution moorings to resolve the waves' modal structure with an antenna of vertically- integrated measures of variability to resolve the speed and direction of beam propagation. This proposal will instrument one internal-wave resolving (IWR) array that is re-deployable to multiple locations. The IWR Array proposed here comprises two pressure-sensor equipped inverted echo sounders (called PIESs) and five PIESs with an additional current-sensor on each (called CPIESs) and a densely instrumented, full-depth mooring. The CPIES antenna will allow for the detection and separation of low-mode internal waves propagating from multiple directions, while the mooring will measure velocity and vertical displacement signals of five or more vertical modes. The array has been designed, and the data will be examined, in cooperation with a numerical modeling team (see the Buijsman et al. NOPP submission from our collaborators at University of Southern Mississippi, University of Michigan, and the Naval Research Laboratory) allowing for skill-testing and direct comparison with the global internal-tide resolving models that serve as inputs to regional models of the coastal ocean. The IWR Array deployment will be made in collaboration with the NASA JPL Surface Water and Ocean Topography (SWOT) Calibration/Validation (Cal/Val) mooring deployments in 2023 off the California coast. Part of the proposed IWR Array deployment period will coincide with SWOT's 90-day "fast-sampling" phase which will provide once per day repeat sampling and the IRW Array will extend (in time) and augment (in space) NASA's internal wave observations planned for the Cal/Val location.

NOPP BAA: High Resolution Ocean Models for Coupled Earth System Prediction Across Space and Time Scales (1 project, $302,000 total funding over 3 years)

Project Website: NOPP BAA FY2022

Enhancing the Realism of MOM6-SIS2 Simulations with Ocean Tides

PI: Edward Zaron, Oregon State University

Partners: NOAA, NASA, Oregon State University, University of Michigan, Florida State University

Ocean tides comprise a significant fraction of ocean variability – encompassing sea level, ocean currents, and stratification – involving both barotropic and baroclinic processes. The interactions of tidal phenomena with lower-frequency processes, such as seasonal stratification, and higher-frequency processes, such as internal waves and subsurface turbulence, lead to transports of energy and tracers that are not accurately represented in state-of-the-art earth system reanalyses and climate forecasting systems.

This project aims to enhance the realism of global ocean and sea ice simulations based on the coupled MOM6-SIS2 ocean modeling system. We propose to run the MOM6-SIS2 system to simulate the joint atmospherically- and tidally-forced ocean circulation, and then refine the resolution of this system to create skillfully accurate predictions of the barotropic and low-mode baroclinic tides. Our targeted horizontal grid, a nominal (1/48)-degree tripolar grid, is chosen to capture the topographic gradients responsible for generating the low-mode baroclinic tides. While this system represents the state-of-the-art among global modeling components for Earth system prediction, future progress in computing capabilities, numerical methods, and subgrid-scale parameterizations will supersede MOM6-SIS2 with more capable systems. Our goal is to implement a methodology for calibrating the resolution-dependent parameterizations of MOM6-SIS2 to yield accurate predictions of barotropic and baroclinic tides, and to enable the efficient calibration of future systems after MOM6-SIS2 becomes obsolete.

Our approach is based on experience with data-assimilative tidal modeling systems in which it is axiomatic that the accuracy of predictions is proportional to the number of degrees of freedom available as control parameters. Using an ensemble method with 1000 or more degrees of freedom, chosen to reflect the uncertainties in seafloor topography and resolution-dependent parameterizations, we expect to produce MOM6-SIS2-based tide predictions that are comparable in accuracy to the widely-used barotropic TPXO solutions. We are confident that intercomparing and calibrating the simulated baroclinic currents and sea level with observational data – from satellite altimeters, surface drifters, and other high-resolution platforms – will reveal strengths and limitations of the MOM6-SIS2 system and demonstrate the extent to which our understanding of ocean physics fundamentally limits the predictability of baroclinic tidal phenomena.

In parallel with the efforts to model tides globally, we also plan to conduct studies within regional domains. Idealized simulations will be used initially to examine the grid-convergence of MOM6 in the context of barotropic-to-baroclinic conversion at topography. We will also implement the capability of prescribing baroclinic tidal boundary conditions on regional domains. This capability will be used for studying numerical convergence of internal wave scattering at topography, and it will enable more realistic regional MOM6 simulations.

NOPP BAA: US Marine Life Observations: Coordinated Marine Biodiversity Observation Network (MBON) and Animal Telemetry Network (ATN) Activities to Ensure Resilient, Productive Ecosystems and Human Communities in the Face of Change (5 projects, $5M total funding over 5 years)

Project Website: https://marinebon.org ;

https://www.grants.gov/web/grants/view-opportunity.html?oppId=335886

The CeNCOOS MBON: Marine biodiversity information in support of a healthy Blue Economy in the central California Current

PI: Francisco Chavez, Monterey Bay Aquarium Research Institute

Partners: NOAA, Monterey Bay Aquarium Research Institute, Central & Northern California Ocean Observing System, University of California Santa Cruz, Point Blue Conservation Science

We propose to integrate remote sensing products, in situ data and models in support of a healthy Blue Economy in the Central California Current (CCC). Targeted users include NOAA California Current Integrated Ecosystem Assessment (CCIEA), National Marine Sanctuary Programs, the Bureau of Ocean Energy Management, and the State of California. Our goal is to quantify relationships between climate, the ocean environment (physics, chemistry) and marine food webs (from microbes to fish and top predators), with the aim of providing predictive understanding of marine ecosystem responses to environmental change. The proposed team has been expanded from current ongoing MBON efforts, adding new observations by participants of the Animal Telemetry Network (ATN) and from deep-sea coral and sponge ecosystems. The team includes members from academic/research and development (University of California Santa Cruz, Monterey Bay Aquarium Research Institute, Stanford, Point Blue, Humboldt State), federal government (NOAA) and IOOS Regional Association (the Central and Northern California Ocean Observing System - CeNCOOS) institutions. In situ data will be collected, processed and provided by NOAA Fisheries, academic and private non-profit research institutions, including traditional (nets, microscopes), animal tagging and innovative (eDNA, acoustics, video) approaches. These temporal and spatial in situ data will be integrated with remote sensing products and numerical model output to develop time-varying species habitat models and biodiversity ecoscapes for central California. The information and products developed will be managed and served by the CCIEA and CeNCOOS and support National Marine Sanctuary condition reports as well as a wide variety of users. These products will benefit sustainable development of fisheries, proposed renewable energy systems in the marine environment and evolving challenges in ecosystem management arising from climate variability and change. New data from surveys (including eDNA where available) animal telemetry will be processed routinely and delivered to local, national and international repositories. A similar process will be followed for externally supplied data to our MBON project. Products generated from our modeling framework will inform potential improvements to EcoCast and WhaleWatch and made available through CeNCOOS data portal systems, established with user engagement to guide their format, display and delivery.

Quantifying marine biodiversity through movements and feeding: Assessing coastal marine ecosystem dynamics near estuary mouths

PI: Nathan Furey, University of New Hampshire

Partners: Office of Naval Research, NOAA, University of New Hampshire, Gulf of Maine Research Institute, Northeastern Regional Association of Coastal Ocean Observing Systems

This project will integrate powerful technologies (acoustic telemetry, environmental DNA [eDNA], and acoustics) with traditional fisheries sampling to quantify impacts of changes in local and regional water conditions on individuals, populations, and community structure. We will study the impacts of forage species and environmental conditions on Atlantic cod and common terns in both New Hampshire and southern Maine (Casco Bay) coastal waters. To study the movements of these predators, we will use tracking tags (GPS technology for terns, acoustic technology for Atlantic cod) to follow their movements. We will also examine their diet, but analyzing gut contents from Atlantic cod (both visually and via genomic methods) and terns (via genomics of fecal samples). We will quantify the availability of forage species (including river herring, Atlantic herring, and squid) through tracking, active acoustics, passive acoustics, and eDNA of water samples. Information on animal movements and diet will be integrated with a variety of environmental conditions from oceanographic buoys, other sensors, and ocean simulation models. We will use mathematical models to predict how changes in water temperature and diet will affect Atlantic cod and terns. Comparing and contrasting species' responses to environmental change will help us determine the "winners and losers" of climate change. All efforts each year will be informed by a variety of stakeholders representing resource managers and non-profit organizations. Our team also includes experts in data management and accessibility to ensure data are accessible in a timely manner.

Collectively, these results demonstrate the value in novel technologies in tracking shifts in biodiversity across space and time. Our efforts would build on the known strengths of each method (eDNA, diet analyses, active acoustics, and passive acoustics) while also exploring their integration and defining scales of appropriate use. We will define how each method describes marine biodiversity in both unique but also shared ways. This knowledge would allow stakeholders to integrate these methods into their own efforts, aiding research and monitoring. Marine ecosystems are dynamic, and our approach would determine at which scales ecosystem components change, and which methods best detect such variation. Broadly, our results would demonstrate the relative importance of environmental conditions and food availability on marine communities to promote proper conservation and management in a rapidly changing Gulf of Maine.

Louisiana Deltaic Estuaries MBON: Sea Level Rise Sentinels

PI: Cassie Glaspie, Louisiana State University

Partners: Louisiana Universities Marine Consortium (LUMCON); Louisiana State University (LSU); NOAA Fisheries Southeast Regional Office; Gulf of Mexico Coastal Observing System (GCOOS); Imagine Water Works; Jillian Tupitza (eDNA)

Estuaries are extremely diverse, but muddy, deltaic estuaries have not been represented in the US MBON until now. We are focusing on Louisiana's coastal estuaries, a unique ecosystem that is already experiencing the most severe impacts of sea level rise and can serve as "sea level rise sentinels''- our

nation's test case for the impacts of coastal retreat on ecosystem function and services. Here in Louisiana, we have a massive array of environmental monitoring stations from state and federal agency partners, but there has been little coordination among efforts and a lack of focus on biological indices of ecosystem health. Existing monitoring will be integrated and augmented using advanced methods, including advanced algorithms for satellite remote sensing of suspended sediments and colored dissolved organic matter in coastal waters, sediment eDNA for genetic diversity of fish and invertebrates, acoustic telemetry for fish habitat use, passive acoustic data to identify species diversity of sound-producing organisms, and the development of an index of biotic integrity using benthic macroinvertebrates. Our goal is to develop indices that can assess landscape and local diversity from automated or efficient sampling techniques. This project is also a concerted effort to develop a monitoring framework that can be comparable in many different types of marine environments, from coastal to open ocean.

We are partnering with the New Orleans-based non-profit Imagine Water Works to ensure that the indices we develop and the data we produce are communicated effectively and valued by the people in this region who are also contending with sea level rise in their daily lives. The PIs will also recruit students and technicians from under-represented groups most impacted by sea level rise. As the estuaries change around us, it is important for us to learn the language of our sea level rise sentinels, and this MBON will improve science communication where it is needed most- in local communities that face tough decisions regarding their history, culture, and livelihoods due to land loss in the Gulf of Mexico.

AMBON (Arctic MBON) - linking biodiversity observations in the Arctic

PI: Katrin Iken, University of Alaska Fairbanks

Partners: NASA, Office of Naval Research, U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management, University of Alaska Fairbanks, University of Maryland Center for Environmental Sciences, Oregon State University, University of Washington, Alaska Ocean Observing System, Native Village of Kotzebue

The Arctic Marine Biodiversity Observation Network (AMBON) is designed to provide high-quality biodiversity data from the Arctic Chukchi Sea across trophic levels, from microbes to whales. The Arctic Ocean marginal seas are among the fastest-warming regions in the world, with ecosystem changes across all trophic levels that carry repercussions to ecosystem function. The Alaskan Arctic is also home to numerous Indigenous communities that depend on marine resources for food security and traditional cultural lifestyle. Arctic biodiversity data are important for understanding these changes and supporting decision-making by regional and federal resource managers, Indigenous communities, and other stakeholders. The objectives of the AMBON project are to collect biodiversity data across trophic levels and in relation to environmental conditions; to use biodiversity data to detect changes in species composition, including invasive species; and determine effective in situ observing designs through modeling. For this, we employ a combination of traditional collection tools and approaches with state-of-the-art technologies. The latter include year-round moored instrumentation: a microphone recorder to detect marine mammal sounds, environmental DNA (eDNA) analyses from a time series water sampler, and a benthic time-lapse camera. We also aim to apply a new, regionally-downscaled seascape model for the Chukchi Sea to regional biodiversity data. In this proposal, the AMBON project also engages in new partnerships to extend biodiversity observations. First, we link our Chukchi Sea

regional biodiversity and environmental observations to animal tracking data, by assessing the prey field of migrating short-tailed shearwaters in their Arctic feeding grounds and their Australian breeding ground reproductive success. This collaboration will foster a new connection between two NOAA-led programs: the Animal Telemetry Network (ATN) and the MBON. Second, we engage in a new partnership with Indigenous stakeholders by expanding our shelf-based observations to include coastal, year-round observations from a community-based coastal observing network in Kotzebue Sound. This will extend our spatial extent to a currently undersampled but ecologically significant region, as Kotzebue Sound is a biologically productive shallow-water embayment that receives the largest riverine influx of the Chukchi Sea. Another important objective of the AMBON project is to continue and expand its networking and collaborations from regional to national to international scales. Regionally, we will collaborate with other research projects for shared logistics, complementary sampling, and common data sharing strategies. Nationally, we have been an active partner of the MBON program since the inception, providing a polar perspective, and we will continue to contribute to the goal of standardized biodiversity observations, common sampling protocols, and joint shared open-access data sharing policies. Internationally, pan-Arctic linkages such as with an Arctic Council biodiversity working group place the AMBON data within a broader polar context. The AMBON project also was an organizing partner of the Marine Life 2030 initiative, which has been endorsed by the UN Decade of Ocean Science for Sustainable Development and which provides a platform to coordinate biodiversity information on a global scale. Lastly, the ultimate key to a successful biodiversity observing network is timely, open-access data sharing, for which we strive as a project and as a coordinated MBON group.

The Southeast US Marine Biodiversity Observation Network (MBON): Toward Operational Marine Life Data for Conservation and Sustainability

PI: Frank Muller-Karger, University of South Florida

Partners: NASA, NOAA, University of South Florida, Oregon State University, Texas A&M University, University of Miami, Gulf of Mexico Coastal Ocean Observing System (GCOOS), Southeast Coastal Ocean Observing Regional Association (SECOORA), Florida Fish and Wildlife Research Institute, EcoQuants

We propose a Marine Biodiversity Observation Network (MBON) to serve as a regional collaboration hub of the U.S. Integrated Ocean Observing System (IOOS) to address needs for marine biodiversity information in the US Gulf of Mexico and Southeast US Exclusive Economic Zone. The effort focuses on the needs of resource managers of the Florida Keys National Marine Sanctuary and other federal and state jurisdictions spanning Biscayne Bay, the Florida Keys, the West Florida Shelf, and deep corals. The objectives of the proposed Southeast MBON are to 1.) Co-design biodiversity monitoring and assessment with users to generate knowledge on ecosystem services in the context of climate change and human uses of the ocean and at scales aligned with those of management; 2.) Converge on subsets of marine Essential Ocean Variables and Essential Biodiversity Variables for regional applications; 3.) Use existing species distribution models and generate forecasts; 4.) Establish a protocol for online distribution of products; and 5.) Serve as MBON Team Leader. We propose novel approaches, including integrating activities across two IOOS Regional Associations (Southeast Coastal Ocean Observing Regional Association; Gulf of Mexico Coastal Ocean Observing System). We use the framework of ocean observing to develop Essential Biodiversity Variables from Essential Ocean Variables to solve management problems. The project continues to advance technologies of remote sensing (e.g., Seascapes), animal tracking, sound measurements, molecular methods (environmental DNA), and apply regional circulation and species distribution models to document, understand, and forecast

connectivity of plankton and larger organisms between the Gulf of Mexico and the Atlantic Ocean across the Florida Keys National Marine Sanctuary. The Team Leader will help liaise between the US MBON projects, the applied science and user community, and international programs. The effort addresses NOAA's priorities of science, service, and stewardship. MBON helps to assess ecosystem integrity, advance protection of marine resources, and promote conservation. The interdisciplinary team is diverse in gender and includes members from under-represented groups. The project is a contribution to the UN Decade of Ocean Science for Sustainable Development with active participation in the Marine Life 2030 Program.

Other NOPP funded opportunities

Electrochemical Acid Sequestration to Ease Ocean Acidification (EASE-OA)

PI: Brendan Carter, University of Washington and NOAA Pacific Marine Environmental Laboratory

Partners: NOAA, Department of Energy, ClimateWorks Foundation, University of Washington, Ebb Carbon Inc.

Ocean alkalinity elevation (OAE) has the potential to mitigate both global CO2-driven climate change and regional impacts of ocean acidification (OA). However, there is currently a disconnect between theoretical and practical research into OAE: most modeling studies are focused on the global implications of elevating alkalinity over entire ocean basins while most studies testing implementations remain limited to laboratory tests or mesocosms. We aim to push the field forward by bringing these two research spheres together to focus on the spatial scales that will be meaningfully affected by early field trials for OAE approaches. Through an ambitious partnership between the University of Washington (UW), the National Oceanic and Atmospheric Administration (NOAA), the Department of Energy (DoE), and Ebb Carbon, Inc. (Ebb Carbon), we propose to implement Ebb Carbon's electrochemical OAE technology in a field trial at the Pacific Northwest National Laboratory (PNNL) and to model and monitor the OAE and the regional chemical impacts. Each of the three components—the field trial, modeling, and monitoring—will be integrated to address the cross-cutting questions facing this and other pointsource OAE approaches:

- How effectively will the OAE approach mitigate OA and remove CO2, and what are the best metrics for gauging the efficacy?

- What observing assets are needed to ensure the safe operation of the approach when using real-time measurements in the region of alkalinity dispersal as feedback to the alkalinity generating system?

- What temporal and spatial scales are most critical to resolve to capture the OA mitigation?

- What limitations are imposed on the rate of OAE by the seawater mixing, local regulations, and ecosystem tolerances for elevated alkalinity and pH?

- How does the performance of this OAE approach vary when simulating tie-in with intermittent renewable energy sources with battery back up?

- How cost effective is the approach in this field trial?

Offshore Analysis of Seafloor Instability and Sediments (OASIS Partnership) with Applications to Offshore Safety and Marine Archaeology

PI: Samuel Bentley (LSU) and Chaytor, Jason (USGS), Louisiana State University and U.S. Geological Survey

Partners: USGS, LSU, The Water Institute of the Gulf, SEARCH, Inc.

The Mississippi River Delta Front (MRDF) off the coast of Louisiana is a heavily sedimented area of known seafloor instability that is prone to subsea gravity flows (e.g., mudflows, debris flows, hypopycnal flows, turbidity flows, gravity currents, etc.). Despite previous research —primarily limited to discrete study areas within the MRDF — and recent developments in seafloor mapping, sampling, and modeling, large knowledge and data gaps exist regarding the environmental forcing mechanisms driving gravity flow occurrence, as well as the location, frequency, and magnitude of such events. The MRDF also contains extensive development of State and Federally regulated oil and gas infrastructure, as well as numerous known and potential archaeological sites (e.g., historic shipwrecks). The purpose of this Agreement is for BOEM and its designated Federal partners to assist the State of Louisiana in: (1) producing a map of the entire MRDF for the first time using modern seafloor mapping tools and techniques, (2) collecting and analyzing oceanographic, geological, and geotechnical data sets at selected locations within the MRDF, (3) incorporating numerical modeling and machine learning to identify areas of low-to-high probability for future gravity flow occurrence and associated risk to offshore infrastructure, (4) evaluating new and/or existing technologies to detect and monitor gravity flow events, and (5) identifying benthic habitats and conducting archaeological analyses of selected shipwrecks that have been or have the potential to be impacted by gravity flows. This information will primarily be used to inform the State's and BOEM's environmental analyses and regulatory decision-making regarding offshore conventional and renewable energy development.

Appendix 3. Reported Annual Agency Contributions to NOPP Projects

Agency	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
BOEM	$1,052,620	$3,100,025	$5,968,527	$4,694,001	$7,913,019	$5,391,734	$2,475,464	$990,269	$3,003,277
BSEE	$0	$0	$0	$0	$0	$0	$0	$0	$0
Department of Energy	$0	$0	$0	$0	$0	$4,900,000	$100,000	$890,000	$350,000
NASA	$1,881,041	$2,044,965	$1,978,308	$1,411,618	$776,886	$2,447,638	$2,000,000	$1,861,996	$1,484,595
NOAA	$550,000	$438,321	$409,000	$3,347,554	$5,009,402	$11,412,750	$4,700,000	$3,000,000	$1,227,092
NSF	$0	$149,416	$0	$0	$2,824,953	$1,940,721	$1,767,013	$287,408	$4,612,635
ONR	$3,750,000	$8,094,000	$7,441,000	$8,278,806	$7,864,000	$8,137,000	$8,034,238	$8,364,000	$8,569,754
U.S. Coast Guard	$0	$0	$0	$586,250	$0	$0	$0	$0	$0
USGS	$0	$0	$0	$0	$0	$0	$2,400,000	$0	$0
Total	**$7,233,661**	**$13,826,727**	**$15,796,835**	**$18,318,229**	**$24,388,260**	**$34,229,843**	**$19,076,715**	**$15,393,673**	**$19,247,353**

Appendix 4. All NOPP Projects Active through Fiscal Year 2022

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Offshore Analysis of Seafloor Instability and Sediments (OASIS Partnership) with Applications to Offshore Safety and Marine Archaeology	https://nopp.org/projects/offshore-analysis-of-seafloor-instability-and-sediments-oasis-partnership-with-applications-to-offshore-safety-and-marine-archaeology/	USGS, LSU, The Water Institute of the Gulf, SEARCH	Bentley, Samuel (LSU); Chaytor, Jason (USGS)	Louisiana State University and U.S. Geological Survey	5	2022
Enhancing the Realism of MOM6-SIS2 Simulations with Ocean Tides	https://nopp.org/projects/enhancing-the-realism-of-mom6-sis2-simulations-with-ocean-tides/	NOAA, NASA, Oregon State University, University of Michigan, Florida State University	Zaron, Edward	Oregon State University	3	2022
Electrochemical Acid Sequestration to Ease Ocean Acidification (EASE-OA)	https://nopp.org/projects/electrochemical-acid-sequestration-to-ease-ocean-acidification-ease-oa/	NOAA, Department of Energy, ClimateWorks Foundation, University of Washington, Ebb Carbon Inc.	Carter, Brendan	University of Washington and NOAA Pacific Marine Environmental Laboratory	2	2022
The CeNCOOS MBON: Marine biodiversity information in support of a healthy Blue Economy in the central California Current	https://nopp.org/projects/the-cencoos-mbon-marine-biodiversity-information-in-support-of-a-healthy-blue-economy-in-the-central-california-current/	NOAA, Monterey Bay Aquarium Research Institute, Central & Northern California Ocean Observing System, University of California Santa Cruz, Point Blue Conservation Science	Chavez, Francisco	Monterey Bay Aquarium Research Institute	5	2022

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Quantifying marine biodiversity through movements and feeding: Assessing coastal marine ecosystem dynamics near estuary mouths	https://nopp.org/projects/quantifying-marine-biodiversity-through-movements-and-feeding-assessing-coastal-marine-ecosystem-dynamics-near-estuary-mouths/	Office of Naval Research, NOAA, University of New Hampshire, Gulf of Maine Research Institute, Northeastern Regional Association of Coastal Ocean Observing Systems	Furey, Nathan	University of New Hampshire	5	2022
Louisiana Deltaic Estuaries MBON: Sea Level Rise Sentinels	https://nopp.org/projects/louisiana-deltaic-estuaries-mbon-sea-level-rise-sentinels/	LUMCON, LSU, NOAA Fisheries Southeast Regional Office, Texas A&M GCOOS, Imagine Water Works, Jillian Tupitza (eDNA)	Glaspie, Cassie	Louisiana State University	5	2022
AMBON (Arctic MBON) - linking biodiversity observations in the Arctic	https://nopp.org/projects/ambon-arctic-mbon-linking-biodiversity-observations-in-the-arctic/	NASA, Office of Naval Research, U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management, University of Alaska Fairbanks, University of Maryland Center for Environmental Sciences, Oregon State University, University of Washington, Alaska Ocean Observing System, Native Village of Kotzebue	Iken, Katrin	University of Alaska Fairbanks	5	2022
The Southeast US Marine Biodiversity Observation Network (MBON): Toward	https://nopp.org/projects/the-southeast-us-marine-biodiversity-observation-	NASA, NOAA, University of South Florida, Oregon State	Muller-Karger, Frank	University of South Florida	5	2022

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Operational Marine Life Data for Conservation and Sustainability	network-mbon-toward-operational-marine-life-data-for-conservation-and-sustainability/	University, Texas A&M University, University of Miami, Gulf of Mexico Coastal Ocean Observing System, Southeast Coastal Ocean Observing System, Florida Fish and Wildlife Research Institute, EcoQuants				
Diagnosis and validation of the time and spatial variability of remotely generated internal waves in global ocean simulations	https://nopp.org/projects/diagnosis-and-validation-of-the-time-and-spatial-variability-of-remotely-generated-internal-waves-in-global-ocean-simulations/	National Research Laboratory, University of Michigan	Buijsman, Maarten	University of Southern Mississippi	3	2022
Improving the representation of internal waves in the Navy and NOAA data assimilative forecasting systems	https://nopp.org/projects/improving-the-representation-of-internal-waves-in-the-navy-and-noaa-data-assimilative-forecasting-systems/	Naval Research Laboratory NOAA/NCEP, U. of Southern Mississippi, U. of Michigan, Tendral, LLC.	Chassignet, Eric	Florida State University	3	2022
A global distributed observing program for shear, energy flux, and mixing by internal waves	https://nopp.org/projects/a-global-distributed-observing-program-for-shear-energy-flux-and-mixing-by-internal-waves/	University of Washington, NOAA, Teledyne Webb Research	Girton, James	Woods Hole Oceanographic Institution	3	2022
The internal wave spectrum and boundary mixing in the sub-tropical south Atlantic	https://nopp.org/projects/the-internal-wave-spectrum-and-boundary-mixing-in-the-sub-tropical-south-atlantic/	University of Delaware, University of Maryland, Georgia Institute of Technology, National Research Laboratory	Polzin, Kurt	Woods Hole Oceanographic Institution	3	2022

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
A distributed network of internal wave resolving moored arrays for assessing tide-resolving model fields and improving forecasts in the coastal ocean	https://nopp.org/projects/a-distributed-network-of-internal-wave-resolving-moored-arrays-for-assessing-tide-resolving-model-fields-and-improving-forecasts-in-the-coastal-ocean/	Scripps Institution of Oceanography University of California San Diego, Woods Hole Oceanographic Institution, Jet Propulsion Laboratory Pasadena	Waterhouse, Amy	University of California, San Diego, SCRIPPS	3	2022
COAMPS-TC deterministic, ensemble, and nowcast model support of the ONR NOPP project: Predicting hurricane coastal impacts	https://nopp.org/projects/coamps-tc-deterministic-ensemble-and-nowcast-model-support-of-the-onr-nopp-project-predicting-hurricane-coastal-impacts/	ONR, Naval Research Laboratory	Komaromi, William	Naval Research Laboratory	1	2021
Coastal Elevation Models and Land Surface Variables for Use in Forecasting Hurricane Impacts	https://nopp.org/projects/coastal-elevation-models-and-land-surface-variables-for-use-in-forecasting-hurricane-impacts/	ONR, USGS, NOAA, University of Colorado Boulder, Marda Science LLC, University of North Carolina Greensboro	Gesch, Dean	U.S. Geological Survey	4	2021
Remote Sensing of the U.S. Coastline Impacted by Land-Falling Hurricanes	https://nopp.org/projects/remote-sensing-of-the-u-s-coastline-impacted-by-land-falling-hurricanes/	ONR, National Geospatial Intelligence Agency, University of Miami, Airbus USA, University of Massachusetts Amherst, Capella Space	Romeiser, Roland	University of Miami	4	2021
In-situ measurements of ocean waves from air-deployed Directional Wave Spectra Drifters (DWSD) and Alamo Floats	https://nopp.org/projects/in-situ-measurements-of-ocean-surface-waves-from-air-deployed-directional-wave-spectra-drifters-dwsd-and-air-launched-	ONR, NOAA, University of California San Diego, University of Miami, Woods Hole Oceanographic Institution, U.S. Naval	Centurioni, Luca	Scripps Institution of Oceanography	4	2021

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
	autonomous-micro-observer-alamo-floats/	Academy, MRV Systems LLC				
Air-deployed wave buoys for hurricane forecast improvements	https://nopp.org/projects/air-deployed-wave-buoys-for-hurricane-forecast-improvements/	ONR, NOAA, University of Washington, Sofar Ocean Technologies, University of Colorado Boulder	Thomson, Jim	University of Washington	4	2021
Real-time and observed measurements of hurricane-induced hydrodynamics and flooding	https://nopp.org/projects/real-time-and-observed-measurements-of-hurricane-induced-hydrodynamics-and-flooding/	ONR, USGS, NOAA, Sofar Ocean Technologies	Brown, Jenna	U.S. Geological Survey	1	2021
Forecasting Coastal Impacts from Tropical Cyclones along the U.S. East and Gulf Coasts using the ADCIRC Prediction System	https://nopp.org/projects/forecasting-coastal-impacts-from-tropical-cyclones-along-the-us-east-and-gulf-coasts-using-the-adcirc-prediction-system/	ONR, NOAA, University of Georgia, Renaissance Computing Institute, University of North Carolina Chapel Hill, The Water Institute of the Gulf, Oregon State University, North Carolina State University, Seahorse Coastal Consulting, University of Rhode Island	Luettich, Richard	University of North Carolina Chapel Hill	4	2021
Forecasting Hurricane Impacts on CoastS - FHICS	https://nopp.org/projects/forecasting-hurricane-impacts-on-coasts-fhics/	ONR, USGS, Deltares, University of Central Florida, Naval Research Laboratory, IHE Delft Institute for Water Education	Nederhoff, Kees	Deltares USA	3	2021

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Coupled Ocean Atmosphere Waves Sediment Transport (COAWST) - Waves, Sediment, Surge and Structure Response (WSSSR) Forecasting System	https://nopp.org/projects/coawst-wsssr-coupled-ocean-atmosphere-waves-sediment-transport-waves-sediment-surge-and-structure-response-forecasting-system/	ONR, USGS, University of Florida, Fathom Science LLC, Louisiana State University	Olabarrieta Lizaso, Maitane	University of Florida	4	2021
Offshore Wind, Fisheries and Protected Species Science to address the U.S. Climate Crisis	https://nopp.org/projects/offshore-wind-fisheries-and-protected-species-science-to-address-the-u-s-climate-crisis/	NOAA, BOEM, Naval Research Laboratory	Lipsky, Andrew (program manager)	NOAA Northeast Fisheries Science Center	3	2021
The Effects of Sea Level Rise (ESLR): surface transportation resilience in collaboration with the Department of Transportation	https://nopp.org/projects/the-effects-of-sea-level-rise-eslr-surface-transportation-resilience-in-collaboration-with-the-department-of-transportation/	NOAA, Federal Highway Administration, Auburn University, University of South Alabama, University of Wisconsin-Madison, Alabama Department of Transportation, University of New Hampshire, Rockingham (New Hampshire) Planning Commission, JFK Environmental Services LLC, South Coast Engineers Inc.	Bowers, Benjamin: Sias, Jo	Auburn University : University of New Hampshire	2	2021
Ocean Surface Topography Science Team	https://nopp.org/projects/ocean-surface-topography-science-team/	NOAA, NASA, University of Maryland, Global Science & Technology Inc., Rutgers University	Carton, James; Egido, Alejandro; Farrell, Sinead; Wilkin, John	University of Maryland; Global Science & Technology	3	2021

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
				Inc.; Rutgers University		
U.S. EEZ Mapping and Exploration in the Aleutian Islands	https://nopp.org/projects/u-s-eez-mapping-and-exploration-in-the-aleutian-islands/	NOAA, BOEM, University of New Hampshire, Saildrone Inc., Monterey Bay Aquarium Research Institute	Mayer, Larry	University of New Hampshire	3	2021
Piloting Bio-GO-SHIP on US cruises: Towards a global analysis of large-scale changes to ocean plankton systems	https://nopp.org/projects/piloting-bio-go-ship-on-us-cruises-towards-a-global-analysis-of-large-scale-changes-to-ocean-plankton-systems/	NOAA, NSF, NASA, University of California Irvine, Woods Hole Oceanographic Institution, Old Dominion University, Oregon State University, Bigelow Laboratory for Ocean Sciences, Mississippi State University	Martiny, Adam	University of California, Irvine	2	2021
Satellite Hosting Atmospheric and Littoral Ocean Water Sensors (SHALLOWS) Project: Phase A 2 (continuation from 2018 start)	https://nopp.org/projects/satellite-hosting-atmospheric-and-littoral-ocean-water-sensors-shallows-project-phase-a-2/	ONR, NASA, NOAA, U.S. Army Corps of Engineers, University of Cincinnati, Air Force Institute of Technology, University of Alabama	Tolbert, Carol	NASA Glenn Research Center	1*	2021 (from 2018 start)
Development of lightweight, power-efficient, soft electronic sensor systems for next-generation oceanographic measurements (continuation from 2018 start)	https://nopp.org/projects/development-of-lightweight-power-efficient-soft-electronic-sensor-systems-for-next-generation-oceanographic-measurements/	ONR, University of Connecticut, Northwestern University, Teledyne	Wang, Xueju	University of Connecticut	2	2021 (from 2018 start)

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Bichromatic Littoral Temperature Observer (BLTO) Instrument (continuation from 2018 start)	https://nopp.org/projects/bichromatic-littoral-temperature-observer-blto-instrument/	ONR, Sierra Lobo Inc., University of Cincinnati	Putman, Philip	Sierra Lobo Inc.	2	2021 (from 2018 start)
SOAR Cellular Ocean Altimetry / Scatterometry Technology (COAST), Phase A-2 (continuation from 2018 start)	https://nopp.org/projects/soar-cellular-ocean-altimetry-scatterometry-technology-coast-phase-a-2/	ONR, GeoOptics, University of Colorado	Yunck, Thomas	GeoOptics	1	2021 (from 2018 start)
Escanaba Trough hydrothermal sulfide system - exploring the seafloor and oceanic footprints	https://nopp.org/projects/escanaba-trough-hydrothermal-sulfide-system-exploring-the-seafloor-and-oceanic-footprints/	USGS, NOAA, BOEM, University of Hawai'i at Mānoa, Memorial University, National Oceanography Centre, University of California Davis, University of Washington, University of Bergen	Gartman, Amy	U.S. Geological Survey	1.5	2020
A Low Cost Optical Sensor to Measure Underwater Flow	https://nopp.org/projects/a-low-cost-optical-sensor-to-measure-underwater-flow/	ONR, University of California San Diego, Creare LLC	Jaffe, Jules	University of California San Diego	3	2020
Proposal for unified handling of ADCP data from ocean data collection projects. Includes the development of standardized data formats and software converters	https://nopp.org/projects/unified-access-to-adcp-data/	ONR, NortekUSA Inc., Teledyne RDI	Lohrmann, Alte	NortekUSA Inc	2	2020
Onboard Processing and Transmission of Slocum Glider Acoustic Current Profiler Velocity Profiles	https://nopp.org/projects/onboard-processing-and-transmission-of-slocum-glider-acoustic-current-profiler-velocity-profiles/	ONR, Rutgers University, Teledyne Webb Research	Miles, Travis	Rutgers, The State University of New Jersey	2	2020

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
Electromagnetic Velocity Profiling float: velocity and mixing measurements with adaptive sampling capabilities	https://nopp.org/projects/electromagnetic-velocity-profiling-float-velocity-and-mixing-measurements-with-adaptive-sampling-capabilities/	ONR, University of Washington, Teledyne Webb Research	Szuts, Zoltan	University of Washington	3	2020
Seafloor Habitat Characterization in Cordell Bank, Greater Farallones and Monterey Bay National Marine Sanctuaries	https://nopp.org/projects/seafloor-habitat-characterization-in-cordell-bank-greater-farallones-and-monterey-bay-national-marine-sanctuaries/	NOAA, USGS, California Academy of Sciences, Greater Farallones Association	Lipski, Danielle	NOAA Office of National Marine Sanctuaries	2	2020
Advancing sustainable shellfish aquaculture through machine learning and automated data collection on fish communities	https://nopp.org/projects/advancing-sustainable-shellfish-aquaculture-through-machine-learning-and-automated-data-collection-on-fish-communities/	NOAA, USGS, University of Washington, Microsoft, Taylor Shellfish	Sanderson, Beth	NOAA Northwest Fisheries Science Center	2	2020
Developing and scaling up emerging image-based technology for evaluating Mission: Iconic Reefs large-scale coral restoration in the Florida Keys National Marine Sanctuary	https://nopp.org/projects/developing-and-scaling-up-emerging-image-based-technology-for-evaluating-mission-iconic-reefs-large-scale-coral-restoration-in-the-florida-keys-national-marine-sanctuary/	NOAA, USGS, University of Miami, University of California San Diego, Coral Restoration Foundation, Mote Marine Laboratory, Reef Renewal USA	Viehman, Shay	NOAA National Centers for Coastal Ocean Science	2	2020
High-fidelity three-dimensional coastal compound flooding prediction system in support of disaster mitigation and safe navigation	https://nopp.org/projects/high-fidelity-three-dimensional-coastal-compound-flooding-prediction-system-in-support-of-disaster-mitigation-and-safe-navigation/	NOAA, ONR, USGS, Virginia Institute of Marine Science, Axiom	Pe'eri, Shachak	NOAA Office of Coast Survey	2	2020
Basin-Scale Marine Mammal Monitoring: A Case Study Using Artificial Intelligence and Cloud Computing to Track Humpback Whales	https://nopp.org/projects/basin-scale-marine-mammal-monitoring-a-case-study-using-artificial-intelligence-and-cloud-computing-to-track-humpback-	NOAA, ONR, University of Washington, Google	Berchok, Catherine	NOAA Alaska Fisheries Science Center	2	2020

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
from their Breeding to their Feeding Grounds	whales-from-their-breeding-to-their-feeding-grounds/					
Saildrone as a research and operational platform for the Eastern Tropical Pacific	https://nopp.org/projects/saildrone-as-a-research-and-operational-platform-for-the-eastern-tropical-pacific/	NOAA, University of Washington, Saildrone Inc., Center for Scientific Research and Higher Education at Ensenada, French National Research Institute for Sustainable Development	Cronin, Meghan	NOAA Pacific Marine Environmental Laboratory	3	2020
Leveraging transformative 'omics technologies to alleviate barriers to American shellfish production	https://nopp.org/projects/leveraging-transformative-omics-technologies-to-alleviate-barriers-to-american-shellfish-production/	NOAA, Pacific Hybreed, University of Washington, Washington Sea Grant	Gavery, Mackenzie	NOAA Northwest Fisheries Science Center	2	2020
Enhancement of Private Sector Partnerships and NOAA Vessel Infrastructure for 'Omics Tracking of Ecosystem Condition and Trends	https://nopp.org/projects/enhancement-of-private-sector-partnerships-and-noaa-vessel-infrastructure-for-omics-tracking-of-ecosystem-condition-and-trends/	NOAA, CosmosID, Monterey Bay Aquarium Research Institute	Goodwin, Kelly	NOAA Atlantic Oceanographic and Meteorological Laboratory	3	2020
Building the genomic infrastructure for cetacean research and management	https://nopp.org/projects/building-the-genomic-infrastructure-for-cetacean-research-and-management/	NOAA, Rockefeller University, San Diego Zoo Wildlife Alliance, Revive & Restore	Morin, Phillip	NOAA Southwest Fisheries Science Center	3	2020
Expanding exploration and using innovative technologies to assess the rapidly changing Bering and Chukchi Seas	https://nopp.org/projects/expanding-exploration-and-using-innovative-technologies-to-assess-the-rapidly-changing-bering-and-chukchi-seas/	NOAA, University of Washington, Oregon State University, Bigelow Laboratory for Ocean Sciences	Stabeno, Phyllis	NOAA Pacific Marine Environmental Laboratory	2	2020

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A Mixed-Precision Hybrid Saddle-Point 4D-Var System for ROMS with Application to Assimilation of Remotely-Sensed Bio-Optical Properties	https://nopp.org/projects/a-mixed-precision-hybrid-saddle-point-4d-var-system-for-roms-with-application-to-assimilation-of-remotely-sensed-bio-optical-properties/	ONR, NOAA, Rutgers University, University of California Santa Cruz	Wilkin, John	Rutgers, The State University of New Jersey	3	2019
Sea Surface Salinity From a Cubesat with Novel Spatial Light Modulator Imaging System	https://nopp.org/projects/sea-surface-salinity-from-a-cubesat-with-novel-spatial-light-modulator-imaging-system/	ONR, NASA, Florida Atlantic University, Texas Christian University, Space and Naval Warfare Systems Center Pacific	Twardowski, Mike	Florida Atlantic University	2*	2019
Flexible Sensor Technologies for In-Situ Ocean Monitoring	https://nopp.org/projects/flexible-sensor-technologies-for-in-situ-ocean-monitoring/	ONR, University of Southern Mississippi, University of California San Diego, Sea-Bird Scientific	Azoulay, Jason	University of Southern Mississippi	3	2019
Lagrangian and Coupled Data Assimilation enhanced by Machine Learning to improve Operational Ocean Prediction	https://nopp.org/projects/lagrangian-and-coupled-data-assimilation-enhanced-by-machine-learning-to-improve-operational-ocean-prediction/	ONR, University of Maryland, University of California San Diego, Naval Research Laboratory	Carton, James (formerly Stephen Penny)	University of Maryland	3	2019
COAST: A CubeSat for Measuring Sea Surface Salinity with Integrated Atmospheric Correction Capabilities	https://nopp.org/projects/coast-cubesat-ocean-atmosphere-sensor-technology-a-cubesat-for-measuring-sea-surface-salinity-with-integrated-atmospheric-correction-capabilities/	ONR, Woods Hole Oceanographic Institution, Massachusetts Institute of Technology, Naval Research Laboratory	Gawarkiewicz, Glen	Woods Hole Oceanographic Institution	2	2019
An Innovative CubeSat Exploring Littoral Oceanographic & Atmospheric Dynamics	https://nopp.org/projects/an-innovative-cubesat-exploring-littoral-oceanographic-and-atmospheric-dynamics-iceload/	ONR, University of Miami	Graber, Hans	University of Miami	2	2019

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Ultrafast and Compact Fiber-Optic Temperature Sensor for Unmanned Underwater Vehicles	https://nopp.org/projects/ultrafast-and-compact-fiber-optic-temperature-sensor-for-unmanned-underwater-vehicles/	ONR, Michigan State University, Naval Research Laboratory	Han, Ming	Michigan State University	3	2019
Global Multi-Resolution Ocean Prediction/Analysis with Scale Recursive Estimation and Multi Sensor Data Fusion	https://nopp.org/projects/global-multi-resolution-ocean-prediction-analysis-with-scale-recursive-estimation-and-multi-sensor-data-fusion/	ONR, University of Miami, Florida State University, Tendral LLC, Woods Hole Group Inc.	Iskandarani, Mohammed	University of Miami	3	2019
Real-time Analysis of Turbulent Spectra for Adaptive Tracking of Environmental Features and UUV Wakes	https://nopp.org/projects/real-time-analysis-of-turbulent-spectra-for-adaptive-tracking-of-environmental-features-and-uuv-wakes/	ONR, University of California Santa Barbara, Rockland Scientific	Nidzieko, Nicholas	University of California Santa Barbara	3	2019
Cost Effective Soft Material Conductivity, Temperature and Depth (CTD) Sensors	https://nopp.org/projects/cost-effective-soft-material-conductivity-temperature-and-depth-ctd-sensors/	ONR, Johns Hopkins University, Naval Postgraduate School, RBR-Global, Materials Dynamics & Devices Inc.	Xia, Zhiyong	Johns Hopkins University Applied Physics Laboratory	3	2019
EPIC-DAUG: An Enhanced Propulsion Integrated Capability – Deep Autonomous Underwater Glider for Shore Launch/Recovery and High-Endurance Unattended Mapping	https://nopp.org/projects/epic-daug-an-enhanced-propulsion-integrated-capability-deep-autonomous-underwater-glider-for-shore-launch-recovery-and-high-endurance-unattended-mapping/	NOAA, Naval Postgraduate School, Woods Hole Oceanographic Institution, Teledyne Webb	Camilli, Richard	Woods Hole Oceanographic Institution	3	2019
Developing an autonomous biogeochemical profiling float to monitor biological productivity, ocean-atmosphere CO_2 fluxes, and	https://nopp.org/projects/new-bgc-argo-projects-funded-by-noaa-cpo-oomd/	NOAA, NASA, University of California San Diego, MRV Systems LLC, Monterey Bay	Purkey, Sarah	Scripps Institution of Oceanography	3	2019

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hypoxia in the Tropical Pacific Ocean		Aquarium Research Institute				
Improvements to Profiling Float Technology in Support of Equatorial Pacific Biogeochemical Studies	https://nopp.org/projects/new-bgc-argo-projects-funded-by-noaa-cpo-oomd/	NOAA, NASA, University of Washington, Monterey Bay Aquarium Research Institute, Sea-Bird Scientific	Riser, Stephen	University of Washington	3	2019
The CeNCOOS MBON: Integrating remote sensing, in situ data and models to understand central California ecosystem responses to environmental change	https://marinebon.org/us-mbon/california-central/	NOAA, University of California Santa Cruz, Oregon State University, Monterey Bay Aquarium Research Institute, Point Blue, Humboldt State University, Central and Northern California Ocean Observing System	Chavez, Francisco	Monterey Bay Aquarium Research Institute	3	2019
A sustainable, integrated AMBON in the Chukchi Sea	https://marinebon.org/us-mbon/arctic/	NOAA, University of Alaska Fairbanks	Iken, Katrin	University of Alaska - Fairbanks	3	2019
Marine Biodiversity Observing Network in the Northern California Current: Understanding patterns and drivers of biodiversity and ecosystem functioning from plankton to seascapes	https://marinebon.org/us-mbon/pacific-northwest/	NOAA, Oregon State University, Northwest Association of Networked Ocean Observing Systems	Kavanaugh, Maria	Oregon State University	3	2019
Saildrone Surveyor: Autonomous Mapping and Environmental Characterization	https://nopp.org/projects/saildrone-surveyor-autonomous-mapping-and-environmental-characterization/	NOAA, University of New Hampshire, Monterey Bay	Mayer, Larry	University of New Hampshire	3	2019

Title	Project Web Link	Partners	Lead Principal Investigator(s)	Lead Institution(s)	Duration (years)	Start (fiscal year)
		Aquarium Research Institute, Saildrone Inc.				
Southern California Bight Marine Biodiversity Observation Network	https://marinebon.org/us-mbon/california-southern/	NOAA, University of California Santa Barbara, California Cooperative Fisheries Investigations, Southern California Coastal Water Research Project	Miller, Bob	University of California - Santa Barbara	3	2019
Implementing a Marine Biodiversity Observation Network (MBON) in South Florida to Advance Ecosystem-Based Management	https://marinebon.org/us-mbon/south-florida/	NOAA, University of South Florida	Muller-Karger, Frank	University of South Florida	3	2019
MBON expansion into the Gulf of Maine: the NERACOOS/NROC Integrated Sentinel Monitoring Network (ISMN)	https://marinebon.org/us-mbon/gulf-of-maine/	NOAA, Northeastern Regional Association of Coastal Ocean Observing Systems, Northeast Regional Ocean Council	Runge, Jeffrey	Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)	3	2019
Shore Launched Autonomous Underwater Vehicle Demonstration Leading Towards Shipless Deepwater Exploration of the U.S. Exclusive Economic Zone	https://nopp.org/projects/shore-launched-autonomous-underwater-vehicle-demonstration-leading-towards-shipless-deepwater-exploration-of-the-u-s-exclusive-economic-zone/	NSF, NOAA, Woods Hole Oceanographic Institution	Hartsfield, J. Carl (formerly Carl Kaiser)	Woods Hole Oceanographic Institution	4	2019

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Small-Sat Lidar Sea Surface Vector Winds and Height Measurements System	https://nopp.org/projects/small-sat-lidar-sea-surface-vector-winds-and-height-measurements-system/	ONR, NASA, University of California Irvine	Boyraz, Ozdal	University of California Irvine	2	2018
Developing a Compact 670-GHz Polarmetric Radiometer for CubeSat with Novel Spatial Light Modulator Imaging System	https://nopp.org/projects/developing-a-compact-670-ghz-polarmetric-radiometer-for-cubesat-with-novel-spatial-light-modulator-imaging-system/	ONR, NASA, Virginia Diodes Inc.	Racette, Paul	NASA Goddard Space Flight Center	2	2018
Long Wave Infrared Instrument for Sea Surface Temperature Measurement by CubeSats	https://nopp.org/projects/long-wave-infrared-instrument-for-sea-surface-temperature-measurement-by-cubesats/	ONR, Sierra Lobo Inc., Teledyne Judson, University of Cincinnati	Putman, Phil	Sierra Lobo Inc	2	2018
High Quality Littoral Ocean and Aerosol Characterization from a CubeSat With Novel Spatial Light Modulator Imaging System	https://nopp.org/projects/high-quality-littoral-ocean-and-aerosol-characterization-from-a-cubesat-with-novel-spatial-light-modulator-imaging-system/	ONR, Florida Atlantic University, Space and Naval Warfare Systems Center Pacific, University of Maryland Baltimore County	Twardowski, Michael	Florida Atlantic University	2*	2018
Multi-sensor Improved Sea Surface Temperature: continuing the GHRSST Partnership and Arctic Data	https://nopp.org/projects/multi-sensor-improved-sea-surface-temperature-continuing-the-ghrsst-partnership-and-arctic-data/	NOAA, NASA, Earth and Space Research, University of Colorado, University of Miami, University of Washington, University of Maryland	Gentemann, Chelle	Earth and Space Research	4	2018

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Membrane-free In-situ Underwater Gas Analyzer Using Laser Spectroscopy in a Compact Hollow Fiber Cell	https://nopp.org/projects/membrane-free-in-situ-underwater-gas-analyzer-using-laser-spectroscopy-in-a-compact-hollow-fiber-cell/	NOAA, NASA, Opto-Knowledge Systems Inc., California Institute of Technology, University of Washington, Oregon State University	Kriesel, Jason	Opto-Knowledge Systems	3	2018
Improving the Technology Readiness Level of the 6000-m capable Conductivity Temperature Depth sensor mounted on Deep Argo floats	https://nopp.org/projects/improving-the-technology-readiness-level-of-the-6000-m-capable-conductivity-temperature-depth-sensor-mounted-on-deep-argo-floats/	NOAA, University of California San Diego, Sea-Bird Scientific	Zilberman, Nathalie	University of California San Diego	3	2018
Development of Drifting Buoys to Measure Dynamic Ocean Topography and Precipitable Water Vapor	https://nopp.org/projects/development-of-drifting-buoys-to-measure-dynamic-ocean-topography-and-precipitable-water-vapor/	NSF, NOAA, NASA, University of Washington	Morison, James	University of Washington	3*	2018
Dissolved Methane Sensor	https://nopp.org/projects/dissolved-methane-sensor/	NSF, NOAA, Woods Hole Oceanographic Institution RingIR Inc., National Academy of Sciences	Michel, Anna	Woods Hole Oceanographic Institution	3*	2018
Development of a Carbon Seaglider for ocean acidification Monitoring and Inorganic Carbon Processes Studies	https://nopp.org/projects/development-of-a-carbon-seaglider-for-ocean-acidification-monitoring-and-inorganic-carbon-processes-studies/	NSF, University of Alaska Fairbanks, Alutiiq Pride Shellfish Hatchery, Kongsberg Underwater Technology	Hauri, Claudine	University of Alaska Fairbanks	3*	2018

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Minions: A Low-cost Float for Distributed, Lagrangian Observations of the biological Carbon Pump	https://nopp.org/projects/minions-a-low-cost-float-for-distributed-langrangian-observations-of-the-biological-carbon-pump/	NSF, NASA, University of Rhode Island, Monterey Bay Aquarium Research Institute, Massachusetts Institute of Technology, Woods Hole Oceanographic Institution, Universities Space Research Association	Omand, Melissa	University of Rhode Island	3*	2018
Spray 2.0: Development and technology transition of a next-generation underwater glider	https://nopp.org/projects/spray-2-0-development-and-technology-transition-of-a-next-generation-underwater-glider/	NSF, University of California San Diego, Marine Robotic Vehicles	Rudnick, Daniel	University of California, San Diego	2*	2018
Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS)	https://nopp.org/projects/gommapps/	BOEM, NOAA, USGS, U.S. Fish and Wildlife Service	Damour, Melanie J.	Bureau of Ocean Energy Management	4	2017
Deepwater Atlantic Habitats II: Continued Atlantic Research and Exploration in Deepwater Ecosystems with Focus on Coral, Canyon, and Seep Communities (DEEP Search)	https://nopp.org/projects/deep-search/	BOEM, NOAA, USGS, Temple University, TDI Brooks International, University of Georgia, Nova Southeastern University, Florida State University, University of New Hampshire, Harvey Mudd College, Netherlands Institute of Sea Research	Cordes, Erik	Temple University	5	2017

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Atlantic Deepwater Ecosystem Observatory Network (ADEON) - An Integrated System	https://nopp.org/projects/adeon/	BOEM, ONR, NOAA, University of New Hampshire, TNO, JASCO, Stony Brook University, Applied Ocean Sciences	Miksis-Olds, Jennifer	University of New Hampshire	5**	2016

* - These projects received no cost extension due to unforeseen COVID circumstances.

** - This project is complete. ADEON met objectives for being transferable/relocatable with infrastructure, best practices, and analysis approaches and has been deployed in the Gulf of Maine as the Acoustic and Environmental Observation Network (AEON). Best practices developed under ADEON are being adopted by other groups including the Regional Wildlife Science Collaborative for Offshore Wind (RWSC).

Acronyms

AMBON	Arctic MBON
BAA	Broad Agency Announcement
BOEM	Bureau of Ocean Energy Management
CEQ	Council on Environmental Quality
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EASE-OA	Electrochemical Acid Sequestration to Ease Ocean Acidification
EPA	Environmental Protection Agency
FY	Fiscal Year
GO-SHIP	Global Ocean Ship-based Hydrographic Investigations Program
IWG	Interagency Working Group
ISS	Integrated Systems Solutions, Inc.
MBON	Marine Biodiversity Observation Network
mCDR	marine Carbon Dioxide Removal
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NSF	National Science Foundation
OASIS	Offshore Analysis of Seafloor Instability and Sediments
ONR	Office of Naval Research
OPC	Ocean Policy Committee
OST	Ocean Science and Technology Subcommittee
OSTP	Office of Science and Technology Policy
PI	Principal Investigator
ProTech	Professional, Scientific, and Technical Services Program
SOST	Subcommittee on Ocean Science and Technology
USCG	United States Coast Guard
USGS	United States Geological Survey
US IOOS	US Integrated Ocean Observing System