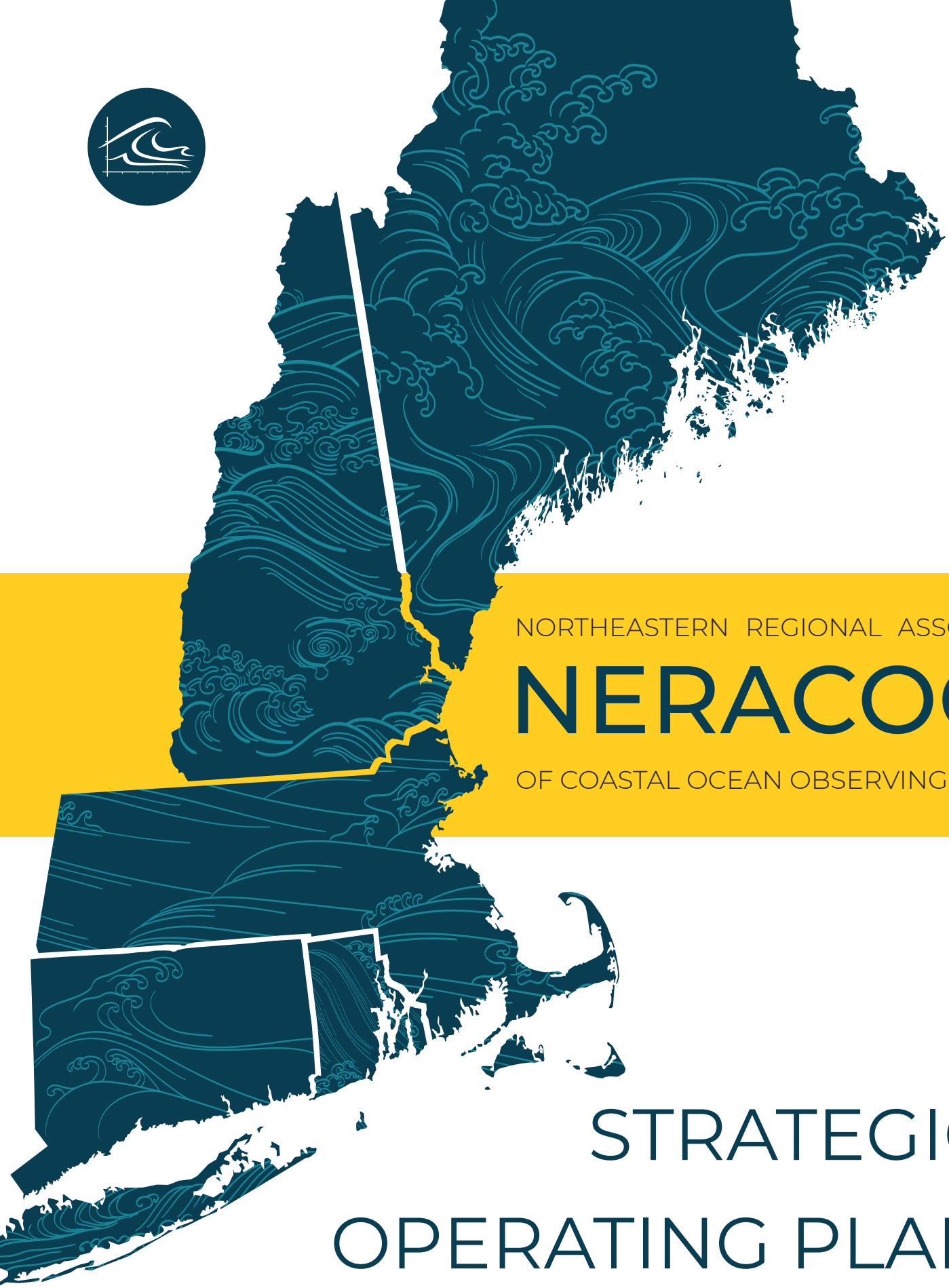


NORTHEASTERN REGIONAL ASSOCIATION

NERACOOS

OF COASTAL OCEAN OBSERVING SYSTEMS

STRATEGIC OPERATING PLAN 2022

“In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed.”

Charles Darwin (1809 - 1882)

Table of Contents

1 NERACOOS Strategic Operating Plan

1.1 Background and Context

Initial sustained ocean observing capacity was established in the late 1990s and early 2000's through sub-regional pilot programs included the Long Island Sound Coastal Observing System (LISICOS), the Gulf of Maine Ocean Observing System (GoMOOS), and the UNH center for Coastal Ocean Observation and Analysis (COOA). NERACOOS was incorporated as an independent, 501-c3 nonprofit organization in the fall of 2008 after a multiyear governance planning process. Over the past decade NERACOOS has evolved these sub-regional systems into a more integrated and effective regional observing system.

To achieve this goal NERACOOS uses an integrated system design comprised of several subsystems, these include governance and management, data management and cyberinfrastructure, modeling and analysis, and an observing system composed of fixed platforms, mobile platforms, and remote sensing.

It's the desired outcome of NERACOOS that the resulting operational observing system is the largest regional provider of publicly available continuous real-time ocean information in the Northeast that is relied upon by those using and managing the coastal ocean.

1.1.1 Goals and Objectives

We believe that everybody should have the information they need to advance resilient communities, economies & marine ecosystems. To that end, we serve people by creating, organizing, and sharing information about the ocean. We work in ways that are science-based, policy-neutral, and collaborative as we strive to meet the needs of ocean-reliant communities.

NERACOOS partners and users identified two strategic priorities of particular importance that will shape the execution of this Plan:

1. Our observing activities and infrastructure must keep pace with accelerating climate change, the effects of which are already being felt throughout the Northeast.
2. We must be attentive to the principles of Diversity, Equity, Inclusion, and Accessibility (DEIA), ensuring that we serve all people in the region who are connected to the ocean.

These issues will be touchstones that guide many of the actions we take to achieve our vision of communities, economies, and marine ecosystems made more productive and resilient through access to ocean information.

The NERACOOS Strategic Priorities include:

- Sustain and modernize the ocean observing system.
    - Strengthen the buoy network through sensor upgrades and full

mooring replacements.
    - Collaboratively develop strategies for expanded use of gliders and other autonomous observing tools, and improved mapping of surface currents throughout the region.
    - Maintain and diversify ocean modeling activities to meet evolving end-user needs.
    - Capitalize on innovations in sensor technologies, artificial intelligence, machine learning, Big Data, and other tools that can improve the resolution and reliability of the observing system.
- Provide reliable and accessible ocean data.
    - Implement updated data management guidelines as a NOAA Certified Regional Information Coordination Entity, maintaining high standards and best practices.
    - Improve the delivery of observations and model outputs by upgrading existing data products and developing new products informed by community needs.
    - Expand discoverability and accessibility of data through online interfaces and outreach to users.
- Develop new tools and networks to meet the challenges nearshore environments are facing.
    - Support upgrades and new deployments of water quality and water level sensors, particularly to benefit underserved communities.
    - Establish a regional community of practice on water level monitoring to share experiences and prioritize deployment of new stations.
    - Develop and launch new products providing real-time water quality and water level data, including integrated forecasts and alerts.
- Expand partnerships and activities focused on marine life and habitats.
    - Promote discoverability, integration, and application of plankton data through a centralized web platform.
    - Sustain and expand the geographic and temporal scope of Harmful Algal Bloom (HAB) prediction, detection, and tracking capabilities in the Northeast region, including direct monitoring of HABs and the key environmental drivers.
    - Sustain and expand established programs to understand dynamics of pelagic ecosystems, while initiating parallel programs in other marine ecosystems, consistent with the objectives of the Integrated Sentinel Monitoring Network.
    - Leverage partnerships with nearshore and ocean management areas to establish sentinel sites in a variety of marine environments for tracking effects of climate change.
    - Develop and implement strategies for deployment of new biological observing technologies, including passive acoustics, genomics, ocean carbon accounting, and animal tracking.
- Engage with people to understand their needs and communicate

our work.

- Deepen understanding of how best to serve current and future users of ocean observing information, especially emerging industries such as offshore wind energy, offshore aquaculture, and other users who will be affected by industry growth.
- Coordinate and lead regional initiatives that fulfill stakeholder needs, such as the Northeast Coastal Acidification Network and the Ocean Acidification Information Exchange.
- Increase awareness of conditions by communicating observations, weather events, climate impacts, and other important changes in the ocean to ensure emergency services and the public are informed and safe.
- Audit engagement efforts and work to fill identified gaps in partnerships, services, and products.
- Support the efforts of educators who are bringing information from ocean observing systems into learning spaces.

The strategic priorities are reviewed and updated every three years to ensure they are in alignment with the needs of the organization, stakeholder priorities, as well as emerging regional and national priorities.

1.2 Governance & Management Subsystem

NERACOOS is governed by a Board of Directors with a mandated broad and balanced membership. Established as an office in 2009, NERACOOS has successfully managed multiple multi-million-dollar grants and is currently staffed by seven employees.

NERACOOS provides highly valued data and services to a multitude of users, including the U.S. Coast Guard, National Weather Service forecasters, managers, mariners, scientists, engineers and developers, commercial and recreational fishers, formal and informal educators, and many more.

1.2.1 Engagement, Planning, Prioritization, and Evaluation

Implementation of the observing system is informed by the ongoing multi-faceted stakeholder engagement process that identifies end-user needs and more broadly how NERACOOS addresses four primary themes, including:

1. Marine operations,
2. Coastal hazards,
3. Ecosystems, fisheries and water quality, and
4. Climate variability and change.

Engagement of key users was built into the initial governance structure with Directors derived from state government, industry, and academic organizations. The NERACOOS team brings together stakeholders from various sectors to create and implement plans and priorities. Additionally, staff members regularly attend

meetings and conferences to further understand user needs and to communicate activities. NERACOOS also helps coordinate and lead regional initiatives such as the Integrated Sentinel Monitoring Network (ISMN) and the Northeast Coastal Acidification Network (NECAN). NERACOOS and the Northeast Regional Ocean Council (NROC) have developed two joint working groups, one on Ocean and Coastal Ecosystem Health (OCEH) and another on Coastal Hazards Resiliency. The website, newsletters, social media, and an Annual Report communicate programs and document success. Collaboration through the IOOS Outreach Committee leverages expertise in outreach and communications. National collaboration is achieved through involvement with the IOOS Association and IOOS Office. Binational collaboration with Canada is facilitated through the Gulf of Maine Council (GOMC, Kritzer is a councilor) and Canadian Coastal Ocean Observing System Atlantic (CIOOS, Motyka is an Advisory).

The process of collecting user requirements for the observing system has been a cumulative and iterative process that seeks feedback and input from users. NERACOOS first identified key needs and priorities for ocean observing in 2010 through the Regional Planning Initiative which engaged experts from state and federal agencies, private sector academia and NGOs. This process results in a set of regional priorities which were further vetted and refined, most recently in 2020 in preparation of the IOOS five-year proposal completed in December 2020.

1.2.2 Five-year proposal process

For preparation of the main five-year proposal for the U.S. IOOS Office the NERACOOS Board forms an oversight committee of un-conflicted Directors to monitor and assess the process developed and implemented by staff and ensure its openness and transparency, as well as to evaluate the performance of existing CO-PI's. The overall process consists of a formal stakeholder engagement process to identify priority needs and gaps, an open call for mini-proposals based on these priorities, and then mini-proposal review by unconflicted board members. The result is a prioritized set of integrated projects that are then reviewed by the Executive Director and a final slate of projects is selected for inclusion. The 2020 final proposal has been made available online.[1]

1.2.3 Annual planning process

The annual planning process is an extension of the stakeholder engagement and system evaluation process which aligns the scope of work, financial revenue, and observing priorities as informed by the IOOS five-year proposal. These priorities are assessed each year to reflect new needs or initiatives identified by the ongoing and multifaceted stakeholder engagement process described above. The annual work plan, as reflected in the descoped documentation submitted annually to NOAA IOOS

[1] See links to proposals at http://www.neracoos.org/governance/

Program Office, and is constructed by NERACOOS staff, and approved by the Executive Director.

Additional efforts may be supported through funds raised from other sources such other Federal and foundation grants as well as through membership contributions or philanthropic donations. Information regarding the NERACOOS membership[2] program are available on the NERACOOS website.

1.2.4 Evaluation of individual(s) and partners

The Board of Directors is responsible for hiring and evaluating the Executive Director. The Executive Director is responsible for hiring all other NERACOOS staff.

It is the policy of NERACOOS that all positions be filled by fully qualified people who have been examined based on job-related criteria. All hiring shall be made based on organizational need, individual ability, and the Equal Opportunity Policy. Candidates must meet the minimum qualifications for the position.

The Executive Director may form an ad hoc hiring committee to assist in the hiring process. Hiring committees may be responsible for screening applications, checking references, conducting interviews, and making hiring recommendations. The authority of final selection shall remain with the Executive Director.

The work of each NERACOOS employee is reviewed continuously with the supervisor to provide a systematic means of evaluating performance. In addition, NERACOOS follows a formal annual performance appraisal process, which is overseen by the Finance Director. This process includes an individual review of performance by both an individual and their direct supervisor, as well as a formal in person review of these responses. This information is then compiled, reviewed, and signed by both participants, and submitted to the Finance Director.

Each of the partner organizations that employ individuals responsible for observations systems management have a similarly robust hiring and annual performance appraisals.

NERACOOS regularly monitors and evaluates its partners, subawardees, and/or contractors who perform tasks as part of the operations of the observing system. In choosing partners to work on projects, NERACOOS and the Board oversight committee, as referenced above, also review past performance of funded partners to ensure performance is satisfactory.

NERACOOS further evaluates the system by; 1) soliciting user feedback through periodic on-line surveys that are announced at the NERACOOS website; 2) assessing use of NERACOOS assets through analytics on the NERACOOS website and other sites that also distribute the data such as NDBC; 3) assessments of funded partners to assure they are meeting performance metrics; and 4) through partner

[2] See NERACOOS Membership Program http://www.neracoos.org/governance/

performance against established milestones as reported by the partner through biannual progress reports.

1.2.5 Strategy to Sustain and Enhance the System

As discussed above the organization goes through an assessment every five years in preparation of the five-year proposal to the U.S. IOOS Office. A critical component of this process is assessing the existing observing system, considering opportunities for enhancements and upgrades, as well as new activities that should be included for inclusion. NERACOOS works closely with partners to seek complementary support to evolve and enhance the observing system as informed by a review of the Regional Build-out Plan[3] (RBOP) and asset inventory[4].

1.2.5.1 Connection to the Regional Build-out Plan

NERACOOS initially developed a RBOP in 2011, since then this Plan has evolved and been updated to include regional priorities and gaps as informed by stakeholder needs and the five-year proposal to IOOS. The RBOP acts as a roadmap for the organization, connecting needs with technologies.

1.3 Observing Subsystems

The Northeast observing system is composed of four primary subsystems, which include: governance and management, data management and cyberinfrastructure, modeling and analysis, and an observing system composed of fixed platforms, mobile platforms, and remote sensing. The sustained activities of each subsystem are detailed subsequently.

The overall governance and management are implemented by the NERACOOS office, while the other subsystems are implemented by collaborators through a competitive process administered every five years. These collaborators are grouped into two categories, subrecipients and contractors. Generally, subrecipients are CO-PI's on the NERACOOS five-year IOOS proposal and are actively engaged in the regional development of the observing system (listed in table 1). Comparatively, contractors are hired to fulfill a specific scope of work (listed in table 2). NERACOOS' contribution to operations and maintenance for each component of the observing system has been included for year two of the current five-year cooperative agreement below, although additional details may be requested by NOAA.

PARTNER	CONTRIBUTION	YEAR 2 OPERATING & MAINTENANCE COST
UNIVERSITY OF MAINE	Observing: fixed platform & remote sensing	$790,065
UNIVERSITY OF NEW HAMPSHIRE	Observing: fixed platform	$135,000

[3] See RBOP at www.neracoos.org/governance/

[4] See Asset Inventory at www.neracoos.org/governance/

WOODS HOLE OCEANOGRAPHIC INSTITUTION	Observing: mobile platform & remote sensing	$207,230
UNIVERSITY OF RHODE ISLAND	Observing: fixed platform	$59,999
UNIVERSITY OF CONNECTICUT	Observing: fixed platform Modeling & analysis	$325,000
GULF OF MAINE RESEARCH INSTITUTE	Data management & cyberinfrastructure	$137,654
BEDFORD INSTITUTE OF OCEANOGRAPHY	Modeling & analysis	$20,000
UNIVERSITY OF MASSACHUSETTS, DARTMOUTH	Modeling & analysis	$120,000

Table 1: *NERACOOS subaward recipients on the IOOS five-year award are included above, as well as their specific contribution to the observing system and the associated operations and maintenance cost in year two of the current five-year cooperative agreement with IOOS contributed by NERACOOS.*

PARTNER	CONTRIBUTION	YEAR 2 OPERATING & MAINTENANCE COST
U.S. GEOLOGICAL SURVEY: MAINE	Observing: fixed platform	$15,000
CHARYBDIS GROUP	Observing: fixed platform	$21,500
WOODS HOLE GROUP	Observing: fixed platform	$73,148

Table 2: *NERACOOS contractors on the IOOS five-year award are included above, as well as their specific contribution to the observing system and the associated operations and maintenance cost in year two of the current five-year cooperative agreement with IOOS contributed by NERACOOS.*

1.3.1 Calibrating, validating, operating, and maintaining equipment

All equipment purchased through NERACOOS is owned and operated by external subcontractors. Through subaward agreements, these subcontractors certify that, 1) they follow manufacturers' guidelines and industry best practices for equipment maintenance and operation (including calibration); and 2) they will make equipment maintenance documentation available to NERACOOS upon request.

1.3.2 Maintaining equipment inventories, shipping, and instrument logs

All equipment purchased for NERACOOS activities is owned and managed by the partner organization. All academic organizations purchase, manage, and dispose of equipment in compliance with section § 200.313 Equipment of 2 CFR Part 215 – Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals, and Other Non-profit Organizations. This requires that property records are maintained including a description and serial number, a physical inventory taken at least every two years and that it is reconciled with

records, control systems are developed to ensure adequate safeguards to prevent loss, damage, or theft of the property, and that maintenance procedures must be developed to keep the property in good condition.

All equipment is the responsibility of the individual co-PI charged with operating the equipment. In accordance with NERACOOS inventory management best practices, each co-PI maintains digital records of equipment performance, history, location, and utilization, including but not limited to: a) instrument deployment details (location, date/time, status, data frequency); b) service records (date, repair reason, calibration coefficients); c) instrument location, including shipping logs (deployed, in-transit, in lab); d) instrument serial number; and e) instrument insurance records (including current value and replacement cost).

1.3.3 Fixed platforms

BUOYS: NERACOOS has managed a regional observing system by building on assets and experienced pilot programs (Figure 1). Multipurpose moorings, measuring surface and subsurface properties, form the system's backbone. These are cost-effective platforms (less than half the operational cost of a 24/7 glider line) capable of carrying large sensor payloads and able to resolve temporal scales of variability. The return on investment for moorings is arguably higher than any other platform as their information is used by all ocean use sectors from harbor pilots to ecosystem scientists and managers.

Offshore: Seven moorings in the GoM supported by NERACOOS (Pettigrew et al., 2011) carry meteorological sensors similar to National Data Buoy Center (NDBC) buoys and additional sensors for atmospheric visibility, surface currents, water-column current profiles, temperature and conductivity, fluorescence (for "chlorophyll a" estimation), and backscatter at multiple depths. Additional separately funded sensors, such as receivers for fish tracking (NMFS) and bats sensors (Stantec), have been added to most buoys, contributing to the national telemetry network. Two deep water buoys are located in Jordan Basin and five coastal buoys are strategically located along the coast from Maine to Massachusetts. The mooring within Massachusetts Bay, supported with contributions from the Massachusetts Water Resources Authority (MWRA), addresses water quality concerns in the densely populated region around Boston, MA and includes additional sensors such as dissolved oxygen. Three Coastal Data Information Program (CDIP) wave buoys located on Jeffreys Ledge, Cape Cod Bay, and Buzzards Bay provide detailed wave measurements. The NOAA Ocean Acidification Program (OAP) funds an OCA mooring off the Isles of Shoals which has provided atmospheric and in-water pCO_2 time-series measurements since 2005.

Nearshore & Estuarine: In Long Island Sound (LIS), NERACOOS supports three moorings that measure wind speed and direction, salinity, conductivity, temperature, pressure, currents, and dissolved oxygen near the surface, bottom and mid-depth supporting hypoxia monitoring and research used by both

Environmental Protection Agency (EPA) Long Island Sound Study (LISS) and CT Department of Energy and Environmental Protections (DEEP). NERACOOS also funds a highly instrumented mooring in Great Bay, NH during ice-free months. Mooring stations of the Narragansett Bay Fixed Site Monitoring Network (NBFSMN) have been integrated into the NERACOOS data management framework. Such work has advanced knowledge of water clarity and water quality for protecting critical habitats.

OTHER FIXED PLATFORMS: Tide gauges in Scituate and Gloucester, MA, Hampton, NH, and Camp Ellis, ME provide water level information which helps validate models and is essential for emergency managers. Additionally, NERACOOS supports two coastal monitoring stations: one located at the University of Rhode Island, Graduate School of Oceanography dock monitoring coastal nutrient conditions; and one located at the University of New Hampshire's Coastal Marine Laboratory, located at the mouth of the estuary to monitor water quality and carbonate parameters.

1.3.4 Mobile Platforms

GLIDERS: Since Dec. 2019 NERACOOS has supported an operational passive acoustic glider line for the near real-time detection of baleen whales from mid-coast Maine to Cape Cod Massachusetts.

1.3.5 Remote sensing

SATELLITE-BASED: High-resolution (1km) satellite data provides the only complete coverage of the entire NERACOOS region for any ocean variable, is an operational, ongoing, consistently processed, unbroken time series extending back over 30 and 17 years (for Sea Surface Temperature, SST, and color respectively).

HIGH-FREQUENCY RADAR: As part of the national surface current mapping plan, NERACOOS operates a High Frequency Radar (HFR) network at three locations in the eastern GoM. These data are ingested by the US Coast Guard (USCG) Environmental Data Server (EDS) for search and rescue. Satellite tracked drifters and bottom current meters via NOAA Environmental Monitors on Lobster Traps (eMOLT) program help to validate HFR data and surface current models.

The NERACOOS observing system compliments other US and Canadian federally funded observations and fills critical gaps in capacity (see details in Figure 2).

1.4 Data Management & Cyberinfrastructure Subsystem

The backbone of the Data Assembly Center for the Northeast is a standards-based Data Management Framework[5] developed and implemented by NERACOOS DMAC (GMRI). The NERACOOS Data System (NDS) is a framework for aggregation, interoperability, discovery and dissemination of observing data (gridded and observational) from the region. The NDS leverages over twenty years of open-source

[5] See DMF at http://neracoos.org/documents

software development and data management expertise by the GMRI team and is based on the suite of standards and best practices developed, tested and recommended by IOOS and the greater IOOS RA DMAC community. The NDS provides the mechanisms and protocols for the full data life cycle by integrating, aggregating and distributing data through a centralized access portal (NERACOOS.org). Following the DMAC Guiding Principles, the NDS provides the core capacity that connects and integrates observations and forecasts, making quality-controlled data discoverable and accessible to stakeholders through a wide variety of information products.

In the majority of cases, data are acquired directly from data providers by connecting to standards-based storage systems through automated protocols using webservices and APIs (application programming interface). The majority of NERACOOS data providers have implemented standards-based data storage platforms (e.g., THREDDS: Thematic real-time Environmental Distributed Data Services, or ERDDAP) to make data available. Using this approach, data providers are able to store and make available the highest quality data, reducing redundance and replication and providing direct access to end-users. The NERACOOS DMAC team works closely with the data providers to transform observation data and metadata into compliant formats that conform to data and quality control standards and protocols. As a result, the data managed and curated through the NDS are more interoperable and can be aggregated in region-wide products, though the data are served from distributed systems. All the available datasets have been registered with the IOOS Catalog since its inception and are also exposed to the catalog crawler through search-engine friendly Web Accessible Folders (WAF). For data providers lacking bandwidth or capacity to serve data reliably or in compliant formats, the NDS also has the capacity to ingest, apply standards, store, and serve these data through the NERACOOS system. The data access services available through the NDS enables end users to access data directly and programmatically. The protocols and services of the NDS provide a roadmap to integrate new data providers quickly and efficiently (Figure 1) [6].

[6] See DMF and Data Management Plan at http://neracoos.org/governance/

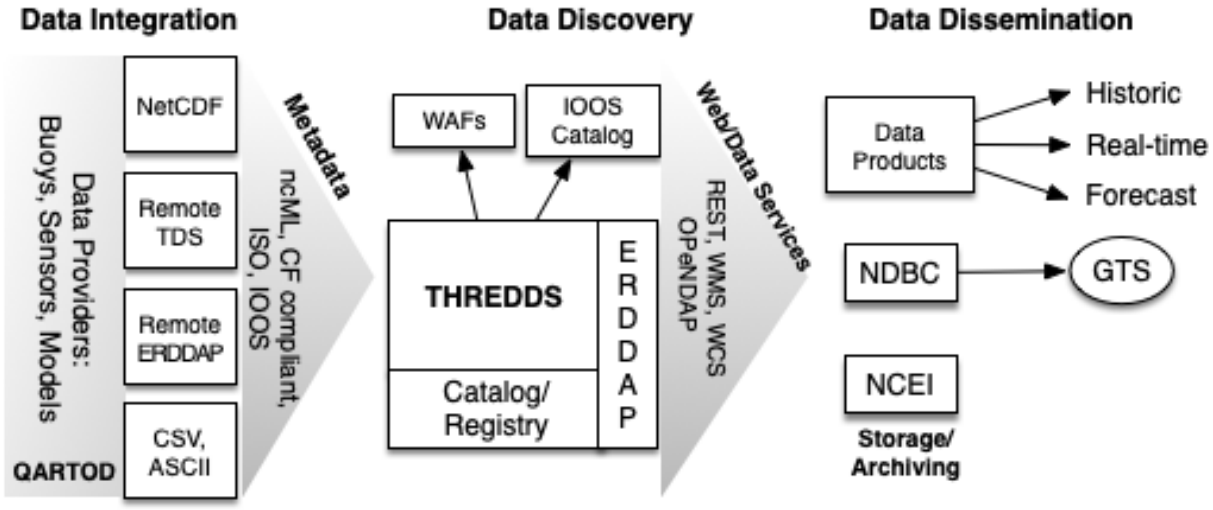


Figure 1: NERACOOS DAC schematic. The data managed and curated through the NDS are interoperable and aggregated in region-wide products, though the data are served from distributed systems. The protocols and services of the NDS provide a roadmap to integrate new data providers quickly and efficiently.

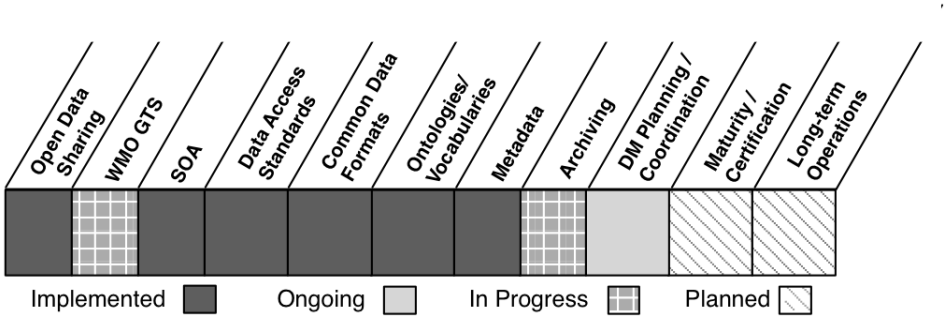


Figure 2: Status of Implementation of DMAC Subsystem Guiding Principles.

The NDS is entirely cloud based, deployed on an Amazon Web Services Virtual Private Cloud environment composed of dedicated EC2 instances, S3 storage, and an infrastructure of managed containerized services. The system is backed up nightly, preserving the data, software and configuration of the instances and services for guaranteed disaster recovery. NERACOOS has used a cloud-based system since 2014. The flexibility of a cloud-based infrastructure has made managing the system more efficient by saving costs and making it easier to scale the system and upgrade hardware and software as the NDS evolves.

The NERACOOS DMAC team has been able to implement, manage, and evolve the NDS, following best practices and fully or partially adopt most of the DMAC Subsystem Guiding Principles put forward by NOAA and IOOS.

1.5 Modeling & Analysis Subsystem

NERACOOS developed the Northeast Coastal Ocean Forecast System (NECOFS) as a state-of-the-art “end-to-end” model system to produce accurate forecasts of the coastal ocean. Since 2008, NECOFS has made daily experimental forecasts of surface atmospheric forcing, water elevation, and 3-D currents and water properties (temperature and salinity) from central New Jersey to the eastern end of the Nova Scotian Shelf. The core of this system is the Finite-Volume Coastal Ocean Model (FVCOM) (Chen et al. 2003, 2006a, 2006b), which features an unstructured triangular grid in the horizontal and a generalized terrain-following coordinate in the vertical. NECOFS includes the NOAA/NCAR Weather Research and Forecast (WRF) mesoscale weather model and added (1) an unstructured-grid version of the Simulating WAves Nearshore (SWAN) surface wave model (SWAVE) (Qi et al. 2009), (2) modules for wave-current interaction, runup, and overtopping, (3) methods for seamless nesting of higher resolution coastal inundation forecast subdomains, and (4) updated the regional model grid. The WRF output is used to drive SWAVE and FVCOM-GOM4, which are both used to drive the higher-resolution domains. Data critical to initializing the models include National Centers for Environmental Prediction (NCEP) model, ocean tidal and WAVEWATCH III (WW3) forcing, satellite SST and radiation, river discharge, NOAA, NDBC buoys and shore stations, and NERACOOS observations. Forecasts including ship icing potential are also provided to local NWS WFOs in their preferred format.

A state-of-the-art surface wave model system also makes high-resolution accurate 2-day forecasts for marine operations and safety, especially during storms. This model system is based on the NOAA NCEP operational WW3 system, using efficient fine-resolution computational grids in the NERACOOS region, the latest physics parameterizations for wind input, wave dissipation, and related wave processes, and operational NCEP products as input. Since 2008, model forecast runs have been made four times a day and disseminated through NERACOOS.

Additionally, as part of national surface current mapping, NERACOOS operates the national Short Term Prediction System (STPS) providing HFR surface current forecasts to the USCG EDS for search and rescue.

1.6 Key RICE Personnel

Key RICE Personnel includes those responsible for overall RICE Management and Observation System Management. Each of these individuals have been identified in

table X below. A corresponding CV for each key personnel is available on the NERACOOS website[7].

Individuals	Institution	Role
Jake Kritzer	NERACOOS	RICE Management
Jackie Motyka	NERACOOS	Observation System Management
Neal Pettigrew	University of Maine	Observation System Management, Buoy Observations
James O'Donnell	University of Connecticut	Observation System Management, Buoy Observations
Doug Vandermark	University of New Hampshire	Observation System Management, Buoy Observations and Coastal Station
Andrew Thomas	University of Maine	Observation System Management, Satellite Images
Anthony Kirincich	Woods Hole Oceanographic Institution	Observation System Management, High-Frequency Radar
Mark Baumgartner	Woods Hole Oceanographic Institution	Observation System Management, Glider Observations
Francesco Peri	Charybdis Group, LLC.	Observation System Management, Water Level Stations
David Walsh	Woods Hole Group	Observation System Management, Buoy Observations and Coastal Station
Tom Shyka	NERACOOS	Data Management
Riley Young Morse	Gulf of Maine Research Institute	Data Management
Alex Kerney	Gulf of Maine Research Institute	Data Management
Dylan Pugh	Gulf of Maine Research Institute	Data Management

Table 3. *RICE key personnel are identified above, as well as their organizational affiliation and role within the RICE.*

1.6.1 Overall RICE Management

Jake Kritzer is the lead NERACOOS Principal Investigator and NERACOOS Executive Director. Jake is responsible for responsible for organizational budgets and operations, vision, workplans, and oversight of the regional observing system.

1.6.2 Observations System Management

Observing System Management:

Jackie Motyka is the NERACOOS Operations Manager. Jackie oversees the regional observing system, including NEPA environmental compliance.

[7] See NERACOOS Key RICE Personnel CV's http://www.neracoos.org/governance/

Neal R. Pettigrew is a Professor of Oceanography at the University of Maine. Neal is responsible for the operation and maintenance of seven buoys in the Gulf of Maine.

James O'Donnell is a Professor at the University of Connecticut School of Marine Sciences. He is responsible for the operation and maintenance of three buoys in Long Island Sound.

Doug Vandermark is a Research Professor at the University of New Hampshire. Doug is responsible for the operation and maintenance of the Great Bay buoy, the CO_2 buoy, the CDIP Jeffrey's Ledge Buoy, and the Coastal Marine Laboratory.

Andrew Thomas is a Professor of Oceanography at the University of Maine. Andrew is responsible for processing and delivering satellite data within the NERACOOS observing system.

Anthony Kirincich is an Associate Scientist with Tenure at the Woods Hole Oceanographic Institution. Anthony is responsible for the operation and maintenance of four high frequency radar stations throughout the Gulf of Maine (Gloucester, MA, Provincetown, MA, Salisbury, MA, and Scituate, MA).

Mark Baumgartner is a Senior Scientist at the Woods Hole Oceanographic Institution. Mark is responsible for the operation and maintenance of a passive acoustic glider in the Gulf of Maine.

Francesco Peri is President and CEO of Charybdis Group, LLC. Francesco is responsible for the operation and maintenance of three tide gauge stations (Hampton, NH, Gloucester, MA, and Scituate, MA).

David Walsh is a Senior Project Manager/Coastal Scientist at Woods Hole Group. David is responsible for the operation and maintenance of two CDIP buoys (Cape Cod Bay and Buzzards Bay), as well as a current profiler in Buzzards Bay).

Data Management System Management:

Tom Shyka is the NERACOOS Product & Engagement Manager. Tom oversees the regional data management system.

Riley Young-Morse is the Senior Program Manager of the Gulf of Maine Research Institute's Ocean Data Products team. Riley and her team at GMRI implement and adapt web-based information technologies in support of data discovery, access and integration for marine and coastal data.

Alex Kerney is a Web Developer at the Gulf of Maine Research Institute. Alex specializes in development of data driven applications, time series and gridded data visualization, data API development, and container-based application deployment and data infrastructures.

Dylan Pugh is a Web Developer at the Gulf of Maine Research Institute. Dylan leads the data integration work to ensure continuous real-time integration of data from regional data providers, and implementation of IOOS standards and practices for integration into ERDDAP and NDBC (IOOS metadata, compliance checker, QARTOD).

1.7 Budget Plan

1.7.1 Financial Supporters

NERACOOS is primarily funded by NOAA through the U.S. IOOS Program, although additional support is received annually from federal and non-federal sources. In fiscal year 2021, which ended September 30, 2021 the organizational revenue was $3.84 million, of which 99.3% of funds originating from federal sources (figure X).

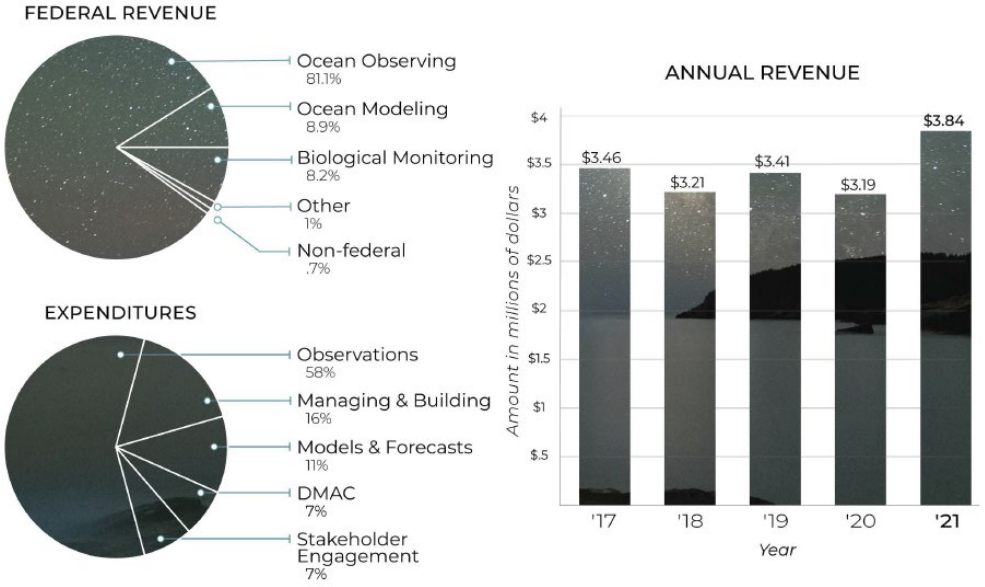


Figure 3. *A summary of NERACOOS financials as of September 30, 2021. The amounts reported above are derived from unaudited financial statements.*

Maintaining revenue streams from diverse partners is critical for NERACOOS' long-term success. Funds from these sources, including a small amount from our membership program, allow NERACOOS to strategically expand our system and provide new products and data to our users as informed through our engagement and RBOP as discussed above. A list of the current federal awards to NERACOOS are included below (table 4).

Award #	Funding Agency	Award Period
NA16NOS0120023	Integrated Ocean Observations Systems	6/1/2016 – 11/30/2022
NA16NOS0120023	Integrated Ocean Observations Systems	7/1/2021 - 6/30/2026
NA18NOS0120156	Integrated Ocean Observations Systems	9/1/2018 - 8/31/2022
NA18NOS4780178	Ocean Acidification Program National Centers for Coastal Ocean Science	9/1/2018 - 8/31/2022

NA19NOS0120197	Integrated Ocean Observations Systems	9/1/2019 - 8/31/2023
N000142012560	Office of Naval Research	6/2/2020 – 06/1/2023
NA22OAR4310557	Climate Program Office	9/1/2022 – 8/31/2025

Table 4. *A list of NERACOOS awards received from the federal government are included above.*

1.7.2 Funding Constraints

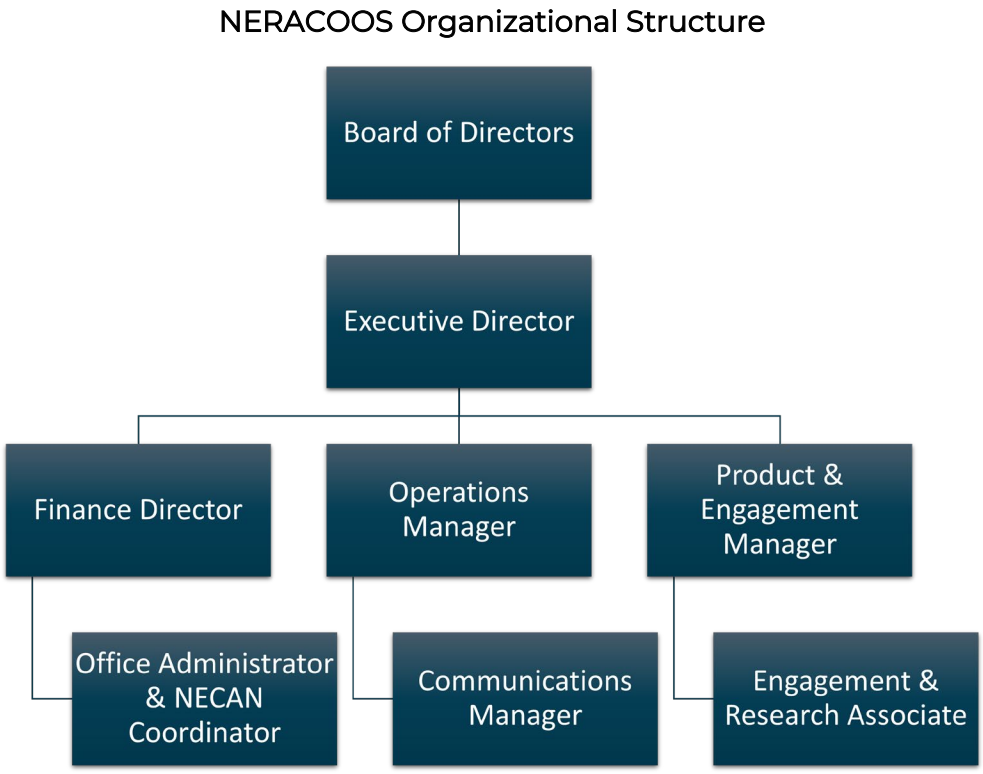
Moving forward, NERACOOS needs significant, sustained, and consistent annual financial support to provide for basic operations (system maintenance, upgrades and replacement of assets, salary support for personnel, etc.) as well as to allow for successful execution of our strategic initiatives.

For the foreseeable future, NERACOOS expects that the IOOS Office will be our primary source of income. We will continue to seek out and obtain funding from other partners, while at the same time working with elected officials, Federal agency personnel, and members of the IOOS community to sustain and grow support for the IOOS Program within the Federal budget process.

NERACOOS is currently supported by grants, cooperative agreements, membership dues, funds raised by partner organizations that leverage NERACOOS support (leveraged funds), and direct contributions from partner organizations.

2 Appendices

2.1 Appendix I: Organizational Structure



NERACOOS was established as an independent, 501(c)(3) nonprofit organization in 2008. NERACOOS is governed by a Board of Directors with standing Executive, Finance and Nominations subcommittees. The NERACOOS Board of Directors is responsible for the overall operations of the Corporation and complies with its adopted Bylaws (November 13, 2008).

The Executive Director is responsible for the day-to-day business activities of the Corporation and to support the Board, Teams, and Working Groups. The office is responsible for management of awards to NERACOOS including subaward management and reporting to funding agencies. The Executive Director is a full-time position, is not a member of the Board, and is the Principal Investigator of many NERACOOS proposals. The rest if the NERACOOS staff assists the Executive Director, as well as members of the Board, Teams, and Working Groups, employee positions include: Finance Director (a full-time position), Operations Manager (a full-time position), Product & Engagement Manager (a part-time position), NECAN Coordinator & NERACOOS Administrator (a full-time position), Engagement & Research Association (a part-time position), and Communications Manager (a full-time position).

Plans and priorities are developed for NERACOOS as advised by the Strategic Plan and Board of Directors, which has been constituted to reflect the geographic range of the region and the diverse needs for ocean observations.

NERACOOS' financial administration is led by the Finance Director. The Finance Director leads and conducts the Financial Management Services for NERACOOS including regular bookkeeping (payables, receivables, and payroll account services), consultation on financial matters, financial report preparation including those for Board meetings and as required by funding agencies including NOAA and other Federal agencies, support for the annual audit including preparation of documents and consultation with the auditors, and preparation of the annual Indirect Cost Proposal for submission to the Department of Commerce.