MID-ATLANTIC COASTAL OCEAN OBSERVING REGIONAL ASSOCIATION (MACOORA): A 501 (c) (3) Non-Profit Corporation

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Proposed Title: Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA)

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Project Summary

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Brief Project Summary: The Integrated Ocean Observing System Development Plan (OceanUS, 2006) calls for an integrated system of observations that support national and regional priorities. The Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) is one of eleven Regional Associations (RAs) within the U.S. Integrated Ocean Observing System (IOOS). Its footprint encompasses 9 states with 66 million people and five major estuaries. MACOORA ports handled 23% of the total US waterborne commerce in 2005, including cargo valued at over $130 billion at the Port of New York/New Jersey alone. MACOORA's objective is to mount a comprehensive effort to engage stakeholders at the local and regional level in order to ascertain regional priorities for data collection, data delivery, and data products. MACOORA will build on its previous progress, engage stakeholders in the conduct of the regional association, coordinate the design and implementation of its regional operational observing system (MARCOOS) to meet local, regional, and national coastal observing needs leading to informed decision making. Through MACOORA, the ocean user community has identified four initial priority goals, with objectives and intended benefits, for ocean observations in the Mid-Atlantic region as follows: (1) Coastal Inundation, providing offshore conditions for local inundation forecasts to safeguard lives and property; (2) Maritime

Safety, providing maps of ocean currents to improve Search and Rescue; (3) Ecosystem Decision Support, providing ocean temperatures for improved fisheries management; (4) Water Quality, providing ocean data for monitoring the health of near-shore ecosystems and enhanced public safety. The initial structure of MARCOOS has been designed to achieve these objectives. To do so, Weatherflow, Inc., an industry member of MACOORA, will coordinate integration of the numerous government, industry and academic wind observations in the Mid-Atlantic to produce a regional diagnostic surface wind product. Atmospheric forecasting groups including Weatherflow, Rutgers, SUNY & UMassD will partner with the region's five National Weather Service (NWS) Regional Centers to produce an ensemble of high resolution weather forecasts to feed the PSE&G Alert Criteria. The Mid-Atlantic High Frequency Radar Consortium (9 university operators, Weatherflow, CIT, NOAA, NASA & USCG) will operate the existing nested high frequency (HF) radar network (over 30 sites) to produce real-time surface current maps extending across the region and into its bays, sounds and harbors. UConn and SAIC will produce and enhance the statistical Short Term Prediction System (STPS) forecasts for input to the USCG Search and Rescue Optimal Planning System (SAROPS) and be applicable region-wide. Rutgers, Stevens & UMassD will produce regional ocean forecasts driven by the ensemble of wind forecasts and ultimately assimilating surface currents. The forecasts will enhance SAROPS, foster transition of operational modeling to NOS, and provide boundary conditions vital for regional and sub-regional inundation models. Rutgers' ongoing 5 year Office of Naval Research Multi University Research Initiative (ONR MURI) effort on data assimilative modeling in the full Mid-Atlantic Bight will feedback advanced data assimilation methods using RCOOS data that are applicable across IOOS.

Project Description

A. Goals and Objectives: The evolution of IOOS and the Regional Associations, including MACOORA has been achieved through a strong, facilitated collaboration between information

providers and information users concerned with data needs in the coastal ocean. The mechanisms for this collaboration have been a series of workshops, reports, refinements, and more workshops. It is a testament to both the compelling societal need and the dedication of these participants that the design and structure of IOOS have evolved in advance of the delivery of operational data products, and in advance of truly sustainable funding. However, the recent awards for developing Regional Observing Systems, for product development, and for data management have provided a sense of reality, focus, and even excitement that have been difficult to achieve heretofore. The MACOORA region was fortunate, with two successful proposals, one for the establishment of the Regional Observing System—MARCOOS—and one for the development of a prototype inundation prediction system—CIPS—for the Chesapeake Bay, a sub-region of MACOORA. MACOORA's overarching goal is to build a regional coastal ocean observing system capability, commensurate with levels of sustained funding, that provides observations, analyses, interpretations, and forecasts addressing high priority needs for both the region and the nation. With the establishment of MARCOOS, MACOORA's primary role will be to interface between the user community at both the regional and sub-regional level and with the federal agencies. This responsibility includes setting priorities for both new and existing observing systems. In addition, MACOORA will make specific recommendations for improvements and enhancements to the national backbone. To achieve these goals, MACOORA will focus on interactions among the broad and diverse user community and will coordinate the demonstration and assessment of products emanating from these new systems.

MACOORA's objective is to mount a comprehensive effort to engage stakeholders at the local and regional levels in order to ascertain regional priorities for data collection, data delivery, and data products. MACOORA will build on its previous progress (conducting multiple needs assessment workshops, incorporating as a not-for-profit, approving by-laws, electing a Board of

Directors, etc.), engage stakeholders in the conduct of the regional association, coordinate the design and implementation of its regional operations system (MARCOOS) to optimize deployment to meet regional needs, and coordinate with stakeholders (data providers, information users, and other interested parties) to achieve an organization with a unified network of data acquisition, management, and product development that meets local, regional, and national data collection needs. MACOORA, with its Observing System MARCOOS, and with the ocean user community has identified four initial priority goals, with objectives and intended benefits. Through MACOORA, the ocean user community has identified four high priority areas for ocean observations in the Mid-Atlantic region; they are as follows: for ocean observations in the Mid-Atlantic region: (1) Coastal Inundation – providing offshore conditions for local inundation forecasts to safeguard lives and property; this goal supports NOAA's mission goals to *understand climate variability and change to enhance society's ability to plan and respond* and to *serve society's needs for weather and water information*; (2) Maritime Safety – providing maps of ocean currents to improve Search and Rescue; this goal supports NOAA's mission goal to *support the Nation's commerce with information for safe, efficient, and environmentally sound transportation*;

(3) Ecosystem Decision Support – providing ocean temperatures for improved fisheries management; this goal supports NOAA's mission goal to *protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management*; (4)Water Quality – providing ocean data for monitoring the health of near-shore ecosystems and enhanced public safety; this goal supports NOAA's mission goals to *serve society's needs for weather and water information,* and to *protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management*.

In the context of the four high priority areas of (1) coastal inundation, (2) maritime safety, (3) ecosystem decision support, and (4) water quality, MACOORA will engage stakeholders to

achieve the following objectives:

1. To formalize and actively engage the MACOORA governance structure, including a stakeholder council (YR 1). MACOORA was incorporated as a not-for-profit in December 2005, at which time a Board of Directors was constituted (See Appendices g & n). While the Board and MACOORA's membership continue to meet regularly, there is a need to strengthen and expand the stakeholder (User's) council.
2. To refine and update an organizational operating plan (e.g., business plan) that guides MACOORA's communications, management, and operations (Each YR). Three previous meetings of the MACOORA membership have provided input to the Business Plan. The most recent draft (See Appendix h) will undergo two more iterations, working with its consultant, former NOAA Administrator Dr. James Baker, and with input from MACOORA's industry stakeholders. The Business Plan will be put up for approval by MACOORA's membership at its next Annual Meeting, October 9-10, 2007.
3. To complete and refine a needs assessment for IOOS information in the region (Each YR). MACOORA co-sponsored a needs assessment on inundation for Emergency Managers and Coastal Zone Managers in November 2007, and is currently planning a similar workshop for Spring 2008 (under its existing planning grant) for Water Quality, primarily targeting State and local agencies. MACOORA will explore additional opportunities to engage in focused needs assessment for its stakeholders at its regional and sub-regional meetings, and will continue to incorporate such data into its rolling Business Plan. In YR 3, MACOORA will prepare and disseminate a comprehensive report of regional needs assessment findings.
4. To develop and refine a website that displays a common identity with other components of IOOS, including other regional associations and has common pathways to obtain information (YR 1). MACOORA has recently updated its website, including incorporation of a number of features "borrowed" from other Regional Association websites, and will continue in those

activities. MACOORA's website will make it clear that MACOORA is a Regional Association for IOOS representing the Mid-Atlantic region. See also Goal #11 below.

5. To refine and document regional priorities and requirements for observing system information (Each YR). This will be part of the process described in Goal #3 above for ongoing needs assessments.
6. To design a regional observing system to address the priorities; this plan will articulate types and locations of sensors, data management and distribution operations, and product development (Each YR). Initial system design has been accomplished as part of the MARCOOS effort, and detailed in the MARCOOS proposal (See Appendix i). With regard to DMAC, MACOORA will consult with Rob Cermak, AOOS Data Management, UAF, and others to assure that its DMAC strategy (See Appendix j) is consistent with national DMAC design standards, and will incorporate concepts developed at the October 2007 IOOS Regional Coordination Workshop for consensus and guidelines on how to write or revise DMAC plans. This work will be accomplished as part of the existing planning grant.
7. To develop Concept of Operations document and to obtain approval by governance body (Accomplished). Corporate by-laws (See Appendix g) for MACOORA were approved by MACOORA's membership in December 2005 and are in use by its Board of Directors.
8. To communicate and coordinate with other Regional Associations and with federal agencies to ensure interoperability of data and information products (Each YR). MACOORA communicates regularly with all of the Regional Associations as an active member of NFRA, and in particular with its neighbors to the north (NERA) and south (SECOORA). MACOORA works with NOAA and other Federal agencies and its RA partners and neighbors to coordinate and integrate federal backbone and sub-regional activities.
9. To apply for certification as a Regional Association (YR 1), subject to adoption of certification criteria and implementation of a certification process by NOAA.

10. To plan and seek funding for regional pilot demonstration projects (Each YR). Note that as part of its existing planning grant, MACOORA will develop a prototype Delaware River Watershed Environmental Monitoring and Analysis System (DR-WEMAS), (See Appendix k for specifics).
11. To coordinate education and outreach activities with Sea Grant, COSEE, NERR, EPA's NEP (National Estuary Program), and others (Each YR). Note that as part of MACOORA's existing planning grant, The COSEE-NOW Community Center has been engaged (See Appendix l) to provide an online collaborative work/exchange space where scientists and education and public outreach professionals can interact with each other, as well as with other COSEE-NOW audiences.

B. Background and Audience: The rationale for the selection of the four high priority areas and the audiences intended to be reached are as follows:

(1) Coastal Inundation: The NOAA Storm Surge Leadership Team and a MACOORA Coastal Managers Workshop determined from coastal stakeholder comments that improvements are required in the resolution and accuracy of storm-surge forecasting and improved integration of surge and overland flood models down to the street level.

Coastal Inundation Audience: Local inundation projects require information on the regional scale of storms that can be enhanced with even higher resolution models. Local inundation models require surface forcing fields, boundary conditions from regional atmospheric/ocean models for nesting, and datasets for assimilation, including surface and subsurface temperature structure to improve estimates of upper ocean heat content, thickness of the wind-driven layer, and current/drifter data for assimilation to improve the surface layer response. Nested models for winds, waves and currents will then be run by the inundation groups to provide local guidance on water levels, wind speeds and wave heights.

(2) Maritime Safety: The Maritime Safety priority for MACOORA is evidenced by its focus on establishing the region-scale Mid-Atlantic HF Radar network. Measured surface current maps by the Mid-Atlantic HF Radar Consortium (MAHFRC) are recognized (1) by the Coast Guard to improve their Search And Rescue (SAR) activities and (2) by NOAA HazMat to improve emergency response to hazardous spills. Nationally, the Coast Guard receives an average of 13 SAR calls per day, of which 10 are successful rescues. To reduce the lives lost, the critical USCG need is to optimize SAR operations to minimize Search time. HF Radar information in the gap between the inshore NOAA PORTS and recommended offshore NDBC buoys will allow SAR operations to be optimized. The basic infrastructure for CODAR operations is in place to fill the gap. The USCG Office for Search And Rescue has concluded that by using CODAR currents (with their estimated uncertainty) in the existing EDS for SAROPS, an additional 50 lives per year will be saved.

Another Maritime Safety issue is rip currents, which are the primary cause of ocean drowning and rescue incidents along U.S. coasts. According to the U.S. Lifesaving Association (USLA), 71% of the total surf zone rescues (12,137 incidents) in 2003 were due to rip currents. As demonstrated by NOAA Sea Grant research and recognized by the NWS, HF Radar provides wave/current information that improves rip current forecasting.

Maritime Safety Audience: The major MARCOOS products for Maritime Safety are the 2D surface current fields observed by the HF Radar network and predicted by the statistical and dynamical forecasts. The primary users are the USCG and NOAA HAZMAT. Both require surface current products to be delivered into centralized operation centers and loaded into tactical decision aids. USCG SAR users are the operational controllers that direct deployment of aircraft and vessels using an operational decision aid called SAROPS. SAROPS uses observed or predicted surface wind and surface current fields from the USCG's EDS to predict the trajectories of floating objects. During an actual event, or test, a cluster of a few hundred virtual

objects is deployed in surface wind and current fields downloaded from EDS and allowed to drift over time. The cluster disperses based on the uncertainty estimates in the winds and currents. If SAROPS data has lower uncertainties there is lower dispersion in the cluster, a smaller search area, and greater likelihood for success. NOAA HAZMAT operations have similar decision aids. HAZMAT is collaborating with the USCG to link EDS and HAZMAT oil spill drift models. Other Maritime Safety products enabled by the HF Radar network are nearshore waves and alongshore currents being developed with SeaGrant. Where available, these products are *already* used by the Mount Holly WFO. The WFOs presently use observed and forecast surface waves to predict the probability of rip currents as low, medium or high. In the event of a nearshore search emergency, the direction of the alongshore drift is then the key unknown.

(3) Ecosystem Decision-Support: Commercial and recreational fishing represent a multi-billion dollar industry in the Middle Atlantic (MA). Management of these resources is difficult as many of the species are migratory and poorly sampled using traditional strategies. An integrated regional perspective is required. Timing and migration patterns of living marine resources are strongly influenced by the structure of MA water properties. Unless regional hydrography is mapped on at least monthly time scales, it is difficult to assess the efficacy of fisheries management approaches based on marine protected areas, no fishing areas, marine reserves, and rotating closures. Regional hydrography and circulation from MARCOOS observations and models will facilitate analysis of the movement of water masses and their associated populations, assisting the interpretation of population breeding dynamics and connectivity. For species with mobile adult stages, retention-through-migration can effectively counteract the dispersing effect of physics. Species with less mobile juvenile or adult life stages (e.g. sea scallops) depend on circulation processes to maintain them within their habitat range. For example, scallops, the 2nd highest ex-vessel revenue in the Northeast fishery, contribute $431.5 million annually to the MA

domain. MARCOOS modeling will provide spatial patterns of the MA physical ocean to fishery managers for use in their individual-based models of larval dispersal, settlement and recruitment.

Many commercial pelagic species aggregate within or at frontal boundaries between water masses with physical, chemical or biological signatures. These fronts are visible in present web-served satellite products, with MA fishers the majority user of the existing Rutgers observatory web pages. Web-served surface spatial information is also used by NOAA NFMS for adaptive sampling of fisheries in the MA. The second most requested data product is subsurface temperature and salinity fields. Subsurface data is needed because of their relevance to population distributions. For example, bottom temperatures can impact the survival of larval and juvenile shellfish and fish. Long-term changes in the MA are being increasingly implicated in changes in migration patterns of species and shifts in historical fishing areas. The MARCOOS goal to provide 3D pictures of water masses in near real-time support these user needs. To accomplish this, we will use a multi-platform approach of proven technologies, including satellites, gliders, and data assimilative models to integrate into synoptic fields. Satellites provide maps of surface temperature, chlorophyll a, and a suite of existing ocean color products, such as absorption and backscatter. Satellite information will be fed into objective water mass classification algorithms being developed through NASA. Gliders, operated by the Mid Atlantic Glider Consortium (RU, UMassD, UMaryland, and UNC-CH) will measure the month-to-month changes in the 3-D water property structures over the MA. Gliders will be outfitted to measure temperature, salinity, currents, chlorophyll a fluorescence, particle backscatter, and, while surfaced, waves. Combined satellite and glider data will be assimilated into numerical circulation models, each with different assimilation schemes. Comparisons of this ensemble of 3D realizations will be used with measurements to estimate uncertainties. The model realizations will be used to characterize 3D water mass patterns for Web display.

Ecological Decision-Support Audience: Primary MARCOOS regional products for Ecological

Decision Support for Fisheries are 3D temperature and circulation fields. These primary products include both real time data (satellite surface maps and subsurface glider data) and model predictions from the ensemble of data-assimilative forecast models. Users include recreational, commercial and management fishing groups.

Recreational and commercial fishing communities access the data via websites and use it to decide where and when to fish, often accessing the data daily. Fishing groups then use their own knowledge of fish behavior relative to temperatures and fronts, or rely on value added services such as OceanTemp or Jenifer Clark's Gulf Stream that interpret the data available on the websites for a subscription fee. Outreach and training efforts are required to improve webpage displays that are easy for the fishing public to interpret. The fisheries management community is very much aware of the importance of 3D circulation, temperature and salinity fields on fish. Real-time data needs include adaptive sampling for fisheries management and continued analyses of fishery cruise results to relate stock distributions to the environment. Adaptive sampling is facilitated by web access from shore support sites or fisheries vessels using cell phones. Both methods have been used to coordinate fisheries sampling in the MA (see letters of support). An important aspect of adaptive sampling is real-time feedback between vessels at sea and gliders. As recently demonstrated, a regional glider flight from Mass. to NJ broke away from its mission to assist a fisheries vessel by flying repeat sections along the same cross-shelf sampling transect. Fisheries managers are sophisticated users of ocean data and will require little more than background training on access and quality.

(4) Water Quality: The MARCOORA domain that extends across the EPA's designated Virginian Province contains nearly 25% of the US population. It is the most urbanized coastal region in the US, representing 24% of the national economy. Buoyant coastal currents in the MA are fed by many urbanized rivers, which provide anthropogenic inputs into coastal waters. Nutrient and organic matter loadings fuel hypoxia/anoxia, a focus of some sub-regional

proposals which will benefit from information on shelf circulation, density structure, waves and sea surface heights.

Water Quality Audience: Water quality at a given location depends both on the advection into or out of the area as well as local processes. Advection in many locations requires knowledge of the regional response to wind and buoyancy driven flows. Real-time surface circulation maps and forecasts provided by MARCOORA will help coastal managers concerned with water quality better understand where the water in their area is coming from, and where it is going.

C. Approach: MACOORA is managed by a Board of Directors with an elected Chair. The achievement of stated objectives will be facilitated by the MACOORA organizational structure shown in Figure 1 below.

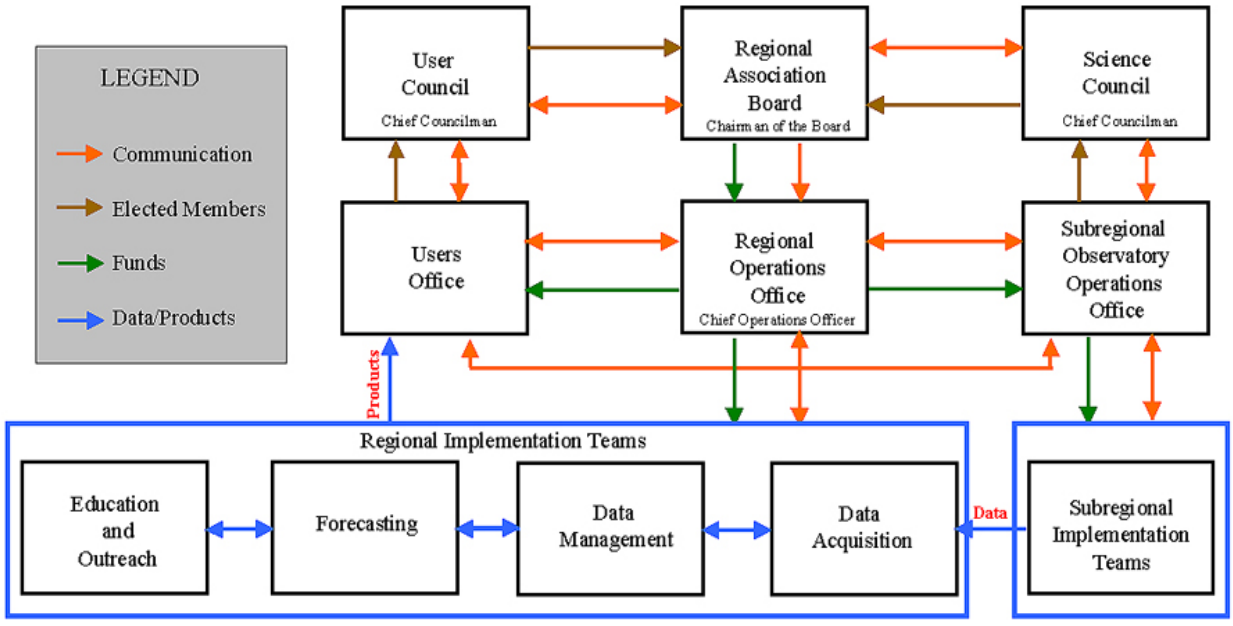

Figure 1. MACOORA Organization/Governance Structure

For this proposal cycle, particular attention will be given to strengthening the User Council. The overarching philosophy in the operation of the MACOORA Task Force is one of inclusiveness rather than exclusiveness. There is a strong belief among the MACOORA co-investigators that users must be involved from the outset and that the ultimate success of MACOORA rests on informed support and commitment from many different constituencies.

To ensure broad participation from within the inherently complex Mid-Atlantic region, with its nine states and five major ecosystems in addition to the coastal ocean of the Mid-Atlantic Bight, the MACOORA by-laws require representative Directors from each of the five sub-regions. Current representatives are as follows:

Massachusetts and Rhode Island Bays and Shelf: Dr. Wendell Brown, UMassD Dartmouth

Long Island Sound: Dr. Jim O'Donnell, UConn

New York Bight: Lucy Ambrosino, Port Authority of NYNJ

Delaware Bay: Bob Tudor, Delaware River Basin Commission

Chesapeake Bay: Dr. Fredrika Moser, MD Sea Grant College

This sub-regional approach is being used to reach and engage as many interested parties in the MACOORA organizational process as possible. The day-to-day integration of the sub-regional activities and the general oversight of MACOORA are vested in the Chief Operating Officer (COO), Mr. David Chapman. The networking skills of the Sea Grant Directors in all MACOORA states are also being tapped to bring their contacts with vested interests in the marine and coastal environments to the needs assessment workshops.

The primary activities in this proposed effort include the running of the MACOORA administrative office, the provision of regular communications via an up-to-date website, the close integration and support of MARCOOS operations, and conduct of user workshops, both regionally and sub-regionally. The regional MARCOOS supports sub-regional efforts by providing the outer boundary forcing and other region-scale information. While the proposed MARCOOS operations do not depend on data and/or information from the sub-regional efforts, their products will be incorporated with MARCOOS information. The COO and the staff of the MACOORA Operations Office will be responsible for carrying out the day-to-day activities required for accomplishing the stated objectives. The Operations Office reports to the MACOORA Board of Directors. Since MACOORA has already accomplished its goal of setting

up its organizational structure, the Operations Office will focus on strengthening the User's Council and its ability to conduct needs assessment and engage stakeholders, as well as working closely with the MARCOOS Product Development Team, Operations Team, and Resource Groups (described under *MARCOOS Management* below).

During this proposal cycle, three regional plenary workshops/annual meetings will be held in the Fall. During the first year of this three-year project period, the workshop will be devoted to strengthening the User's Council. The second workshop held in the fall of 2009 will be devoted to defining the path toward interoperability among MACOORA partners and transparency for users, as well as critiquing MARCOOS's progress. The third workshop will be devoted to an evaluation of MACOORA progress to date and responsiveness to stakeholders and major user communities. To maximize the efforts of workshop attendees and to ensure successful workshops, the MACOORA Operations Office will provide prior planning, communication, and coordination and the MACOORA membership will be engaged in working groups to accomplish the agreed upon plans of work. The principal investigator and Operations Office staff will attend to workshop logistics and coordination with the assistance of the Co-principal investigators. Workshop reports will be assembled and delivered to participants shortly after each meeting. Between workshops, the User's Council will be assigned to solicit matters of interest to the MACOORA members and to further expand the reach and sphere of influence of MACOORA.

MARCOOS Management Structure: The MARCOOS Co-Directorship will guide the activities of the MARCOOS Product Development, Operations, and Resource Groups (see below). They are responsible for building the MARCOOS capability and evaluating performance, altering procedures if necessary, and responding to the MACOORA Board of Directors. Their primary charge is to ensure organization, communication, production, and accountability of the system. As with MACOORA, day-to-day operations oversight, coordination, and communication are

handled by a dedicated manager. *Product Development Team (PD).* Early in Year 1, the PD team will work with the different MARCOOS Team Leaders to define the initial suite of MARCOOS Products under the Maritime Safety and Ecosystem Decision-Support themes. Thereafter the PD team, under the leadership of the MARCOOS Product Development Team Leader will work in parallel with the MARCOOS Operations teams, drawing in the Resource Teams as needed, to define MARCOOS products for Year 2 and beyond. Many of these products may be refined versions of Year 1 products based on user feedback. *Operations Teams.* The initial suite of MARCOOS products will define (1) operational scenarios for the Weather, CODAR, Glider and Modeling Groups, and (2) how the data/information are integrated operationally (24/7) and quality-controlled to produce the required data/information products. The MARCOOS Operations Manager will work directly with the individual Operations Team Leaders to establish and maintain quality assurance metrics, and to assure that the required information is available in time to produce the products. *Resource Groups.* The MARCOOS development of an end-to-end system will require the regular input from its suite of MARCOOS Resource Groups concerning many technical matters as well as the dissemination and evaluation of user response to MARCOOS products. The Resource Group Leaders will be points of contact for MACOORA-wide capabilities in data management, education and outreach, user-engagement and marketing, and economic impact. The Resource Groups parallel those in MACOORA Working Groups, and leverage support from MACOORA.

MARCOOS Teams	**Team Leaders**	**MARCOOS Teams**	**Team Leaders**
Project Management		**Product Development**	
Co-Directors	S. Glenn, W. Boicourt	Maritime Safety	M .Bruno
Operations Manager	M. Crowley	Ecological Decision Support	W. Brown
Operations Teams		**Resource Groups**	
Weather	J. Titlow	DMAC	J. O'Donnell
HF Radar	J. Kohut	Education & Outreach	J. McDonnell
Gliders	O. Schofield	User Engagement/ Marketing	A. Voros

Modeling	A. Blumberg	Economic Benefit	D. King

Responsiveness to User Needs and IOOS Development Plans: Communications with IOOS and users is ensured through the present overlap in MACOORA/MARCOOS membership. Specifically, Scott Glenn, Chair of the MACOORA Product Development working group, works closely with Andrew Voros, Chair of the MACOORA User Engagement working group. Bill Boicourt is a MACOORA representative to the National Federation of Regional Associations (NFRA) - the MACOORA/MARCOOS conduit to IOOS. Jim O'Donnell, as Chair of the MACOORA Data Management working group, will help ensure that DMAC standards are adopted in MARCOOS protocols. The industry experience of Jay Titlow, MACOORA Treasurer, will help ensure that MARCOOS development remains cost effective.

D. Benefits: The benefits expected within each of the high priority areas addressed in this proposal are detailed below.

(1) Coastal Inundation: Coastal inundation projects will benefit from MARCOOS regional products through improved boundary conditions for nesting, improved surface forcing, and improved spatial data for assimilation. Access to these advanced products will be facilitated by the DMAC team. OPeNDAP servers provide a common access protocol for data assimilation by all local modelers. Nesting within atmospheric and ocean models is model specific, and is a significant component of each sub-regional inundation projects. This will be facilitated by regional model providers and by the DMAC team.

(2) Maritime Safety: The initial primary user of the 2-D surface currents will be USCG SAR operations. The benefits include reduced search time, more lives saved, and more time available for law enforcement missions. Specific implementation guidance is provided by Art Allen from the USCG Office of SAR. Once MARCOOS surface currents are made available on EDS by ASA, they are available to operational SAR controllers by the same methods used to access other less accurate current fields. NOAA HAZMAT operations have similar decision aids for

spill response. USCG is already discussing with NOAA HAZMAT the potential for accessing data from EDS for improved spill response. This will potentially enable any surface current fields in EDS, or in a parallel NOAA system, to be used in the HAZMAT decision aids.

The primary user of the nearshore wave and current product enabled by the 26 CODAR sites in the MA is the NWS Regional WFOs. The benefit will be improved forecasts of rip current probabilities. In the event of a Search, the alongshore current product delivered by MACOORA could be used by the WFOs to assist emergency response personnel in determining the speed and direction of alongshore drift. MARCOOS information is delivered to a central WFO operations center and then distributed by the agency to the users in the field. At present, a prototype nearshore CODAR product is delivered via real-time webpage displays, a process that will be facilitated by the MARCOOS website. The MACOORA User Engagement working group will continue regular visits to WFOs. The MARCOOS SeaGrant liaison will specifically work with SeaGrant using its effective outreach and training capabilities to devise the next generation of nearshore products to assist WFO activities supporting rip current forecasting and response.

(3) Ecological Decision Support: Primary users of MACOORA's 3-D circulation and temperature fields are the recreational, commercial and management fisheries communities. Benefits are improved management of marine living resources and the economic savings of reduced fuel consumption and search time for fishing operations. Recreational fishing groups have already contributed to the design of satellite SST web pages at the shelf break canyons (Saltwater Fisherman, 2006). The next level of information advocated by fishing community leaders is subsurface temperature data. Users in the Fishing communities are distributed and operate independently, preferring website delivery of information. Commercial value-added industry groups (e.g., OceanTemp) already access the existing data and products over the Internet. The MACOORA/MARCOOS COSEE liaison will leverage their extensive E&O materials already developed for the fisheries community in other regions and apply them to the

MA. User needs assessments and attendance at regional fisheries council meetings will enable MACOORA/MARCOOS webpage products to be tailored and refined in a proven-effective iterative process based on the fishing community's needs. Fisheries management personnel are advanced users of observatory data, requiring access to real time web pages for adaptive sampling, but also to historical datasets for retrospective analyses. Access to the real-time and archived datasets beyond web pages will be facilitated by OPeNDAP server access. Leveraging regional IOOS observatories for the development of potential Fisheries ecosystem observatories is an envisioned synergistic collaboration.

(4) Water Quality: Water quality efforts will be facilitated through continuing close interactions with the MACOORA community coordinated by the operations manager. The potential range of interactions include: (1) real-time data web pages for local water quality decision-makers, (2) the NJDEP/EPA proposal to monitor dissolved oxygen with gliders that makes use of the MARCOOS glider technology support and data management, and (3) the Delaware Bay National Water Quality Monitoring Network (NWQMN) Pilot Study that will demonstrate synergistic linkages between IOOS and NWQMN. Local water quality managers tell us that MARCOOS will enhance their ability to evaluate how ocean currents may transiently affect stormwater-related bacteria that is discharged into the ocean, offering better public health protection and improved homeland security from the dispersal of chemical and radiological pollutants.

Milestone Schedule:

Year One	June, 2008	Anticipated start date
	July, 2008	Submit RA Certification application
	October, 2008	Workshop I: User's Needs Assessment workshop
Year Two	June, 2009	Start of second year funding and progress report on YR 1
	October, 2009	Workshop II: Interoperability; MARCOOS workshop
Year Three	June, 2010	Start of 3rd year of funding and progress report on YR 2
	October, 2010	Workshop III: Progress evaluation; stakeholder/user consensus for MACOORA's future direction

June, 2011	Project Final Report, including comprehensive report of the needs assessment findings for the region

Project Budget: Dr. Carolyn Thoroughgood is the Principal Investigator and Coordinator of the project; co-investigators Drs. Scott Glenn, William Boicourt, and Larry Atkinson, who bring the perspective and experience of regional ocean observing system operators, will assist her. MACOORA is managed by a Board of Directors (including Drs. Scott Glenn, William Boicourt, and Larry Atkinson) with an elected Chair (Dr. Thoroughgood). Board Members and the Chair agree to serve at no cost to this project. The salary budget provides for a full-time Chief Operating Officer and part-time Data Management Coordinator and part-time Communications staff, including Webmaster. Funds are requested for a marine studies graduate student for Member support activity. Funds have been budgeted to support annual regional workshops as well as sub-regional workshops. The regional workshop budget has been designed to provide travel grants including overnight accommodations. A separate travel budget of $12,000 has been requested to cover business travel of the MACOORA COO as well as travel costs of Board Directors (if requested) for in-person Board Meetings (two/year). Legal fees are budgeted to cover costs associated with MACOORA's incorporation. Professional fees of $5,000 will cover consulting fees for professional services. NFRA dues of $5,000 are also budgeted. Support funds are requested for Data Management, Communications, and Education and Outreach activities. Lastly, a Supplies and Expenses request is made to cover general Regional Association administrative office operations. (For additional Budget details please see Appendix c).

Please note that MACOORA, Inc. has signed an Administrative Services Agreement with the University of Delaware (UD) to handle its financial and other administrative needs (See Appendix f).

Budget:

Budget Category	Year 01	Year 02	Year 03	Summary
Chief Operating Officer, 12.0 mm each yr	$110,000	$114,400	$118,976	$343,376
Data Management, 3.0 mm each yr	$15,000	$15,600	$16,224	$46,824
Communications (incl. webmaster), 2.3 mm; 2.3 mm; 2.3 mm	$14,147	$14,713	$15,301	$44,161
Grad Student, 36 wks x 20 hr/wk x $15/hr	$10,800	$10,800	$10,800	$32,400
Total Salaries	$149,947	$155,513	$161,301	$466,761
Fringe Benefits:				
34% of COO, DM, & RC salaries	$47,310	$49,202	$51,170	$147,683
4% of Student salary	$432	$432	$432	$1,296
Total Fringe Benefits	$47,742	$49,634	$51,602	$148,979
Total Salaries & Benefits	$197,689	$205,147	$212,904	$615,740
Professional Fees	$5,000	$5,000	$5,000	$15,000
Supplies and Expenses	$5,790	$5,790	$5,790	$17,370
Travel	$12,000	$12,480	$12,979	$37,459
Workshops:				
Conference Rooms and Meals	$20,000	$20,800	$21,632	$62,432
Travel Grants & Rooms	$15,000	$15,600	$16,224	$46,824
Sub-region Workshop support	$40,000	$41,600	$43,264	$124,864
NFRA Dues	$5,000	$5,000	$5,000	$15,000
Insurance	$2,500	$2,600	$2,704	$7,804
Legal Fees	$1,000	$1,000	$1,000	$3,000
Data Management Support	$5,000	$5,000	$5,000	$15,000
Research Comm's (incl. web) Support	$5,000	$5,000	$5,000	$15,000
Education and Outreach Support	$5,000	$5,000	$5,000	$15,000
Total Direct Costs	$318,979	$330,017	$341,497	$990,493
Indirect Costs, 25.4% (Off campus)	$81,021	$83,824	$86,740	$251,585
Total Costs	$400,000	$413,841	$428,236	$1,242,077