Synthesis of Coastal Managers Needs for Ocean Observing Products and Services

September 2006

Prepared for the
Northeast Regional Association of Coastal Ocean Observing Systems

Prepared by
The Keeley Group
Jefferson, Maine

Table of Contents

Cover Photo Credits (clockwise from upper right): Naval Postgraduate School; Maine Coastal Program / Gulf of Maine Council on the Marine Environment; Naval Postgraduate School; National Oceanic & Atmospheric Administration; Rutgers University, Coastal Ocean Observation Lab

Introduction

The Northeast Regional Association of Coastal Ocean Observing Systems (NERA) and the Gulf of Maine Ocean Observing System (GoMOOS) seek to serve a variety of customers in the public, for-profit and non-profit sectors. One priority customer that they intend to focus on is the coastal management community. This report describes what ocean observing products and services these users have said they need.

Coastal managers work at all levels of government (e.g., local, sub-state, state, regional and federal), in the region's First Nations and in industry. For the purposes of this assessment NERA chose to focus on coastal managers that work in state/provincial government. Their professional training is quite diverse (e.g., planners, engineers, biologists, fishery managers, maritime trades, lawyers, economists, etc.). On a daily basis they contribute to the formation of coastal/marine policy, write & enforce permits, conduct research/science, offer technical assistance to coastal stakeholders, and perform other tasks that manage the region's coastal lands, waters and marine resources. As a result their needs span the continuum of raw data (e.g., support existing and enable new modeling) to highly synthesized products (e.g., maps, forecasts, web site tools that allow compilation and analysis, etc.).

While the breadth of coastal management is quite broad this report focuses on managers that are involved in four categories of activities (see figure 1).

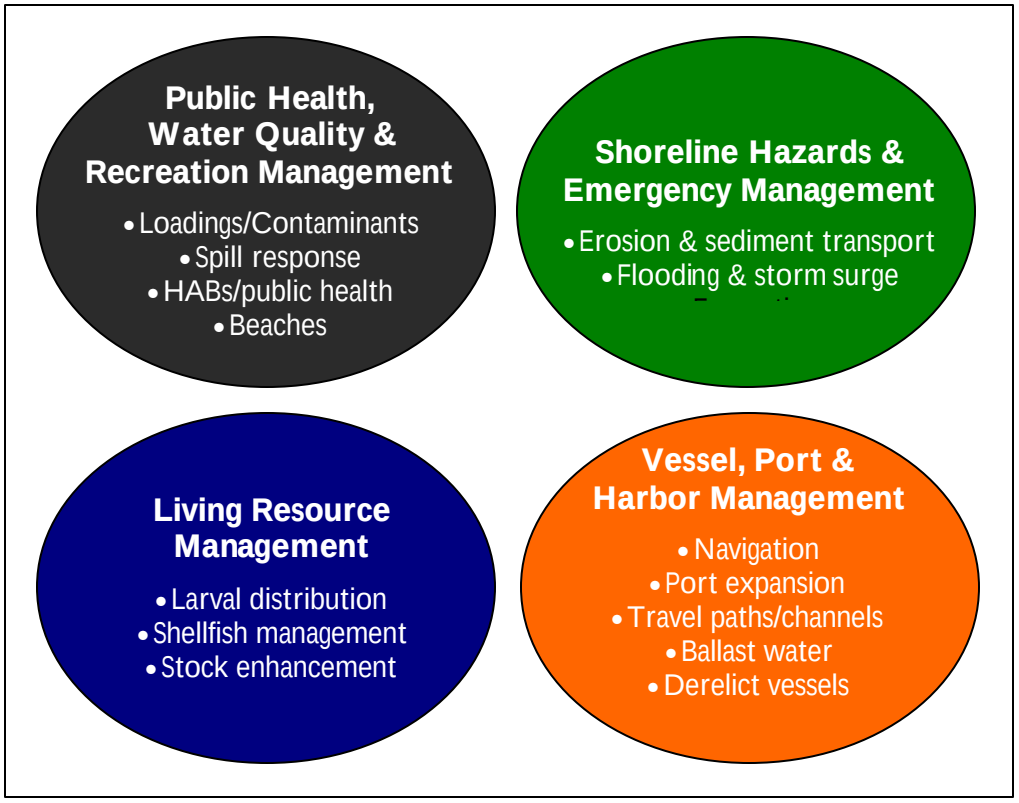

Figure 1. Coastal Management Applications of Ocean Observing Data and Information

Purpose

This report provides an assessment of coastal managers needs for ocean observing products and services. It is based on a review of over 20 thoughtful and informed reports from the Gulf of Maine and other coastal regions of the United States as well as discussions with coastal managers. These managers have said their needs to apply the data and information flowing from ocean observing programs are quite varied – ranging from planning and assessment needs to being legally defensible in a regulatory context. They spoke of:

- The wide variety and complexity of decisions coastal and land management agencies need to make (e.g., water quality protection, habitat conservation, hazards management, dredge disposal) is mirrored by the varying coverage, densities and temporal scales of the data required to make informed decisions;
- The need to link monitoring efforts with ocean observing products (e.g., targeted monitoring to find problems vs. state-wide ambient monitoring, regulatory monitoring vs. ecosystem monitoring, etc.);
- The requirement to implement state/provincial standards and the need to address "impaired waters;"
- The density of measurements required to make management decisions and the need to work in an estuary-nearshore area that has a critical mass of sensors. Then to aggregate that information, create value-added products and to use it to simulate how a fully operational system would work solving real-world problems;
- The frequent need to integrate/synthesize biological and environmental data into products that support planning and regulatory decisions;
- The role of modeling to fill in the gaps in biological data; and
- The need to help users find the data they need via accessible and rigorous metadata

Northeast Regional Assessments

There are two recent northeast regional assessments that provide some statistical data on manager's priorities and ocean observing needs. They conclude:

1. Management Priorities – The two top-ranked management topics that the Northeast region considers to be very important or important are habitat change (98%) and land use (96%), followed by nutrient enrichment (82%), non-indigenous species (70%), environmental contamination (68%), sediment management (52%), ocean management (44%), coastal hazards (26%) and marine debris (13%). (Urban Harbors Institute, 2004)

2. Coastal Observation and Monitoring Needs – Respondents were asked to identify continuous observation and monitoring variables they considered necessary to help address nine management topics over the next five years. The table below presents the results for each observation and monitoring variable across each management topic. (The percentages are also identified by shading to fall within one of four groups of percent responses: 0-24%, 25-49%, 50-74%, and 75-100%.)

Table 1. Northeast Importance of Coastal Management Issues

Observation and Monitoring Variables	*Habitat Change*	*Land Use*	*Nutrient Enrichment*	*Environmental Contamination*	*Nonindigenous Species*	*Coastal Hazards*	*Sediment Management*	*Ocean Management*	*Marine Debris*
Sea level	63%	31%	5%	2%	11%	85%	40%	25%	0%
Surface and/or subsurface currents	17%	~	15%	25%	26%	35%	63%	40%	27%
Surface waves	6%	5%	4%	4%	5%	74%	52%	24%	0%
Surface winds	9%	5%	7%	17%	7%	36%	39%	21%	0%
Surface salinity	20%	~	17%	10%	17%	0%	4%	25%	0%
Surface temperature	23%	5%	18%	9%	16%	0%	4%	31%	0%
Light penetration	40%	~	49%	15%	16%	0%	12%	35%	27%
Bathymetry/bottom type	58%	10%	12%	25%	23%	24%	65%	65%	0%
Organic matter	26%	17%	46%	50%	9%	0%	18%	23%	0%
Dissolved inorganic nutrients	51%	41%	65%	50%	24%	0%	6%	27%	0%
Dissolved oxygen	66%	48%	84%	49%	31%	0%	0%	44%	0%
Zooplankton species	30%	9%	39%	43%	40%	0%	2%	40%	0%
Phytoplankton species	38%	12%	68%	52%	44%	0%	2%	40%	0%
Ocean color	2%	2%	13%	2%	2%	0%	0%	7%	27%
Aerial/satellite imagery	72%	81%	28%	27%	39%	58%	58%	64%	46%
Other	23%	31%	11%	25%	32%	37%	18%	21%	43%

~ Not included

0 – 24% 25 – 49% 50 – 74% 75 – 100%

The percent of Northeast respondents identifying observation and monitoring variable as "necessary" to address each management category ranged from a low of 0% for twenty-two variables, to a high of 85% indicating a need for sea level data for coastal hazard needs. The need for sea level data is closely followed by dissolved oxygen (84%) for nutrient enrichment topics and aerial/satellite imagery (81%) for land use topics. Based on the percent of responses, aerial/satellite imagery is consistently needed by more than 25% of Northeast respondents across all of the management topics. Ocean management has the most (11) observation and monitoring variables identified by more than 25% of Northeast respondents. (Urban Harbors Institute. 2004)

Participation of Coastal Managers in Ocean Observing Systems

In 2004 and 2005 coastal managers in the Gulf of Maine, the Southeast and the Great Lakes articulated the context for their participation in ocean observing systems through a series of guiding principles. These were shared with the managers of ocean observing systems and seen as helpful as they engaged coastal managers in defining the products and services they need.

Principles for Coastal Manager Participation in Observing Systems

1. Context for coastal observing systems

- Formally integrate coastal managers at the highest levels of decision-making in ocean observing systems as well as in advisory capacities
- Assist managers to integrate ongoing environmental monitoring (e.g., water quality, fishery trawls, river & watershed monitoring, etc.) and traditional knowledge with observing data in ways that produce value-added products.
- Augment existing data sets/information on biological resources and chemical conditions in ways that facilitate work on timely and important regional issues
- Target products at specific places and needs

2. Support capacity building of coastal managers and users

- Regional systems need to dedicate resources to help mangers use observing data and information (e.g., professional development and training to use raw data, help others in accessing and using these materials, etc.)
- Assist managers create and disseminate information derived from observing data

3. Require Observing Programs to provide service to users

- Support targeted projects needed by coastal managers and obtain contributions/participation from them (e.g., sustain effective partnerships, area-wide characterizations with multiple applications, etc.)
- Prepare materials useful to policy-makers (e.g., local officials, members of cabinet, legislators, etc.)

Coastal Managers Needs

Individuals working to manage the nation's estuarine, coastal and near-shore ocean resources need a variety of data and information to perform their jobs. This report presents these needs in four broad categories (see figure 1). Further, it:

- Provides a general description of the planning, regulatory and policy issues managers pursue in each of these categories;
- Characterizes the types of management decisions that are being made on a daily basis;
- Provides examples of what physical, chemical and biological parameters need to be measured, at what spatial density, how frequently, for immediate/real-time use or for creation of time series for modeling and predictions, etc.; and
- Identifies the types of products and services that managers need. These often involve real-time web-based data, maps, point information or contoured information. It can be trend information and projections. In other instance it can simply be databases available to a third party for modeling and predictions for private clients.

Public Health, Water Quality and Recreation Management

Description	Types of management decisions	Examples of Product Requirements	Types of Products
Protect the public and the marine environment from water quality impairment Minimize adverse effect of shoreline development on coastal water quality	Determine relative contributions of sources of nutrients & other contaminants to coastal waters (e.g., urban runoff, residential fertilizers, municipal landscaping, illicit discharges to storm drains, ocean wastewater discharges, agriculture, forestry, marinas, atmospheric deposition, subsurface waste disposal, recreational boating, etc.) Influent, effluent and sludge monitoring Assess threats of toxins in the marine foodchain to public health Determine compliance with standards	• Contaminant profiles at the watershed scale for low flow, high flow and normal conditions (e.g., 1"and 2" of rainfall, etc.) Daily or greater measurements. Increased spatial and temporal resolution of rainfall events • Mobile, short-term (i.e., three years) near-shore data stations (e.g., wind, wave, chlorophyll) • Dissolved oxygen, nutrients, salinity, temperature, flushing rates, wind, currents, velocities, turbidity at watershed scale for non-point source detection • River inflow contributions of nutrients and flow variations • BOD, TSS, chlorine residue, pH, temperature, DO, ammonia, and fecal coliform • Dissolved inorganic nitrogen, phosphorus and silicate (monthly, seasonal & inter-annual)	• Studies of typical urban watersheds by rainfall event to determine relative contributions of each source • Large scale maps showing hydrologic connections of coastal rivers, watersheds and estuaries • Studies of discrete causal mechanisms for symptoms in eutrophied waters & classifications for different types of eutrophication • Loading estimates for wet and dry inputs (air, land-based, offshore) • Estimate contaminant releases from existing benthic sources (sediment) • Predictive ecosystem response models to determine point of "undue effect" • Nitrogen attenuation/loss coefficients by source for wetlands, groundwater, etc. • Integrated watershed-coastal models (rainfall, groundwater recharge, loading, non-point) for TMDL calculation, NPS assessments, beach and shellfish closures on embayment scale down to individual beaches • Real-time monitoring at ocean outfall (e.g., DO, optical measurements, etc.) • Microbial source tracking tools • Monitoring and evaluations of BMP effectiveness

Description	Types of management decisions	Examples of Product Requirements	Types of Products
			• Real-time data on the internet • Bulletins for water supply managers that integrate water quality monitoring data • Circulation models to determine lobster broodstock source for larval settlement and harvest areas and the relationship and relative contributions of the inshore and offshore broodstock • Models to describe urchin spawning, settlement survival, size/age ratio, and other biological measures in a local context
Address eutrophication through coastal planning, permitting and enforcement	Determine whether eutrophication is a problem in the near-shore environment and the relationship of estuarine eutrophication to open ocean waters Identify sources, estimate wet and dry inputs of nutrients Identify acceptable rates and loading standards Enhance understanding of eutrophication impacts in shallow waters where short-term process, sediment interaction, resuspension, and shoreline erosion complicate management Enhance understanding of the relationship between suspended sediment and nutrient impacts and what NPS actions really work (e.g., proven with monitoring data)	• Chlorophyll a (90^{th} percentile plus spatial coverage of highest concentrations plus frequency of occurrence of highest concentrations) • Macroalgae, Epiphytes, and Nuisance/Toxic Blooms (problems are heuristically determined as detrimental impacts to any biological resource plus frequency of occurrence) • Bottom Water Dissolved Oxygen (10^{th} percentile plus spatial coverage of highest concentrations plus frequency of occurrence) • Loss of SAV (decreases in spatial coverage of submerged grasses) • Nutrient (DIN, DIP) load/concentration/Ratio • Zoobenthos/fish kills	• Databases of ambient conditions (nutrients, pathogens/toxins, bacteria, dissolved oxygen) of waters within 1000' of shore available to third party for modeling (hydrodynamic, circulatory etc.) • Bottom contours that interpolate DO • Algorithms to allow comparisons with monitoring data • Synthesis of seasonal & inter-annual nutrient fluxes to assist in reviewing water quality permit requests • Eutrophication indicators (algal biomass, colored dissolved materials, suspended materials, water clarity, primary productivity [organic particle fluxes, fish structure,] bacteria growth in marsh systems)

Description	Types of management decisions	Examples of Product Requirements	Types of Products
		• Water clarity • Seasonal inventory of total organic carbon, total organic nitrogen, phosphorus, and Chlorophyll a by embayment	• Indicators of susceptibility, nutrient inputs, future nutrient pressures, etc. • Assessment of overall eutrophic condition & human influence • Estuarine classification schemes & data to support outstanding waters designations • Load - Response relationships to facilitate predictions and linkage to management measures (e.g., loading coefficients specific to watershed locations and condition) • Nitrogen attenuation/loss coefficients by source (e.g., atmospheric deposition, etc.) for wetlands and groundwater transport. • Mass loading assessments for open marine ecosystems where offshore upwelling is the primary source of nutrients
Ensure seafood is safe and healthful	Predict or provide early warning of occurrence (timing and location) of harmful algal blooms, target state sampling resources, open and close shellfish areas, help elderly and asthmatics avoid bloom areas, etc. Enhance understanding of the direct effect of HABs on living resources so that we can better determine the levels to which we need to control these blooms to protect living resources	• Currents, wind speed and direction, optical back scatter, organic nutrients, temperature, salinity, turbidity, chlorophyll concentrations, *Alexandrium tamarense* blooms, dissolved oxygen	• 3-7 day trajectory models to assist managers understand the timing, formation, duration, location and movement of HABs (e.g., projected shore-fall sites) and to support allocation of resources (e.g., state sampling staff, health advisories, beach closing, etc.). The Aquaculture industry can also move product to safer waters or harvest it. • Real-time weekly reports on the distribution and abundance of HABs

Description	Types of management decisions	Examples of Product Requirements	Types of Products
			• Historical synthesis of the frequency (monthly, seasonal & inter-annual), duration and spatial occurrence of HABs • Trend data on DO levels to document bloom die-off and effect on marine organisms • Spatial coverage of the rates and locations of brown-tide die off • Trophic index updated no less than weekly (such data would be very useful in conjunction with satellite (e.g. MODIS) data and surface temperatures) • Inter-annual and seasonal assessments of off-shore vs. near-shore sources of nutrients
Increase public safety	Posting & enforcement of swim beach alerts/restrictions (e.g., location and intensity of rip currents, etc.) In-water safety patrols for surfers, scuba divers & recreational fishermen	• Real and near-real time information on rip currents, undertow and long-shore currents • Pressure gauge data, temperature and salinity values for beach safety	• Access to databases for third party use • 3-D models for long-shore transport & water mass movement of waterborne contaminants that improve the timing and location of swim beach monitoring – moving toward adaptive sampling methods • Daily, real-time data & forecast for wind driven ocean levels on the beach • Daily & hourly warnings of the likelihood of rip current location and intensity

Shoreline Hazards and Emergency Management

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
Improve management responses to coastal shoreline erosion	Permitting of shoreline structures Determining setbacks based on erosion rates Assess impact of public & private shoreline structures (e.g., breakwaters, groins, etc.) on hydrology and biology Assessing isostatic rebound and effect on shoreline management decisions	• Shoreline erosion/recession and accretion rates (seasonal, 10-year to 100-year) • Sediment load maps (Supply, fate and effect/transport) & influence of dredging • Quality of the sand/sediment in the system • Historic sea level • Real-time surface waves, surface winds, bathymetry/bottom type in the near-shore	• Historical coastal shoreline and nearshore substrate maps to evaluate change (10-year intervals back to the 1930s) and set baseline data including calculating erosion rate/recession rates (1:6000 every ten years); need to be legally defensible • Sediment budgets & load maps/models to understand sources (tributaries, etc.) & impacts of increasing sedimentation, transport & appropriate setbacks at a local scale • Models linking erosion and sea level during storm events (hourly predictions in embayments and river mouths, wave observations, isostatic rebound, resonance, accretion, down-cutting, steep slopes) • Topography and bathymetry (LIDAR) mapping on 10-year cycle for shorelines and more intensive mapping for wetlands • Landscape response to sea level rise/salinity changes (requires detailed topography, bathymetry and habitat baselines) • Web-based tool on effects of sea level rise at the property level, for public education and government decision-making

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
			• Regionally based predictions on sea level rise
Assess impacts and document systematic changes in ecosystem functions	Incident command decision-makers response to spill emergencies (e.g., protect sensitive resources, deploy spill clean-up equipment & personnel, protect worker safety, respect operational limits of response equipment, etc.) Implement ecosystem-based approaches to management	• Localized real-time sea surface and air temperature, subsurface salinity levels, ocean currents, fog, ice, tides & wind speed to determine proper dispersants and assist with bird/animal rescue efforts	• Access to real-time data • Continuous aerial photography of coastal areas to locate habitat type, extent and determine effects of human activities • Trajectory and hydrodynamic models (i.e., 6, 12, 24, 48 and 72 hour maps) at various depths & three dimensional models of upwelling and down welling (e.g., identify areas at risk when oil is in the water) • Climate change modeling
Protect the public and infrastructure from and during coastal storms	Identify low lying areas that will be inundated by coastal storms Determine emergency responses measures	• Wind, directional waves, wave height and period, barometric pressure to identify wind and flood prone areas	• Produce wave run-up models to calculate infrastructure exposure • Map and zone high risk areas (e.g., wave run-up models, storm surge predictions for managers to understand how high water levels will be, how long the areas will be inundated, what direction flood waters will flow, what properties are at risk, etc.) • On-scene tools to mitigate human and infrastructure risks
Facilitate appropriate coastal dredging and beneficial re-use of sediment	Identify and permit “dredging windows” in ports and channels Manage beach systems and nourishment projects	• Area specific surface and subsurface currents, velocities, wind speed and direction, temperatures, water chemistry	• Sediment transport models to predict sediment location and movement post dredging activities; effectiveness of nourishment projects & long-

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
		• Historic and current erosion and accretion /deposition rates • Wave data covering large areas (to track sediment transport)	shore transport in surf zone; and capping of disposal sites • Databases to assist in cost-benefit calculations (e.g., how long sand will remain in the beach) and improving FEMA map products
Derelict ships & search and rescue	Locate mariners in distress	• Precise wind direction, sea state and speed	• Predictive drift models of where people in rafts would drift before being rescued or where derelict ships would drift to • Real-time sea surface temperature for survivability

Living Marine Resource Management & Ecosystem-based Approaches

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
Protect fish habitat to conserve biodiversity and the functioning of marine ecosystems	Monitor and predict environmental conditions that affect living marine resources Understand larval transport for lobster, urchin and other species to improve understanding of the structure and dynamics of populations, including spatial connectedness, variability, etc., and support related management efforts (e.g., management plans characterizations of the nearshore environment, population dynamics work, etc.), and fishery controls (size limits, harvest limits, gear restrictions, seasons, spawning closures, etc.) Identify and regulate shellfish growing areas and Essential Fish Habitats Assess climate change & impacts of the change – to understand effect of the changes in abundance of species and changes in weather Determine life history and habitat requirements of fish species Protect endangered and other species of special concern	• Near-shore current direction, advection & velocities, wind speed & direction, wave action, chlorophyll, primary productivity • Bathymetry and sea surface temperatures to mange crab and scallops • Sea surface temperatures to manage upper trophic level organisms (i.e., migratory patterns, vertical movements of fish)	• Predictive models that link physical and biological data that document conditions for successful year-class recruitment (distribution and population estimates) • Ecosystem mapping of megafauna tied to potential forcing factors – support ArcGIS applications • Estimates of annual variation in larval/juvenile recruitment • Estimates of food availability for the early life stages of key fish species & other conditions that influence survival • Produce upwelling index maps (pressure differences) for priority areas (possibly tied to temperature) • Larvae and egg-transport maps (entrainment, settlement, etc.) for priority species & scallop spat movement & collection for aquaculture grow-out • Models to guide managers making biotoxin (e.g., PSP, DSP) closures • Physical and biological data (e.g., temporal and spatial) combined with life history data (e.g., spawning, feeding, etc.) for key species • Compilation of data to support MPA designations (areas not affected by

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
			land-based inputs and long-shore transport, including point source effects, thermal discharges, stormwater runoff & heavy paths of river discharges that may deliver high loads of contaminants) & condition of benthic habitat within and outside of MPA • Maps of sediment concentration and accumulation rates • Estimates of the condition and extent of EFH • Estimates of benthic community structure and abundance (& conditions that alter that habitat) • Inventories of species at reference sites and representative stations for macrobenthic animals and plants, microphytoplankton, macrozooplankton, fish, mammals, and birds • Annual reports on species legally defined as at-risk that are increasing, decreasing or stable
Manage marine aquaculture	Identify areas most suitable for aquaculture Regulate net-pen and shellfish aquaculture	• Water chemistry (DO, nitrates, ammonia); currents and velocities; phytoplankton species, abundance, diversity, and location; • Water temperature; salinity, nutrients, current direction, velocity, chlorophyll, primary productivity	• Historic and real time databases (e.g., assess suitability of sites to assimilate increased waste loads, inter-annual changes, and decadal changes, etc.) • Circulatory models to track the movement of Infectious Salmon Anemia (ISA) • Bay-specific characterizations

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
			• Monitoring benthic eH and sulphides
Work with shippers to avoid Right whales	Notify mariners and assist fixed gear fishermen get gear out of the water Increase public awareness of the presence of cetaceans	• Ocean currents, winds and nutrients, acoustic monitoring	• Notice to Mariners • Data to predict migratory paths and timing in support of fisheries surveys for stock assessments and management plans

Vessel, Port and Harbor Management

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
Port development and expansion	Port authorities seek to accommodate larger vessels Coastal managers promote vessel safety	• Weather and tide information, winds, currents, & bathymetry • Current, swells, wave information • TSS and factors controlling sediment transport	• Real-time and variability on .1 hour to inter-annual data on weather to improve decisions on ship movement (safety, scheduling, fuel economy, etc.) • Marine forecasts for mariners, buoy tenders, tugs, etc. such as wind-driven seas, swells, etc. that add to fuel costs if unpredicted, raise safety issues and affect scheduling • Digitized historical tide data (100-years) • Predictive models to assess likelihood of repeat dredging for port development and expansion
Port use	Determine safest and most efficient travel paths/routes (graphical depictions vs. text to avoid language problems associated with international crews)	• Shoaling, movement of channels, sediment budgets, and bathymetry • Period of waves and swells, wave height, average height and wave direction, period • Surface and near-shore currents (speed, direction, forecasts, velocities via HF radar); wind speed, gusts and direction; wave conditions; tidal levels, & current and projected weather conditions including fog and severe storms, visibility, precipitation	• Real time, referenced water level .1 hour to inter-annual information on safe channel depths • Port specific reports that identify safe and efficient locations for port facilities (piers, jetties, mooring locations, channels) • Coastal bathymetry harbor reports (monthly, seasonal & inter-annual) • Produce harbor/bay sea state wind and wave data at 6-12 hour intervals & interface with area data • Wind forecasts at 6-8 hour intervals

Description	Types of management decisions	Product Requirements[1]	Types of Products[2]
			• Surface current velocity vector maps (10-220 km via HF radar) • Real-time surface and subsurface current maps and access to forecast fields up to 12-hours & historical fields for the 30 days previous • Real-time accumulation of ice on vessel superstructures • Pre-programmed routing forecasts for cheapest and most efficient routes
Minimize adverse effects of invasive species	Standards for discharge of ballast water Control spread of invasive species	• Circulation patterns, near-real time current data	• Projected delivery mechanisms for invasives in ballast water discharges & areas off-limits to ballast water uptake and discharge • Annual report on non-native species in coastal embayments where occurrence is measured in terms of both surface area affected and number of species relative to the number of native species
Derelict ships & search and rescue	Locate mariners in distress	• Precise wind direction, sea state and speed • Surface currents, SST, waves, air temperature, visibility, precipitation	• Improved predictive drift models of where people in rafts would drift before being rescued or where derelict ships would drift to • Real-time sea surface temperature for survivability • 3 – 30 day forecasts within 10 km of shore

Bibliography

Alaska User Needs Assessment, May, 2004 Appendix A

Boyd. Coastal and Ocean Observing System User Requirements: An Examination of User Surveys. 2000 Technology Planning and Management Corporation/Coastal Services Center

Bricker, Lipton, Mason, Dionne, Keeley, Latimer, Pennock. 2005. Improving Methods and Indicators for Evaluating Coastal Water Eutrophication: A Pilot Study in the Gulf of Maine. NOAA/CICEET. p 8

Coastal States Organization. Recommendations to the US Commission on Ocean Policy. 2004

Eslinger. SECOORA Ocean Observing Market Analysis; Appendix A Compendium of Needs Assessment Documents. 2004 SECOORA

Great Lakes Observing System. Public Survey. August 24, 2005.

Great Lakes Observing System. Business Plan. October 26, 2004

Keeley, Gregorio, Bailey, More Effectively Using Observing, Monitoring, Research and Education Infrastructure. 2002. California and the World Ocean Conference Proceedings

Keeley. 2003. Ocean Observing and Coastal Managers Users Needs. Coastal States Organization/Anchorage Alaska Annual Meeting.

Keeley. Great Lakes Coastal Managers User Needs Focus Group. 2005. NOAA & Coastal States Organization – Chicago, Illinois

Keeley. Southeast Coastal Managers User Needs Focus Group. 2004. NOAA & Coastal States Organization – Jacksonville, Florida

Keeley. Nutrients and Coastal Managers Needs. 2002. NOAA Eutrophication Workshop – Patuxent Maryland.

Magnien, Maryland Coastal Program. Personal Communication. 2002

Mercer. Information Needs for Fishery Management in Maine. 2002 Gulf of Maine Modeling Workshop – Portland, Maine

Mitreteck Systems. National Ocean Service Requirements for the integrated Ocean Observing System: Case Study for Coastal Management. 2005. NOAA

Schoch, McCammon. A Demonstration of the Alaska Ocean Observing System in Prince William Sound: Alaska Ocean Observing Workshop. 2005. Alaska Ocean Observing System

Shackeroff. 2002. Coastal Eutrophication – Perspectives from the California Coastal Commission's Water Quality Unit. (Personal communication)

Thurlow, Kruse, Bierling. A User Assessment of Coastal Ocean Observation Systems in the Gulf of Mexico. 2004. Texas Sea Grant Program/Texas A&M University System

Urban Harbors Institute. State Coastal Observations and Monitoring Needs: Results of a Survey to Assess Coastal Management Needs. 2004. Coastal States Organization/SEACOOS Outreach and Education Work Group

Urban Harbors Institute. Improving Links Between Science and Coastal Management: Results of a Survey to Assess Science and Technology Needs. 2004. Coastal States Organization/NOAA - Cooperative Institute for Coastal and Estuarine Technology

Watson. Summary of Needs from CeNCOOS Stakeholders. 2004

Workshops

Managing Nitrogen Impacts in the Gulf of Maine. 2001
Gulf of Maine Coastal Monitoring Strategy. 2002
Northeast Coastal Indicators Workshop. 2004
Gulf of Maine Summit. 2004

Preliminary Priority Products

NERACOOS Advisory Board

In August 2006 members of the Advisory Board were requested to review the types of coastal management products identified in draft report *Synthesis of Coastal Managers Needs for Ocean Observing Products and Services* and to identify those they found most compelling. Those that responded identified the following items as being most important.

Public Health, Water Quality and Recreation Management

- 3-7 day trajectory models to assist managers understand the timing, formation, duration, location and movement of harmful algae blooms (e.g., projected shore-fall sites) and to support allocation of resources (e.g., state sampling staff, health advisories, beach closing, move product to safer waters or harvest it, etc.)
- Mesoscale hydrodynamic models for northeast estuaries and embayments
- Trophic index updated no less than weekly (such data would be very useful in conjunction with satellite (e.g. MODIS) data and surface temperatures)
- Nitrogen attenuation/loss coefficients by source (e.g., atmospheric deposition, etc.) for wetlands and groundwater transport
- Assessment of overall eutrophic condition & human influence

Shoreline Hazards & Emergency Management Priority Products

- Produce wave run-up models to calculate infrastructure expose (High - Nor'easter Model would be very useful)
- Map and zone high risk areas (e.g., wave run-up models, storm surge predictions for managers to understand how high water levels will be, how long the areas will be inundated, what direction flood waters will flow, what properties are at risk, etc.)
- On-scene tools to mitigate human and infrastructure risks (clarify exactly what these tools would consist of)
- Databases to assist in cost-benefit calculations (e.g., how long sand will remain in the beach) and improving FEMA map products
- Models linking erosion and sea level during storm events (hourly predictions in embayments and river mouths, wave observations, isostatic rebound, resonance, accretion, down-cutting, steep slopes)
- Landscape response to sea level rise/salinity changes (requires detailed topography, bathymetry and habitat baselines)
- Web-based tool on effects of sea level rise at the property level, for public education and government decision-making

- Trajectory and hydrodynamic models (i.e., 6, 12, 24, 48 and 72 hour maps) at various depths & three dimensional models of upwelling and down welling (e.g., identify areas at risk when oil is in the water)
- Sediment transport models to predict sediment location and movement post dredging activities; effectiveness of nourishment projects & long-shore transport in surf zone; and capping of disposal sites
- Predictive drift models of where people in rafts would drift before being rescued or where derelict ships would drift to
- Real-time sea surface temperature for survivability

Living Marine Resource Management

- Produce upwelling index maps (pressure differences) for priority areas (possibly tied to temperature)
- On-line tools that integrate known migratory patterns, aerial surveys and the real-time presence of phytoplankton to identify prime frontal boundary conditions (e.g., plankton patches)
- Data to predict migratory paths and timing in support of fisheries surveys for stock assessments and management plans

Vessel, Port and Harbor Management

- Surface current velocity vector maps (10-220 km via HF radar)
- Real-time surface and subsurface current maps and access to forecast fields up to 12-hours & historical fields for the 30 days previous