Water Quality Monitoring Managers' Needs Assessment Workshop for Estuarine, Coastal, and Ocean Observations

WORKSHOP REPORT
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IOOS INTEGRATED OCEAN OBSERVING SYSTEM
NOAA
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MACOORA coordinates and facilitates observations of the ocean and estuaries between Cape Hatteras and Cape Cod as part of a national effort to improve scientific observations of our coastal oceans. MARCOOS is the regional observing system of MACOORA. Currently, the top two priorities for MACOORA and MARCOOS are inundation and water quality. For more information on MACOORA, see www.macoora.org.

The New Jersey Marine Sciences Consortium / New Jersey Sea Grant is an affiliation of colleges, universities and other groups dedicated to advancing knowledge and stewardship of New Jersey's marine and coastal environment. NJMSC/NJSG meets its mission through its innovative research, education and outreach programs. For more information about NJMSC/NJSG, visit www.njmsc.org.

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Workshop Goals and Outputs

In March 2008, the Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) hosted a Needs Assessment Workshop on Water Quality Monitoring for Managers as part of its mission to establish its regional, integrated ocean observing system driven by stakeholder input. The two-day Workshop focused on key coastal resource management issues in light of existing and contemplated observing systems, research priorities, and the needed cooperation among MACOORA sub-entities. The Workshop focused on the current management knowledge base and data availability for addressing water quality-related coastal resource management issues; the prioritization of water quality-related coastal resources management issues; current capabilities to improve the condition of MACOORA estuaries and coastal bays; and the resource-use conflicts and management challenges for resolving the issues. A dedicated group of federal, state, and local coastal water quality managers and scientists from the MACOORA region participated in the Workshop. They shared their knowledge and current capabilities to develop a set of recommendations that MACOORA should take to address their needs.

Several action items for MACOORA were recommended in regards to coastal water quality. In general, these included developing and providing a central database system, developing newer and more powerful models, working with managers and scientists to develop sampling protocols, providing outreach and training to managers on new IOOS tools, having new technologies accepted by state and federal agencies, and being proactive in its outreach/extension mission. The following value-added recommendations were developed from them as a starting point for the development of water quality information products that meet user needs.

1) MACOORA should develop a predictive spatiotemporal screening tool to identify high risk areas to beach bathers/swimmers (Public Health Issue).

2) MACOORA should develop a predictive screening tool to identify high *Vibrio* conditions that trigger resource manager assessment for shellfish bed closures (Public Health Issue).

3) MACOORA should establish a "braintrust" of “on-call” scientists to respond to algal bloom events and provide real-time information to elected officials and resource managers (Hypoxia/Algal Bloom Issue).

4) MACOORA should establish additional assets, sensors, and coordination on a regional scale to significantly enhance management capacity that addresses wetland condition (e.g., inundation, water quality, habitat and living resource issues (Habitat Loss and Freshwater Inflow Issue).

5) MACOORA should establish a proactive outreach team (Sea Grant and MACOORA scientists) to retrieve stakeholder input and to market user-defined tools and products.

A more detailed description of the discussion and summation of the two-day workshop follow in this report.

Workshop Organization

The Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) hosted a Needs Assessment Workshop on Water Quality Monitoring for Managers as part of its mission to establish its regional, integrated ocean observing system driven by stakeholder input. The New Jersey Marine Sciences Consortium / New Jersey Sea Grant co-hosted the Workshop held outside Philadelphia, Pennsylvania on March 11-12, 2008. The Workshop focused on key coastal resource management issues in light of existing and contemplated observing systems, research priorities, and the needed cooperation among MACOORA sub-entities. The goals of the Workshop were to present and evaluate the current management knowledge base and data availability for addressing water quality-related coastal resource management issues; assign priority to the water quality-related coastal resources management issues; identify what is being done to improve the condition of MACOORA estuaries and coastal bays; and describe resource-use conflicts and management challenges for resolving the issues.

A dedicated group of 35 federal, state, and local coastal water quality managers and scientists from the MACOORA region participated in the Workshop. They shared their knowledge and current capability, techniques, and methodology to help develop a set of recommendations for how MACOORA should take practical steps to address their needs, including product development.

The workshop commenced with an initial welcome and definition of meeting rationale to the attendees. This preamble was followed by five workshop presentations that laid the groundwork for the later breakout sessions. The first two speakers provided perspectives on water quality issues at the national level (Jawed Hameedi) and at the regional level of the Delaware Estuary (Robert Tudor). These presentations were followed by three outstanding case studies by state and local coastal water quality managers regarding current monitoring programs and challenges in Long Island Sound (Matthew Lyman), coastal New Jersey (William Simmons) and Chesapeake Bay (Mark Trice). These water quality managers had partnered with the scientific community (Lyman with James O'Donnell; Simmons with Scott Glenn; and Trice with Kevin Sellner) to make use of IOOS type protocols in their decision making process. Breakout sessions discussed the particular needs of coastal water quality managers for data, data products, or tools; to identify data gaps; and how to reduce the gap in capabilities by looking to MACOORA and IOOS for opportunities and solutions. The second day plenary session was dedicated to a summation of key findings from the breakout sessions. The plenary session was followed by a discussion panel, composed of coastal water quality managers and MACOORA scientists, to encourage further discussion and reaction. Discussion and consensus from the plenary session and discussion panel formed the basis of the recommendations for MACOORA found in this report.

Background

There are several water quality-related issues that impact coastal waters nationally and are of concern to NOAA, IOOS and other federal agencies. Coastal water quality issues are unique in that energy (storms, tides), materials (water, sediment, nutrients, toxics, pathogens) and human activities converge in these areas. The NWQMN focuses on eight water quality-related issues. These water quality-related issues include Coastal Pollution (toxics concentration in comparison with guidelines, over-enrichment of nutrients (eutrophication), source attribution of toxic chemicals and nutrients; toxic contaminants in the environment and biota); Shellfish Bed Closures; Seafood Consumption Advisories; Beach Closures and Swimming Advisories (Pathogens and microbes); Harmful Algal Blooms; Hypoxia(oxygen depletion); Impact of Non-indigenous Species (Invasive species); Habitat Loss and Modifications (including freshwater requirements) (Habitat degradation); Sedimentation and Impacts of Extreme Natural Events on Water Quality.

Coastal water quality issues are a high priority for the mid-Atlantic region as evidenced in the following case study snap shots. Beach closures due to medical wastes (floatables) have occurred in New Jersey, most infamously in the 1980's and more recently in Avalon and Ocean City (2008). As revealed in the presentation by William Simmons, nationally, beach closures are up with a record of 25,643 beach closures or warnings in 2006 (up 28 percent) due to high levels of harmful bacteria, for a second straight record setting year. In New Jersey the 134 ocean and bay beach closures and advisories in 2006 (most due to preemptive closures in Monmouth County since 2002) were a 70 percent increase from 79 closures in 2005. These closures cause significant economic and enjoyment hardship.

Furthermore, there are more frequent occurrences of harmful algal blooms (HAB) in Long Island Sound, coastal Long Island (south shore), New Jersey Coast (brown tides), and Chesapeake Bay (including the *Pfeisteria* outbreak in the late 1990's). Human health concerns have arisen from *Pfeisteria* and other HAB; and increases in presence of *Vibrio* in shellfish (oysters) resulting in shellfish bed closures (New Jersey closed shellfish beds in Delaware Bay in 2008). The lobster fishery in Long Island Sound was recently greatly reduced by a die off caused by combined warmer water temperatures and a parasitic amoebae infection. Long Island Sound undergoes seasonal hypoxia (overviewed in the presentation by Matt Lyman) joining the Chesapeake Bay in battling this problem. Both HAB and hypoxia have resulted in fish kills. The Barnegat Bay in New Jersey is under stress from eutrophication due to nutrient input and loss of ecosystem function from reduced wetlands (water filter) and increased impervious surfaces in its watershed. This change is ecosystem state may have resulted in the recent appearance of sea nettle (jellyfish) blooms in Barnegat Bay. Thus, by example, coastal water quality issues are a high priority for the mid-Atlantic region.

Coastal water quality issues are of great concern as the MACOORA region encompasses one of the most complex geographic regions in the country that includes 9 states, 66 million people, and 4 major estuaries (Chesapeake Bay, Delaware Bay, Hudson River Estuary, Long Island Sound). The cities of Boston, New York, Philadelphia, Baltimore, and Washington, DC are major population centers and 22% of all US port calls in 2005 occurred in the region.

Concerns about coastal water quality will continue as human population continues to grow along the coast. The Final Report of the United States Commission on Ocean Policy (USCOP) summarized these trends and their potential impacts. Over 50% of the US population lives in coastal watershed counties that comprise less than 25% of the US land area. Total growth from 1970-2000 in coastal watershed counties was 37 million and will increase another 21 million by 2015 (57% growth in rural coastal zone counties; 38% in urban coastal zone counties). Along the Atlantic coast an increase of over 11 million (28.5%) in coastal watershed counties occurred from 1970-2000.

The human population growth occurring throughout the coastal watershed results in the increase of impervious surfaces. As little as 10% impervious cover can result in degradation of local water bodies. Several factors related to human population growth, including expanding coastal sprawl, destroy natural habitat, resulting in reduced environmental ability to provide food and refuge for wildlife or supply ecosystem services such as maintaining water quality. Poorly planned growth in coastal areas reduces sedimentation fates and flows to wetland areas and contributes to water pollution (urban, suburban, and agricultural) that impacts fishing, swimming, and other recreational and economic activities. Nationally over half of wetlands (110 million acres) have been lost since settlement (European) thus there has been extensive loss in ecosystem function (e.g., water quality).

The Final Report of the USCOP stressed that America's Ocean and Coastal assets are being undermined by degraded waters that include excess nutrients, other contaminants, harmful algal blooms, and sediment contamination. Thus the USCOP recommended that the three primary federal agencies involved in monitoring (NOAA, EPA, and USGS) work with other agencies and states to develop a National Monitoring Network supported by a federally funded backbone of stations to assess long-term trends and conditions with additional measurements to address regional problems. To this end USCOP recommended (15-2) that "the National Oceanic and Atmospheric Administration should ensure that the national monitoring network includes adequate coverage in both coastal areas and the upland areas that affect them, and that the network is linked to the Integrated Ocean Observing System, to be incorporated eventually into a comprehensive Earth observing system." Developing a National Water Quality Monitoring Network was included as an item in the Administration's Ocean Action Plan (December 2004).

Furthermore, Recommendation 23-5 states "the NOAA, EPA, and Food and Drug Administration, working with state and local managers, should fully implement all existing programs to protect human health from contaminated seafood and coastal waters." Different NOAA line offices use water quality-based data and information products in managing protected species (e.g., whales), areas (e.g., National Marine Sanctuaries), and ecosystems (e.g., coral reefs). NOAA also uses such data for establishing connection between impaired water quality and undesirable ecosystem conditions or outcomes (e.g., nuisance or harmful algal blooms, eutrophication, hypoxic conditions, and loss of species and biodiversity). A recent NOAA initiative, entitled Integrated Water Resource Services, is designed to showcase NOAA's extensive expertise, products and capabilities on a regional basis; one of the focus areas under this initiative is Delaware Bay.

This recommendation is being acted upon and is part of NOAA's mission as stressed at the workshop. NOAA seeks multi-disciplinary collaboration, through leveraging, in order to facilitate and expedite the transfer of research to operations for new services related to water resources, coastal / estuary / inland environmental stewardship, and hazard risk management. Activities by NOAA's Water Resource Services are to lead to ecosystem stewardship based on sound decision making.

NOAA responded to the USCOP recommendation for accommodating IOOS observations in the design of the National Water Quality Monitoring Network by organizing an inter-disciplinary and cross-sectoral workshop at Rutgers University in September 2005 (Rowe, et al., 2006). The workshop, co-hosted by NJMSC/NJSG, focused on water quality-related resource management issues in Delaware Bay. The workshop participants noted that current activities and monitoring assets in the region made the Delaware Bay ecosystem very well suited for this purpose, notably through a) integration of existing discrete sampling sites and monitoring networks, (b) addition of supplemental monitoring from ferries and/or autonomous underwater vehicles, (c) incorporation of existing air deposition sites and networks, and (d) enhancement of existing arrays of shore-based, aircraft or space-borne sensors.

Some of the more specific workshop recommendations linking IOOS and NWQMN monitoring included:

- Current assets should be utilized to develop a cost-effective and comprehensive monitoring program that links system components to serve regional needs;

- Comparable data and an integrative approach to water quality monitoring are essential such that any future IOOS-NWQMN monitoring should be tailored to meet specific resource management goals;

- The temporal and spatial scale of monitoring should be enhanced by application of new sensors and observation technologies;

- Monitoring should be strongly linked to current or future management and ecological issues (e.g., wetlands loss due to sea level rise);

- Monitoring should be consistent with requirements for natural resource models in the region (e.g., oyster recruitment and disease incidence models); and

- The Delaware Bay Ecosystem should be used as a pilot or proof of concept model for a linked IOOS-NWQMN, in particular by utilizing IOOS observational assets and data management protocols.

One of the outcomes of this workshop was the development of a Delaware River Basin Pilot Study that identified management issues, inventoried current monitoring programs, identified gaps, investigated data comparability and data sharing issues, and estimated costs of current and needed monitoring. Management issues linked to coastal water quality included habitat

degradation and loss (ecosystem function loss), contaminants, sediment management, nutrient enrichment, oxygen depletion, harmful algal blooms and pathogens. Current data and information gaps include the need for detailed comparison of on-going monitoring and Network design; gaps in number of sites, sampling frequency, and need for additional analytes; and the need for local flexibility in adding tributary rivers. Current plans include adding nutrient monitoring in river, estuary, and Bay; improving the watershed-to-ocean observing system web site to facilitate data sharing; investigating emerging contaminants; and assessing wetlands through a tiered approach. The pilot study was completed in February 2008. Follow-up studies and activities are underway or being proposed through a Delaware Estuary-to-Watershed-to-Ocean Observing System (DEWOOS) regional IOOS proposal.

The above workshop and pilot program emphasizes need to address the freshwater aspects of IOOS monitoring in the MACOORA region. Water quality in the estuaries and coastal areas are strongly influenced by the natural landscape and human activities of the drainage area upstream from the estuaries and coastal areas. Because of the large population centers along rivers in the MACOORA region, the loads of contaminants from the rivers as well as atmospheric deposition need to be address. The water quality connection between the watershed and coastal waters has been highlighted by recent reports from the Delaware River Basin Commission (2008) and the National Water Quality Monitoring Council (2006).

Interagency mechanisms are now in place for collaboration and integration across monitoring programs and observing systems. There is a national need to define a set of key environmental indicators to allow regional IOOS to better communicate and collaborate with each other. New observational technologies need wider applications to become both cost-effective and profitable. The IOOS, a federal and regional cooperative partnership, is a potential source of information on coastal issues including those for coastal water quality managers. Regional IOOS Associations have been established (e.g., MACOORA) and they will be a vital link to coastal managers and stakeholders to assure that IOOS has a strong customer focus and relevance.

Regional IOOS Associations rely on numerous platforms (buoys, gauges, satellites, surveys, high frequency radar, gliders, etc) to gather data about the coastal and ocean environment and to provide users with timely information and predictions. IOOS consists of federal assets (NOAA weather buoys, stream gauges, satellites, etc.) and a network of regional Associations that focus on the needs of regional users (e.g., coastal WQ managers). The centralizing theme of IOOS is the integration of data from multiple sources into models for developing predictions and information products.

In the Mid-Atlantic region, MACOORA serves the regional association and the interface between local users and the national IOOS. The MACOORA region ranges from Cape Cod to Cape Hatteras and includes 5 subregions – Chesapeake Bay, Delaware Bay, New York Bight, Long Island Sound, and the Massachusetts and Rhode Island Bays – and covers nine states and the District of Columbia. MACOORA is a partnership of data providers and users from both private and public sectors that use, depend on, study and manage coastal environments and their resources in the region MACOORA is responsible the design,

coordinated development and eventual operation of a regional coastal Ocean Observing System (RCOOS) that is responsive to the needs of multiple user groups and improves as new knowledge and technologies become available. The information gained from this workshop will be considered in the design of MARCOOS.

Summary of Breakout Sessions – Key Findings

The plenary presentations of the first day provided background information on IOOS-related water quality monitoring programs at the national (NOAA) and regional (Delaware River Basin Pilot Study) levels. The presentations were followed by three case studies within the MACOORA region that combined IOOS-type monitoring with coastal water quality management. All the presentations provided insight into current capabilities as well as needs within the MACOORA. The plenary session set the stage for the following three breakout sessions that captured key findings in 1) Needs and Requirements; 2) Needs vs. Current Capabilities (Gap Analysis); and 3) Filling the Gaps: Identifying Opportunities and Solutions. The summary of each breakout section contains bulleted remarks that reflect the comments and suggestions presented by the participants in each breakout. During the second plenary session on Day 2 the most important findings were highlighted. In the following sections of this report all comments are bulleted with plenary recommendations moved to the top of the list and highlighted in bold text).

Needs and Requirements (Breakout 1)

The first Breakout session on needs and requirements for coastal water quality managers was divided into three subgroups based on pre-meeting feedback in regards to water quality issues and threats of most concern. The three areas were Public Health, Hypoxia/Algal Blooms, and Habitat Loss and Freshwater Requirements. The question-set for each of these subgroups were nearly identical and included questions on current water quality decisions, information to local communities, and on human health and aquatic habitats. The breakout was also open to the discussion of extreme events (e.g., tidal marsh inundation from sea level rise and resultant loss of ecosystem function). See Appendix A for complete question list.

Breakout Group A: Public Health

The case study on public health issues in regards to coastal water quality (Simmons presentation) set the stage for this breakout session. Beach closures (often precautionary) have been increasing in New Jersey and nationally. Simmons was able to use IOOS-type data from IMCS Rutgers to help predict (forecast) or manage for beach closures due to bacteria and floatables in Monmouth County, New Jersey. Topics of discussion of the user needs and requirements on public health issues included concentrations of toxic chemicals (preferably in comparison with criteria or guidelines); shellfish bed closures (acute - storm or spill event; *Vibrio*); seafood consumption advisories; beach closures and swimming advisories (including false notifications; bacteria and floatables); source attribution of toxic chemicals and nutrients (atmospheric deposition, rivers, surface runoff, groundwater, coastal

ocean). Additional areas of concern discussed included Homeland security, industrial and shipping spills, fish advisories in terms of long term integration of toxics (e.g., PCB's); seabreeze and aerosols (e.g., asthma), and pharmaceuticals.

Based on the discussion by the Public Health Breakout Group, MACOORA should:

- **Enhance forecasting and modeling capabilities (e.g., longshore currents).**
- **Work with partners to enhance development of sensors and sensor specificity.**
- **Integrate consistent data format into central portal to reduce search and decision time.**
- **Communicate to managers the proper interpretation of data.**
- **Provide better (understandable) public outreach (public literacy and communication) and for specific events (e.g., spills).**
- **Work to get newer technologies (e.g., site specific sensors for algae (HAB), etc.) accepted by EPA so that states can use them.**
- Provide assistance in determining appropriate temporal and spatial scaling for monitoring of offshore, nearshore, and estuarine waters.
- Assist in integrating communities in order to reduce costs of water quality monitoring or to better respond to beach closures, spills and other events.

Breakout Group B: Hypoxia/Algal Blooms

The case studies of hypoxia in Long Island Sound (Lyman) and algal blooms in Chesapeake Bay (Sellner) provided this breakout group some of the successes that managers have achieved using IOOS-type monitoring. Further, they provided a foundation to discuss additional needs and requirements that coastal water quality managers have in regards to hypoxia and algal blooms. Needs and requirements were in this area were addressed in light of over-enrichment of nutrients (nutrient imbalance, eutrophication, etc.); the nature and incidence of harmful algal blooms; hypoxic conditions in estuaries, coastal bays, and continental shelf; and future planning for detection of blooms and bloom toxins.

Based on the discussion by the Hypoxia/Algal Blooms Breakout Group, MACOORA should:

- **Provide better synthesis of understanding in order to develop an observing system that informs management decisions.**
- **Identify and analyze gaps in existing observing assets.**
- **Provide scientific "brain trust" as a resource to managers in addressing an event such as a large algal bloom or hypoxia (e.g., resource for shellfishery events).**
- **Provide information/understanding for states/municipalities to come to a common consensus on criteria (e.g., state response to proposed DO criteria).**
- **Help develop and evaluate monitoring criteria.**
- Provide analysis of information to better explain sources/causes regarding HAB events.
- Determine where (and what) data is truly needed (strategic data collection).

Breakout Group C: Habitat Loss and Freshwater Requirements

During the plenary session, the presentation on the Delaware River Basin Pilot Study (Tudor) addressed several of the water quality issues facing the Delaware Estuary, one of the major estuaries in the MACOORA region. The presentation set the background for the breakout session on Habitat Loss and Freshwater Requirements. During this breakout session, discussion of the user needs and requirements included issues on habitat loss and modifications (coastal armoring, maintenance dredging and deepening of ship channels, coastal erosion); impact of non-indigenous species; freshwater requirements to maintain integrity of estuarine ecosystems; and assured continued propagation of fish (including shellfish) and wildlife. Several of the recommendations were similar to the Hypoxia/Algal Bloom Breakout Group and included identifying gaps in existing observing assets; helping develop and evaluate monitoring criteria; and providing information to come to a common consensus on criteria.

Based on the discussion by the Hypoxia/Algal Blooms Breakout Group, MACOORA should:

- **Monitor how variables (Flexible Flow Management Plans, channel deepening, climate change (sea level rise)) affect Fresh Water Inflow and** hydrodynamic mixing **and its impact on biota/habitat along the gradient and within tributaries of estuaries.**
- **Improve sensors and monitoring that are linked to the proper biological/ecological questions and flood inundation projects.**
- **Identify, monitor and link wetland health (diseases and food quantity/quality) to freshwater inflow (salinity) and water quality.**
- **Improve observing system to include lateral sampling in estuaries and tributaries and their associated habitats.**
- **Inventory available biological data for analysis and modeling (e.g., oysters, eel grass) for finer tuned wetland analysis.**
- Develop a trend analysis and finer-tuned analysis for wetlands.
- Assess sudden wetland dieback.
- Evaluate replenishment of wetlands via sediment addition.

Needs versus Current Capabilities (Gap Analysis) (Breakout 2)

After addressing the needs and requirements during the first breakout session, the meeting participants focused on addressing those needs by assessing the current IOOS capabilities within the MACOORA region. The presentations during the morning plenary session highlighted some of the current capabilities in the MACOORA subregions. As such, this breakout session was divided into the subregions for discussion, with some of the subregions combined to achieve critical mass for the breakout subgroups (Delaware Bay, Long Island Sound and Chesapeake Bay, New York Bight and Massachusetts-Rhode Island Bays). Additionally some suggestions and comments were received prior to, during, and after the workshop by interested managers and scientists that could not attend. Discussions focused on a question-set that included inquiry on the sufficiency of current observation and

monitoring programs for meeting these needs; gaps in observations/data; impediments for overcoming the gaps; and sufficiency of current models in meeting these needs? See Appendix A for more detailed questions for this breakout session.

The following gaps were identified:

- **Uncertainty in frequency and duration of impaired waters (DE Bay)**
- **Real-time sensors needed to improve response to impairment criteria (DE Bay)**
- **Agencies require tech support in addressing real-time streams of data sharing and standards problem (DE Bay)**
- **Lack of web portal to make data access easier and with common data format (LIS and Chesapeake Bay)**
- **Improvement in wave sensing and analysis (Chesapeake Bay)**
- **Lack of system response monitoring for groundwater, nutrients, non-point source contamination (LIS)**
- **Improve QA/QC and common formatting of different datasets (NYB)**
- **MACOORA needed as switchboard for data needs and accessibility (user-friendly) for emergency response (NYB)**
- **Improve LIDAR coverage (elevation) in estuaries to assess habitat loss (NYB)**
- **Lack of sampling (biological, physical, chemical) at scales useful for specific estuaries (MA-RI Bays)**

Additional gaps for Delaware Bay:

- Model development guided by user driven management questions
- Linking models to capture the connectivity of the estuary, coast, and ocean
- Reduce uncertainty in planning for sea level rise, changing precipitation events, flood events and its implication for ecosystem events
- Integrate dissolved Oxygen impacts with biological impacts
- Reduce impediments to data sharing (e.g., firewalls) and increase integration between federal and state agencies

Additional gaps for Long Island Sound and Chesapeake Bay:

- Increase in high frequency vertical profiles
- Increased spatial coverage in tributaries and shallow waters
- Common QA/QC protocols for measured parameters
- Fast response to events
- Development of nearshore sampling methods for salinity and bacteria
- Improved sampling for additional contaminants
- Improved understanding of the interaction of ground water and surface water
- Better time series of biological production and respiration rates

Additional gaps for New York Bight and Massachusetts/Rhode Island Bays:

- Fill in data gaps in water quality parameters for TMDL on south shore of Long Island
- Real-time data of basic parameters (temperature and salinity) along south shore of Long Island, New York Harbor and Coastal New Jersey
- Improved data on nearshore dissolved oxygen
- Better understanding of coastal currents and offshore dissolved oxygen (hypoxia)
- Improved understanding of complex trends of submerged aquatic vegetation
- Improved understanding and data for nutrient fluxes at inlets

Filling the Gaps: Identifying Opportunities and Solutions (Breakout 3)

The third breakout session convened to identify opportunities and solutions to the needs and gaps recognized in the first two breakout sessions. This was an opportunity for MACOORA to obtain ideas and potential actions that would be useful in fulfilling its stated thematic goals in addressing coastal water quality issues. In particular, it was an opportunity to determine the kinds of data and information products (current and planned based on stakeholder input from this workshop) from MACOORA that would be useful in fulfilling the duties and responsibilities of coastal water quality managers. Suggested data and products from MACOORA that were put up for discussion included desktop decision making tools (models), access to detailed information, real-time data, format of data, and maps. Input for the discussion included the impacts of extreme natural events (e.g., floods, hurricanes, and drought). Subgroups in this session were to address opportunities and solutions in the short-term (0-3 years) and long-term (3+ years).

Short Term

In the short term MACOORA should:

- **Seek to make sure that MARCOOS proposals are critiqued against national standards where available to meet future DMAC compliance.**
- **Develop a brain trust of scientists to provide guidance to managers.**
- **Identify and/or create canned information software applications as templates that are available to academic teams and that can be applied across multiple jurisdictions (e.g., GIS type spatial dataset).**
- **Make available a clearing house of current activities in each subregion (also regionally and nationally) so that managers can decide if they want to develop those methodologies for their locale.**
- Make data available and accessible.
- Talk/work with Sensor experts and others using currently available sensors to develop sensors that meet their current and future needs.
- Build or adapt forecast models
- Expand its horizon beyond physical/ chemical parameters and look at development of other products (e.g., biota, habitat) to ensure meaningful measurements that will lead to informed decisions.

Long Term

In the long term MACOORA should:

- **Identify and prioritize core observations and locales for monitoring.**
- **Monitor vegetative tidal wetland area trends and changes that are critical to our understanding them (e.g., LIDAR).**
- **Develop a baseline of ecosystem structure in light of frequent changes.**
- **Provide a range of models (evolvable and revisable) for long term trends to inform management issues.**
- Maintain and sustain long term observations of tidal elevation, river discharge, and winds, etc.
- Prepare a science-based strategic plan to prioritize maintenance of assets and the expansion of new assets.
- Develop a comprehensive network of permanent stations and some movable assets to refine fine scale structure.
- Support long term observations in temperature and habitat change, etc. in regards to capturing climate change in coastal waters (e.g., to overcome shifting baselines).
- Determine the impact of sea level rise on both the natural environment and coastal infrastructure and their interaction with coastal water quality issues.
- Develop models that are critically assessed and continually reassessed with new technology and data.
- Determine how changes in water supply are likely to modify estuaries.
- Create a bibliography of ocean observation studies in the MACOORA region and nationally.

Summary of Panel Discussion

The plenary session on day two of the workshop focused on summarizing, highlighting and prioritizing the findings of the previous day's breakout sessions. After that session a panel discussion was held to get reactions from coastal water quality managers and MACOORA scientists. The panelists included Mark Trice (MD DNR), Matt Lyman (CT DEP), Leslie McGeorge (NJDEP & NJ Water Monitoring Council), Jim O'Donnell (U. Connecticut), and Rich Patchen (NOAA/NOS/OCS/Coast Survey Development Lab). They provided information on their backgrounds and projects and responded in general to questions provided them ahead of time. The questions focused on currently existing IOOS-type capabilities and their useful to managers, required knowledge to address water quality issues, specific actions by MACOORA to address the issues, and establishing on-going mechanisms for communication and coordination between managers and MACOORA. A general reaction by the managers was an appreciation for the meeting organizers for inviting them and for trying to develop tools that managers need and not vice versa (e.g., to find needs for tools). MACOORA is on the right track.

Mark Trice (MD DNR)

- **There is need for partnering and leveraging to fund continuous deployment of water quality sensors (e.g., MD DNR deployed DO sensors off NOAA buoys in the Chesapeake Bay).**
- **State water quality monitoring programs cannot monitor everywhere, so they must pick and chose the best locations to run predictive models and provide reliable information to make sound decisions (e.g., must be accountable and reach state goals).**
- **States can be at the forefront of testing new sensor technologies by collaborating with industry that want people to use year products (e.g., pro bono use for one year).**
- **MACOORA can help states get proposals funded by providing letters of support, handouts, technical abilities, and operational components.**
- **MACOORA can assist managers in site selection for monitoring (sampling design) based on funders reasons, desired research products, most dynamic range with limited number of sites, and to help fill data gaps.**
- **MACOORA needs to define the incentives, data standards (sensitivity to different agency databases) and timeliness for state agencies to submit their data over other databases. (Is data submission to MACOORA voluntary or mandatory?)**
- There is need for using remote sensing as tool to assess water quality and habitat changes in a qualitative sense in regards to extreme events and rapid response.
- There is a need for a full assessment of the Chesapeake Bay stem, especially for better vertical profiling to address the importance of stratification on DO and nutrients.
- There is a need for better HAB analysis and models as more outbreaks are expected (e.g., *Vibrio* outbreaks are correlated to warmer to water temperatures).

Jim O'Donnell (U. Connecticut)

- **Water quality monitoring programs and models must be evaluated for effectiveness and sound science (e.g., sampling at the proper spatial and temporal scales or sampling proper biotic parameter).**
- **MACOORA should increase coordination of managers and communication between them and scientists on infrastructure needs and standards.**
- **There is a need to develop capabilities and cooperation for operational support that comes from different agencies and different funding sources.**
- There is need for continuous, higher frequency monitoring in Long Island Sound for DO, nutrients, temperature and salinity, etc. as these parameters vary vertically, tidally, and daily but are currently only sampled weekly
- There is need for better models and understanding of (re)stratification in Long Island Sound is driven by wind mixing, thermal heating, and freshwater inflow and salt water mixing (tides).
- To model circulation and various parameters (e.g., DO) infrastructure in LIS must be obtained and maintained.

Rich Patchen (NOAA/NOS/OCS/Coast Survey Development Lab)

- **NOAA, through its line offices and the Integrated Water Resource Services initiative is prepared to work with MACOORA as part of NOAA's key mission of science, service and stewardship.**
- **Consistent with NOAA's "responsible drivers", MACOORA manages and MARCOOS observes and models.**
- **There is a need for strong baseline data (datum) in light of sea level rise and other environmental (ecosystem) changes.**
- **MACOORA should continue to support and develop coastal and estuarine models (e.g., bathymetry) by working and sharing with communities, building and sharing tools, and partnering as NOAA moves from PORTS models to regional models.**
- **MACOORA should look for opportunities to add sensors to existing monitoring networks (e.g., buoys).**
- **NOAA has ability to collaborate with others (MACOORA, communities, scientists and managers) by participating in a "SWAT team" of experts to review programs or applications.**

Leslie McGeorge (NJDEP & NJ Water Monitoring Council)

- **MACOORA can best establish ongoing communications and partnerships with water monitoring councils and other state agencies by visiting them.**
- **As the Clean Water Act requires states to determine and develop criteria and evaluate standards (including long term monitoring and sensing strategies), MACOORA could assist in developing and supporting criteria, develop tools, and assess designated uses of coastal waters.**
- **MACOORA needs to make aware their current IOOS capabilities, especially their application to aquatic life issues, shellfish, and recreational uses along the coast and estuaries.**
- The state of New Jersey has already had success in using IOOS-type monitoring for coastal water quality via remote sensing, real-time continuous monitoring, gliders and CODAR. States (NJ) would like to expand coastal water quality monitoring through IOOS tools.
- State of New Jersey is willing to partner with MACOORA to solicit funding sources (both small and large) in order to maintain and redeploy sensors. States do not have the operational funds to maintain sensors by themselves.
- MACOORA can create database system that integrates IOOS data with other water quality and habitat monitor data.
- MACOORA should assist in development of DMAC systems to share with partners and the public.

Matt Lyman (CT DEP)

- **MACOORA can assist managers in explaining the importance of monitoring to legislators.**
- **MACOORA must make managers aware of its capabilities and what it can offer managers.**
- **MACOORA can assist state water qua1ity managers make their data available to water monitoring councils, agencies, scientists and public in an accessible format and location (e.g., online).**

Additional Discussion

- **MACOORA needs to make sure that managers know that they are partners in a stakeholder driven association.**
- **MACOORA can be a more active partner with managers by insuring that its activity within a state is distributed throughout all states (e.g., MACOORA should visit and work with state water monitoring councils.**
- **MACOORA should get involved nationally by participating in upcoming assessments and reauthorizations (e.g., EPA wetlands assessment (2011) and NOAA CZM (2010)).**
- There is a needed mechanism to transfer funds (passthrough funds) from NOAA for specific MACOORA projects.
- Proposals submitted by MACOORA organizations may have more success by stressing maintenance rather than new monitoring.

Recommendations

MACOORA has been active in the mid-Atlantic region in promoting and developing IOOS monitoring programs. Its two major thematic goals are to advance IOOS capabilities in response to inundation and water quality issues. This workshop was dedicated to receiving feedback from its stakeholders (managers) on coastal water quality issues. Based on its recent history, MACOORA has already been successful in engaging managers and scientist on coastal water quality issues. The three case studies presented at this workshop focused on better forecasting for beach closures in New Jersey; monitoring the seasonal hypoxic zones in Long Island Sound, and monitoring and developing tools for identifying algal blooms in Chesapeake Bay. These successful partnerships between managers and scientists will result in sound science to guide sound management and policy decisions.

The heart of the workshop was receiving water quality manager input during the breakout sessions on needs and requirements, gap analysis, and identifying opportunities and solutions. To that end much of the discussions keyed on four major areas. Both managers and scientists need an accessible and reliable data management and communications (DMAC) system. MACOORA can greatly assist in the development, testing and promoting new sensor technology and in determining the locations of IOOS instruments. MACOORA should support the development of flexible (evolvable and revisable) models that meet the long term needs of the users. Finally, MACOORA must develop partnerships (including for

the solicitation of funding) and be active in communicating to its partners and stakeholders. Several participants noted that this workshop and its target audience was one such step in developing active partnerships and that they were appreciative of the bottom-up stakeholder driven nature of MACOORA.

As a result of this workshop, MACOORA was able to extend the impact of this meeting by hosting a special session at the NWQMC's Sixth National Monitoring Conference (Monitoring: Key to Understanding our Waters) held in Atlantic City, New Jersey in May 2008. The MACOORA session featured a summary of this workshop, additional speakers working on water quality issues in the region and the opportunity to receive comments, suggestions, and feedback from coastal water quality managers from different regions of the country.

MACOORA should strongly consider the following recommendations (action items) in its commitment to address coastal water quality issues.

1) MACOORA will develop and provide a central database system (web portal) in a standard and accessible format to users at all levels.

2) MACOORA will assist in the development of newer and more powerful models (hindcast, nowcast and forecast) that are evolvable and revisable.

3) MACOORA will work with managers and scientists to develop sampling protocols that are strategically placed and at the proper spatial and temporal scales.

4) MACOORA will provide outreach and training to managers on new IOOS tools, techniques and instruments for water quality.

5) MACOORA will assist in getting IOOS methods/tools accepted by state and federal agencies by demonstrating the validity and benefits of IOOS technologies.

6) MACOORA will be proactive in its outreach/extension mission to coastal water quality monitoring agencies at all levels.

Overall, MACOORA must ensure coordination and integration across the subregions and watersheds within its area of purview, but also must define its role in coordination and assessment of activities. MACOORA should assume a central role in linking observations and monitoring (primarily at resource management agencies) with scientific research and modeling activities (primarily at academic and research institutions), ensuring effective feedback mechanisms, and evaluating the success of water quality management strategies and outcomes.

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Appendix A: Workshop Agenda

Tuesday – 11 March 2008

7:30 Continental Breakfast [Room: Ballroom A]

8:15 *Plenary Session:* [Room: Ballroom A]

8:15 Welcome, Introductions & Purpose of Workshop - David Chapman (MACOORA)
8:30 Water Quality Issues: A National Perspective - Jawed Hameedi (NOAA)
9:00 Water Quality Issues in the Region - Bob Tudor (Delaware River Basin Commission)
9:20 Regional Case Studies

Long Island Sound (Hypoxia) - Matt Lyman (CT DEP) & Jim O'Donnell (U. Connecticut)
Chesapeake Bay (HAB) - Mark Trice (MD DNR) & Kevin Sellner (Chesapeake Research Consortium)
New Jersey Coast (Beach Closures) - Bill Simmons (Monmouth County Health Dept.)
& Scott Glenn (Rutgers IMCS)

10:00 Charge to the Working Groups - Peter Rowe, NJ Sea Grant

10:10 Coffee Break

10:20 Working Groups Session #1: User Needs and Requirements

What water quality issues are of most concern? What are the water quality threats?
Breakout Groups (Public Health, Hypoxia/Algal Blooms, Habitat Loss and Freshwater Requirements)

Breakout Group A: Public Health [Room: Ballroom A]
Group Leader: Bob Tudor Reporter: Pete Rowe See Attachment 1A

Breakout Group B: Hypoxia/Algal Blooms [Room: 1776]
Group Leader: Larry Swanson Reporter: Jon Miller See Attachment 1B

Breakout Group C: Habitat Loss and Freshwater Requirements [Room: Autumn]
Group Leader: Eric Vowinkel Reporter: Danielle Kreeger See Attachment 1C

11:45 Summary of Working Groups Session #1 and Charge for Afternoon Sessions

12:30 Lunch [Room: Reflections]

1:15 Working Groups Session #2: Needs versus Current Capabilities (Gap Analysis)

How sufficient are the current observation and monitoring programs for meeting these needs? What gaps are there in observations/data? What are the impediments for overcoming the gaps?
Breakout Groups (MACOORA Sub-regions) See Attachment 2

2:45 Break and refreshments

3:00 Working Groups Session #3: Filling the Gaps: Identifying opportunities and solutions

What kind of data and information products would be of use in fulfilling your job?
Breakout Groups (Short-term & Long-term Water Quality Issues) See Attachment 3A & 3B

4:30 *Plenary Session:* Recap of Afternoon Sessions

5:00 Adjourn for the day; Reception; Working Group Leaders/Reporters Meeting

6:00 Dinner

Wednesday – 12 March 2008

7:30 Continental Breakfast [Ballroom A]

8:30 *Plenary Session:* Final Recommendations [Ballroom A]

Review major outcomes of working groups; Develop recommendations; Develop Action Plan

10:20 Coffee

10:30 Panel Discussion: Reactions from Water Quality Managers and MACOORA

Panelists: Mark Trice (MD DNR), Matt Lyman (CT DEP), Leslie McGeorge (NJDEP & NJ Water Monitoring Council), Jim O'Donnell (U. Connecticut), Scott Glenn (Rutgers IMCS), Bill Boicourt (U. Maryland CES), Rich Patchen (NOAA/NOS/OCS/Coast Survey Development Lab)

What IOOS-type capabilities currently exist and are they useful to you as managers?
What knowledge is required to address these water quality issues?
What specific actions can MACOORA undertake to address these issues?
How can we establish an on-going mechanism for communication and coordination between managers and MACOORA?

11:30 Summary and Next Steps

12:00 Adjourn

ATTACHMENT 1A

Working Groups Session #1: User Needs and Requirements

Breakout Group A: Public Health [Room: Ballroom A]

Group Leader: Bob Tudor Reporter: Pete Rowe

What water quality issues are of most concern? What are the water quality threats?

Public health issues include concentrations of toxic chemicals (preferably in comparison with criteria or guidelines); Shellfish bed closures; Seafood consumption advisories; *Beach closures and swimming advisories (including false notifications); Source attribution of toxic chemicals and nutrients (atmospheric deposition, rivers, surface runoff, groundwater, coastal ocean).*

During this breakout session, discuss the user needs and requirements of **Public Health** in regards to the following questions.

What decisions regarding water quality do you currently make or influence? (i.e., do you provide information to local communities on human health? On contamination? On aquatic habitats? Other?)

Do you support local comprehensive planning? (e.g., Project water supply needs?)

What data do managers currently use?

Where do managers get the data? How easy is it to get data?

On what time scale do you need? Do you need real-time data? Do you need trend data?

What is the geographic scale of the data that managers need?

What data format is required?

What is the reliability of existing data?

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

ATTACHMENT 1B

Working Groups Session #1: User Needs and Requirements

Breakout Group B: Hypoxia/Algal Blooms [Room: 1776]

Group Leader: Larry Swanson Reporter: Jon Miller

What water quality issues are of most concern? What are the water quality threats?

Hypoxia/Algal Bloom issues include Over-enrichment of nutrients (nutrient imbalance, eutrophication, etc.); the nature and incidence of harmful algal blooms; and hypoxic conditions in estuaries, coastal bays, and continental shelf.

During this breakout session, discuss the user needs and requirements of **Hypoxia/Algal Blooms** in regards to the following questions.

What decisions regarding water quality do you currently make or influence (i.e., do you provide information to local communities on human health? On contamination? On aquatic habitats? Other?)?

Do you support local comprehensive planning (e.g., Project water supply needs)?

What data do managers currently use?

Where do managers get the data? How easy is it to get data?

On what time scale do you need? Do you need real-time data? Do you need trend data?

What is the geographic scale of the data that managers need?

What data format is required?

What is the reliability of existing data?

What are future plans for detecting blooms or bloom toxins?

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

ATTACHMENT 1C

Working Groups Session #1: User Needs and Requirements

Breakout Group C: Habitat Loss and Freshwater Requirements [Room: Autumn]

Group Leader: Eric Vowinkel Reporter: Danielle Kreeger

What water quality issues are of most concern? What are the water quality threats?

Habitat loss and Freshwater Requirement issues include habitat loss and modifications (coastal armoring, maintenance dredging and deepening of ship channels, coastal erosion); Impact of non-indigenous species; and freshwater requirements to maintain integrity of estuarine ecosystems, and assure continued propagation of fish (including shellfish) and wildlife.

During this breakout session, discuss the user needs and requirements of **Habitat Loss and Freshwater Requirements** in regards to the following questions.

What decisions regarding water quality do you currently make or influence? (i.e., do you provide information to local communities on human health? On contamination? On aquatic habitats? Other?)

Do you support local comprehensive planning? (e.g., Project water supply needs?)

What data do managers currently use?

Where do managers get the data? How easy is it to get data?

On what time scale do you need? Do you need real-time data? Do you need trend data?

What is the geographic scale of the data that managers need?

What data format is required?

What is the reliability of existing data?

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

ATTACHMENT 2

Working Groups Session #2: Needs versus Current Capabilities (Gap Analysis)

*The **MACOORA Sub-region Breakout Groups** should discuss their Needs versus Current Capabilities (Gap Analysis) with respect to the following questions.*

MA-RI Bays	Group Leader: TBD	Reporter: TBD	Room: Spring
Long Island Sound	Group Leader: TBD	Reporter: Jon Miller	Room: 1776
New York Bight	Group Leader: Bob Connell	Reporter: Jenny McCormick	Room: Ballroom A
Delaware Bay	Group Leader: Ed Santoro	Reporter: Dave Chapman	Room: Ballroom B
Chesapeake Bay	Group Leader: TBD	Reporter: TBD	Room: Autumn

How sufficient are the current observation and monitoring programs for meeting these needs?

How sufficient are current models in meeting these needs? (Are coastal water quality managers aware of them and interested in them? Are they operational and do they have the capabilities to provide data at scales appropriate for subregional use?) (e.g., circulation and hydrodynamic models, hypoxic events, HAB, ecosystem change, and impervious land cover)

What gaps are there in observations/data?

Are there impediments in access to the data (including formatting issues)?

What barriers are there in data application and interpretation?

What are the impediments for overcoming the gaps?

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

ATTACHMENT 3A

Working Groups Session #3: Filling the Gaps: Identifying opportunities and solutions

Short-term Water Quality Issues

Group Leader: TBD Reporter: TBD Room: Ballroom A

What kind of data and information products would be of use in fulfilling your job?

Data and products can include desktop decision making tools (models), access to detailed information, real-time data, format of data, and maps.

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

ATTACHMENT 3B

Working Groups Session #3: Filling the Gaps: Identifying opportunities and solutions

Long-term Water Quality Issues

Group Leader: Jim Nickels Reporter: TBD Room: 1776

What kind of data and information products would be of use in fulfilling your job?

Data and products can include desk top support tools (models), trends analysis, maps, and alternative futures.

You may include in your discussion the impacts of extreme natural events (floods, hurricanes, and drought).

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