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Coastal Café: Linking State Water Quality Monitoring Programs with Coastal Ocean Observations to Protect Human Health

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The purpose of this coastal café was to receive recommendations for more efficiently enhancing state water quality monitoring programs with the developing Integrated Ocean Observing System (IOOS). Following overview presentations, participants discussed the links between IOOS, Oceans and Human Health (OHH), and the U.S. Commission on Ocean Policy (USCOP) and Ocean Action Plan (OAP) reports as they relate on a regional basis. Two case studies illustrating applications of IOOS to state water quality monitoring provided a foundation for discussions of ways that IOOS may enhance water quality monitoring efforts.

Key Points

These summary points were distilled from the presentation and discussion notes in the following pages

- Obstacles include: adoption of new technologies, engaging all user groups, liability and regulatory issues, accounting for all pollution sources, and data collection, integration, and sharing issues.
- Public health and water quality monitoring programs require accessible and understandable information
- Must coordinate and standardize methodologies for water quality data collection among states and between freshwater and saltwater
- Provide for transition from research to operations, including sustained maintenance and operations
- Accuracy and precision are crucial when comparing data sets
- There is a strong need for integrating data AND identifying gaps and addressing them

- Consider all potential sources of contamination and ensure appropriate observing methods are being used to measure them
- Greater interagency cooperation and cooperation with state and local agencies is required
- The system will not work unless regional, state, and local folks including industry, are involved and provide specificity
- National Water Quality Monitoring Program and IOOS should be closely coordinated

General Overview

US Integrated Ocean Observing System (IOOS): Monitoring to Protect Human Health
Brian Melzian, U.S. EPA Atlantic Ecology Division
(presentation available at http://www.csc.noaa.gov/cz)

- IOOS description
  - Multi-institutional (federal, state, NGO, local)
  - Sustained
  - User driven
  - End to end
  - Multi-disciplinary (physical-, chemical-, and biological oceanography, human health, medicine, engineering, etc)
  - Multi-scale
- Seven IOOS Societal Goals (Coastal Café will emphasize reducing public health risks)
- Why is IOOS being developed? Implement ecosystem based management, regional development
- US Commission on Ocean Policy (USCOP) recommended an IOOS
- Ocean.US: Ten executive agencies that signed Memorandum of Agreement to support the IOOS
- US Ocean Action Plan – IOOS is a major element of GOOS
- Potential benefits
  - Safe navigation
  - Natural hazards
  - Safety hazards
  - Ecological forecasting
- IOOS architecture
  - Global component
  - Coastal component
    - National Backbone: operated by National Ocean Partnership Program agencies and partners
    - Includes Great Lakes, goes out to exclusive economic zone
- Regional Systems
  - Will provide detail and increased resolution to some core variables
- Sustained, Integrated, End-to-End system:

    - Rapid access to diverse data from many sources (satellite, aircraft, fixed platforms, ships, drifters and floats, autonomous underwater vehicles)
    - Data Management and Communications (DMAC) standards will help achieve this goal
- EPA programs related to Oceans and Human Health (OHH)
    - EPA Beach monitoring programs – $42 million since 2001, risk-based, tiered monitoring, improved state programs
    - EPA published document "National List of Beaches"; available on web (approximately 6,000)
    - Under Beach Act, EPA established beach advisory and closing on-line notification
    - Harmful Algal Blooms (HABs) integration – uses buoy winds, satellite-predicted winds, ocean color from satellites, field measurements, and meteorological information
- NOAA projects
    - Harmful Algal Bloom (HAB) Bulletin
    - HAB Forecasting system
- Harmful Algal Blooms
    - Requires Federal, state, & local coordination
    - Requires integration of the data (oceanographic processes, species ecology, ocean color, etc.)
- Future IOOS Human Health activities
    - EPA International Cyanobacteria HABs Symposium
    - IOOS Human Health Workshop
    - Regional Association (RA) development
    - Development of new indicators, sensors, and monitoring designs
- Take Home Messages
    - Requires sustained involvement
    - Not federal top-down, but also bottom-up (including tribes and states)

Oceans and Health: A Prescription for Future Monitoring & Research
Paul Sandifer, NOAA National Ocean Service, Hollings Marine Laboratory
(presentation available at http://www.csc.noaa.gov/cz)

- Important for individuals at the state and local levels to guide this initiative; if not, it will get done by those who are far less knowledgeable about the subject matter
- Drivers for OHH Initiative
    - National academy reports
    - US Commission on Ocean Policy (USCOP)
    - US Ocean Action Plan (USOAP)
    - Ocean and Human Health Act of 2004
    - NOAA Strategic plan
- Ocean Threats to Human Health
    - Coastal development – we haven't a clue of all the threats (many things are driving toxic substances and low dissolved oxygen)

    - Mercury concentrations in high-level ocean predators that humans consume
    - Exposures to toxins coming ashore (pregnant women, young people, those with compromised immune systems are vulnerable)
- Many USCOP recommendations to improve water quality
    - Highlight coordination and cooperation among feds, state, and local governments
- Chapter 14: USCOP recommendations to improve water quality
- Chapter 15: USCOP recommendations for national monitoring
    - Monitoring efforts are necessarily linked w/federally-funded backbone
    - Should cover coastal and upland areas directly feeding the coast
    - Core variables, clear goals need to be built in from beginning
- USCOP conclusion
    - "Coastal and ocean observations provide critical information for protecting human lives"
    - Need a sustained IOOS
- Chapter 26: USCOP recommendations for IOOS – proactively seek input from those at the state and local levels to develop support and consensus on observations and systems
- Core variables to be collected by ALL components
- US Ocean Action Plan recommendations: released 12/17/2004
    - References OHH Act of 2004 and Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA) of 2004
    - Supports regional partnerships, particularly in Gulf of Mexico states
    - Commitment to Global Ocean Observing System (GOOS)
    - Monitoring and sharing current data
    - Creating national water quality monitoring network
    - Emphasis on major management questions that come out of the national network (the state/local folks are in the position to tell us what those drivers are)
- Where are we on IOOS and OHH?
    - Interagency OHH research and development program established
    - National emphasis on non-point source pollution
    - Commitment and partnership are a necessity

General Overview Discussion Report Out

1) **How Do You See These Recommendations Impacting Water Quality Monitoring in your Region?**
    - Who will be accountable for IOOS in my region? Who can one call? What are they doing or planning to do?
    - Need to plan for regional differences. Will these efforts be linked within the IOOS RAs?
    - How are states and local governments getting involved? Is their input being actively sought?

- How will a national scale effort really help or add to local management of watershed? (Comment: seems interesting to generate report but what are we getting on the ground?)
- Will it be constructed to use future data only or also add/mine past state water quality data for trends?
- Beach Act funding to states is effective; perhaps transfer from research programs to sustained programs requiring maintenance
- Need integration, but all top-down so far; needs to flow both ways
- Antibiotics, detergents, etc.
- Evolving sensors, technologies – applications impacting Methods and Data Comparison Board
    - Established for linking fresh- and saltwater methods
    - Use in permits
    - Legal obstacles
- National Water Quality Monitoring Council data delivery – merge saltwater and freshwater
    - Persistent problems with data integration – Need to improve
    - Total Maximum Daily Load (TMDL)
    - Water Quality Standards (WQS)
  - Regionally friendly data
  - Oceans-21, regional data base
  - Sense of belonging
  - Core variables – national backbone?
  - Assumption: Tools are there? Work with what we have?
  - Database beach quality database good effort
    - Constituency input (not EPA alone)
  - Difference in "currency" between IOOS/Coastal management needs
    - Fixed platform – networks and discrete sampling sites
    - Dissolved oxygen, contamination, fish advisories, volatile org. compounds, MTBE
  - Merging of water quality network into IOOS
  - Agencies monitoring up river need to be involved
  - Will improve predictive capabilities, e.g. for commercial and recreational fishing, contaminant loads, clean-up needs
  - Less reluctance among groups to share data if they see the benefit of contributing
  - Moving from research program to sustained program – most scientists don't want to maintain a system for many years.
  - Had a lot of concern that science community thinks that this is a worthwhile effort, but there is a whole other sector (tourism) that is not as certain. Will they be receptive? This is an issue that must be dealt with immediately.
  - There is a need to measure other variables not typically gauged by sensors (ex. number of birds on beach, number of people on beach, etc) in order to wholly monitor water quality. Sensors can't measure everything.

- New technology and techniques are really not being used because of legal obstacles, permitting obstacles. Reluctance in coastal managers.
- Communication needs to be much broader than the research community and immediate public health implementers – needs to involve management, tourism, etc

2) How could the Recommendations be Implemented in Your Region?

- There will be regional differences
  - Alaska will be easier
  - Mid-Atlantic region more difficult because of size
  - Gulf of Mexico-five states and Mexico
- Lack of communication at all levels (federal, regional, state, local) who is doing what? What data being collected? How can it be linked?
- Need to coordinate and standardize data collection among states (e.g. does South Carolina know what water quality data North Carolina and Georgia are collecting? - Need an inventory of existing activities in regions. Scale and scope of data? Need common data standards so information can be shared: need resources)
- Need more participation by state/local entities in IOOS
- Need to involve NGOs
- Can look at IOOS as both integrating current data and adding new data
- Need tools/capacity to get data into a useable form for state/local government
- Need user-specific pilot projects
- Needs to be reliable, real-time, and a continuous ongoing commitment AND accountability

3) What factors may be barriers to implementation?

- Lack of resources-need trained staff
- Need clear understanding of local user needs
- Tourism
- Assessment resolution
- Inflexibility to adapt
- Lack of technology
- Need flexible policy
- Data management and integration
- Money for research, technical development, implementation
- Complications due to regulatory aspects
- Timeliness of end product
- Liability of data collectors

Case Studies

Case Study 1: SwimCast: Protecting Swimmers from E. coli Concentrations Infection at Two Illinois Beaches
Mark Pfister, Lake County Health Department
(presentation available at http://www.csc.noaa.gov/cz)

- Beaches in Lake Michigan – a lot of variability in terms of *E. coli* /bacterial concentrations
- Late May-Labor Day is beach season in Illinois
- Lake Michigan's primary *E. coli* source is from gulls and other avian species
- Project uses IOOS concepts, monitors bacterial concentrations and comes up with predictive models
- Staff collect samples daily/count gulls daily also
- Guidelines
    - Utilize electronic instruments
    - Deploy sensors around surf zone
    - Meteorological towers close to beaches
    - Monitor beach water
    - Come up with predictive model
- Two beaches where equipment deployed
    - City of Lake Forest-Forest Park Beach
    - Illinois Beach State Park-South Beach
- Readings every hour – real time
- Public reaction was that they were unattractive but useful
- Looked at indicators for *E. coli*
- High tides=greater wave height=resuspends *E. coli* trapped in sediment
- Good correlations between wave height at both beaches, but *E .coli* levels were quite variable between the two
- A.M. v. P.M. *E. coli* concentrations were also variable, so monitoring at only one time of the day would not give accurate picture
- Real-time predictive modeling using IOOS needed
- Results
    - By using SwimCast people were only subject to bacteria on 7 occasions. If we had only used monitoring data there would have been 19 occasions.
    - Predictive models very good because they are more accurate
    - Predicting the need for swim bans cannot be determined from samples taken a day or even hours earlier
    - Monitoring data is not good predictor – monitoring data is useful for looking at long-term datasets
    - Research in 2005 – in Chicago area we've been having drought (so not many beach closures except at beaches with large gull populations)

Case Study 2: In Situ Optical Early Warning System to Detect Harmful Algal Blooms
Lisa Campbell, Texas A&M University
(presentation available at http://www.csc.noaa.gov/cz)

- Restoring and maintaining healthy ecosystems key, so measuring biological and chemical parameters important
- Texas Automated Buoy System (TABS)
    - Network of current- and wind-monitoring measuring buoys
- Texas General land office has provided some new buoys – much larger than current TABS II buoy (will have a nutrient analyzer and an O2 sensor, current sensor)
- Forecast models of surface currents (uses wind data from TABS buoys and NOAA and NCEP wind data)- works best nearshore
- Goal is to add biological component (harmful algal blooms) – *in situ* imaging system (sensors) that will go on the TABS buoys.
- Typical background is about 1 cell per milliliter
- Shellfish harvesting areas closed when counts reach 5 cells/ml
- Project is using a flow cam and *in situ* nitrogen analyzer, and fluoroprobe, and assays
- New buoy is going in near Corpus Christi (about 1 month from now). Little entanglement with fishing vessels and is an area of bloom initiation.
- HABs
    - An unusually high concentration of toxic or nuisance algae
    - early detection best way to mitigate HABs
    - global problem
- New TABS buoy sensors and an *in situ* imaging system will improve early warning capabilities
- Constraints of TABS
    - data retrieval and processing
    - fouling
    - hazards
    - power requirements of software and operating systems
    - lab-based instruments deployed at sea
- Conclusion
    - Energy-efficient optical systems have promise for real-time detection of HABs in Gulf of Mexico
    - No single instrument can provide all the data required
        - *In situ* measurements
        - Flowcam
        - Remote sensing
    - Training is needed for connections to IOOS – Texas A&M has M.S. of Geosciences in Ocean Observing Systems.

Case Studies Discussion Report Out/Plenary Synthesis

- **Priorities related to IOOS and water quality monitoring**
  - Data more accessible and understandable
  - Agencies need to coordinate and cooperate, including upland agencies
  - Transfer from research instrument to sustained program requiring long-term maintenance (costs, etc.)
  - Systems need to be tailored regionally
  - Assurance on QA/QC of this data
  - Information to make better decisions
  - A suite of parameters to focus effort (will need consensus on what to include)
  - Tourism industry may be a barrier to implementation-have they been included as a user-group? Are they aware of IOOS?
  - IOOS could enhance density of observations and could be useful for coastal managers
  - Once capability of acquiring/delivery of data delivery, then data comparability/quality necessary to meet regional/local needs
  - Difference in currencies between how IOOS would collect/deliver data and how coastal managers would like to see the data collected/delivered
  - Accuracy of remotely- or aircraft-sensed measurements questionable
  - Difficulty of coordinating at different scales
  - We need to be able to measure parameters that cannot be determined by sensors (# of birds on beach, # of people, etc.)
  - Reluctance to implementing new technologies/techniques because there may be legal/permitting obstacles to doing so
  - Effectively communicating the science to the managers is as important as the technology used and data collected