8-2014

Real-Time Oceanographic Data: From Safety to Science

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Scholar Commons Citation
Meyers, Steven D.; Scudder, Jeffrey; and Luther, Mark E., "Real-Time Oceanographic Data: From Safety to Science" (2014). Marine Science Faculty Publications. 542.  
https://scholarcommons.usf.edu/msc_facpub/542

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Real-Time Oceanographic Data: From Safety to Science

Coastal areas such as bays and estuaries host 30%–50% of the global human population and shipping ports that handle 80% of world trade. These areas are increasingly vulnerable to chemical and biological contamination and to storm surge in the short term and to sea level rise in the long term.

The dynamics of such coastal areas are complex and difficult to predict, being influenced by local characteristics of tides, winds, insolation, freshwater discharge, shoreline morphology, and bottom bathymetry. As the human population grows and threats to coastal populations and their marine transportation systems increase, there is a need for reliable observational data to aid in protection, restoration, and adaptation strategies.

The Physical Oceanographic Real-Time System (PORTS), managed by the National Oceanic and Atmospheric Administration (NOAA), collects and disseminates real-time meteorological and oceanographic data 24 hours a day in 23 locations on the coast and Great Lakes of the United States (http://tidesandcurrents.noaa.gov/ports.html; see Figure 1). Though the primary function of PORTS is to help maintain the safety and efficiency of maritime operations, the data gathered have proven scientific applications. PORTS data are being used to examine a growing set of critical issues related to a diverse range of research topics in coastal science and management, from estuarine circulation to biological hazards to climate.

Tracking the Movement of Freshwater

The movement of freshwater through an estuary is essential for maintaining optimal salinity for various marine organisms as well as the overall ecological health of the estuary. Changes to the freshwater input from rivers, as anticipated to occur in a changing climate, can create a cascade of impacts, affecting salinity, nutrient fluxes, estuarine biology, and water quality.

In Delaware Bay, PORTS data were used in conjunction with data from other monitoring programs to examine changes in salinity during a large freshwater river discharge event. Changes to the salinity field coincided with an unusually large transport of nutrients into the lower bay, resulting in a phytoplankton bloom and loss of dissolved oxygen in the system [Voytenko and Sharp, 2012].

Similarly, current speeds from a PORTS acoustic Doppler current profiler have been used to estimate volume flux from the Hudson River into the coastal zone and the formation of a freshwater “bulge.” This feature restricted mixing with the coastal current, temporarily creating an isolated biological community and altering the transport of nutrients into the surrounding coastal waters [Chant et al., 2008].

Monitoring and Predicting Water Levels

Storm surge generated by extreme weather events can bring devastation to coastal communities when low atmospheric pressure or high winds raise the ocean water levels and overwhelm the coastline. For example, non-tidal water levels in Galveston Bay were shown to be affected by local surface winds and remotely generated water levels at the bay mouth using PORTS tide gauge and wind data. These data were then treated as inputs in a neural network model that made accurate predictions of water levels within the bay [Guannel et al., 2001].

In addition, data from several tide gauges in the PORTS program have been used to demonstrate an increase in the seasonal cycle of water level in the eastern Gulf of Mexico, with implications for estimating storm surge [Wahl et al., 2014].

PORTS-style scientific observational systems have been replicated at offshore sites and at sites around the world, providing new sources of regular, quality-controlled data. The Coastal Ocean Monitoring and Prediction System (COMPS) operates instruments on the West Florida Shelf. COMPS is now part of both the Southeastern Coastal Ocean Observing Regional Association (SECOORA) and the Gulf of Mexico Coastal Ocean Observing System (GCOOS), 2 of the 11 regional observing systems contributing to the Integrated Ocean Observing System (IOOS), which has more than 2500 monitoring sites around the globe.

As climate change drives an uncertain future, real-time monitoring will assume an even greater role in protecting coastal environments and their surrounding communities.
Acknowledgments

Partial support for this work was provided by the Greater Tampa Bay Marine Advisory Council-PORTS, Inc., by NOAA through the Alliance for Coastal Technologies, and by SECOORA, GCOOS, and the University of South Florida.

References


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