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Tech for a sustainable environment

"Earth provides enough to satisfy every man's need, but not every man's greed."

- Mahatma Gandhi

What lies beneath

A collaborative project in the US will provide geospatial data for informed decision making to meet human and energy needs while protecting coastal and estuarine environments

Image courtesy: University of Connecticut, Connecticut Department of Environmental Protection, National Undersea Research Center, and Long Island Sound Resource Center

Long Island Sound is the drainage basin for New York City and much of New England, a region that is home to nearly nine million people. Long Island Sound region is vital to the economy, security, culture and ecology of the United States, but sustaining its coastal resources necessitates a balance between growing and often competing uses and activities. A new collaborative effort by state, federal and academic partners is helping managers and officials strike that balance by integrating various seafloor mapping technologies, sciences and capabilities. When finished, the data will present the most comprehensive picture of the Sound, improve understanding of the area's underwater environment and provide mapping tools critical to ocean and environmental planning.

Evaluating proposed development activities, such as telecommunication cables, gas pipelines and other large-scale infrastructure, and ensuring effective coastal planning requires the availability of marine informational products to help inform the decision-making process. While informative geospatial products (e.g., aerial photography, terrain/elevation models, environmental GIS data layers, etc.,) for terrestrial environments are generally available, this is lacking or inadequate for marine environments. Even where data of sufficient temporal and spatial scale is available, the thematic focus tends to be

too narrow to support alternatives.

In response, the Connecticut Department of Energy and Environmental Protection, the US Environmental Protection Agency, the New York Department of Environmental Conservation, and the Connecticut and New York Sea Grant programmes are guiding efforts to develop improved benthic data products for Long Island Sound. While sufficient funding is not available to map the entire Sound, regional stakeholders were able to prioritise areas to identify locations of greatest need. These priority focus areas represent the convergence of several factors, including ecological value, multiple uses and potential for further development. A pilot area was chosen from the focus areas to serve as an operational testbed.

The mapping is being implemented by the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Coastal and Ocean Science (NCCOS), NOAA's Office of Coast Survey (OCS) and academic consortiums led by the University of Connecticut (UConn) and Columbia University's Lamont Doherty Earth Observatory (LDEO). This partnership exemplifies NOAA's commitment to integrated ocean and coastal mapping — "map once, use many times." The philosophy emphasises coordination with state and regional partners, reducing redundancies, improving efficiencies, developing common standards and stimulating innovation and technological development.

"Ocean floors are amazingly dynamic and we have to chart those changes to provide precise and accurate navigational data for today's maritime economy," explained Cmdr. Lawrence Krepp, commanding officer of the NOAA Ship Thomas Jefferson. "Our data are used to update NOAA's nautical charts, but as is the case in the Long Island Sound project, the hydrographic information also supports a number of non-navigation uses, ranging from benefits to fisheries management to support of regional ocean planning efforts like this."

Benthic habitats and ecological processes

Benthic habitat maps provide information about the extent and composition of marine resources. Understanding benthic habitat structure and ecological characteristics are critical to their management and conservation. Current benthic maps for Long Island Sound primarily depict geological attributes and are based on data largely collected before 1990. For new maps, the data will be integrated using a habitat classification scheme designed specially for Long Island Sound to produce new benthic habitat and ecological mapping products.

Acoustic intensity and seafloor topography

To provide meaningful information about the distribution and composition of seafloor habitats, backscatter-derived images (also known as acoustic intensity products) depicting the composition, roughness, and texture of the seafloor are required. These data, when combined with additional products that provide depth and topographic relief, are the foundation for building tools that address benthic habitats and other environmental conditions.

Portions of the pilot area were previously mapped by the OCS but were based on data collected in 2001 and 2003. There are significant portions that remain unmapped. To address this, scientists will reprocess existing acoustic data with contemporary software and methodologies. Survey vessels will provide new data from multi-beam echo sounders (MBES), vertical beam echo sounders (VBES), and side scan sonar (SSS) for unmapped areas.

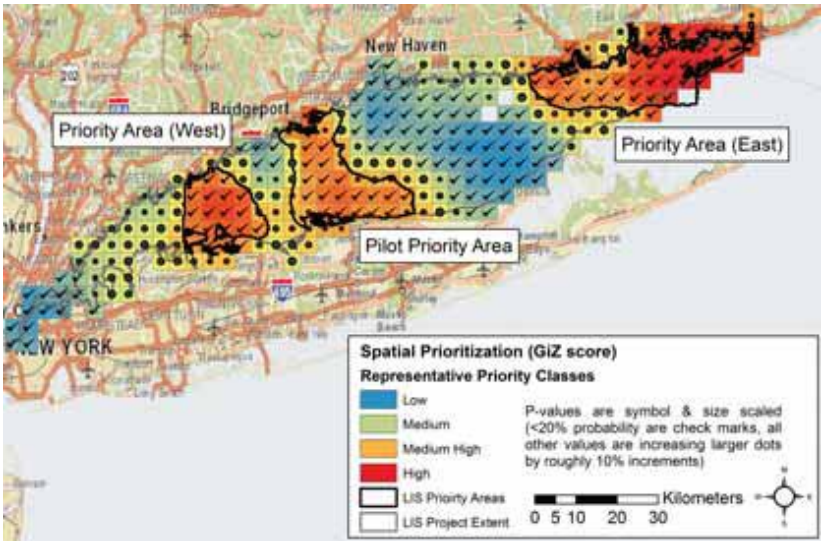
Sediment texture and grain size distribution

Mud, sand and gravel-dominated areas provide very different habitats, so sediment grain size composition and texture are essential components for habitat classification. While existing geologic data products for the Sound can be re-used, researchers need additional sediment grain size information to support the detailed habitat classification. They will use acoustic backscatter information gathered by survey vessels to determine where new samples are needed and then collect them.

Sedimentary environments

The stability and suitability of different habitats for vari-

The project will deliver raw data and interpretive geospatial products such as shapefiles, rasterised imagery and digital maps in convenient GeoPDF formats. The team will utilise a central data management system for storage and transfer of information



A spatial depiction of ranking factor information compiled from regional stakeholders used to identify priority mapping regions within Long Island Sound.

ous species depend on processes such as erosion, deposition and transportation of sediment. Mapping these sedimentary environments is not only important for understanding habitats, but also helps planners anticipate the potential for change. Sedimentary environment maps exist, but are based on data of limited resolution and accuracy. Reviews found that new, high-resolution acoustic products were needed for accurate interpretations. Additionally, data on what lies below the sea-floor surface is needed; this will help in, for example, differentiating true sandy bottoms from thin layers of sand simply resting on bedrock.

Physical and chemical environments

Lastly, the project will create products depicting temperature, salinity, dissolved oxygen and bottom stress. These are central elements of habitat classification and are critical in predicting and monitoring the impact of management decisions and marine resource conservation.

A fair amount of information is available, but the project's gap analysis indicated there were no geospatial products that describe the physical-chemical environment near the seafloor. The project will therefore deploy bottom sensors for salinity, temperature and dissolved oxygen and will measure bed stress, turbidity and re-suspension rates. They will also collect common oceanographic data while mapping surveys are being conducted.

Data to support marine spatial planning

The types of products to be produced for Long Island Sound have a myriad of applications to assist in marine spatial planning. These issues range from site-specific regulatory and permitting assessments of development proposals, to broader long-term monitoring of ecological conditions within the Sound. For instance, these data will help answer specific questions needed for environmental analyses including:

- Which ecologically significant areas in the Sound should remain untouched?
- Are current ecological sampling strategies appropriate for monitoring biological health?
- Which biological communities are most heavily impacted by human stressors and where are they at maximum risk?
- Are current resource management strategies effective in maintaining a healthy Long Island Sound ecosystem?
- What are the areas that could support infrastructure siting and why?

The project will deliver raw data and interpretive geospatial products such as shapefiles, rasterised imagery and digital maps in convenient GeoPDF formats. The project team will utilise a central data management system provided by the LDEO and UConn to facilitate storage and transfer of information during the project. As data sets are finalised, they will be made available to the public through the data system as well as to appropriate repositories such as the US National Geophysical Data Center.

Frank Nitsche, a geophysicist at LDEO says, "The wealth of the new seafloor data that we collect during this project will provide a scientific basis for management of the seafloor ecosystem and provide an excellent basis for future research."

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