MEETINGS

Using Satellite Data Products to Manage Living Marine Resources

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With the 2006 efforts by the U.S. Congress to renew the Magnuson-Stevens Fishery Conservation and Management Act and the 2004 U.S. Commission on Ocean Policy report, issues regarding the management of living marine resources and the use of ocean observing systems are receiving significant attention. Internationally, the Group on Earth Observations (GEO; http://www.earthobservations.org) is highlighting efforts by national governments, including those of the U.S. government, to use Earth science measurements to support decision-making for societal benefits. In addition, the U.S. National Oceanic and Atmospheric Administration (NOAA) is placing greater emphasis on ecosystem-based approaches to addressing its management responsibilities.

Given the continuity, global coverage, and high temporal and spatial resolution of satellite observations, they represent important tools for monitoring and characterizing marine ecosystems. Most of the spatial features that are important to characterizing ecosystems (i.e., ocean fronts, eddies, convergence zones, river plumes, and coastal regions) cannot be adequately resolved without satellite data. However, the potential of satellite data to more fully enhance operational applications within NOAA Fisheries has not yet been realized, such as improving the accuracy of fisheries stock assessments and contributing to Integrated Ecosystem Assessments (IEAs).

NOAA and NASA sponsored a May 2006 workshop, "Integrating Satellite Data Into Ecosystem-Based Management of Living Marine Resources," to identify specific ways to incorporate Earth science satellite observations, data, and associated models into NOAA Fisheries Service stock assessment and habitat classification activities and decision-making.

This workshop focused on identifying specific, near-term (2006–2008) joint projects that NASA and NOAA could pursue to make immediate progress, affect decision-making, and support interagency collaborations. The workshop also addressed associated issues regarding access to satellite observations and model products. On the basis of detailed project concepts the workshop participants developed, NASA and NOAA selected four projects (described below), which commence in October 2006.

Meeting Highlights

Discussions at the workshop reflected NOAA's increasing attention to ecosystem-based management, including roles for climate data in fisheries stock assessment analyses, impacts of climate change, and trade-offs related to ecosystem governance. These discussions also emphasized the opportunities for large-scale satellite observations of geophysical phenomena to support a more integrated understanding of the ecosystem components under management.

Steven Murawski, director of scientific programs at NOAA National Marine Fisheries Service (NMFS, Silver Spring, Md.) and NOAA Ecosystem Program Goal lead, spoke about the use of adaptive approaches to management, the need to consider multiple causes of observed changes, and the challenges of addressing multiple sources of uncertainty in assessment and prediction. Richard Methot, stock assessment coordinator at NMFS (Seattle, Wash.), discussed opportunities to improve how NOAA incorporates environmental and climate data into assessments to help explain recruitment variability, growth rates, and ecological relationships.

Participants presented current uses of satellite observations and in situ data, including data collected through animal-tagging efforts. Other talks explored the state of the art in regional physical and ecological ocean modeling. Yi Chao, NASA Jet Propulsion Laboratory (Pasadena, Calif.), discussed the multiscale, nested Regional Ocean Modeling System (ROMS) approach to simulating the three-dimensional (3-D) ocean at spatial scales required for ecosystem and fisheries applications. Chris Orphanides, NOAA Northeast Fisheries Science Center (Narragansett, R.I.), discussed applications of satellite-derived products in limiting marine mammal by-catch, including model results showing sea surface temperature (SST) and water depth to be significant factors in predicting white-sided dolphin by-catch in some fisheries.

Other presentations discussed additional aspects of using environmental data in fisheries and marine mammal management, developments in model capabilities, developments and results from in situ and animal-collected data, and availability of satellite data and model outputs. NOAA and NASA representatives discussed plans for, and access to, observations from current and future planned satellites.

During two breakout sessions at the workshop—on stock assessments and habitat classifications—participants identified and formulated concepts for potential joint projects that could further integrate environmental measurements and predictions into fisheries decision-making. During each breakout session, there was discussion of possible project ideas and the selection of two to three projects for in-depth development. During the breakout groups, the systems architecture adopted by GEO and U.S. GEO (http://usgeo.gov) was used to construct the candidate projects.

The project concepts noted below are those that received a detailed description for further consideration by NASA and NOAA management.

Stock Assessments: Sablefish

The sablefish fishery in Alaska has experienced a significant population decrease related to heavy fishing in the 1970s and subsequently faced strict fishery regulations and truncated seasons. The sablefish project integrates relevant environmental information into the annual Stock Assessment Fishery Evaluations (SAFE) report, including oceanographic conditions (e.g., transport, temperature) and features (e.g., front locations). In particular, the project examines the benefits and mechanics for Earth science satellite observations (e.g., QuikSCAT, Jason 1, Advanced Very High-Resolution Radiometer (AVHRR), Moderate Resolution Imaging Spectroradiometer (MODIS)) and model-derived products (e.g., 3-D ocean circulation, National Centers for Environmental Prediction (NCEP) reanalysis for atmospheric forcing) to support SAFE analyses and recommendations.
A primary goal of this project is to reduce uncertainty in model parameters, which can allow for faster response to stock recruitment variability and more confidence in future yield estimates. These improvements can help in determining total allowable catch, stock status, and apportionment and allocation among user groups.

Stock Assessments: Cod/Haddock

Cod and haddock stocks on the Georges Bank off New England currently are subject to rebuilding plans. Workshop participants noted that environmental factors (e.g., near-surface water temperature) affect haddock and cod larval growth and that recruitment strength of both stocks is associated with the North Atlantic Oscillation and wind stress during the spawning season.

The project focuses on integrating environmental and oceanographic data into AGEPRO, which is a decision support model NMFS uses to help rebuild depleted groundfish stocks. The goal of this project is to improve recruitment predictions, which are used to set total allowable catch levels and meet rebuilding plan objectives.

Habitat Classifications: Sea Turtle By-Catch

NOAA Fisheries is mandated to protect marine turtles from adverse fisheries interactions. This project focuses on the by-catch of the threatened loggerhead and endangered leatherback sea turtles in commercial longline fisheries in the central North Pacific Ocean and trawl fisheries in the northwest

Atlantic Ocean. Despite regulatory gains, sea turtle by-catch continues to occur in some fisheries, often requiring significant time-area closures of commercially valuable fisheries once the by-catch quotas are met.

This project integrates satellite-derived products (e.g., SST, chlorophyll, ocean currents, and fronts), electronic tags, fishery observer logs, and high-resolution coupled physical-biological models to characterize critical sea turtle habitat and help predict the likely times and locations of potential sea turtle/fishery interactions. The primary goal is to use Earth science data to help NMFS and commercial fisheries reduce sea turtle by-catch, reduce the time-area closures of pelagic longline fisheries, and increase seasonal longevity of the relevant fisheries.

Habitat Classifications: California Current Habitat Characterization

Protection of highly mobile and broad-ranging species requires an understanding of which environmental components are important for survival, growth, and reproduction, including effects from climate-driven changes in ocean conditions.

This project seeks to identify and characterize multispecies essential fish habitat (EFH) and marine mammal critical habitat (CH) in the California Current region. This effort integrates satellite data, in situ observations, animal-collected data, survey data, and coupled physical-biological models to enhance EFH and CH 'zoning' maps for the exclusive economic zone of the North American west coast for key species (tunas, cetaceans, salmon, sharks, and sea turtles). The goal is to develop explicit characterization regarding designation of EFH and CH for pelagic species in the California Current region and to identify influences on animal distribution.

Stock Assessments: Fishery Rebuilding Analysis Tool

NOAA Fisheries uses rebuilding analysis tools to develop rebuilding plans for fish stocks that have been overfished. The analysis tool produces a probability distribution for the expected time to rebuild, allowing a regional fishery management council to determine the level of allowable catch that balances rebuilding goals and fishing community needs. Workshop participants cited the need to account for possible roles of climate-driven 'regime' shifts in the rebuilding plan.

This project assesses satellite-based products that capture interannual variability (e.g., SST and sea surface height) as well as in situ data and model-derived products, and initial efforts focus on depleted rockfish stocks off the U.S. west coast. The project goal is to improve the precision and ability of the rebuilding tools to portray a more realistic characterization of possible fishery outcomes.

Data Management Needs and Future Directions

The workshop presentations and discussions highlighted the fact that between the current availability of different satellite data sets and output from advanced ocean models, there is a wealth of environmental data that can be used to better characterize and manage marine ecosystems. Workshop presentations also noted, though, that the efficient use of these resources requires user-friendly tools for accessing and manipulating the large volumes of available data.

Participants identified the need for a specific data management tool that would integrate and analyze data through time at a nonfixed location, such as a ship track or a tagged animal location. This 'point-in-time' tool would provide an easy mechanism to associate specific locations with temporal environmental conditions and then extract similar environmental information across millions of records.

This technique would allow fishery investigators to examine the relationships between environmental parameters and their data through multivariate analyses or other statistical techniques. Representatives from the NASA Physical Oceanography Distributed Active Archive Center (PODAAC), the NASA Ocean Biology Processing Group, and the NOAA National Environmental Satellite, Data, and Information Service (NESDIS) are addressing this issue.

Following the meeting, the NASA/NOAA Workshop Committee evaluated the project concepts. In July, NASA/NOAA selected four of the projects outlined above to pursue. The projects commence with the teams developing detailed plans and schedules in October 2006.

The committee provided comments to the fifth project team (California Current Habitat Characterization), and, based on project revisions and funding availability, there is a possibility that NASA/NOAA will pursue this project in 2007. If these projects show early promise, the NASA/NOAA committee may consider issuing a joint solicitation in 2007 or 2008 for additional projects integrating Earth science satellite observations and associated model products into NOAA Fisheries management, guidance, and decision-making.

The Workshop Committee currently is preparing the workshop report and expects to complete it in Fall 2006; it will be available through the workshop Web site.

The Integrating Satellite Data Into Ecosystem-Based Management of Living Marine Resources workshop, sponsored by the NASA Science Mission Directorate, NOAA NMFS, and the NOAA NESDIS, was hosted by the Monterey Bay Aquarium Research Institute at its facilities in Moss Landing, Calif. on 3–5 May 2006. All of the presentations are available through the workshop Web site: http://www.pfeg.noaa.gov/events/workshops/NASAworkshop2006/

Acknowledgement

The workshop committee prepared this meeting summary, and it thanks all of the participants for their contributions to the workshop.

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