Harmful Algal Blooms and Hypoxia in the Gulf of Mexico

Introduction

Dead fish or dolphins lining a beach. Respiratory problems. Shellfish closures. Harmful algal blooms (HABs) and hypoxia (severe oxygen depletion) are harming an increasing number of coastal and Great Lakes communities, economies, and ecosystems. Virtually every coastal state has reported recurring blooms and over half of our Nation's estuaries experience hypoxic conditions. Impacts include massive fish kills, devastation of critical coastal habitats, loss of commercially valuable and culturally vital shellfish resources, illness and death in populations of protected marine species, and threats to human health. HAB outbreaks pose an immediate and long-term challenge to the tourism industry, which underpins the economies of many coastal communities. Just one harmful algal bloom event can impose millions of dollars in losses upon local coastal economies. The National Oceanic and Atmospheric Administration (NOAA) in conjunction with federal, state, and university partners are leading efforts to understand, predict, and ultimately mitigate HAB and hypoxic events and their impacts to ecosystems and coastal communities.

The Problem

Research into the types, causes and effects of HABs is a relatively new field of investigation and the list of species and types of impacts are expanding rapidly. Some blooms, such as the persistent blooms along the western Florida cost in 2005, produce toxins that cause illness in humans and marine life, including respiratory distress in beachgoers. Other blooms reach such a large size that the decay of the algae robs the water of all oxygen, resulting in hypoxic "dead zones" in the bottom of estuaries and coastal environments and subsequent death of marine animals. The annual Gulf of Mexico hypoxia event at the mouth of the Mississippi is perhaps best known, but sporadic events can also be devastating, such as the hypoxia on the west Florida coast in 2005 that killed large expanses of coral reefs, benthic organisms, and fish that could not escape the area.

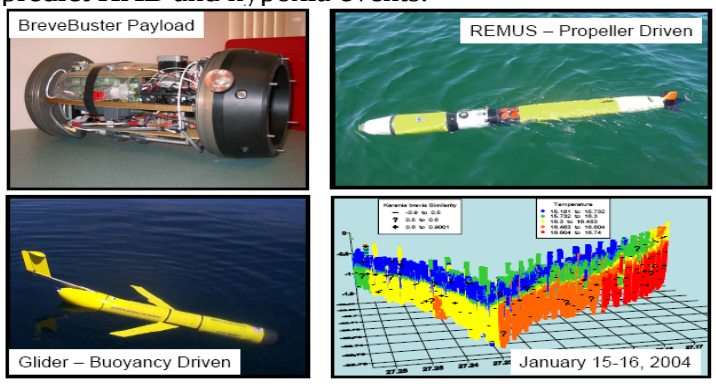
NOAA supported researchers are investigating how to predict and mitigate HABs, such as this Florida red tide

Program Description

In the Gulf of Mexico, NOAA has supported multi-year, interdisciplinary research studies to address HABs and hypoxia. Working closely with federal, state, and academic partners, NOAA has investigated the factors that regulate the dynamics of HABs and how they cause harm, developed models that lead to HAB forecasts, and used satellites and ocean observing systems, molecular methods from medical science, and biochemical analysis for the detection and tracking of algal species and their toxins. Through these efforts, NOAA has made considerable progress in the ability to detect, assess, and in some cases, predict HAB and hypoxia events.

NOAA HAB and Hypoxia Programs in the Gulf of Mexico

- ECOHAB
- MERHAB
- NGOMEX
- Event Response
- Marine Biotoxins
- CoastWatch



AUVs (Slocum Glider and REMUS) with automated sensor for *Karenia brevis* (Breve Buster) and example of temperature and red tide abundance data during operation (graphics provided by Gary Kirkpatrick, Mote Marine Lab)

Accomplishments

These interdisciplinary research studies are helping to advance the state of the science and also lead to results with direct application to needs of state coastal resource and public health managers. Recent successes in forecasting HAB and hypoxia events demonstrate the value of NOAA's long-term research investments in the region to help coastal managers undertake short- and long-term efforts to reduce, and ultimately, prevent the detrimental effects caused by these phenomena:

HAB Forecasts: The ability to forecast HABs helps protect human health and mitigate economic impacts. State and local officials use forecast information to provide more timely warnings, limiting public exposure. The forecast also supports more accurate pinpointing of impacts, helping to more carefully target beach closures. In Florida, where blooms have perhaps been most prevalent, NOAA initiated in 2004 an operational ecological forecast for HABs. Satellite imagery, wind data, and transport models that are the building blocks of an integrated ocean observing system (IOOS) are used to identify potential HABs and predict their movement. This information is then relayed to coastal managers so they can more effectively target expensive and time-consuming field sampling to confirm the presence of toxic algae. Several years of research supported by the Ecology and Oceanography of Harmful Algal Bloom (ECOHAB) and the Monitoring and Event Response (MERHAB) Programs helped to develop this HAB forecasting system and have produced an in-water sensor that can detect the Florida red tides, including deployment of an underwater autonomous vehicle (AUV).

Hypoxia Forecasts: NOAA-sponsored studies through the Gulf of Mexico Ecosystems and Hypoxia Assessment (NGOMEX) program have produced considerable evidence supporting the hypothesis that nutrient loading from the Mississippi River system is a dominant factor driving the Gulf of Mexico "dead zone." Monitoring efforts, using ships and observing systems, have documented the long-term size of the "dead zone", a key nutrient management metric. NOAA has also developed the capability to forecast the size of the "dead zone", a critical leap forward toward evaluating the effectiveness and potential success of nutrient management reduction efforts within a watershed encompassing greater than 40% of the contiguous United States. These research studies are providing critical information for an interagency scientific reassessment of this problem currently underway.

Event Response: NOAA has established a suite of programs which provide immediate assistance to state and federal coastal managers and public health officials to reduce the impact of HAB events through rapid, coordinated assistance during toxic algal blooms, related health incidents, and marine animal mortality events. In 2004, the programs provided rapid observational support to NOAA's Marine Mammal Health and Stranding Response Program in response to the multi-species mortality event along the Florida Panhandle, and provided critical research and observation support to the 2005 HAB event along the west Florida coast. In 2008 NOAA is providing assistance to a team of researchers and managers coordinated by the Texas Parks and Wildlife Dept. responding to an ongoing toxic algal bloom of the species *Dinophysis*. This species produces the biotoxin okadaic acid, which can accumulate in shellfish and can cause Diarrhetic Shellfish Poisoning when consumed.

Looking to the Future

NOAA is poised to improve the capacity for resource managers to anticipate and respond to HAB and hypoxic events in the region. In July 2006 NOAA sponsored a scientific workshop in Sarasota, FL bringing together 75 experts on Gulf of Mexico red tide to identify research gaps and formulate future research priorities. Efforts are underway to expand the operational HAB forecasting system in Florida to other regions, including the western Gulf of Mexico and to employ new tools, such as the AUV mentioned above, that increase the precision and lead time of warnings. Hypoxia research efforts are underway to improve predictions of the size of the "dead zone" under various management scenarios and to understand the impacts of hypoxia on the Gulf of Mexico ecosystem, including commercially and recreationally important species.

Resources: Contact Dr. Quay Dortch, ECOHAB Program Coordinator, 301-713-3338 x157, quay.dortch@noaa.gov or Dr. Libby Jewett, Hypoxia Research Program Manager, 301-713-3338 x 121, libby.jewett@noaa.gov; website: http://www.cop.noaa.gov/