Harmful Algal Blooms and Hypoxia in the Gulf of Mexico

Introduction

Dead fish or dolphins lining a beach - respiratory problems- shellfish harvesting 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) is leading the nation in to understanding, predicting, and mitigating HAB and hypoxic events and their impacts to ecosystems and coastal communities.

The Problem

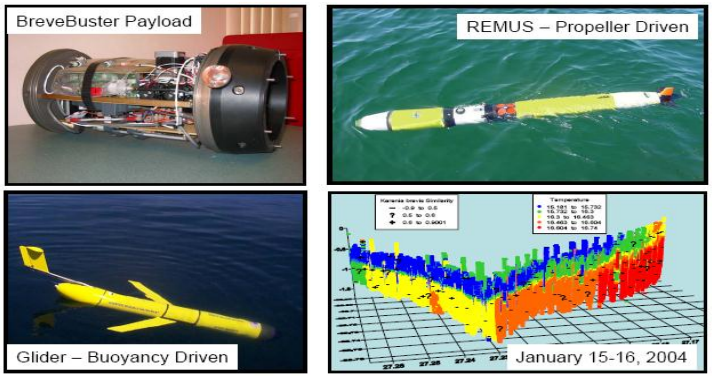
The types and extent of HABs and their impacts has expanded in the Gulf of Mexico. Some blooms produce toxins that cause illness in humans and marine life, including respiratory distress in beachgoers. Other blooms reach such a large size that the decay of the algae robs the water of all oxygen, resulting in hypoxic "dead zones" in the bottom of estuaries and coastal environments and subsequent death of marine animals. The annual Gulf of Mexico hypoxic zone at the mouth of the Mississippi River is perhaps best known. Sporadic events can also be devastating, such as the hypoxia on the west Florida coast in 2005, triggered by a toxic HAB, that killed large expanses of coral reefs, benthic organisms, and fish.

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 ecosystem research to address HABs and hypoxia, authorized by the Harmful Algal bloom and Hypoxia Research and Control Act (1998, 2004). NOAA, in conjunction with federal, state, and academic partners has investigated the factors that regulate the dynamics of HABs and hypoxia, leading to predictive models that have been successful in forecasting specific HAB and hypoxia events. Other research efforts have developed new methods of detecting HABs and their toxins, investigated the impacts of HABs and hypoxia on ecosystems and coastal economies, and created new approaches for preventing or controlling HABs, hypoxia, and their impacts. The purpose is to assist state and coastal resource and public health managers undertake short- and long-term efforts to reduce, and ultimately, prevent the detrimental effects of these phenomena.

Accomplishments

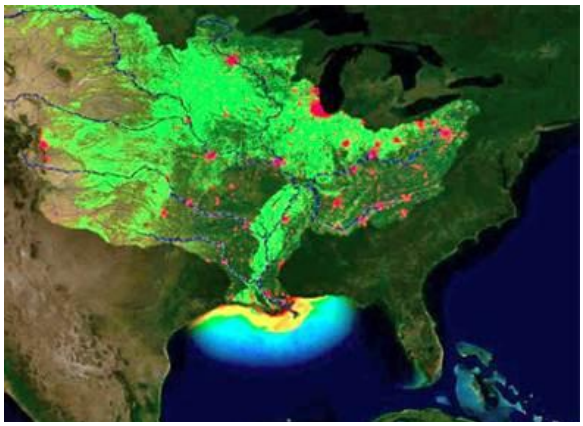


AUVs (Slocum Glider and REMUS) with automated sensor for *Karenia brevis* (Breve Buster) and example of temperature and red tide abundance data during operation (graphics provided by Gary Kirkpatrick, Mote Marine Lab)

HABs: 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 and minimizing shellfish harvesting or beach closures. NOAA's Harmful Algal Bloom Operational Forecast System (HAB-OFS) in the Gulf of Mexico integrates satellite imagery, field observations, and buoy data to provide information on the location, extent, and potential for development or movement of HABs in the along the coasts of Florida and Texas where toxic blooms of the Florida red tide, *Karenia brevis*, occur most frequently. Florida and Texas HAB Bulletins are distributed twice weekly to the management community by NOAA Ocean Service (NOS). They were developed collaboratively by NOS scientists with key contributions from external investigators funded by NOS via the Monitoring and Event Response for Harmful Algal Blooms (MERHAB) program.

Research supported by the Ecology and Oceanography of Harmful Algal Bloom (ECOHAB) and MERHAB Programs have led to a rapid test for the toxins produced by *K. brevis* that has revolutionized understanding of toxin transfer through food webs and impacts on protected species, such as manatees and dolphins. An in-water sensor has been developed that can detect cells of *K. brevis*, that can be deployed on an autonomous underwater vehicle (AUV) or a mooring. Current projects are investigating the role of nutrients from natural and anthropogenic sources in stimulating *K. brevis* blooms on the west coast of Florida in order to develop strategies to reduce the incidence of blooms; determining the cause of *K. brevis* blooms along the Texas coast in order to provide better early warning; and developing protocols for treating endangered sea turtles sickened by brevetoxins.

Hypoxia: 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 funded investigations and forecast development for the dead zone since 1990. The capability to forecast the size of the "dead zone" is 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.



Visualization of dead zone along the northern Gulf of Mexico continental shelf (red and yellow areas) that is formed in the spring through summer in response to nutrient loading from the Mississippi River watershed.

Event Response: NOAA has a suite of programs which provide immediate assistance to coastal managers and public health officials, helping to reduce the impact of HAB events through rapid, coordinated responses to toxic algal blooms, related health incidents, and marine animal mortality events. In 2004 and 2005 these programs supported NOAA and partner efforts to respond to a large marine animal mortality events in Florida. In 2008 they assisted Texas Parks and Wildlife Dept. respond to an unprecedented toxic bloom of *Dinophysis*, supporting a decision to close oyster harvests averting a widespread outbreak of Diarrhetic Shellfish Poisoning at a seafood festival.

Resources: NOAA Website: http://www.cop.noaa.gov/; telephone: 301-713-3338.
For HAB issues, contact Quay Dortch (ECOHAB), quay.dortch@noaa.gov, or Marc Suddleson (MERHAB, Event Response), marc.suddleson@noaa.gov.
For hypoxia issues, contact Alan Lewitus, alan.lewitus@noaa.gov.