NASA Gulf of Mexico Initiative Hypoxia Research

The Applied Science & Technology Project Office at Stennis Space Center (SSC) manages NASA’s Gulf of Mexico Initiative (GOMI). Addressing short-term crises and long-term issues, GOMI participants seek to understand the environment using remote sensing, in-situ observations, laboratory analyses, field observations and computational models. New capabilities are transferred to end-users to help them make informed decisions. Some GOMI activities of interest to the hypoxia research community are highlighted below.

Project Title: Monitoring the Mississippi River Plume from the Opening of the Bonnet Carré Spillway
Principal Investigator: Bill Graham, NASA Stennis Space Center

In the spring of 2011, there was tremendous flooding along the Mississippi River. To save Baton Rouge and New Orleans, the US Army Corps of Engineers opened the Morganza and Bonnet Carré spillways in May 2011, allowing floodwaters to flow into Lake Pontchartrain and the Atchafalaya River basin. Supporting the United States Geological Survey National Wetland Research Center flood response, NASA scientists at Stennis Space Center used data from the MODIS, ASTER, AL and LANDSAT instruments flying on four satellites to generate flood maps. The maps were used to study the extent of the flooding and to monitor the outflow of nutrient-rich fresh water into the coastal lakes, the Mississippi Sound and the Louisiana shelf.

In this image, sediment in the floodwater is yellow. Daily updates from several sensors enabled NASA and FDACS scientists to monitor flooding on a regional scale and quickly detect local features such as the flow of fresh water from Lake Pontchartrain into Lake Borgne.

Project Title: Enhancing Estuarine Water Quality Management Through Integrating Earth Science Research Results: A Targeted Project for Tampa Bay, Florida
Prime Investigator: Chuanmin Hu, University of South Florida

Presently, monitoring of estuarine water quality in the Gulf of Mexico is largely based on in-situ surveys. These costly and labor-intensive efforts may be inadequate to fully characterize short-term status and long-term trends, and thus could lead to biased statistics and decisions. Tampa Bay researchers have been monitoring for several decades using boat surveys, which provided a unique data set to test our remote sensing approaches to water quality monitoring and management. The first objective was to improve existing water quality decision models (MOW) through use of the latest high spatiotemporal satellite (MODIS and others) observations of Tampa Bay. Florida’s largest open-water estuary. The second objective was to expand such remote sensing capacity to other estuaries and to work with the Gulf of Mexico Alliance Water Quality and Nutrient Reduction Priority Information Teams, as well as other research groups, to establish a concerted and consistent plan for Gulf of Mexico estuaries. The series of images to the right show annual mean chlorophyll-a concentrations derived from MODIS. The decreasing trend from 2003-2004 to 2005-2006 is primarily driven by climate variability (precipitation).

Project Title: On the recurrent Ulva profusica blooms in the Yellow Sea and East China Sea
Prime Investigator: Chuanmin Hu, University of South Florida

Approximately location and distribution of Ulva profusica identified from MODIS imagery between April 2000 and May 2009. The background MODIS RGB images (3 June 2003) show the red and green plume from the Subei Shantou Bank in the East China Sea (ECS). Nearly all Ulva profusica algae in the ECS were found in the downstream portion of this plume, which occurs every year between fall and spring following cross-shelf currents from the Subei Bank and the ECS. (a) MODIS RGB image and (b) MODIS image showing Ulva profusica blooms in 1 x 1 degree in the Yellow Sea and ECS on 31 May, 2003 and 17 July, 2006, respectively.

Project Title: Enhancing NASA’s COAST Online Application for Agricultural Best Management Practices Decision Support
Principal Investigator: Katherine Milla, Florida A&M University

Project Title: DEMAND - GIS Environment for Modeling of Atmospheric/Nutrient Deposition
Principal Investigator: Madhukar Nar, University of Alabama, Huntsville

Atmospheric nutrient deposition plays a role in the formation of hypoxic zones in the Gulf of Mexico. MODIS data created with output from the chemical/aerosol transport model (CMAQ/GRAPES) are used to estimate and map dry deposition of nutrients (N, S, Fe) on land, inland water bodies, estuaries and the Gulf of Mexico region. Output from the model is used by multiple researchers to address national and environmental issues through integrated science models.

Project Title: Improved Hypoxia Modeling for Nutrient Control Decisions in the Gulf of Mexico
Principal Investigator: Shafid Habib, NASA Goddard Space Flight Center

The Gulf of Mexico Modeling Framework is a suite of coupled models linking the deposition and transport of sediment and nutrients to atmospheric-, terrestrial-, riverine- and oceanic processes and the resulting effect on concentrations of dissolved oxygen in coastal waters of Louisiana and Texas. The project will use NASA data products and modeled output to improve the estimation of water and dry deposition of nitrogen.