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 Carre 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 Carre 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 food response, NASA scientists at Stennis Space Center used data from the MODIS ASTER, ALI, and LandSat instruments flying on seven satellites to generate flood maps. The maps were used to study the extent of the flooding and to monitor the influx of nutrient-rich freshwater 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 FGS 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 spatial and seasonal trends and thus could lead to biased statistics and decisions. Tampa Bay researchers have been monitoring for several decades using boat surveys, which provide a unique dataset to test new remote sensing approaches to water quality monitoring and management. The first objective was to improve an existing water quality decision support system for Tampa Bay. 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: Enhanced NASA’s COAST Online Application for Agricultural Best Management Practices Decision Support
Principal Investigator: Katherine Mills, Florida A&M University

The lower Suwannee River basin in central Florida has been subjected to increased use of pesticides and fertilizers, runoff from dairy and poultry farms, and contaminants from pulp mills and paper mills. The Florida Department of Agriculture and Consumer Services (FDACS) Office of Agricultural Water Policy implements agricultural best management practices (BMPs) which can reduce inputs of agricultural nutrients to surface waters that empty into the Gulf of Mexico. Because adoption of BMPs is voluntary, it is crucial that FDACS personnel have tools that can effectively communicate the benefits of nutrient management and can assist in selecting the BMPs for specific fields. This project integrated NASA's Coastal On-line Assessment and Synthesis Tool (COAST) and a simulation hydrological model provided by Soft Water Engineering Technology, Inc. The resulting 3D virtual river presents information in a way familiar to land owners, enables FDACS personnel to capture site data and simulate conditions that identify BMPs for test sites. The results of this proposal can be adapted for different geographic regions that contribute nutrient inputs to the Gulf of Mexico to help reduce the overall nutrient inputs to the Gulf.

Project Title: DEMAND - DDS Environment for Modeling of Atmospheric/Nutrient Deposition
Principal Investigator: Ishtyakfar Nair, University of Alabama, Huntsville

Atmospheric nutrient deposition plays a role in the formation of hypoxic zones in the Gulf of Mexico. MODIS Aqua data with output from the chemical/aerosol transport model (CAMx/AERMOD) are used to estimate and disperse deposition of nutrients (N, S, Fe and P) over land, inland water bodies, estuaries and the Gulf of Mexico region. Output from the model is used to partition observed aerosol collected into different categories and deposition potentials are computed. DEMAND helps decision making processes related to water quality and nutrient inputs into aquatic ecosystems in coastal and inland waters in this state of Alabama. Results are hosted on the Virtual Alabama (VA) system. VA is a Google Earth-based system developed by the Alabama Department of Homeland Security with the impetus purpose of sharing of information between different governmental agencies within the state of Alabama. End users include the Alabama Department of Environmental Management and the Mobile Bay National Estuary Program.

Project Title: Improved Hypoxia Modeling for Nutrient Control Decisions in the Gulf of Mexico
Principal Investigator: Shadid 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 subaqueous areas and the hypoxic processes and the resulting effect on concentrations of dissolved oxygen in coastal waters of Louisiana and Texas. The project aims to use NASA data products from modeled aerosol to attempt to improve the estimation of wet and dry deposition of nitrogen.