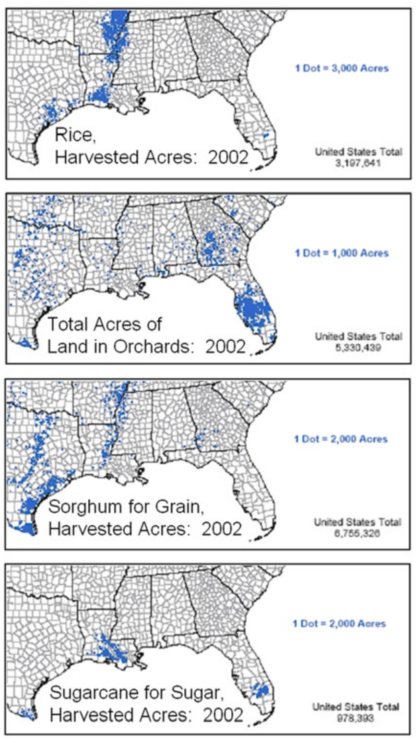
INTRODUCTION AND OVERVIEW

Around the Gulf of Mexico, high-input crops in several regions make a significant contribution to nutrient loading of small to medium estuaries and the near-shore Gulf. Some crops cultivated near the coast include sorghum in Texas, rice in Texas and Louisiana, sugarcane in Florida and Louisi-ana, citrus orchards in Florida, pecan orchards in Mississippi and Alabama, and heavy sod and ornamental production around Mobile and Tampa Bay. The distributions of several of these crops are shown in Figure 1. This project seeks to use NASA data to enhance the spatial and temporal resolu-tion of near-coast cropping information available to the coastal community. In doing so, we hope to contribute to an improved understanding of nutrient loading and nutrient sources for sensitive water bodies around the Gulf of Mexico.



U.S Department of Agriculture. National Agricultural Statistics Service – 2002 Census of Agriculture

Figure 1

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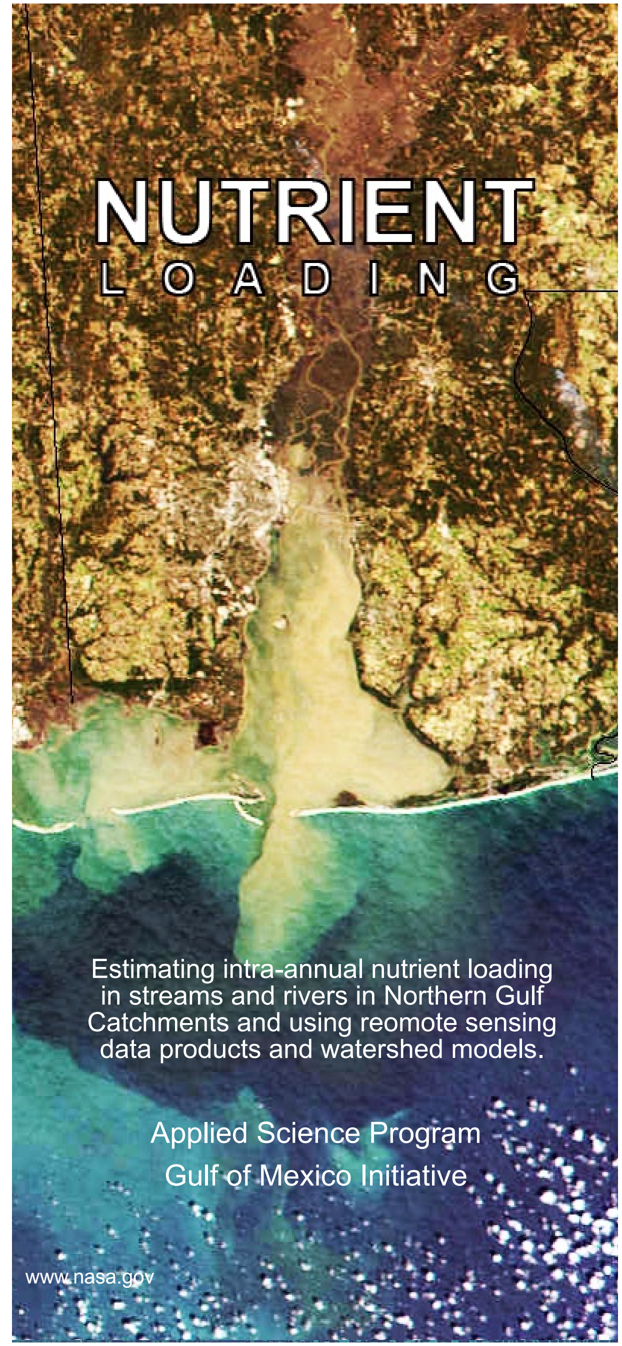

NUTRIENT LOADING

Estimating intra-annual nutrient loading in streams and rivers in Northern Gulf Catchments and using reomote sensing data products and watershed models.

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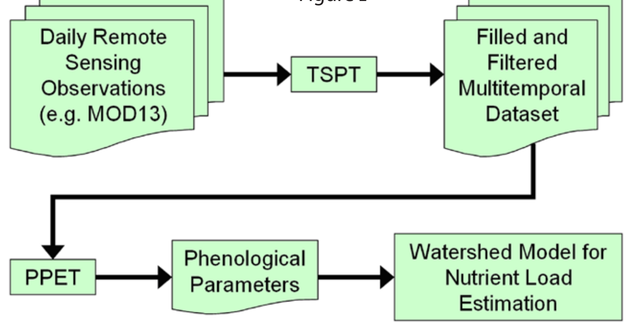
Nitrate and phosphate occur in runoff water from fertilizer, animal waste, wastewater treatment plants, and industrial discharges. When these nutrients reach estuaries and open waters of the Gulf, they can cause phytoplankton and macroalgae to multiply, leading to depletion of dissolved oxygen, death of important marine organisms, habitat loss, and eutrophication. Fluxes of nutrients in rivers that drain upland watersheds are typically the dominant new source of nutrients to coastal waters.
Participants at all of the GOMA Community Workshops identified water quality as a priority issue and recognized the need to find the proper balance between nutrient inputs required to sustain healthy ecosystems and excessive inputs that pollute their waters with algal blooms and that kill fish. Participants at all Workshops consistently recommended further research on the connection between nutrient levels and hypoxia. In particular, participants at the Port Aransas, TX, Community Workshop identified the need to better understand the timing of nutrient loading relative to circulation and seasonal factors that influence hypoxia. The purpose of this Investigation project is to develop crop/fertilization information products applicable to small to medium watersheds surrounding the Gulf of Mexico. Our goal is for these products to be incorporated into a long-term monitoring framework being implemented by the GOMA Nutrient Reduction working group. These crop information products would enhance model inputs for crop non-point source nutrient contributions, both temporally and spatially.

The NASA products and capabilities envisioned as contributing to watershed modeling of nutrient loading estimation include the following elements:
• MOD13, the standard vegetation index product of the MODIS sensor, which acquires near-daily coverage of the Earth onboard both the Aqua and Terra satellites
• TSPT (Time Series Product Tool), software developed for NASA at Stennis Space Center to provide continuous multitemporal datasets by removing clouds and filtering out variance due to atmosphere, sensor geometry, etc. PPET (Phenological Parameters Estimation Tool), software developed for NASA at Stennis Space Center to enable estimation of seasonal vegetation parameters, such as the beginning and end of season.
These components are proposed to work together to yield input for watershed models as shown in Figure 2

Figure 2


To demonstrate the feasibility of this approach, archived MODIS data has been acquired for the area around Mobile Bay for 2005 and processed to “start-of-season,” a phenological parameter with potential relevance to one or more nutrient models. The 2005 MOD13 time series after filling in cloudy pixels and otherwise filtering is shown in Figure 3.

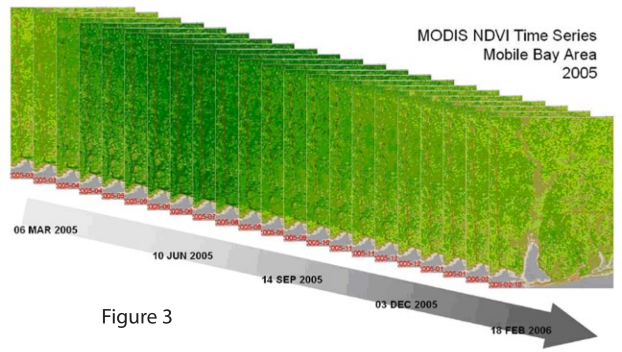
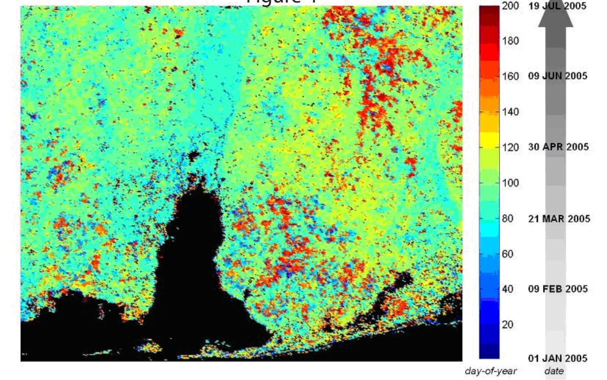


Figure 3

In the time series, the overall trend of maximum greenness around June and July is readily observed, but the details of seasonality are seen clearly after analysis with PPET. Figure 4 shows the “start-of-season” estimate taken directly from the time series of the previous figure. In the “start-of-season” grid, the cyan coloring shows that the wetlands including the Mobile River delta are starting their season in March, while the greens and yellows show that upland forests and grasses are greening up in April. Quite separate from this pattern are large patches with the beginning of the steepest growth either in February and earlier, or later than June. These two extremes in green-up tend to be closely associated spatially. This association can be observed on the east side of Mobile Bay and also in the northeastern corner of the scene. These are cropping areas where farmers take advantage of the long growing season by often planting winter wheat after peanuts or soybeans.

Figure 4


This “start-of-season” prototype demonstrates the potential to derive both crop cover and fertilization timing by remote sensing combined with ancillary data. The presence of large areas of crops with relatively high fertilizer requirements so near a major estuary highlights the potential of this approach.