National Aeronautics and Space Administration

COASTAL FOREST

Gulf of Mexico Initiative

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Monitoring Coastal Forest Conditions with NASA Satellite Data

This Discovery project assesses the technical feasibility of using NASA Earth observation data for monitoring targeted coastal forest health conditions along the Northern GOM (Gulf of Mexico). Coastal forests are important to sustainable community resiliency and habitat ecology in the littoral zone. Such forests are also exposed to multiple threats, natural and anthropogenic, as well as biotic and abiotic in nature. Remote sensing from sensors such as MODIS (Moderate Resolution Imaging Spectroradiometer), Landsat, and ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) can be used to monitor and assess changes in coastal forest conditions at regional to site specific scales. Information on coastal forest change is important to multiple GOMA (Gulf of Mexico Alliance) priorities, particularly with respect to coastal community resiliency, wetland restoration, habitat identification and characterization, and water quality.

A major component of the project regards the regional to site-specific monitoring of forest damage from hurricanes. The major hurricanes of 2004 and 2005 damaged coastal forests in Texas, Louisiana, Mississippi, Alabama, and Florida. Some of the impacts were short-lived, whereas other impacts are still evident in the residual forests that are recovering today. Since these hurricanes, much forest salvage harvesting has been performed. MODIS data has shown promise for assessing coastal forest damage across an entire hurricane impact zone. Landsat and ASTER data are available and have been used to assess forest damage and recovery at more local scales.

Damage from Hurricane Katrina, south of I-10 in Hancock County, Mississippi. These tracts were planted pine that had been thinned in the last 2 years.

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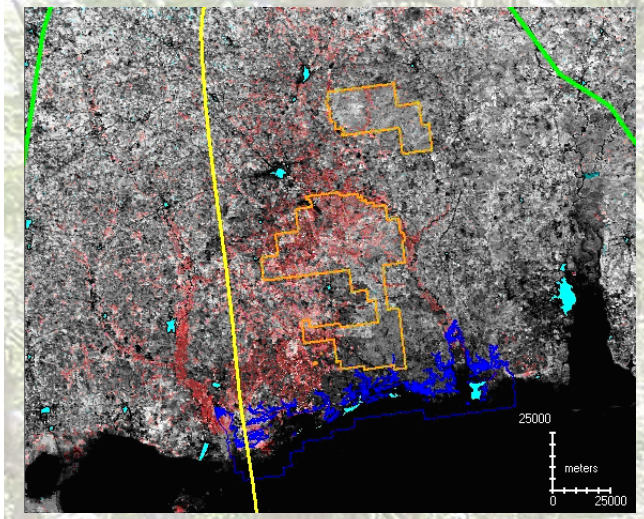
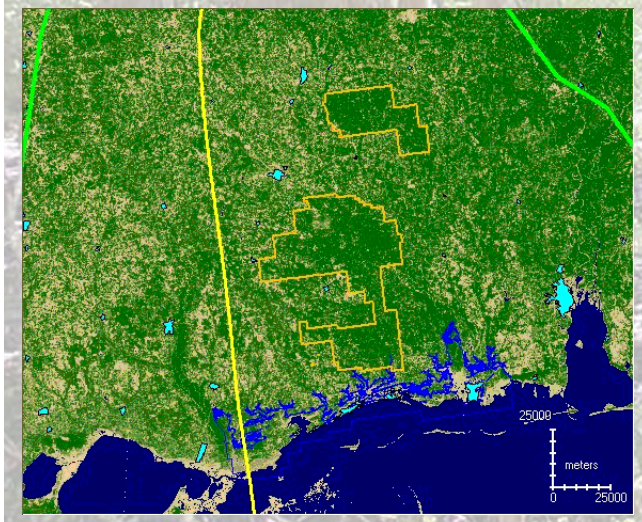
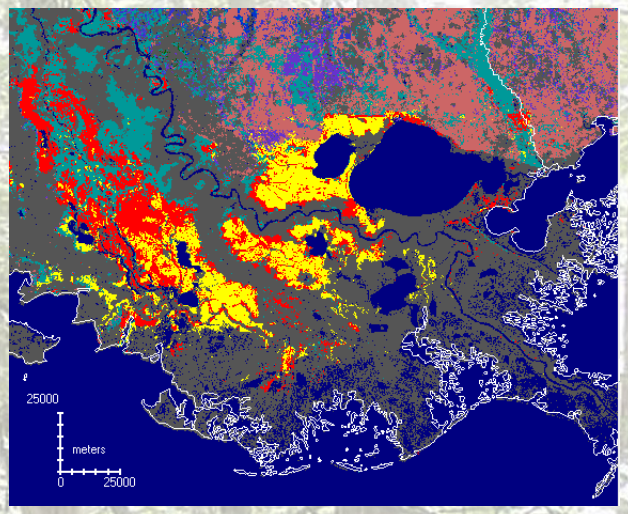


MODIS view of Hurricane Katrina forest damage. Background image is from two dates of MOD13 NDVI (Normalized Difference Vegetation Index) 16-day composites. The date just before the storm is loaded in the red color gun and the date just after the storm is loaded into the blue and green guns. The pink to red tones depict defoliated vegetation related to decreases in NDVI caused by the storm. The yellow vector identifies the storm track, the green vectors outline the hurricane force wind boundaries, the blue area highlights the storm surge zone, the cyan polygons identify the municipalities, and the orange vectors outline the DeSoto National Forest.



Percent tree canopy cover map computed from U .S. Geological Survey National Land Cover Data (NLCD) data. Gradient color table shows 0 percent tree cover in tan and 100 percent tree cover in dark green. The yellow vector identifies the storm track, the green vectors outline the hurricane force wind boundaries, the blue area highlights the storm surge zone, the cyan polygons identify the municipalities, and the orange vectors outline the DeSoto National Forest.



Location of baldcypress-dominated forest in coastal Louisiana based on USFS and NWI maps from 2003. Red denotes baldcypress-water tupelo stands mapped on the 250-m USDA Forest Service (USFS) forest type map. The overlain yellow denotes baldcypress-dominated stands, based on 1988 National Wetlands Inventory data. Water is from the NLCD 2001 land use land cover map. The remaining colors: sea green denotes other wetland forest, dark grey denotes non-forested land, pink denotes southern pine types, purple denotes upland mixed hardwood/ softwood forest and all other colors are from the USFS data. Note that color coding for the USFS product has been simplified to aid data visualization.

Baldcypress forest in coastal Louisiana

The Discovery project also documents the need to monitor specific types of certain coastal forest types in decline due to multiple threats. A prime example is the baldcypress forest, which can be threatened by subsidence, altered hydrology, persistent flooding, insect-induced forest defoliation, erosion, and non-sustainable timber harvesting practices. Large expanses of baldcypress forest exist in the coastal watersheds along the GOM. The ability to map the baldcypress type and its condition has been researched using Landsat data, although the topic remains experimental. The best maps of the baldcypress cover type and condition along the GOM are currently out of date.

This project also assesses the need for improved datasets on the monitoring of GOM coastal forest health. There is a strong need by GOMA end-users for current information on coastal forest health at regional to site specific scales. However, no standard mechanism is currently in place to ensure that such information is being collected, kept up-to-date, and made available to GOMA end users. Some projects are underway regarding coastal forest monitoring along the GOM, although the known completed projects are case-study specific and generally confined to small regions. The techniques for supplying such products have not yet been standardized and need additional research.

The Discovery project's findings has led to an accepted proposal for an investigation project to assess the technical feasibility of GOM coastal forest monitoring based on actual application of NASA satellite data from the MODIS, Landsat, and ASTER sensors.