**DEVELOP National Program**

Marshall Space Flight Center

**Spring 2013**

**South Carolina Ecological Forecasting**

*Utilizing NASA Earth Observations to Analyze Wetland Gain and Loss in Threatened Wetland Areas in South Carolina*

**Team Lead:** Katelyn Salem, University of Alabama in Huntsville, katesalem08@gmail.com

**Team Members:**

Rebecca Frye, University of Alabama in Huntsville

Ralph Evans, University of Alabama in Huntsville

**Advisors & Mentors:**

Dr. Jeff Luvall, NASA MSFC NSSTC Global Hydrology and Climate Center

**Applied Sciences National Applications Addressed:**

Ecological Forecasting

**Study Area:** South Carolina; Charleston area and Bulls Island.

**Study Period:** 1989 and Summer 1984 through Summer 2011

**Community Concerns**

* Wetland loss affects unique habitats for wildlife and migratory birds as well as threatened and endangered species.
* Erosion occurring on the north-east coast of Bulls Island threatens the Jacks Pond managed wetland impoundment.
* Living conditions of freshwater plants within coastal freshwater marshes can be impacted by saltwater brought in by hurricanes.
* Wetlands around urban areas need to be sustained to help alleviate flooding due to runoff from streets and buildings.

**80-100 Word Blurb**

Wetlands are an important component in maintaining a healthy ecosystem. They improve water quality by acting as a filter for sediments and chemicals, while also alleviating flood waters, which is especially important for urban areas which build up surface water runoff from streets and buildings. They are also considered to be some of the most diverse ecosystems in the world, supporting endangered species and providing homes for various plants and wildlife. Wetland maps are a prerequisite for wetland inventory and provide basic spatial data for wetland development planning, management, protection, and restoration. This project’s goal is to create land gain loss maps in the chosen study areas to aid regional agencies in monitoring wetlands.

**Abstract**

The concerns of wetland regulation and conservation are significant in South Carolina which has one of the largest ranges of wetlands in the Southeast. The South Carolina Department of Health and Environmental Control (SCDHEC), the US Army Corps of Engineers, National Wildlife Federation (NWF) and other federal and regional agencies provide regulations but do not actively monitor wetland gain and loss. Research was completed to aid the analysis of wetland standings with land loss and gain data for the end-users. This project combined Normalized Difference Water Index (NDWI), Normalized Difference Vegetation Index (NDVI), and Normalized Difference Soil Index (NDSI) to form a product named “NDXI” to aid in land cover classification along with land cover classes from USDA CropScape. Land cover categories were created using Landsat data from 1984 and 2011 for Charleston and Bulls Island. Change detection on the classified images was displayed as four classes; land without change, water without change, land that changed to water, and water that changed to land. Using a combination of band ratios, change detection was also completed for the coastline of Charleston before and after Hurricane Hugo in 1989. This project resulted in wetland gain and loss data for the aid of wetland regulation in South Carolina.

**Earth Observations & Parameters**

Landsat 5, TM – land cover, NDVI, NDWI, NDSI

**Future Applicable NASA Missions**

LDCM - Land cover

**Models Utilized**

NDXI (NDVI, NDSI, NDWI)

**Ancillary Datasets Utilized**

USDA CropScape

GIS shapefiles for each study area

**Software Utilized**

ENVI – QUAC, atmospheric correction of Landsat 5 TM images

ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat5 TM

**Decision Support Tools**

* Change detection for 1984 through 2012 land/water gain and loss to assess wetland and coastal statuses of the study areas.
* Coastline change detection of Charleston before and after Hurricane Hugo in 1989 to analyze the effects of hurricanes on urban areas and wetlands.

**Partners/Collaborators**

US Fish and Wildlife Service, Raye Nilius, Project Leader, South Carolina Lowcountry Refuge Complex

South Carolina Department of Health and Environmental Control

US Army Corps of Engineers

**Current Management Practices & Policies**

South Carolina coastal wetland policies and regulations have been adopted in accordance to a Section 401 Water Quality Certification Program. Regulations of wetlands are administered by the South Carolina Department of Health and Environmental Control (SCDHEC) Office of Ocean and Coastal Resource Management (OCRM) which issues permits for certain activities under the state’s Coastal Zone Management Act for critical areas of the state’s coastal zone including coastal water, tidelands, beach/dune systems, and beaches. For non-critical zones, the SCDHEC’s Office of Environmental Quality Control, Bureau of Water regulates state waters under Section 404 of the Clean Water Act.

On average, the OCRM reviews about 1,000 permit applications a year with anywhere from three to five percent of them being denied. Both the OCRM and the Bureau of Water’s budget are primarily from state appropriations, with some additional funding for the Bureau provided by the USEPA Wetland Program Development Grants. The OCRM and Bureau of Water have been building up a database of proposed impacts, locations, mitigation activities, restoration methodologies, and monitoring reports including GIS maps but do not actively monitor the statuses of all wetlands in South Carolina. Monthly meetings are also held between the US Army Corps of Engineers, SCDHEC, EPA, US Fish and Wildlife Service, National Marine Fisheries Service, SCDNR, and South Carolina Department of Archives and History to discuss permits and their applications.

**Benefit to End-User:**

* A technical paper providing methodologies and techniques that may be applied by the end-user to other research areas.
* Information on how remote sensing may be applied for classification of land gain and loss maps.
* Project results analyzing the effects of hurricanes on urban areas and wetlands for future planning and restoration projects.