NASA's Contributions to the Gulf of Mexico Alliance

Mark Glorioso
Gulf of Mexico Applications Project
Stennis Space Center

GOMAP

Corpus Christi, Texas, August 21, 2008

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Workshop Agenda

1:00-1:10	**Check-in**
1:10-1:15	**Welcome (Mr. Ted Mason)**
1:15-1:30	**NASA Applied Science Program Overview (Dr. Teresa Fryberger)**
1:30-2:30	**NASA SSC Coastal Activities (Mr. Mark Glorioso)**
	NASA SSC Coastal Initiative Coastal Online Assessment and Synthesis Tool (COAST) Completed Projects Current Projects DEVELOP ROSES-08
2:30-3:00	**Introduction of Coastal Strategic Plan (Mr. Mark Glorioso)**
3:00-3:30	**COAST Demonstration (Mr. Richard Brown)**
3:30-3:45	**Break**
3:45-4:45	**Panel Discussion: (Moderator: Mr. Mark Glorioso)**
	Best methods to develop partnerships that enhance the transition from coastal research to operations
4:45- 5:00	**Wrap up (Mr. Mark Glorioso)**

NASA Applied Sciences

The NASA Earth Science Applied Sciences Program *discovers and demonstrates* practical applications of NASA Earth science research and capabilities.

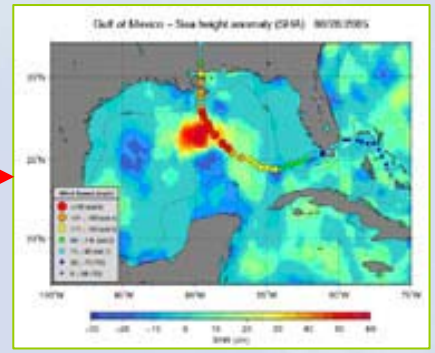
Our goals are to:

- Expand the benefits of NASA Earth science across a broad range of societal needs.
- Demonstrate new decision support tools for resource managers and policy makers for potential operational use.
- Provide the applications viewpoint in the design of new missions and research. Demonstrate and communicate the value of Earth science to the public and to decision, policy, and law makers.

Current Missions:
Direct Coastal Applications

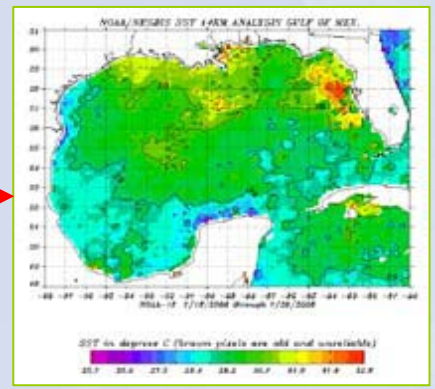
Jason-1 and Jason-2

- Ocean Surface Topography
- Sea Surface Height Anomalies
- Ocean Circulation
- Wave Heights
- Wind Speed



Terra and Aqua

- Colored Dissolved Organic Matter (MODIS)
- Algal Blooms (MODIS)
- Sea Surface Temperature (MODIS/AMSR-E)
- Ocean Surface Roughness (AMSR-E)

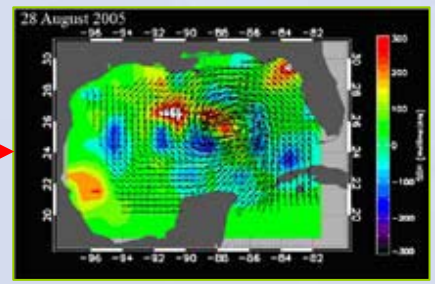


GRACE

- Ocean Circulation

QuikSCAT

- Wind Speed and Direction Over Oceans



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Missions In Development: Direct Coastal Applications

- **Aquarius**
  - Sea Surface Salinity
  - Surface Roughness

- **NPP (VIIRS)**
  - Algal Blooms
  - Surface Temperature
  - Colored Dissolved Organic Matter
  - Suspended Matter

Decadal Survey Missions: Direct Coastal Applications

- **SMAP** (Soil Moisture Active Passive)
  - Algal Blooms
  - Waterborne Infectious Disease
  - Surface Water and Ocean Topography

← **2010-13**

- **SWOT** (Surface Water/Ocean Topography)
  - Ocean Circulation
  - Algal Blooms
  - Waterborne Infectious Disease
  - Surface Water and Ocean Topography
- **GEO-CAPE** (Geostationary Coastal and Air Pollution Events)
  - Coastal Water Quality
  - Algal Blooms
  - Waterborne Infectious Disease
- **ACE** (Aerosol/Cloud/Ecosystem)
  - Algal Blooms
  - Waterborne Infectious Disease

2013-16

- **PATH** (Precipitation and All-weather Temperature and Humidity)
  - Algal Blooms
  - Waterborne Infectious Disease
- **GRACE II**
  - Ocean Circulation
  - Sea Surface Height

2016-20

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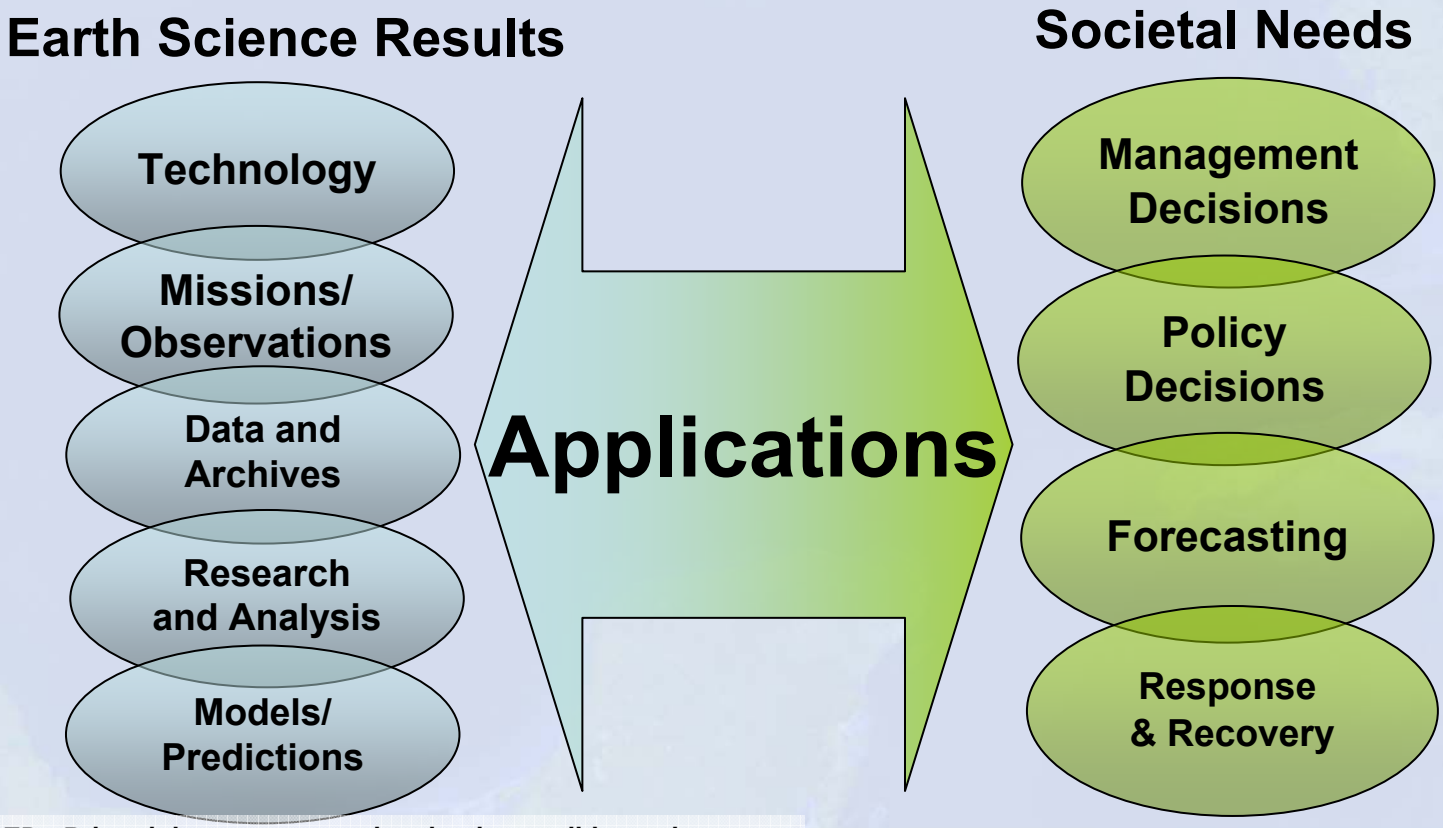
NASA Earth Science Applications

Applied Sciences will work across the "gap" and will employ all means to utilize Earth Science results, within the limits of NASA's mission



NASA Letter to GOMA

January 18, 2008

- **Coastal Initiative Focused on Gulf of Mexico**
  - Product-driven approach to Gulf of Mexico issues
  - Emphasis on NASA SSC collaborations with GOMA Federal, State, and regional partners
- **Goals of NASA Gulf Coast Applications Program at SSC**
  - Focus NASA SSC expertise, capability on coastal science to support Gulf management issues and NASA Applied Sciences Program strategy
  - Strengthen collaborations and integrate projects with GOMA entities and other regional efforts
  - Evaluate NASA and affiliated data and research results for Gulf of Mexico coastal management suitability
- **Initial Projects**
  - Gulf of Mexico Alliance Applications Pilot: Assessing Land-Use Land-Cover Change in the Mobile Bay Region from 1972–Present
  - Coastal Online Assessment and Synthesis Tool (COAST) data acquisition, display, and visualization in Gulf-wide or estuary format
  - Integrated Approach to Hypoxia Assessment of the Northern Gulf of Mexico

Gulf of Mexico Initiative

- NASA Stennis Space Center has been instructed to:
  - Focus the efforts of its applied science program on the issues facing the Gulf of Mexico and its coastal regions as identified by the Gulf of Mexico Alliance (GOMA)
  - Interact and collaborate with the coastal management community and other entities to identify areas that can benefit from the utilization of NASA Earth science
  - Develop a 3–5 year strategic plan that will be used to guide the deployment of NASA resources in the Gulf of Mexico

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National Aeronautics and Space Administration

COAST:
Coastal Online Assessment and Synthesis Tool

COAST

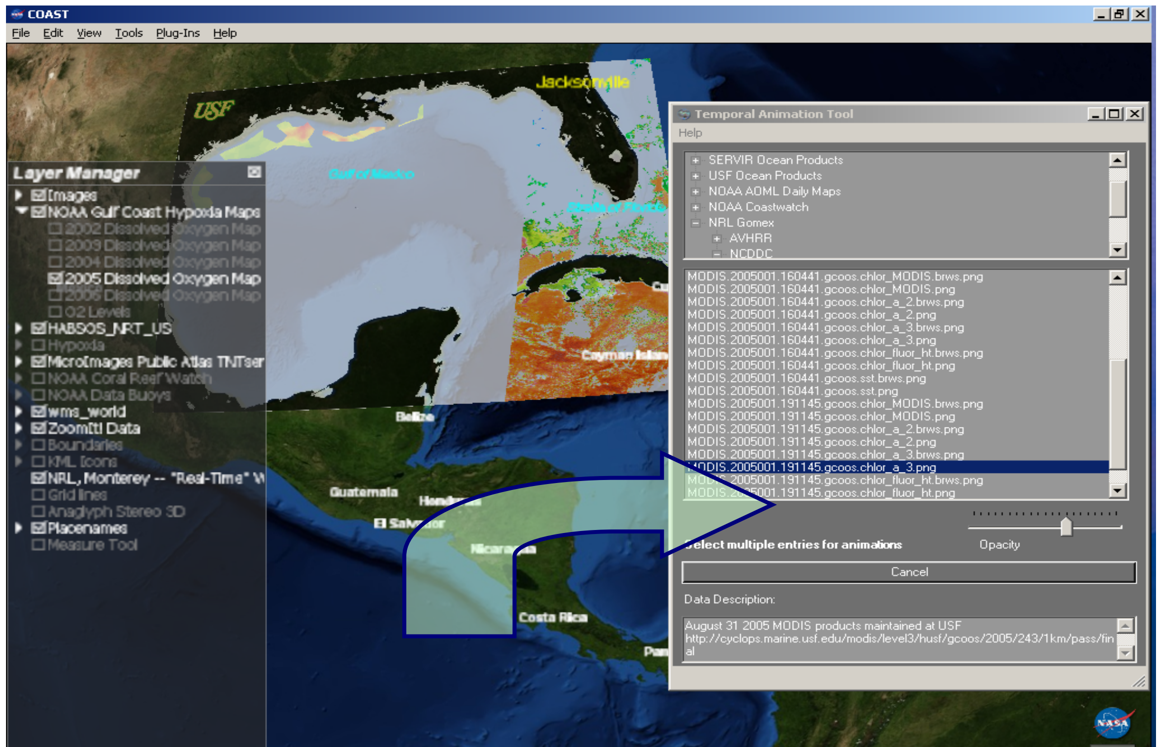
*Integrating the most appropriate and useful tools from other **World Wind** derivatives and sources into a new code compilation that maps datasets pertinent to coastal research purposes*

In other words…

If good extensible tools are already made and are open source…

Collaborate, borrow, modify, and recompile.

And save man-hours.



NRL Weather Tool code modified into Temporal Animation Tool with links into Hypoxia-related online data directories from: SERVIR, USF, NOAA AOML, NOAA Coastwatch, NRL Stennis, and local data

http://www.coastal.ssc.nasa.gov/

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Richard Brown (SSAI, Stennis Space Center)

Completed NASA SSC Gulf of Mexico Application Projects

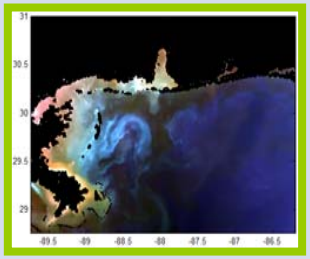
Regional Sediment Management

Purpose:
Detect Suspended Sediments Using MODIS and VIIRS Simulated Data

End User:
U.S. Army Corp. of Engineers

Study Area:
Alabama, Mississippi, Louisiana

Project Leads:
Jean Ellis (NASA)
Maria Kalcic (SSAI)



Suspended Sediments Map

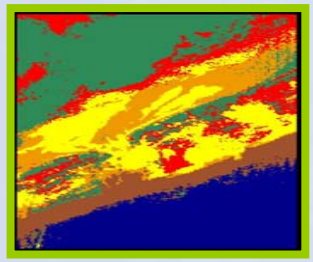
Coral Reef Early Warning System

Purpose:
Determine if NASA Next Generation Sensors can produce Key Data Layers for the NOAA CREWS Decision Support Tool

End User: NOAA

Study Area:
Looe Key, FL; Kaneohe Bay, HI

Project Leads:
Callie Hall (NASA), Lee Estep (SSAI)



Benthic Classification Map

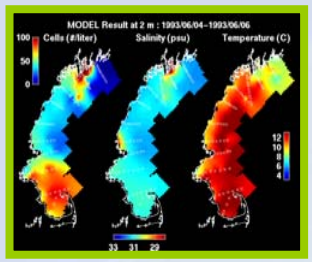
Harmful Algal Bloom

Purpose:
Identify Current and Future NASA Data Products that can be used in the NOAA HABMAPS Decision Support System

End User: NOAA

Study Area: Gulf of Mexico

Project Leads: Callie Hall (NASA), Lee Estep (SSAI)



HAB Forecast Map

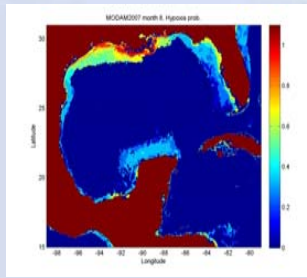
Hypoxia

Purpose:
Predict the Spread of Hypoxia using MODIS Data and the Time Series Product Toolkit

Potential End User:
Regional Planners

Study Area: *Gulf of Mexico*

Project Leads:
Callie Hall (NASA), Bruce Spiering (NASA), Maria Kalcic (SSAI)



Hypoxia Probabilities Map

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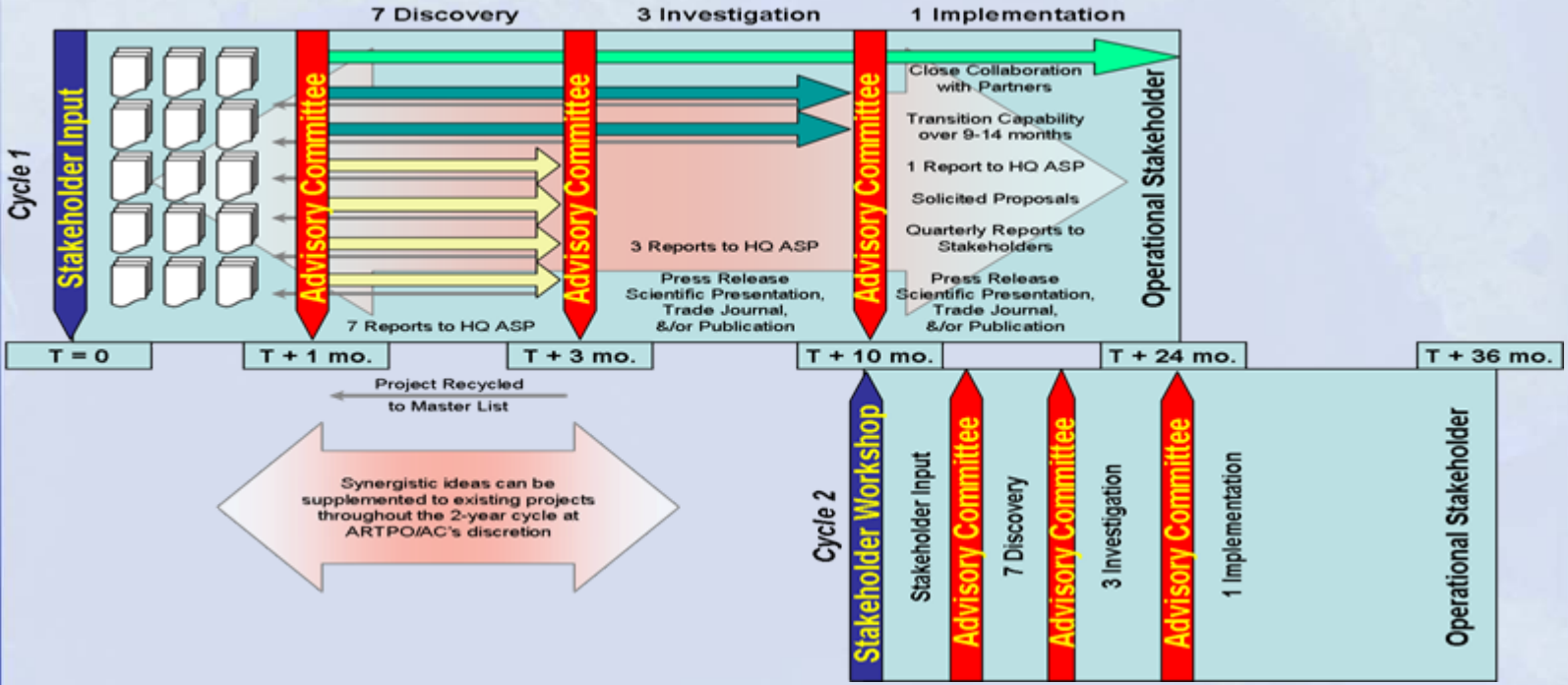
Methodology 7-3-1



- Independent Steering Committee established (Oct 07)
- 28 one-page proposals reviewed (Dec 07)
  7 selected for proposal development
- Selected 4 for further development (Mar 08)
- Steering committee will meet again to review results of the 4 selections (Sept 08)

Steering Committee

NASA Stennis Applied Science Program - Gulf of Mexico Initiative

Dr. Becky Allee, NOAA Gulf Coast Services Center
Mr. David Ruple, Grand Bay National Estuarine Research Reserve
Dr. Dawn Lavoie, United States Geological Survey
Dr. James Pahl, Louisiana Department of Natural Resources
Mr. Charles Kovach, Florida Department of Environmental Protection
Dr. Larry McKinney, Harte Research Institute for Gulf of Mexico Studies
Dr. Steve Lohrenz, University of Southern Mississippi
Dr. Michael Carron, Northern Gulf Institute
Mr. Phil Bass, U.S. Environmental Protection Agency, Gulf of Mexico Program
Ms. Roberta Swann, Mobile Bay National Estuary Program
Dr. Rost Parsons, NOAA National Coastal Data Development Center
Mr. Steven Wolfe, Florida Department of Environmental Protection

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Current NASA SSC
Gulf of Mexico Application Projects

- Gulf of Mexico Alliance Application Pilot: Land-Use and Land-Cover (LULC) Change from 1974–2008 around Mobile Bay, AL (Dr. Jean Ellis, NASA)
- Satellite Estimation of Suspended Particulate Loads in and around Mobile Bay, AL (Dr. Jean Ellis, NASA)
- 7:3:1 PROJECTS
  - Estimating Relative Nutrient Contributions of Agriculture and Forests Using MODIS Time Series (Bruce Spiering, NASA)
  - Use of NASA Satellite Data in Monitoring Gulf Coast Forest Conditions (Duane Armstrong, NASA)
  - Coastal Marsh Monitoring for Persistent Saltwater Intrusion (Callie Hall, NASA)
  - A Standardized Remote Sensing Product for Water Clarity Estimation within Gulf of Mexico Coastal Waters (Dr. Jean Ellis and Callie Hall, NASA)

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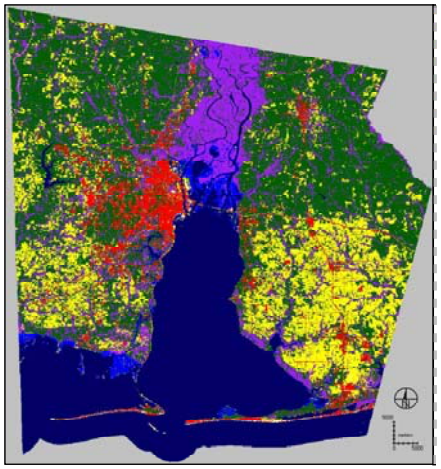
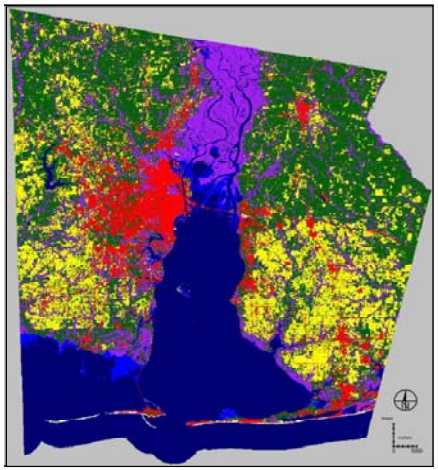
Gulf of Mexico Alliance Application Pilot: Land-Use and Land-Cover (LULC) Change from 1974–2008 around Mobile Bay, AL

***Purpose*: Assess LULC changes of Mobile and Baldwin counties, AL, for 1974–2008** ***End-User*: Mobile Bay NEP**





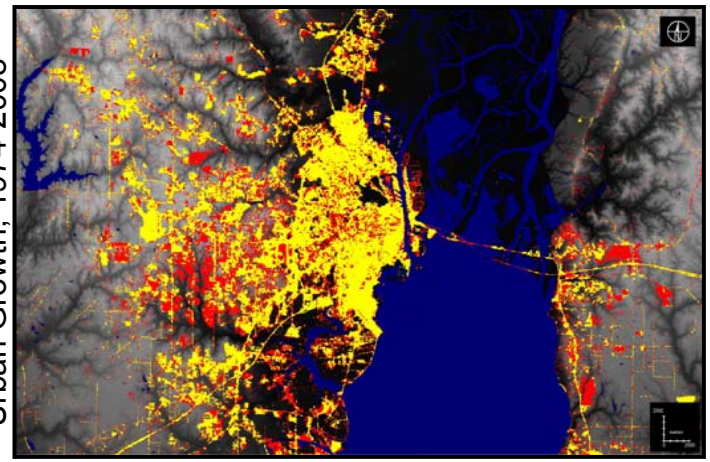
(Top) Landsat MSS (11/12/1974); (Bottom) Landsat TM (3/16/08)

Landsat-derived geospatial statistics to analyze LULC in Mobile and Baldwin counties have been calculated for nine dates between 1974–2008. Project data and data products are tailored for Mobile Bay NEP and will be available on-line [Regional Ecosystem Data Management (NOAA/NCDDC)].

Class	1974 Total Acres	1974 Percent	2008 Total Acres	2008 Percent
Open water	485,302	26.4	504,431	27.2
Barren	3,504	0.2	7,954	0.4
Agriculture	272,024	14.8	284,436	15.3
Non-woody wetland	38,631	2.1	39,964	2.2
Upland forest	674,298	36.6	586,523	31.6
Woody wetland	270,618	14.7	282,213	15.2
Urban	96,688	5.3	151,644	8.2
Total	1,841,065	100.0	1,857,165	100.0

Landsat-derived LULC change statistics from 1974-2008.

Urban Growth, 1974-2008



Yellow: 1974 and 2008 urban extent (Landsat MSS, 11/12/1974); Red: Urban growth from 1974 to 2008 (Landsat TM, 3/16/08); Backdrop: USGS DEM, darker grey shades indicate lower elevations

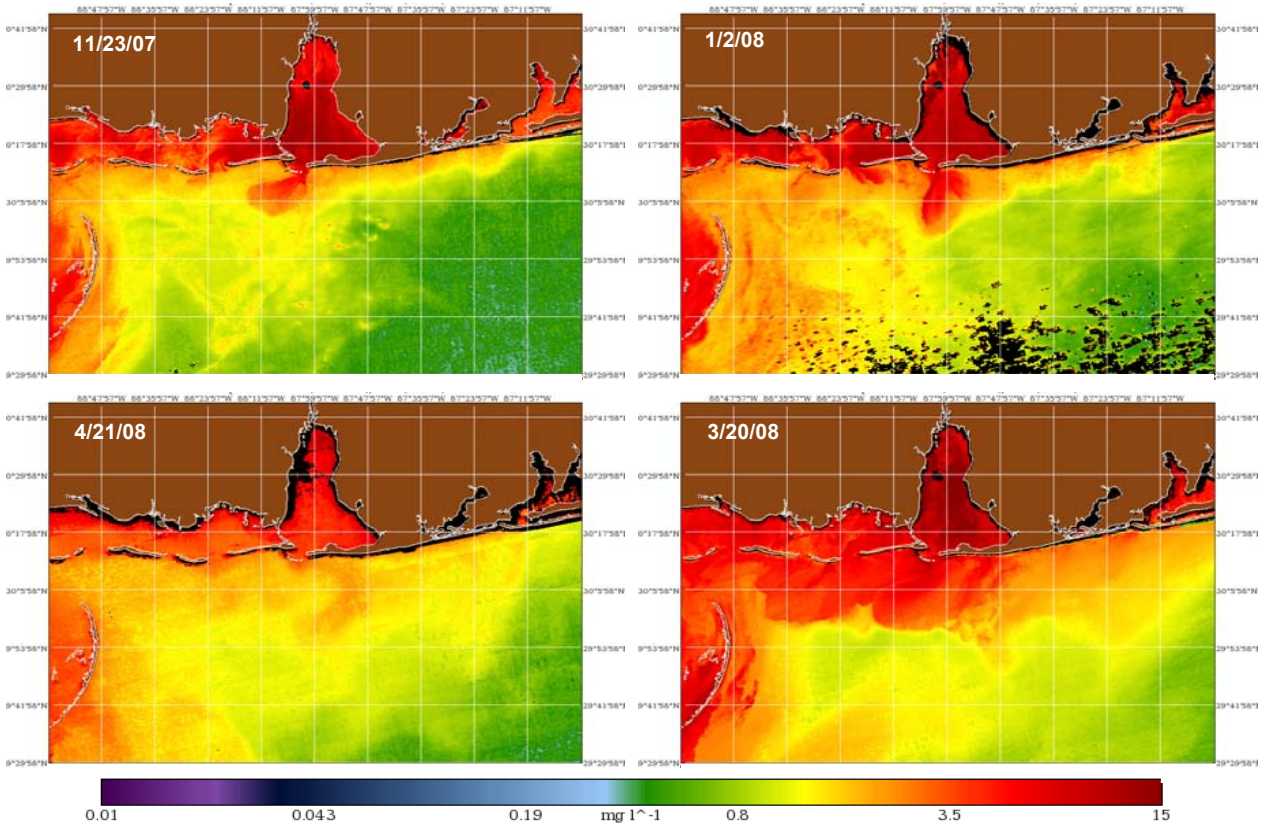
Project Leads: Jean Ellis (NASA, Stennis Space Center) and Joseph Spruce (SSAI, Stennis Space Center)

Satellite Estimation of Suspended Particulate Loads in and around Mobile Bay, AL

***Purpose*: Examine spatial and temporal variability of the Mobile Bay sediment plume**

The variability of the Mobile Bay sediment plume, which impacts water clarity, dissolved oxygen levels, and ultimately seagrass health, will be tracked using MODIS (250 m) and in situ measurements from 10/1/07 to 9/30/08. Total suspended solids are partitioned into organic and inorganic content. Plume area will be delineated and a time-series analysis will be produced.

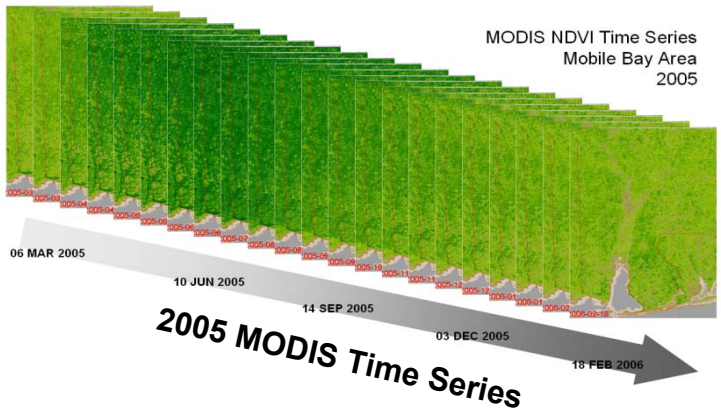
Total Suspended Solids (organic and inorganic particulates, mg/l)



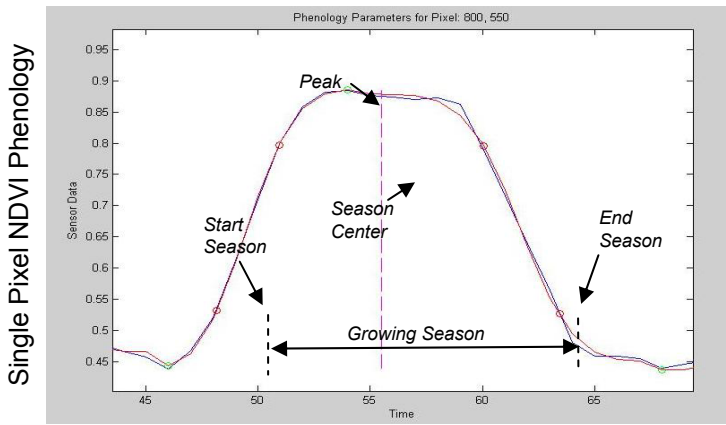
Project Leads: Joan Ellis (NASA, Stennis Space Center), Richard Gould and Gina Smith (Naval Research Laboratory, Stennis Space Center)

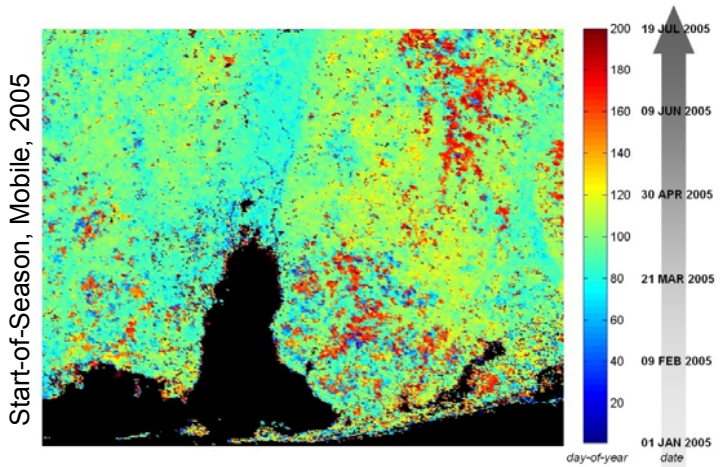
Estimating Relative Nutrient Contributions of Agriculture and Forests Using MODIS Time Series

***Purpose*: Demonstrate viability of nutrient source products for small to medium watersheds around Gulf of Mexico**
***End-User*: MDEQ, potentially other state environmental agencies**



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. In addition to crops, management of timberlands in proximity to the coasts also plays a role. Nutrient source information products can be derived from remotely sensed time series data. Conceptually, these products are intended to complement estuarine nutrient monitoring.





Project Leads: Bruce Spiering (NASA, Stennis Space Center) and Kenton Ross (SSAI, Stennis Space Center)

Use of NASA Satellite Data in Monitoring Gulf Coast Forest Conditions

Purpose: **Assess potential of Gulf Coast forest monitoring products derived from NASA satellite data**
***End User*: USDA Forest Service, USGS NWRC, and the LA-DNR**

Regional monitoring of forest damage from hurricanes

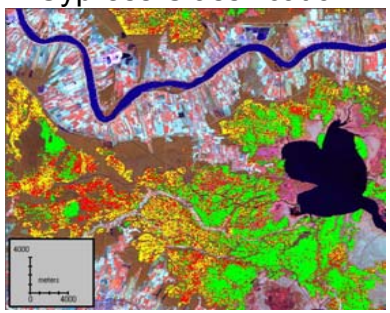
Stand-specific monitoring of baldcypress forest

Study areas – coastal Mississippi and Louisiana

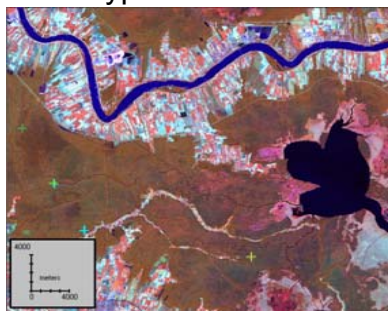
Status – developed and began to assess preliminary products

- Baldcypress stand condition products from Landsat and ASTER data
- Hurricane Katrina forest damage products from MODIS data

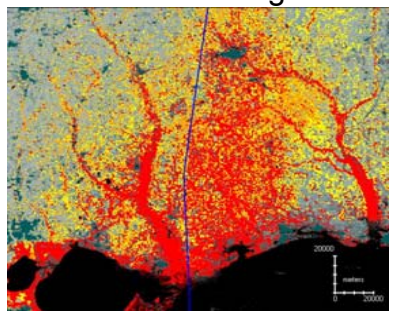
Landsat
Cypress Classification



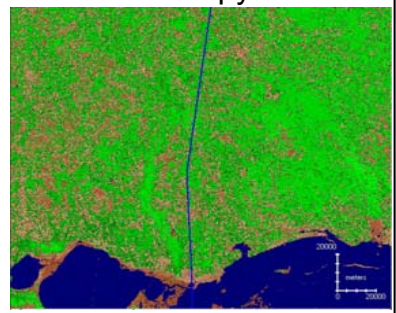
Reference
Cypress Points



MODIS-Based
Forest Damage



NLCD
% Tree Canopy Cover



Project Leads: Joseph Spruce (SSAI, Stennis Space Center) and Duane Armstrong (NASA, Stennis Space Center)

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Coastal Marsh Monitoring for Persistent Saltwater Intrusion

***Purpose*: Assess the feasibility of using NASA satellite data to monitor persistent saltwater intrusion in coastal marshes**
***End User*: USGS National Wetlands Research Center and Louisiana Department of Natural Resources**

Approach: Use time series of vegetation indices to identify stressed vegetation (NDVI), moisture indices to determine if persistent flooding is cause of stress (NDMI, NDWI), and CDOM absorption to determine flood water salinity (a_g – salinity relationship)

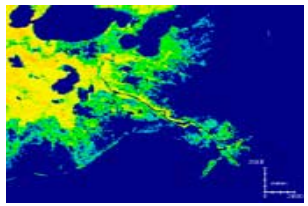
- Sensors: MODIS, Landsat, Hyperion, ALI, ASTER
- Tools: Time Series Product Tool (TSPT)

Study Area: Sabine-Calcasieu River Basin (Louisiana)

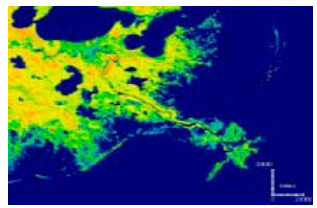
Decision Support: Coast-Wide Reference Monitoring System (CRMS) created by Louisiana Coastal Wetlands Conservation & Restoration Task Force

- Determine effectiveness of Breaux Act restoration projects by providing reference sites for which no paired reference areas exist
- Ensure strategic coastal plan for Louisiana is effective in re-creating sustainable coastal ecosystem

Selected Accomplishments: Analyzed NDVI, NDMI, NDWI time series (2004–2006) of study area; isolated storm surge events and time-shifts in output indices and implemented user-defined region-of-interest selection with TSPT; validated satellite data products with extensive in situ data from CRMS monitoring sites; preliminary generation of additional indicators based on multiple time series variables.



Cumulative NDVI Integral 2004

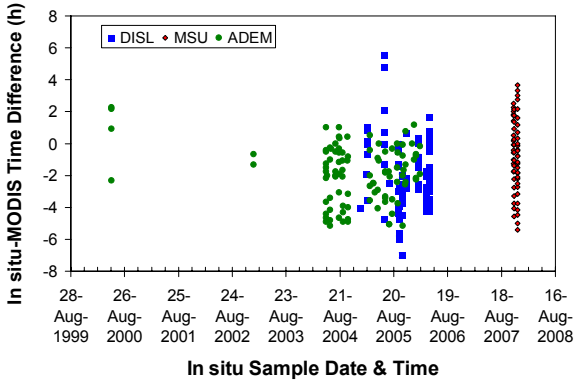


Cumulative NDVI Integral 2006

Project Leads: Callie Hall (NASA, Stennis Space Center), Maria Kalcic and Lee Estep (SSAI, Stennis Space Center), Greg Steyer and John Burras (USGS)

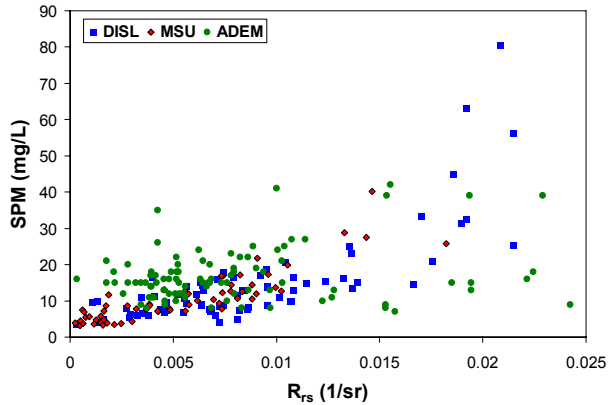
A Standardized Remote Sensing Product for Water Clarity Estimation within Gulf of Mexico Coastal Waters

***Purpose*: Develop a standard remote sensing data product for total suspended sediment**
***End User*: Gulf of Mexico Alliance Nutrients and Water Quality Priority Issue Team**



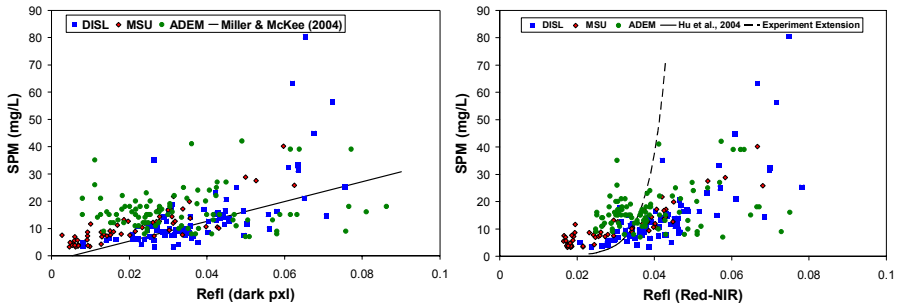
In situ data from 2002 to 2007: Total suspended sediment (TSS) suspended particulate matter (SPM) Secchi disk depths.

Data courtesy of:
MSU, DISL-MSU-NASA, and Alabama Department of Environmental Management (ADEM). Additional data (not shown) has been provided by University of South Mississippi (USM) and Louisiana Department of Environmental Quality (LDEQ).
Additional data are welcome!



Obtained and atmospherically corrected MODIS data that was temporally and spatially concurrent to the in situ measurements. Mobile Bay data shown here.

Tested the correspondence between published algorithms and our data. Mobile Bay data are shown here.



Project Leads: Jean Ellis and Gallie Hall (NASA, Stennis Space Center), Slawomir Blonski and DeNeice Guest (SSAI, Stennis Space Center)

DEVELOP

DEVELOP is a student-run, student-led scholarship program that conducts research projects relevant to community concerns to demonstrate the benefits of NASA Applied Sciences capabilities.

Projects are conducted in 10- to 20-week terms and are presented at high-level forums to target community leaders and policy makers as well as industry and federal agency partners.

The goal is to establish ongoing local activity that continues to benefit the community and foster human capital development.

More information on the program can be found at:

http://develop.larc.nasa.gov/index.html

Assessing Hurricane Forest Damage

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NASA ROSES-2008 A.28 Solicitation

A.28 EARTH SCIENCE FOR DECISION MAKING: GULF OF MEXICO REGION
Proposals are due September 30, 2008. **Encourage the pursuit of appropriate partnerships with the emerging commercial space sector**.

Overview
NASA solicits proposals that develop and demonstrate innovative and practicable applications of NASA Earth science observations, models, and research to support resource management, planning, and decision making activities in the Gulf of Mexico Region.

Total Amount of Funding	**$8M total**
Deadline	**9/30/2008**
Anticipated Number of Awards	**10–25 projects**
Expected Range of Award per Project	**$150K – $400K total**
Period of Performance	**up to 24 months**
Expected Project Start Date	**circa January 1, 2009**

Partner in-kind contributions strongly encouraged. However, partner funding does not count toward funding level guidelines.

ROSES Solicitations Online:
http://nspires.nasaprs.com/external/

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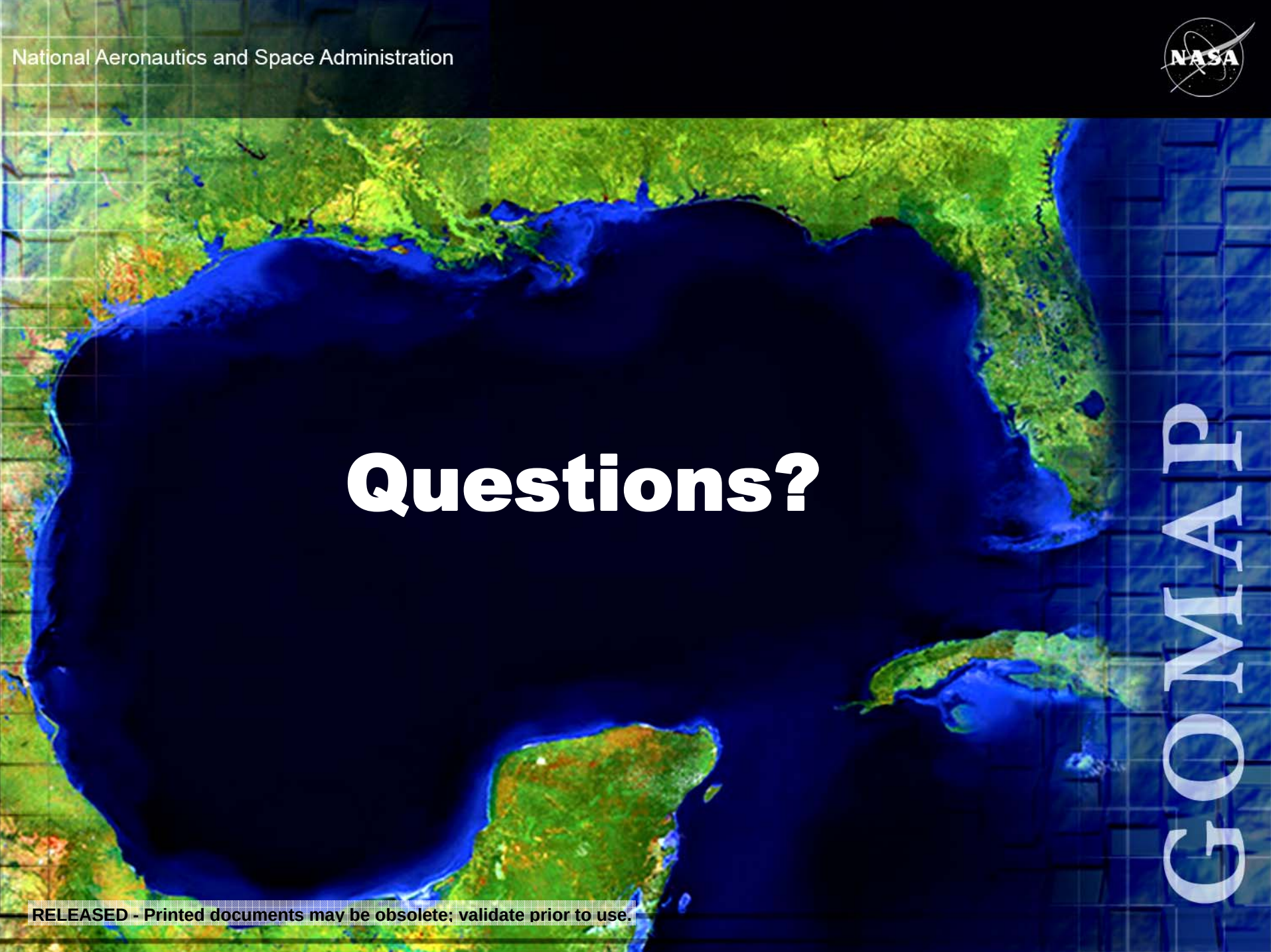
The New Course

- Implement NASA Coastal Initiative 3–5 year Strategic Plan
- Successfully compete and win ROSES proposals
- Execute FY 2009 Project Plan, incorporating Lessons Learned
- FY 2009 continued focus on building partnerships
- Establish University Affiliated Research Center

"The pessimist complains about the wind; the optimist expects it to change; the realist adjusts the sails."

-William A. Ward



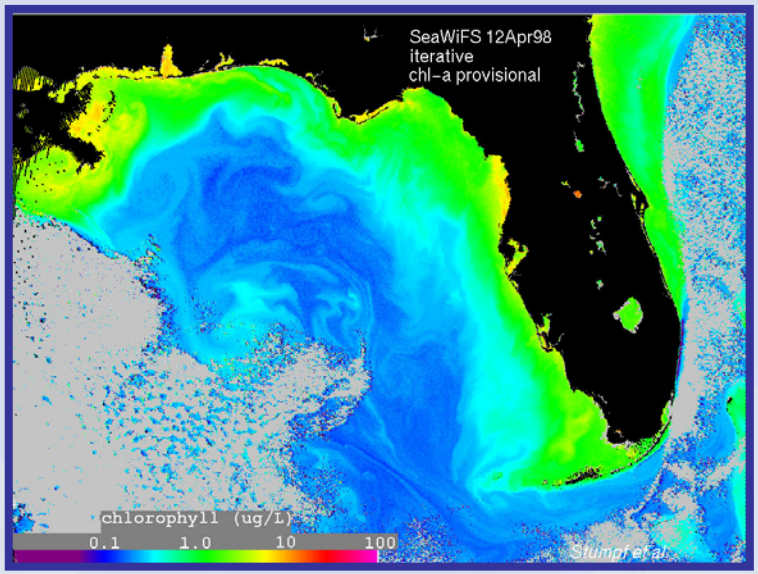
Questions?

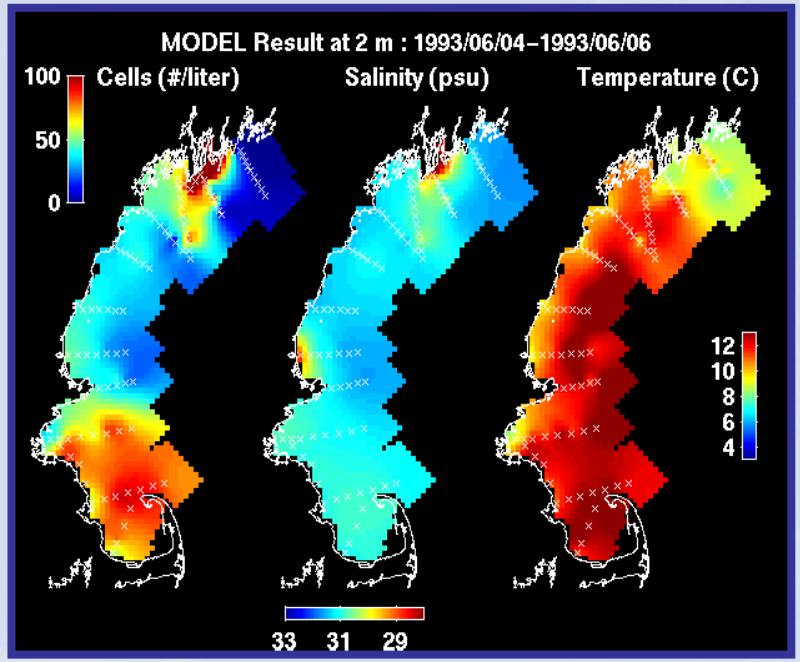
Unedited Backup slides follow

Coastal Management
Predicting Algal Blooms

Current Capacity:

Respond to bloom detection with bio-physical models using satellite data and in situ sampling to forecast trajectories and impacts





Future Capacity:

Prediction of bloom onset

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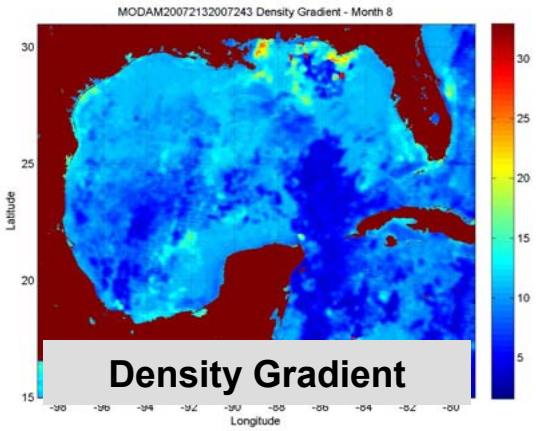
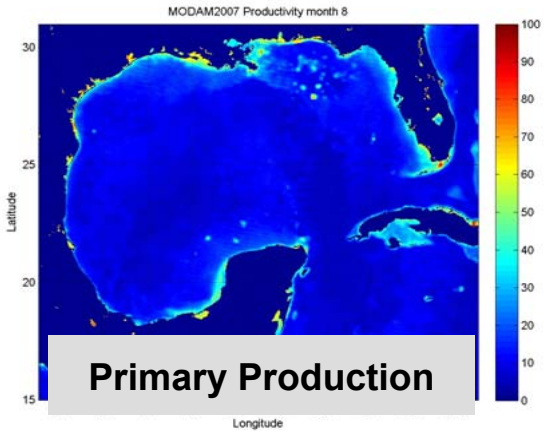
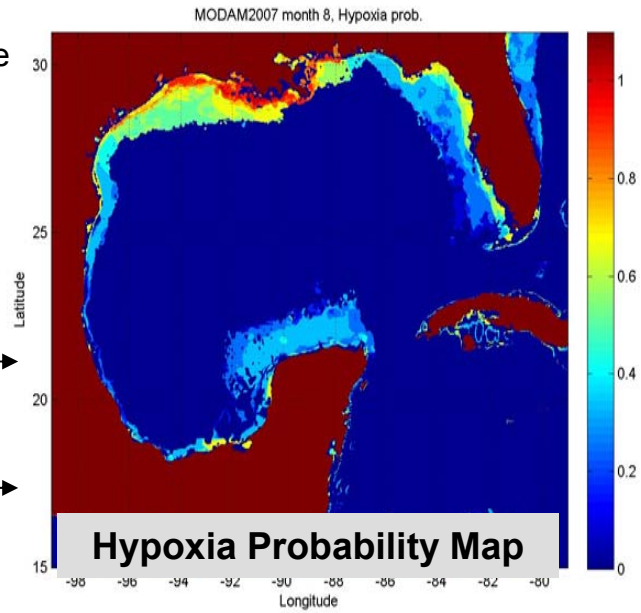
Hypoxia Probability Map



MODIS-derived Sea Surface Temperature and Sea Surface Salinity & Mean In Situ Bottom Temperature and Salinity for Monthly Density Gradient Calculation



Primary Production (Eppley et al., 1985)[1] Derived from MODIS OC3 [Chlorophyll a] Processed by NRL APS

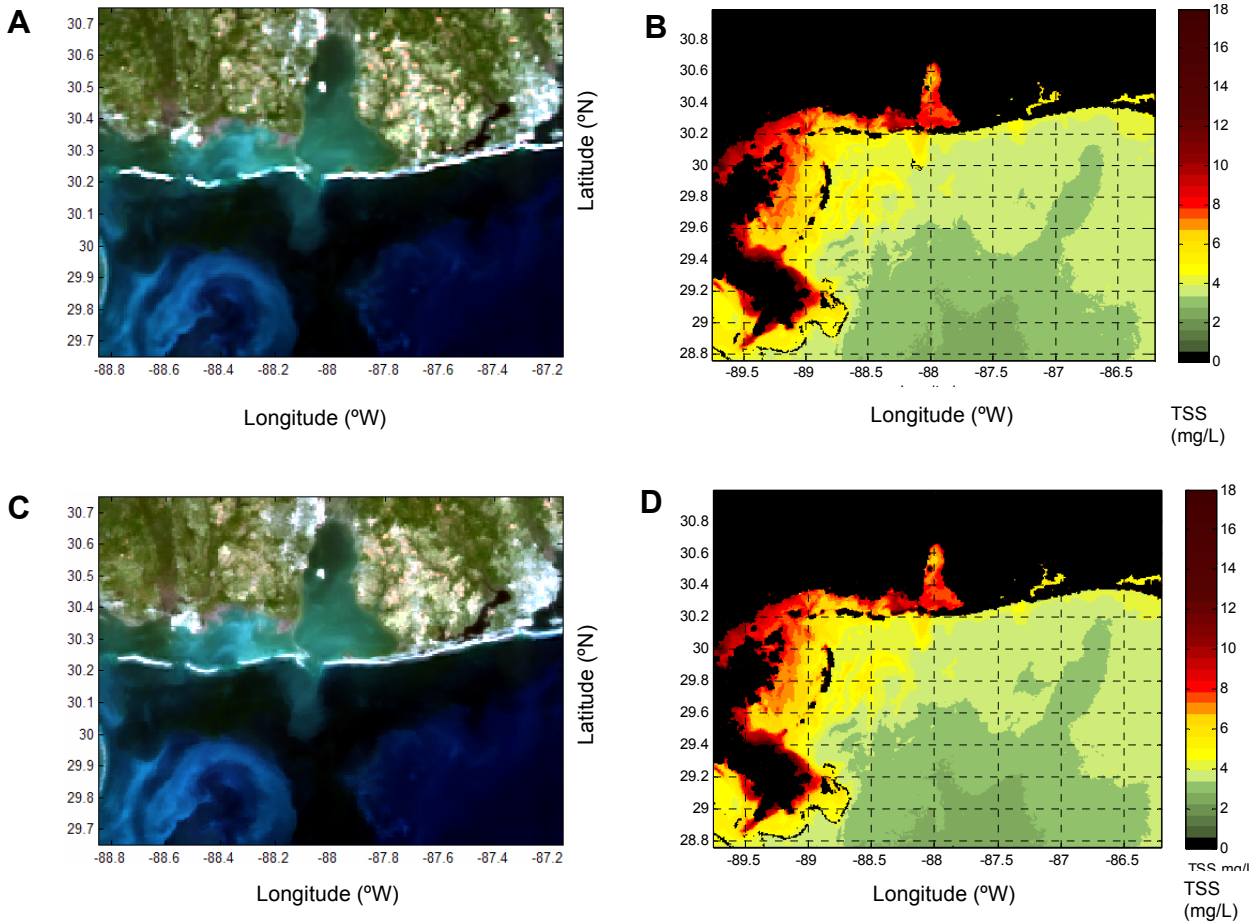


Total nitrogen discharge obtained from USGS monitoring station at Mississippi River

[1]Eppley, R.W., E. Stewart, M.R. Abbott, and U. Heyman. 1985. Estimating ocean primary production from satellite chlorophyll. Introduction to regional differences and statistics for the southern California Bight. *Journal of Plankton Research* 7:57-70.

Mobile Bay Sediment Plume Mapping Using MODIS and VIIRS

Purpose: **Identify the Mobile Bay sediment plume using MODIS and simulated VIIRS data**



MODIS images (A&B, 1000m, 9 Nov 2007) are calibrated and validated using in situ data collected in collaboration with Mississippi State University and Dauphin Island Sea Lab. VIIRS simulations (C&D, 750m, 9 Nov 2007) are based on MODIS data.

Chalky, white colored waters in A&C indicate higher total suspended sediments (TSS). Higher TSS is evidenced by darker red shades in B&D. TSS concentrations in excess of 8 mg/L are found inside Mobile Bay.

This project demonstrates VIIRS may be used to detect TSS in coastal waters.

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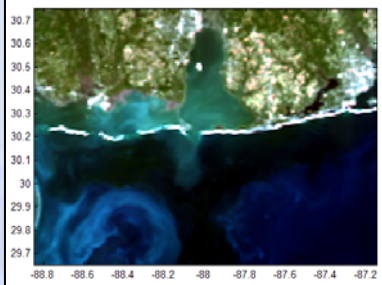
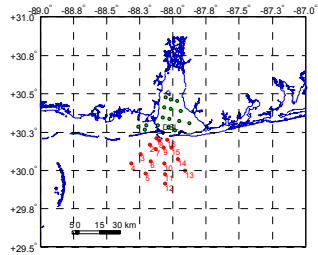
Project Leads: Jean Ellis (NASA, Stennis Space Center) and Maria Kalcic (SSAI, Stennis Space Center)

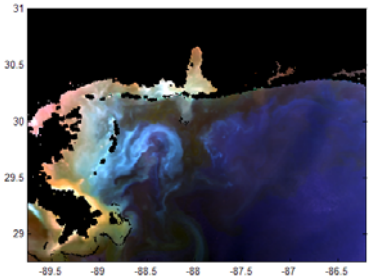
RSM Project Plan



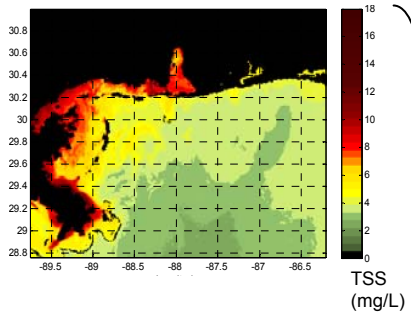
1. Obtain MODIS images

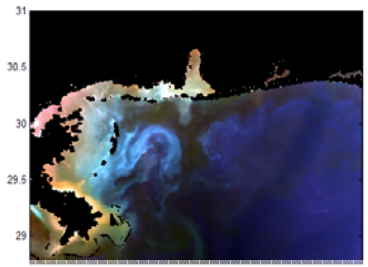


4. Calibrate and validate MODIS with in situ data

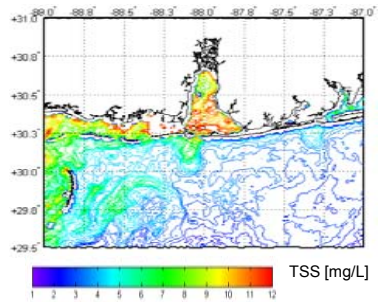


2. Enhance MODIS to detect TSS concentrations





3. Simulate VIIRS using MODIS



5. Determine TSS concentrations

Coastal Marsh Monitoring for Persistent Saltwater Intrusion

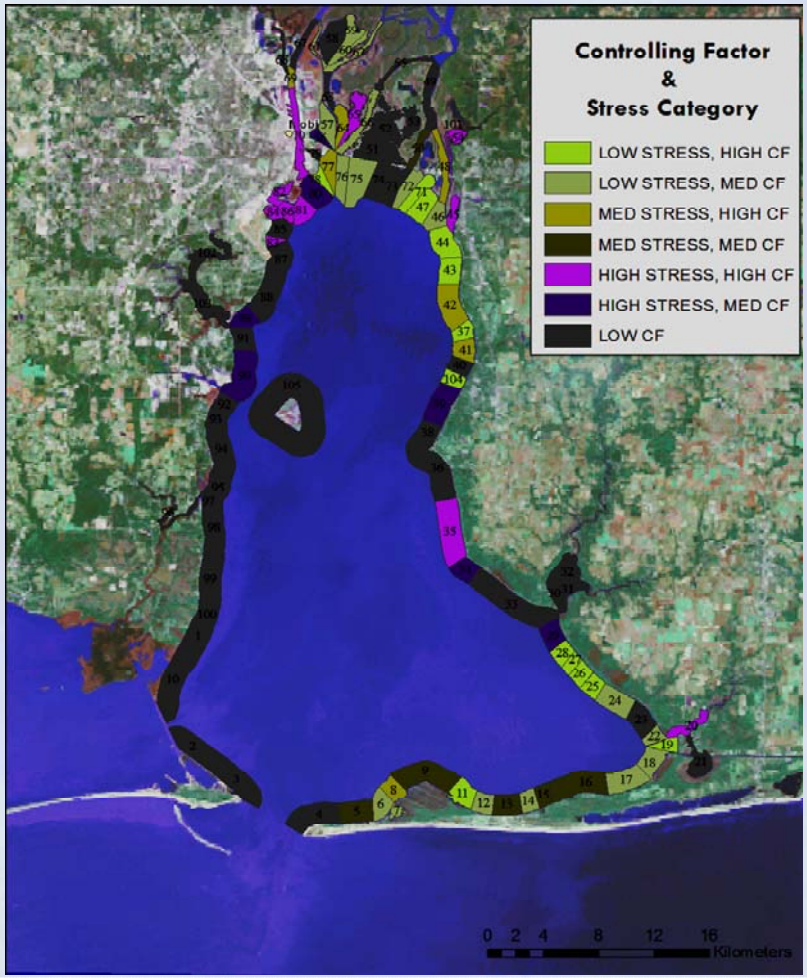
Callie Hall (NASA), Maria Kalcic and Lee Estep (SSAI), Greg Steyer and John Burras (USGS)

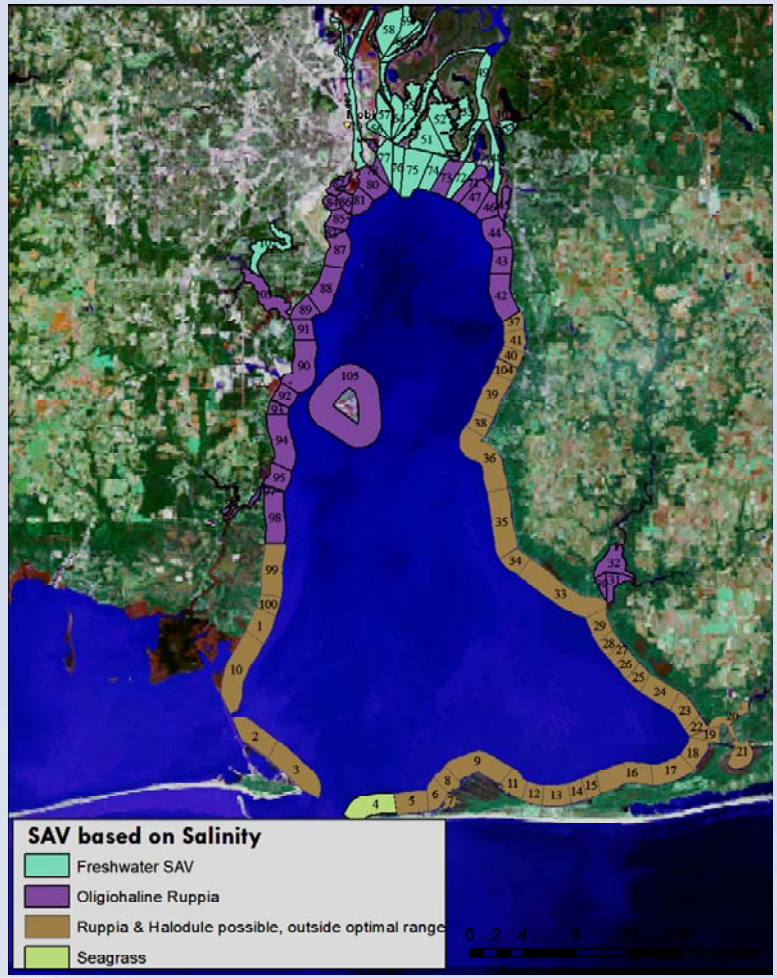
Next Steps

1) Perform land-cover change analysis using all acquired datasets and indices to determine best indicators of persistent flooding
2) Produce time series of flooded areas using best set of indicators
3) Perform additional salinity studies using ALI and other datasets to improve model estimates for different dates before and after Hurricane Rita
4) Investigate additional modeling approaches to salinity inversion
5) Produce time series of salinity gradient over the study area for either monthly or seasonal averages
6) Merge salinity time series with flooding time series to produce time series maps for determination of persistent saltwater intrusion
7) Meet with USGS CRMS representatives in Baton Rouge in late July/early August to discuss investigation results and preliminary products

Gulf of Mexico Regional Collaborative (GOMRC)

Restoration Prioritization Toolset Demo:
SAV Prioritization and Salinity Classification





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