National Aeronautics and Space Administration

Monitoring Coastal Marshes for Persistent Flooding and Salinity Stress

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PROJECT TEAM

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USGS science for a changing world

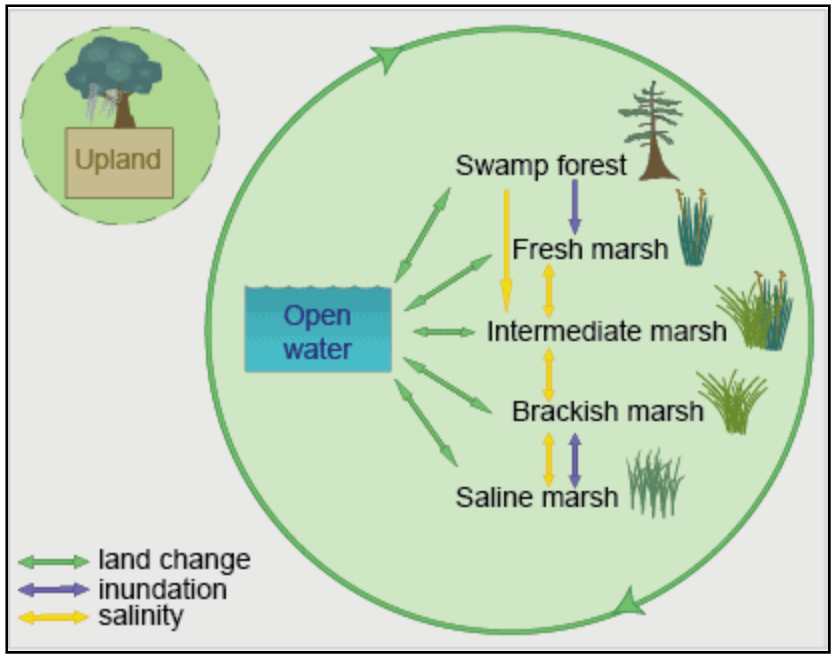
Project Background

- Our objective is to provide **NASA remote sensing products**, in combination with radar data products, to provide inundation and salinity information on an ecosystem level to support habitat switching models.
- Project born out of need by the **Coastal Restoration Monitoring System (CRMS)**, joint effort by Louisiana Department of Natural Resources (LDNR) and the U.S. Geological Survey (USGS), for information on persistence of flooding by storm surge and other flood waters.
- The results of the this work support the habitat-switching modules in the **Coastal Louisiana Ecosystem Assessment and Restoration** (**CLEAR**) model, which provides scientific evaluation for restoration management.
- **CLEAR** is a collaborative effort between the Louisiana Board of Regents, the LDNR, USGS, and the U.S. Army Corps of Engineers (USACE).

Support to the Gulf Of Mexico Alliance

- Links to GOMA Priority Action Plan Items:
  - ***Coastal Community Resilience***
    - *Assess risks to natural and built environments and identify models that assess both the economic and environmental consequences associated with coastal hazards and climate changes.*
  - ***Habitat Conservation and Restoration***
    - *Provide improved conservation and restoration management tools through the application of science and technology*
  - ***Ecosystems Integration and Assessment***
    - *Develop an Emergent Wetlands Status and Trends Report to provide scientists and decision makers with regional information to guide management decisions.*

Habitat Switching Module



Visser et al. [1]

Habitat switching between marsh types depends on salinity and inundation. The module simulates shifts in vegetative community type given long-term shifts in salinity and inundation due to restoration projects.

Switches at 1-year time step

Year 0 habitat ⇩	Inter-mediate marsh	Brackish marsh	Saline marsh
Fresh marsh	⇨ s > 2.5		
Inter-mediate marsh	1 < s ≤ 6 ⇨	s > 6	
Brackish marsh	⇨ s ≤ 6	6 < s ≤ 15 and pfl ≤ 85% ⇨	s > 15 or s > 6 and pfl > 85%

Excerpt from table in Visser et al. [1]

s=average salinity (ppt) over the time step;
pfl=average percentage inundation over the time step

[1] *Visser, J.M., C. Kaiser, and A.B. Owens. 2008. Forecasting 50-years of Habitat Switching in Coastal Louisiana: No Increased Action & Preliminary Draft Master Plan, Vol. IV, Chapter 4. In Coastal Louisiana Ecosystem Assessment & Restoration (CLEAR) Program: A tool to support coastal restoration., edited by R. R. Twilley. Baton Rouge.*

Coastwide Reference Monitoring System (CRMS) stations in Sabine Calcasieu Basin, SW Louisiana

390 CRMS Stations across Coastal LA

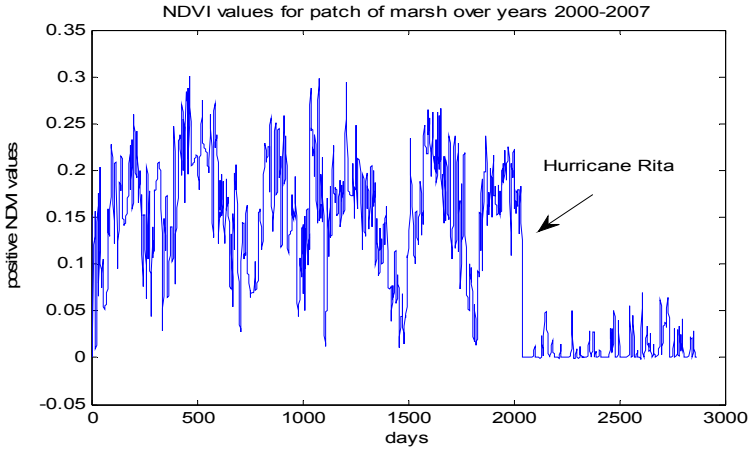
Measurements include:

- ***Hydrology***
- ***Accretion data***
- ***Forested Swamp Vegetation Data***
- ***Herbaceous Marsh Vegetation Data***
- ***Soil Properties***
- ***Surface Elevation***

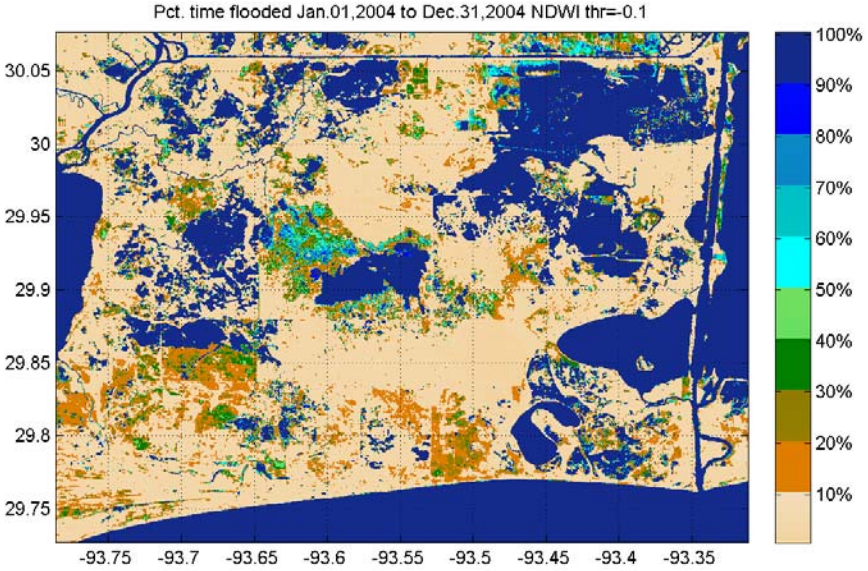
Data available at http://www.lacoast.gov/crms2/Home.aspx

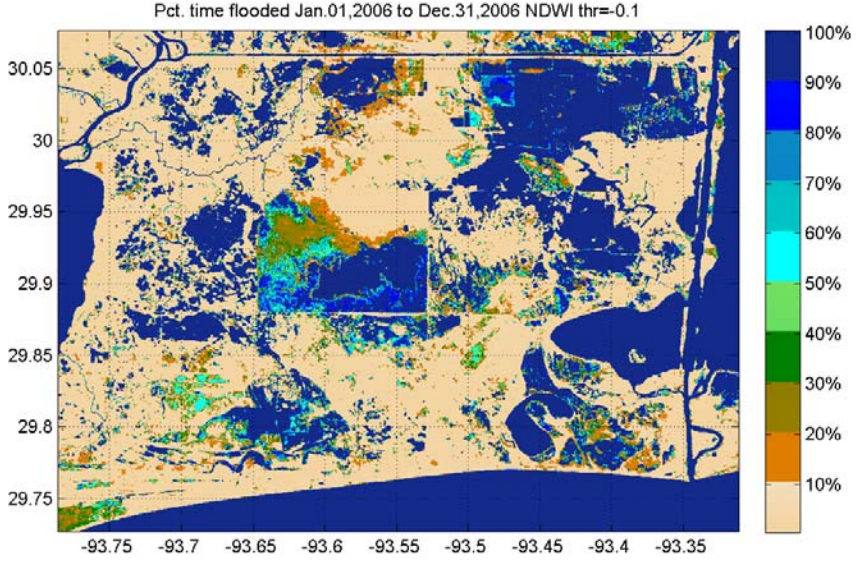
Percent Inundation from NASA products

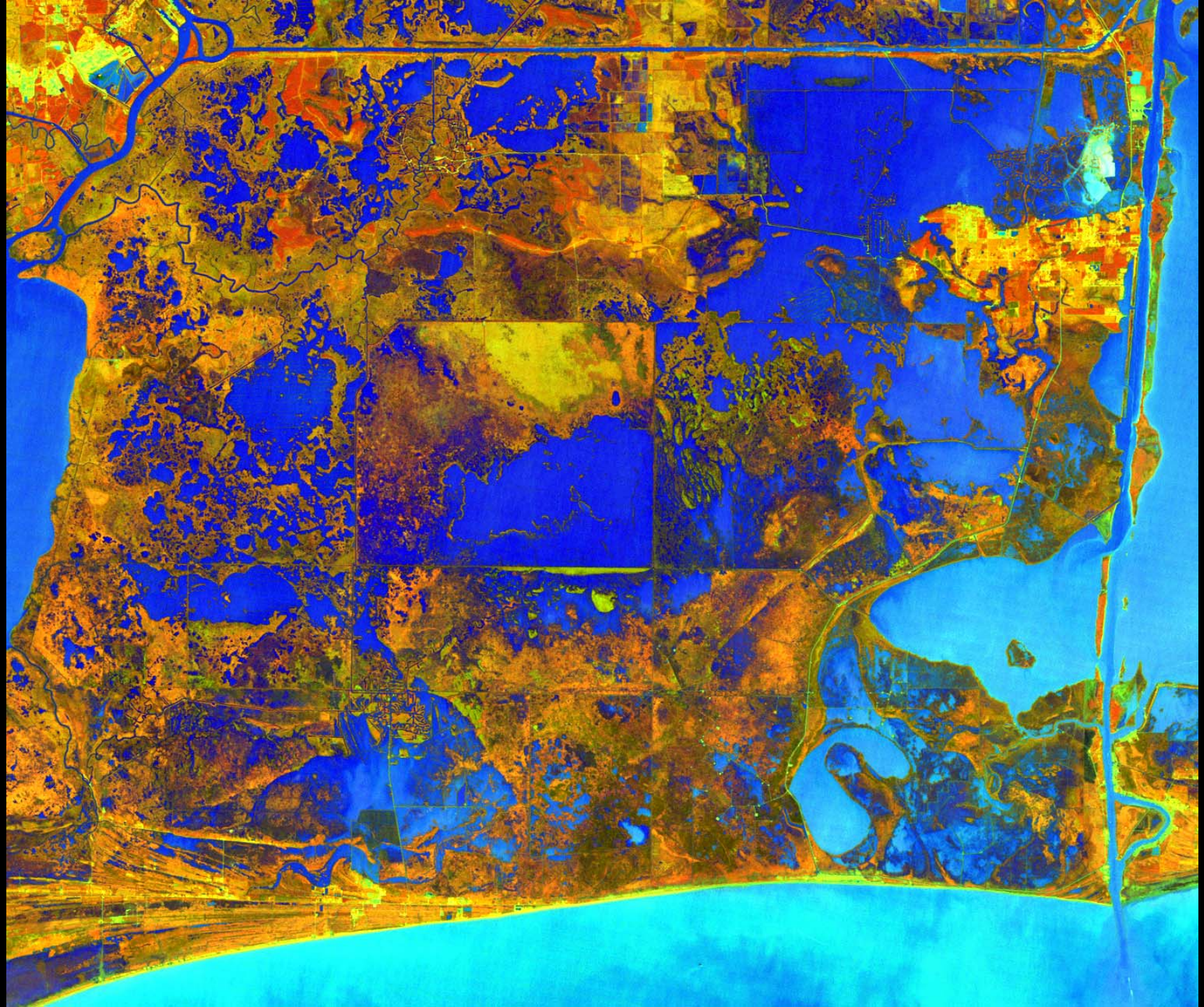
- Percent Inundation derived using NASA/SSC Time Series Product Tool (TSPT) with
  - MODIS daily Aqua/Terra
  - Landsat weekly (L5/L7)
- TSPT product sample for NDVI time series spanning 2000-2007 (right):



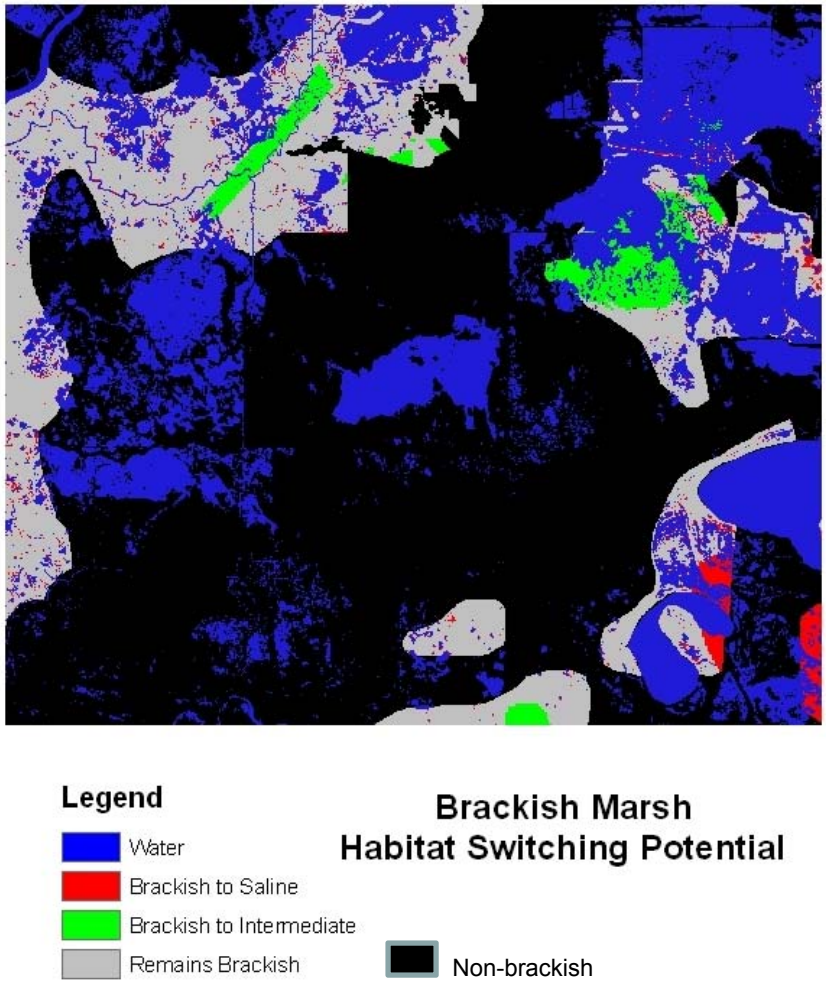
Sabine-Calcasieu Basin shown here with annual percent inundation for 2004 (left) and 2006 (right).





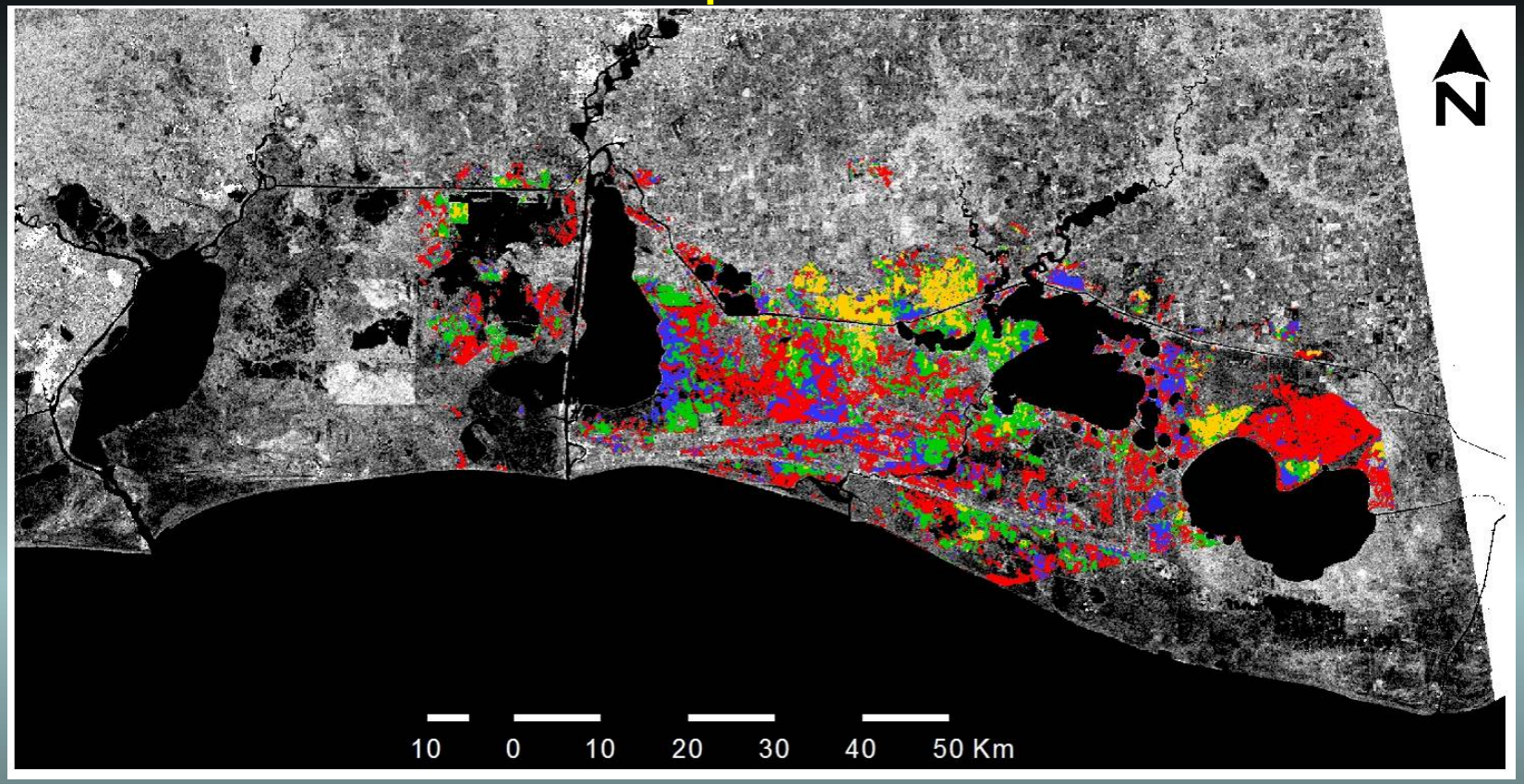


Anticipated Results



- Sample result produced using
  - 2006 Landcover types
  - 2006 Landsat-derived percent inundation (using TSPT NDWI)
  - 2006 average salinity derived from kriging of in-situ CRMS salinity data.
- Anticipated results will use
  - Resolution enhanced time series data combining spatial resolution of Landsat with temporal resolution of MODIS for inundation estimates
  - Potential salinity products from radar and multispectral modeling.
  - Combined inundation and salinity inputs to habitat switching module to produce habitat switching maps (shown left)

Residual Flood Map from Envisat ASAR



Year 2005	Hurricane Rita Land Fall 24 September
7 days	Envisat ASAR 01 October
26 days	Envisat ASAR 20 October
45 days	Envisat ASAR 20 October
61 days	Envisat ASAR 24 November

USGS

Ramsey III, E., Z. Lu, Y. Suzuoki, A. Rangoonwala, and D. Werle, in review. Monitoring duration and extent of storm surge flooding along the Louisiana coast with Envisat ASAR data (Review)

End Users

- End Users are coastal restoration managers using the CLEAR habitat switching module or other models
- End Users for this project transition will be
  - –USGS National Wetlands Research Center-Coastal Restoration Field Station/LSU
- Other potential end users:
  - –Barataria-Terrebonne National Estuary Program
  - –Louisiana Dept. of Natural Resources (LDNR)
  - –NOAA Fisheries Service

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