**NASA DEVELOP National Program**

**Fall 2015 Project Proposal**

NASA Jet Propulsion Laboratory

**Louisiana Ecological Forecasting**

Examining Historic Trends and Modeling Sediment Transport in Delta Building within Louisiana’s Wax Lake Delta Using UAVSAR and AirSWOT Instruments to Inform Restoration Efforts

**Objective:**

To use remotely sensed data to obtain a better understanding of why the Wax Lake Delta is experiencing aggregation and model sediment transport within the Delta to help predict future extent of the Delta to provide crucial data to coastal scientists and managers for insight into how to direct coastal restoration projects.

**Community Concern:**

Land loss due to erosion, land subsidence and sea level rise along the Louisiana coast has amounted to a staggering 4900 km2  since the 1930’s, threatening one of the most economically important port systems in the United States as well as the tapestry of unique cultures that contributes to the region’s rich history. The State of Louisiana’s Comprehensive Master Plan for a Sustainable Coast (2012) confirmed that Louisiana has the potential to lose up to an additional 4500 km2 over the next 50 years unless immediate efforts are taken to combat this trend. Yet, while most of the rest of the coast is degrading, the Wax Lake Delta has been growing at a rapid rate. Much work has been done to understand what natural processes contribute to this growth, but these studies are limited by a lack of tested models and key observations. Measurements that do exist are largely boat-based and inherently spatially and temporally limited. A synoptic view of the accretion process at Wax Lake will help guide coastal managers’ efforts in land loss reduction and preserve the future of the Louisiana coastline.

**Partner Organizations:**

Naval Research Laboratory (End-User, POC: Richard Crout, Supervisory Oceanographer)

Louisiana Universities Marine Consortium (Collaborator/Boundary Organization, POC: Alexander Kolker, Assistant Professor)

Richard Crout is an oceanographer at the Naval Research Laboratory at Stennis Space Center, MS, where they are investigating buoyancy plume modulation of coastal processes in the area impacted by the Mississippi and Atchafalaya River discharge. Their project utilizes an ocean circulation model complement *in-situ* observations that requires water level and discharge rates from the Atchafalaya Bay and Wax Lake outlet region. The products of the proposed project will be delivered to Dr. Crout to help initiate the model.

Dr. Kolker is an academic liaison to Louisiana’s Comprehensive Master Plan for a Sustainable Coast that is being developed for 2017. The products of this project will provide Dr. Kolker with a broad-scale picture of the accretion process to inform the development of an improved sediment distribution algorithm that will help these managers understand how to direct land restoration efforts along the Louisiana coast. The results of this project will be presented to Dr. Kolker virtually, and a copy of the tech paper will be made available as well.

**Decision Making Process:**

Currently, restoration decisions are based on findings from ~400 projects identified by experts, citizens and government studies. Restoration efforts can take the form of structural protection, bank stabilization, oyster barrier reefs, ridge restoration, shoreline protection, barrier island restoration, marsh creation, sediment diversion, and hydrological restoration. Nearly all of these projects rely on moving or trapping sediment, yet Louisiana has limited supplies of, or access to, renewable sediment. It is thus imperative to understand the dynamics of delta building to maximize the use of the limited sediment available. These dynamics are currently studied using spot field measurements and labor-intensive boat-based surveys.

**Earth Observations:**

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| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| **NASA King Air B200** | AirSWOT | Sea Surface Extent |
| **NASA Gulfstream III** | UAVSAR | Sea Surface Roughness |

**NASA Earth Observations Highlighted:**

AirSWOT is a new airborne sensor, in the testing stage at JPL, designed for centimeter-level detection of water surfaces and flood plains. Water-surface gradients measured by this instrument will be used to constrain deposition rates on deltas, yielding new insight into how delta tops keep pace with sea-level rise.

UAVSAR provides high-resolution (<10 m) radar data collected regularly over the study area. Actively growing fronts of deltas are not at the shoreline, but rather offshore in the form of submarine channels and islands that extend offshore at hundreds of meters per year. SAR shows great promise in detecting shallow bathymetry because the radar detects changes in water-surface roughness (e.g., waves), which are influenced by water depth and can be observed under a range of wind and current conditions.

**Ancillary Datasets:**

Bathymetric data - <http://sonris-www.dnr.state.la.us/gis/dnld/download.html>

Land cover and land use maps - <http://map.louisiana.gov/losco_2007_Zip.html>

Infrastructure (levees, etc) - <http://sonris-www.dnr.state.la.us/gis/dnld/download.html>

Accretion estimates - <http://cims.coastal.la.gov/monitoring-data/>

**Models:**

Delft-3D open-source numerical suite (POC: Marc Simard, JPL), Marsh Equilibrium Model (POC: Jim Morris, University of South Carolina Python Script available from Past JPL Develop Projects

**Decision Support Tools & Analyses:**

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| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Time Series of AirSWOT Data | Where and how restoration is conducted | Tidal gauges, field measurements |
| Modeled Elevation Time Series | Where at risk zones are located | n/a |
| Comparison of Different Datasets | Where and how restoration is conducted | n/a |

*Time Series of AirSWOT Data* – Visualization of data from surveys taken during river flood episodes and through different parts of the tidal cycle.

*Modeled Elevation Time Series* – Visualization produced using the Marsh Equilibrium Model (MEM) showing estimates of projected changes in coastal elevation. The MEM model highlights regions which are more prone to impacts of sea level rise and the regions that would most benefit with restoration efforts.

*Comparison of Different Datasets* – Analysis of correlations among all datasets (Marsh Equilibrium Model, TELEMAC model, AirSWOT with tidal gauges, etc.); the TELEMAC model is a sediment transport model, which we can use to estimate current and projected sediment transport within the Wax Lake delta. Using the MEM model DEVELOPers can estimate the at risk areas, then combining this knowledge with a sediment transport model (such as TELEMAC) DEVELOPers can estimate if restoration projects will help reduce land loss due to sea level rise or subsidence. \*Note that TELEMAC is a downloadable open source program.

Modeled results from this project are expected to improve coastline change prediction accuracy. These models can serve as decision support to control or reduce the impacts from modifications to infrastructure such as addition or removal of levees, dredging of channels or from natural phenomena such as storm surges, hurricanes, and land cover and land use change within watersheds. This DEVELOP project may result in a publishable journal article if the project goes well and is completed during the term.

**Project Details:**

**National Application Area Addressed:** Ecological Forecasting

**Source of Project Idea:** DEVELOP JPL representatives heard about the AirSWOT campaign, and through past DEVELOP projects we learned about the decreasing coastal elevation within Louisiana. By combining AirSWOT data, modeled outputs, and UAVSAR data, DEVELOPERs would be able to better inform restoration efforts within Louisiana, to promote coastal aggradation.

**Study Location:** Wax Lake Delta, Louisiana

**Period being Studied:** May 2009- May 2015 depending on data availability

**Advisors:** Dr. Cathleen Jones (JPL), Dr. Marc Simard (JPL)

**Participants Requested:** 3-4

**Project Timeline:** 1 Term: 2015 Fall

**Previous Related DEVELOP Work:**

Fall 2014 (JPL) - Gulf Coast Ecological Forecasting: Utilizing Spaceborne and Airborne SAR Sensors to Monitor the Health of Louisiana’s Coastal Wetlands

**Software & Scripting Requested:**

* ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation of UAVSAR and AirSWOT Data
* QGIS – Radiometric Correction of UAVSAR Data
* TELEMAC - open source sediment transport modeling program; model sediment transport within the Delta and the Coast of Louisiana