**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**NASA Langley Research Center & NASA Jet Propulsion Laboratory**

**Mississippi Sound Water Resources**

*Synthesizing Trends in Water Quality Parameters that Affect Oyster Reef Health in the Mississippi Sound Using NASA Earth Observations*

**Project Overview**

***Project Synopsis*:** The objective of this project is to develop a climatology of water quality observables in the western portion of the Mississippi Sound to support the Mississippi Department of Marine Resources in mapping environmental conditions that affect oyster reef health. This project utilizes Aqua MODIS, SMAP, and Landsat 7 and Landsat 8 data to create a time series of changes in several environmental parameters from 2000 to 2016 to differentiate between subtle and episodic impacts on oyster reefs.

***Community Concern:*** Oyster reefs provide important ecological services as they filter particulates from the water column, provide habitat and food resources to other species, and can reduce wave action and storm surge. Over the past few decades, many events, including changes in water quality and stochastic occurrences like Hurricane Katrina, have significantly depleted and reduced the productivity of oyster reefs in the Gulf of Mexico (GoM). Understanding the environmental conditions that affect oyster health, as well as being able to predict when poor conditions are imminent, is important for the continued management of the oyster reefs in the Mississippi Sound.

***Source of Project Idea:*** The project idea was originally proposed by the Mississippi Department of Marine Resources (MDMR) after conversations with the NASA DEVELOP National Program Office.

***National Application Area Addressed:*** Water Resources

***Study Location:*** Mississippi Sound, MS

***Study Period:*** January2000 to December 2016

***Advisors:*** Dr. Kenton Ross (NASA Langley Research Center); Ben Holt (NASA Jet Propulsion Laboratory), Dr. Severine Fournier (NASA Jet Propulsion Laboratory)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Mississippi Department of Marine Resources | Scott Gordon, Director of Shellfish Bureau  Charlie Robertson, Shellfish Bureau  Karen Clark, GIS Administrator  Robert Gruba, GIS Technician  Amber Jones, Digital Media Coordinator | End-User | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***

The Mississippi Department of Marine Resources is responsible for monitoring and ensuring the continued health of oyster reefs in the Mississippi Sound. Since 2004, oyster harvest has decreased by more than 90% in the Sound. As a result, Mississippi’s governor signed an Executive Order establishing an Oyster Council in order to halt and potentially reverse the downward trend in oyster harvest. Several restoration efforts are currently underway, including a reduction or cap on oyster harvests, as well as continued research into aquaculture and other technologies to restore oyster populations to previous levels.

***End-User’s Capacity to Use NASA Earth Observations:***

*Mississippi Department of Marine Resources* – The end-user is familiar with NASA Earth observations, but does not currently integrate them as the major component in their decision-making process.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team lead will be the main POC for the project. Biweekly telephone or video calls will be conducted with the project partners to discuss methodology and deliverables, in addition to emails updating the partners on weekly progress.

***Transition Plan*:** End products will be delivered through a webinar conducted at the end of the term in order to facilitate discussion and feedback on the products. The time series will be immediately available for partner analysis and integration into their decision-making process.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Aqua MODIS** | Chlorophyll-a, CDOM, water leaving radiance, sea surface temperature | Time series of chlorophyll-a and CDOM concentrations to assess trends in these parameters; used to analyze changes in temperature over study period |
| **SMAP** | Salinity | To investigate changes in salinity over study period and relationship to other water quality parameters, 2015-2016 |
| **Landsat 7 ETM+, Landsat 8 OLI and TIRS** | Chlorophyll-a, water color, sea surface temperature | Time series of chlorophyll-a and temperature to assess trends in these parameters |
| **MUR** | Sea surface temperature (daily 1km blended product) | To analyze changes in temperature over study period |

***Ancillary Datasets:***

MDMR and USGS Real-Time Hydrological Monitoring Stations – *in situ* temperature, salinity – validate remotely sensed data

ESA SMOS – salinity – validate remotely sensed data

River Discharge data – flow rates – used in model calculations

***Software & Scripting:***

ESRI ArcGIS – analysis of watershed (ArcSWAT); SMAP

SeaDAS– MODIS, Landsat 8 analysis

Matlab – SMAP analysis

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Climatology of Chlorophyll-a, CDOM, and Sediment | Will provide information on trends in chlorophyll, CDOM, and turbidity from 2000-2016 for future decision making | Aqua MODIS; Landsat 7 ETM+; Landsat 8 OLI and TIRS; creation of time series and then mean/median statistics to establish trends | I |
| Current Conditions Map | Will Illustrate recent conditions in chlorophyll-a, CDOM, and sediment to indicate effectiveness of recent management decisions | Aqua MODIS; Landsat 7 ETM+; Landsat 8 OLI and TIRS; SMAP; comparison to climatology maps and general trends | I |
| Ocean Salinity and River Discharge Analysis | Depicts ocean salinity related to freshwater flow into Gulf of Mexico to assess potential runoff impacts | SMAP, 2015-2016; model creation and regression between spectral data and empiral salinity | I |

***End-User Benefit*:** The results of this project will benefit the end-user by providing a historical perspective on different water quality parameters that impact oyster reef health. The resulting time series can be incorporated into future research and management efforts as the MDMR analyzes the products for recent trends that may impact future productivity of the reefs.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Spring

***Related DEVELOP Work:***

2015 Summer (ARC) – Mexico Water Resources: Utilizing NASA Earth Observations to Detect Factors Contributing to Hypoxic Events in the Southern Gulf of Mexico

2015 Fall (WC) – Virginia Water Resources II: Monitoring Chlorophyll and Harmful Algal Blooms through NASA Earth Observations in the Lower Chesapeake for Improved Water Management

2009 Spring (SSC) – Louisiana Disaster Management and Ecological Forecasting: Assessment of Tropical Cyclone Induced Transgression of the Chandeleur Islands for Restoration and Wildlife Management

2011 Fall (SSC) – Gulf of Mexico Ecological Forecasting: Analyzing Multi-Year Trends of Chlorophyll, Ocean Color, Light Extinction Coefficient (K490), and Fluorescent Line Height Values from MODIS Oceanographic Data Products to Aid NOAA’s Decision Support Systems for Coral Reef Ecosystem Management within the Flower Garden Banks National Marine Sanctuary