**NASA DEVELOP National Program**

NASA Langley Research Center

*Summer 2017*

**Short Title: Mississippi Sound Water Resources II**

**Subtitle:** Analyzing the Impact of Environmental Disturbances on Oyster Reef Health in the Mississippi Sound Using NASA Earth Observations

**VPS Title:** The Mississippi Sound Oyster: A Small Animal with a Big Problem

**Project Team**

**Project Team:**

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**Advisors & Mentors:**

Dr. Kent Ross (NASA Langley Research Center)

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**Project Overview**

**80-100 Word Objectives Overview:**

The objectives of this project were to analyze the effects of major environmental disturbances on the Mississippi Sound and its oyster reefs, as well as to develop a timeline of water quality parameters for the marshes surrounding the Biloxi State Wildlife Management Area. This project utilized Aqua and Terra MODIS, MUR, Sentinel-2 MSI, Landsat 7 ETM+, and Landsat 8 OLI and TIRS data which can be used by the Mississippi Department of Marine Resources (MDMR) to support their efforts in monitoring oyster reef health.

**Abstract:**

Oysters are vital to the environmental health of the Mississippi Sound and a critical part of Mississippi’s economy. Environmental disturbances, such as Hurricane Katrina, major flooding events, and the Bonnet Carré spillway openings, have caused oyster populations to decline and have has negatively affected the water quality and economy of the Sound. Oysters purify water via filter feeding and a decline in their population could lead to increased levels of dissolved solids in the waterways. In collaboration with the Mississippi Department of Marine Resources (MDMR), the team focused on specific case studies of significant disturbances by combining data gathered in the Spring 2017 Term with data on the degradation of marshlands in the area. The team investigated the relationships between extreme weather events, salinity, freshwater discharge and diversion, chlorophyll-a, and oyster reef health. These case studies will help inform MDMR about how these factors are interdependent and impact the overall health of the Sound. This information will assist the MDMR in making better-informed decisions in preparing for and managing ecological stressors.

**Keywords:**

Mississippi Sound, water quality, oyster reefs, hurricanes, flooding, NASA Earth observations, MODIS, MDMR

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Mississippi Department of Marine Resources | George Ramseur, Office Director  Charlie Robertson, Shellfish Scientist;  Karen Clark, GIS Administrator;  Robert Gruba, GIS Analyst  Scott Gordon, Director of Shellfish Bureau (retired) | End User | No |

**Community Concerns:**

* Oysters are vital to the ecological health of the Mississippi Sound by filtering particulates from the water column, providing habitat and food resources to other species, and reducing wave action and storm surge.
* Over the past few decades, oyster productivity has significantly decreased due to changes in water quality, especially changes following major environmental disturbances such as hurricanes and flooding in coastal areas.
* Understanding the environmental conditions that impact oyster health and the ability to recognize when harmful conditions are imminent is critical to the continued management of oyster reefs in the Mississippi Sound.
* Oysters greatly contribute to the economy of the region. The decline in oyster population has necessitated further regulations on harvests.
* These limitations in conjunction with the overall decline in population amount to a decrease in oyster landings, which yields lower annual revenue for the industry.

**Current Decision-Making Practices & Policies**:

The Mississippi Department of Marine Resources is responsible for monitoring and ensuring the continued health of oyster reefs in the Mississippi Sound. Data are collected primarily through water quality sampling near the reefs, in addition to scuba studies conducted during the harvesting season. MDMR also utilizes USGS *in situ* monitoring stations as a secondary source of water quality information, particularly discharge information from tributaries and their confluence in the Mississippi Sound. Since 2004, oyster harvests have 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.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software**  **Release** |
| Oyster Health and Water Quality Correlation Analysis | Aqua and Terra MODIS  SMAP  Landsat 7 ETM+, Landsat 8 OLI, Landsat 8 TIRS  MUR  ESA Sentinel-2 MSI | This end product will demonstrate what patterns exist between water quality parameters and oyster health. If our partners become aware of data that indicates imminent or current conditions that have previously had a negative correlation with oyster health, they can initiate conservation efforts they deem appropriate. | N/A |
| Environmental Disturbances Case Studies | Aqua and Terra MODIS  SMAP  Landsat 7 ETM+, Landsat 8 OLI, Landsat 8 TIRS  MUR  ESA Sentinel-2 MSI | This end product will provide our partners with observations on the environmental effects of particular events, specifically hurricanes, floods, and the openings of spillways. This end product can also assist our partners in understanding what situations impact oysters and how to manage these effects. | N/A |
| Climatology and Time Series | Aqua and Terra MODIS  SMAP  Landsat 7 ETM+, Landsat 8 OLI, Landsat 8 TIRS  MUR  ESA Sentinel-2 MSI | These observations will complement the data obtained from the spring term of the project. This new box around the Biloxi Marsh will allow end users to track where the freshwater is flowing once it leaves Lake Borgne. | N/A |

**Project Benefit to End User**:

These deliverables will benefit the end user by providing an insight into how ecological disturbances impact water quality in the Mississippi Sound. This knowledge may assist MDMR managing oyster reef health in the future.

**Project Details**

**Applied Sciences National Application Addressed:** Water Resources

**Study Area:** Mississippi Sound, MS & LA

**Study Period:** 2002 – 2017

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| Aqua MODIS | Chlorophyll-a, ADG, sea surface temperature, surface reflectance | Aqua MODIS parameters will be used to update chlorophyll-a and ADG data from the end of term one to now. |
| Terra MODIS | Surface reflectance | Terra MODIS will be used to assess turbidity using linear relationships with reflectance. |
| SMAP | Salinity | SMAP data will be used to update the salinity data from term one of the project to now. |
| Landsat 7 ETM+ | Chlorophyll-a, sea surface temperature | Landsat data will be used to gather data on chlorophyll-a and SST on a finer special scale than MODIS. |
| Landsat 8 OLI | Land cover | These data will be used to gather high resolution multispectral images of our project area. |
| Landsat 8 TIRS | Land cover | These data will be used to gather high resolution multispectral images of our project area. |
| MUR | Sea surface temperature (daily 1km blended cover) | MUR will be used to analyze changes in temperature over the current study period, as well as a comparison with MODIS |
| ESA Sentinel-2 MultiSpectral Imager (MSI) | Chlorophyll-a, turbidity | Sentinel-2 will be used as a comparison with Landsat data. |

**Ancillary Datasets Utilized:**

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

**Software Utilized:**

* SeaDAS – imagery processing and enhancement
* Esri ArcGIS – imagery enhancement and map creation of Landsat imagery, Aqua and Terra MODIS data
* ACOLITE – imagery processing, masking cloud and land cover

**Project Handoff Package**

**Transition Plan:**

End products will be distributed to our partners in the form of two packages and emailed to the MDMR. The first package will be a compilation of graphs we have created that display possible correlations between data. The second package will include imagery before and after major environmental events. End products will then be discussed over a conference call to allow the project partners to discuss the team’s findings.

**Team POC:** Carter Grimm, cgrimm95@vt.edu

**Handoff Package:**

* Correlation analysis between oyster health and catch data, and set water quality parameters
* Case studies on environmental disturbances in the area
* Climatology and time series for Biloxi marsh area
* Technical paper final draft