**NASA DEVELOP National Program**

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

*Spring 2017*

**Short Title: Mississippi Sound Water Resources**

**Subtitle:** Synthesizing Trends in Water Quality Parameters Affecting Oyster Reef Health in the Mississippi Sound Using NASA Earth Observations

**VPS Title:** Don’t be Shellfish: Water Quality and Oyster Reef Production in the Mississippi Sound

**Project Team & Partners**

**Project Team:**

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**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **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 Analyst  Amber Jones, Digital Media Coordinator | End-User | No |

**Project Details**

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

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

**Study Period:** January 2002 - December 2016

**Earth Observations & Parameters:**

Aqua, Moderate Resolution Imaging Spectroradiometer (MODIS) – aDG, chlorophyll-a, surface reflectance, and sea surface temperature

Soil Moisture Active-Passive (SMAP) Radiometer – sea surface salinity

Soil Moisture and Ocean Salinity (SMOS), Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) – sea surface salinity

Landsat 5, Thematic Mapper (TM) – chlorophyll-a, turbidity

Landsat 7, Enhanced Thematic Mapper Plus (ETM+) – chlorophyll-a, turbidity

Landsat 8, Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) – chlorophyll-a, turbidity

Multi-scale Ultra-High Resolution (MUR) – sea surface temperature (daily 1 km blended product)

Sentinel-2 MultiSpectral Instrument (MSI) – chlorophyll-a, turbidity

**Ancillary Datasets Utilized:**

* USGS Current Water Data for the Nation – salinity, discharge, and temperature

**Software Utilized:**

* ESRI ArcGIS – data manipulation and analysis, map creation, and technical image creation
* SeaDAS – MODIS processing and analysis
* Sentinel Application Platform (SNAP) – visualization of Sentinel-2 data
* Python – batch downloading and processing of MUR,  MODIS, SMOS, and SMAP data
* R – data analysis of Landsat 5/7/8, Sentinel-2, MODIS,  SMOS, SMAP, and MUR images
* ACOLITE – analysis of Landsat 5/7/8 and Sentinel-2 imagery

**Project Overview**

**80-100 Word Objectives Overview:**

The objective of this project is to develop a climatology and time series of water quality variables potentially affecting the production of oyster reefs in the Mississippi Sound. These results could assist the Mississippi Department of Marine Resources (MDMR) in their efforts to continually assess oyster reef health and local water quality conditions. This project utilized several NASA Earth observing products, including MUR, Aqua MODIS, Terra MODIS, SMAP, and Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI and TIRS, plus the ESA products Sentinel-2 MSI and SMOS. The study period for the project spans from 2002 to 2016 in order to differentiate between both subtle and episodic ecological events that have occurred in the Mississippi region.

**Abstract:**

Commercially-harvested oysters are a significant ecological and economic driver in multiple coastal regions throughout the world. In the last decade, the Mississippi Sound has seen a rapid decline in oyster reef production, especially in the years following large ecological disturbances such as Hurricane Katrina in 2005 and the flooding of the Mississippi River in 2011. In partnership with the Mississippi Department of Marine Resources, the NASA DEVELOP team utilized remotely-sensed products in order to create a climatology and time series of specific water quality parameters that can have impact on oyster reef productivity. These parameters included salinity, sea surface temperature, chlorophyll-a, aDG (absorption due to gelbstoff and detrital material), total suspended matter, and turbidity. The project utilized data from several Earth observing satellites including Aqua MODIS, SMAP, Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI and TIRS, and MUR, as well as data from ESA’s Sentinel-2 MSI and SMOS. The results from this project could potentially assist the Mississippi Department of Marine Resources by providing products for additional mapping and assessment of future oyster reef health in the Mississippi Sound. These products will also allow the project partners to improve future management practices for species recovery and the creation of additional oyster reefs.

**Keywords:**

Mississippi Sound, water resources, water quality, oyster reefs, remote sensing, SMAP, MODIS, MUR, SeaDAS, SMOS

**Community Concerns:**

* Oyster reef production in the Mississippi Sound has declined 90% since 2004, impacting the local economy and the ecological integrity of the region.
* Major events such as Hurricane Katrina and periodic flooding of the Mississippi River can disrupt the water quality of the Sound, impacting the current and long term health of oyster reefs.
* Low oyster reef production has a negative effect on regional recreational, educational, commercial, and economic benefits.

**Current Management Practices & Policies**:

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 in 2015 establishing an Oyster Restoration and Resiliency Council made up of citizens, scientists, oystermen, and seafood industry leaders, 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:**

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| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software**  **Release** |
| Climatologyand time series of chlorophyll-a and turbidity. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI and TIRS, Sentinel-2 MSI | Allows project partners to identify short and long term changes in chlorophyll-a and turbidity and how this relates to oyster reef production. | I |
| Climatology and time series of sea surface salinity. | SMAP, SMOS | Allows project partners to identify short and long term changes in the salinity regime and how this relates to oyster reef production. | I |
| Climatology and time series of sea surface temperature. | MUR, Aqua MODIS | Allows project partners to identify short and long term changes in sea surface temperature and how this relates to oyster reef production. | I |
| Climatology and time seriesof chlorophyll-a, aDG, and total suspended matter. | Aqua MODIS | Allows project partners to identify short and long term changes in total suspended matter, aDG, and chlorophyll-a and how this relates to oyster reef production. | I |