**NASA DEVELOP National Program**

**2017 Summer Project Proposal**

**Mobile County Health Department and Marshall Space Flight Center**

**Coastal Alabama Oceans**

*Using NASA Earth Observations to Detect Water Quality in Coastal Alabama in Order to Enhance Marine Wildlife Management*

**Project Overview**

***Project Synopsis*:** Sea life in coastal ocean areas have very specific niches with extremely sensitive water quality parameter thresholds, such as those concerning salinity, sea surface temperature and turbidity. Changes in these parameters have adverse effects to coastal ocean ecosystems. This project aims to address changing coastal ecosystems by creating habitat suitability products for the Mobile Bay and Mississippi Sound area along the Gulf Coast. The Suomi National Polar-Orbiting Partnership Visible Infrared Imaging Radiometer Suite (NPP VIIRS), Aqua Moderate Resolution Imaging Spectroradiometer (MODIS), Landsat 8 Operational Land Imager (OLI), and Sentinel-2 Multispectral Instrument (MSI) will be utilized to determine the best way to detect salinity, turbidity, sea-surface temperature levels around the coast. Project partners will use this information to better understand marine mammal movement and habitat suitability for various species including oysters.

***Community Concern:*** Marine wildlife habitat is highly dependent on a number of factors such as temperature, salinity, and turbidity. Many community leaders, researchers, and commercial fisheries in the coastal Alabama area rely heavily on measurements of temperature and salinity to assist their business, hobbies, or research. Due to decreases in abundance and availability of these resources, many wildlife species such as manatees and oysters are closely monitored. Recently, manatees have been seen stranded on Alabama land. Understanding their movement is important to understand these trends and salinity plays a role in the animals’ movement patterns. In addition, oysters are an important part of the local ecosystem and economy: Thirty-five percent of the nation’s oysters comes from the Gulf of Mexico and, globally oyster reefs are the single most impacted marine habitat with more than 85% loss of historic coverage. A new program, which is being led by a former NASA DEVELOP partner, has been made to collect oyster shells from restaurants. The purpose of the Alabama Oyster Shell Recycling Program is to put that valuable natural resource back into local water to help additional oysters grow.

***Source of Project Idea:*** The idea for this project was brought up after a DEVELOP presentation at the Mobile Bay National Estuary Program’s August 2016 Science Advisory Committee Meeting and through the Mobile County Health Department (MCHD) node’s previous partnership with the Alabama Coastal Foundation. Further communications regarding the project between Dr. Ruth Carmichael from the Dauphin Island Sea Lab and Dr. Maury Estes as well as between the MCHD node and Mark Berte, executive director of the Alabama Coastal Foundation, resulted in a DEVELOP proposal being put forth for an upcoming term.

***National Application Areas Addressed:*** Oceans, Water Resources

***Study Location:*** Mobile Bay, AL and Mississippi Sound, MS

***Study Period:*** January 2007 – May 2017

***Advisors:*** Dr. Jeffrey Luvall (NASA Marshall Space Flight Center), Dr. Robert Griffin (University of Alabama in Huntsville), Dr. Maury Estes (Universities Space Research Association), Dr. Kenton Ross (NASA Langley Research Center), Joe Spruce (SSAI), Leigh Sinclair (University of Alabama in Huntsville, Information Technology and Systems Center)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Alabama Coastal Foundation (ACF) | Mark Berte, Executive Director | End-User | Yes |
| Mobile Bay National Estuary Program (MBNEP) | Tom Herder, Watershed Protection Coordinator | End-User | No |
| Weeks Bay National Estuarine Research Reserve | Mike Shelton, Coastal Training/Watershed Program Coordinator | End-User | No |
| Dauphin Island Sea Lab, Manatee Sighting Network | Dr. Ruth Carmichael, Senior Marine Scientist II | Collaborator | No |
| Universities Space Research Association (USRA) | Dr. Maury Estes, Assistant Director of USRA-Huntsville | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***The ACF, MBNEP, and Weeks Bay National Estuarine Research Reserve currently rely on field measurements and buoy data in order to collect salinity, temperature, and turbidity data for management purposes. The data they currently collect is an important factor in the management of aquatic wildlife. Additionally, Alabama Coastal Foundation (ACF) began the Oyster Shell Recycling Program in fall of 2016 and since then, has collected over 1.5 million shells to place back into the water to promote oyster population growth. The program started with 6 restaurants and has now expanded to 27. This upcoming fall the ACF will begin the process of placing recycled oyster shells.

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

*Alabama Coastal Foundation (ACF)* –The ACF is familiar with NASA Earth observations and has used them in a previous project partnered with DEVELOP.

*Mobile Bay National Estuary Program (MBNEP)* – The MBNEP does not currently implement NASA Earth observations in their research and can benefit from including it in their research and decision making processes. The MBNEP is familiar with DEVELOP and has worked with them in a previous project.

*Weeks Bay National Estuarine Research Reserve* –The end user does not currently implement NASA Earth observations in their research and can benefit from including it in their research and decision making processes.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

*Dauphin Island Sea Lab, Manatee Sighting Network* –The end-user has experience with the Gulf Coast marine life and can provide data and advice for the teams.

*Universities Space Research Association (USRA)* – The USRAwill guide the team by providing expert knowledge in coastal hydrology. In addition, they will also provide the basis for the coastal salinity algorithm.

***Dissemination by Boundary Organizations*:**

The ACF would like to ensure that the information from this project has a large impact for all of its partners throughout the state. As a result, they will not only utilize information from the project themselves but distribute resulting products amongst their partners and use the project to educate the public. The ACF plans to work with local partners, environmental groups, as well as high schools and colleges, in order to identify potential areas for oyster reef restoration and promote the importance of the oyster shell recycling program to the area.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Communication will initiate during the first week of the term to introduce the team and determine if there have been any changes to the desired end products. The team will ask the project partners how often they would like to receive updates; however, it is typically once every two weeks. Communication may be more frequent with local partners, such as USRA or the ACF. The two teams will meet weekly to ensure cohesion with the project. An opportunity for the teams may arise to travel to Dauphin Island to meet in person and do field work with the Sea Lab.

***Transition Plan*:** The end products will be handed off to USRA in-person via a presentation of the results. Virtual presentations or teleconferences will be given to the non-local partners and the end products will be delivered electronically. The combined end products will aid the project partners in their research about how salinity, sea surface temperature and turbidity may be affecting wildlife along the Alabama coastline. A software release is not anticipated for this project.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Aqua MODIS** | Surface Reflectance | Certain bands in Aqua MODIS will be used to calculate an algorithm that will estimate the salinity levels throughout the Mobile Bay area. |
| **Suomi NPP VIIRS** | Surface Reflectance | Certain bands in Suomi NPP VIIRS will be used to calculate an algorithm that will estimate the salinity levels and sea surface temperature throughout the Mobile Bay area. |
| **Landsat 8 OLI & TIRS** | Surface Reflectance | OLI bands in Landsat 8 will be used to detect turbidity and TIRS bands will be used to detect sea surface temperature along the Alabama Coast. |
| **Sentinel-2 MSI** | Surface Reflectance | Certain bands in Sentinel 2 MSI will be used to detect turbidity along the Alabama Coast |

***Ancillary Datasets:***

Mobile Bay National Estuary Program – Buoy Data – water quality measurements throughout the Gulf Coast

NASA Goddard Space Flight Center – Ocean Color – measurements of aerosols and land vegetation cover as well as air, water, and land temperatures

Dauphin Island Sea Lab – Manatee Tracking Data – GPS and manatee sighting locations

***Software & Scripting:***

Esri ArcMap 10.3 – raster processing/manipulation, vector data processing, map creation of Aqua MODIS, Suomi NPP VIIRS, Landsat 8 OLI and TIRS, and Sentinel-2

Exelis ENVI – raster processing/manipulation of Aqua MODIS and Suomi NPP VIIRS

SeaDAS – raster processing/manipulation of GSFC’s Ocean Color data

ACOLITE - Landsat 8 and Sentinel-2 data processing to analyze turbidity

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Coastal Salinity Algorithm with Aqua MODIS** | This end-product will assist in filling a data gap for the end-user. The end-user currently does not have reliable salinity measurements available for their decision-making processes. | This end-product will apply a pre-existing salinity algorithm to Aqua MODIS data. The results will be compared to local buoy data for accuracy. | N/A |
| **Coastal Salinity Algorithm with Suomi NPP VIIRS** | This end-product will assist in filling a data gap for the end-user. The end-user currently does not have reliable salinity measurements available for their decision-making processes. | This end-product will apply a pre-existing salinity algorithm to Suomi NPP VIIRS data. The results will be compared to local buoy data for accuracy. | N/A |
| **Sea Surface Temperature Time Series Analysis** | This end-product will provide the end-users with measurements of sea surface temperature for the area and assist in establishing baseline conditions. | This end-product will be used as a parameter in the overall habitat suitability map. Data will be compared to local buoy data for accuracy. | N/A |
| **Turbidity Time Series Analysis** | This end-product will provide the end-users with measurements of turbidity for the area and assist in establishing baseline conditions. | This end-product will be used as a parameter in the overall habitat suitability map. Data will be compared to local buoy data for accuracy. | N/A |
| **Habitat Suitability Maps** | This end-product will benefit the end-users by providing them with a visualization of areas where habitat may be changing for marine mammals or where oyster restoration may be suitable. This product will provide the end-users with a better understanding of where to focus resources. | This end-product will combine the MODIS, VIIRS, Landsat 8, and Sentinel-2 data into a finalized map product. | N/A |

***End-User Benefit*:** These end-products will help fill an important data gap for the end-users. Salinity, sea surface temperature and turbidity are critical factors in species movement and are important for the management of coastal wildlife. These end-products will provide the end-users with additional data and algorithms in order to strengthen their decision-making processes and management strategies in the future, in particular as to where to place the recycled oyster shells. Additionally, these end-products will potentially reduce the number of hours required to collect salinity, sea surface temperature and turbidity data in the field as well as increase the temporal resolution of measurements.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Summer

***Related DEVELOP Work:***

2015 Fall (NASA Jet Propulsion Laboratory) – Los Angeles Oceans: Remote Sensing Detection of Wastewater Plumes to Assess Public Water Quality in Los Angeles County

2015 Fall (Mobile County Health Department) – Coastal Texas Water Resources II: Using NASA Earth Observations to Laguna Madre Water Conditions through Land Cover Mapping and Thermal Analysis

2015 Summer (NASA Goddard Space Flight Center) – Maryland Ecological Forecasting: Utilizing NASA Earth Observations to Monitor and Strengthen the Survivorship of Maryland’s Sea Turtles

**Notes & References:**

***Notes*:** As this will be a joint project, the nodes have decided to distribute the workload between the two nodes. MSFC will focus efforts on creating the Coastal Salinity Algorithm with Aqua MODIS and Suomi NPP VIIRS. MCHD will focus their efforts on the creation of Sea Surface Temperature and Turbidity Time Series Analyses. Both nodes will work together to combine end-products for the creation of Habitat Suitability Maps.