**NASA DEVELOP National Program**

**2018 Summer Project Proposal**

**Virginia – Wise**

**Louisiana Ecological Forecasting**

*Monitoring and Predicting the Spread of the Roseau Cane Mealy Bug* (Nipponaclerda biwakoensis) in the Mississippi Delta Using NASA Earth Observations

**Project Overview**

***Project Synopsis*:** *Nipponaclerda biwakoensis*, a scale insect commonly known as the Roseau cane mealy bug, has recently caused dieback of nearly 5.5 miles of Roseau cane, *Phragmites australis*,on the banks of the Mississippi River in southern Plaquemines Parish of southeast Louisiana. An estimated 100,000 acres of Roseau cane are under immediate threat. Therefore, the National Wildlife Federation, along with its national and local partners, is striving to use science-based solutions to identify pressing issues to inform their advocacy work for restoration and maintenance of the Mississippi River Delta. We propose to assist the coastal zone damage assessment and habitat restoration work by using Landsat 5 TM, Landsat 8 OLI, Terra and Aqua MODIS to map, monitor, and assess Roseau cane habitat disturbance being caused by Roseau cane mealy bug. These products will be used in conjunction with Software for Assisted Habitat Modeling (SAHM) to aid in assessing and forecasting its impact on the Mississippi Delta.

***Community Concern:*** Roseau cane is a tall grass that occurs on the higher elevations of coastal marsh (e.g., by natural levees). This grass species stabilizes sediment and provides valuable wildlife habitat in the Mississippi River Delta. Due to extensive restoration efforts of Roseau cane, erosion on the Louisiana River Delta has declined since 2008; however, time, money, and effort put into the restoration is at risk due to the Roseau cane mealy bug outbreak. In just a few months, the Roseau cane mealy bug devastated large areas of Roseau cane along the Mississippi River. It is unclear exactly how much Roseau cane has become victim to this invasive species, but the insect has reportedly caused damage to 80% of the Pass Loutre Wildlife Management Area’s 110,000 acres. Roseau cane is essential to shoreline stability, and losing the cane would set back almost a decade worth of restoration and threaten navigation routes by exponentially increasing the amount of sediment in the Mississippi River Delta.

***Source of Project Idea:*** This project proposal originated from a conversation between current Virginia – Wise Center Lead, Eric White, and the previous Center Lead, Michael Brooke discussing the issue.

***National Application Area Addressed:*** Ecological Forecasting

***Study Location:*** LA

***Study Period:*** January 2006 – 2018; Forecasting to 2030

***Advisors:*** Joseph Spruce (Science Systems & Applications, Inc.), Dr. L. DeWayne Cecil (NOAA National Center for Environmental Information, Global Science & Technology, Inc.), Bob VanGundy (The University of Virginia’s College at Wise)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **National Wildlife Federation, Mississippi River Delta Restoration Campaign** | Dr. Alisha Renfro, Coastal Scientist | End User | No |

***End-User Overview***

***End User’s Current Decision-Making Process:***Currently there are several proposed plans to mitigate the impact of this invasive species; however, no plans have been implemented yet. Their current usage of remote sensing allows only for the visualization and statistical analysis of mealy bug destruction and Roseau cane loss. By enhancing the use of current remote sensing practices, areas of importance will be identified with more detail allowing for improvement of mitigation practices and better allocation of resources.

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

*National Wildlife Federation, Mississippi River Delta Restoration Campaign* – In their work to advocate for science-based restoration of the Mississippi River Delta, the National Wildlife Federation and their partners have used NASA Earth observations to evaluate and communicate about the cane mealy bug and importance of addressing the land loss issue in Louisiana. However, the use of NASA Earth observations in forecasting the spread of the insect is currently an area where capacity can be built.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The team will communicate project milestones with Dr. Alisha Renfro at the National Wildlife Federation via bi-weekly teleconferences. The Project Lead will serve as the main DEVELOP POC.

***Transition Plan*:** Hand off will be conducted either via webex or Google Hangout. The tools produced by this project will be used by the partners to identify areas that are affected by *Nipponaclerda biwakoensis*, and forecast areas of high concern.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **SRTM** | Digital Elevation Model | SRTM elevation data will be used in ecological forecasting models produce risk maps. |
| **Terra MODIS** | Surface Reflectance, Spectral Vegetation Indices | Terra MODIS data will provide vegetation health indices. This will be used to detect cane marshes with low health indices. |
| **Aqua MODIS** | Surface Reflectance, Spectral Vegetation Indices | Aqua MODIS data will provide vegetation health indices. This will be used to detect cane marshes with low health indices. |
| **Landsat 5 TM** | Surface Reflectance | The NDVI band ratio will be utilized to detect vegetation health at 30 m pixel resolution. This will provide imagery up to 2013. |
| **Landsat 8 OLI** | Surface Reflectance | The NDVI band ratio will be utilized to detect vegetation health at 30 m pixel resolution. This will provide imagery from 2014 to 2017. |
| **Sentinel-2 MSI** | Surface Reflectance | The NDVI band ratio will be used to detect vegetation health at 10 m pixel resolution. Sentinel-2 provides imagery from 2016 and 2017 – the main time frame of cane die-off. |
| **TRMM PR** | Monthly Precipitation | TRMM will be used to help identify the metrological and climatic conditions that the Roseau cane mealy bug need to live and spread. |

***Ancillary Datasets:***

USGS National Land Cover Dataset (NLCD) – identifying of croplands within the study that are possibly at risk of Mealy Bug infection

USGS Water Quality and Turbidity Data – measuring sedimentation increase related to Roseau cane decrease

***Modeling:***

Software for Assisted Habitat Modeling (SAHM) (POC: Amanda West, Colorado State University)

Boosted Regression Trees (BRT) (POC: Amanda West, Colorado State University)

Generalized Linear Model (GLM) (POC: Amanda West, Colorado State University)

Maximum Entropy (MAXENT) (POC: Amanda West, Colorado State University)

Multivariate Adaptive Regression Splines (MARS) (POC: Amanda West, Colorado State University)

Random Forest Classification Model (POC: Amanda West, Colorado State University)

***Software & Scripting:***

ESA Sentinel Application Platform (SNAP) – image processing/visualization

ERDAS Imagine – image stacking

Esri ArcGIS – shapefile creation

Exelis ENVI – FLAASH atmospheric correction

Microsoft Excel – statistical analysis

QGIS – Sentinel data downloading and pre-processing

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Roseau Cane Monitoring and Mapping Package** | The National Wildlife Federation will use this map package to identify areas of Roseau cane, and areas that are potentially infested with the cane mealy bug due to Roseau cane loss. | Landsat 5 TM, Landsat 8 OLI, Sentinel-2 MSI, and ForWarn MODIS data will be utilized to detect Roseau cane and compare the number of acres destroyed since 2006. | II |
| **Roseau Cane Disturbance Forecasting Map** | This map will show the total amount of Roseau cane lost since 2006 and forecast the spread of the mealy bug infestation using SAHM to improve current mitigation efforts. | TRMM PR, SRTM Landsat 5 TM, Landsat 8 OLI, and Sentinel-2 MSI will be utilized to detect Roseau cane locations, trace the current spread, and forecast areas that are at risk of infection using SAHM until the year 2030. | II |

***End-User Benefit*:** NASA DEVELOP’s products will assist the National Wildlife Federation in tracking the loss of Roseau cane, as well as identifying potential areas at risk of infestation. The use of NASA Earth observations will allow for enhanced classification of high risk areas, leading to improved decision making, forecasting, and mitigation practices. NASA DEVELOP will deliver vital information to the National Wildlife Federation that will sanction the maximization of resources to aid in the effort of the control of the Roseau cane mealy bug.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: Summer 2018 to Fall 2018

***Multi-Term Objectives:***

* **Term 1 (Proposed Term):** 2018 Summer (Virginia – Wise) – Louisiana Ecological Forecasting
  + This term will develop a host map of Roseau cane, disturbance detection maps, and also research the methodologies needed to forecast the spread of the Roseau cane mealy bug. The first term is critical in identifying meteorological and climatic conditions necessary for this insect to persist, as well as the health from the beginning of Roseau cane restoration efforts in 2008 to the introduction of the Roseau cane mealy bug. Partner interaction with the NWF will provide necessary information on current *in situ* data not available to the general public.
* **Term 2:** 2018 Fall (Virginia – Wise) – Louisiana Ecological Forecasting II
  + The second term will enhance the forecasting component of the project. Weighted regression, cubic spline regression, and generalized estimating equations will provide an accurate representation of how fast habitat destruction is occurring. This term will also include an effort to develop a Roseau cane monitoring capability based on VIIRS data. It will also look at the potential of improved disturbance monitoring using Sentinel-2 red edge data in conjunction with various NASA EO data. A project hand-off will occur by screen share via Cisco WebEx, and the data will be transferred through NOMAD Large File Transfer Service.

***Related DEVELOP Work:***

Spring 2018 (LaRC) – Amistad Ecological Forecasting: Using Landsat and Sentinel to Identify and Detect Giant Cane in Amistad National Recreation Area for Future Invasive Species Land Management

Spring 2017 (UGA) – Eastern India Ecological Forecasting II: A Multi-Sensor Approach to Enhance the Prediction of Mangrove Biophysical Characteristics in Chilika Lagoon and Bhitarkanika Wildlife Sanctuary, Odisha, India

Summer 2017 (UGA) – Eastern India Ecological Forecasting III: A Multi-Sensor Approach to Enhance the Prediction of Mangrove Biophysical Characteristics in Chilika Lagoon and Bhitarkanika Wildlife Sanctuary, Odisha, India

Spring 2015 (MCHD) – Mississippi Water Resources: Mapping Extent and Modeling Land Use of Critical and Endangered Watersheds to Assist Restoration Efforts and Conservation Planning Using NASA Earth Observations

**Notes & References:**

***Notes*:** This invasive species has the capability of impacting sorghum, sugar cane, and a multitude of other crops.

***References:***

Louisiana Wildlife & Fisheries. (2017). Roseau Cane Mealy Bug continues destructive path through southern Plaquemines Parish. Retrieved from <http://www.wlf.louisiana.gov/news/41260>

Baurick, T. (2017). Roseau cane plague on Louisiana coast might have started a year earlier. Retrieved from <http://www.nola.com/environment/index.ssf/2017/08/mississippi_delta_wetland_plag.html>