**NASA DEVELOP National Program**

**Virginia – Wise**

*Project Summary – Summer 2018*

**Louisiana Ecological Forecasting**

*Monitoring and Predicting the Spread of Roseau Cane Die-offs Connected to the Invasive Mealy Bug* (Nipponaclerda biwakoensis) and Other Contributing Factors in the Mississippi River Delta Using NASA Earth Observations

**VPS Title:** Louisiana Land-loss, Taking a Roseau Cane Stand: Remote Monitoring and Forecasting in the Lower Mississippi River Delta

**Project Team**

***Project Team*:**

Jen Schellman (Project Lead), jentlen1nja@gmail.com

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***Advisors & Mentors*:**

Joseph Spruce (Science Systems & Applications, Inc. Consultant)

Dr. L. DeWayne Cecil (NOAA National Center for Environmental Information, Global Science & Technology, Inc.)

Dr. Marguerite Madden (The University of Georgia)

Dr. Kenton Ross (NASA Langley Research Center)

Bob VanGundy (The University of Virginia’s College at Wise)

Brooke Colley (NASA DEVELOP Virginia – Wise)

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**Project Overview**

***Project Synopsis*:** Marsh decline and land-loss in the lower Mississippi River Delta is under investigation; contributing factors include the Roseau cane scale (*Nipponaclerda biwakoensis)*, relative sea-level rise, subsidence, salinity, plant pathogens, pollution-related variables and other anthropogenic causes. Roseau cane (*Phragmites australis*) stabilizes sediment and decreases erosion. An estimated 100,000 acres of Roseau cane are under immediate threat. The National Wildlife Federation strives to use science-based solutions to identify areas for restoration within the Mississippi River Delta. This project used NASA Earth observations and the Software for Assisted Habitat Modelling to map, monitor and forecast the vegetative health of this fragile marsh ecosystem.

***Abstract*:**

The Roseau cane mealy bug (*Nipponaclerda biwakoensis*) is an invasive scale insect discovered in the United States during the 2016-2017 die-offs of Roseau cane (*Phragmites australis)* in the Mississippi River Delta, Plaquemines Parish, LA. Roseau cane stabilize sediment, protect against wave-action and storm surge, and provide critical habitat to wildlife. Roseau cane is the dominant vegetation type in the Mississippi River Delta and its loss will affect coastal marsh extent, shipping interests in the Mississippi River, and property owners along the lower Mississippi River Delta. The NASA DEVELOP Louisiana Ecological Forecasting team partnered with the National Wildlife Federation to use NASA Earth observations, Landsat 5 Thematic Mapper (TM) and Landsat 8 Operational Land Imager (OLI), to monitor and assess the history of Roseau cane die-offs. These data, along with *in situ* observations from the Coastwide Reference Monitoring System (CRMS) stations and the National Agricultural Imagery Program (NAIP) imagery, were input into the Software for Assisted Habitat Modeling (SAHM) model to forecast and predict the vegetative health of the marsh out to 2030. The NDVI maps created assessed yearly changes and overall trends throughout the study period to identify areas of the marsh most impacted by major disturbance events (e.g. hurricanes) elucidating critical areas of interest for mitigation and restoration planning. Modeling with SAHM indicated a continued threat to Roseau cane stands through 2030 as overall marsh health continues to decline and relative sea-level rise (RSLR) coupled with subsidence continues to raise water levels and increase saline conditions for marsh plants.

**Keywords:**

Roseau cane, Phragmites, *Nipponaclerda biwakoensis*, SAHM, Landsat, NDVI, remote sensing

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

***Study Location:*** LA

***Study Period:*** 2005 – 2017; Forecasting to 2030

***Community Concern:***

* Recent Roseau cane dieback of more than 80% in the Pass-a-Loutre Wildlife Management Area in the Delta National Wildlife Refuge has prompted research into the issue.
* Roseau cane stabilizes sediment, protecting against wave action and storm surge.
* Due to an overabundance of nutrient loss caused by the mealy bug, areas of the common reed converted to open water; a large cane die-off could lead to significant land-loss and decreased protection from inland inundation.
* The National Wildlife Federation requires accurate vegetation distribution maps to best inform restoration efforts and allocation of resources in the Mississippi River Delta (MRD).
* *In situ* observations of Roseau canedie-off across the MRD are difficult to acquire and limited in availability.

***Project Objectives:***

* Generate NDVI maps to monitor marsh vegetative health between 2005-2017
* Assess land cover change in the study area during the study period
* Create a series year to year annual NDVI changes between 2005-2017
* Forecast out to 2030 the vegetative health of the marsh
* Assess marsh collapse zones considering various associated environmental factors

**Partner Overview**

***Partner Organization(s):***

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

***Decision Making Practices & Policies***:

Currently, there are several plans being proposed to mitigate the impact of this invasive, herbivorous insect species. However, no plans are currently implemented. The National Wildlife Federation is striving to use science-based methods to identify pressing issues to inform their advocacy work for restoration and maintenance of the Mississippi River Delta. The current usage of remote sensing is very periodic and allows only for the visualization and statistical analysis of mealy bug destruction and Roseau cane loss as an occasional “snap shot in time.” By enhancing the use of remote sensing practices, areas of Roseau cane marsh decline will be identified with resulting geospatial data then available for improvement of marsh damage mitigation practices and better allocation of resources for achieving coastal marsh restoration.

***Project Benefit to End User***:

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 damage to coastal Louisiana Roseau cane and the importance of addressing the land-loss issue in coastal Louisiana. The use of NASA Earth observations in forecasting and predicting vegetative health of the marsh out into the future and interpreting patterns that already exist with concerns to marsh resilience after disturbance events (e.g. hurricanes, floods, oil spills etc.) will assist in mitigation and planning efforts to restore the marsh.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter** | **Use** |
| **Landsat 5 TM** | Surface Reflectance | NDVI band combination will be utilized to detect vegetation health at 30 m pixel resolution. This will provide imagery up to 2013. |
| **Landsat 8 OLI** | Surface Reflectance | NDVI band combination will be utilized to detect vegetation health at 30 m pixel resolution. This will provide imagery from 2014 to 2017. |

***Ancillary Datasets:***

USGS National Land Cover Dataset (NLCD) – identify areas of persistent water to delineate between land/water edges

USGS Coastwide Reference Monitoring System (CRMS) – *in situ* monitoring of Roseau cane

National Agriculture Imagery Program (NAIP) – unsupervised classification of marsh vegetation and designate Roseau cane absence/presence points

USGS CoNED – elevation and bathymetry for forecasting infestation risk

PRISM Precipitation – identify meteorological and climatic conditions affecting Roseau cane health

***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:***

ESRI ArcGIS – shapefile creation

QGIS – NDVI annual change vs mean (avg) change for study period (2005-2017)

Google Earth Engine API– composite image acquisition

Microsoft Excel – statistical analysis

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **Roseau Cane Monitoring and Mapping Package** | Landsat 5 TM, Landsat 8 OLI | The National Wildlife Federation will use this map package to identify areas of Roseau cane die-back and resilience. | II |
| **Roseau Cane Disturbance Forecasting Map** | Landsat 5 TM, Landsat 8 OLI | This map will show predicted Roseau cane loss and forecast the spread of cane die-offs using SAHM to improve current mitigation efforts. | II |

**Project Handoff Package**

**Transition Plan:**

Hand off was conducted at the end of the term 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* as well as other contributing factors that are destabilizing the marsh in the lower Mississippi River Delat, and forecast areas of high concern.

**Team POC:** Jen Schellman, jentlen1nja@gmail.com

**Partner POC**: Dr. Alisha Renfro, renfroa@nwf.org

**Handoff Package:**

* Annual NDVI change maps of marsh vegetation from 2005-2017
* Year to year changes in annual NDVI compared to the average (between 2005-2017) maps from 2005-2017
* Marsh classified distribution maps from 2005-2017
* NDVI change map virtually stacked dates 2005, 2011, 2017
* SAHM forecast maps and statistical analysis of vegetative health out to 2030

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