**NASA DEVELOP National Program**

Mobile County Health Department

**Fall 2015**

**Short Title: Coastal Texas Water Resources II**

**Subtitle:** Using NASA Earth Observations to Assess the Health of the Laguna Madre through Land Cover Mapping and Thermal Analysis

**VPS Title:** Tapping Groundwater Resources--Literally!: Potentially Parasitic Relationship Between the Honey Mesquite and the Laguna Madre

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

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**Past or Other Contributors:**

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**Partner Organizations:**

National Park Service (NPS), (End-User), POC: Joe Meiman

**Project Details**

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

**Study Area:** Laguna Madre, Padre Island National Seashore, Texas as well as Kenedy County, TX

**Study Period:** January 1984 to September 2015

**Earth Observations & Parameters:**

Landsat 4 Thematic Mapper (TM) - Land cover, thermal bands

Landsat 5 Thematic Mapper (TM) - Land cover, thermal bands

Landsat 7 Enhanced Thematic Mapper+ (ETM+) - Land cover, thermal bands

**Ancillary Datasets Utilized:**

* Texas A&M University-Corpus Christi - *In situ* and historic water temperature and salinity data
* USGS National Landcover Dataset (NLCD) - soil data
* Southern Regional Climate Center - *In-situ* precipitation data
* USDA NRCS - Geologic formations and soil data

**Models Utilized:**

* Clark Labs TerrSet Land Change Modeler for ArcGIS/IDRISI Land Change Modeler
* PRISM Climate Group - Precipitation data

**Software Utilized:**

ERDAS IMAGINE - Land classification of Landsat imagery

ArcGIS - Raster analysis of Landsat 5 and 7 and auxiliary data, map creation

dnnpy - Scripts for converting Landsat imagery to TOA reflectance and surface temperature with Python

TerrSet - Land modeling and forecasting of mesquite tree expansion

**Project Overview**

**80-100 Word Objectives Overview:**

The Laguna Madre, located within Padre Island National Seashore, TX, is one of only six hypersaline lagoons in the world—however this may not have always been the case. This project will utilize NASA Earth Observing Systems (EOS), *in-situ* data, and different models to see if the proliferation of honey mesquite (*Prosopis glandulosa*) trees, and their ability to tap into groundwater resources via a well-developed taproot system, has obstructed freshwater inflow to the lagoon. If this is indeed what has led the lagoon to become hypersaline, these findings will allow for changes in future land management decisions.

**Abstract:**

The project partnered with the National Park Service (NPS) to analyze the suspected correlation between the occurrence of honey mesquite trees and the salinity of the Laguna Madre, located within Padre Island National Seashore. The lagoon is a hypersaline estuary, however, there is historical evidence indicating the lagoon was not always so saline. It is hypothesized that the proliferation of the honey mesquite tree (*Prosopis glandulosa*) has contributed to the lagoon’s increased salinity by tapping into groundwater and thereby reducing the amount of freshwater that once flowed into the Laguna Madre. NASA Earth Observations were used in ArcGIS software and ERDAS IMAGINE to create time series maps and conduct data analyses. Landsat 5 and 7 data were used to create LULC maps to analyze the change in mesquite tree coverage compared to various soil types as well as calculate NDVI and NDII. Thermal maps of the lagoon were also created using Landsat 5 and 7 data to identify thermal anomalies and possible inflow of groundwater to the lagoon. *In situ* and modeled PRISM precipitation data were used to target years for analysis and analyze the correlation between precipitation and root zone soil moisture content. Through these analyses the NPS can improve future land management practices.

**Community Concerns:**

* Laguna Madre within Padre Island National Seashore is a hypersaline estuary, but there is compelling historical evidence that this was not always the case.
* There has been a rapid increase in the native honey mesquite tree population. Their taproots are thought to be depleting the area's groundwater resources, which could have previously recharged the Laguna Madre, increasing the salinity of the lagoon
* The increasing salinity of the lagoon is potentially harming this aquatic ecosystem’s inhabitants--namely already threatened species of seagrasses and sea turtles.
* The increase in mesquite trees has occurred on privately-owned land which presents the complexities of managing native plants, and the interconnectivity between private and public land management.

**Current Management Practices & Policies**:

The Laguna Madre is managed by the federal government as it is part of Padre Island National Seashore. However, a large amount of the land surrounding the lagoon is privately owned. As a result, managing the health and water quality for this hypersaline aquatic ecosystem has become increasingly complex and difficult. Currently, the National Park Service collects *in-situ* data from limited locations to monitor different water properties of the Laguna Madre, such as temperature, pH, turbidity, and salinity.

**Decision Support Tools & Benefits:**

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| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| LULC Map Time Series | Landsat 5 TM and Landsat 7 ETM+  | Determining whether changes in land management are needed if increase in mesquite trees correlates with decrease in groundwater and increase in estuary salinity |
| Mesquite Tree Extent Prediction Maps | Landsat 5 TM, and Landsat 7 ETM+ | Determining whether changes in land management are needed if increase in mesquite trees is predicted and correlates with decrease in groundwater and increase in estuary salinity  |
| Vegetation Indices Map | Landsat 5 TM and Landsat 7 ETM+ | Determining whether changes in land management are needed if increase in mesquite trees correlates with groundwater depletion as indicated by vegetation water stress levels |
| Soil Type by Mesquite Tree Occurrence Map | Landsat 5 TM and Landsat 7 ETM+  | Identifying whether soil type can be identified as a factor in mesquite tree location and can be used as a predictor of tree occurrence to be considered in land management decisions |
| Thermal Map of Lagoon | Landsat 5 TM and Landsat 7 EMT+ | Identifying changes in groundwater flow and assessing the need to be addressed through changes in land management practices |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)

**Software Release Requirements**

What category do the tools your project is creating fall within?

Category II