**NASA DEVELOP National Program**

****NASA Langley Research Center

**Summer 2016**

**Short Title: Everglades Ecological Forecasting**

**Subtitle:** Improving the Capacity of the Everglades National Park to Monitor Mangrove Extent using NASA Earth Observations.

**VPS Title:** A Legend in the Making: Mapping Mangroves in the Florida Everglades

**Project Team & Partners**

**Project Team:**

Donnie Kirk (Project Lead), donnie.kirk@nasa.gov

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**Advisors & Mentors:**

Dr. Kenton Ross (NASA DEVELOP National Program Science Advisor)

Dr. Hans-Peter Plag (Old Dominion University, Mitigation and Adaptation Research Institute [MARI])

Dr. Marguerite Madden (University of Georgia)

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| National Park Service,  Everglades National Park  (ENP) | Jed Redwine, Ecologist, South Florida Natural Resources Center | End-User | No |
| Group on Earth Observations, Blue Planet Initiative (GEO-BPI) | Dr. Hans-Peter Plag | End-User | No |
| Mitigation and Adaptation  Research Institute (MARI) | Dr. Hans-Peter Plag | Collaborator | Yes |

**Project Details**

**Applied Sciences National Application Addressed:** Ecological Forecasting

**Study Area:** Everglades National Park (FL)

**Study Period:** Jan 1995 - Dec 2015, 2025

**Earth Observations & Parameters:**

Landsat 5 & 8 – Land cover

USGS Earth Explorer – Landsat Data, MODIS

Sentinal 1a and 2 - landcover

**Ancillary Datasets Utilized:**

* USGS National Land Cover Dataset (NLCD) – land cover
* Dr. Madden’s Everglades Map (1999); Global maps of Mangrove (ESRI, 2011) and Current Mangrove Extent Map
* UGA Vegetation Map, 1999 (http://fcelter.fiu.edu/data/GIS/interactive\_map/)

**Models Utilized:**

TerrSet Land Change Modeler (POC: Dr. Kenton Ross, DEVELOP National Science Advisor)

**Software Utilized:**

* ArcGIS - raster manipulation/analysis, image enhancement & map creation of Landsat, Terra MODIS
* Google Earth Engine - Landsat Data

**Project Overview**

**80-100 Word Objectives Overview:**

This project conducted a spatial analysis using NASA Earth observations and Google Earth Engine to create a replicable methodology that will map and monitor mangrove forest extent and the mangrove-marsh transition in the Everglades National Park. A subset of the coastal areas (10-15% of the coastline) of the Everglades was used to monitor the changes that have taken place using random sampling techniques of remotely sensed data. The goal of this project is to map the rate of change that has taken place between the 1990’s and 2015 and to use this rate to forecast future changes to the mangrove-marsh transition zone.

**Abstract:**

Mangroves act as a transition zone between fresh and salt water ecotones by filtering and monitoring salinity levels along the coast of the Florida Everglades. Mangroves offer specialized habitats and provide shoreline stabilization, critical to a region beset by tropical storms. These areas give way to marshlands that depend on the services mangroves provide, as they require larger quantities of freshwater. In an attempt to assist in maintaining the health of the threatened mangrove species, efforts have been made within the Park to rebalance the ecosystem. The National Park Service requires a way to track the distribution of marshes and mangroves. The DEVELOP Ecological Forecasting team utilized Google Earth Engine and satellite imagery from Landsat 5 and 8 with comparison to existing vegetation maps. The team was able to conduct the classification to display mangrove and marsh regions in 1995, 2005, and 2015. After considering several geospatial analysis platforms, the team selected Google Earth Engine due to the accessibility of its open source platform. In order to make the process replicable for the Everglades National Park, the team developed a comprehensive methodology of classifying mangroves in Google Earth Engine. The process was designed with the intent that the methodology be transferrable to personnel at Everglades National Park. The current extent map, in conjunction with TerrSet and transition maps aided in the creation of forecasted models.

**Keywords:**

Remote Sensing, JavaScript, Coastal Ecosystem, Ecotone, Landsat, Google Earth Engine, Marsh

**Community Concerns**:

* Mangrove forests are one of the world’s most threatened ecosystems.
* Mangroves serve many niche functions that the region depends on, including the monitoring of salinity levels, providing habitat for diverse wildlife, and stabilizing shorelines.
* The health and extent of mangroves are declining due to a changing environment, pollution, and human impact of the land.
* Coastal areas have historically been difficult to monitor given their limited ground accessibility and likelihood for abrupt change when compared to their terrestrial counterparts.
* The National Park Service (NPS) does not have updated maps to aid in regional decision making.

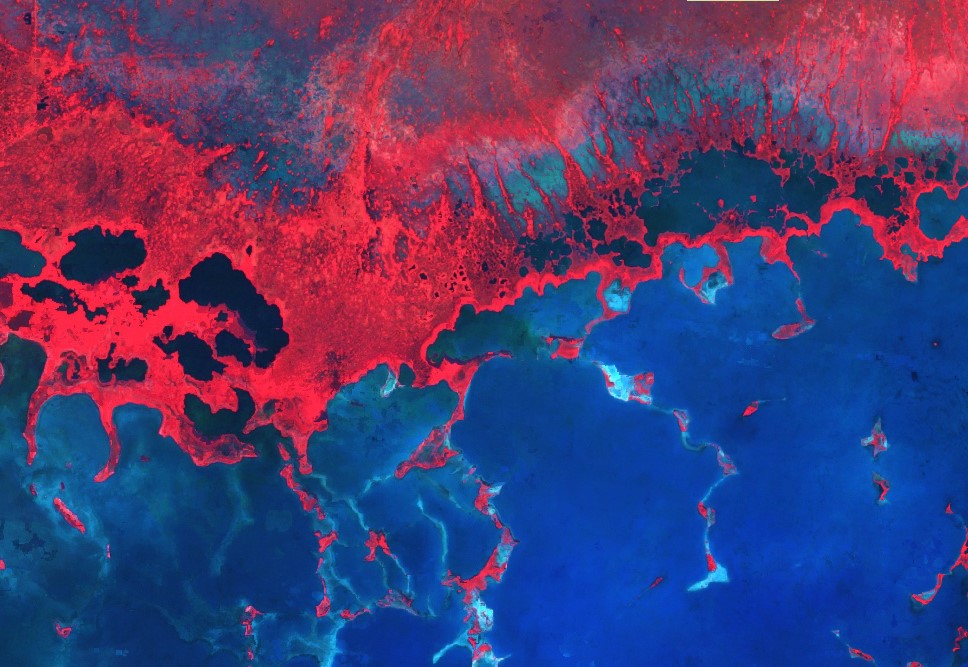
**Current Management Practices & Policies**:

Many of the management practices and policies performed at Everglades National Park focus on variables that influence mangrove forests. Park personnel monitor how fires are concentrated because fires impact the regrowth of mangrove forests. Researchers also obtain soil and water salinity field measurements throughout the park because the transition from saltwater to freshwater strongly influences the density and size of the mangrove forests. With regard to this collected data, Everglades National Park re-routed water from reservoirs to regulate ecosystems within the park. As many areas within the park are inaccessible, the personnel at Everglades National Park utilize mangrove extent maps in their decision making for re-routing water. The mangrove extent map currently being used to make these decisions was last updated in 2000.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software**  **Release** |
| Current Mangrove Extent Map | Landsat 5 and 8 | The partner will use this to help better understand the extent of the mangroves and identify areas that require better monitoring practices | 3 |
| Mangrove Extent Change Maps | Landsat 5 and 8  Dr. Madden’s Everglades Map (1999); Global maps of Mangrove (ESRI, 2011) and Current Mangrove Extent Map | The partner will use this to help assess areas where mangrove forests have been declining. | N/A |
| Mangrove Forecasting Maps | Dr. Madden’s Everglades Map (1999); Global maps of Mangrove (ESRI, 2011) and Current Mangrove Extent Map | The partner will use this to help plan mangrove protection policies | N/A |
| Tutorial | Google Earth Engine in conjunction with Landsat 5 and 8 | The partner will use the methodologies developed during the project to apply to other study areas | N/A |

**Project VPS/Booklet Imagery**



**Caption:** Landsat 5 image highlighting the Florida Everglades Mangrove extent using a cloud filtering algorithm and false color bands.

**Image:** 2016\_LaRCSum\_ EvergladesEco\_VPSimage.jpg