**NASA DEVELOP National Program**

****NASA Jet Propulsion Laboratory

**Spring 2016**

**Short Title: Bolsa Chica Ecological Forecasting**

**Subtitle:** Analyzing the Success of the Bolsa Chica Wetland Restoration Using Multi-spectral NASA Earth Observations

**VPS Title:** Where’s a Bird to Go? Mapping Wetland Restoration on the Pacific Flyway

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Cedric Fichot (NASA Jet Propulsion Laboratory)

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**Past or Other Contributors:**

Gwen Miller

**Partner Organizations:**

Amigos de Bolsa Chica (End-User), POC: Joana Tavares-Reager; Boundary Organization

**Project Details**

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

**Study Area:** Bolsa Chica Ecological Reserve, Huntington Beach, CA

**Study Period:** 1984-2015

**Earth Observations & Parameters:**

ER-2, AVIRIS – vegetation type

Landsat 5, TM - land cover, NDVI

Landsat 7, ETM+ – land cover, NDVI

Landsat 8, OLI – land cover, NDVI

**Ancillary Datasets Utilized:**

* USDA National Agriculture Imagery Program (NAIP) – aerial imagery
* NOAA – tidal gauge or stream gauge data

**Software Utilized:**

ENVI – Classification of AVIRIS Imagery

ArcGIS – NDVI calculation for Landsat imagery, creation of vector layers representing vegetation and water extent, map layouts

Leaflet – Creation of web maps

**Project Overview**

**80-100 Word Objectives Overview:**

Urban expansion has dominated the majority of coastal Southern California over the course of the last century. However, the Bolsa Chica wetlands have largely avoided this development due to private oil extraction operations in the area, which inadvertently created a haven for birds and other wetlands species. Then, in 1997, the State of California acquired the site and has since been restoring it to a more natural state. By incorporating NASA Earth observations, we can show a time series of maps depicting the extent of vegetation and water before and after key restoration events that the project partner can use to educate the public and assess the current state of the site.

**Abstract:**

The Bolsa Chica Ecological Reserve in Huntington Beach, California, consists of 1550 acres of undeveloped coastal wetland and is home to several endangered species, including underwater life, vegetation, and migratory birds that fly along the Pacific flyway. Since the 1800’s, farming, land subsidence, resource extraction, and land development have impacted these wetlands, affecting the habitat’s biodiversity. The Amigos de Bolsa Chica advocacy group has made a 40-year effort to preserve, restore, and maintain the wetlands through volunteer work and public outreach, impacting public policy and management practices. However, there has been no previous attempt to assess the success of the restoration using aerial imagery. This project utilized NASA Earth observations, National Agriculture Imagery Program (NAIP) imagery, and field surveys to highlight the changes in habitat and tidal water extent from 1984 to 2015, with a particular focus on the changes that ensued from the opening of a channel connecting the site to the ocean in 2006. Using a before and after time series based off of our analysis and vegetation maps of the current site, the Amigos de Bolsa Chica will be able to enhance their education and outreach to create better tools to engage the community into management of the wetlands and prioritize areas of future concern.

**Community Concerns:**

* The landscape of the wetlands has been impacted by past human activity, including farming and oil extraction.
* In the past two decades, state agencies have been attempting to restore tidal flow and vegetation to their more natural state to provide habitat for endangered species and other wildlife with few other nesting site options along the Southern California coast.
* No analysis has been done comparing the site’s current state to what it was before restoration efforts began to gauge the success of the restoration.
* Since the reserve belongs to California residents, it’s important to educate them on the importance of this restoration effort as well as show them how effective their tax dollars have been thus far.

**Current Management Practices & Policies**:

The Bolsa Chica Ecological Reserve is managed by the California Department of Fish and Wildlife, while the California Coastal Commission regulates any development within the site. The Amigos De Bolsa Chica is one of two non-profit groups that are affiliated with the site. Both groups are stakeholders and give their input and feedback at regulatory and decision-making meetings. The Amigos’ efforts lay primarily within the realm of community involvement and education through activism and advocacy. They have created the Follow and Learn about the Ocean Wetlands (FLOW) program to monitor water quality and create a citizens scientist corp. Given that they are a non-profit volunteer organization, wetland surveys rely on volunteers of various skill levels who monitor the wetlands to determine its state of health.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Satellite Time-Series | Landsat 8 OLILandsat 7 ETM+Landsat 5 TM | Visual imagery showing change in wetlands over time that can easily be understood by the general public |
| Maps of changes in vegetation and water extent | Landsat 8 OLILandsat 7 ETM+Landsat 5 TM | These maps will show the changes in vegetation and water extent that the site has undergone since it was reopened to tidal influences in 2006. It can help show those involved in the restoration how successful their restoration efforts have been. |
| Map of Current State of Vegetation Currently at the Site | ER-2 AVIRIS | This map will show the locations of notable plant species such as: eel and cord grass and invasive species such as iceplant and saltgrass. Many parts of the wetland are not accessible on foot, so groups affiliated with the wetlands have not been able to fully study the extent of these habitats, many of which provide shelter to endangered species. |
| Interactive Web Map  | Landsat 8 OLILandsat 7 ETM+Landsat 5 TMER-2 AVIRIS | Other end products will be combined and put online, via Leaflet, to create an interactive education tool for the project partner to use on their website. |
| Video Documentary | N/A | This video will enhance the public outreach campaign of the Amigos de Bolsa Chica by utilizing digital media and the NASA DEVELOP VPS. |

**Project Imagery**

**[Insert image here]**

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

**Image:** TBD 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

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**Full Software Description and Plan**

**Introduction/Objective:**

What motivated the creation of this software, what problem does it address?

Our project partner would like to include interactive maps that we create as part of this project on their website to educate the public about the changes the restoration has brought to the wetlands.

**Applications and Scope:**

Where and how will this software be used to influence decisions?

It is unlikely that this software will be used in decision making processes, but it will be used as part of the public education efforts that the project partner is engaged in.

**Capabilities:**

What can it do better than what was previously available?

There are currently no interactive maps on the partner’s website, so this will improve upon what they have now by providing them with interactive educational content.

**Interfaces:**

How is one expected to use the software? For example, command line, GUI, script execution, etc.

The software in question will not be visible to the public. It will be embedded in a web page by the project partner’s web developer. All that will be visible to the public is the interactive map with layers that can be turned on and off.

**Assumptions, limitations, & Errors:**

What areas that the software could be improved upon in the future? This is where limitations of the theory, model, science, etc should be briefly documented. If the tools only work for a specific scenario, say so.

In the future, the map could be updated with new aerial imagery and shapefiles is someone is available to do the work required. Otherwise, it can continue as is.

**Testing:**

What validation techniques and testing strategy will be used to build confidence in the software?

The only testing or validation required will be to view the map in various web browsers to see if it is displaying properly.