Inventory of Vegetation Spectral Properties in the South Bay Salt Ponds: A Database for Enhancing Decision Support And Restoration Mapping

DEVELOP

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Objectives

- Create a spectral library of relevant vegetation
- Perform an analysis of the spectral variation between different vegetation types
- Track the historical changes in vegetation distribution from 2000 to present to assess the health and progress of the wetland restoration effort, now that levees are being breached

Study Area

Kristy & Eve on a boardwalk in the Alviso Area

Field Guide David Thomson guiding Lee & Rachael through the vegetation to gather spectral signatures in the Alviso Area

Located on the southern end of San Francisco Bay are three salt pond sites currently undergoing restoration: Alviso Ponds, Eden's Landing Ponds and the Ravenwood Ponds
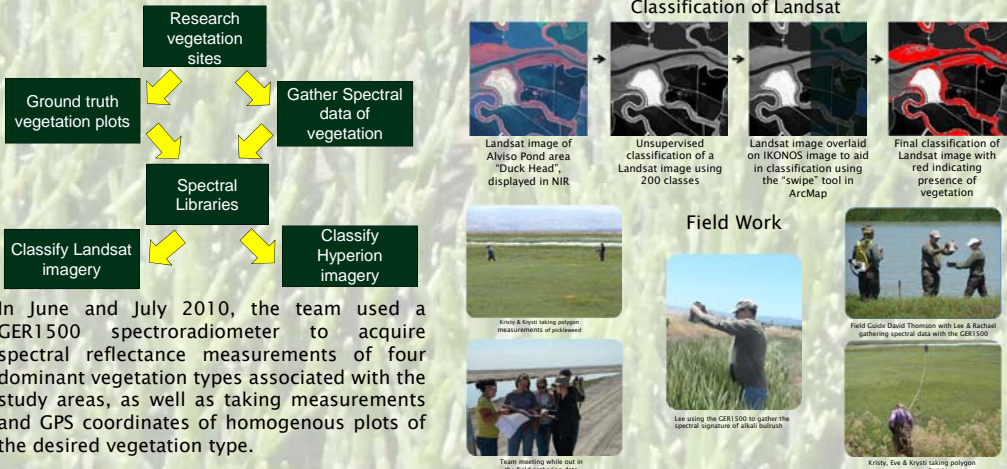
Earth Observation Sources

Landsat 5   GER-1500   EO-1

Introduction

In the past century, more than 85% of the historical marshlands in the San Francisco Bay were converted to salt ponds or filled for urban development with the resultant loss of biodiversity. The municipalities along the southern margin of the San Francisco Bay are in the process of one of the most extensive tidal wetland restoration projects ever undertaken, The South Bay Salt Pond Restoration Project (SBSPRP). The goal of this study was to perform an analysis of the spectral variation between different salt pond vegetation types and to track the historical changes in vegetation distribution from 2000 to present. This project has identified the specific spectral characteristics of vegetation through the use of in-situ spectral measurements and spectral un-mixing of remotely sensed imagery from EO-1 Hyperion and Landsat. These data can be used to produce a vegetation classification of imagery that will be shared with the SBSPRP partners to aid in their 3-year classification of the vegetation. Students' fieldwork in the salt ponds included the use of a handheld spectrometer to gather spectral data for image classification. Plots were classified by taking an inventory of each vegetation species within each plot. Percent cover of each species was used to perform a supervised classification and compared to an un-mixed Landsat image.

Methodology

Research vegetation sites → Gather Spectral data of vegetation → Spectral Libraries → Classify Hyperion imagery → Classify Landsat imagery → Ground truth vegetation plots → Research vegetation sites

Classification of Landsat

Landsat image of Alviso Pond area "Duck Head", displayed in NIR

Unsupervised classification of a Landsat image using 200 classes

Landsat image overlaid on IKONOS image to aid in classification using the "swipe" tool in ArcMap

Final classification of Landsat image with red indicating presence of vegetation

Field Work

Kristy & Krysti taking polygon measurements of pickleweed

Field Guide David Thomson with Lee & Rachael gathering spectral data with the GER1500

Team meeting while out in the field gathering data

Lee using the GER1500 to gather the spectral signature of alkali bulrush

Kristy, Eve & Krysti taking polygon measurements of pickleweed

In June and July 2010, the team used a GER1500 spectroradiometer to acquire spectral reflectance measurements of four dominant vegetation types associated with the study areas, as well as taking measurements and GPS coordinates of homogenous plots of the desired vegetation type.

National Application Areas and Partners

Ecological Forecasting   Water Resources

USGS science for a changing world

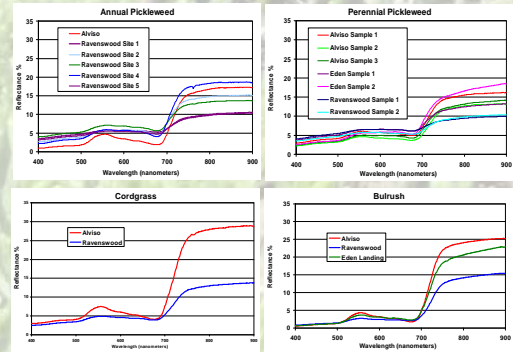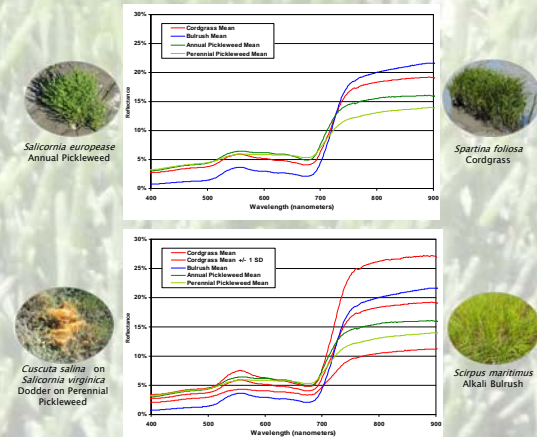South Bay Salt Pond Restoration Project

Conclusions

- Landsat imagery is too coarse for the distinction between the different vegetation species.
- Spectral Library of the different species was created using VIPER tools, a plug-in for ENVI.
- Hyperion imagery works with the GER1500 data, although more spectral measurements of endmembers are needed to improve the accuracy.

Results Continued
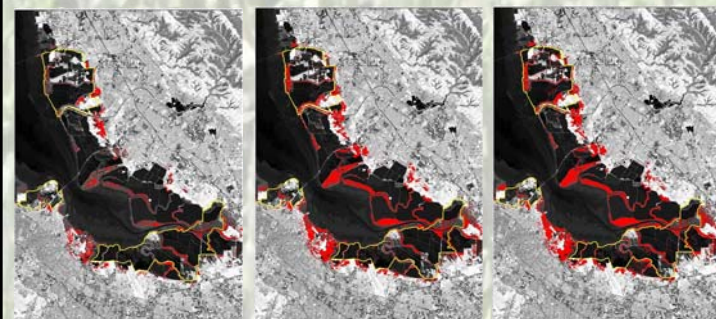
Spectral Signatures for Various Vegetation

Annual Pickleweed

Perennial Pickleweed

Cordgrass

Bulrush

Means and Standard Deviations for Vegetation Samples

Salicornia europaea Annual Pickleweed

Spartina foliosa Cordgrass

Cuscuta salina on Salicornia virginica Dodder on Perennial Pickleweed

Scirpus maritimus Alkali Bulrush

Results

Historical Vegetation Growth from 2000-2010 using Landsat TM 5 Images

August 2, 2000   June 13, 2005   June 11, 2010

Landsat is successful in illustrating the increase in overall vegetation changes in the south San Francisco Bay salt pond area over the past decade.

Classification Results using Hyperion Image

GER 1500 Spectral Data

Image Derived Data

Threshold 0.993936

Threshold 0.993687

Spectral similarity to pickleweed

less   more
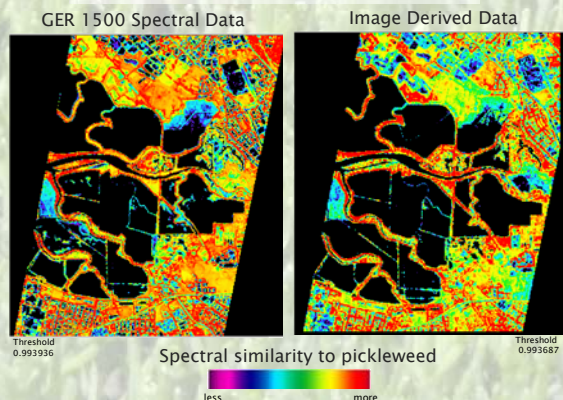
A subset image of the classified July 7th, 2010 Hyperion data showing the Alviso area using the SAM classification algorithm with spectral library constructed in ERDAS IMAGINE. The results of the SAM classification algorithm shows pickleweed in red. The classification from both the GER 1500 data and the image derived data are able to identify the occurrence of pickleweed in the Alviso area