Mangrove Conservation in Southern Florida
An Analysis of Changes in the Mangrove Ecosystem from 1988 to 2003

Research Objective
Mangroves are threatened by disturbances in water composition and quality due to human development, and are vital to local ecosystems and coastline storm protection. This research seeks to examine whether recent conservation efforts have had any positive effects on the mangrove ecosystem, using images of the mangroves from 1988 and 2003. Classification and post-classification comparison change detection were used to analyze the change in mangroves by area and percentage, as well as the change in mangrove height and health.

Results/Conclusions
There is evidence of mangrove erosion along the coastline, a decrease in healthy vegetation, and expansion of mangroves into historically freshwater areas due to saltwater encroachment. In total, mangrove area decreased by 5.2%, or roughly 27.5 sq km. While this rate of decline is not as severe as mangrove loss in other tropical areas, it still indicates that conservation efforts must be strengthened to prevent further mangrove loss along the western coastline of southern Florida. It is particularly important to restore the drainage relationship between Lake Okeechobee and the Everglades that was destroyed by human development.

Methodology

Preprocessing
Images of southern Florida were obtained through USGS Earth Explorer. A Landsat TM image from March 15, 1988 and a Landsat SLC image from February 13, 2003 were used. After layer stacking, mangrove areas in the southwestern part of each image were clipped with an ROI mask. A Normalized Difference Vegetation Index (NDVI) was used, with Band 3 as the red and Band 4 as the near-infrared, to compare the change in vegetation in the two areas. An unsupervised K-means classification of the enhanced 2003 image was able to distinguish between taller, denser mangroves and shorter, less dense mangroves.

Classification/Change Detection
The first three MNF bands of each image were used to run an unsupervised K-means classification, specifying 10 classes and 12 iterations, and merged into 4 final classes: water, mangroves, coastal salt marsh, and coastal prairie. These results were somewhat successful, but not sufficiently accurate at distinguishing the non-mangrove land cover. Principal Component Analysis (PCA) was used with the MNF method in order to reduce noise and enhance the mangrove features.

Suggestions for Improvement
The lower spatial and spectral resolution of the Landsat images made it difficult to distinguish between certain types of land cover. It was impossible to classify land cover for the 2003 image of southern Florida, or to distinguish non-mangrove land cover types from one another with confidence. This information would have enhanced the quality of analysis.

It would also have been useful to include an image from the 1970s in the comparison in order to better chronicle how rates of mangrove loss have changed in accordance with conservation efforts. Unfortunately, high-quality satellite images from the 1970s are difficult to find.