Change Detection Analysis of the Shrinking Great Salt Lake

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Remote Sensing in Environmental Analysis

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Introduction

The Great Salt Lake provides breathtaking scenery and a wide variety of recreational opportunities in northern Utah. Recreational activities range from boating, swimming, sunbathing on the white sand beaches at Antelope Island State Park, to hiking, camping and mountain biking.

Great Salt Lake is situated in a shallow desert basin. The lake's maximum depth is 35 feet. As a result, small disruptions in the water's surface elevation drastically change the lake's surface area.

Droughts and warmer temperatures have caused excessive evaporation of Great Salt Lake in Utah, drawing down the lake to record low levels. In addition to rainfall, the lake gets its water from four main rivers and numerous small streams. A portion of the freshwater that used to flow to the lake is now being diverted for consumption, further contributing to the low water levels. Not only does the water level affect the recreational use of Great Salt Lake, but, being one of the largest migratory bird magnets in Western North America, it also has a negative impact on the surrounding wildlife habitats.

This poster illustrates the assessment using remote sensing to visually show the changes of the size of Great Salt Lake from 1985 to 2010.

Methodology

To perform this assessment, Landsat 4-5 TM images were downloaded from USGS Global Visualization Viewer (glovis.usgs.gov) for the Great Salt Lake area from September 1985 and September 2010. To properly perform the change detection analysis, all images had to be free of cloud cover, so that all areas of water remained 100% visible.

http://glovis.usgs.gov/ — September 1985

http://glovis.usgs.gov/ — September 2010
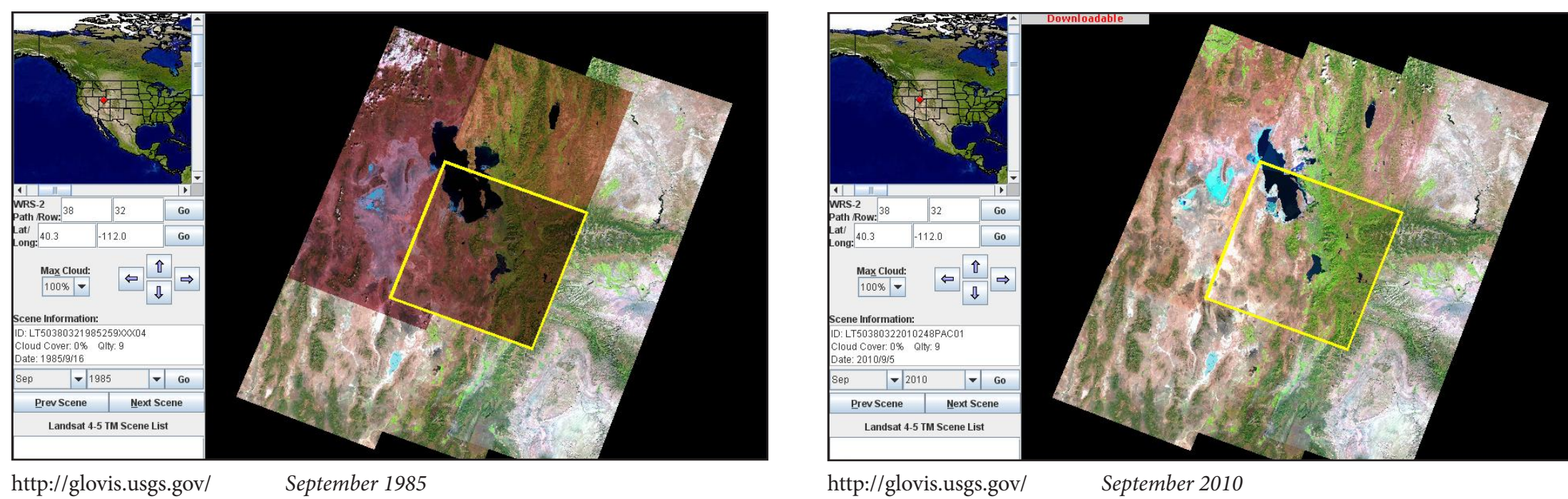
Image Mosaicking and Clipping

Due to the large area covered by Great Salt Lake, four separate satellite images for each year were downloaded and mosaicked together. Once mosaicked, the images were clipped to the same study area to zoom in on the lake.

1985

2010

1985

2010
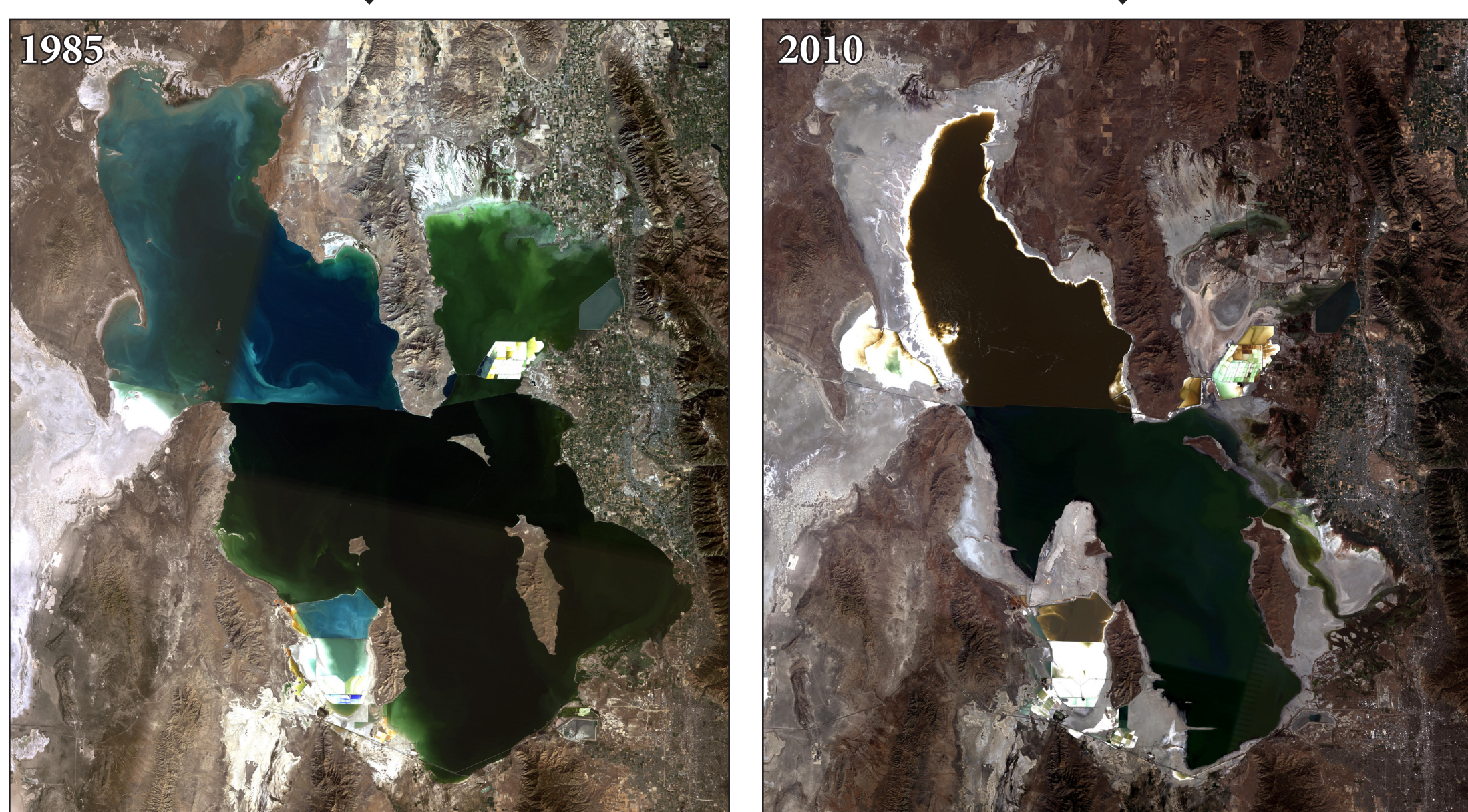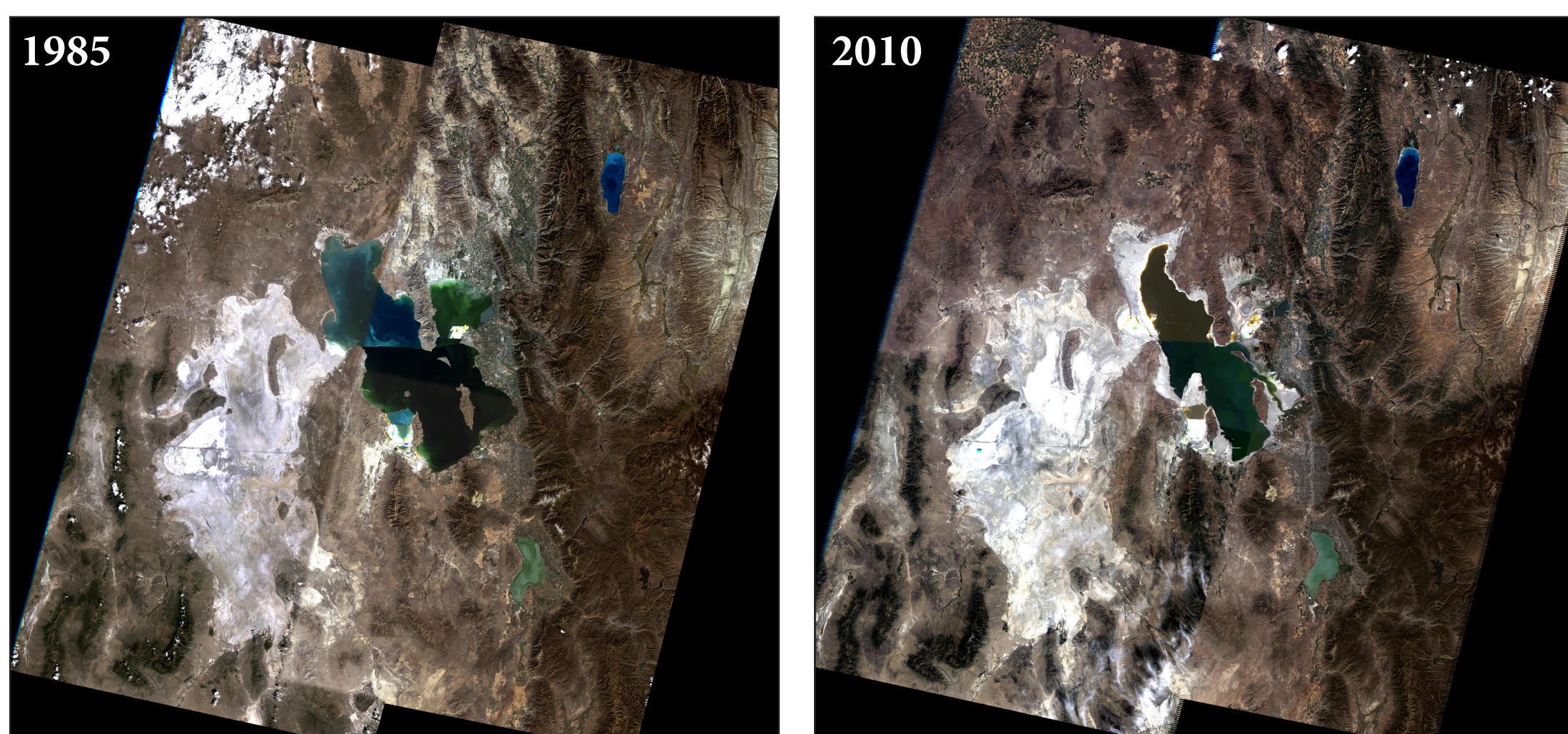
Classification

ROI's (regions of interest) were created by selecting digitized training samples for two classes: water and land. A supervised classification using maximum likelihood was performed on both images to calculate the probability of which pixels belonged to the water class and which pixels belonged to the land class. Post classification processing using majority/minority analysis was then performed on both images to reduce the number of falsely classified pixels and to reduce some of the noise. Both images then underwent a classification accuracy assessment by creating a confusion matrix using ground truth ROI's. The 1985 images resulted in an accuracy of 98.5% while the 2010 images resulted in 98.2% accuracy.

1985

2010

Change Detection Analysis
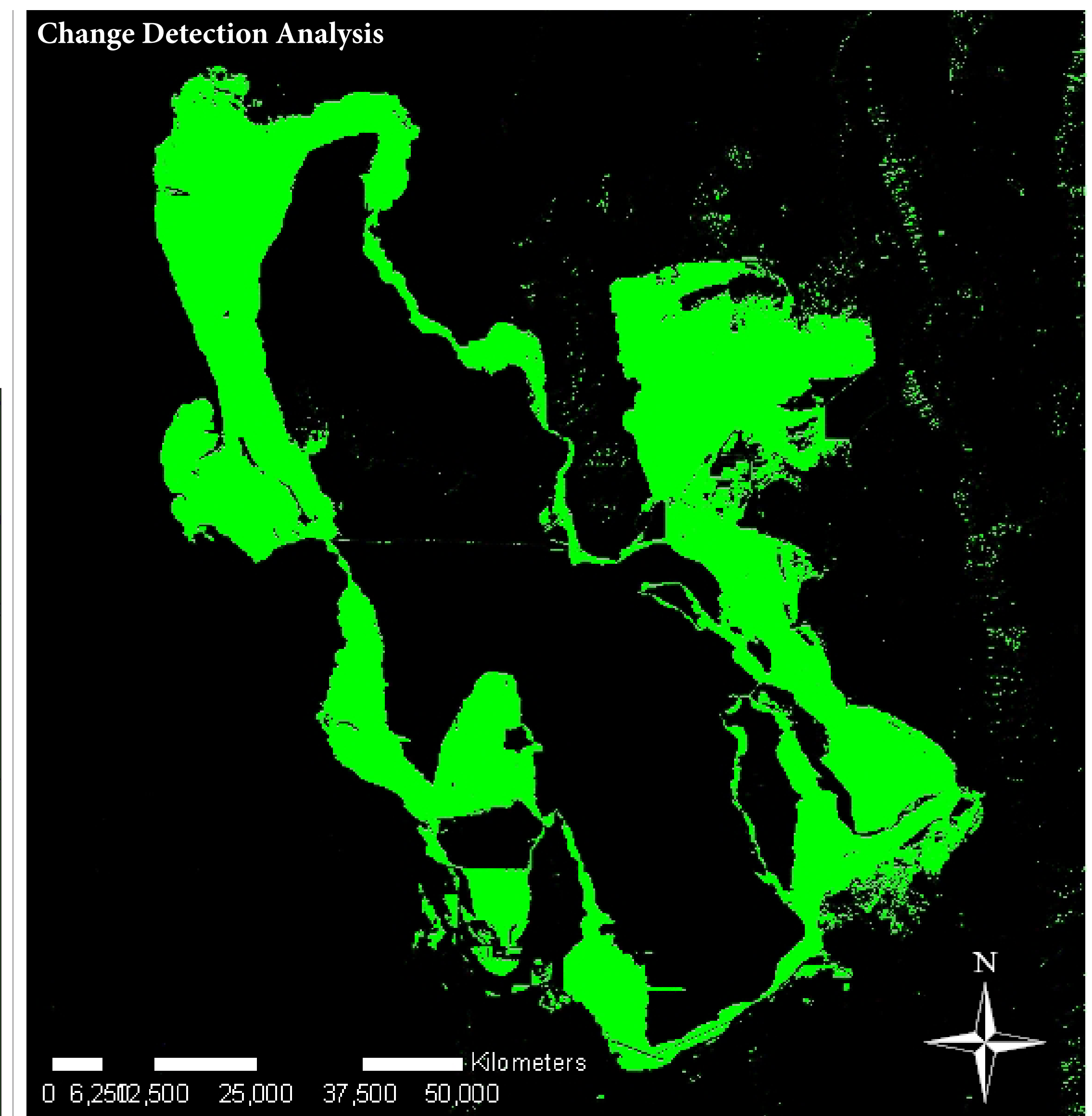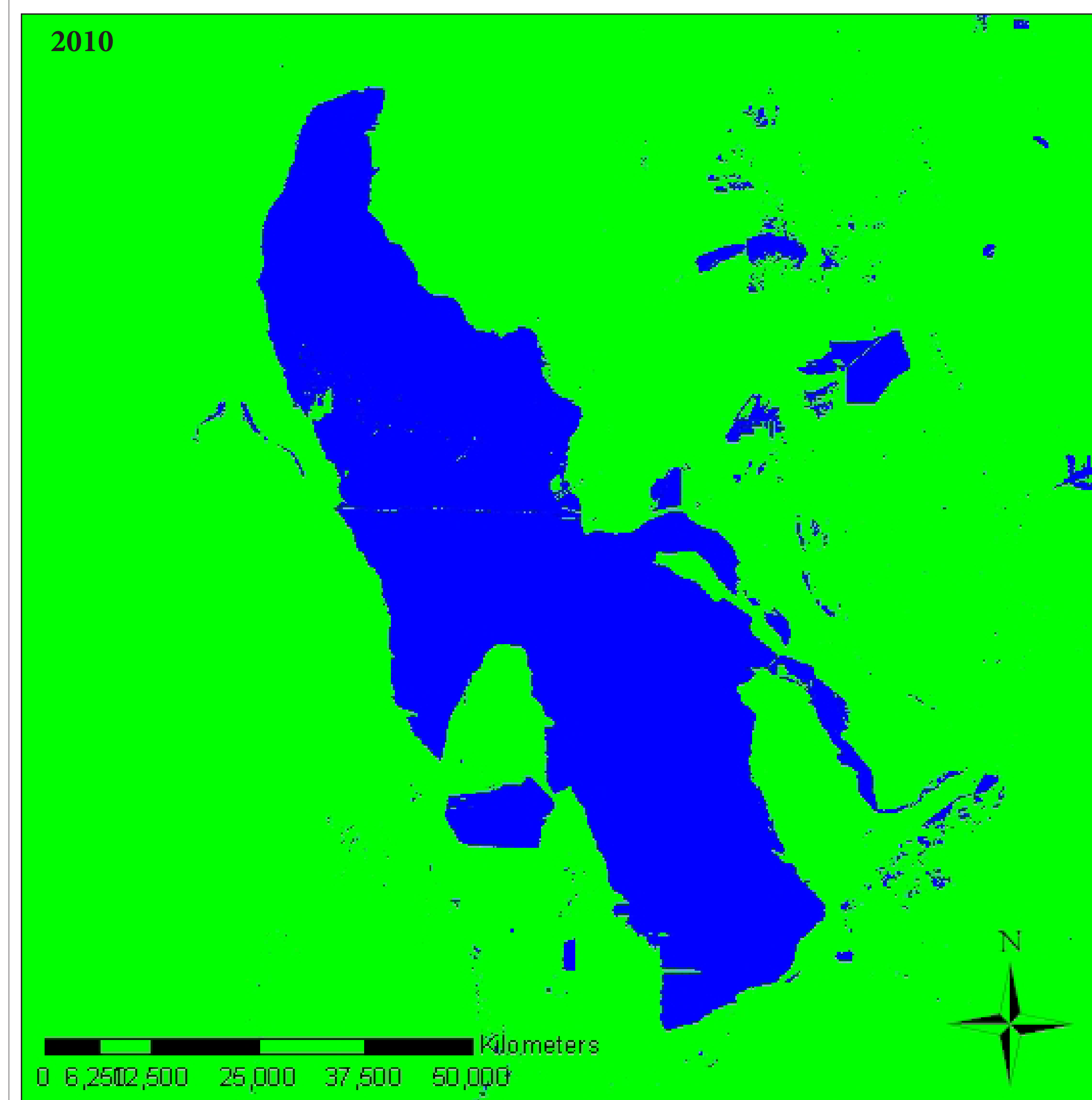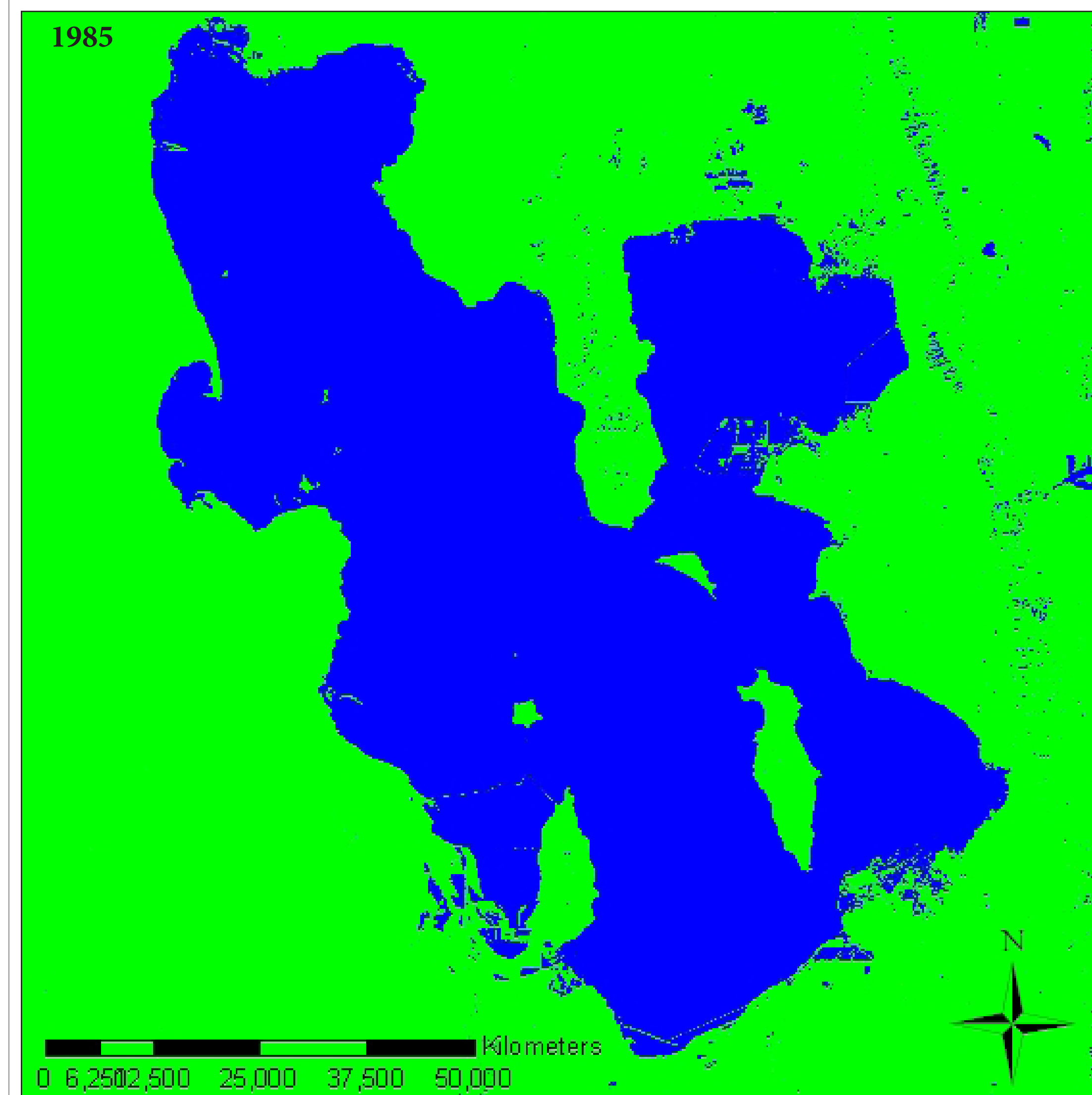
Results

The classified images of 1985 and 2010 underwent another post classification to produce the change detection statistics in order to show the amount that the Great Salt Lake shrank during the 15-year time period. The results of this study showed visual and quantitative data that clearly illustrated the shrinking of Great Salt Lake. The remote sensing analysis shows that during the fifteen years, Great Salt lake has shrunk by 2,887.84 km^2. That shows a loss of 49% of the lake's water surface area.

Conclusion

The ever changing shoreline has frustrated attemps to develope on its banks. As a result, the Great Salt Lake's shoreline is extensively surrounded by wetlands creating an excellent habitat for migrating and nesting birds. This adundance of wetlands and wildlife are preserved as a state park on Antelope Island in Great Salt Lake. However, if the lake continues to shrink at such an alarming rate, the wetlands will soon follow and the state park (which is no longer a true island) will no longer be known for its beaches or unique array of wildlife.

Great Salt Lake Facts

- The largest U.S. lake west of the Mississippi River
- The 4th largest terminal lake (no outlet) in the world
- A remnant of Lake Bonneville, a prehistoric freshwater lake that was 10 times larger than Great Salt Lake
- About 75 miles long, and 28 miles wide, and covers 1,700 square miles
- Has a maximum depth of about 35 feet
- Typically 3 to 5 times saltier than the ocean
- Fish free, the largest aquatic critters are brine shrimp and brine flies
- One of the largest migratory bird magnets in Western North America

References:
http://glovis.usgs.gov/
http://ut.water.usgs.gov/greatsaltlake/
http://www.utah.com/stateparks/great_salt_lake.htm