Geospatial Technology Application in Landscape Change Monitoring of Southeastern United States Coastal Wetlands and Impact from Global Warming and Climate Change

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Presentation Outline

- Background
- Objectives
- Study Area
- Materials and Methods
- Results and Discussion
- Conclusions

Background

- In recent days land cover is changing often and quick and in the coastal areas it is severe due to excessive urban sprawl.
- Natural phenomena such as floods, hurricanes, forest fires, tornadoes, erosion and others cause land cover changes and vice versa.
- Land cover changes due to urbanization or land development heavily affect the Hydrologic Cycle.

Background

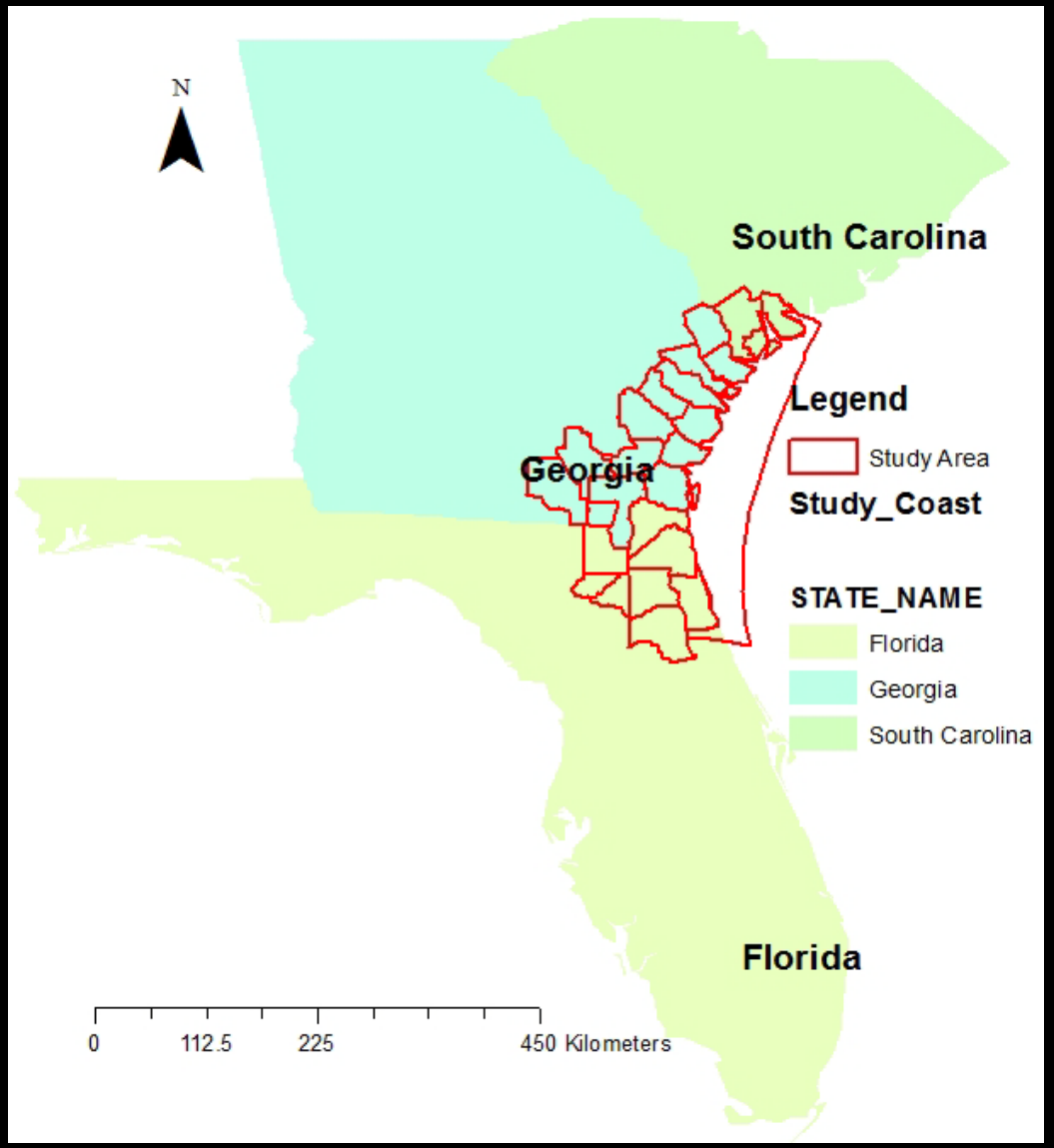
- Wetlands serve as transitional areas between terrestrial and aquatic systems (Ge, 2009; Wang and Liang, 2008).
- Coastal wetlands are society's buffer against hurricanes or tropical storms that make their way to coast (Roy and Yuan, 2009).
- Remotely sensed images are best used for over the period land cover change analysis.
- Geospatial technology can easily verify the probable damage to the land from sea level rise as a consequence of coastal land use change and other factors.

Objectives

- The main objective of this study was to prepare multitemporal imageries for the US Southeast coast and conduct land-use change analysis to determine the reduction of coastal wetlands over 25 years from 1984 to 2009.
- Another objective of the study was to conduct geospatial analysis to show the impact of sea level changes due to global warming and climate change on the coastal Georgia.

Study Area

- The study area contains 23 counties along the Southeastern coast of the United States from South Carolina down thru to Florida.
- The area (4.7 mi ha) includes all of Georgia's Ware County that has the Okefenokee Swamp in it.



Materials and Methods

(Landsat Imagery Collection & Processing)

- Landsat imageries comprising of the study area (Area of Interest (AOI)) was downloaded from the GLOVIS web site for the years 1984 and 2009.
- Path and Row 16, 38; 16, 39; 17, 38; and 17, 39 of leaf on (April/May) season were downloaded for free.
- Cloud cover in all the downloaded imageries were minimum, not more than 10%.
- Photo Science Inc. (PSI) created 2008 Georgia Land cover classified imagery and 1992 land cover classified NLCD data were used for classification accuracy analysis.

Materials and Methods

(Landsat Imagery Collection & Processing)

- Once all the imageries for both years (1984 and 2009) were obtained, the two sets of four scenes were mosaiced in ERDAS Imagine 9.3 software.
- AOI polygon (Coastal counties shapefile) was set in ERDAS Imagine to subset each of the 8 scenes to cut out edge noise.
- Histogram Matching was performed during mosaicking for color correction using the overlapping areas and band to band settings.
- Principal Component Analysis was conducted to obtain a single band (component) information for both year images that contain 7 bands

Materials and Methods

(Landsat TM Mosaic Images)

2009

1984

Materials and Methods

(Landsat Imagery Accuracy Assessment)

- On the principal component images, unsupervised classification (ISODATA) was conducted with 50 probable classes.
- GA-NLCD 1992 classified imagery was used to find the classified land-use comparison of the 1984 images.
  - Although the NLCD image was 8 years ahead of the 1984 land-use, we would get enough comparative classified pixels to perform accuracy assessment.
- Similarly, PSI developed 2008 Georgia classified land-use map was used for the accuracy assessment of 2009 study area unsupervised classified imagery.

Materials and Methods

(Landsat Imagery Reclassification & Change Analysis)

- Reclassification tool of ArcGIS 9.3.1 was used to reclassify the 50 classes of both images into seven land-use classes.
  - Flood Plain, forest, urban, low density urban, wetlands, open water, and clouds.
- Change detection operation was conducted with Map Algebra tool and Reclassification function of ArcGIS to obtain the land-use/land cover change map of the study area from 1984 to 2009.
- The final land-use change map was analyzed to determine the reduction in wetlands in the study area over 25 years.

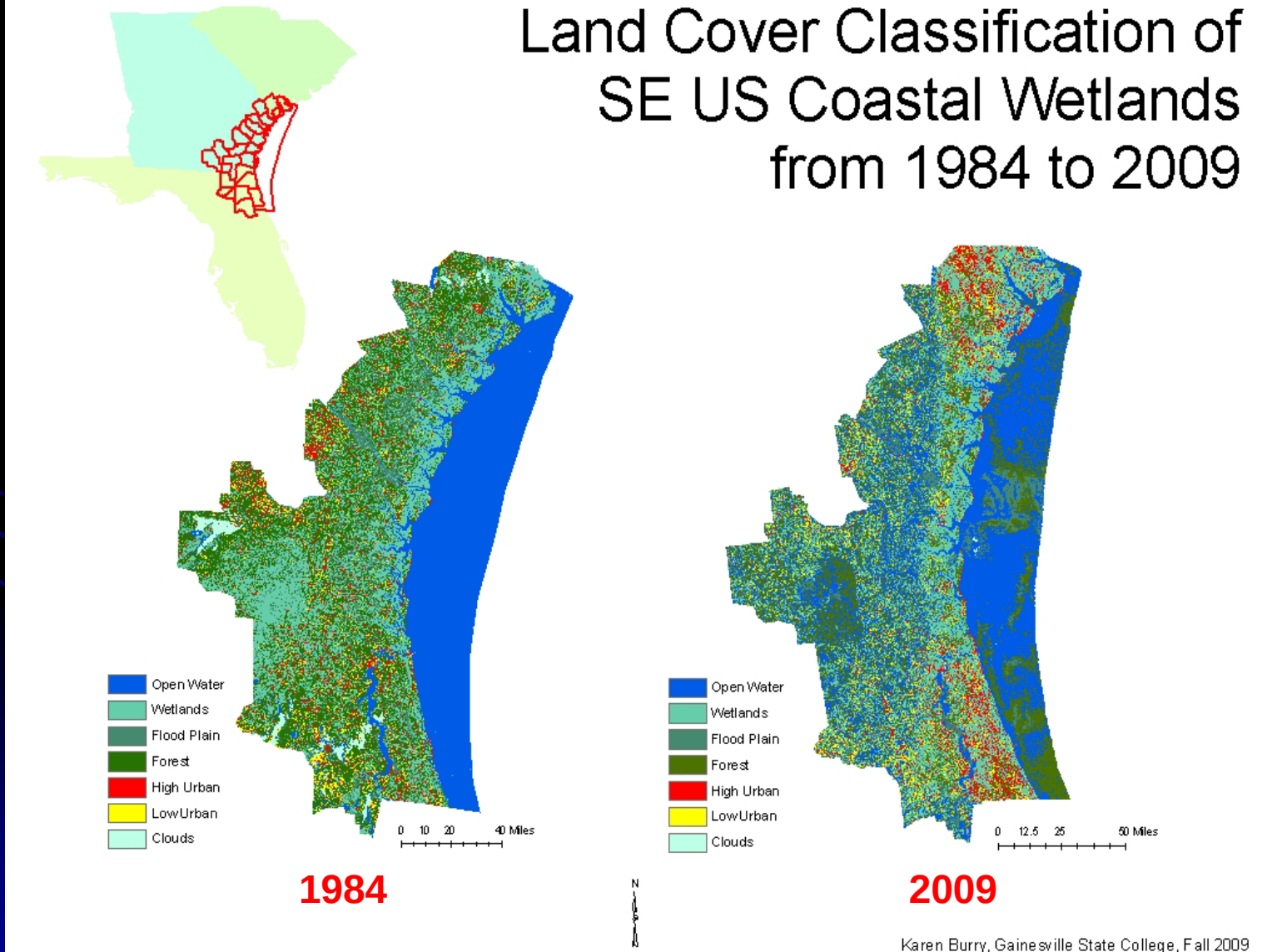
Materials and Methods

(Sea Level Rise Effect Analysis)

- The Georgia coast and county boundaries shape files was used in sea level rise effect analysis.
- Recent Georgia wetlands, coastal cities, and DEM layers were obtained from the Georgia Geospatial Data Clearinghouse and clipped the Georgia coastal counties DEM.
- The coastal cities layer was also overlayed to the DEM.
- Selection by Attribute function was used to determine the elevation pixels that will be covered with a rise of 1, 2, and 3 meter wave heights.
- Selection by Location tool used to determine the cities to be flooded with the rise in tide above MSL.

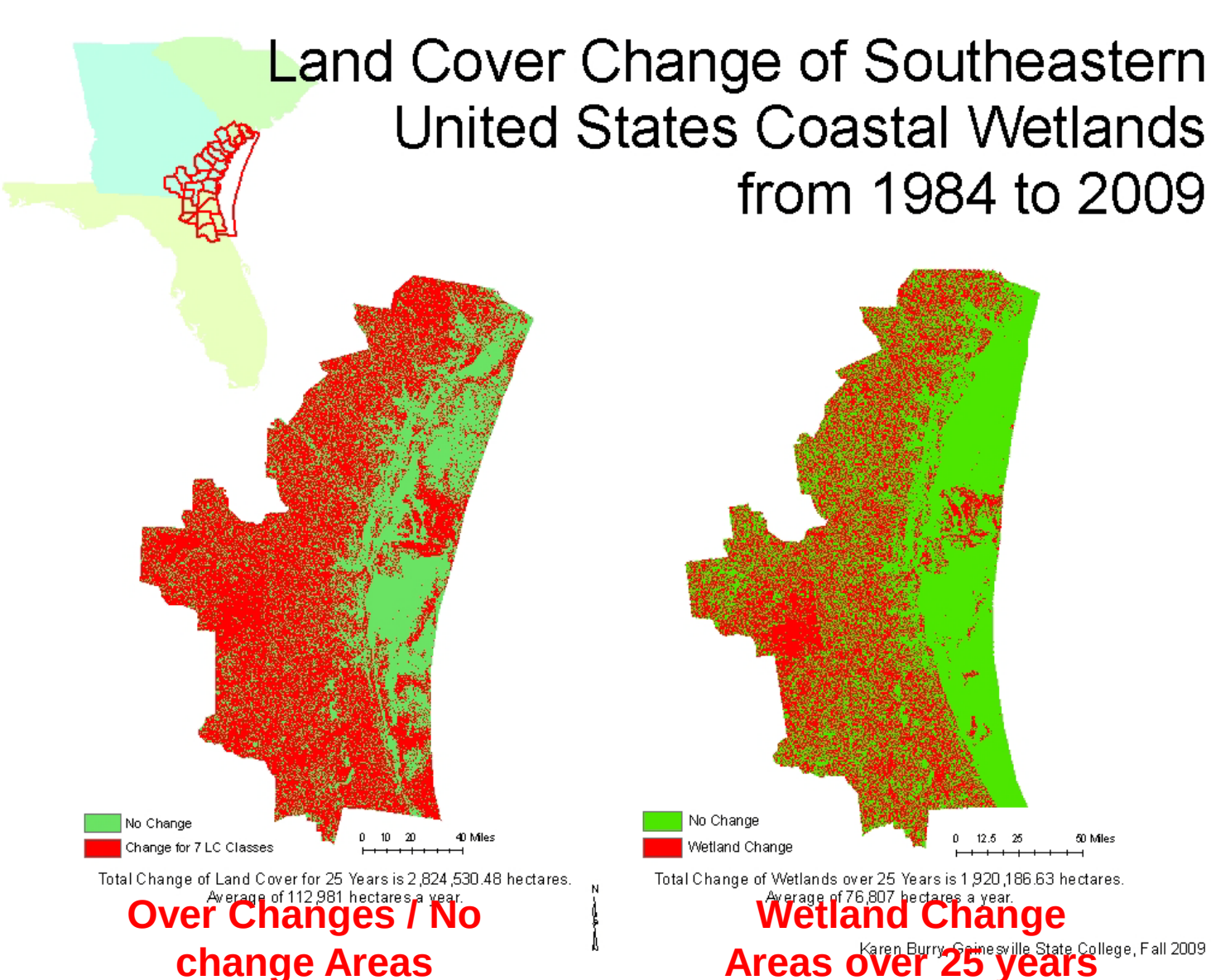
Results and Discussions

(Land Cover Classified Maps)



Results and Discussions

(Coastal Wetlands Change Analysis Maps)



Over Changes / No change Areas

Wetland Change Areas over 25 years

Results and Discussions

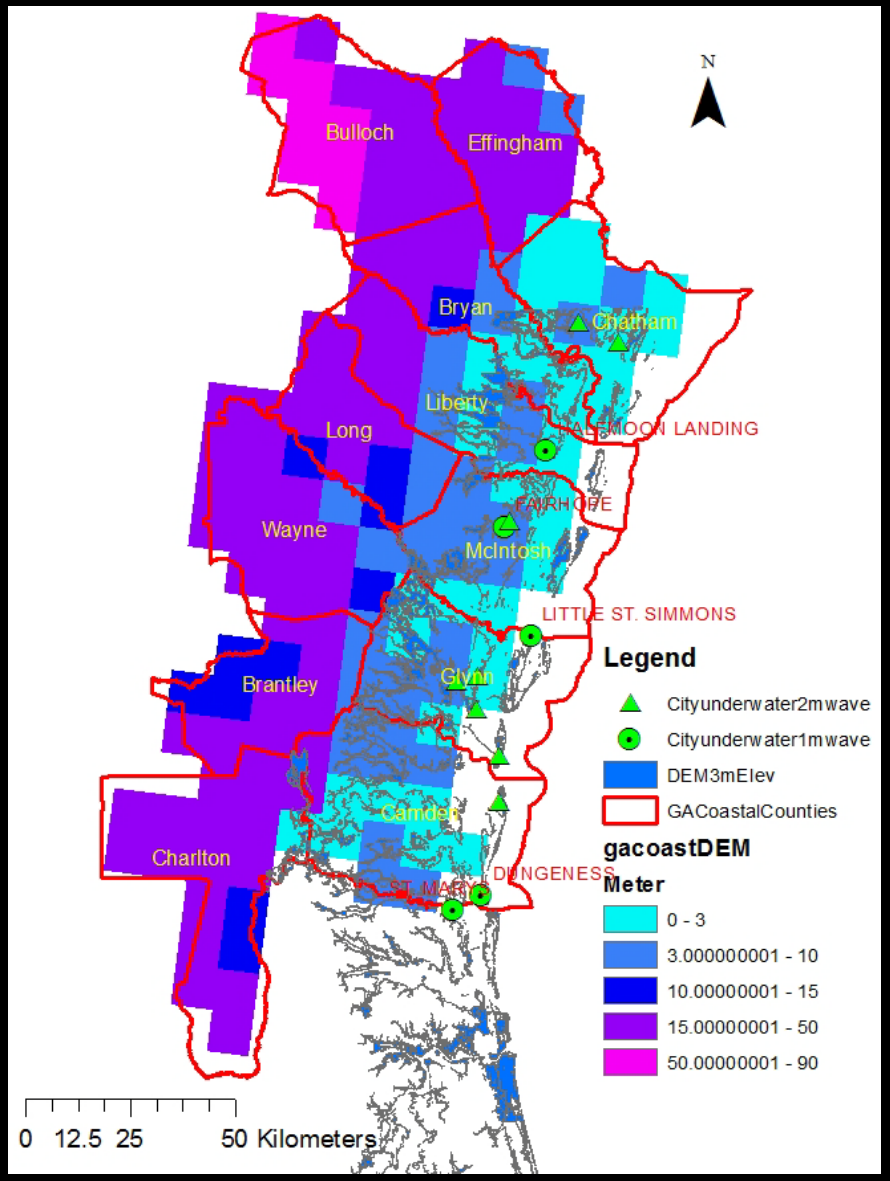
(Coastal Wetlands Change Analysis Maps)

- more than 59% of the study area gone with land cover changes over the 25 years.
- The total study area was of 4,761,161.28 ha and total land cover change in 25 years was 2,824,530.48 ha.
- It suggests that average land cover change in the study area was 112,981 ha per year.
- total wetlands change over 25 years was 1,920,186.63 ha with a per year average wetlands change of 76,807 ha.
- The wetland change of 40% over 25 years for the 23 counties in the southeast coast of USA is in alarming condition.

Results and Discussions

(Coastal Inundation due to Sea Level Rise)

- The wetland depletion in coastal areas are increasing the chances of severe land fall of large hurricanes.
- 11.7%, 14.7%, and 32.52% of Georgia coastal counties will be under water with a 3, 5, and 10 meter high tides.
- Little St. Simons, St. Mary's and Dungeness cities in coastal Georgia would be completely flooded by a 1 - 3 meter waves.



Conclusions

- There was a 60% net change in the study area that comprised of 23 coastal counties in southeast USA.
- It was observed that most changes happened to wetlands land cover (40%) because these wetlands were converted to either urban sprawl or the wetlands changed to open water due to loss of forest cover.
- Due to the dpletion of wetlands in the southeast USA coastal areas we are observing heavy land falls of severe hurricanes.

Conclusions

- The geospatial study performed to know the affects of flooding due to sea level rise and hurricanes, 11.7%, 14.7%, and 32.52% of Georgia coastal counties will be under water with a 3, 5, and 10 meter high tides, respectively.
- Without precautionary measures, Little St. Simons, St. Mary's and Dungeness cities in coastal Georgia would be completely flooded by a 1 - 3 meter wave.
- Therefore, it is important to preserve the coastal wetlands.
- Wetland depletion is also consequence of soil erosion and hence reduction in erosion is essential.

Thank You