USE OF GIS IS ASSESSING THE POTENTIAL IMPACT OF HURRICANE FREQUENCY SCENARIOS RELATING TO CLIMATE CHANGE

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ABSTRACT

The Gulf of Mexico has been hit several times by hurricanes. Models show that the frequency of hurricanes in this region will increase with future global warming. The aim of this study was to utilize the Geographic Information Systems (GIS), statistical methods and remote sensing (RS) in examining the destruction and resilience of green infrastructure in an urban setting to analyze potential damage and mitigation of the vagaries of climate change. The study area is in the Gulfport City, Mississippi urban area. The methodology of the study was an examination of land cover changes relating tree cover in one major hurricane event. The study analyzed green infrastructure destruction scenarios while considering the hydrological impact. This study is a practical application of urban forestry and green infrastructure planning. Data was acquired from aerial photography, topographic maps, and satellite images. This study aims to emphasize the importance of GIS and remote sensing data in urban planning and determination of green infrastructure scenarios. High-resolution aerial photos were used for analysis of environmental scenarios. The study aimed to highlight the challenges faced by regional land cover because of resulting intensification due to climate change. Urban sprawl is a hot issue in regions where the impact of climate change will be felt in the future. An unplanned rural urban interface has to be mitigated with well-planned green infrastructure. This study aims to show that with tangible procedures for landscape planning, it is plausible to plan well to check landuse fragmentation.

STUDY AREA & DATA

In this research, forested regions that covered parts of Harrison County, Mississippi, U.S.A were studied. Harrison County is a county located in the U.S. state of Mississippi. As of the 2010 census, the population was 187,105, making it the second-most populous county in Mississippi. Its county seats are Biloxi and Gulfport. The study area was affected by Hurricane Katrina in 2005. For the study, the landcover satellite imagery for pre-Katrina years 1996, 2001 and post Katrina years 2006 and 2010 were examined for changes following the hurricanes.

METHODS

Satellite images were obtained from National Oceanic and Atmospheric Administration (NOAA) Digital Coast and Tornado data from the Severe Weather GIS (SVRGIS) - Storm Prediction Center websites. These were uploaded into ESRI ArcMap software and the layers overlaid over a current base map. The images were then compared to assess land cover change in the study area for pre and post- Katrina landcover changes through land cover change analysis, and image classification of land cover types. The classes examined were area vegetation.

RESULTS AND DISCUSSION

Figures 1 and 2 illustrate the variation of area of vegetation with respect to years

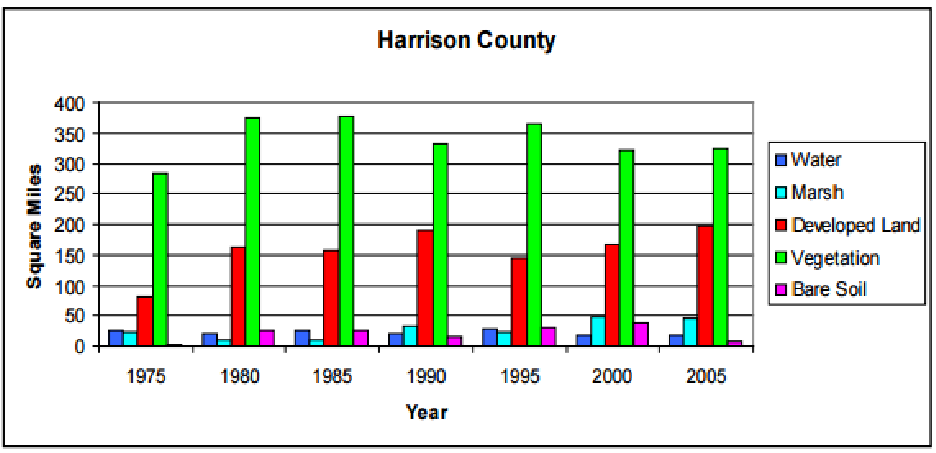

Fig 1. The variation of area of vegetation with years

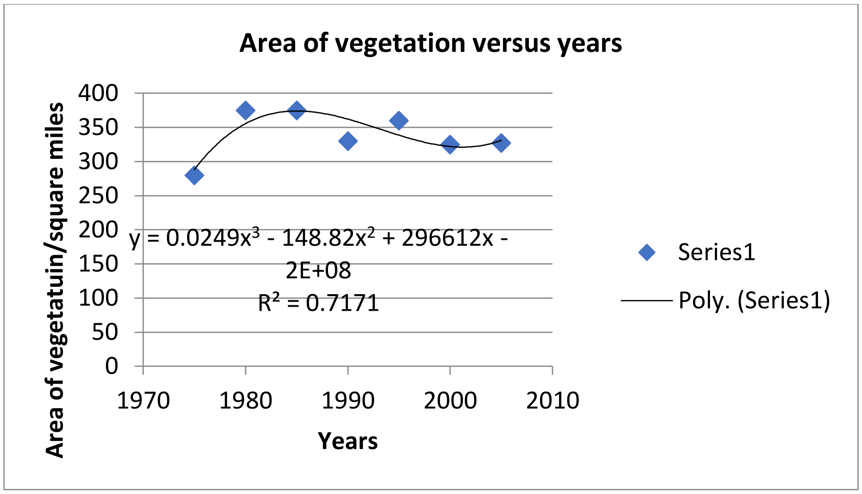

Figure 2 Area of vegetation with respect to years

The cubic model represents about 72% of the variation of the area of vegetation with the number of years. These changes are due to vegetation destruction related impact of hurricane events. Figure 3 illustrates the variation of the area of developed land with respect to years.

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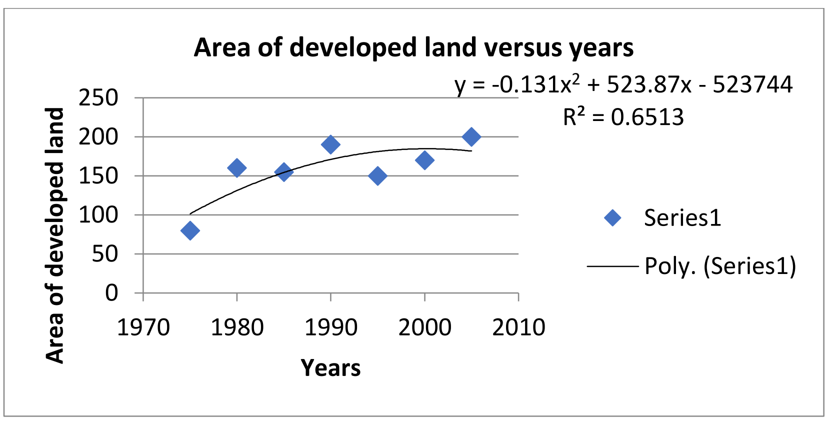

Figure 3. Area of developed land with years

The quadratic model in figure 3. Represents about 65% of the variation between developed land and years.

Figure 4 illustrates the variation of area of marsh with years.

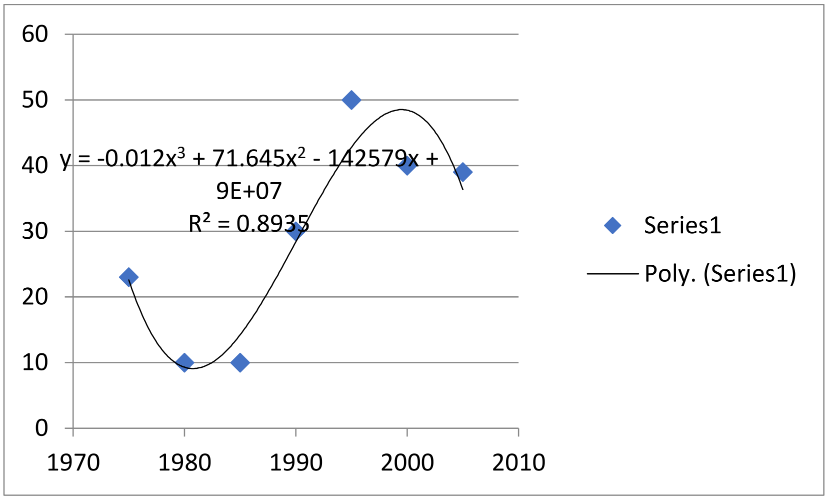

Figure 4 Variation of area of marsh with respect to years

According to the cubic model for the variation between the areas of marsh with respect to years, the area dropped 1970 and 1980. It then rose from 1980 to the year 2000 and then dropped to approximately 40 square miles in 2010.

Figure 5 illustrates the variation of area of surface water with respect to years.

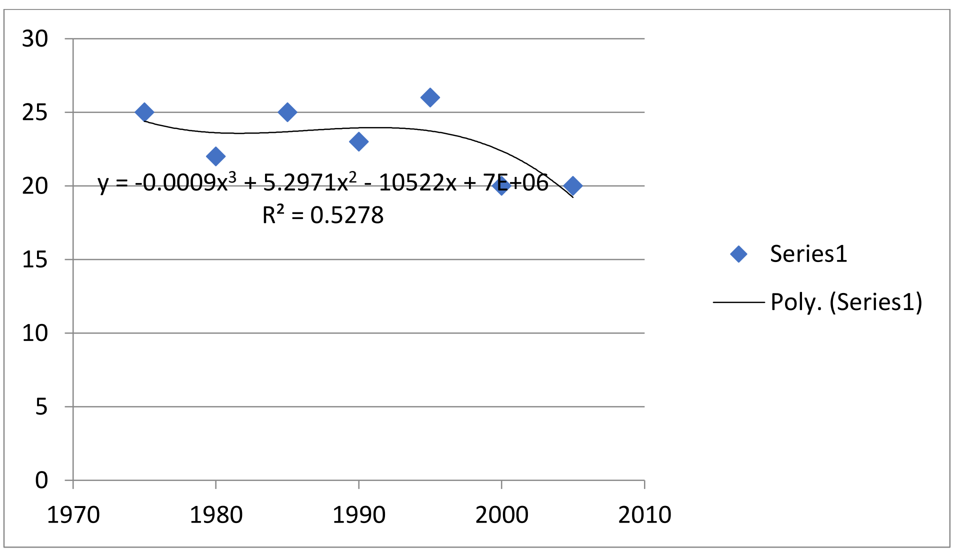

Figure 5 Area of surface water with respect to years

The cubic model representing the variation of the area of surface water with respect to years represents 52% of the actual variation.

Figure 6 illustrates the overlay of 1996 over 2016

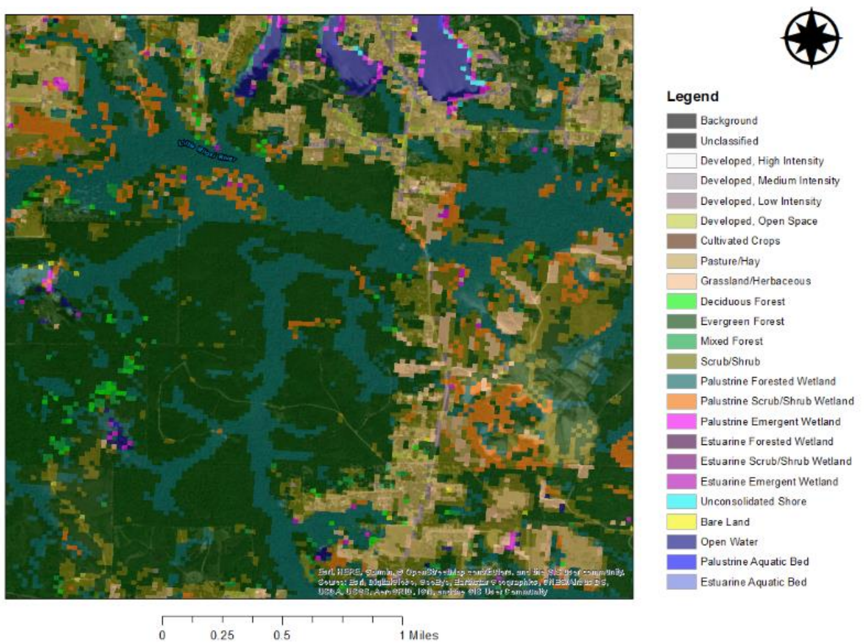

Figure 6 Overlay of 1996 over 2016 land covers

Figure 7 illustrates Pre Katrina land cover for Harrison County

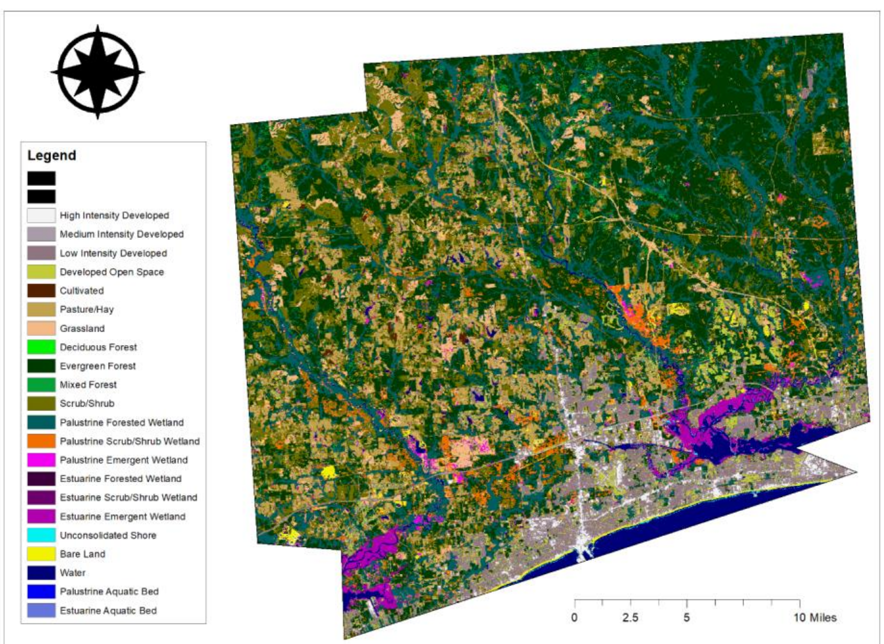

Figure 7 Pre Katrina land cover for Harrison County

Figure 6 depicts the original and pre-Katrina image close inspection of pre-and post Katrina Images show an impacted pattern in the "forest" areas of the county, which may be related to tree damage Field study indicated only minor wind damage during Katrina.

Figure 8 illustrates the overlay of 2006 over 2016 land covers

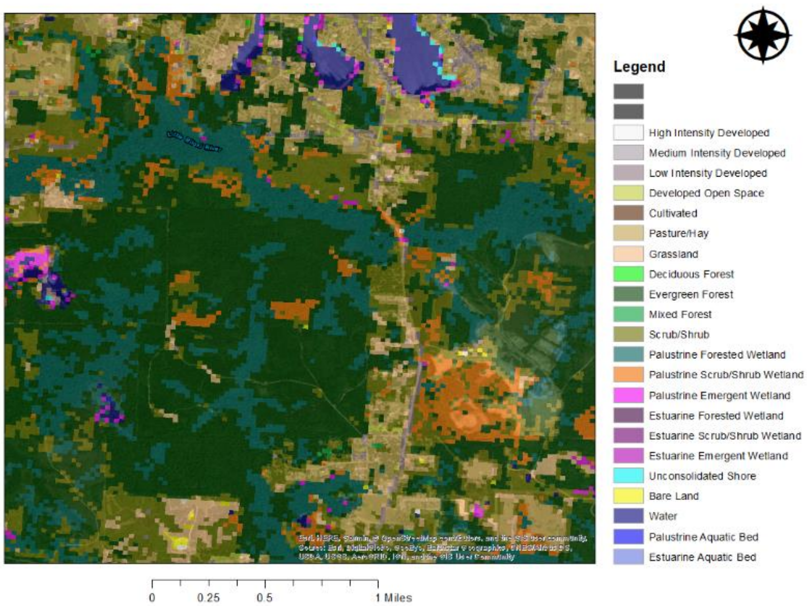

Fig 8.The overlay of 2006 over 2016 land covers

Land cover changes between the two images are presented in in the above images (Fig 8). "Marsh" had the largest relative percent decrease in acreage; the other category that experienced decline was "developed" areas (meaning urban or built-up areas). The "vegetation" land cover, on the other hand, had a relative percent increase. "Water" and "agriculture and others" also had a slight gain. Table 1 illustrates land cover change between 2004 and 2006.

2004\2006	Water	Forest	Ag & Others	developed	Brackish Marsh	Fresh Marsh	Swamp
water	2,349,755 (92.9)	60,474 (2.4)	52,882 (2.1)	8,189 (0.3)	24,002 (1.0)	7,051 (0.3)	26,165 (1.0)
forest	102,127 (1.6)	4,258,194 (65.1)	1,174,554 (18.0)	57,910 (0.9)	223,791 (3.4)	14,558 (0.2)	713,722 (10.9)
ag & others	38,169 (0.6)	1,280,544 (19.6)	4,692,301 (71.8)	216,891 (3.3)	89,652 (1.4)	13,433 (0.2)	201,711 (3.1)
developed	27,705 (4.6)	110,068 (18.4)	364,380 (61.0)	67,999 (11.4)	11,593 (1.9)	1,509 (0.3)	14,138 (2.4)
Brackish marsh	27,314 (3.7)	348,370 (47.7)	52,998 (7.3)	4,674 (0.6)	155,206 (21.2)	12,639 (1.7)	129,806 (17.8)
Fresh marsh	4,515 (2.3)	79,801 (40.4)	33,427 (16.9)	1,813 (0.9)	12,401 (6.3)	19,874 (10.1)	45,906 (23.2)
swamp	57,452 (3.4)	860,406 (50.6)	188,244 (11.1)	20,299 (1.2)	142,597 (8.4)	26,329 (1.6)	403,827 (23.8)

Table 1: Land cover change between 2004 and 2006. Percentage values relative to 2004 (row total) are shown in parentheses (Lam et al., 2011).

Table 1 shows how land cover changed from one category to another. Increases in "marsh" mostly came from "fresh" and "brackish marshes", and probably reflected regrowth of trees that had been damaged and defoliated during hurricanes. All showed decreased total cover most likely reflecting regrowth of trees damaged and defoliated during hurricanes. These changes indicate substantial forest tree regrowth in marshes and swamp forests after wind damage by hurricanes. Because these habitats are fire-suppressed, invasion of hardwoods may have occurred similarly to that shown by Shirley and Battaglia (2008). Invasion may have been temporarily set-back by other hurricane

Increase in “water” area occurred mainly in the uplands. This increase could be less a result of bay erosion due to hurricanes than human activities (e.g., impoundment, pond construction). Similarly, there were large shifts among human influenced categories that reflect changes in land use. Overall, compared to changes in parts of the study area by human activities, the land cover changes around the bay area associated with wind damage in Ivan and subsequent regrowth seem rather insignificant.

Obviously there are limitations of this study, and caution is needed for interpretation. First of all, lack of availability of comparable images for this study area over time is a problem. Ideally, images obtained for the same season pre- and post- a hurricane would be most useful. Some of the changes may well be due to the seasonal changes between the two images. Secondly, although the classification accuracy of the images is considered acceptable, there are misclassifications that might affect our interpretations.

Bibliography

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