Hurricane Impact and Hazard Mapping

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Abstract

This project is meant to address the areas being affected by the increasing number of hurricanes over the past few years. Through the mapping of the tracks of the hurricanes of the 2005 season I could attempt to identify which areas are most at risk. This was possible through the application of a buffer both on the storm track as well as the cities, providing an idea of the areas which would suffer the greatest impact. This in correlation with the population of the cities would allow me to determine the degree of effect felt by each storm, thus providing a This information is important to know, because insurance companies and banks have began to do similar work in determining insurance rates for particular areas.

Introduction

This has been affecting property insurance rates in certain areas and I am interested in finding out why. Through the mapping of the hurricane tracks and application of buffer analysis I want to identify which areas are seeing the most effect of the increased hurricane activity and what sorts of population numbers are being affected.
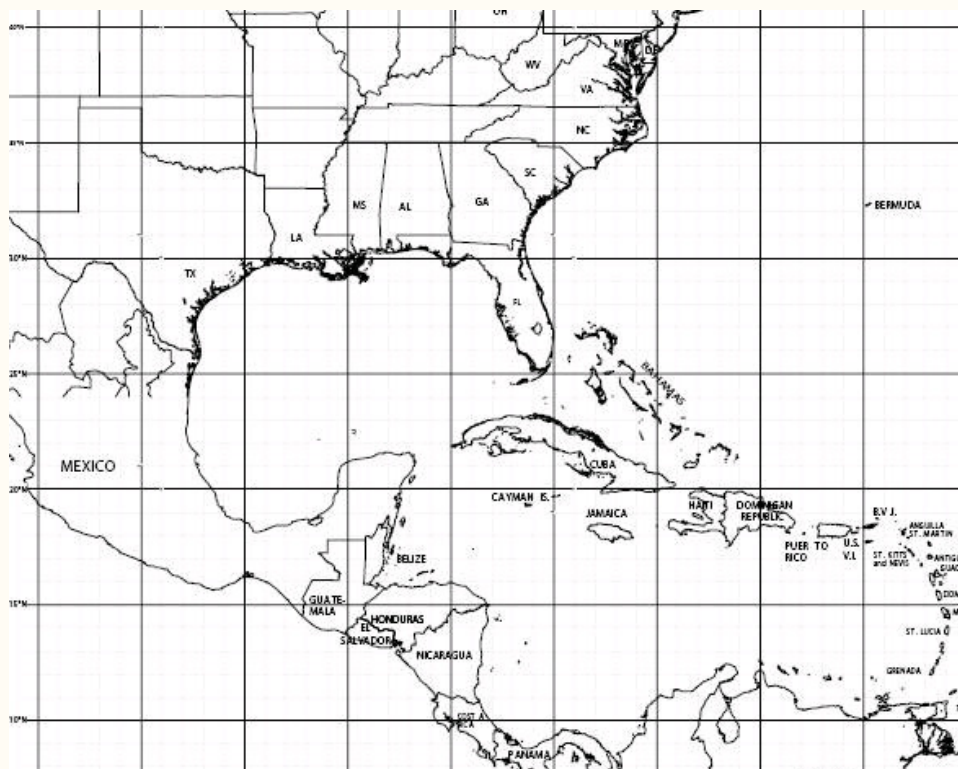
This map illustrates the area addressed during this project.

Data Source

The data required for this project included a base layer map of the affected areas which was obtained from the ESRI Data located on the Ninkasi server at UNBC. Next the point layer of the cities was obtained from Scott, which included the cities within the United States as well as those in the surrounding gulf. Both of these data sets provided the map over which the hurricane layers would be applied. The actual hurricane data came from the website: http://weather.unisys.com/hurricane/atlantic/2005. This data came in the form of a time series with the Latitude and Longitude coordinates of the storm at each point. Based on this data I was able to plot the track of each of the hurricanes of the 2005 season.

Data Manipulation

Both of my base map datasets were already provided in shape files, so the manipulation required on them was minimal. I did however have to convert the projection into latitude and longitude so that there would be no spatial distortion when I plotted my tracks based on coordinates.

The time series of coordinates for the location of the storm however did require some work. First the data had to be organized into a text file which could be read and interpreted into a polyline within ArcMap. This meant following the procedure outlined in lab 8 of the geography 300 lab manual at http://www.gis.unbc.ca. Once the lines were created I converted this into a shapefile. I then added a field called name which allowed me to name each hurricane and then categorize them accordingly.

Spatial Analysis Methods

Once I had tracked the paths of the 2005 hurricanes I had to analyze the areas impacted by these storms. Based on data from the Ocean and Atmospheric Administration hurricane guide I applied buffers to the tracks of the storms I had plotted. These buffers were 150 miles in size which approximate the area which would experience hurricane force winds when the track was followed. I then applied another set of buffers to each of the cities representing the area of the city. I then linked the buffers which were crossed by the tracks of the storms, and mathematically determined the area of each city impacted by each hurricane. These buffers were then intersected to determine the extent of damage and to estimate a population size affected. This process had a few assumptions, such as the idea that topography had no effect on the area affected as well as that the population of each city was evenly distributed over the buffer zone. Despite these assumptions I believe this process gives a unique perception of the number of people affected by these storms, as well as how certain areas have been hit repeatedly.
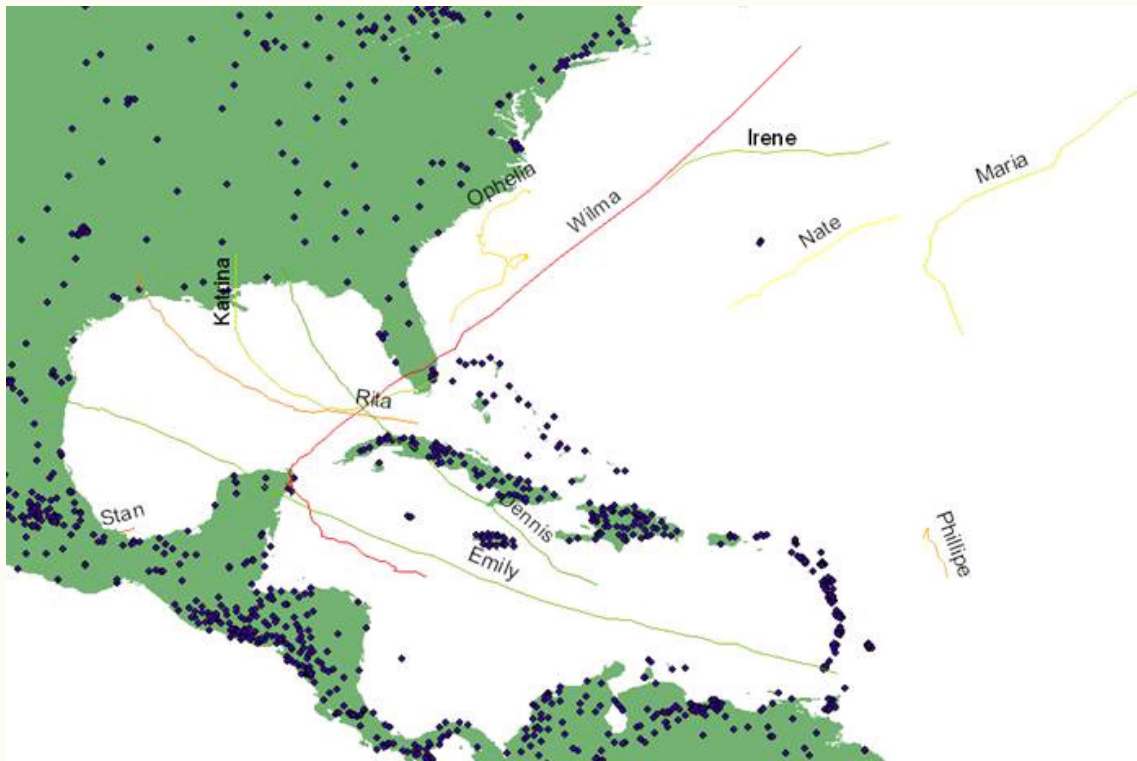
The chart above outlines the paths of the 2005 hurricanes. The buffer was applied to these paths to determine which cities fell into the selected area.

Analysis Results

After the buffers were applied the map appeared as below, the area of each city being increased to the buffer dimension of 20km diameter. Each hurricane was assumed to have a 300mile wide path of destruction. The image below shows the highlighted path of hurricane Katrina, and the associated cites that were affected.
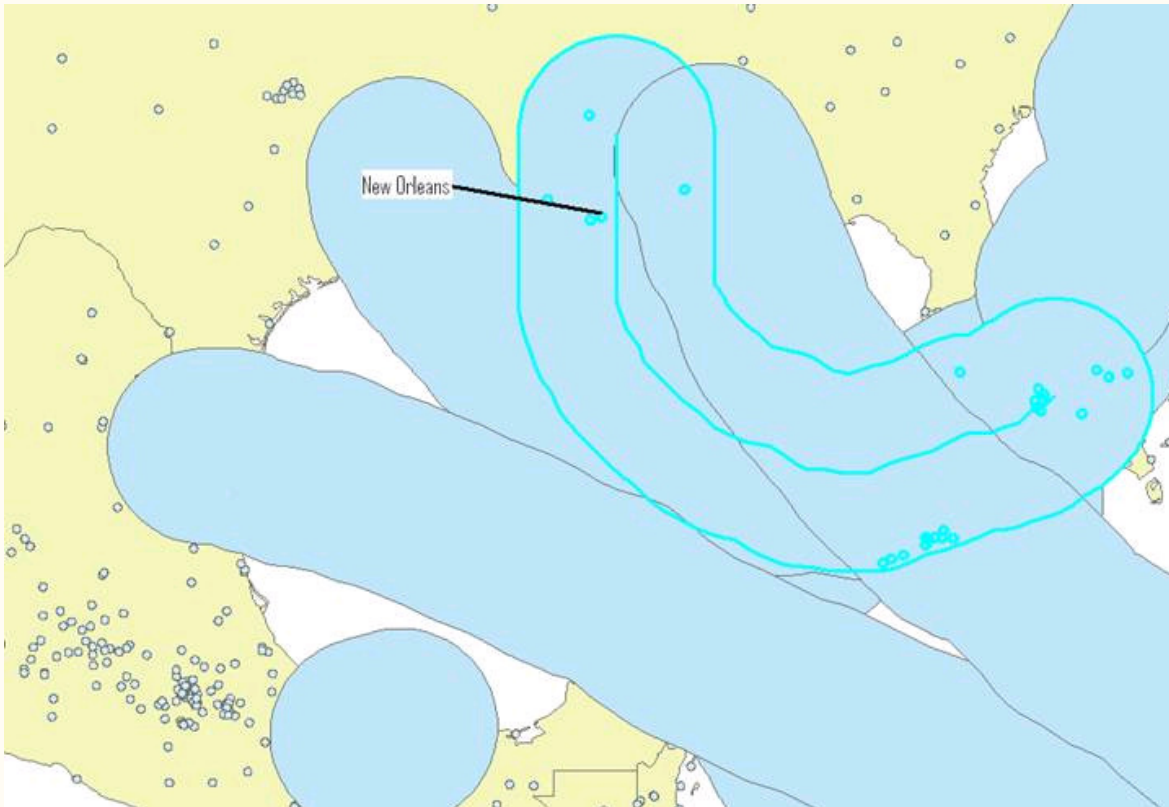
Hurricane	Cities Impacted	Population	Total Population Affected By Each Event
Beta	St. Petersburg	267747	
	Cape Coral	110327	
	Hollywood	150313	
	Miami	390996	
	Ft Lauderdale	164378	1083761
Dennis	Montgomery	118652	
	Mobile	201211	319863
Emily	Macallen	113751	113751
Irene	NONE	0	0
Katrina	Baton Rouge	227348	
	Jackson	186832	
	Metairie	145835	
	New Orleans	483675	
	Mobile	201211	1244901
Maria	NONE	0	0
Nate	NONE	0	0
Ophelia	Virginia Beach	445110	
	Chesapeake	208483	
	Fayetteville	127255	
	Charleston	100353	
	Orlando	200570	1081771

Cities Impacted More Than Once	Population
Saint Petersburg	267747
Cape Coral	110327
Hollywood	150313
Miami	390996
Fort Lauderdale	164378
Mobile	201211
TOTAL	1284972

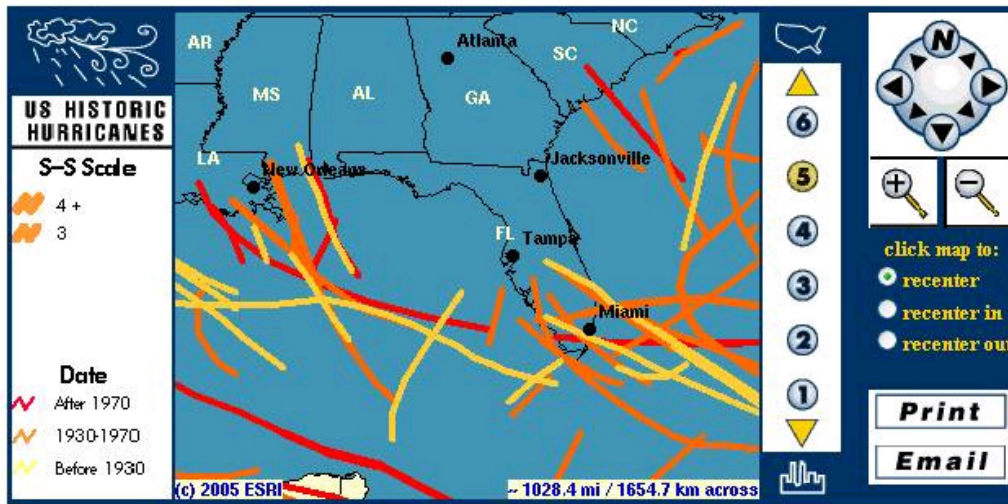| Rita	Shreveport	199732			
	Houston	2088320			
	Pasadena	151441			
	Beaumont	121716			
	Lafayette	110030	2671239		
Stan	NONE	0	0		
Vince	NONE	0	0		
Wilma	St Petersburg	267747			
	Cape Coral	110327			
	Coral Springs	126790			
	Fort Lauderdale	164378			
	Hollywood	150313			
	Pembroke Pines	148231			
	Miami	390996		Grand	
	Hialeah	244219	1603001	Total	8118287

The Above chart outlines all the American Cities that were impacted. It also outlines the cities which were impacted by hurricanes more than once this season, and the total number of people impacted by more than one hurricane. According to this map and population data, 16% of those people affected by a hurricane this year, were impacted more than once.

Conclusions

In conclusion, this sort of map can easily identify and calculate those areas impacted by hurricanes for a given year. Based on this data, we can begin to understand why insurance companies are taking such interest in this sort of analysis. With this information, areas of extremely high risk can quickly be identified and these companies can modify their rates accordingly. The accuracy of this map is all dependant on the data with which it is created. For example if the category of the hurricane could be plotted with its track, and the buffer around it changed with the category, that would provide a very detailed path of influence for each storm. Also if population data was more spatially accurate, there would be no need to apply a buffer to the area of each city, as each area would have an associated population number which could be used. The use of this type of mapping only increases as the accuracy increases, as it could be used for any number of spatial queries such as those required in times of evacuation or rescue, the number of people being searched for could be easily determined.

Future Work

As previously mentioned the current stage of this work is the implementation by insuring companies and banks concerned with mortgage dependability. Within this project I focused on hurricanes and their impact. This same application of GIS however could be continued with areas of flood risk or even land sliding susceptibility. In the future such maps and information might be made available to everyone looking at buying a property, so they could first be made aware of the risks before purchasing. It could also be used by the emergency response crews to more accurately predict the damage within areas so efforts can be coordinated.

References

- http://www.nhc.noaa.gov/books The National Hurricane Center
- http://weather.unisys.com/hurricane/atlantic/2005 Unisys Weather - 2005 Tropical Data
- http://www.esri.com/hazards/makemap.html ESRI/FEMA Hazard Mapping Site
- http://hurricanes.noaa.gov/pdf/hurricanebook.pdf#search='hurricane%20category%20dimensions' National Ocean and Atmospheric Administration – hurricane guide

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