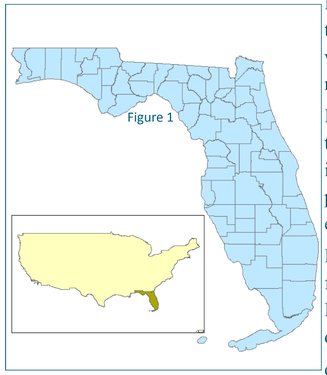
Investigating the Relationship between Predicted Storm Surge and Actual Storm Surge and the Spatial Distribution of Mobile Home Parks Throughout Florida

Background

Storm surge is the water level rise due to the increased rain and wind created by a storm. It does not include the rise in water level that occurs due to normal astronomical tide. Areas such as Florida have developed storm surge maps to help predict the areas that could be affected by a storm. In many cases, storm surges are one of the most dangerous parts of a storm like a hurricane. Though the winds and rain can cause problems of their own, storm surges can cause the worst flooding and often lead either directly or indirectly to fatalities.

Storm surge maps are used to create emergency procedures. They are used to develop evacuation zones, plan evacuation routes, determine the cost of flood insurance, and more. Because storm surge maps are so important, I wanted to see how accurate the storm surge prediction maps developed by NOAA are.



I compared storm surge data from individual storms to the predicted storm surge to see if the predicted storm surge was accurate. I am interested in the areas where storm surge is not accurately anticipated because of the cost of such a mistake.

In areas where storm surge is a problem, insurance can be very high. I assumed that because insurance would be high nearer to the coast, the median household income would be higher along the coast, there would be fewer mobile home parks near the coast, and unemployment would be lower near the coast. I wanted to examine the spatial relationship of these aspects to the storm surge zones.

In addition, because storm surges can be so destructive, I assumed that major infrastructure and critical structures would be located further away from the coast. I wanted to explore the distribution of these throughout Florida in order to understand if storm surge effects planning decisions.

question problem further.

Figure 1 shows the location of my project. I focused my project on Florida because it is often in the news for high storm surges during hurricanes and tropical storms. It is affected by hurricanes that travel through both the Atlantic Ocean and Gulf of Mexico so it thought it would be and interesting location to study.

Methods

In order to get the predicted storm surge maps for different categories of hurricanes, I had to georeference images and then digitize the storm surge levels.

Once the storm surge data for the hurricanes was loaded in ArcGIS, I clipped the layers so that it only showed the storm surge on land. The layers include the storm surges that occurred just in the ocean but I did not need that information for my project. I used the new, clipped layers for the rest of my analysis and got rid of the original layer.

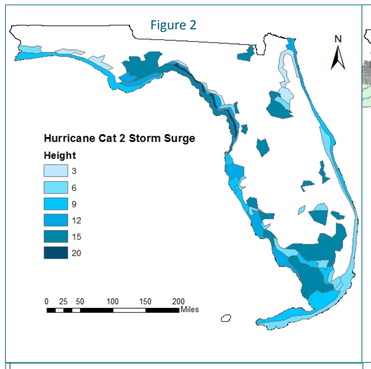
I first wanted to look at the areas where storm surges occurred in individual hurricanes that were not predicted on the predicted storm surge maps. I used the erase tool in ArcGIS to erase the portions of the individual storm layers that overlapped with the prediction layer.

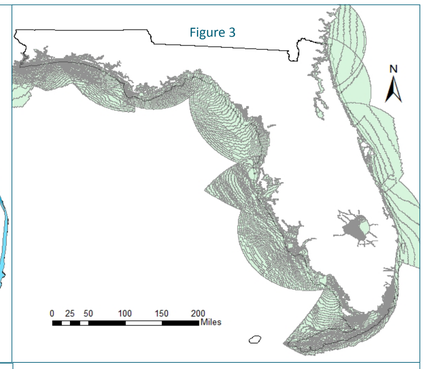
There was not a large area where the storm surge prediction maps failed to predict where a storm surge would occur so I decided to look at where the individual storms had higher storm surges than the predicted storm surge. I created new layers by using a map overlay function. I used the union tool to create a layer using each storm and its relevant hurricane category prediction. I then queried to find all the areas where the hurricane's storm surge was higher than the storm surge for that particular category of hurricane and created a new layer. This new layer included the areas where there was no predicted storm surge as well as the areas where there was a predicted storm surge but it was lower than hurricane's surge. For Tropical Storm Debby, I compared the storm surge to a Category 1 prediction.

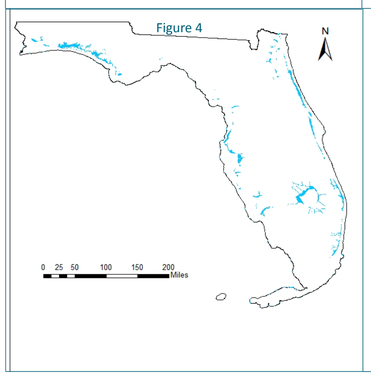
Once I looked at the areas where NOAA failed to accurately predict the storm surge, I wanted to look at some of the patterns in socioeconomic distribution in the areas of Florida where high storm surges are predicted. I thought a good indicator of poverty would be the amount of mobile home parks. I compared how many mobile home parks are located within storm surge zones to how many are located outside of storm surge zone by using a query by location.

I created a raster image of the density of mobile home parks in Florida using the point density spatial analysis tool in ArcGIS.

Results







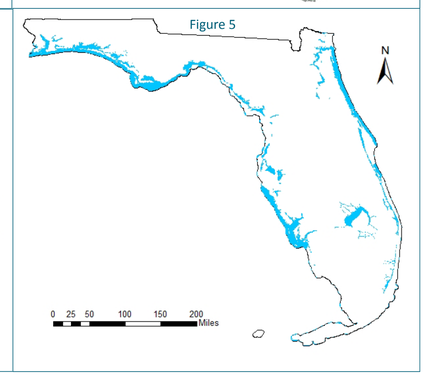
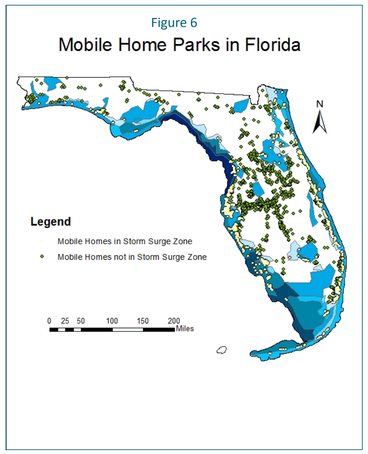


Figure 2 shows the predicted storm surge for a category 2 hurricane.

Figure 3 shows the storm surge from Hurricane Isaac, a category 2 hurricane.

Figure 4 shows the areas of Florida where the storm surge for Hurricane Isaac was larger than the predicted storm surge.

Figure 5 shows the areas of Florida for all of the analyzed storms where the storm surge was higher than the predicted storm surge.



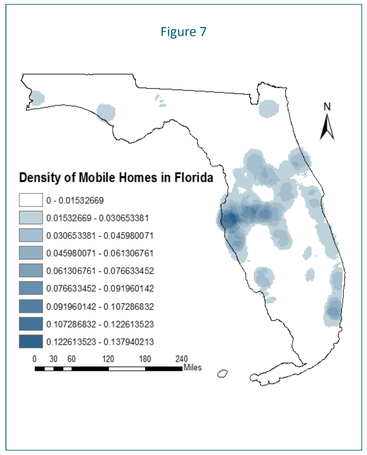


Figure 6 shows the location of mobile home parks throughout Florida.

Figure 7 shows the density of Mobile homes in Florida per half square mile.

Conclusions

The storm surge maps that NOAA developed are generally very effective in predicting storm surge height for various categories of hurricanes along the coast of Florida. The predicted storm surges cover 38 percent of Florida. Based on an analysis of four storms, the storm surge predictions were lower than the actual storm surge over only 4 percent of Florida. This results in an area of only 2,544 square miles.

Whenever Florida is hit by a tropical storm or hurricane, the mobile homes within the evacuation zones are forced to evacuate even if some of the permanent homes in the area are not. As a result, I expected there to be fewer mobile homes within storm surge zones than outside of them. The following table shows the amount of mobile home parks in Florida within and outside of storm surge zones.

Location of Mobile Home	Count
Inside Storm Surge Zones	1018
Outside Storm Surge Zones	1351
Total	2369

The storm surge areas cover only about 38% of Florida but approximately 44% of the mobile home parks in Florida are located within the storm surge zones. This means that per square mile, there are more mobile trailer parks located within storm surge zones than outside of storm surge zones.

Looking at the density of mobile homes in Florida, you can see that a large majority of mobile homes are located along the western and eastern coast of central Florida with a higher concentration on the western coast. This is interesting because looking at the storm surge map in Figure 2, you can see that the western coast generally has higher storm surges that reach further inland.

Sources

U.S. Census. (2011). Retrieved from http://www.census.gov/#

Florida Department of Emergency Management. (2012, December). Retrieved from Florida Disaster: http://www.floridadisaster.org/index.asp

Florida Department of Envionmental Protection. (2012, December). Retrieved from http://www.dep.state.fl.us/

National Oceanic and Atmospheric Administration. (2012, December). Retrieved from Nation Hurricane Center: http://www.nhc.noaa.gov/surge/

University of Florida. (2012, December). Retrieved from Geoplan Center: http://www.geoplan.ufl.edu/

Brittney Veeck

CEE-187

December 17, 2012

Map Projection: NAD 1983