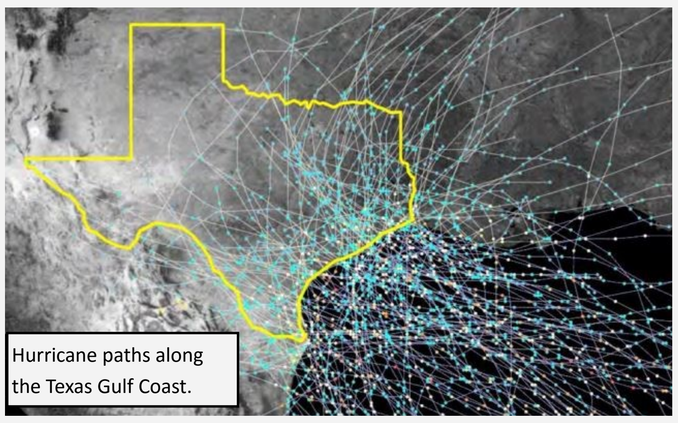
Sea Level Rise and Social Vulnerability

The effect of sea level rise on coastal communities in Galveston County

Kayla Leal
2015 NSF* REU Summer Institute

Study Area and Background

Galveston County is located on the northern Gulf coast of Texas. The image below displays hurricane paths which have hit the area between 1851 and 2005. About every 5 years, any 50-mile segment of the region is hit by a hurricane, with a major hurricane every 15 years. Sea levels are also expected to rise with climate change which will ultimately affect the impact hurricanes can have on the area. Socially vulnerable populations have a greater risk of damage considering they have limited resources, whether monetary or physical, to be able to expect and deal with a natural hazard in an efficient way.


Hurricane paths along the Texas Gulf Coast.

Planning for Community Resilience (Masterson et al. 2014) describes social vulnerability as how social factors influence the ability of communities and their populations (individuals and households) to anticipate, respond, resist, and recover from disasters. When a natural disaster takes place, in this case a hurricane, these socially vulnerable populations have a different experience than others. They typically do not have the resources to prepare for the hurricane by gathering supplies or evacuating, and also do not have the means to repair as quickly as others after the storm. With climate change and rising sea levels there is potential to increase social vulnerability of Galveston County.

Research Focus and Methods

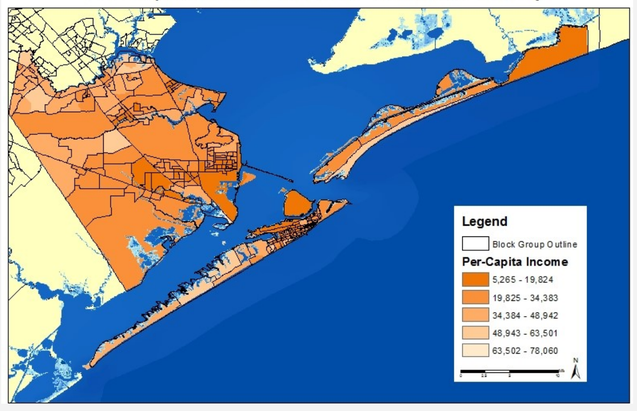
How will rising sea levels affect social vulnerability in Galveston County?

Geographic Information Systems (GIS) was used to conduct spatial analysis of Galveston County. A suitability model was created to display low, moderate, and high levels of social vulnerability. Factors that went into the model were equally weighted.

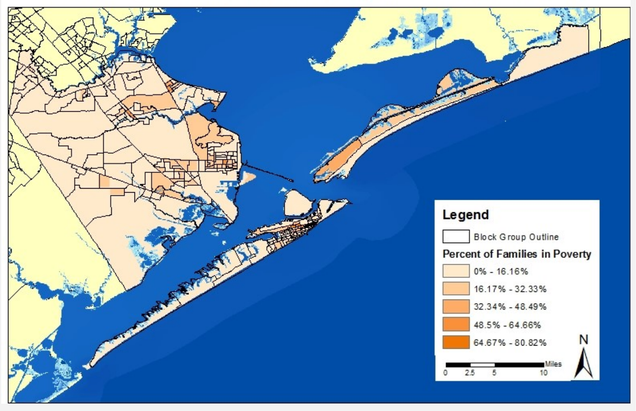
Once the suitability model was made, data collected from the National Oceanic and Atmospheric Administration (NOAA) was used to display a two, four, and six foot rise in sea level.

Suitability Model

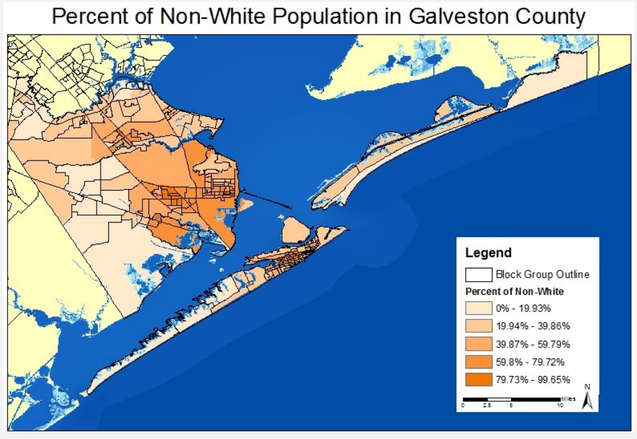
Per-Capita Income Level for Galveston County



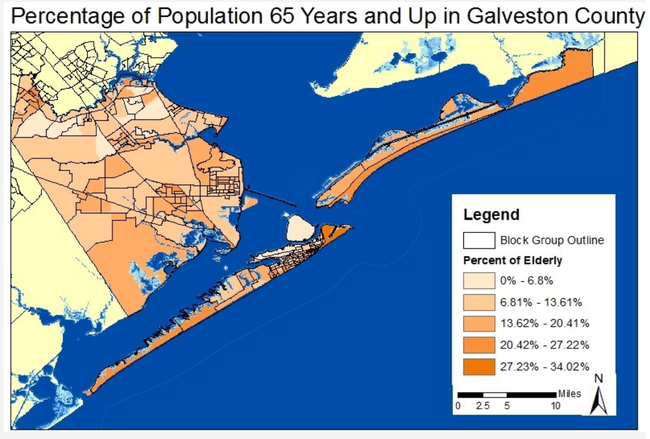
Percentage of Families in Poverty in Galveston County



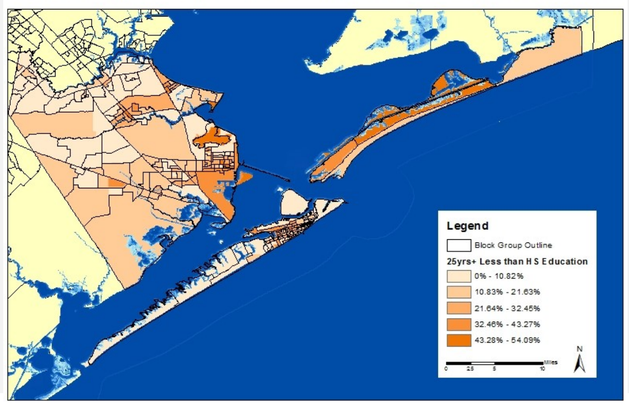
Percent of Non-White Population in Galveston County

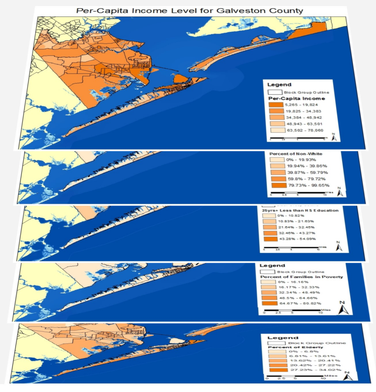


Percentage of Population 65 Years and Up in Galveston County



Percentage of Population 25+ with Less than HS Education

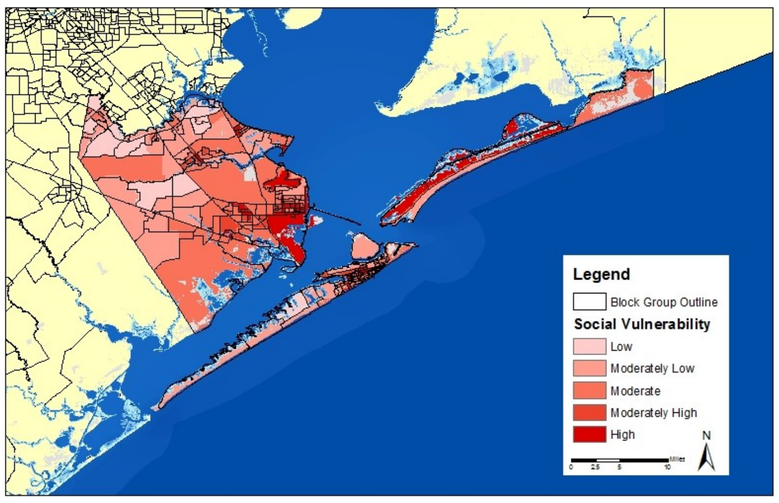




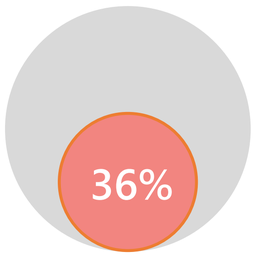
20%
20%
20%
20%
20%

Weighted Sum

Current Levels of Social Vulnerability in Galveston County



Highly Vulnerable Area



Findings and Recommendations

It is found that the population considered highly vulnerable increases about 16% when the sea level rises 2 feet.

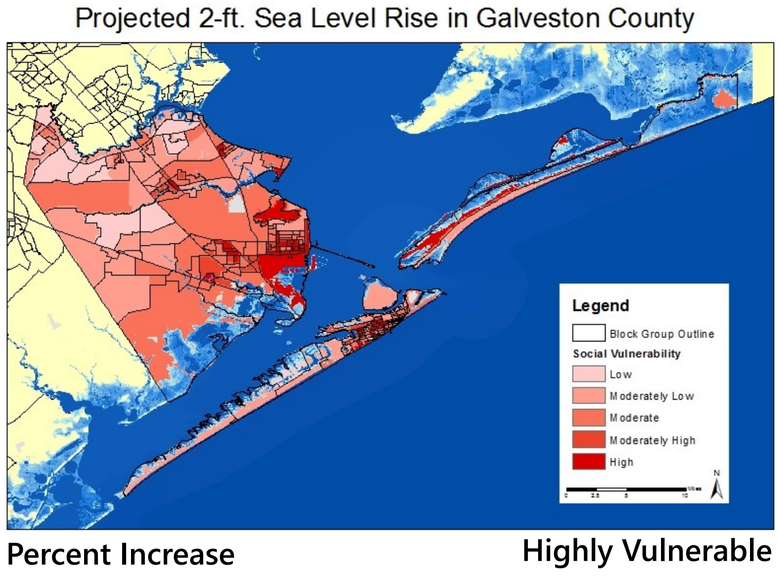
With a 4-foot SLR, highly vulnerable population increases by 6%. This is a 21% increase from the original output map and a 5% increase from a 2-foot SLR.

After a 6-foot rise, the highly vulnerable population increases to 62%. This is almost two-thirds of the population, and a 26% increase from the original output map.

It can be seen that there is an area which was not affected as badly as the rest of the island. This is due to a sea wall that was constructed after the 1900 Hurricane.

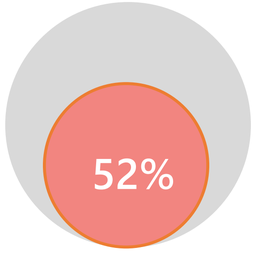
I am recommending that a mitigation of sea-level rise plan be adopted with additional preventative infrastructure design and policy should be placed to withstand future rises in sea levels and the vulnerable areas that will be affected..

Projected 2-ft. Sea Level Rise in Galveston County



Percent Increase
+16% since current

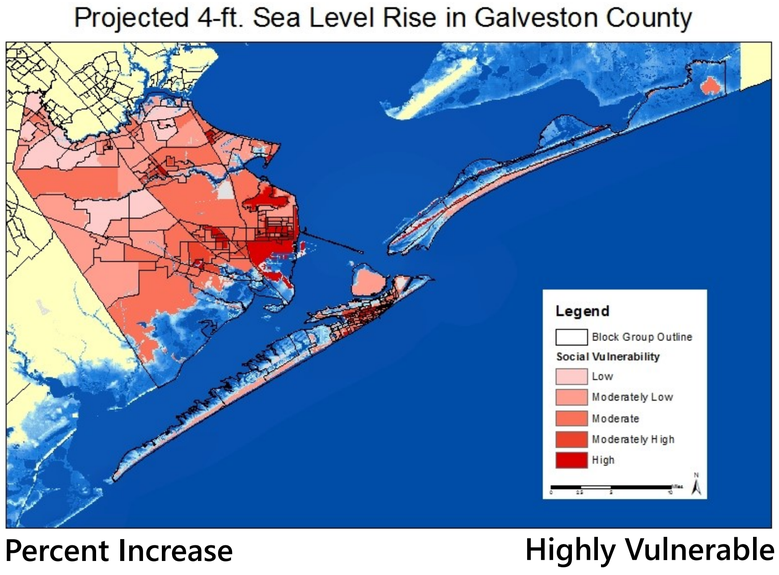
Highly Vulnerable Area



Policy Recommendations:

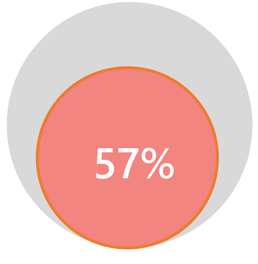
- Adopt and implement a Sea Level Rise Mitigation Plan
- Invest in infrastructure to help mitigate water encroachment

Projected 4-ft. Sea Level Rise in Galveston County



Percent Increase
+21% since current
+5% since 2′

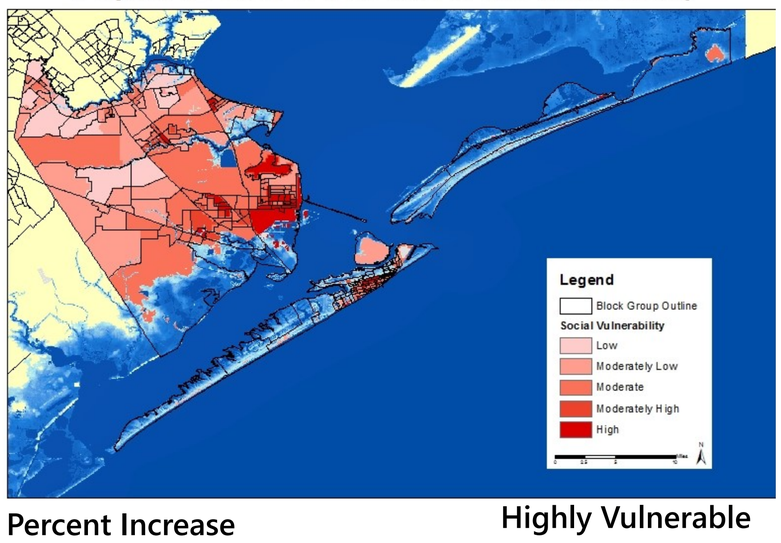
Highly Vulnerable Area



Policy Recommendations:

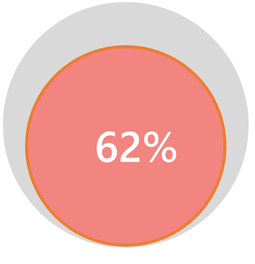
- Require new development to abide by permit conditions consisting of conservative engineering and design
- Strategic land use planning to alleviate highly vulnerable areas

Projected 6-ft. Sea Level Rise in Galveston County



Percent Increase
+26% since current
+5% since 4′

Highly Vulnerable Area



Policy Recommendations:

- Develop design standards to retrofit existing development to withstand rise for as long as possible
- Encourage land use incentives for developing outside of risk zones for residents

Literature Sources:

Masterson, Jamie Hicks, et al. *Planning for Community Resilience*. Washington, DC: Island Press, 2014. Print.

Newman, Galen and Bardenhagen, Eric. The IKE DIKE: Design Strategies for Integrating Surge Protection Infrastructure and Resilient Communities. Institute for Sustainable Coastal Communities, 2014. PDF File.

*NSF funded the REU Summer Institute and does not assume responsibility for these findings.

Data Sources

U.S. Census Bureau

National Oceanic and Atmospheric Administration

American Community Survey,2008-2012

Faculty Advisors: Dr. Galen Newman
Dr. Walter Peacock