Assessing Storm Surge Vulnerability in South Texas Based off of Past Extreme Weather Occurrences in Conjunction with Sea Level Rise

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ABSTRACT

As we move further into the 21st century, Earth's functional processes are experiencing a steady shift, particularly in terms of climate and sea levels. Anthropogenic warming has accelerated the rise of sea levels and increased the frequency, intensity, and rainfall of cyclones and hurricanes. To investigate the impact of rising sea levels on storm surges in vulnerable areas, we utilized remote sensing and GIS technology to come up with an understanding of the influence land cover type has on flood intensity and assess the vulnerability of the Houston area based on storm surges from 2015 - 2022. Our findings underscore the critical need for urgent adaptation and mitigation measures to mitigate the risks associated with changing weather patterns and rising sea levels.

BACKGROUND

Climate change is having a significant impact on the world's ecosystems, with rising sea levels and changing weather patterns affecting regions across the globe. One area that is particularly vulnerable to these changes is the Gulf Coast, which has experienced an increase in the frequency and intensity of hurricanes and tropical storms in recent years. These storms can cause devastating flooding, leading to significant damage to infrastructure and homes, as well as loss of life.

In order to better understand the impact of climate change on storm surges in vulnerable areas such as the Gulf Coast, remote sensing and GIS technology can be used to analyze the influence of land cover on flood intensity. By examining the types of land cover in a given area, such as vegetation, bare ground, and urban areas, researchers can gain insights into how these factors affect the severity and extent of flooding during storms.

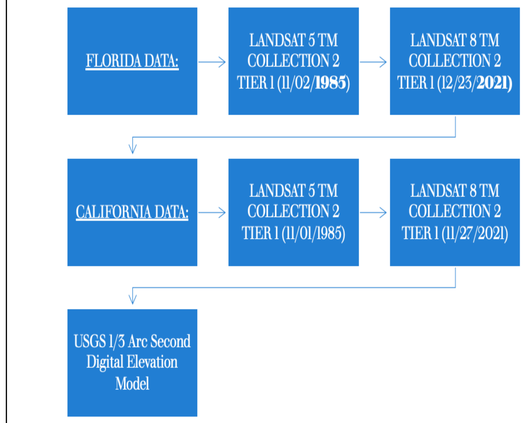
One particular area of focus for this type of research is the Houston area, which has experienced several major storms in recent years, including Hurricane Harvey in 2017 and Tropical Storm Imelda in 2019. By examining the storm surges from these events, as well as other storms that have impacted the region from 2015 to 2022, researchers can gain a better understanding of the vulnerability of the Houston area to flooding and identify areas where adaptation and mitigation measures may be needed.

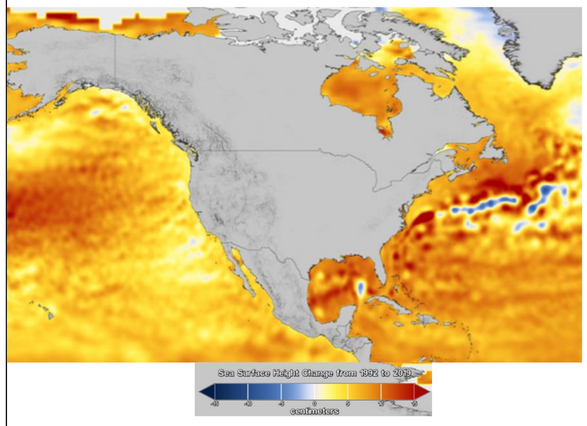
The findings of this research underscore the urgent need for action to mitigate the risks associated with changing weather patterns and rising sea levels. By understanding the impact of land cover on flood intensity and vulnerability, policymakers and other stakeholders can take steps to protect communities and infrastructure from the impacts of climate change, ensuring a more resilient future for the Gulf Coast and other vulnerable regions.

OBJECTIVES

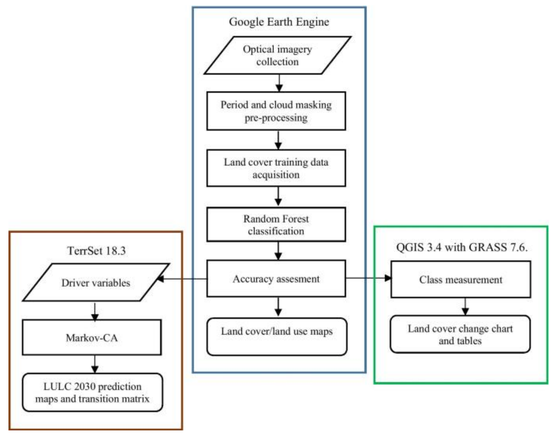
- Create Land Cover maps of the South Texas Area to analyze how land cover has changed from the year 2017, before Hurricane Harvey made landfall to 2021, before Hurricane Nicholas made land fall
- Identify relationships between land cover type flood extent.
- Understand the relationships between land cover type and flood extent.
- Understand the reasons flood extent is getting worse with weaker storms
- Brainstorm the best mitigation methods in order to protect vulnerable coastlines from future storm surges.

DATA

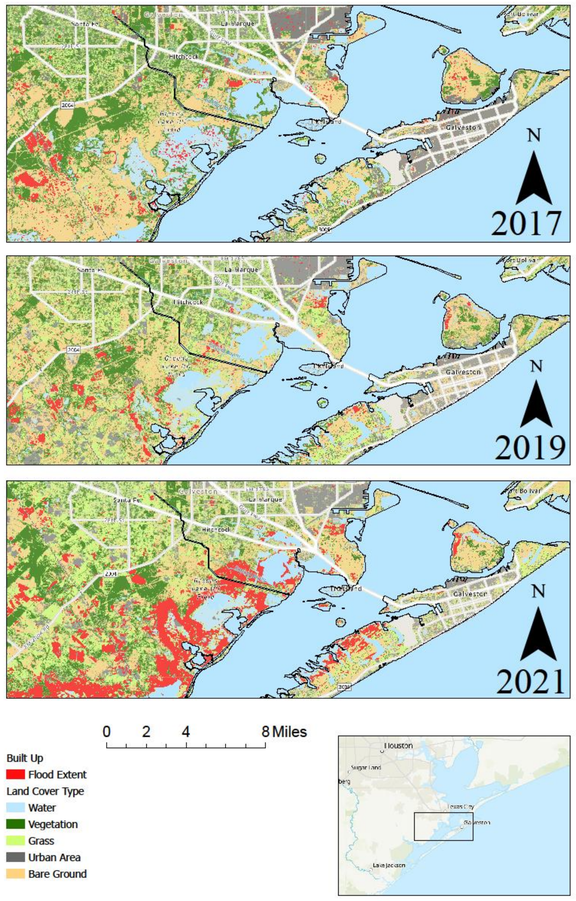




METHODOLOGY



RESULTS

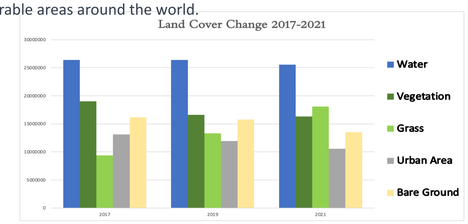


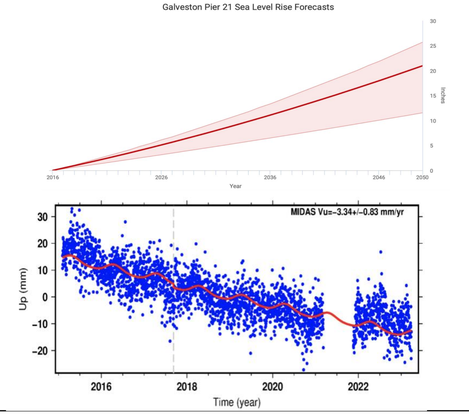
DISCUSSION

The findings of this research are consistent with other studies that have shown a correlation between land cover and flood intensity. Vegetation, for example, can help to reduce flooding by absorbing and slowing down water, while urban areas and bare ground can exacerbate flooding by creating more runoff and reducing the amount of water that can be absorbed by the ground. The results of this study underscore the importance of preserving and restoring natural land cover, such as wetlands and forests, in vulnerable areas to reduce the risk of flooding during storms.

In addition to the impact of land cover on flood intensity, this research also highlights the urgent need for action to address the impact of climate change on the Gulf Coast region. Sea levels are rising in the region, and land subsidence is exacerbating the problem, making coastal areas increasingly vulnerable to the impacts of storms and flooding. This trend is likely to continue in the future, with more frequent and intense storms expected due to climate change.

The implications of these findings are significant, and underscore the need for urgent adaptation and mitigation measures to protect communities and infrastructure from the impacts of climate change. Strategies such as coastal protection and restoration, stormwater management, and the preservation of natural land cover can all play a critical role in reducing the risks associated with flooding and other climate-related impacts. By taking action now, policymakers and other stakeholders can help to ensure a more resilient future for the Gulf Coast region and other vulnerable areas around the world.





CONCLUSION

The analysis of land cover maps and flood maps for Hurricane Harvey, Tropical Storm Imelda, and Hurricane Nicholas revealed that areas with vulnerable land cover, such as urban areas and bare ground, experienced more severe flooding during each storm. The data also showed that there was more flooding during Hurricane Nicholas in 2021, despite it being a weaker storm compared to Hurricane Harvey in 2017. This suggests that future storms in the region could cause even more devastating flooding as sea levels continue to rise and land subsidence occurs.