Housing Problems associated with Flooding in NC

Andrew Mackin, Sophie Brager, Filipp Beldiushkin, Alexandra Ayala
9 апреля 2023 г.

https://www.1tv.ru/news/issue/2022-09-29/21:00#16

Atlantic Hurricane Season (from 1st of June to 1st December of each year), unfortunately, brings a lot of destruction to the Central America, the Antilles archipelago, and the South Atlantic region of the US. One tragic case of such destruction was when Category 3 Hurricane Katrina hit New

https://www.1tv.ru/news/issue/2022-09-29/21:00#16

Orleans, LA in 2005, flooding 80% of the city and killing 1464 people only in New Orleans, most of whom were elderly. There is no wonder that the Atlantic Hurricane Season is widely covered not only nationally, but also internationally, even in countries very far away from the Caribbean Sea and

the Gulf of Mexico like Russia. Above, you can see some photos of the impact of 2022 Hurricane Ian on Florida as covered in the news on the Russian 1st Channel.

Our study, however, will look not at the media coverage of the major hurricanes, but at the housing problems in North Carolina that are caused by the flooding, most frequently caused by the tropical hurricanes and storms. Specifically, our study's research question is *'What, if any, is the spatial relationship between flooding and socioeconomic inequality in NC?'*

Our main hypothesis is that flooding in NC disproportionately affects low-income communities with less access to house insurance.

Methodology

In our study, we used a variety of publicly available datasets published by various departments and offices of the government of North Carolina, as well as federal government.

One such dataset is provided by the Spatial Data Download tool the North Carolina Department of Public Safety created. It allows users to download a lot of information about flooding risks across North Carolina by selecting the area of interest and choosing certain features of interest like flooding zone areas, political boundaries, buildings, etc. We focused our research on six areas: three coastal ones (around Wilmington, Elizabeth City, and Jacksonville) and three interior ones (Research Triangle Park, Charlotte, around Asheville).
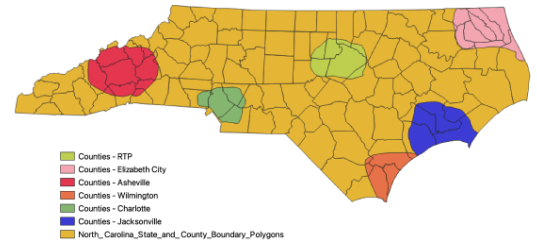
The most valuable piece of information for us in this dataset is the flood area zones designated by FEMA (Federal Emergency Management Agency). FEMA breaks up every county into many areas and predicts the flood risks for each area. If FEMA

believes that the area will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year, it designates this area as SFHA, short for Special Flood Hazard Area (https://www.fema.gov/glossary/flood-zones). The purchase of flood insurance for the structures located in this area is mandatory, and there is a 1 in 4 chance that the structure situated in SFHA will be damaged by a flood over the normal 30-year life of the loan (https://www.irmi.com/term/insurance-definitions/special-flood-hazard-area).

Map of the Selected Areas in North Carolina
By Filipp Beldushkin
Date: 11 April 2023

Counties - RTP
Counties - Elizabeth City
Counties - Asheville
Counties - Wilmington
Counties - Charlotte
Counties - Jacksonville
North_Carolina_State_and_County_Boundary_Polygons

Another source that we used was the Census Population and Housing dataset published here (https://linc.osbm.nc.gov/explore/dataset/census-population-and-housing-linc/analyze/?disjunctive.area_name&disjunctive.year&disjunctive.variable) by the NC Office of State Budget and Management. It has various data on housing in NC on a variety of spatial scales from state to census tract to municipality. After we performed some cleaning to decrease the dataset's size, the dataset used for analysis is available here (https://docs.google.com/spreadsheets/d/1OEMM_1dRwSN1TlBuRFdyAdZCSzjbk4I4/edit?usp=sharing&ouid=115696103452615301320&rtpof=true&sd=true). The variable from the dataset that we used in our analysis is "Median Value of Owner Occupied Units." This variable shows the wealth of the residents of each county, as these residents could afford to buy, rent or take out a loan to be able to live in a housing unit in a county. As data for each county was not available for each year, and sometimes only

for 1970, 1980, or 1990, the 2015 year was taken as a standard, and if data was only available for the years before 2015, the currency calculator developed by the American Institute for Economic Research (https://www.aier.org/cost-of-living-calculator/) was used to account for the inflation that has happened between the year for which data was collected and 2015.

The Climate and Economic Justice Screening Tool (https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5), developed by the Council on Environmental Quality, was used to understand the demographics of the chosen buffer areas. This screening tool allowed demographics of all races to be analyzed in the chosen areas to assess the economic disparities in the state better. The screening tool displayed the percentage of different racial demographics in North Carolina.

As described above, NC Spatial Data Download provided information surrounding floodplain mapping. We used this data to create a map of elevation levels around our interest areas. The most important layer in the spatial data is "base flood elevation" . BFE is used to determine the risk of flooding for building structures. If a structure is elevated above BFE, it has low risk of flooding, hence receiving lower flood insurance rates.

BFE effect on Flood Insurance Prices
https://wetlandswatch.org/national-flood-insurance-program-glossary-and-basic-explanations

Results

Using the "Select by Expression" tool of QGIS, we found the percentages of the SFHA area in each of the areas of interest that we selected for our research. They turned out to be the following:
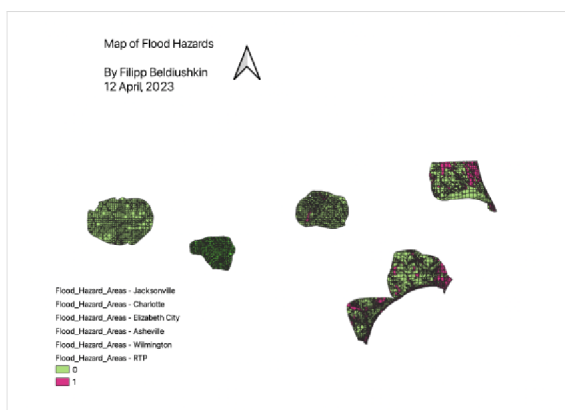
Wilmington - 37,552 %

RTP - 10,016 %

Charlotte - 7,47 %
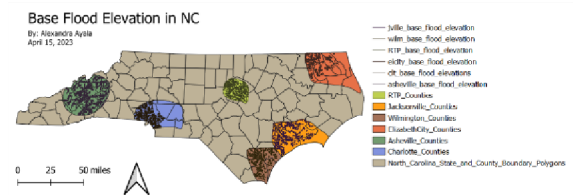
Elizabeth City - 34,262 %

Jacksonville - 32,15 %

Asheville - 3,409 %

We also mapped SFHA areas using the Categorized symbology, where pink depicts the SFHA areas. Here, we see that even though we can see some pink in coastal NC, in the inland NC there is barely any pink.

We then used "select features using expression" in the attribute table of base flood elevation to calculate the average elevation in each area of interest. Here are the results:

Wilmington - 29.68 feet
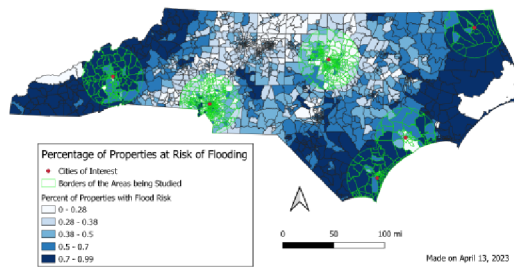
RTP - 276.18 feet

Charlotte - 652.28 feet

Elizabeth City - 17.63 feet

Jacksonville - 33.04 feet

Asheville - 2221.83 feet

Proportion of Properties at Risk of Flooding in the Next 30 Years
By Andrew Mackin

The map on the left demonstrates the percentage of properties within the census tracts of North Carolina which are projected to experience flood damage in the next thirty years. The blue color ramp is used for the percentage, while the green lines are made with a buffer around the red points which represent the cities of interest. Those green lines border the census tracts in the areas of interest, although there may be some which are not accounted for as a result of using a buffer instead of selecting all the census tracts for each county being studied. The areas of interest which are projected to have the greatest amount of property damage are near Asheville, Elizabeth City, and Wilmington. Jacksonville comes next, and the areas near Charlotte and RTP are projected to experience the least flood damage with regards to the percentage of properties which would experience flooding.

Low-Income Population of Block Groups by Percentage
By Andrew Mackin
Made on April 14, 2023
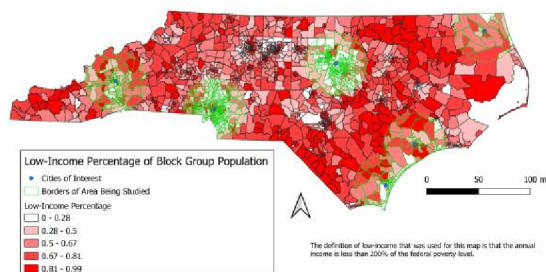
The next map was created using data from the Climate and Economic Justice Screening Tool to show the low-income population distribution throughout North Carolina. Low-income is defined in the data as having an income that is less than 200% of the Federal Poverty Level. The map shows the census tracts in North Carolina with the percentage of their populations that are low-income indicated by a red color ramp. The census tracts in the areas of interest are mostly outlined in green using a buffer from the cities of interest which are listed above and shown as blue points on the map. It shows that the areas of interest with the highest low-income percentages are near Wilmington, Jacksonville, and Asheville. The areas of interest near Charlotte and Research Triangle Park seem to

have much lower percentages of the population in those census tracts overall which are low-income. The area near Elizabeth City is in between the two ends of the spectrum.

Using the Climate and Economic Justice Screening Tool described above in methods, we mapped the non-white population of North Carolina. We also included on the map the yellow buffers of our selected areas of interest. The darker purple colors represent a higher density of the non-white population. From this map, we can see

that coastal NC, as well as major urban areas like RTP and Charlotte, are more populated by people of color than the rural areas in the inland part of NC, especially in the Appalachians. Through the data we were able to quantify the percentage of non-White communities by county. By adding the different demographics, while excluding the white population, we were able to determine the percentage of the non-white population by county. Counties in Asheville and surrounding Asheville, had the lowest percentages of non-white populations, while the RTP counties has the highest percentage of non-white demographics.
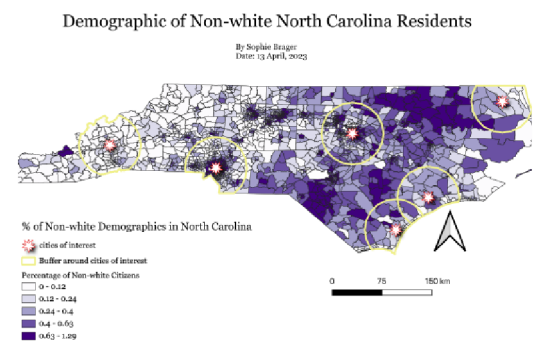
Using the census data, we also found the average "Median Value of Owner Occupied Units" across counties in each area of interest we selected for our research. We discovered that the areas around RTP and Jacksonville are the most economically privileged. while Elizabeth City and Charlotte have the most economically disadvantaged residents. The median value of owner-occupied housing units turned out to be the following:

Wilmington - 132270 USD

RTP - 162081 USD

Charlotte - 118073 USD

Elizabeth City - 111448 USD

Jacksonville - 142580 USD

Asheville - 131178 USD

We also conducted a little bit of correlation analysis to find how flooding data correlates with key socioeconomic parameters. We found a strong positive correlation (coefficient = 0,984) between the percentage of an area designated as SFHA and whether the region of study is coastal or inland. We also found a strong negative correlation (coefficient = -0,742) between the percentage of an area designated as SFHA and the average elevation. Moreover, we discovered a weak negative correlation (coefficient = -0,199) between the percentage of an area designated as SFHA and the median value of owner-occupied housing units in 2015 USD.

Discussion

Most data we compiled and examined interestingly overlapped in results. The data collections, to no surprise, showed that coastal areas are more at risk for floods - shown from the correlation between low elevations and high SFHA percentages. Additionally, this relates to a major increase in flood risk in the future as we need to account for things like sea level rise. Interestingly, Wilmington ranked for strongest correlation between flood risk and low income/percentage of non-white residents. Elizabeth City then Jacksonville followed for 2nd and 3rd ranked respectively. RTP, Charlotte, and Asheville consistently ranked lowest for flood risk and low income areas. However, the only section where this strays is the percentage of non-white residents. Predictably, larger

cities such as RTP and Charlotte are more diverse than smaller cities. **Overall, we found that there is a correlation between flood risk and socioeconomic inequality in NC based on our areas of interest.**

Low income and primarily non-white communities are greatly impacted by inland flooding in North Carolina. This disparity will only become more frequent and cause greater damage with global warming. While evaluating the data, elevation and income had the greatest contributions to risk of flooding and recovery time for these communities. Climate change and social issues cause disproportionate amounts of destruction as evident through the climate and economic justice screening tool, used for three of the maps. This disproportion in damage caused by flooding related to income, is not a new trend in the United States. Socioeconomic inequality has been the center point for other coastal and flooding research, and will continue to impact low income communities (https://doi.org/10.1016/j.joclim.2021.100028). Our results showed disproportionate exposure to flooding in high risk areas in correlation with low income and diverse demographics. To combat this climate injustice, more government intervention is needed to ensure vulnerable populations are being heard. The aim is to achieve equitable climate change resilience for flood risk communities and target areas in need of reformed mitigation plans in North Carolina.

Leah R. Handwerger, Margaret M. Sugg, Jennifer D. Runkle, Present and future sea level rise at the intersection of race and poverty in the Carolinas: A geospatial analysis, The Journal of Climate Change and Health, Volume 3, 2021, 100028, ISSN 2667-2782, https://doi.org/10.1016/j.joclim.2021.100028. (https://www.sciencedirect.com/science/article/pii/S2667278221000250)