When the Levee Breaks

The affect of Levee Failure during Hurricane Katrina on New Orleans' residents and an analysis of the implications of racial disparity during a disaster

Background

New Orleans, Louisiana has seen its fair share of hurricanes, and its residents are known for their resilience and grit. However, on August 29, 2005, Hurricane Katrina made landfall on the Gulf Coast, forever impacting the city. Katrina was a unique storm due to its slow speed, massive size, and path which pushed water up the Mississippi river and Lake Pontchartrain, churning into the crescent city. Though a state of emergency was declared and evacuation mandated in New Orleans prior to the initial storm surge, tens of thousands of people stayed in the area, and when the cities' intricate pump and levee system malfunctioned, millions of gallons of water flooded the city. The flood was fast and deadly. While there were recorded deaths (over 500 in New Orleans alone) in almost every neighborhood of the city, most particularly affected the neighborhoods where also some of the poorest in the city (Schleifstein, 2009). As with many cities in America, New Orleans has extreme economic disparity tied to race, and in this case that disparity resulted in a disproportionate death toll in primarily black neighborhoods. Additionally, there was a cluster effect in more unexpected areas when multiple hospitals and nursing homes were unable to evacuate their residents, leaving the elderly and sick vulnerable to Katrina's damaging water and winds (Lee, 2011).

All in all, the objective of this study was to evaluate where storm fatalities clustered and evaluate how those clusters correspond with ability to evacuate (using income level and hospital and nursing home residents as indicators), and analyze the implications of racial-income disparities when disaster strikes.

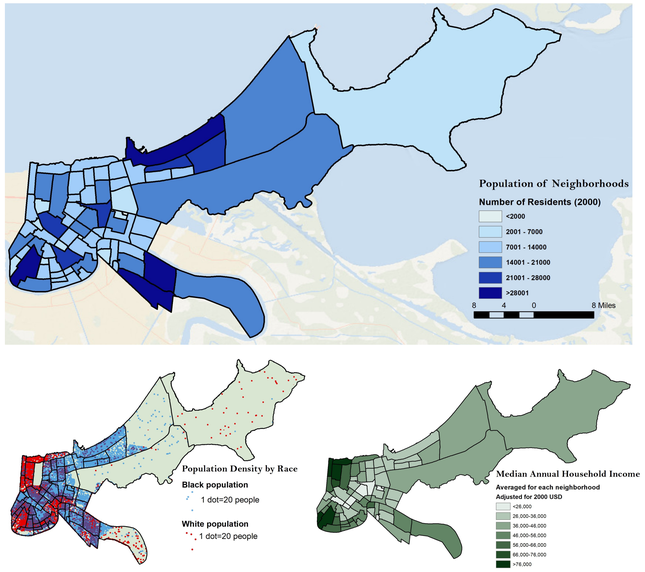


Figure 1. Populations of New Orleans neighborhoods represented as total population, as black and white, and by average annual house hold income of the neighborhood.

Data

The data for this study came from ESRI, the Census Bureau, NOAA, NOLA GIS, the Louisiana Department of Health and Hospitals, and the LSU Hurricane Center. Population (including median household income (averaged for each neighborhood from attribute field HD01VD block group statistics) and race data (HD02_VD02 and HD02_VD03)) came in the form of a table from the Census Bureau. The neighborhood statistical map was in the form of a polygon layer from NOLA GIS. Elevation data was downloaded from NOAA's national elevation raster data. Finally, the fatality coordinates and place of death was composed into a table by the Louisiana Department of Health and Hospitals and the LSU Hurricane Center. The base maps and levee failure maps were from ESRI.

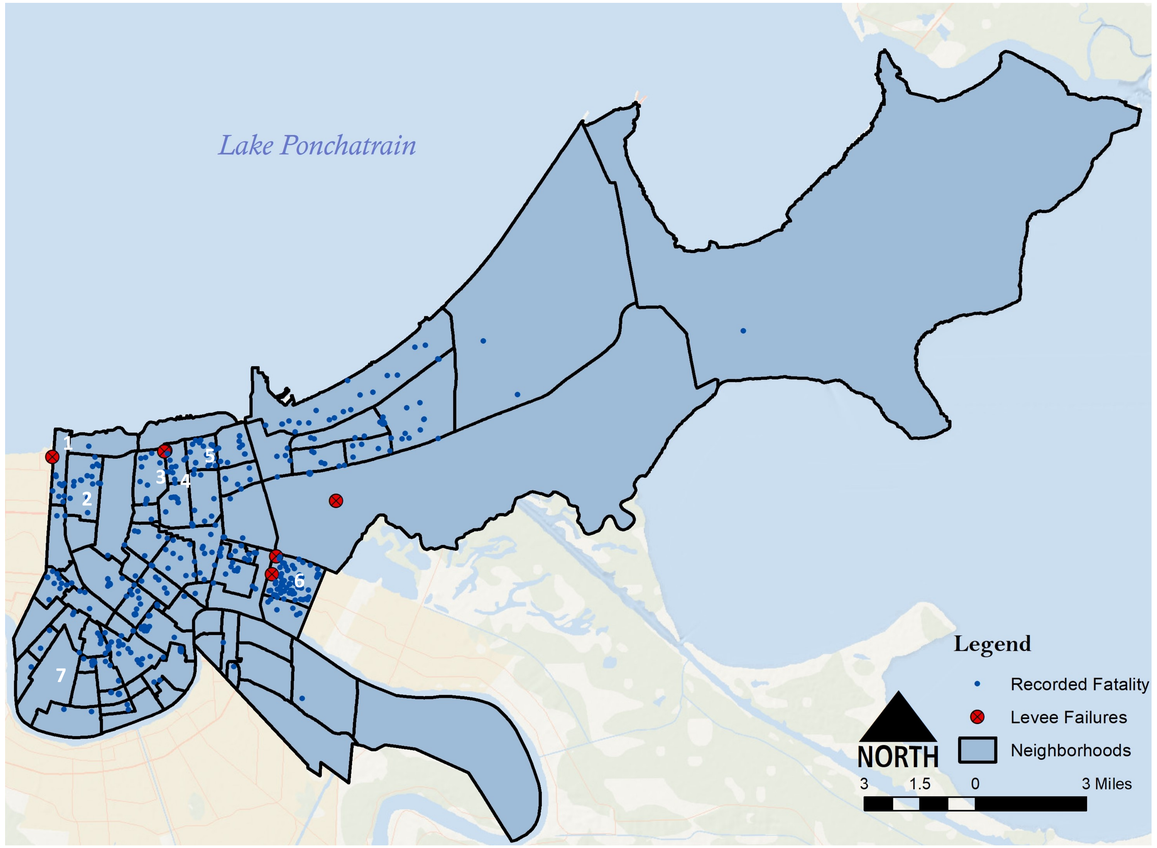
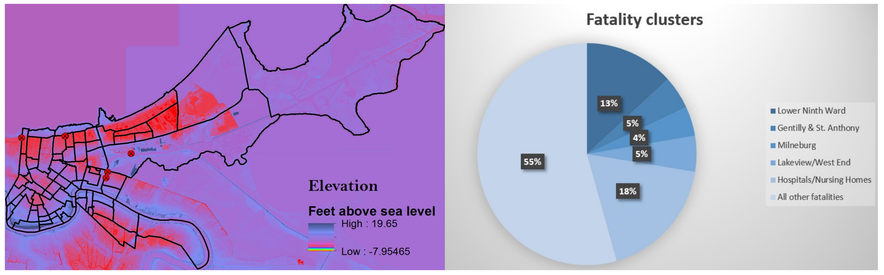


Figure 2. Map of Hurricane Katrina fatalities in each neighborhood, with levee failure sites. (1) Lakeview (2) West End (3) St. Anthony (4) Gentilly (5) Milneburg (6) Lower Ninth Ward (7) Audobon. Elevation map with levee failure sites demonstrating that levee failure mostly occurred in places with especially low elevation. Chart showing fatality clusters by either neighborhood or location of death.



Methods

The neighborhood statistical data was used as a framework for demonstrating information, which was downloaded either as census block groups or as longitude/latitude points. The population data from Census table P007 (using HD02_VD01, HD02_VD02, and HD02_VD03 for the 2000 total population and race population data by block group) and Census table B19013 (using HD01_VD01 for median household income by block group). The neighborhood statistical layer was then overlaid and a spatial join was used to relate the block group data to neighborhoods. In the case of income, the data was averaged per neighborhood using statistics. For total population, the data was summed. For the fatalities map, longitude and latitude points were converted to XY coordinates and overlaid onto the neighborhood layer. Sorting through the Louisiana Health and Hospitals and LSU Hurricane Center data table (from the Hurricane Katrina Fatalities Database), I was able to investigate where the death was recorded (both by neighborhood and by residence/hospital/nursing home/other). There was no overlap in those statistics so the data was easily compiled into a chart that represents the clustered death effect. The important table attributes were Longitude, Latitude, Locatrecv (place of death) and GNOCD_LAB (neighborhood). The elevation map was downloaded as raster squares from NOAA and complied to the extent of New Orleans, showing high (19.65 feet above sea level) and low (7.95 feet below sea level) elevation gradient to assess expected flood likelihood with the neighborhood location.

Cartographer: Téa Pappas. GIS 101: Introduction of GIS (Alexandra Thorn). May 7, 2019. Projection: GCS_WGS_1984

Results

The final results showed that, in 2000, there is a correlation between race and low-income level and that that correlation aligns very clearly with specific neighborhoods (Figure 1). Additionally, the results showed that of the 537 deaths recorded in New Orleans, nearly half appeared to cluster in one of two categories—hospitals and nursing homes throughout New Orleans (where 97 deaths (18%) were recorded), and in neighborhoods near levee failures (the Lower Ninth ward where 71 deaths were recorded, Gentilly & St. Anthony where 26 deaths were recorded, Milne burg were 23 deaths were recorded, and Lakeview/West End where 28 deaths were recorded). The levee failures were mainly the result of excessive amounts of water, which became especially a problem for levees that were in low elevation areas (figure 2). Additionally, four of the six levee failures occurred in areas that had a disproportionately high black and low-income population, and these areas showed a significant number of more deaths than even the Lakeview/West End area that is notably more wealthy and white.

Discussion & Conclusion

This analysis gives empirical data that contextualizes how levee failure during Hurricane Katrina affected residents of New Orleans. Spatial analysis was able to expose the neighborhoods with the most fatalities were not the most populated—in fact, one of the most populated neighborhoods in New Orleans (Audobon) was one of the only neighborhoods to not have any recorded deaths and the Lower Ninth Ward, St. Anthony, Milneburg, and Gentilly have comparatively low populations but very high death tolls, demonstrating that those levee failures resulted in fatality clusters around the city. Interestingly, when compared to the income and race population maps, it is clear that the neighborhoods most effected by levee failure were primarily black and low income.

When comparing the racial population map to the elevation map, there is a general trend of black neighborhoods in lower elevation zones (with the exception of the waterfront Lakeview area), which were more prone to severe flooding and levee failure. This brings to light the historical racial context of land settlement, demonstrating that wealthier and more white areas were established in regions less impacted by severe weather, leaving black populations more vulnerable to hurricanes. Using GIS, I was also able to uncover the clear neighborhood distinctions based on socio economic class and the evident relationship between poverty and race in New Orleans.

Finally, this study brings into light the vulnerability of certain populations during extreme weather events and inaccessibility of evacuation for poor populations. Nursing home and hospital residents were—for the most part—logistically very difficult to relocate in large numbers, so where a nursing home or hospital faced damage in the storm, many people were stuck in harms way and, as demonstrated in figure 2, there were many fatalities. Meanwhile, though the more poor neighborhoods were more susceptible to severe flood damage, without means to evacuate, many residents of the Lower Ninth Ward, Gentilly, St. Anthony, and Milneburg stayed in their homes and were vulnerable to Katrina's damage.

I hope that this information can contribute in the future to investment in better infrastructure poor neighborhoods of New Orleans as well as more holistic and extensive planning so that mass evacuation of from poor neighborhoods more susceptible to damage is accessible when a natural disaster such as Katrina hits New Orleans in the future.

References

Lee, Barbara. 2011. "A Katrina Retrospective: Structural Inequality, Environmental Justice and Our National Discourse on Race." HuffPost.

Louisiana department of Health and Hospitals, LSU Hurricane Center. 2018. "Hurricane Katrina Victims." dataset.

NOAA. 2018. "U.S. National Elevation Mapper" Arc Map database.

Schleifstein, Mark. 2009. "Study of Hurricane Katrina's Dead show most were old, lived near levee breaches" The Times-Picayune

U.S. Census Bureau. 2000. "ACS_13_5YR_B19013_with_ann" American Fact Finder.

U.S. Census Bureau. 2000. "DEC_00_SF1_P007_with_ann" American Fact Finder.

Image Credits: Gary Nichols. 2005. U.S. Navy; Infrogmation of New Orleans. 2005. Flillr; Jocelyn Augustino. 2005. FEMA