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Studying Factors of Environmental Injustice and Ways to Achieve Equity

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Studying Factors of Environmental Injustice and Ways to Achieve Equity



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Abstract

In today's day of age, the biggest concern for current and future generations: the environment. The urban heat island (UHI) with its significant energy, health, and societal impacts is among the major environmental issues in urban regions, especially in historically underserved and socially vulnerable communities (HUSVCs). In the 1930s, the former federal agency, Homeowners' Loan Corporation (HOLC), created "Residential Security" maps of major cities, known today as "redlined" areas. These neighborhoods were often designated as "hazardous" due to the high percentages of people of color living there, leading to systematic disinvestment based on race. While the program ended in 1968, the impacts of discriminatory lending are still experienced in redlined areas in the form of urban hotspots. The advent of new technologies and availability of environmental data from satellite and ground observations such as ArcGIS and QGIS, could improve our understanding of these heat impacts and be used to develop and assess mitigation and resiliency strategies.

Introduction

- In the 1930s the former federal agency, Homeowners' Loan Corporation (HOLC), created "Residential Security" maps of major cities.
- Areas were bordered off and rated for mortgage lending ranging from A to D (D being the most hazardous).
- Neighborhoods were often designated as "hazardous" due to high percentages of people of color living there, leading to systematic disinvestment based on race.
- These D zones, colored red on the original HOLC maps, are known today as "redlined" areas.



Figure 1. 1936 Homeowners' Loan Corporation (HOLC) Residential Security map.

Methods and Data

- The following research consists of data pulled from the NYC open Database for demographic and income information from the US Census Bureau data.
- In addition, satellite imagery such as Landsat 8 from 2013 to present with 30m multi-spectral spatial resolution.
- What is Landsat 8? According to USGS.gov, "Landsat 8 (formerly the Landsat Data Continuity Mission, or LDCM) was launched on an Atlas-V rocket from Vandenberg Air Force Base, California on February 11, 2013. The satellite carries the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS) instruments."

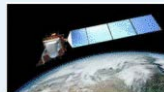


Figure 2. Landsat 8 in orbit

- Running Landsat 8 code from Google Earth Engine Code Editor, generated satellite imagery over NYC for Land Surface Temperature as well as Land Surface Reflectance.
- The Thermal Infrared Sensor (TIRS) has two spectral bands:
 - Band 10 TIRS 1 (10.6 - 11.19 μm) 100 m which directly measures land surface temperature
 - Band 11 TIRS 2 (11.5 - 12.51 μm) 100 m
- However, all the satellite imagery were presented as a raster layer (pixels) that was needed had to be converted to a polygon layer in order to obtain mean surface temperature within zip code boundaries all NYC.
- To get the data within each zip code, QGIS was used to analyze the geospatial data (raster layers) from Google Earth Engine Code Editor and then to be analyzed further in Excel.
- Using QGIS, every zip code's median and household income along with mean land surface temperature was displayed which helped visualize correlations.

Data Sets



Figure 3. Map of Land Surface Temperature ($^{\circ}\text{C}$) using Landsat 8-TIR band, July 2020.

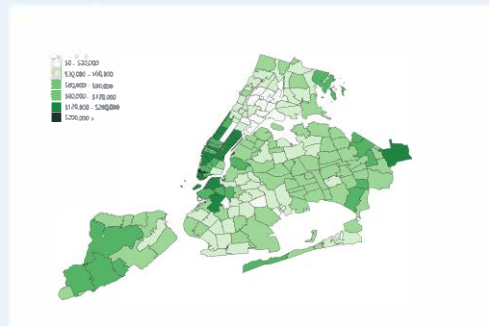


Figure 4. Median income per zip-code in NYC.

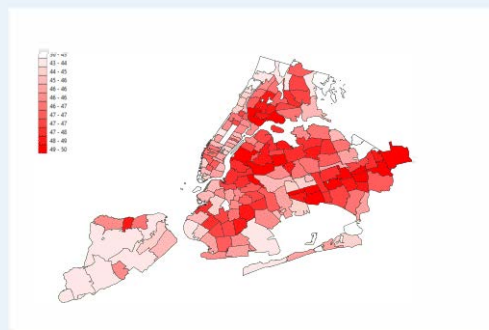


Figure 5. Averaged surface temperature per zip code ($^{\circ}\text{C}$).

Results

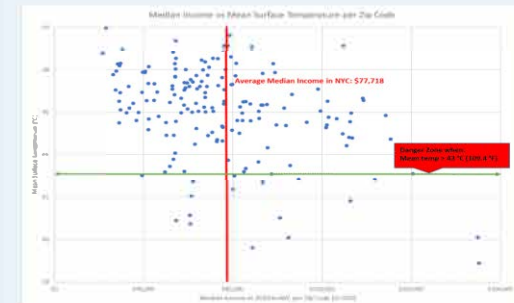


Figure 6. Mean surface temperature per zip code vs median income.

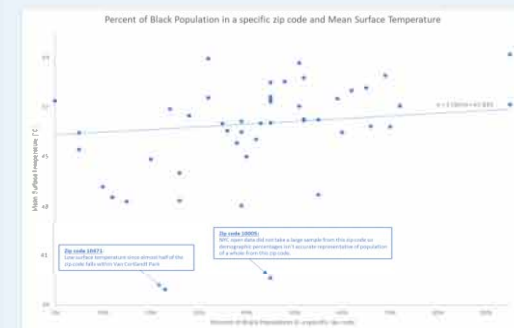


Figure 7. Percentage of black population and mean surface temperature in every zip code in NYC.

Conclusions and future work

- In the research conducted so far, there is a clear positive correlation between income and the land surface temperature among different demographics.
- In addition, the research shows our initial findings and understanding of the matter of environmental justice issues depend on many other factors.
- To conclude, this is an ongoing research project, and more data has yet to be collected and analyzed for future findings.

Acknowledgements and References

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