Remote Sensing Correlations Between Income and Land Cover to Analyze Urban Heat Islands - Austin, Texas

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ABSTRACT

In this study, we investigate the correlation between income and land cover in the context of Urban Heat Islands (UHIs) in Austin, Texas. Utilizing remote sensing data and machine learning, we aim to identify high-risk UHI areas and understand the socioeconomic disparities contributing to these risks. Our initial results indicate a significant correlation between lower income levels and increased impervious surfaces, which exacerbates UHI effects. Clustering analysis further reveals distinct groups of high-risk areas, predominantly in lower-income neighborhoods. These findings highlight the need for targeted urban planning and environmental justice initiatives to mitigate UHI impacts.

INTRODUCTION

Urban Heat Islands (UHIs) are areas with significantly higher temperatures than their surroundings, primarily affecting urban areas. Our study in Austin, Texas focuses on the correlation between income and land cover in the context of Urban Heat Islands (UHIs). Using remote sensing data, we aim to identify high-risk UHI areas and understand the socioeconomic disparities contributing to these risks. We are examining how factors such as impervious surfaces, median household income, and greenness affect the formation of UHIs.

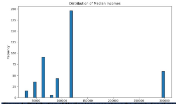


Figure 1: Distribution of Median Incomes shows the distribution of median household incomes in Austin, Texas, based on U.S. Census Bureau data. Each data point represents a specific location, illustrating the variation in economic status across the city.

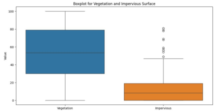


Figure 3: Boxplot for Vegetation and Impervious Surface shows the values of vegetation and impervious surfaces in Austin, Texas; on a scale of 100

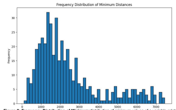
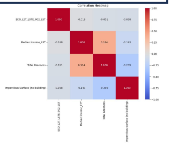


Figure 2: Frequency Distribution of Minimum distribution of minimum values of a variable related to our Urban Heat Islands (UHIs) study. These values represent the lowest recorded land surface temperatures, green space coverage.



METHOD

Land cover data, such as greenness and impervious surfaces, was obtained from remote sensing sources and verified using ground photos from the Globe Observer Database. **The data sources include** the Globe Observer Database for ground photos, NASA AppEARS for remote sensing data, the U.S. Census Bureau for income data, and SEDAC for socioeconomic and demographic data. Unsupervised learning algorithms, such as K-means, Hierarchical, and DBSCAN, were utilized to cluster land cover and income data. The clustering analysis aimed to uncover patterns and correlations between socioeconomic factors and UHI risk.

HIERARCHICAL CLUSTERING

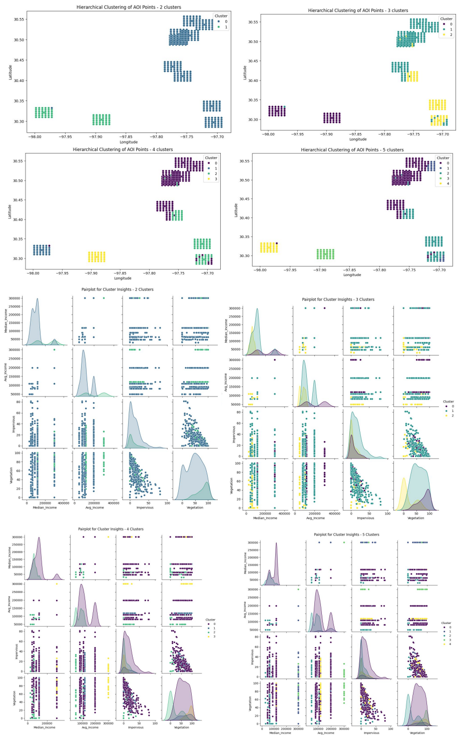
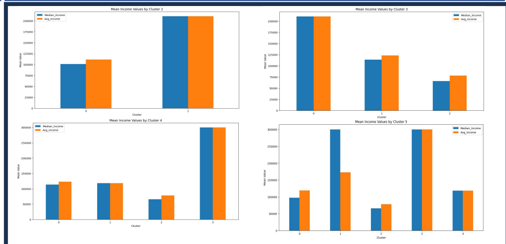
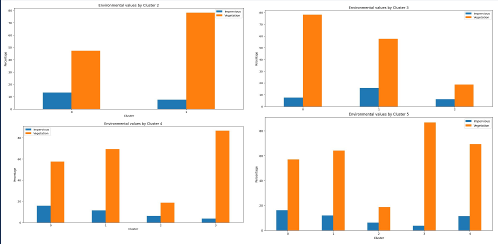


Figure 4: Hierarchical Clustering of AOI Points. These Histograms displaying IDO1 concentration of groups 2.-5 for the different clustering. Additionally, **Pairplots for Hierarchical Clustering** are displaying the data in correlation towards the Hierarchical Clustering AOI Points.

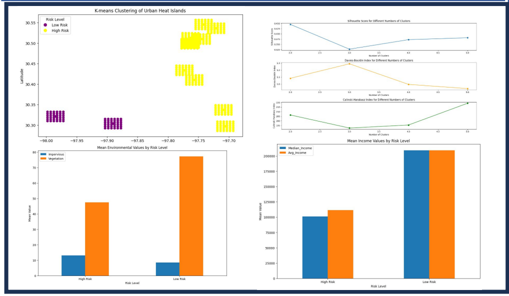
INCOME DISTRIBUTION



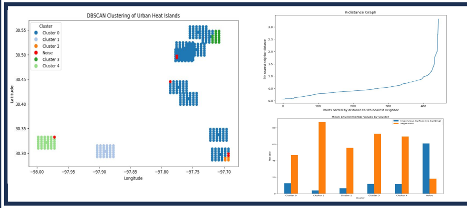
ENVIRONMENTAL VALUES



K-MEANS

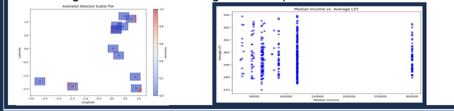


DBSCAN



RESULTS

Our initial findings reveal a strong link between lower income levels and higher impervious surfaces, exacerbating Urban Heat Island (UHI) effects. Lower-income areas are at higher risk for UHIs due to increased impervious surfaces. This highlights the need for targeting urban planning and policies to increase green spaces and reduce impervious surfaces in disadvantaged communities to mitigate UHI impacts.



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REFERENCES

[1] SERVIR – a joint NASA and USAID program. (n.d.). Collect Earth Online. Retrieved from https://www.collect.earth/
[2] The Global Learning and Observations to Benefit the Environment (GLOBE) Program. (n.d.). GLOBE Visualization. Retrieved from https://vis.globe.gov/GLOBE/
[3] GLOBE Observer. (n.d.). Retrieved from https://observer.globe.gov/
[4] ArcGIS Online. (n.d.). Retrieved from https://www.arcgis.com/home/index.html
[5] NASA LP DAAC. (n.d.). Application for Extracting and Exploring Analysis Ready Samples (AppEEARS). Retrieved from https://appeears.earthdatacloud.nasa.gov/
[6] Google Colab. (n.d.). Retrieved from https://colab.research.google.com/drive/1lYaL6vWG7myXnUOir2uSgAggK8Bywnn1?usp=sharing
[7] U.S. Census Bureau. (n.d.). Retrieved from https://data.census.gov/
[8]ArcGIS. (n.d.). LST data. Retrieved from https://igestrategies.maps.arcgis.com/home/item.html?id=8de7c6f3909d42bf901adae6894f6f5d
[9] ArcGIS. (n.d.). CSV file with AOI points in Austin. Retrieved from https://igestrategies.maps.arcgis.com/home/item.html?id=c45eb5dacdec49cd99ca4d081826d89f
[10] ArcGIS. (n.d.). ArcGIS map with variables. Retrieved from https://igestrategies.maps.arcgis.com/home/item.html?id=a8bfd0bb110945a8968a4a91eddc7589
[11] Collect Earth. (n.d.). Globe Observer CEO group. Retrieved from https://app.collect.earth/review-institution?institutionId=104
[12] GLOBE Observer. (n.d.). Globe Observer website. Retrieved from https://observer.globe.gov/
[13] Google Colab. (n.d.). Colab notebook. Retrieved from https://colab.research.google.com/drive/11vQ_2mkSJNe0PoHuM_OGg6-By9UbLNb_?usp=sharing
[14] Google Drive. (n.d.). Final data file for presentation. Retrieved from https://drive.google.com/file/d/1NRXYYOHtaMfDCvfUWPVXYVtmKdBdocLS/view?usp=drivesdk
[15] Google Drive. (n.d.). Google sheet CSV with all collected data. Retrieved from https://drive.google.com/file/d/1NRXYYOHtaMfDCvfUWPVXYVtmKdBdocLS/view?usp=drivesdk
[16] Google Drive. (n.d.). CSV file with points in Austin. Retrieved from https://drive.google.com/file/d/12sqDs0dzbGbcQ0NLTq0rBDBy0HuqdZoC/view?usp=drivesdk
NASA Earthdata. (n.d.). Retrieved from https://appeears.earthdatacloud.nasa.gov/