Green Space Inequity in Long Beach, CA

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Introduction

By 2050, more than 68% of the global population will live in cities. Long Beach, the second largest city in Los Angeles County and the seventh largest in California, has a population of over 449,460 residents (US Census 2024).

Urban areas with a higher density of population, structures, and paved infrastructure experience increased temperatures that create the **Urban Heat Island** effect (**UHI**). Heat islands are caused by the inequitable spread of landcovers in urban landscapes and are often linked to demographic factors such as income and race in under invested communities (EPA 2025).

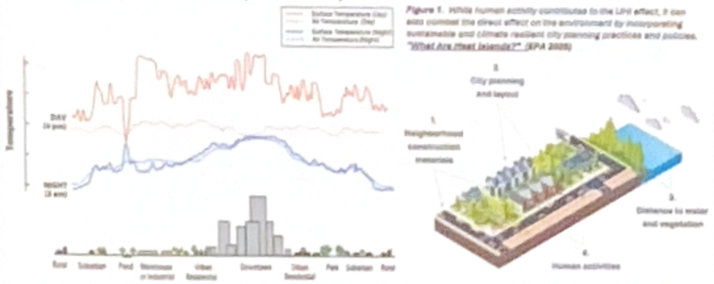


Figure 1. While human activity contributes to the UHI effect, it can also combat the direct effect on the environment by incorporating sustainable and climate resilient city planning practices and policies. "What Are Heat Islands?" (EPA 2025)

Figure 2. Illustrated above are examples of surface temperatures in areas with and without vegetation. The fluctuation in temperature is higher in dense areas with construction materials compared to lower temperatures in areas with trees, water, and vegetation present.

Environmental racism, the discriminatory policies and practices that disproportionately burden communities of color is deeply rooted in Long Beach's history of redlining, decades of disinvestment and discrimination in communities of color. Indicators include the proximity of hazardous pollution sources like major highway, transportation corridors, toxic waste sites, and oil refineries to vulnerable communities as well as the inequitable distribution of tree canopy cover (Kaufman 2021).

Exploring the intersecting relationship between historical **redlining**, the Urban Heat Island effect (UHI), and the disproportionate tree canopy levels in marginalized communities using GIS and spatial analysis, emphasizes the importance of equitable access to green space to promote community wellbeing.

Methods

Tracking vegetation changes in Long Beach using National Agriculture Imagery Program (NAIP) remote sensing imagery and data. By analyzing vegetation trends using Normalized Difference Vegetation Index (**NDVI**) and Soil-Adjusted Vegetation Index (**SAVI**) values using Python on Google Colab, a geospatial analysis will be visualized on Google Earth Engine to present results.

NDVI is used to monitor plant health by measuring the difference between the light absorbed and reflected by plants and the surrounding surfaces.

SAVI is a refined version of NDVI designed to minimize the influence of soil brightness in areas with sparse vegetation. It is particularly useful in arid and semi-arid regions where vegetation is sparse.

Results

Figure 4. NDVI & SAVI Analysis of Long Beach

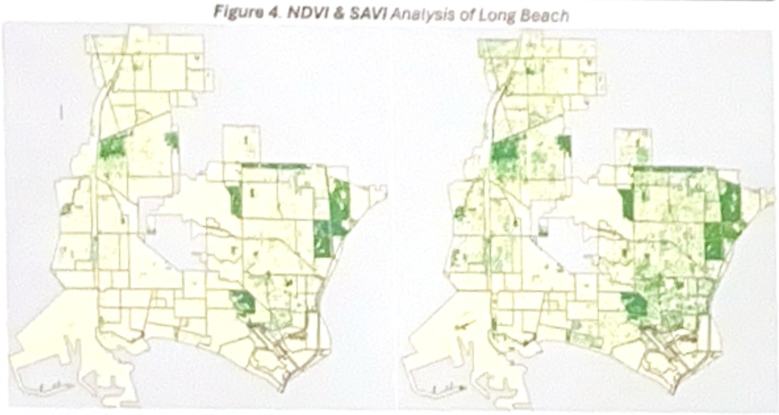
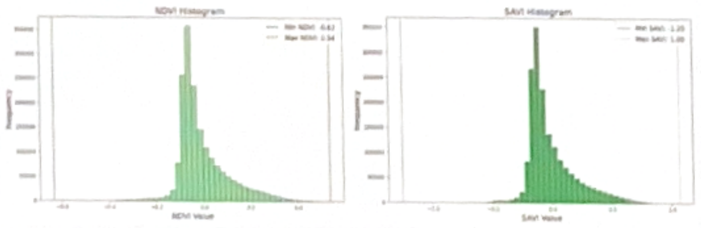


Figure 5. NDVI & SAVI Histograms Analysis of Long Beach



NDVI/SAVI values range from -1.0 to +1.0, where lower values indicate barren areas, moderate values signify sparse vegetation, and higher values represent dense vegetation.

The visualized spatial analysis reflects disproportionate tree canopy and vegetation levels in different neighborhoods of Long Beach. The lighter the color (yellow) the lower the vegetation density. The darker the color (green) is denser the vegetation and tree canopy.

Figure 6. NAIP Satellite image of Bixby Knolls

Figure 7. SAVI Map of Bixby Knolls

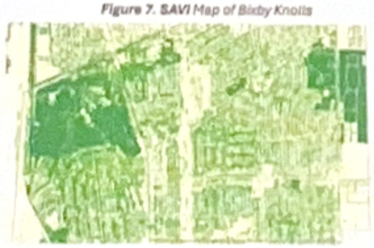


Figure 8. NAIP Satellite image of North Long Beach

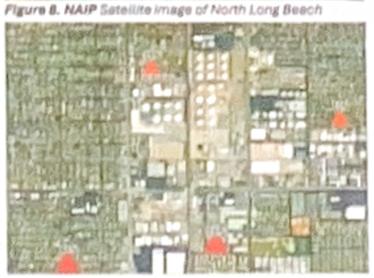
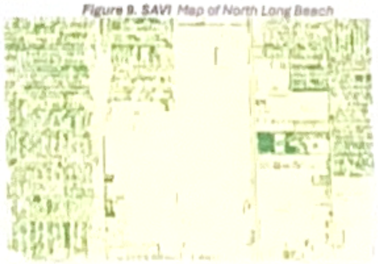


Figure 9. SAVI Map of North Long Beach

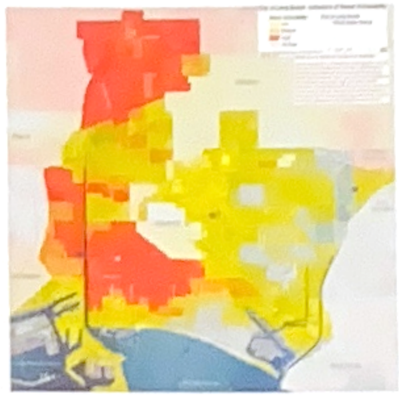


The NDVI/SAVI analysis can help determine suitable areas to allocate city resources to neighborhoods with higher rates of environmental and green space inequity. The SAVI analysis displays an inequitable distribution of tree canopy based on the socioeconomic demographics of the communities based on CalEnviroScreen data.

Green infrastructure enhances community safety and quality of life and can be done at the local level by planting trees, restoring native habitats and wetlands. Green spaces are also vital for urban ecosystems, promoting sustainable and healthy city development.

Conclusion

Extreme heat stemming from climate change and lack of shade is expected to affect the greatest number of people in Long Beach, and its impacts are more concentrated in Central, West, and North Long Beach. Green space mitigate the effects of pollution and can reduce the UHI effect. **GIS** can be used a tool to advance health equity by limiting health disparities and provides ways forward for urban planners, parks managers, and public health professionals to move towards equity, environmental justice, and sustainability.

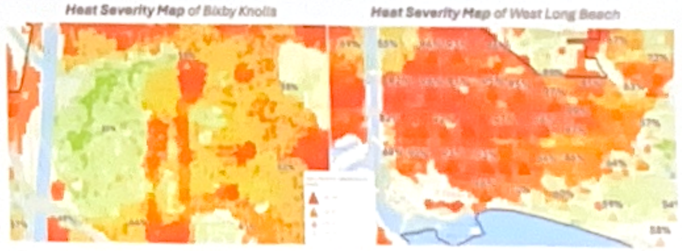


Redlining is linked to higher temperatures and lower vegetation cover compared to affluent/desirable areas of the city.

Figure 10. Shows the percent tree canopy cover of Long Beach land surfaces. This is produced by the Multi-Resolution Land Characteristics Consortium (MRLC) for the National Land Cover Database (NLCD).

Figure 10. Where Will Tree Planting Improve Urban Health?

Heat Severity Map of Bixby Knolls *Heat Severity Map of West Long Beach*



Recognizing the intersectional relationship between green space inequity and the socioeconomic disadvantages of marginalized communities opens the conversation of environmental injustice, social inequity, and health disparities to groups that are historically excluded from the decision and policy making process. These results can serve to educate Long Beach residents to build resilience to current climate changes and reduce future impacts.

Increasing the urban tree canopy benefits the community by protecting the populations most adversely impacted by tree scarcity. Planting more trees helps mitigate pollution, poor air quality, and minimizes the lack of shade that contributes to temperature increases associated with urbanization.

Investing in the community's well-being is just as important as preserving the natural environment, as the loss of human potential is detrimental to the planet.

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