Mapping Urban Heat Islands in Worcester, MA: A Sentinel 2 and Landsat Study on Environmental Justice and Land Surface Characteristics

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Introduction

This research examines the aspects of the Urban Heat Island (UHI) effect discernible via remote sensing methodologies using Sentinel-2, Landsat-8, and Landsat-9 data from 2016 to 2023 in Worcester, MA. Key aspects of this work include the analysis of surface reflectivity (Albedo), vegetation cover (SAVI), urban build up (NDBI), and water bodies and content (NDWI) to and their influence on Land Surface Temperature (LST), this study aims to quantify the primary factors contributing to the UHI effect using remotely sensed data.

Data and Study Area

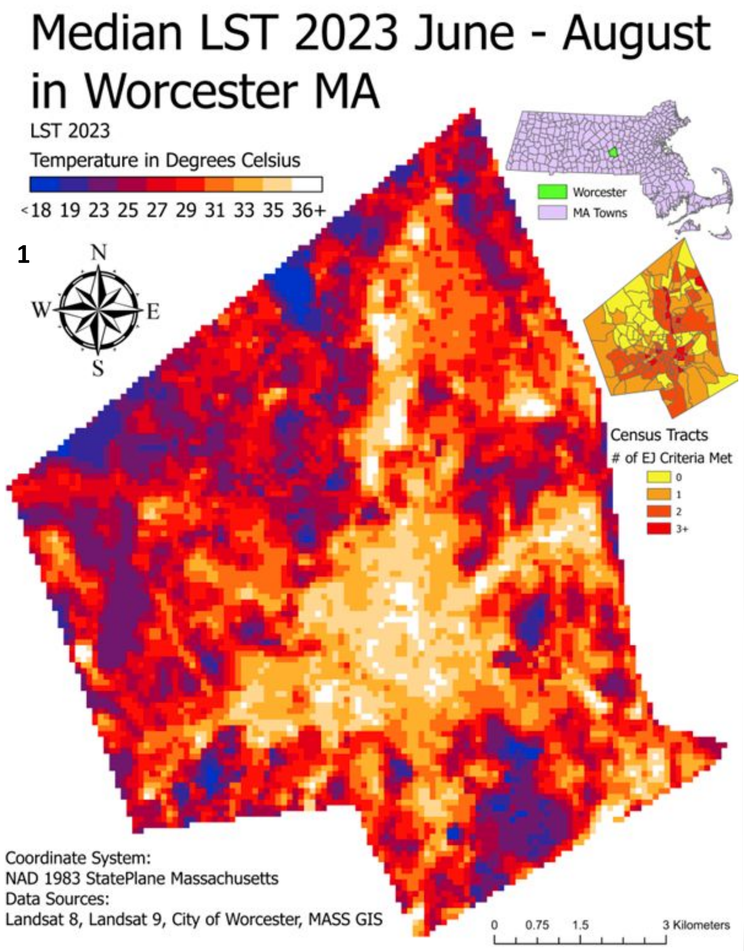

Figure 1: Map showing study area of Worcester, MA, with median LST values of all cloud free pixels from June to August in 2023, at 100 meter pixel resolution

Analysis

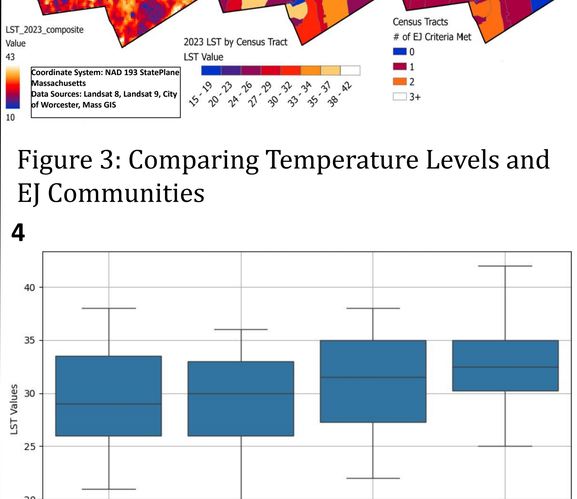

Figure 2: Emerging Hotspot Analysis on LST in Worcester, MA, 2013-2023

Figure 3: Comparing Temperature Levels and EJ Communities

Figure 4: Box Plot of Average LST Based on Number of EJ Criteria Met

Figures 2, 5, 6, and 7 are maps showing the spatial distribution of various Land Surface Characteristics and their relationship to the number of Environmental Justice criteria met in each census block group.

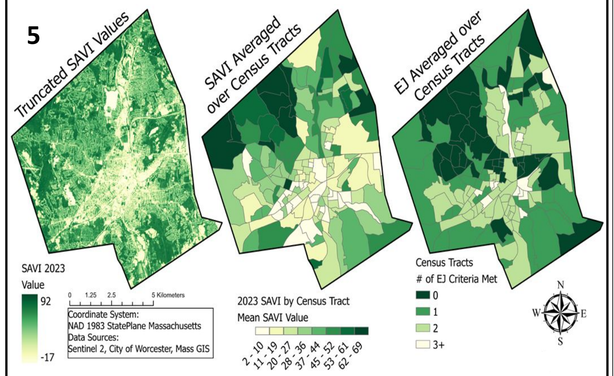

Figure 5: Comparing Vegetation Levels and EJ Communities

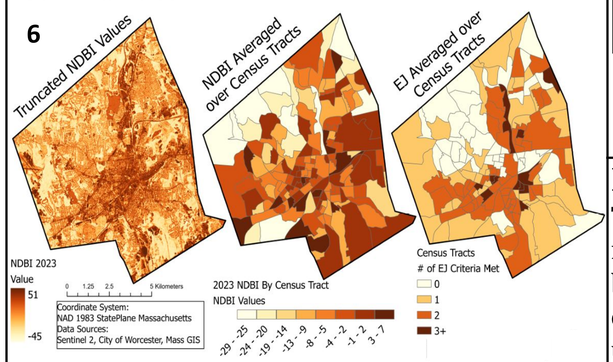

Figure 6: Comparing Urban Built-Up Levels and EJ Communities

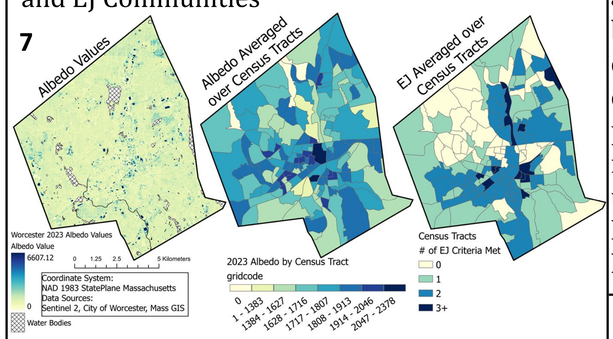

Figure 7: Comparing Albedo Levels and EJ Communities

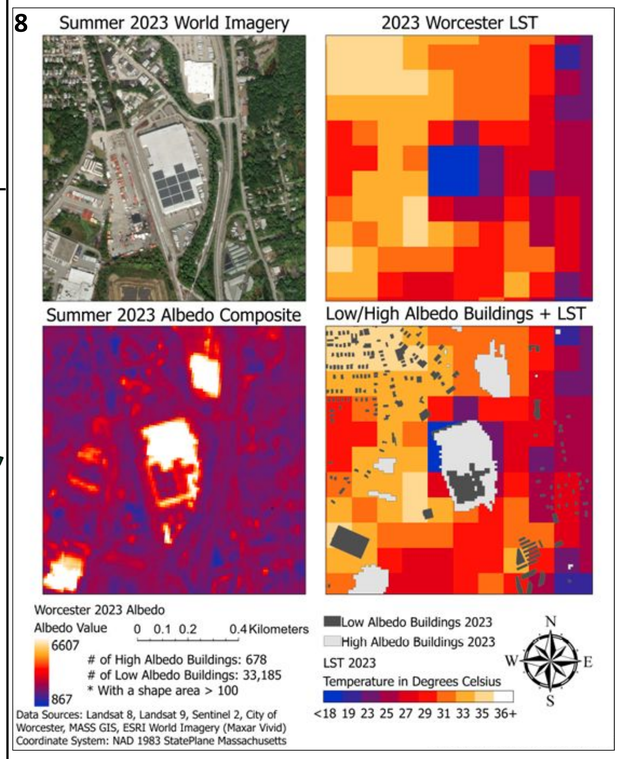

Figure 8: Effect of Large High Albedo Buildings on LST

Results and Discussion

The goal of this research was to assess thermal inequity in Worcester using EJ criteria subdivided by census block group. The study succeeded in examining thermal inequity in Worcester and unraveling the impact of the chosen Land Surface Characteristics (LSCs), namely Albedo, SAVI, NDBI, and NDWI. Each UHI-contributing LSC was found to be more prominent in areas meeting two or three EJ criteria as compared to areas meeting zero or 1 EJ criteria. Urban planners should prioritize expanding parks and green spaces, planting trees, and increasing prominence of reflective roofs in underserved areas to balance access and reduce health risks from heat stress. Cities should establish long-term monitoring programs to track LST trends.

Acknowledgements

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