The Implications of Neighborhood Mobility Networks on Urban Heat Exposure

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Introduction

- **Climate change** is driving **global warming**, with city residents experiencing the most severe impacts due to the **urban heat island effect**.
- Prior studies have identified **significant disparities** in how urban temperatures impact different **racial and socioeconomic groups in the neighborhoods they live** (Dialesandro et al., 2021)**.**
- We study **the 100 most populated cities** in the United States, examining the relationship between **urban temperatures, mobility networks, and demographic factors** in the neighborhoods that resident visit for daily routines**.**

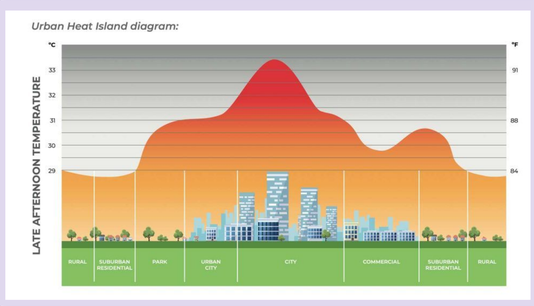


Figure 1: Urban Heat Island Diagram (Green Roof Organisation)

Research Question

What is the relationship between urban summer temperatures and neighborhood mobility networks?

Data & Methods

Demographic data:
Income, race/ethnicity, education, age, disability status, and automobile access

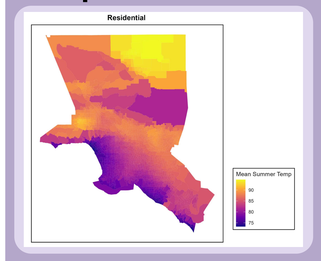
Canopy data:
Tree canopy coverage

Temperature data:
Maximum surface temperature

Cell phone data:
Trips

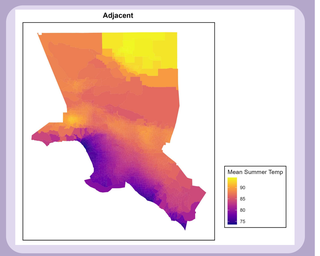
- We **researched, collected, and cleaned data** from various sources to determine which dataset would best support our project's needs
- We utilized **raster-based, tract-level datasets** to produce **maps, figures, and matrices** that show the **correlation** of our variables
- In the future, we will be producing **linear regression analyses** to confirm relationships between our independent and dependent variables

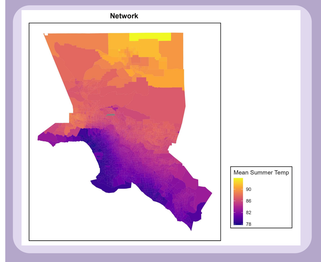
Maps



- Cooler temperatures prevail along the coast and in higher elevation areas
- Desert regions experience the highest temperatures
- East LA tends to be warmer than surrounding areas

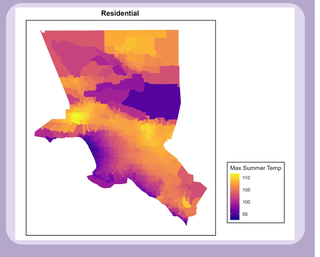
- Temperatures decreased in the mountainous areas near Angeles National Forest due to their elevation and proximity to warmer regions
- This helped to smooth out the overall temperature variance across the area

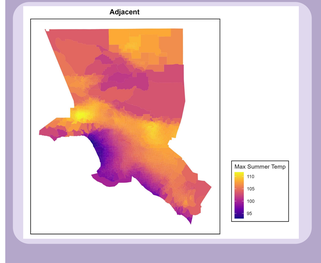




- Cooler temperatures were observed across the greater Los Angeles metro area
- Coastal areas near the Pacific Ocean may see increased visitors seeking relief from the heat

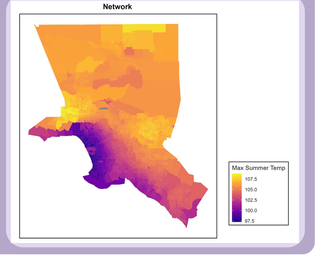
- The highest maximum temperatures occurred in the San Fernando Valley and East LA
- The lowest maximum temperatures were recorded along the coast and in higher elevation areas





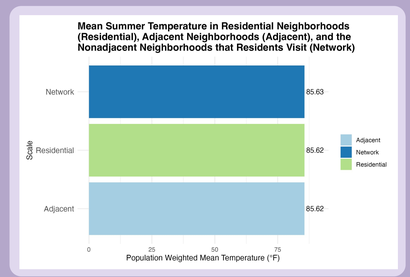
- Overall temperature variance has become more balanced across the region
- The San Fernando Valley and East LA continue to stand out as persistent "hot spots"

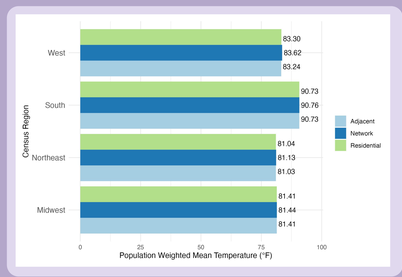
- Most of the metro area experienced high maximum temperatures
- Areas with lower maximum temperatures saw little to no increase
- Tracts with high maximum temperatures remained hot or became even hotter



Results

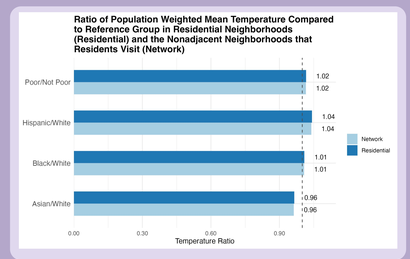
- Little difference between the different spatial scales
- People travel to census tracts with similar mean summer temperatures





- The South region of the United States is significantly warmer than the other regions
- Little difference across different spatial scales across regions

- Asian neighborhoods were on average cooler than White neighborhoods
- Hispanic neighborhoods have the highest ratio of mean summer temperature



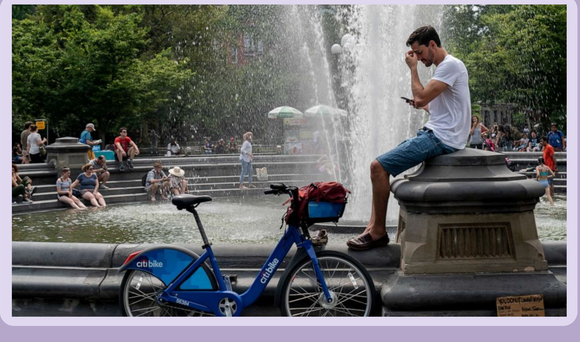
- No difference between the residential and network scale

Rank	Name	Residential	Network	Differential
1	Provo-Orem, UT	86.79	87.64	0.86
2	Ogden-Clearfield, UT	84.68	85.33	0.65
3	Chattanooga, TN-GA	87.69	88.27	0.58
4	Albuquerque, NM	90.65	91.22	0.57
5	Spokane-Spokane Valley, WA	78.97	79.47	0.50
96	San Jose-Sunnyvale-Santa Clara, CA	81.80	81.58	-0.22
97	Charleston-North Charleston, SC	88.99	88.70	-0.29
98	Los Angeles-Long Beach-Anaheim, CA	84.19	83.72	-0.48
99	Oxnard-Thousand Oaks-Ventura, CA	81.36	80.84	-0.52
100	San Francisco-Oakland-Hayward, CA	76.78	76.18	-0.60

- Largest temperature differences between 0.5-1 degree Fahrenheit
- Largest differences are in inland areas, negative differences are in coastal areas

Conclusions

- Residents are **exposed to similar extreme heat temperatures in their residential settings, surrounding neighborhoods, and the neighborhoods they travel to** for daily routines.
  - Applies to all regions
- There is **variation** by metropolitan area
  - Temperatures are **cooler** at the network scale in **coastal metros** whereas they are **warmer** in desert and **inland metros.**
- Black/White, Hispanic/White and Poor/Nonpoor **inequalities persist in the daily mobility networks.**
  - While much research has demonstrated these inequalities in residential neighborhoods, this is the **first study** to show that these inequalities also exist in the **neighborhoods residents visit.**



Next Steps

- Run multivariate **spatial regression models** to estimate heat exposure levels.
- Further examine metropolitan area **heterogeneity** in heat exposure differences.
- Examine **tree canopy** as a **potential modifier** of heat exposure.

References

Dialesandro, J.; Brazil, N.; Wheeler, S.; Abunnasr, Y. Dimensions of Thermal Inequity: Neighborhood Social Demographics and Urban Heat in the Southwestern U.S. Int. J. Environ. Res. Public Health 2021, 18, 941. https://doi.org/10.3390/ijerph18030941

Gro. (2023, June 28). Green roofs and the urban heat island effect. Green Roof Organisation. https://www.greenrooforganisation.org/2023/06/23/green-roofs-and-the-urban-heat-island-effect/

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