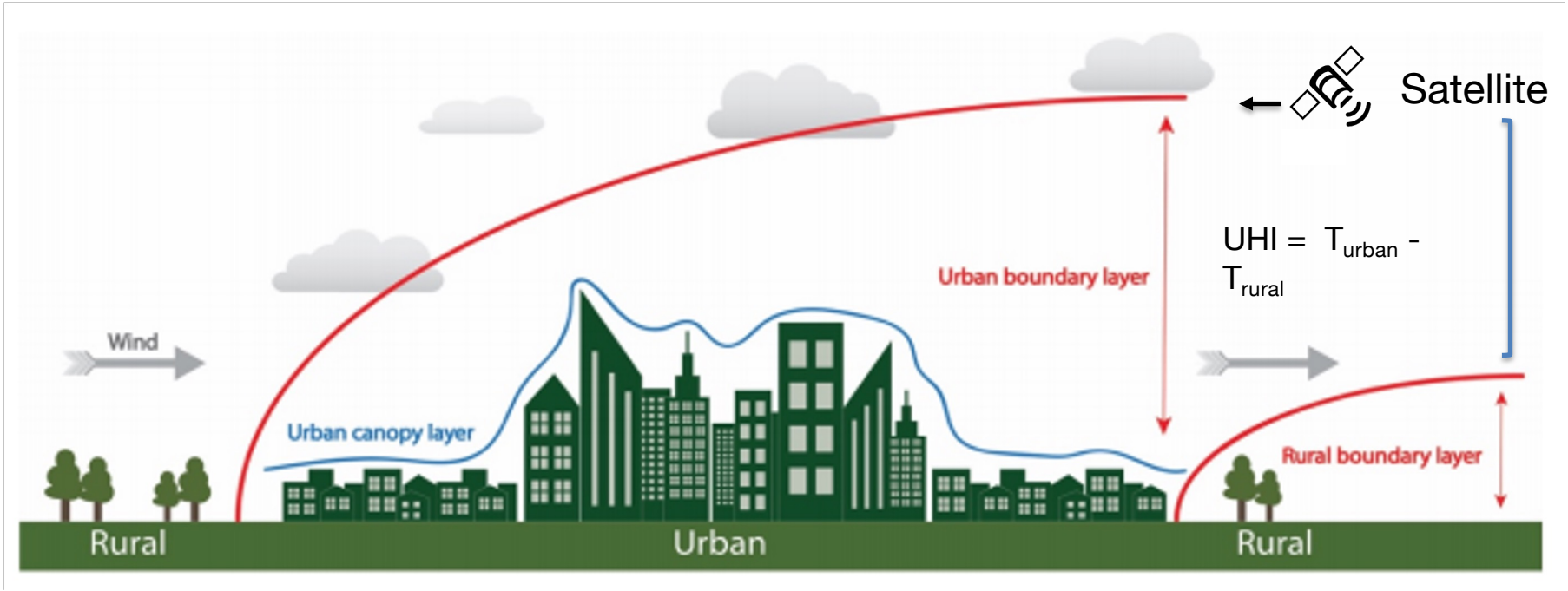
DATA DRIVEN ENVIROLAB

Citizen and Machine Learning-aided high-resolution mapping of urban heat exposure and stress

Wang, X., Hsu, A., & Chakraborty, T. (2023). Citizen and machine learning-aided high-resolution mapping of urban heat exposure and stress. Environmental Research: Infrastructure and Sustainability. https://doi.org/10.1088/2634-4505/acef57

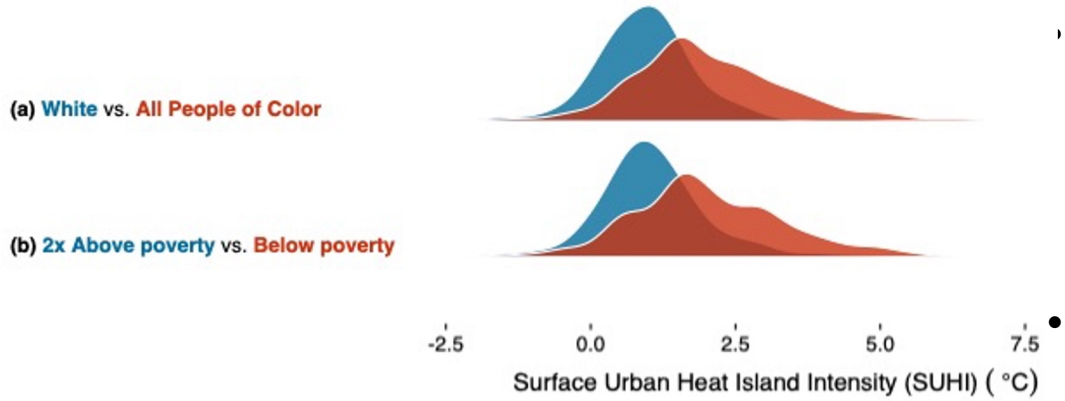
Presenter: Xuewei Wang, July, 2023

RECAP OF UHI AND HOW TO MEASURE IT



Source: Kershaw, T. (2017). *Climate Change Resilience in the Urban Environment*. IOP Publishing.

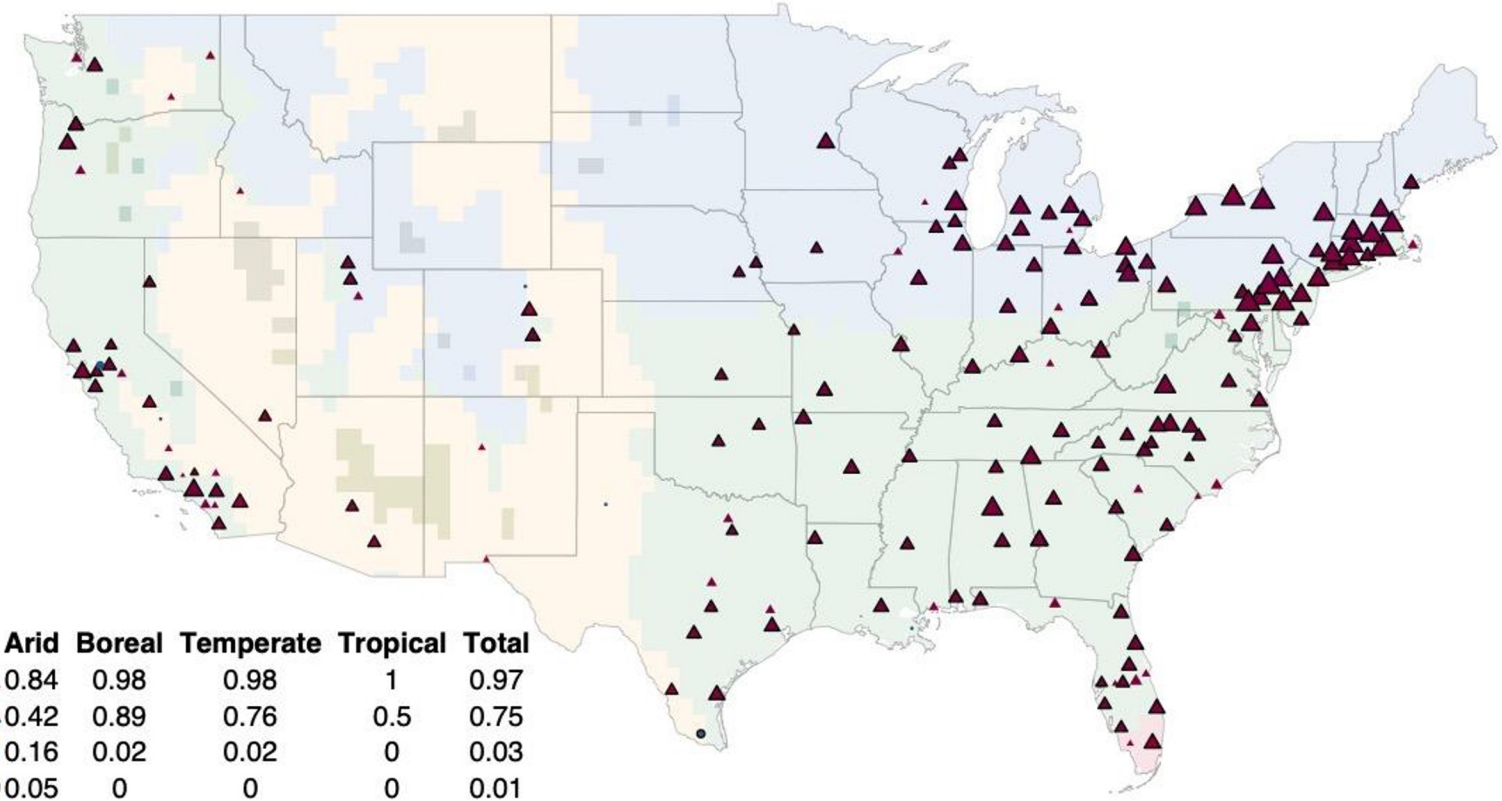
PATTERNS OF URBAN HEAT ISLAND DISPARITIES



Hsu, A., Sheriff, G., Chakraborty, T. et al. Publisher Correction: Disproportionate exposure to urban heat island intensity across major US cities. Nat Commun 12, 4104 (2021). https://doi.org/10.1038/s41467-021-23972-6

- In most major U.S. cities, populations in red exposed to higher urban heat island intensity than populations in blue.
- Exposure patterns virtually identical for populations c) Below poverty and People of Color.
- Distributions for age alone similar, except when combined with race (g-h).

97% MAJOR US CITIES – EXPOSE MINORITY POPULATIONS TO HIGHER URBAN HEAT ISLAND INTENSITY



	Arid	Boreal	Temperate	Tropical	Total
▲	0.84	0.98	0.98	1	0.97
▲	0.42	0.89	0.76	0.5	0.75
●	0.16	0.02	0.02	0	0.03
●	0.05	0	0	0	0.01

UHI Difference (°C) · 0 · 0.5 • 1.0 • 1.5 ● 3.5

Worse for • Worse for ▲

Climate zone Arid Snow Temperate Equatorial

CITIZEN SCIENCE FOR URBAN HEAT – NOAA HEAT WATCH

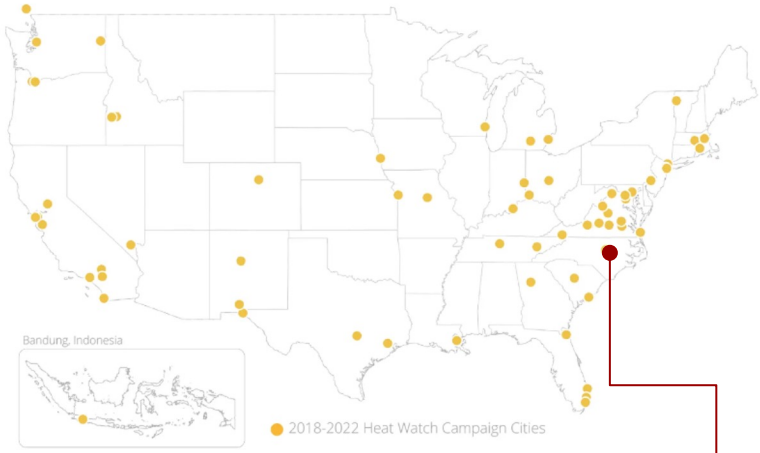


Image source:https://www.capastrategies.com/heat-watch

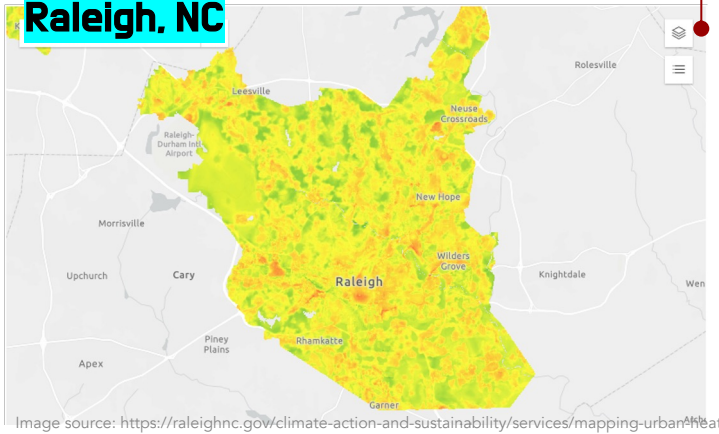
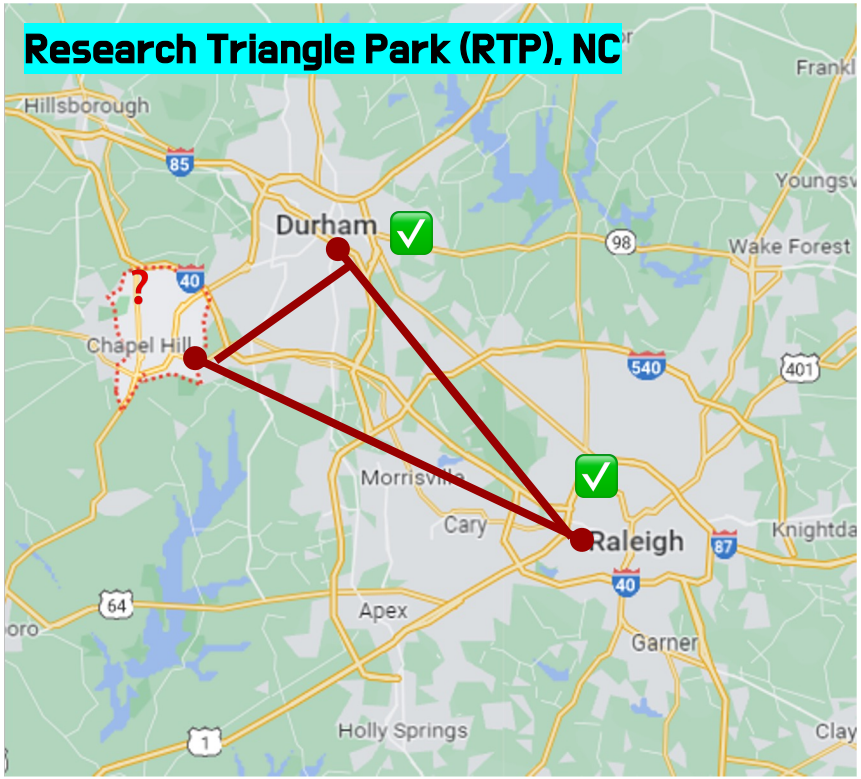
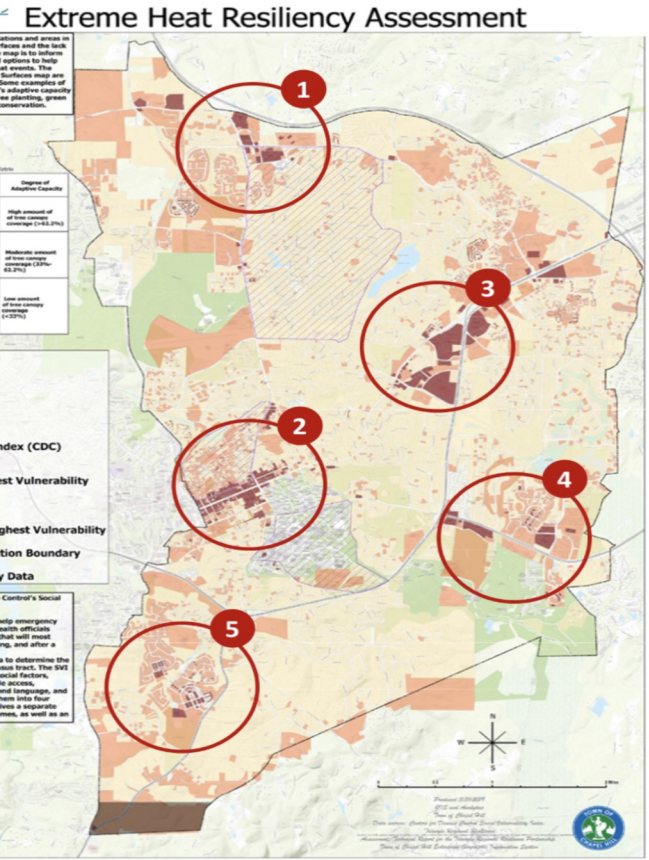
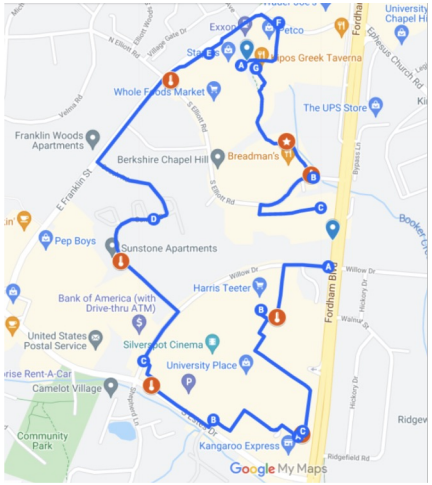


Image source: https://raleighnc.gov/climate-action-and-sustainability/services/mapping-urban-heat-islands



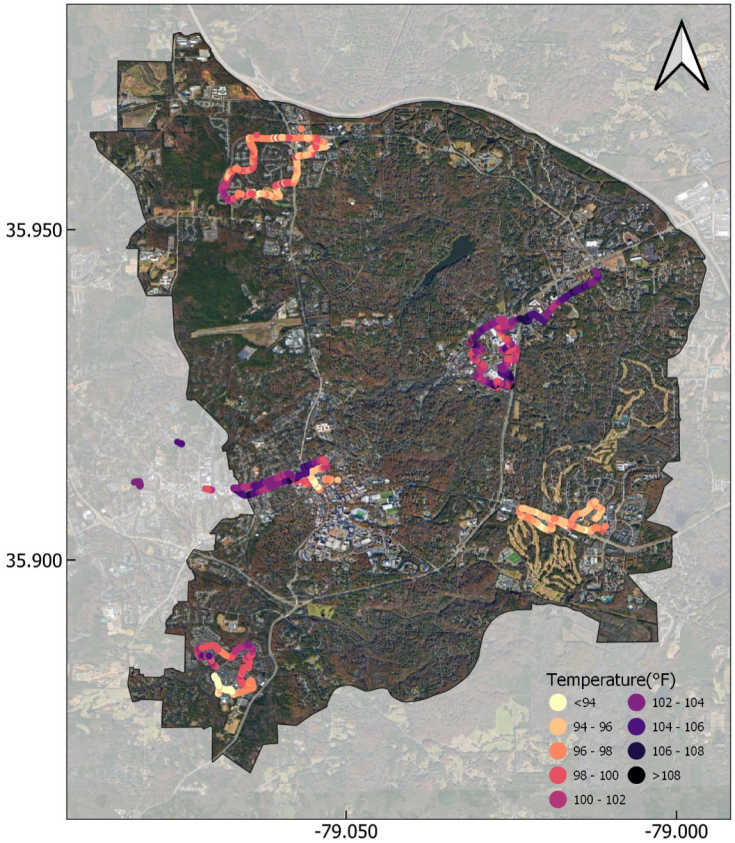
URBAN HEAT MAPPING CAMPAIGN IN CHAPEL HILL



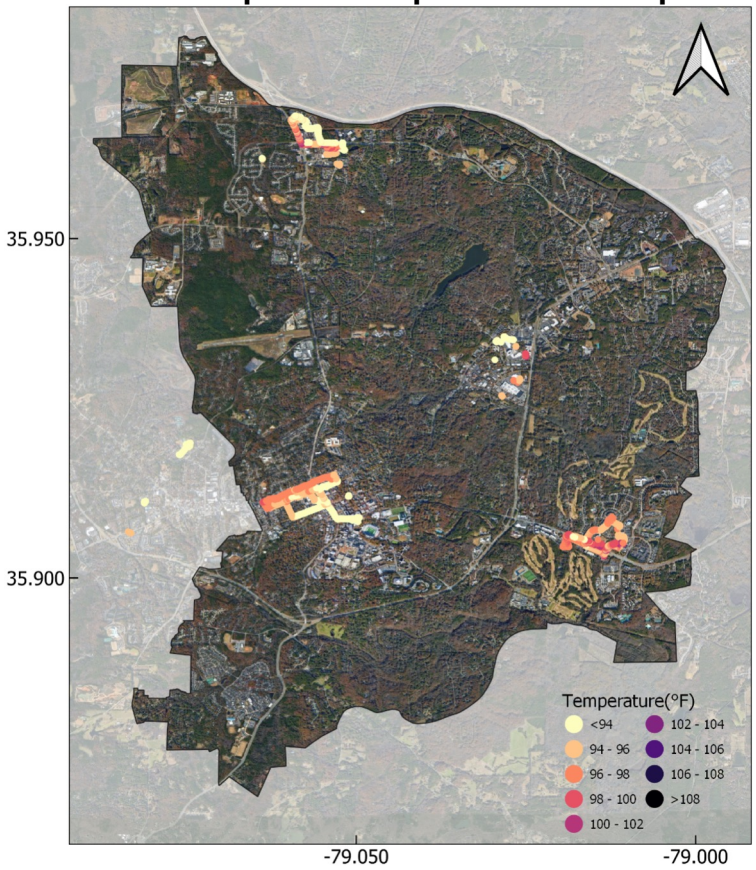


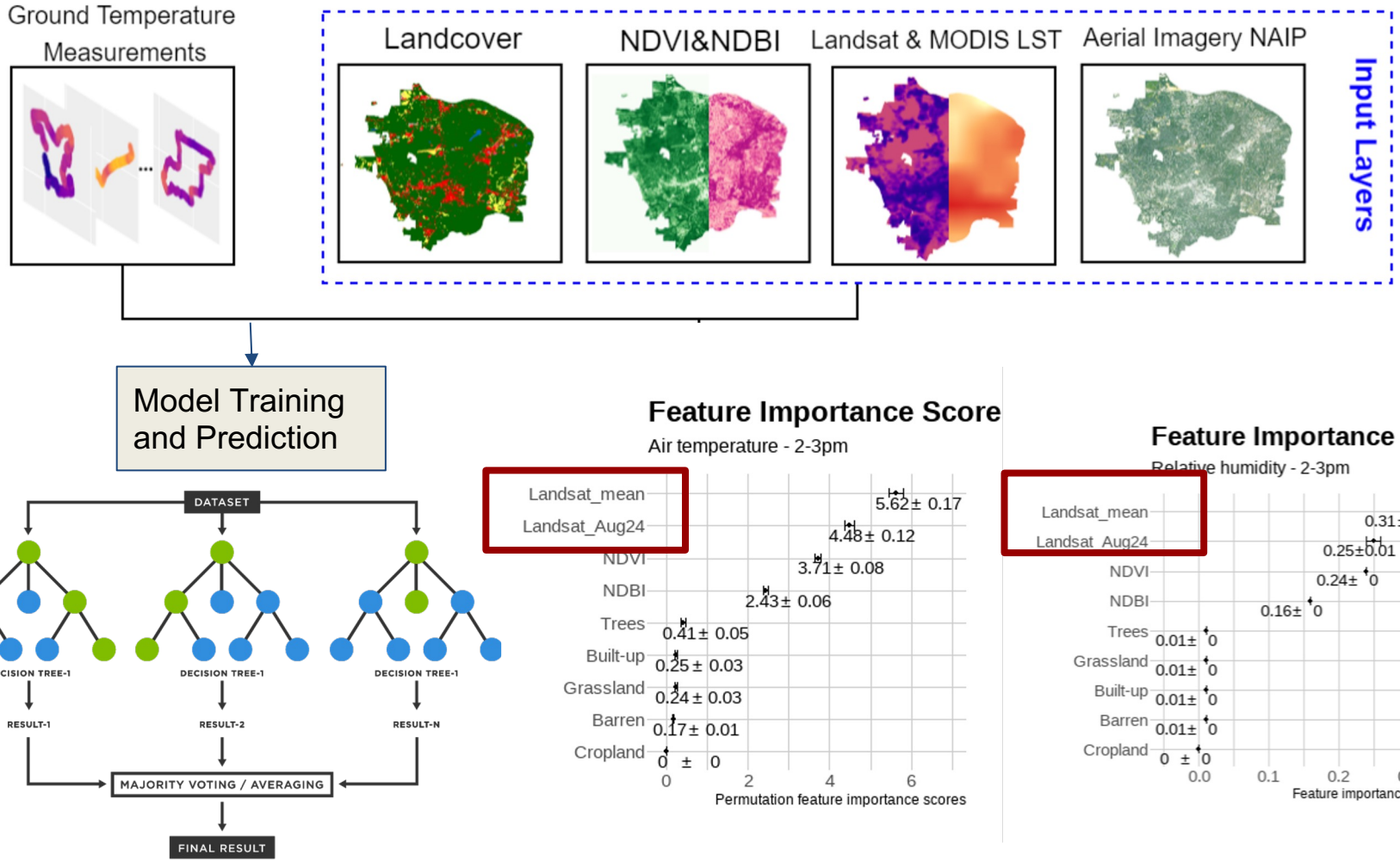
TRAVERSE MAPS

Chapel Hill 2-3 pm Traverse Map

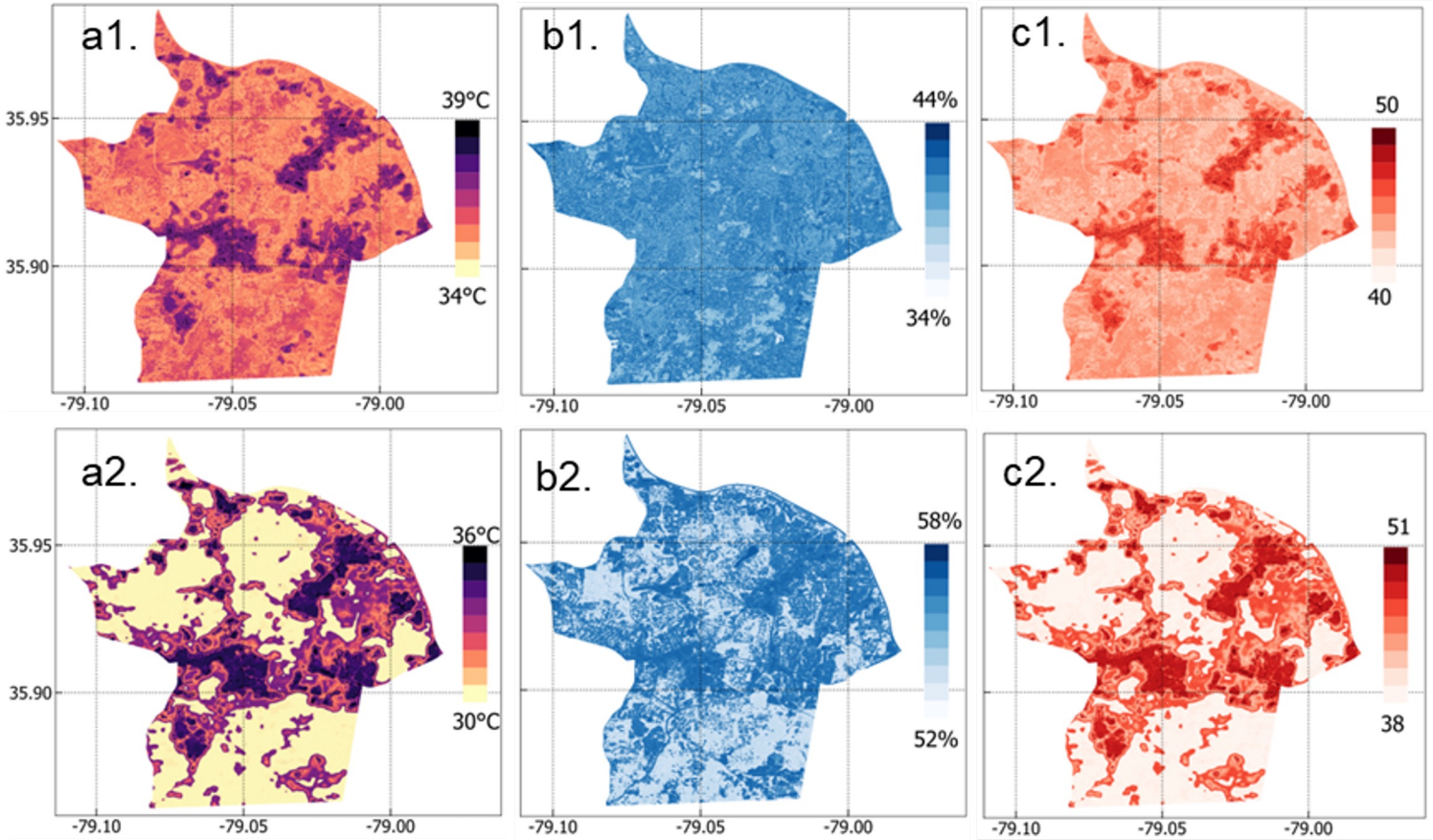


Chapel Hill 5-6 pm Traverse Map

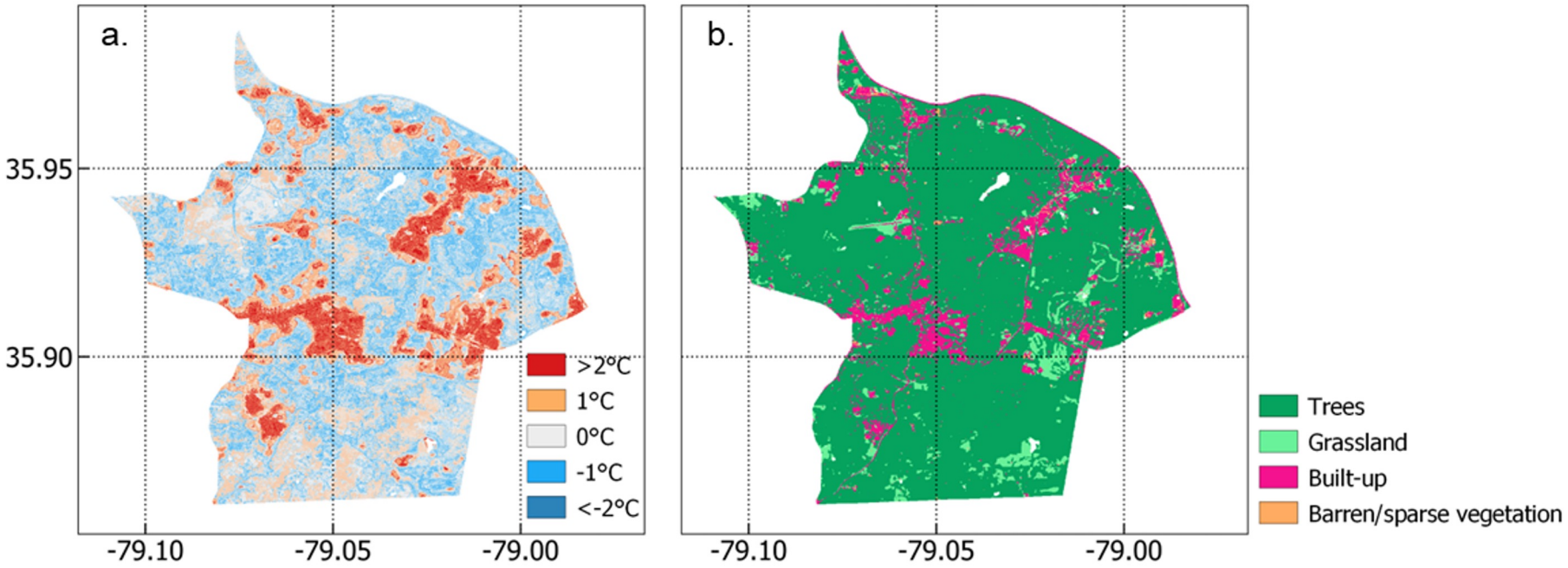



Ground Temperature Measurements
Landcover
NDVI&NDBI
Landsat & MODIS LST
Aerial Imagery NAIP
Input Layers
Model Training and Prediction
DATASET
DECISION TREE-1
DECISION TREE-1
DECISION TREE-1
RESULT-1
RESULT-2
RESULT-N
MAJORITY VOTING / AVERAGING
FINAL RESULT
Feature Importance Score
Air temperature - 2-3pm
Landsat_mean
Landsat_Aug24
NDVI
NDBI
Trees
Built-up
Grassland
Barren
Cropland
5.62± 0.17
4.48± 0.12
3.71± 0.08
2.43± 0.06
0.41± 0.05
0.25 ± 0.03
0.24 ± 0.03
0.17± 0.01
0 ± 0
0
2
4
6
Permutation feature importance scores
Feature Importance Score
Relative humidity - 2-3pm
Landsat_mean
Landsat_Aug24
NDVI
NDBI
Trees
Grassland
Built-up
Barren
Cropland
0.31±0.01
0.25±0.01
0.24± 0
0.16± 0
0.01± 0
0.01± 0
0.01± 0
0.01± 0
0 ± 0
0.0
0.1
0.2
0.3
Feature importance: Gain

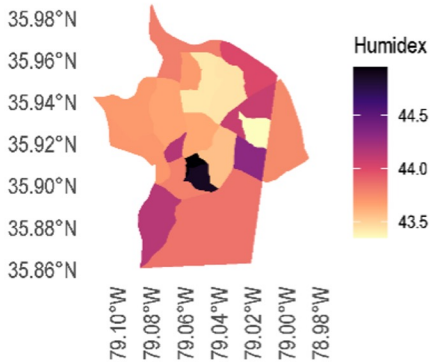
Predicted air temperature(°C), Relative Humidity(%) & Humidex

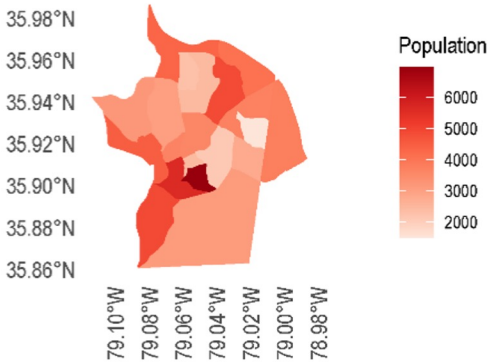


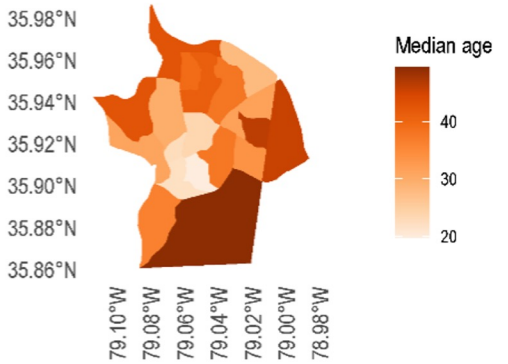
Predicted air temperature anomalies (°C) and land cover

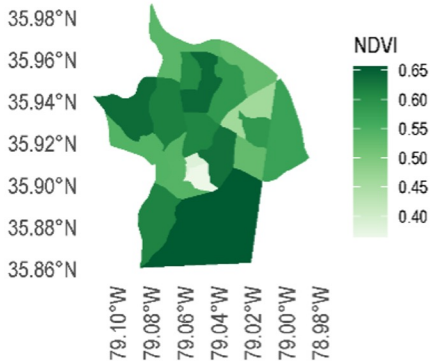


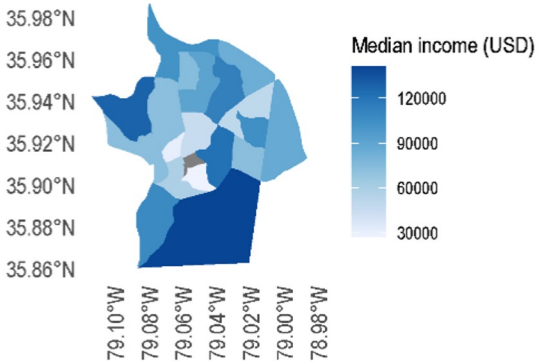
Sociodemographic Analysis by Census Tracts

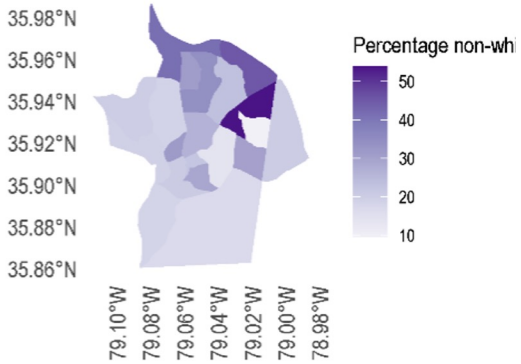


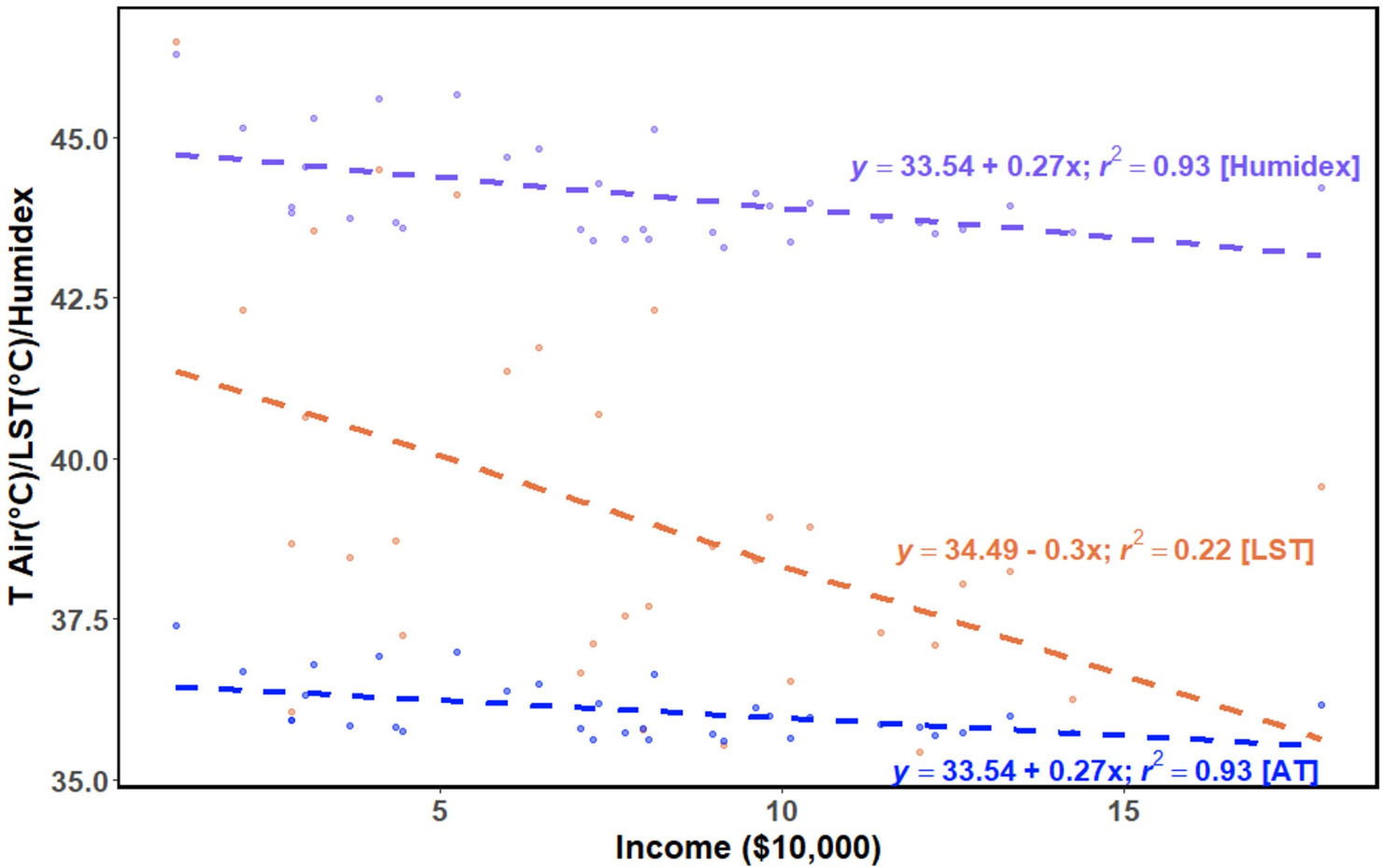




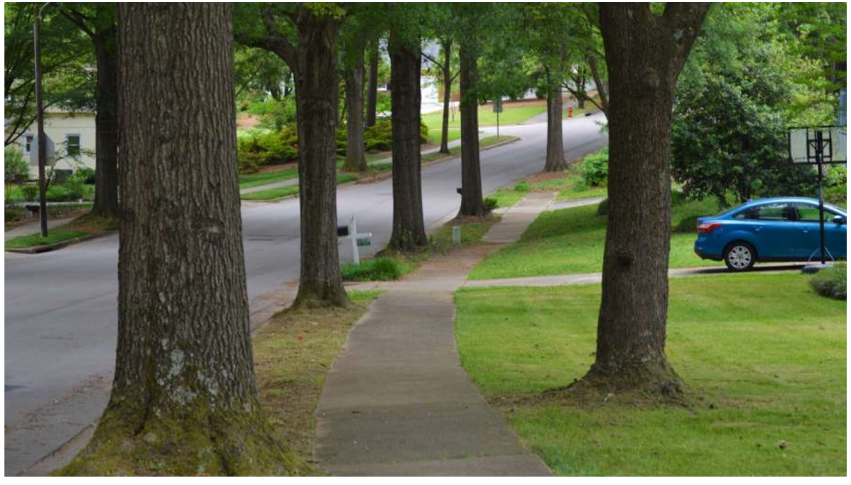







T Air(°C)/LST(°C)/Humidex
45.0
42.5
40.0
37.5
35.0
5
10
15
Income ($10,000)
y = 33.54 + 0.27x; r2 = 0.93 [Humidex]
y = 34.49 - 0.3x; r2 = 0.22 [LST]
y = 33.54 + 0.27x; r2 = 0.93 [AT]

Effective Interventions and Solutions



https://raleighnc.gov/parks/urban-forestry-program

Planting more trees

https://raleighnc.gov/climate-action-and-sustainability/mitigating-extreme-heat

City of Raleigh : Cool Roadways Pilot Project

Mapping Heat with

DATA DRIVEN ENVIROLAB

THANK YOU

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@DATADRIVENLAB
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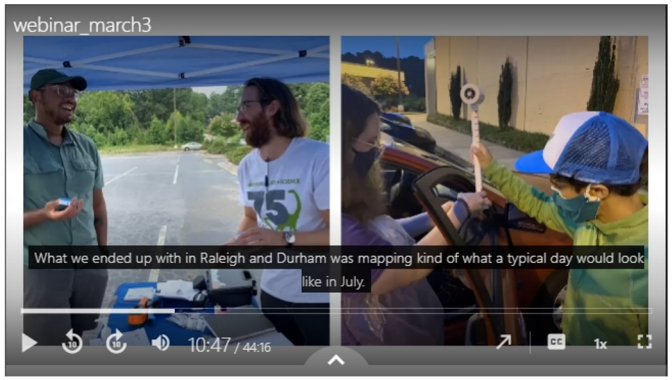
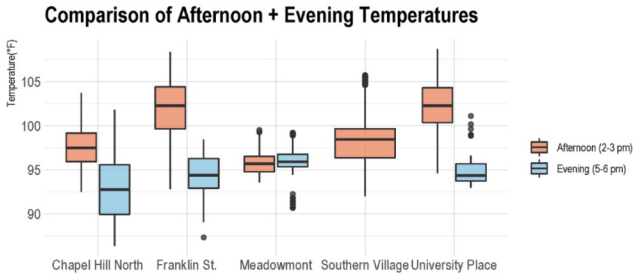
BLOG POST & REPORT FOR CHAPEL HILL HEAT WATCH





https://datadrivenlab.org/climate/ddl-releases-2021-chapel-hill-heatwatch-data-report/