



HARC

Cooling Our Cities: Urban Reforestation and Citizen Science Unite to Combat Heat

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2025 Urban Riparian Symposium



HARCresearch.org



A landmark, five-year, community forestry initiative to improve tree canopy equity, build resilience, and create green employment opportunities.



HARCresearch.org

Urban Heat

Urban and extreme heat are among the most significant health and climate issues facing Houston and Harris County.

We need to understand patterns:

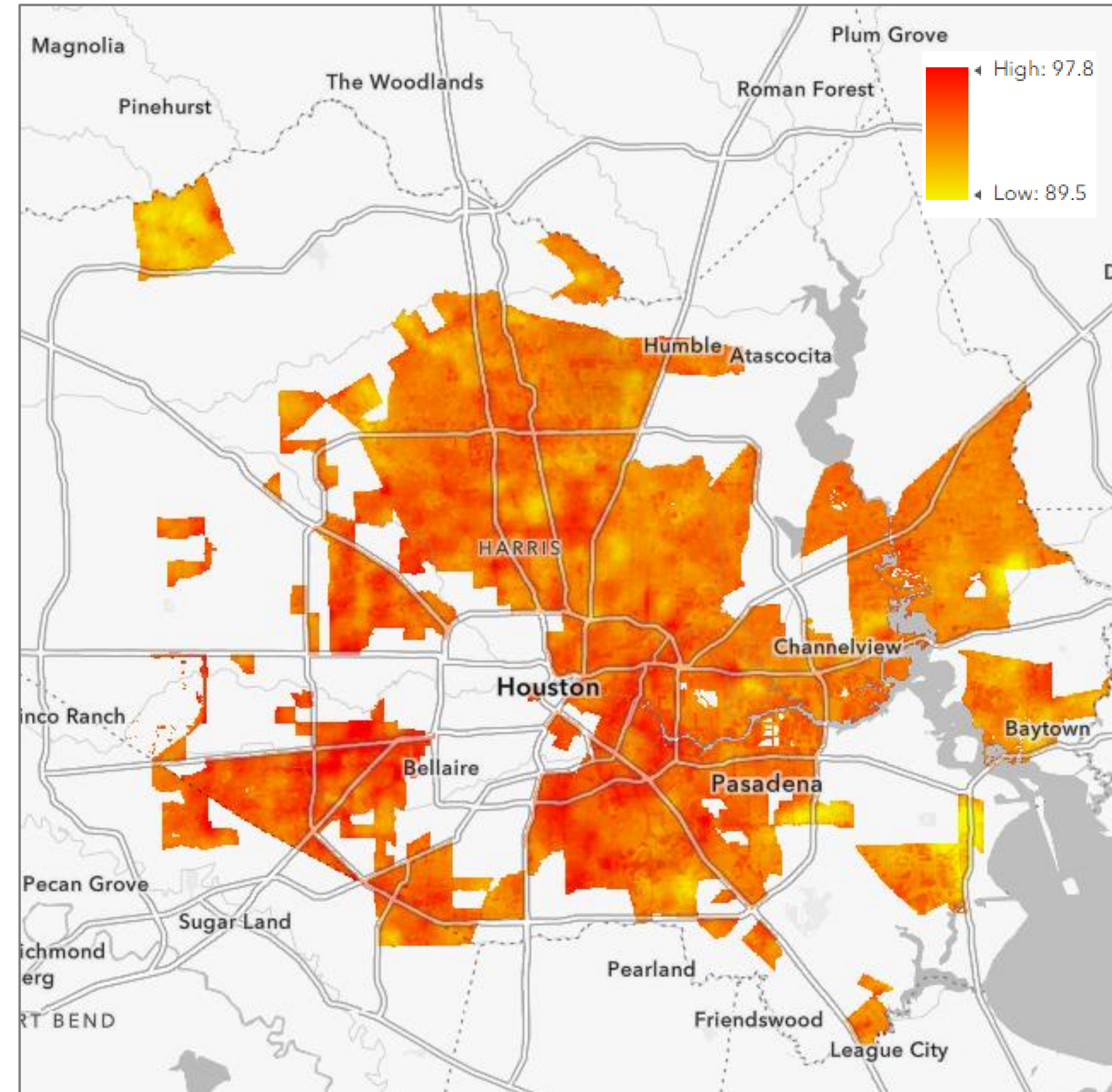
- Role of cities in heating and cooling
- How heat exposure varies with land cover and between neighborhoods
- How greenspace and tree canopy coverage relate to the observed patterns in heat

To implement effective mitigation measures:

Short term: Help officials develop cooling interventions to manage extreme heat days

Long term: Guide adaptation and mitigation efforts to reduce heat exposure

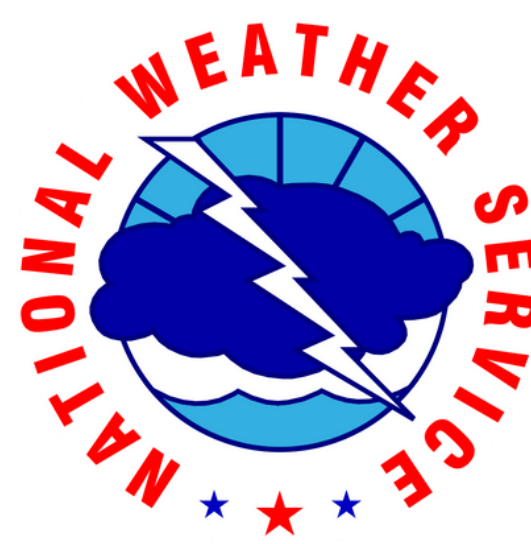
[HARCresearch.org](https://harcresearch.org)



2024 Heat Mapping Results: Afternoon Temperature Model

2024 Heat Mapping Campaign

1 day
9 Partners
157 Volunteers
69 Routes



[HARCresearch.org](https://www.harcresearch.org)

<https://www.h3at.org/>

Pre-Campaign: Recruiting & Training Volunteers



Feeling the Heat in Houston?

Take action by participating in a community H3AT mapping study!

Be a "street scientist" and help discover which areas of Houston and Harris County are hotter and cooler during an extreme weather event.

- Why is mapping heat in Houston and Harris County important? You'll learn about how different neighborhoods vary in terms of heat across our region, and why.
- On a designated "Campaign Day" this summer, you'll collect thousands of temperature and humidity measurements over 3, one-hour periods.
- Your contribution will reveal the distribution of heat across your region, helping the City of Houston and Harris County plan for the future and provide much needed relief.

You can be in the H3AT Mapping Campaign as a:



Driver



Navigator

If you would like to participate, please fill out the Volunteer Interest Form found [here](#). Find out more at www.H3at.org or by emailing heatmapping@harcresearch.org.

This campaign is being made possible through funding provided by the Inflation Reduction Act and the USDA Forest Service, Urban and Community Forestry Program.



These institutions are equal opportunity providers.



- Two training options:
 - Live, online volunteer training with Q&A session
 - Recorded, online training video

- Flexible volunteer shifts
 - Morning (6-7 AM)
 - Afternoon (3-4 PM)
 - Evening (7-8 PM)

- Volunteers picked up their sensors from 9 different hubs prior to starting their route

HEAT WATCH SENSOR INFO SHEET PAGE 1

On/Off Button

Press the Button to turn the sensor ON*

- The Function Light should show a BLINKING BLUE light.
- The Battery Light will blink the current battery level for 5 seconds (green, yellow or red). If it shows red, plug it in to charge.

*Due to a manufacturing defect, you may need to press the button multiple times for it to latch to ON; Repeat gently. After 5 to 10 tries, try charging it.

Function Light

BLINKING BLUE = GPS is searching for signal (wait to move)
SOLID BLUE = GPS signal is locked (good to go!)

The GPS signal usually locks within 5 minutes

If the GPS light starts to BLINK again, find a safe, open place to stop driving and wait for it to go SOLID again.

The sensor function will work the same whether charging or not charging; you can operate the sensor while charging.

Rapid Blinking RED-BLUE Light: This means the sensor is malfunctioning and not recording data; First turn it off & on again.

If this light persists, before, during or after your traverse hour, pull over and get in contact with your organizer to receive a back-up sensor.



Technical Specifications

Air Temperature: -40 to 80°C, ±0.5°C
Relative Humidity: 0 to 100%, ±2 to 5%
Global Positioning System (GPS): ±3.0m, ±0.1m/s

Sensor ID #

Battery Light

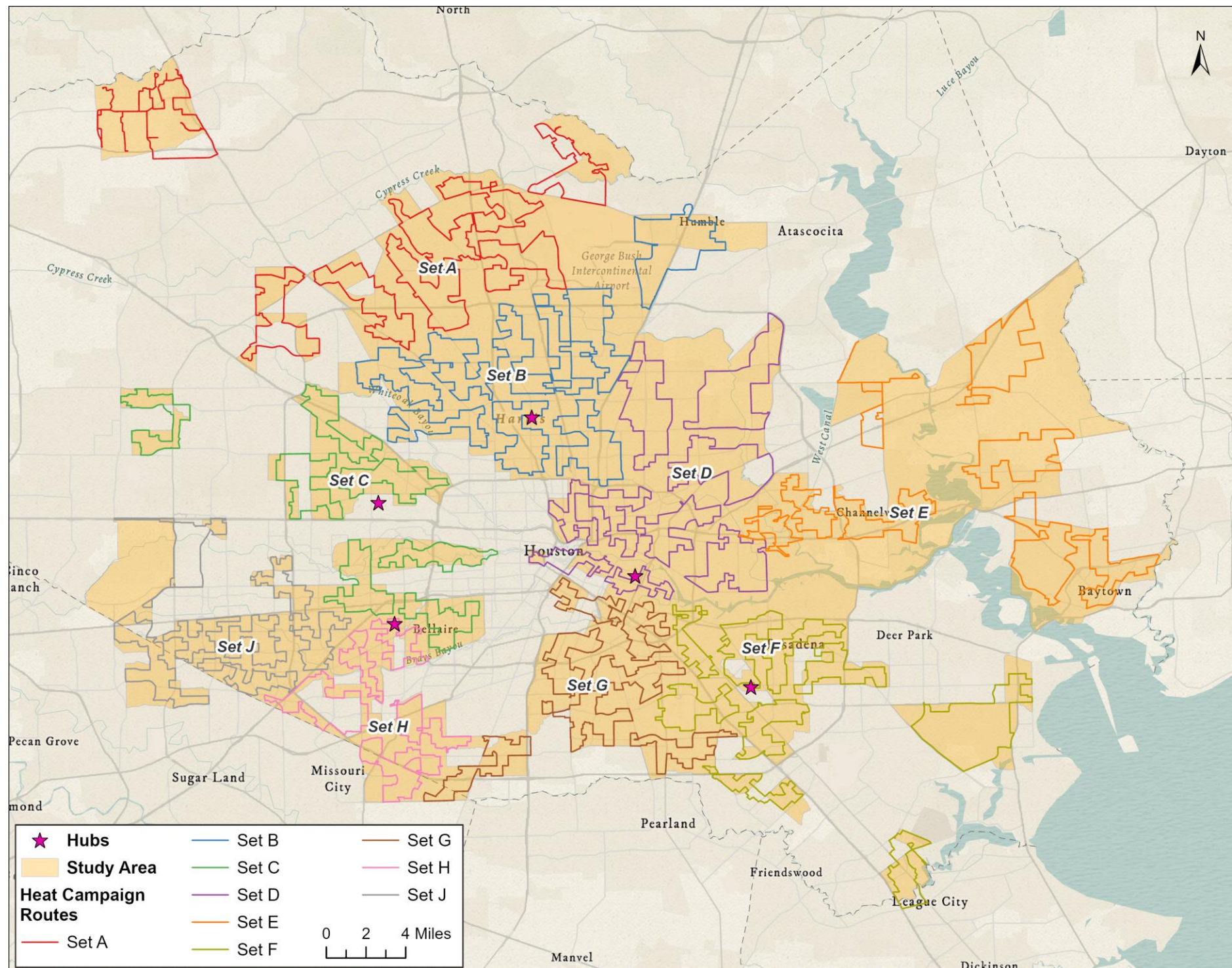
When the sensor is turned ON, the Battery Light blinks the current battery level of the sensor for 5 seconds (green, yellow, or red).

To charge the sensor, connect a USB-C to A charging cord to any power supply.

The sensor requires 2+ hours to fully charge from 0% to 100% (depending on the power source, cord and current battery level).

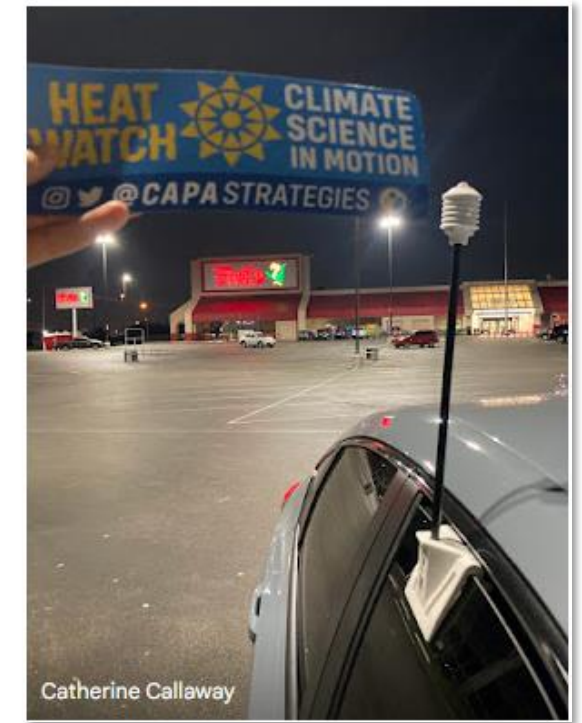
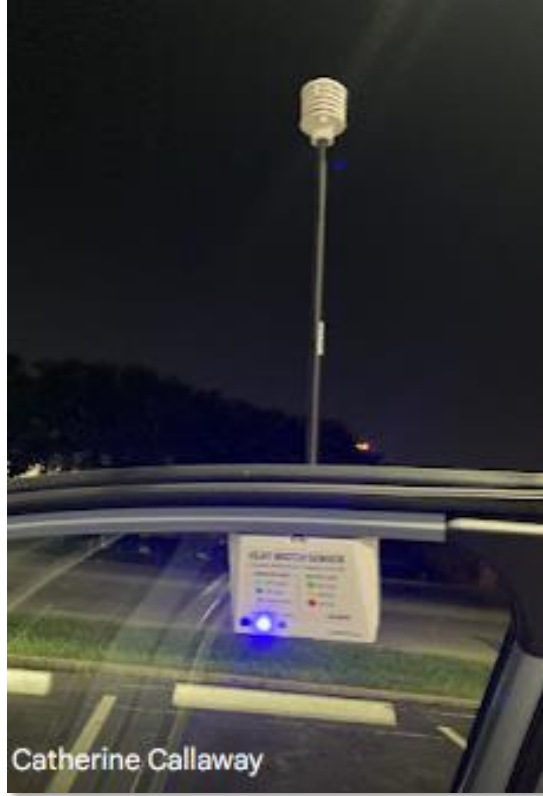


Heat Mapping Campaign Day 2024



- Largest single-day heat mapping campaign in the U.S.
- Partners served as hub managers and primary contacts for sensor troubleshooting and reporting issues
- Community scientists drove a total of **3,446 miles** and collected **431,348 heat and humidity data points**
- Nearly all areas measured are identified as disadvantaged by CJEST

Community Scientists in Action



Post-Campaign: Transmitting & Processing Data



Modeling Method

The three key steps and geospatial processes that allow CAPA analysts to transform traverse point data into area-wide models of temperature.



1 Download & Filter



Download raw heat data from cloud storage



Compare data with field notes and debrief interview



Trim data to proper time window, speed, and study area

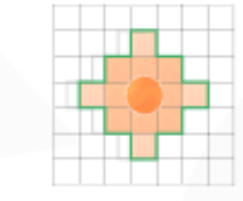
2 Integrate & Analyze



Download multi-band land cover rasters from Sentinel-2 satellite



Calculate spectral indices reflecting land cover features

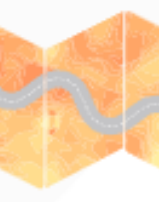


Transform land cover rasters using a moving window analysis

3 Predict & Validate



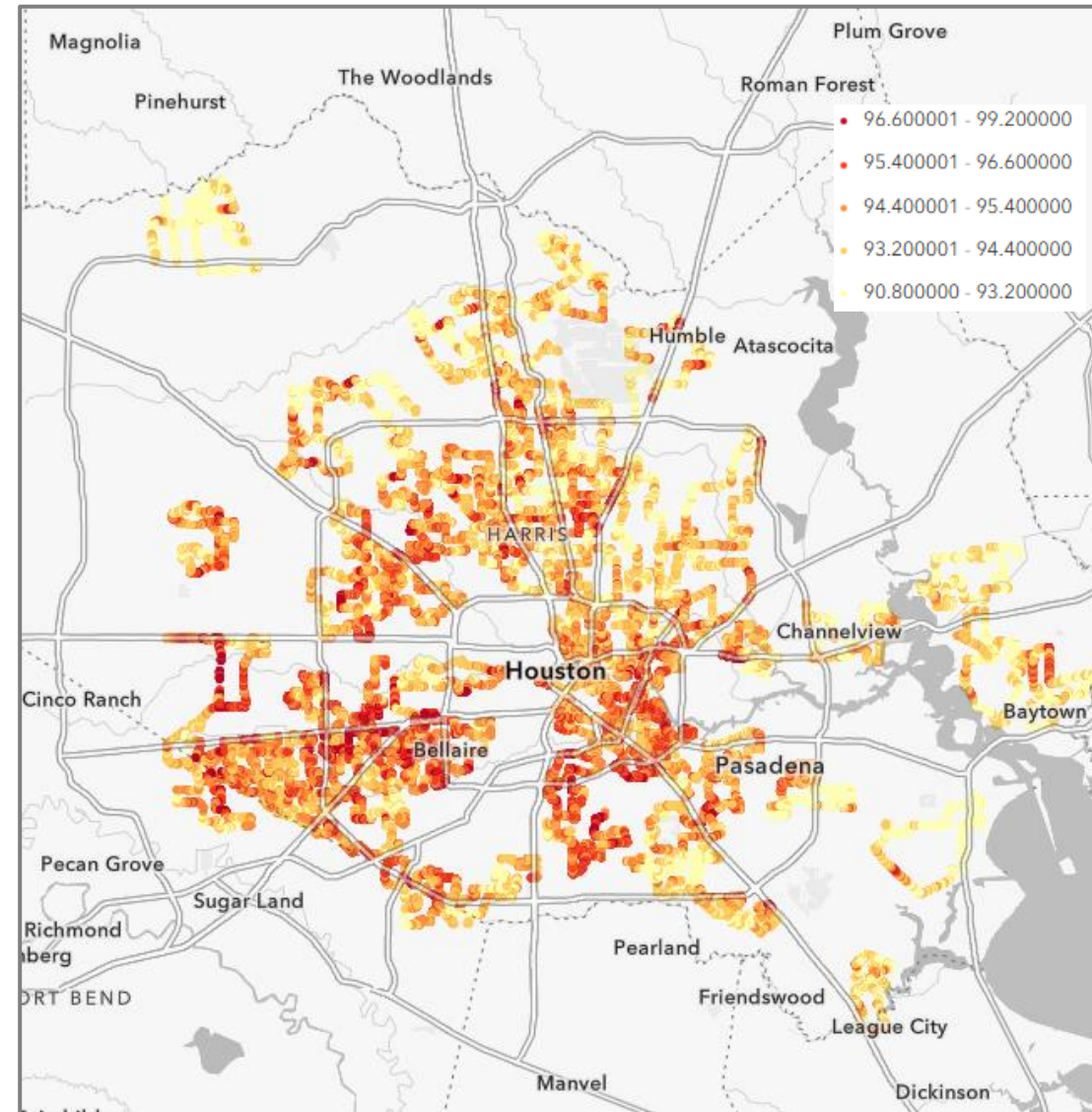
Combine heat and land cover data in geostatistical model



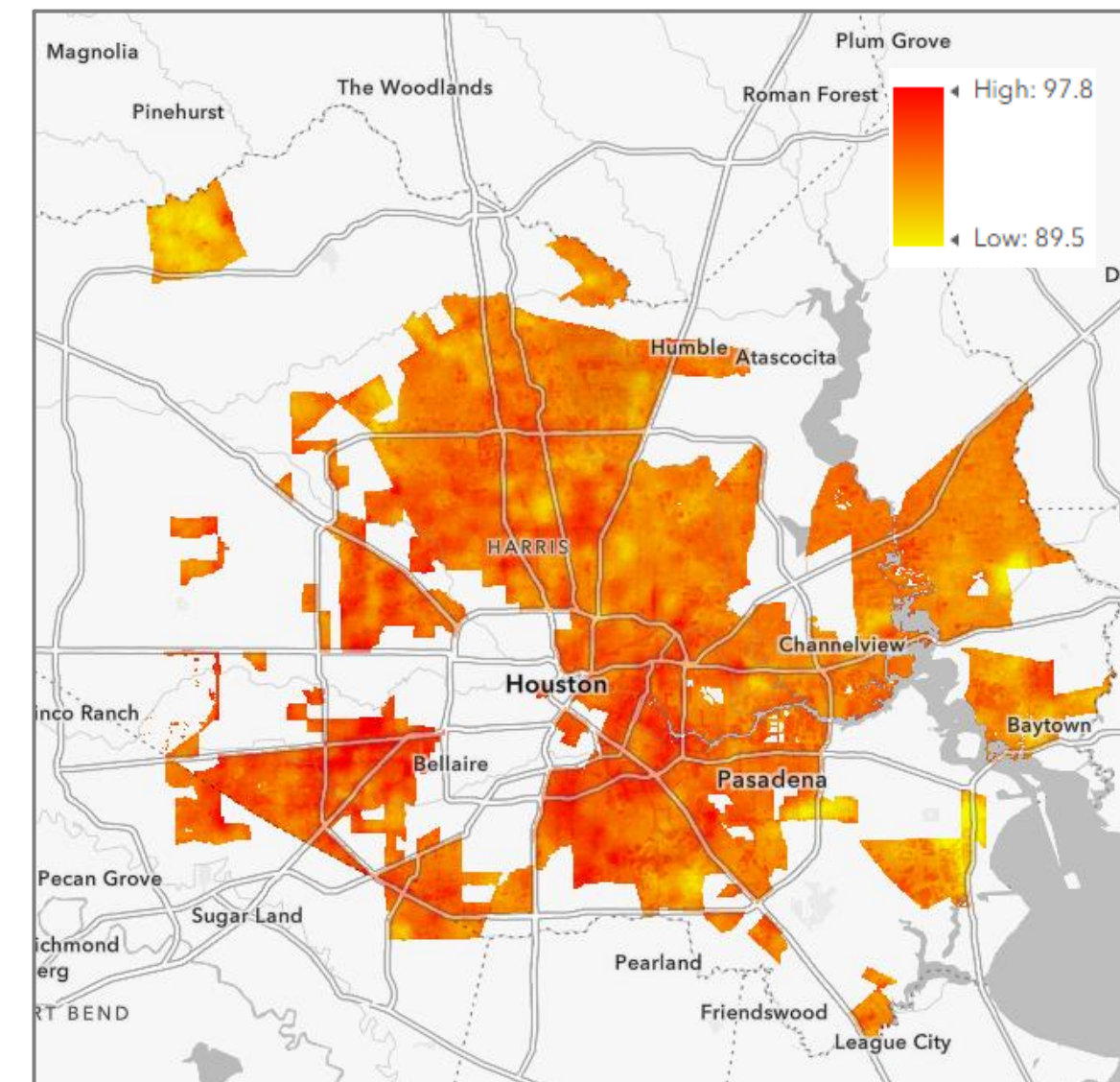
Create predictive raster surface models of each period



Perform cross validation using k-fold holdout method



Afternoon Traverse Points



Afternoon Temperature Model

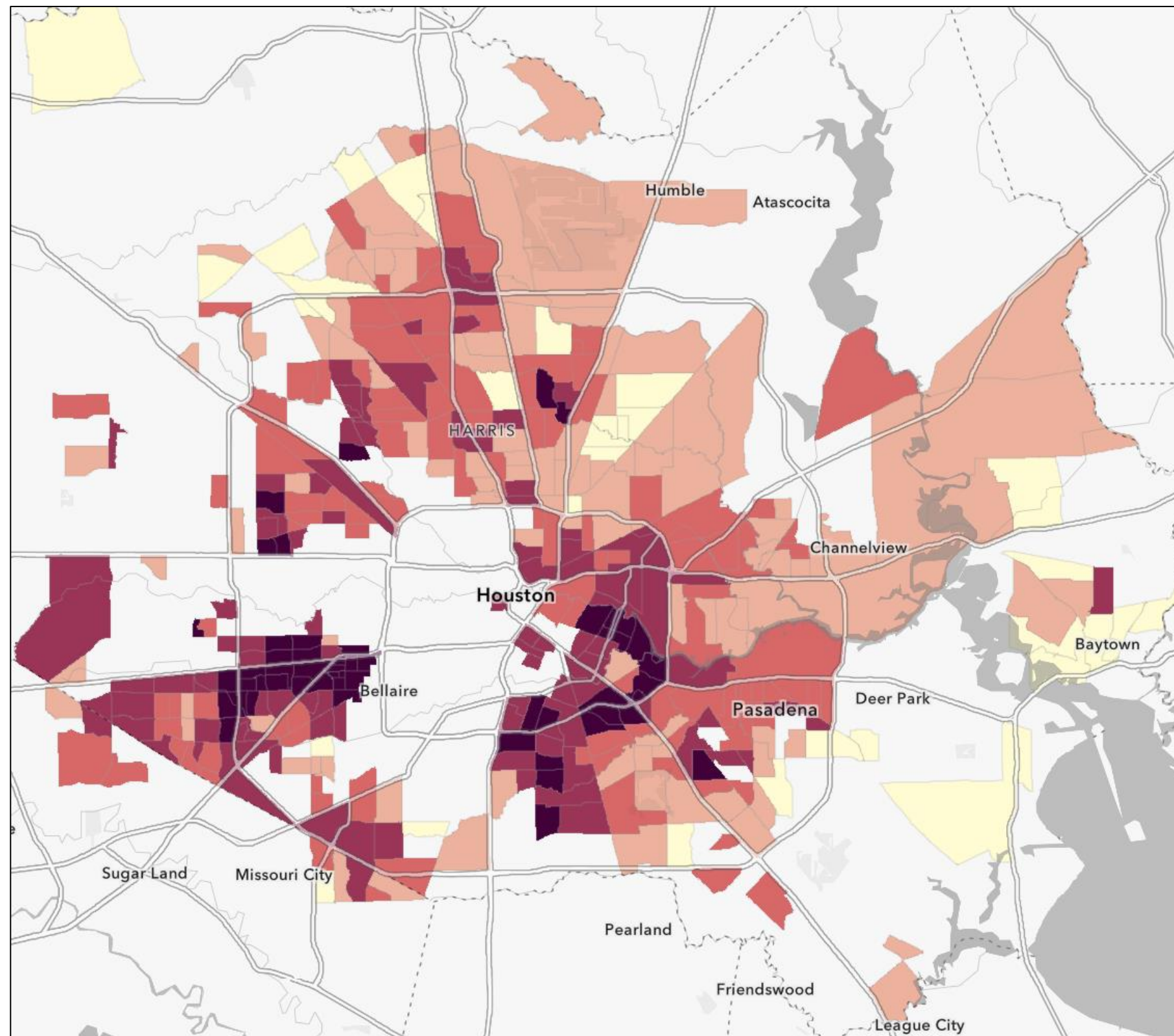
The most relevant and recent publications include:

Shandas, V., Voelkel, J., Williams, J., & Hoffman, J., (2019). Integrating Satellite and Ground Measurements for Predicting Locations of Extreme Urban Heat. *Climate*, 7(1), 5. <https://doi.org/10.3390/cli7010005>

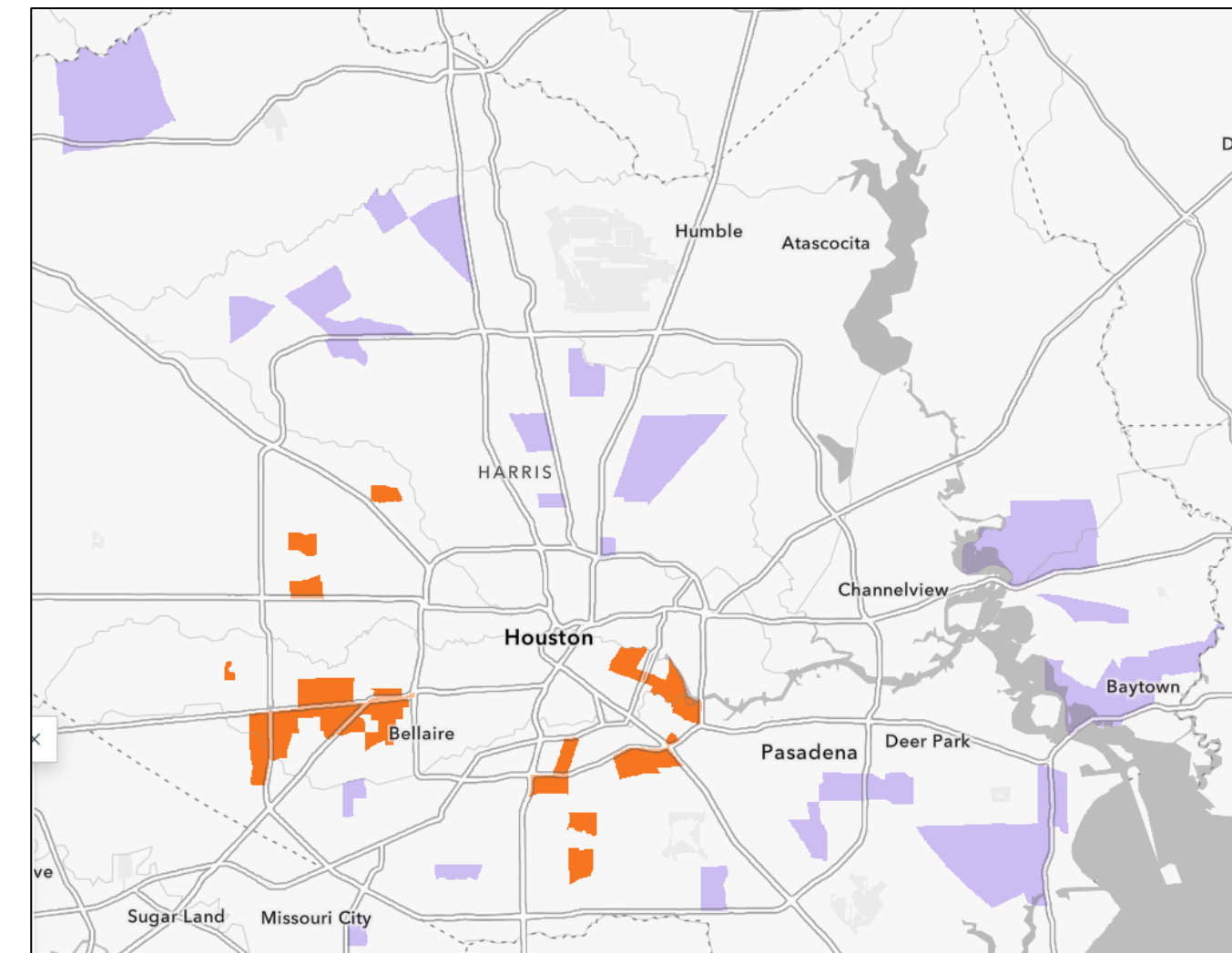
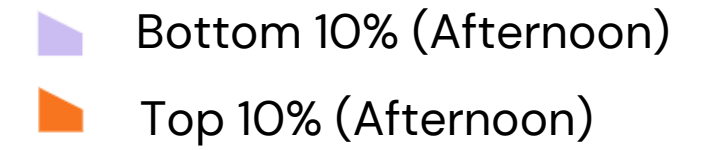
Voelkel, J., & Shandas, V. (2017). Towards Systematic Prediction of Urban Heat Islands: Grounding Measurements, Assessing Modeling Techniques. *Climate*, 5(2), 41. <https://doi.org/10.3390/cli5020041>

- Maximum afternoon temperature observed: **103°F**
- Observed maximum **14°F** difference between neighborhoods

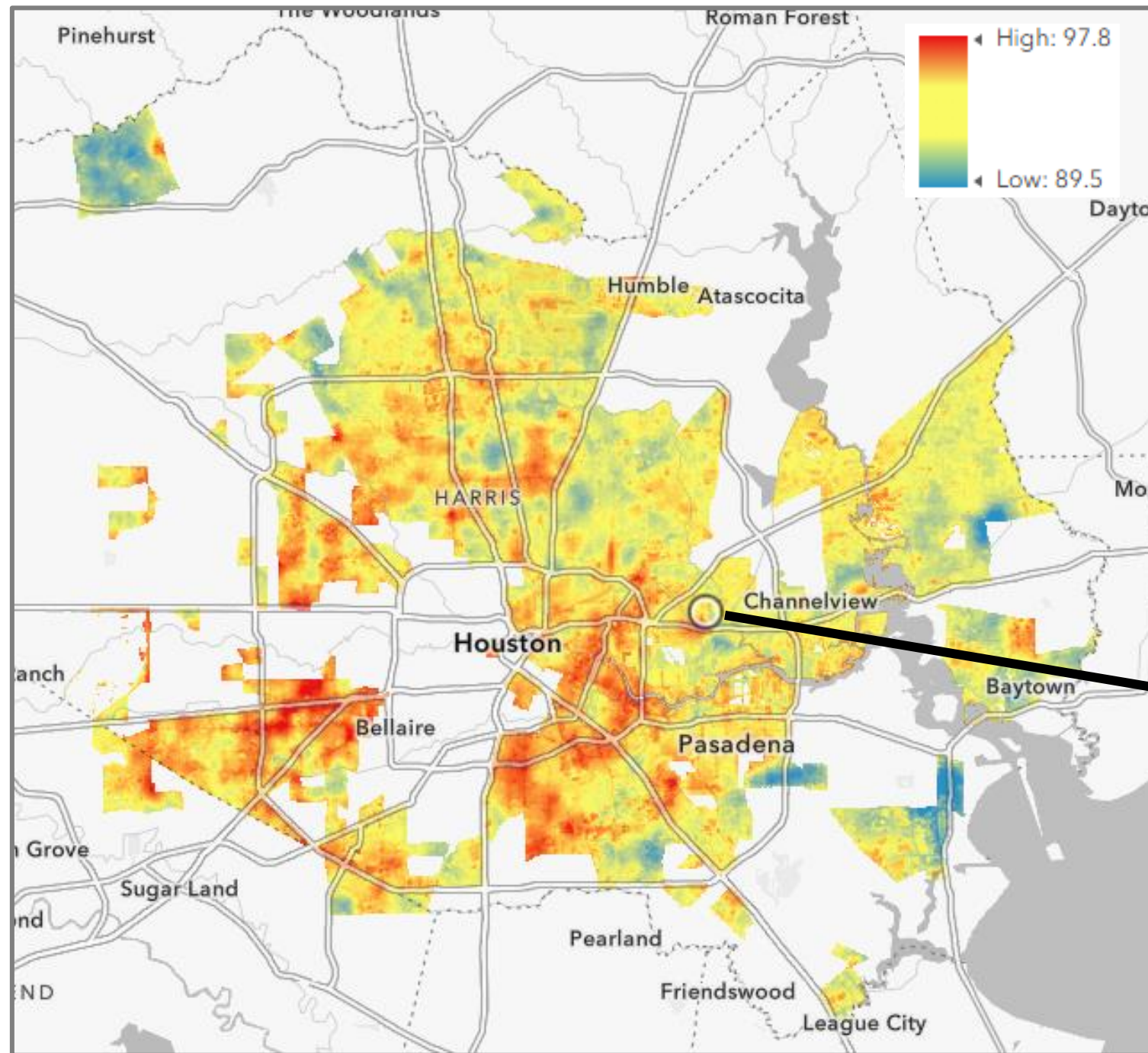
Post-Campaign: Heat Mapping Results



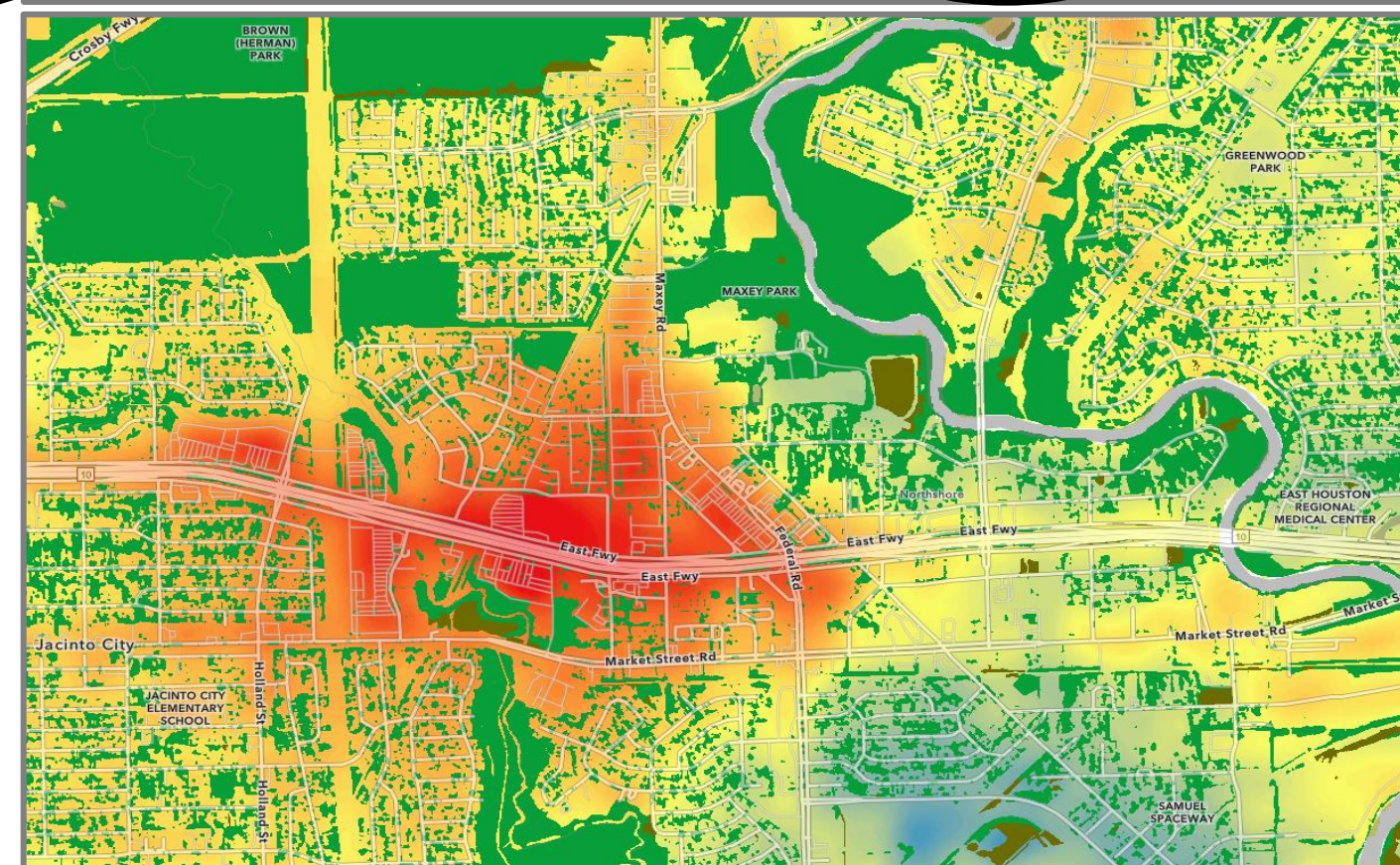
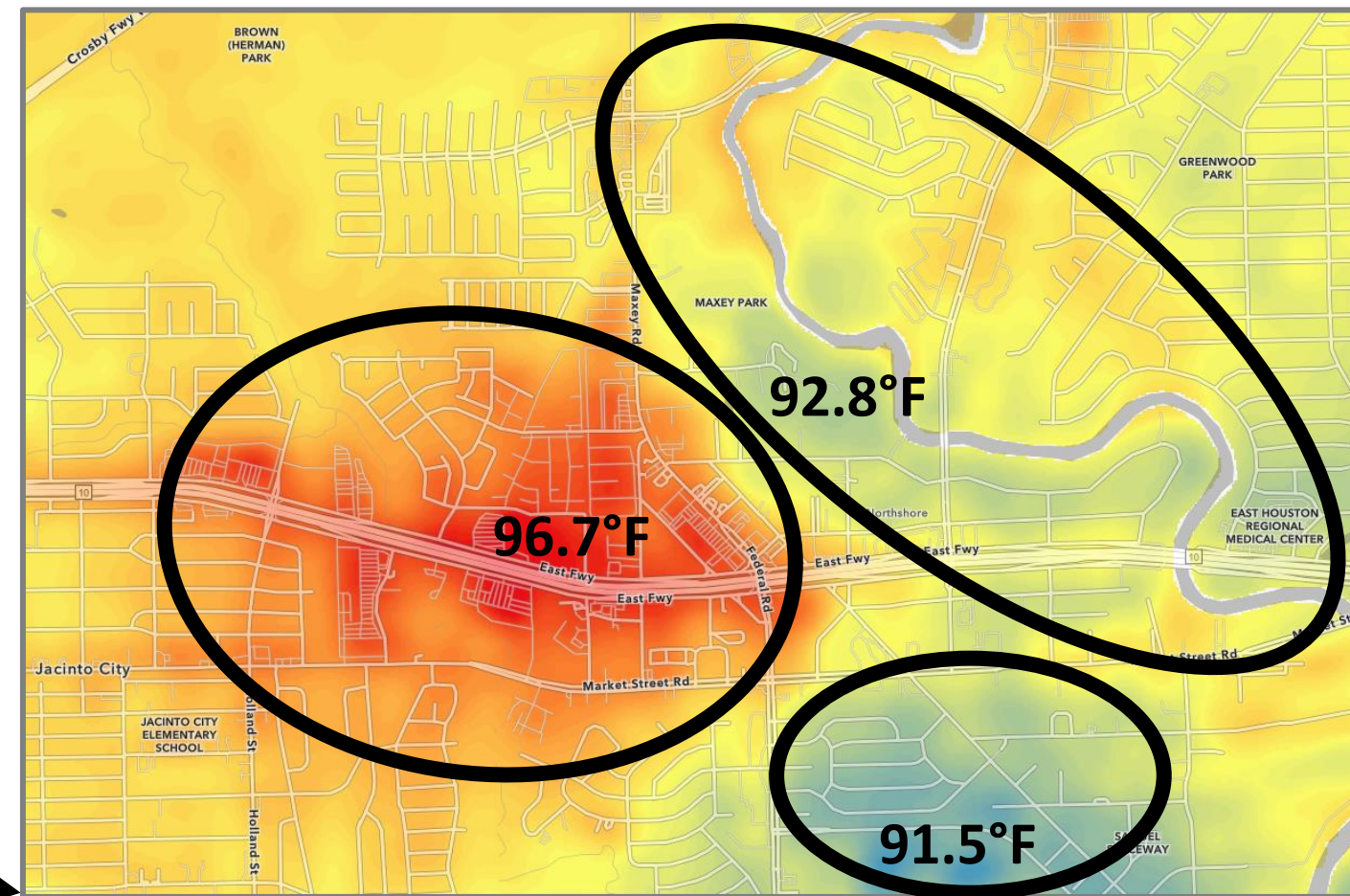
Afternoon Heat Anomaly (Degree F):



Post-Campaign: Heat Mapping Results



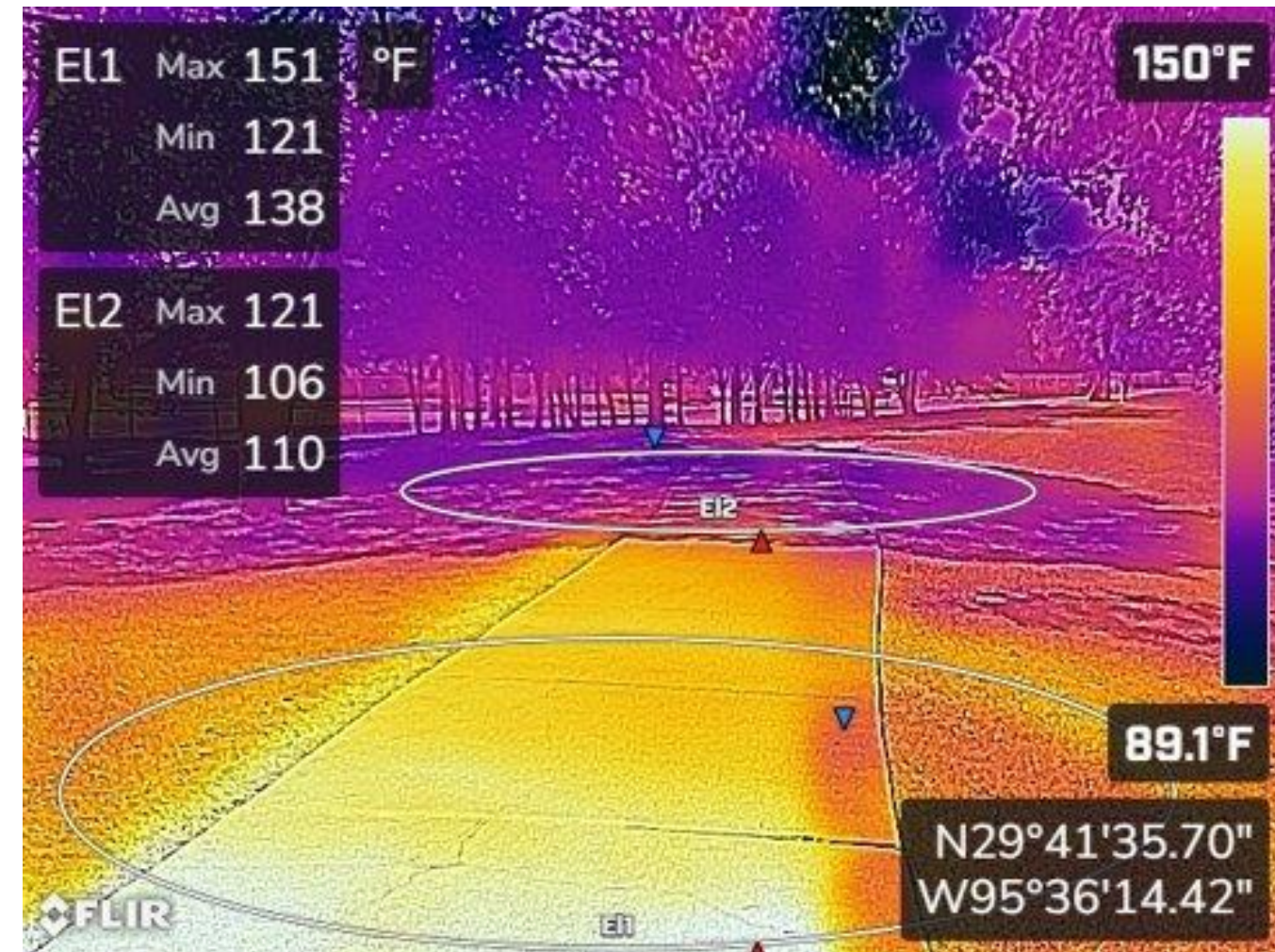
Afternoon Temperature Model



- NOAA C-CAP
Tree Canopy**
- Upland Tree (Forest)
 - Scrub/Shrub

The Importance of Tree Canopy

Urban Park in August – Ambient Temperature of 102°F



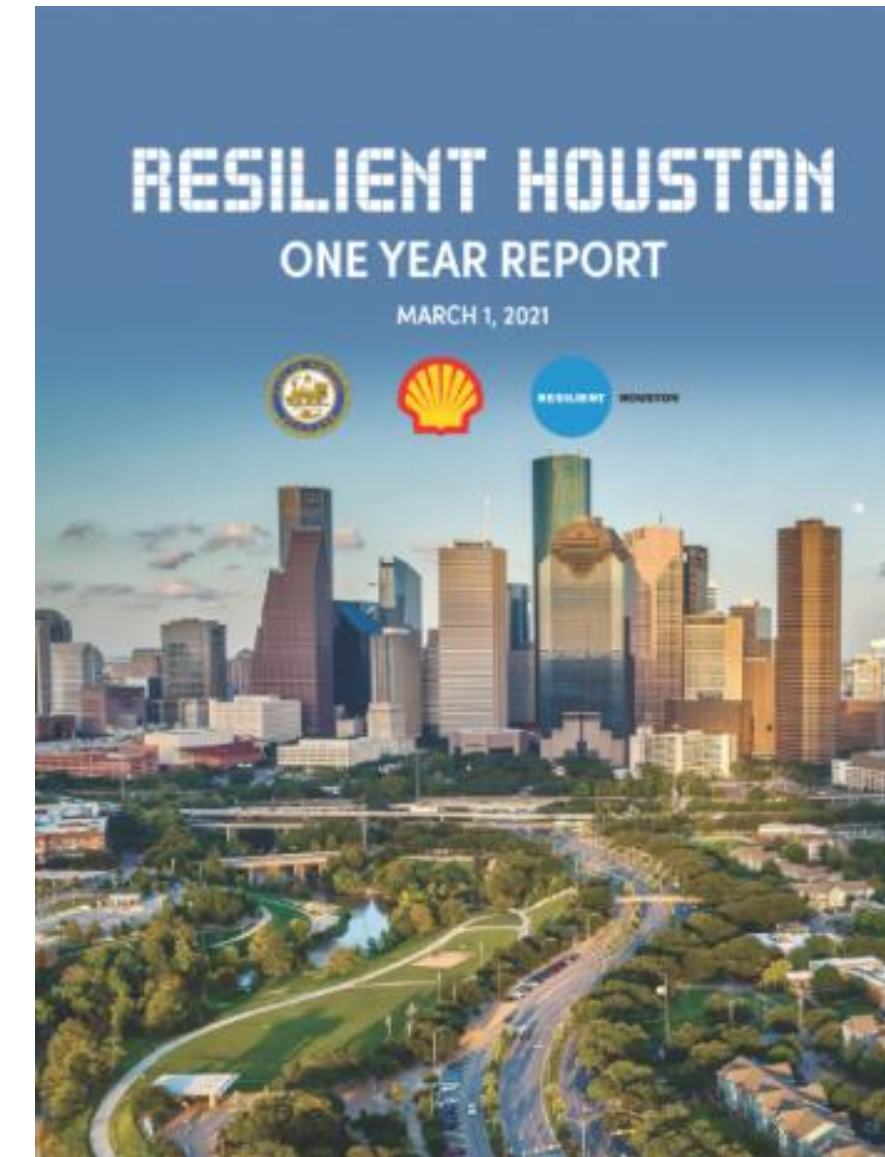
How will these data be used?



Inform strategic tree planting efforts to increase tree canopy equity and mitigate UHI impacts at the local scale

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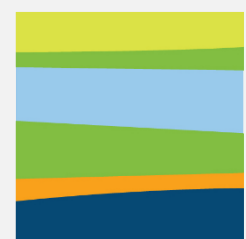
Identify which neighborhoods in Houston and Harris County are hottest



Local environmental reports

Shared at Community Town Hall events

For further information and to explore the data check out h3at.org and forustreehtx.org, or contact me at kvernin@harcresearch.org



HARC

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