



NIHHIS Urban Heat Island Mapping Campaigns 2022

How the NIHHIS Urban Heat Island Mapping Campaigns create awareness among the public and develop local heat communities

Hunter Jones, Extreme Heat Risk Initiative Program Manager, NOAA/NIHHIS

Thanks to the NIHHIS team & partners, CAPA team, and myriad other volunteers!



Heat exhaustion or heatstroke? Know the signs of heat illness.

Focus areas: Weather Topics: heat waves, human health, extreme weather, sun safety

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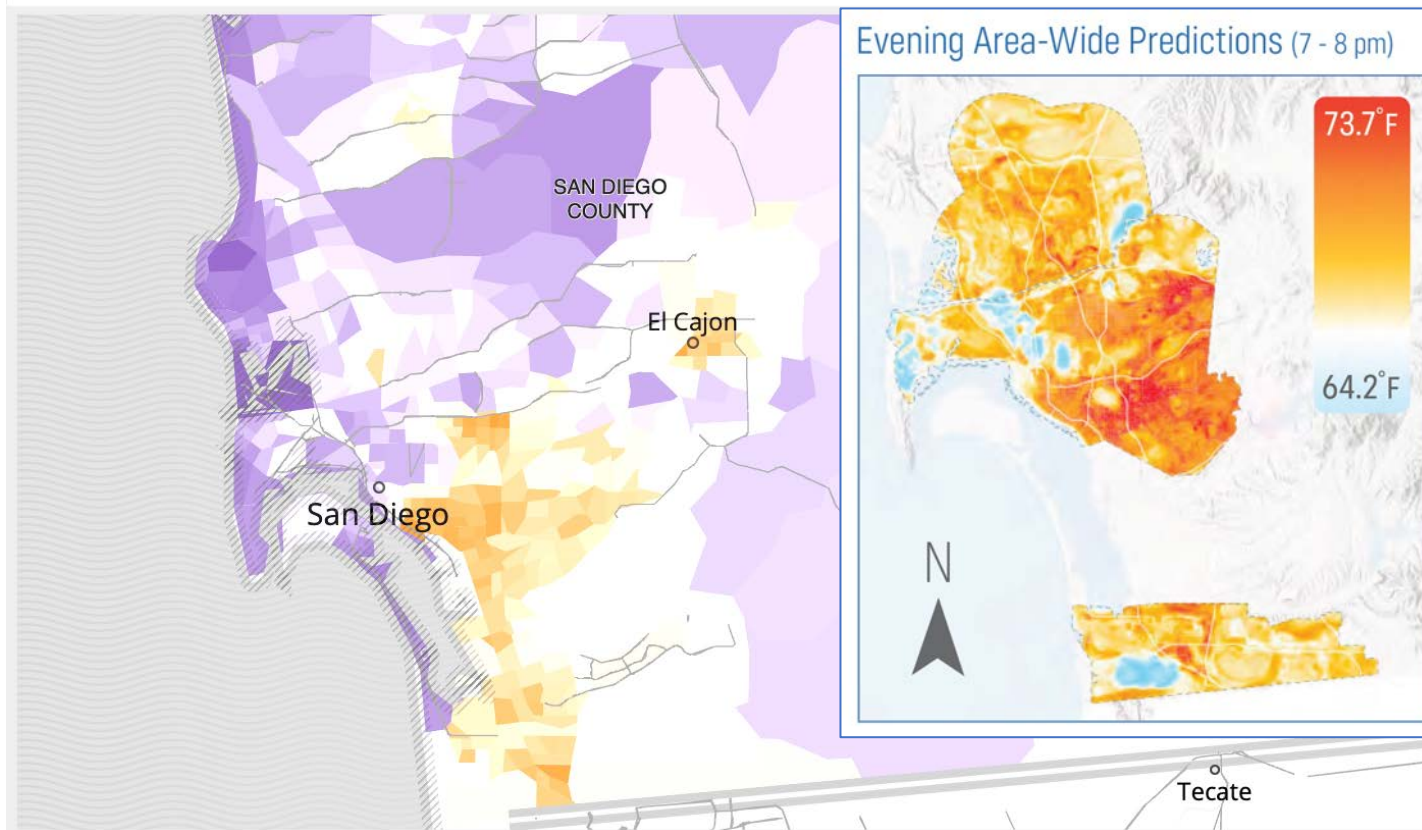
June 18, 2014 — If you plan on being out and about in summer, chances are you'll be exposed to a lot of sun and higher temperatures.



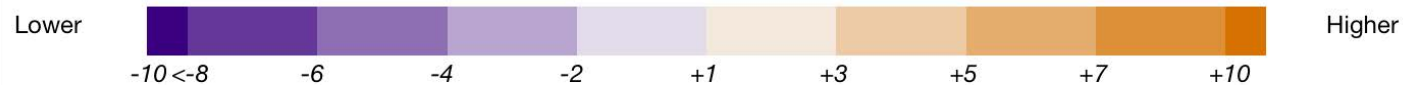
*“The most important finding is that **knowledge** and subjective heat sensitivity are **directly correlated** with heat risk perception, meaning **people who know more about heat waves are more likely to perceive heat as a risk** and take adequate adaptation measures.”*

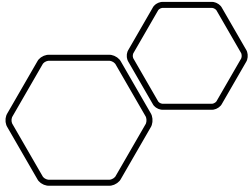
– Beckmann & Hiete, 2020

San Diego County, CA



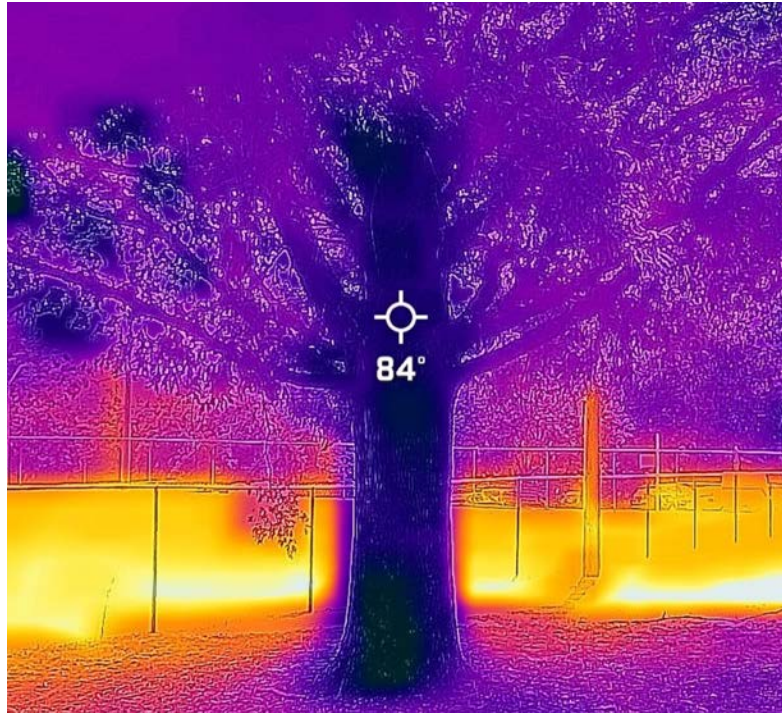
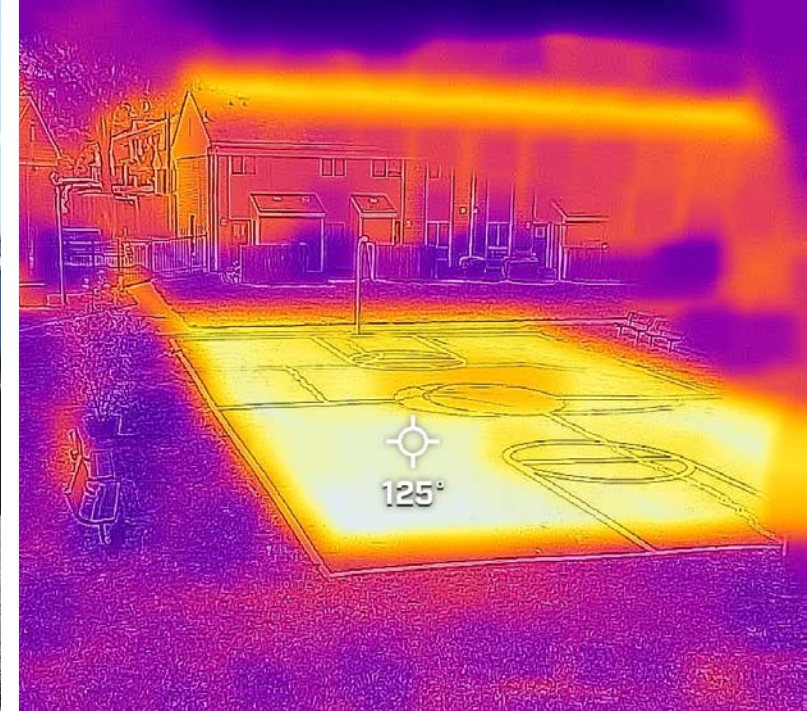
Risk Perception Index (County Average: 41 | US Average: 40)

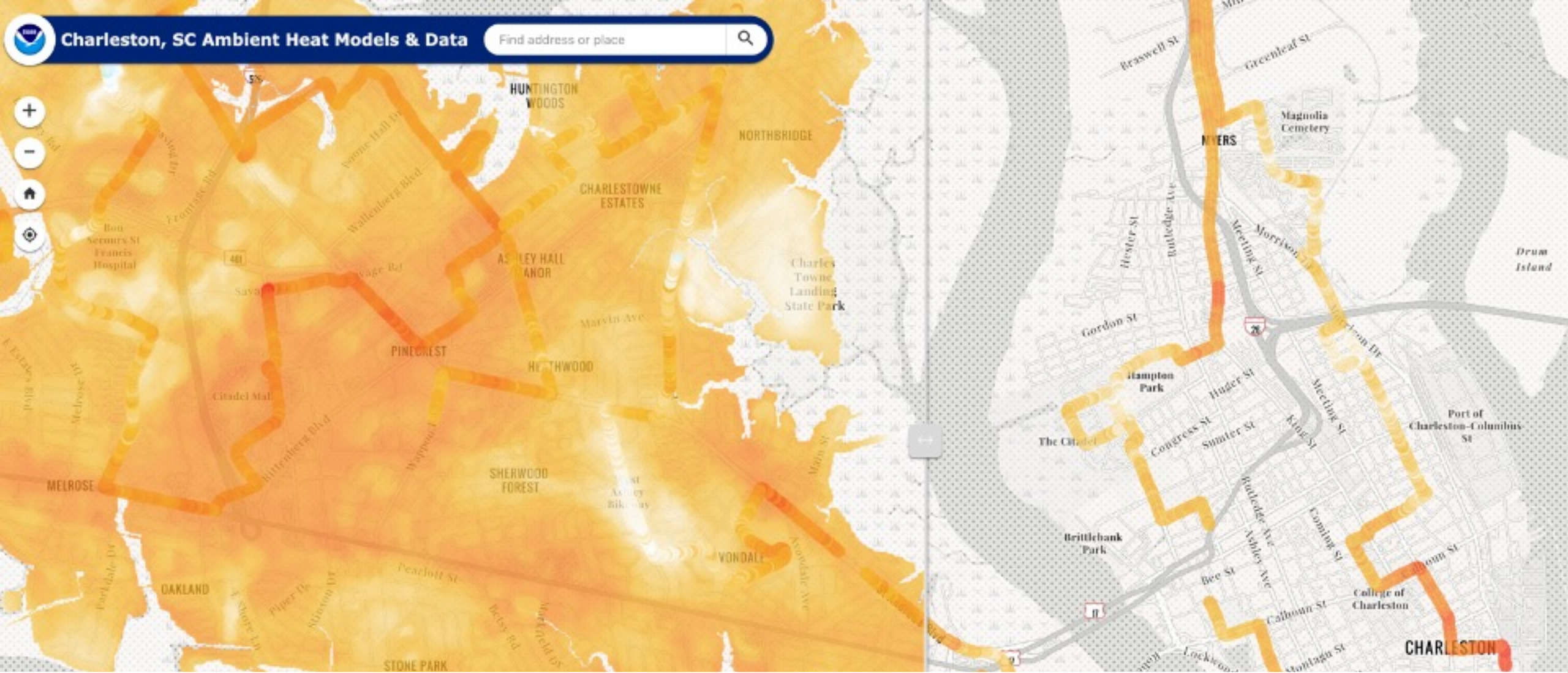




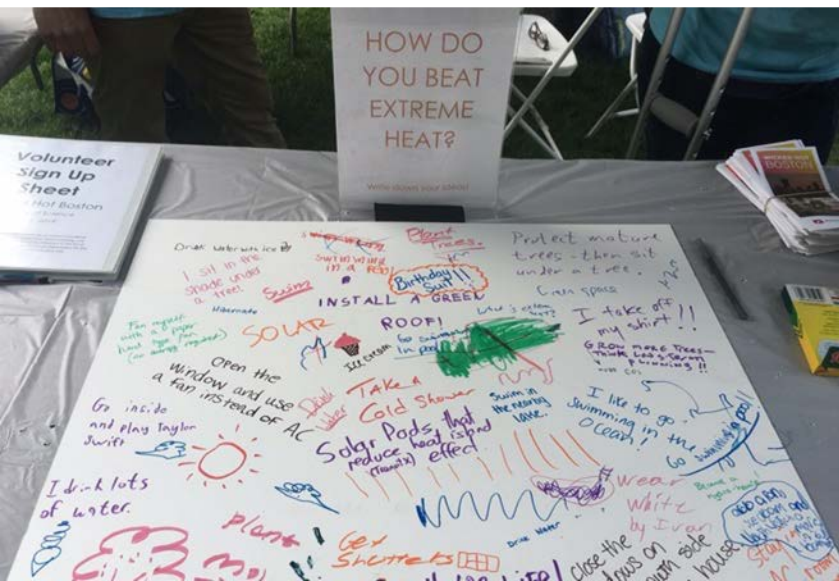
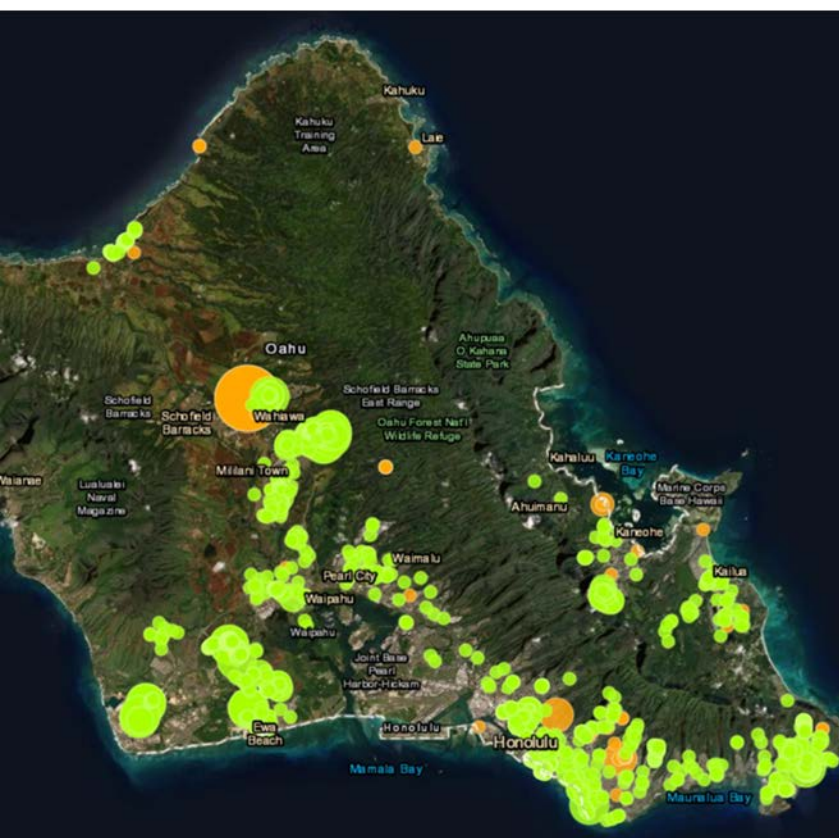
Learning during the campaign

- Upper-left: a bicycle-mounted sensor in Charlottesville, VA
- Lower-left: a FLIR infrared camera photo of a tree in Raleigh, NC
- Upper-right: a FLIR infrared camera photo of a basketball court in Charlottesville, VA
- Lower-right: Campaigners examining FLIR imagery in Atlanta, GA





Air temperature and Heat Index maps make community-level variation in heat visible.



Worcester's Street Trees



Project background
This is an initiative to plant more street trees in Worcester. We focused our research on Britain Square, Main Middle, Main South, and Shrewsbury St.



Worcester Heat Map
The image on the left is a heat map of Worcester, indicating the warmer areas of the city in red, and the cooler areas in blue. We studied 4 locations in particular based on their proximity to heat islands.

Locations we studied

1. Brittan Square
2. Main Middle
3. Main South
4. Shrewsbury St



Adopt a tree!
You can have an impact by watering small trees close to your residence. Go to treeworcester.org to learn more and get involved!



Isaac Abouaf, Phillip Abell, David Martindale, Natalie Jesionka

The real reason for citizen science

Clockwise from upper-left:

10,000 Trees Honolulu (NGOs)

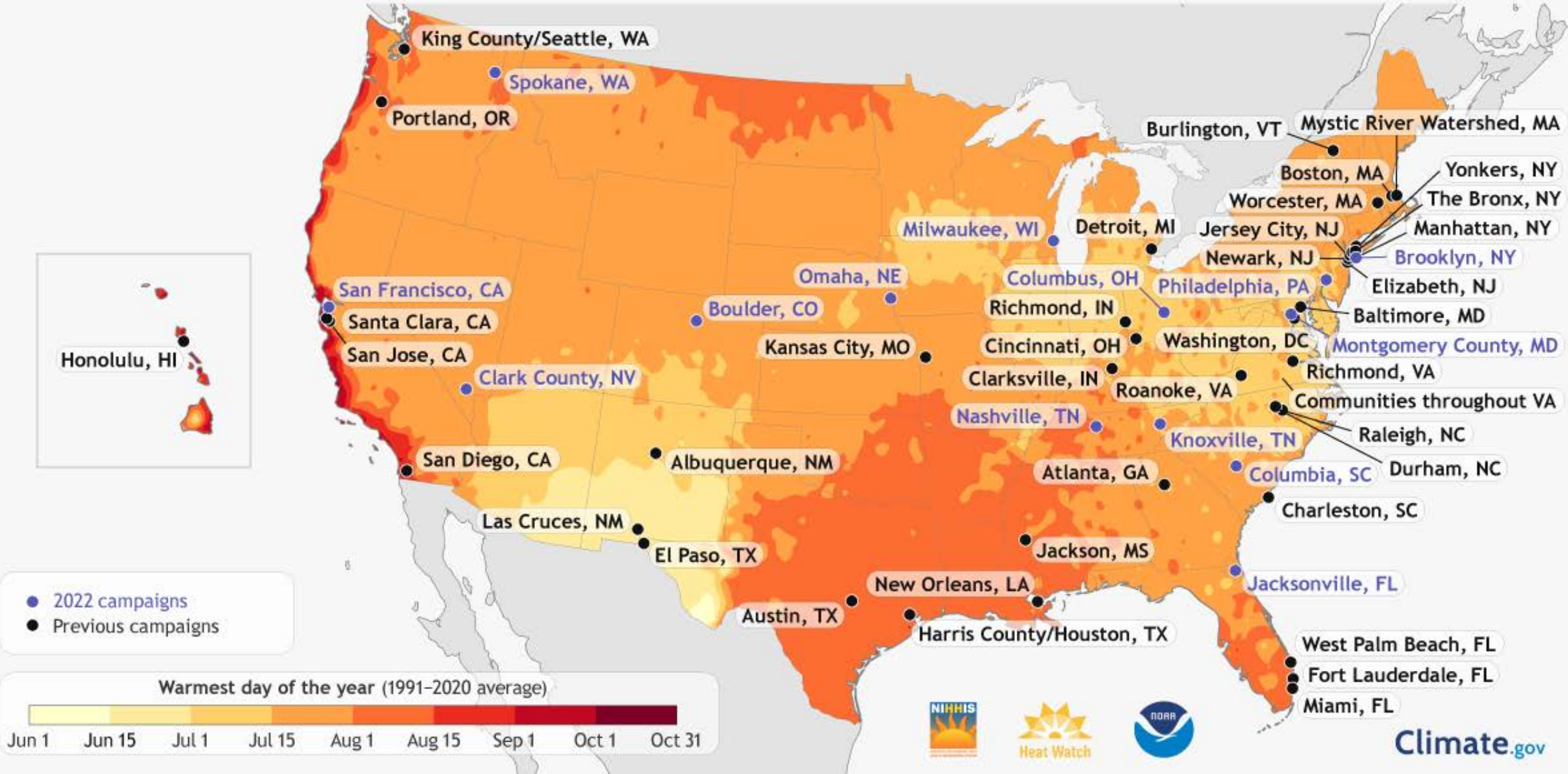
Houston Resilience Plan (city & county government)

Worcester Polytechnic Institute Bachelor of Science Qualifying Student Project (educational institutions)

Museum of Science Boston, Wicked Hot Boston (museums)



NOAA Urban Heat Island Mapping Campaigns: All Locations, 2017-2022



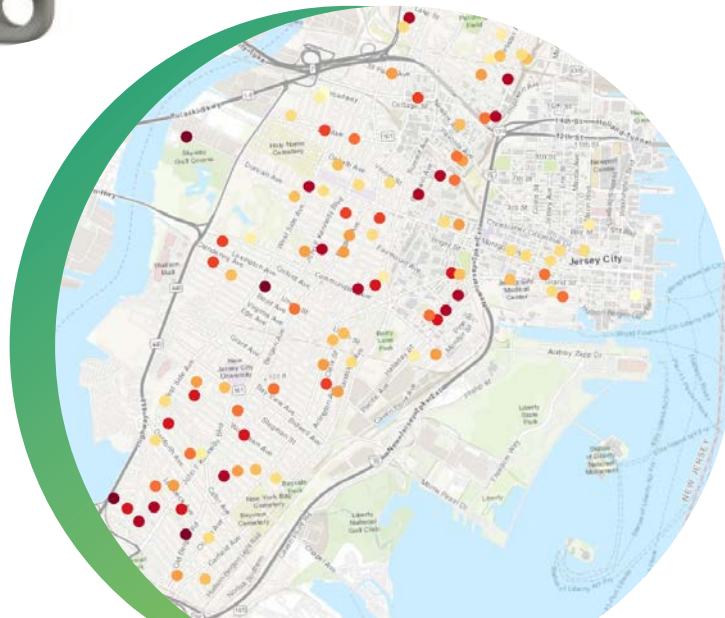
Northeast UHI Campaigns 2021

Community	Contact	Organization	Target Weeks	Campaign Type
Brooklyn, NYC	Sarah Slack	NYC Department of Education	July 30 & Aug 6	Mobile Temp/HI
Philadelphia, PA	Richard Johnson	The Academy of Natural Sciences of Drexel University	July 30 & Aug 6	Mobile Temp/HI Air Quality
Columbus, OH	David Celebrezze	City of Columbus Public Utilities	Aug 6 & 13	Mobile Temp/HI Air Quality
Montgomery County, MD	Michael Boldosser	Montgomery County OEMHS	Aug 6 & 13	Mobile Temp/HI
Columbia, SC	Kirstin Dow	Univ. of SC/ Carolinas RISA	Aug 20 & 27	Mobile Temp/HI Stationary Temp/HI

Up-to-date campaign timing estimates [available on Google Drive](#).



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Additional Monitoring Products in '22

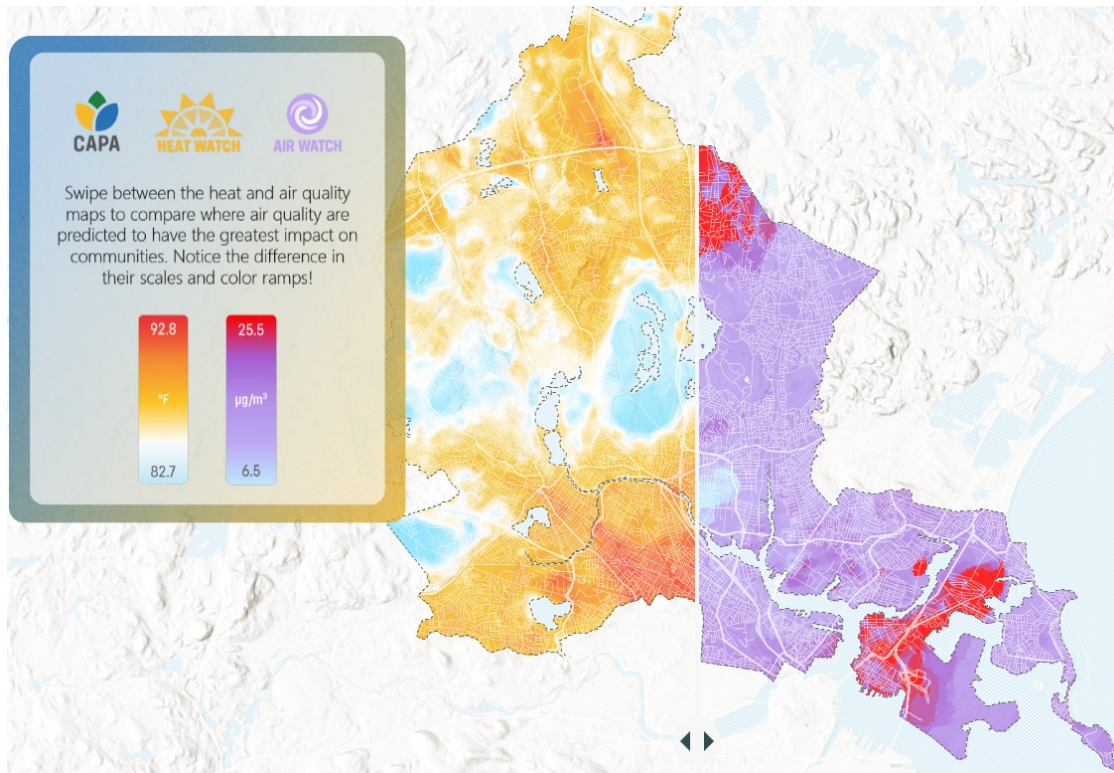
Stationary Sensors

- 10 additional stationary monitors (HOBOS) in Las Vegas, NV and Columbia, SC.
- In place for ~30 days or more.
- Used in conjunction with existing stationary monitors (METAR, COOP, CWOP, etc...) to characterize diurnal cycle of UHI over many days and under varying meteorological conditions.
- Image at left is stationary monitoring in New Jersey in 2021 by Montclair University.

Additional Monitoring Products in '22

Air Quality

- 10 AirBeam 3 monitors for installation on cars at the same time as mobile temp/HI monitors.
- Measuring PM 2.5 in Philadelphia, PA and Columbus, OH.
- Should complement other air quality monitors such as EPA stations and PurpleAir.



Story Map from Wicked Hot Mystic campaign in MA





NWS Atlanta ✓
@NWSAtlanta

HEY ATL WX NERDS!!

We're looking for volunteers for a 1-day field campaign to study temperatures across Atlanta to better understand the local Urban Heat Island. It's led by [@SpelmanCollege](#) in collab w/ [@urbanheatatl](#) & [@NOAAClimate](#) Sign up & Learn more at: bit.ly/HeatWatch

6:16 PM · Aug 4, 2021 · Twitter Web App

26 Retweets 2 Quote Tweets 50 Likes



Tweet your reply

Reply



Julian M Wx @BrokerWx · Aug 4, 2021

Replying to [@NWSAtlanta](#) [@SpelmanCollege](#) and 2 others
Are there any requirements to participate in this?



NWS Atlanta ✓ @NWSAtlanta · Aug 4, 2021

Nope! None at all!
This is [#CitizenScience](#) at its best and open for public participation. Enthusiastic go-getters with a love/interest in weather are bonuses though!



Urban Heat Island Forecast Outlook from WPC and CPC

Note: This is a general outlook based primarily on large-scale conditions and data from official forecast products. Please follow up with a local forecast office for more detailed questions and information.

For the Day 3-7 Outlook, temperature forecasts will be highlighted green if they exceed the 90th percentile for that location (1991-2020). The "other" box will be checked and highlighted green if light winds, limited cloud cover, and no or low rain chances are expected. (Provided by WPC)

For Week 2-3 Outlooks, the boxes will be checked green for increased chances of hot weather, for increased chances of less rainfall, and for increased chances of weaker winds. (Provided by CPC)

			THU Aug 19		FRI Aug 20		SAT Aug 21		SUN Aug 22		MON Aug 23		Week 2 Outlook Aug 24-30			Week 3 Outlook Sep 1-6	
UHI Campaign City Location	Forecast Site	90th Pct Temp	Temp	Other	Temp	Other	Temp	Other	Temp	Other	Temp	Other	Temp	Less Rain	Less Wind	Temp	Less Rain
Albuquerque, NM	ABQ	93	Campaign completed														
Atlanta, GA	ATL	91	87	<input type="checkbox"/>	88	<input type="checkbox"/>	89	<input checked="" type="checkbox"/>	90	<input checked="" type="checkbox"/>	92	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The Bronx and Manhattan, NY	NYC	86	Campaign completed														
Brooklyn, NY	NY5796	85	82	<input type="checkbox"/>	85	<input type="checkbox"/>	86	<input type="checkbox"/>	86	<input checked="" type="checkbox"/>	86	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Data from the New York Avenue CO-OP site in Brooklyn used as a baseline for 90th percentile; LGA and JFK are situated in Queens																	
Charleston, SC	CHS	92	Campaign completed														
Charlottesville, VA	CHO	89	89	<input type="checkbox"/>	86	<input type="checkbox"/>	89	<input checked="" type="checkbox"/>	89	<input checked="" type="checkbox"/>	90	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Kansas City, MO	MCI	89	Campaign completed														
Clarksville, IN	SDF	90	88	<input type="checkbox"/>	87	<input type="checkbox"/>	87	<input type="checkbox"/>	89	<input checked="" type="checkbox"/>	91	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using Louisville, KY as the forecast location because it is right across the Ohio River and is the closest major observation																	
Richmond, IN	INC006	86	84	<input type="checkbox"/>	83	<input type="checkbox"/>	83	<input type="checkbox"/>	85	<input checked="" type="checkbox"/>	87	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
For the 90th percentile used the East-Central Climate Division averages as there was not a close major observation																	

Urban Heat Island Forecasts

NCEP Global Ensemble Forecast System

Initial: 20220524Z00

International Desks

Climate Prediction Center

National Centers for Environmental Prediction

		Week 2: 31May2022 - 06Jun2022					Week 3: 07Jun2022 - 13Jun2022					Week 4: 14Jun2022 - 20Jun2022				
NO	Stations	80th Pctl Clim	Tmax	Rain	Wind	Alert	80th Pctl Clim	Tmax	Rain	Wind	Alert	80th Pctl Clim	Tmax	Rain	Wind	Alert
1	Freetown	31.7	30.8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30.8	29.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30.4	28.8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



CAPA Sensor Specs

Type "T" thermocouple
Temp: -40 to 80°C range; $\pm 0.5^\circ\text{C}$ accuracy
Humidity: 0 to 100% range; $\pm 2-5\%$ accuracy
Sampling rate: 1/s

GPS Unit
Position accuracy: 3.0m
Velocity accuracy: 0.1m/s
Sampling rate: 1/s

Blinking Green Light = GPS is searching for signal
Solid Green Light = GPS signal is locked

- The GPS signal usually locks within 5-10 minutes; if after 10 minutes you don't have a solid green light, move locations.
- Once the light turns solid green, it will very likely stay solid green, so you do not need to check on it constantly.
- If it's difficult to see the GPS light because of daylight, cup your hand around the switch and you should see the light.

Battery light

Solid red light = low battery

- The sensor will arrive to each campaign fully charged with a 10-hour battery life, so you should not need to charge it.
- If the low battery light does come on, plug in the USB charging cable with the car or wall adapter, and connect to the device at the charging port; turn the sensor ON (switch to the left) to charge the equipment.
- The sensor takes 1 hour to full charge, replenishing its 10-hour battery life.

Rapid blinking red light = malfunction (rare occurrence)

- If you see a rapidly blinking red light during your traverse hour, finish your route and then get in contact with your organizer.
- If you see a rapidly blinking red light before or in-between traverses, get in contact with your organizer.

GPS light

The tube elevates the sensor away from the heat of the vehicle, and houses the transfer wires.

The fan keeps air moving through the chamber, even when your vehicle is still.

Additional tips!

- If it starts to rain, pull over, bring the sensor inside the vehicle immediately, and turn it off! The sensor is not waterproof.
- If you need to bring the sensor inside the vehicle or building for any reason, be sure to turn it off first.

Mount the sensor over the passenger side window of your vehicle

- ALWAYS keep a hand of the sensor when installing or removing!
- DON'T ROLL DOWN YOUR PASSENGER WINDOW WHILE YOU'RE MOVING! The sensor will likely fall.
- If your window automatically rolls down when it bumps into an object in the way, try repeatedly & gently tapping the window-up button so that it eases up to the sensor mount.

Charging port & light

Switch On (left) <--> Off (right)

The sensor ID label should be on a sticker here (eg. CAPA1000).

Installing the CAPA Bicycle-Mounted Sensor



All of the operations of the bicycle and car-mounted sensors are identical, except for installation.

The **mounting system** consists of a screw, nut, and washer that secure the mounting loop around handlebars. These parts should remain attached to the mounting system at all times. Two mounting spacers, one thick and one thin, are also provided to help create a snug fit between the mounting loop and the bicycle handlebars.

The sensor should face with the fan, switch, and lights facing back towards the rider, with the open end of the sensor tube facing forwards, straight towards the direction of travel.



Step 1

Unwind the screw until you are able to expand the mounting loop, and pivot the screw to the upwards direction.

Wrap the open mounting loop around your handle bars so that the fan and switch are facing the rear of your bicycle.

If the loop does not fit on your handle bars, try mounting it on your top tube or another part where it can be facing in line with the direction of travel.



Step 2

Pivot the screw to the downwards position, and squeeze the loop to see if you will have a snug fit around your handlebars.

If you do not have a snug fit, curve and slide in one or both of the black mounting spacers.

Wind the screw tightly until it stops turning, so that you have a snug fit around your handlebars.



Step 3

The opening of the sensor tube should be facing into the direction of travel, towards the front of the bicycle.

During your route, the sensor will bob and wiggle, which is okay! You might stop once half-way through your route to check that the mount is still snug and secure on your handlebars.

Mapping Method



1 Download & Filter



Download raw heat data from sensor SD cards



Compare data with field notes and debrief interview

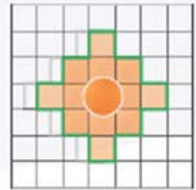


Trim data to proper time window, speed, and study area

2 Integrate & Analyze



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



Transform land cover rasters using a moving window analysis

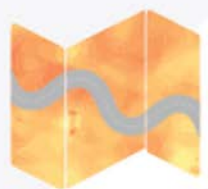


Calculate statistics of each land cover band across multiple radii

3 Predict & Validate



Combine heat and land cover data in Machine Learning model



Create predictive raster surface models of each period



Perform cross validation using 70:30 holdout method

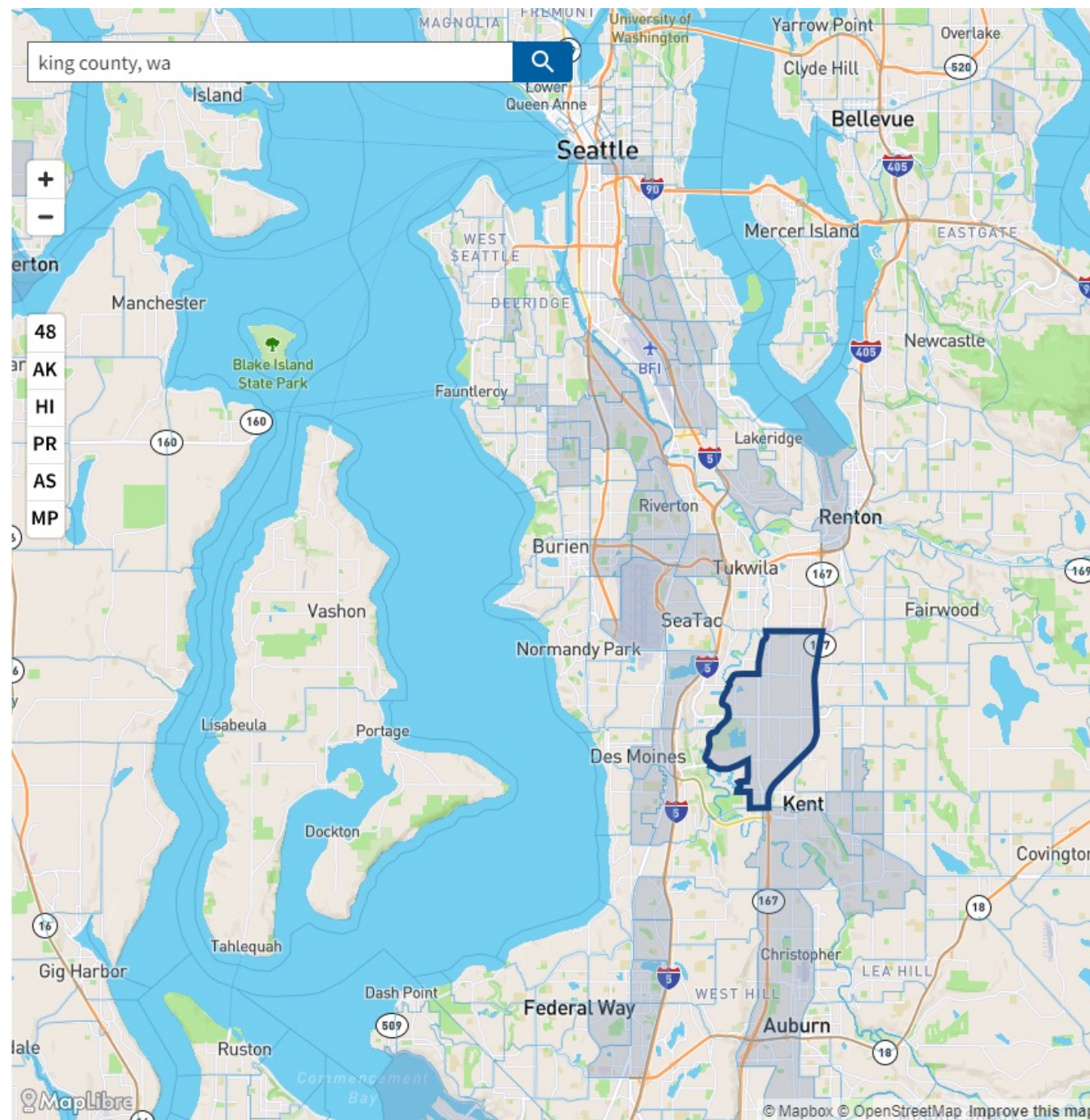
Data processing, modeling, and hosting.

- Final maps and reports are posted to the [Open Science Foundation](#).
- The NESDIS VizLab also processes the data to be RESTful and hosts it on the [NOAA GeoPlatform](#).
- Communities go on to apply the data in Social Vulnerability Indices, Story Maps, briefing materials for city leaders, and scientific projects.

This new tool, developed under the direction of the Council on Environmental Quality (CEQ), helps communities and federal programs meet the Justice40 initiative's goals.

It is open source, and feedback is desired!

screeningtool.geoplatform.gov





A Story Map



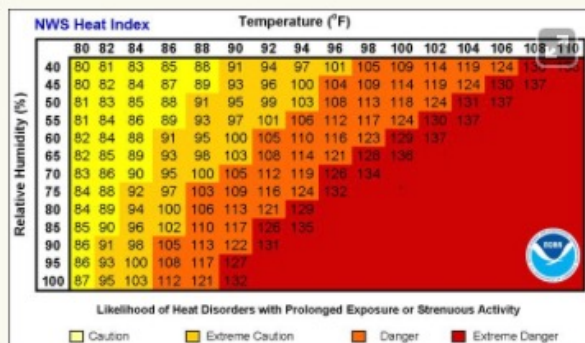
The Intersection of Heat and Social Vulnerability

Which communities get the hottest?

Use the mapping tool to explore the intersection between heat index and social vulnerability.




Heat Index Afternoon

The heat index, also known as the apparent temperature, is what the temperature feels like to the human body when relative humidity is combined with the air temperature.



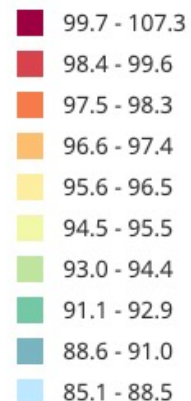
NOAA's National Weather Service Heat Index Chart

Heat Index Afternoon

A Story Map   

Heat Index Afternoon

Afternoon Heat Index



Oahu Social Vulnerability Index

SOVI

