

Highlighting the Hot Spots

NOAA's Urban Heat Island Mapping and VR Heat-Mapping Experience

Our summers are getting hotter and more deadly—extreme heat is one of the leading weather-related hazards in the U.S. Most years, heat kills more people than hurricanes, floods, and tornadoes combined. However, heat impacts tend to affect certain areas more than others. These areas are known as heat islands.

Heat islands are usually in highly developed urban areas, where mid-afternoon temperatures can be 15° to 20°F warmer than other areas within the same city, with little cooling occurring overnight.

Heat islands happen in places with a high concentration of buildings, roads, and other infrastructure that absorb and re-emit the sun's warmth more than natural landscapes like forests and bodies of water. This is why cities become hotter than surrounding suburbs and nature reserves. Heat islands are often linked to demographic factors such as income and race, with historic redlining cited as a contributing factor.

To address this problem, NOAA has been working with citizen scientists in urban areas to map heat islands. This effort is part of a larger campaign launched in 2017 by the National Integrated Heat Health Information System (NIHHIS) and managed by the Climate Program Office (CPO) under NOAA Oceanic and Atmospheric Research (OAR).

This project relies on volunteer community scientists who travel around the city along a predetermined route during the morning, afternoon, and evening of a single day. The volunteers typically conduct these rides on one of the hottest days of the year, and

communities work with their local weather forecast offices to pinpoint a day that will have no precipitation and little cloud cover. Sensors mounted on volunteers' cars or bicycles capture air temperature and humidity data, and these data are used to construct reports that identify hot spots within the city.

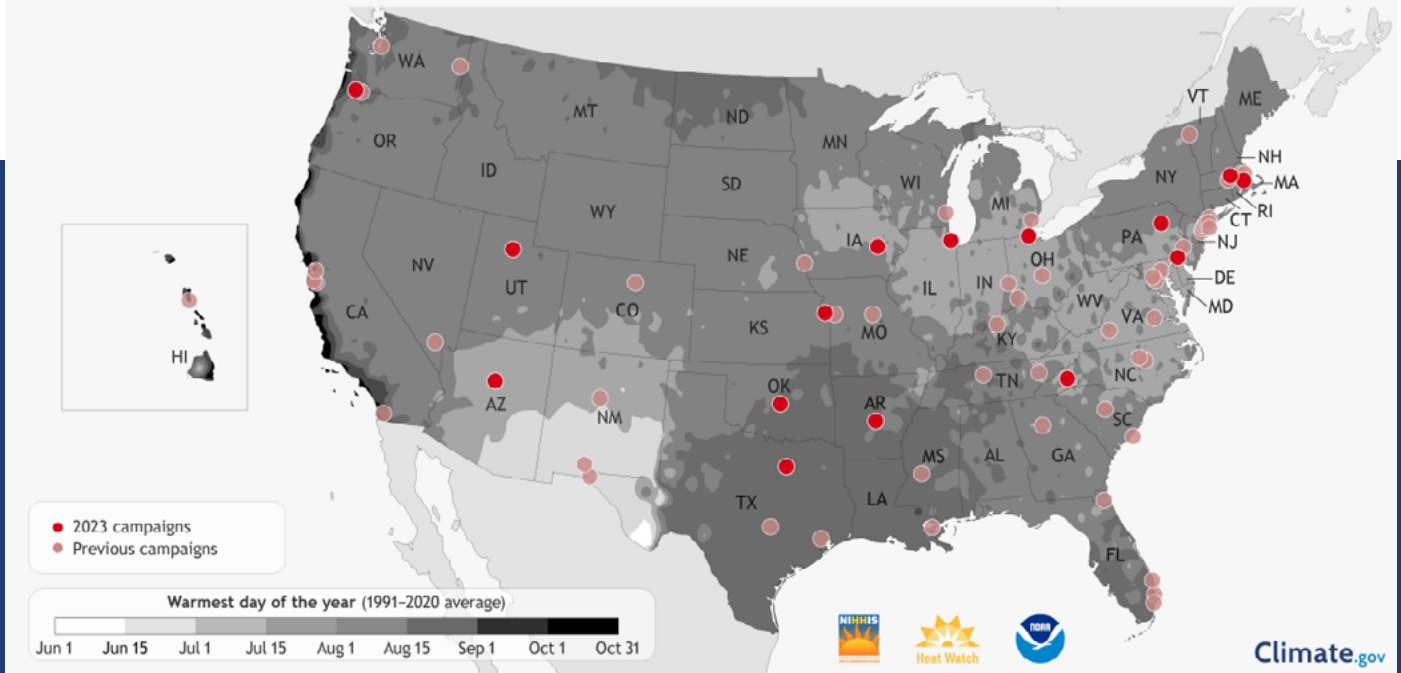
"I love to learn about communities and how the federal government can support them," says Morgan Zabow, MPH, who joined the NOAA's Climate Program Office in 2021. "We help connect communities, and we help them share best practices in implementing solutions." Zabow uses her background in community public health to develop and grow NOAA's heat mapping efforts in concert with community partners.



Morgan Zabow of NOAA CPO and Nicholas Mullenix put a sensor on a car before conducting a data ride in Montgomery County, MD, on August 7, 2022.

These mapping campaigns take place each summer, and approximately 10 to 15 communities are selected every year based on an application process that opens in the fall. During the 2022 urban heat island campaigns, 782 citizen scientists collected over one million measurements in 15 U.S. communities.

NOAA Urban Heat Island Mapping Campaigns: All Locations, 2017-2023



This NOAA mapping effort is instrumental in identifying the hottest neighborhoods in cities across the nation. The data helps city planners in these communities understand how and why different neighborhoods are hotter and encourages the development of cooling solutions.

“Asheville, NC is known as a ‘climate refuge,’” Nicole McNeill, a Heat Mapping Project Manager for Asheville GreenWorks explained, “But urban trees are under particular threat from development.” So McNeil, along with the GreenWorks community, have collected detailed heat data in order to target new tree-planting efforts in the places that can most benefit from them—and identify where it’s imperative to protect existing trees.

McNeill and her team of volunteers completed a heat data collection day in 2023. She hopes their work will help residents understand the connection between heat and their homes, their health, and their future as well as foster better awareness and understanding of heat disparities to develop solutions.

“The choices we all make right now will create the future we experience. Right now, we have the chance, and the responsibility, to choose to thrive.”



Asheville GreenWorks Interim Executive Director Eric Bradford and Interim Operations Director Chelsea Adams teach heat campaign volunteers how to use the sensors during data collection day on July 24, 2023.

The heat-mapping project allows communities to develop hyper-local descriptions of heat and to strategize about solutions specific to each community and its needs. Many cities have already taken action based on this data. Honolulu, HI and Cincinnati, OH have embarked on tree-planting campaigns. Las Vegas, NV is constructing shading stations at bus stops in

hotter areas to provide relief to bus riders. Raleigh, NC is adding titanium dioxide (a material that imparts biocidal, self-cleaning, and smog-abating functionalities) to its concrete surfaces to reduce the amount of heat absorbed by roadways. Many communities have used the data to develop extreme heat action plans, educate residents and policymakers, and inform new research. All data from the UHI campaigns are open access and available on the federal website Heat.gov.

“The most surprising data from the campaign was that in certain areas of the city, there can be as much as a 17-degree variance in temperature,” said Denise Castillo-Gonzalez, a Sustainability Specialist with the City of Albuquerque, NM. She supports heat island mapping projects as a first step in helping to develop both short- and long-term strategies. “Helping us identify where immediate mitigation is needed is very impactful.”

Castillo-Gonzalez is working with her city to establish the New Mexico Urban Heat Cohort, the first effort in the state to bring together various community-based organizations, academia, as well as local, regional, and state government departments and agencies to develop strategies that protect the most vulnerable communities during extreme heat events.

The NOAA Visualization Laboratory (VizLab) within NESDIS has made these city UHI datasets available as public geospatial services on ArcGIS servers, enabling users to quickly add this data to their web map applications and information products. In collaboration with the NOAA Global Systems Laboratory, the VizLab used this data to develop the Urban Heat Island of Washington DC Virtual Reality (VR) Experience. This immersive experience provides a realistic representation of the UHI phenomenon, and aims to raise public awareness about the importance of addressing UHIs in cities as well as the impact of heat inequities. It also provides an example of how NOAA data can be used in innovative ways to educate and inform the general public.

This project used new software that allows gaming engines to access and display GIS map layers and data. This is one of the first practical examples developed using this novel technology, which uses storytelling to explain the information and create an engaging and eye-opening experience for users. This project was recognized by the American Council for Technology and Industry Advisory

Council ACT-AIC with the 2023 Innovation Champion Award (the organization’s highest honor).



Juan Pablo Hurtado from the NOAA Visualization Laboratory shows a user how to navigate the Urban Heat Island of Washington DC Virtual Reality (VR) Experience

The VizLab worked closely with community leaders in developing the VR experience. In 2022, the VizLab’s Juan Pablo Hurtado visited the Fauntery Community Enrichment Center (FCEC) in D.C.’s Deanwood neighborhood during their Juneteenth celebration and demonstrated a simple geoplatform app showing temperatures in Washington, D.C. vs. satellite images. Community members wanted something even more interactive and immersive, so over the next year, Hurtado and his colleagues developed the VR experience based on their feedback. Hurtado returned to the FCEC for their 2023 Juneteenth celebration and demonstrated the new VR product to rave reviews. NOAA awarded a

grant to the FCEC to support a new Resilience Hub for the community. This project will increase the resiliency and preparedness of the community in facing climate change effects, such as heat waves and the urban heat island effect by providing a bird's eye view of their neighborhood and how it compares to the rest of the city.

NOAA's heat island mapping program is part of the Justice40 initiative, a whole-of-government effort to ensure that federal agencies work with states and local communities to deliver 40% of benefits from federal investment in climate and clean energy to disadvantaged communities. The program is also part of America the Beautiful Initiative, as urban heat islands are areas in great need of more access to nature and its health and cooling benefits.

“The burden of heat is not shared equally in our urban areas. Gathering this type of environmental intelligence helps communities measure their hottest places so they can develop strategies to reduce the dangerous effects of heat. Community by community, we’re working to create a Climate-Ready Nation that is resilient in a changing world.”

—NOAA Administrator, Dr. Rick Spinrad



Dr. Rick Spinrad, NOAA Administrator, navigates the Urban Heat Island Virtual Reality Experience at a NOAA exhibit.