

Baltimore, MD, Urban Heat Field Campaign

Review of Findings

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Portland State
UNIVERSITY





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What can we do about it?



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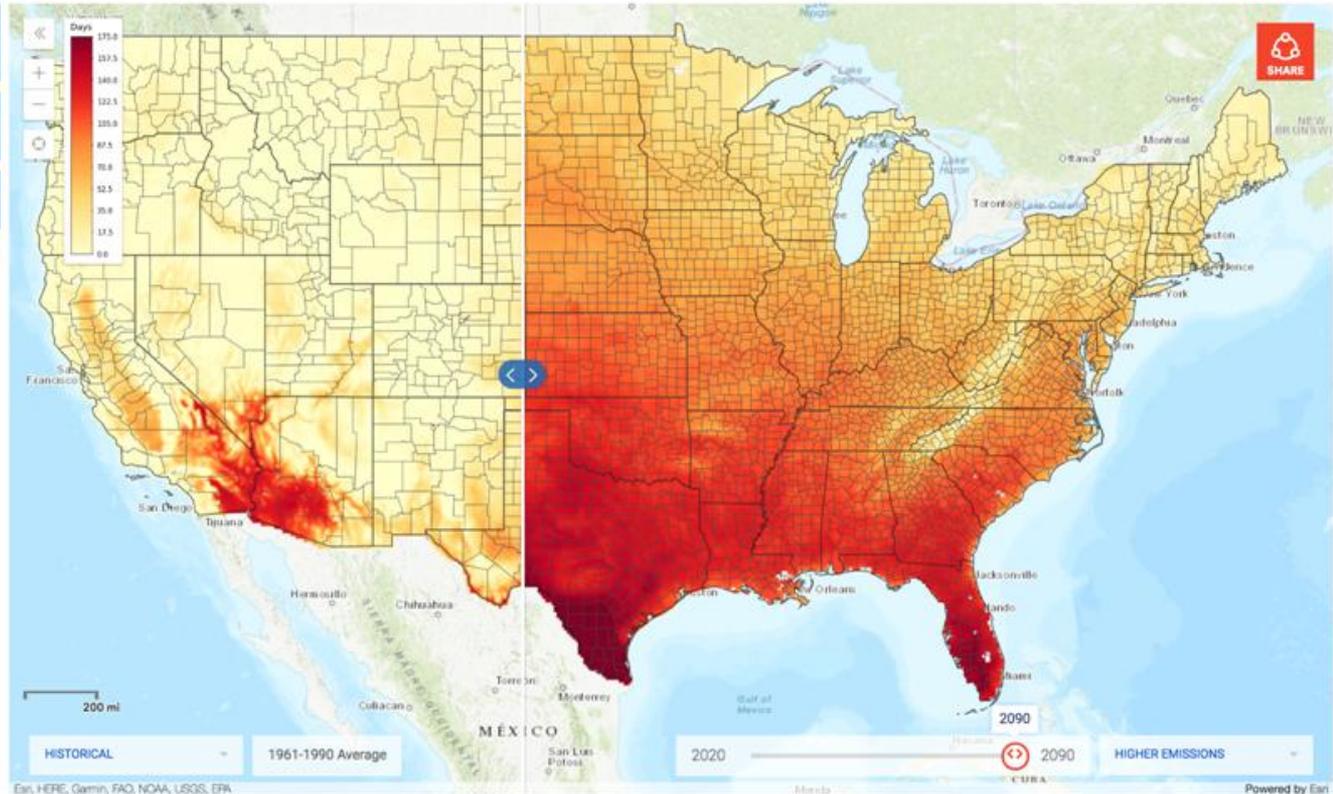
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Zoom to location

Days w/ max > 95°F

About Days w/ max > 95°F



The number of very hot days ($\geq 95^{\circ}\text{F}$) across the U.S. is projected to increase dramatically this century compared to last century.

Temperature

Avg Daily Max Temp (°F) ?

Avg Daily Min Temp (°F) ?

Days w/ max > 90°F ?

Days w/ max > 95°F ?

Annual

Days w/ max > 100°F ?

Days w/ max > 105°F ?

Days w/ max < 32°F ?

Days w/ min < 32°F ?

Days w/ min > 80°F ?

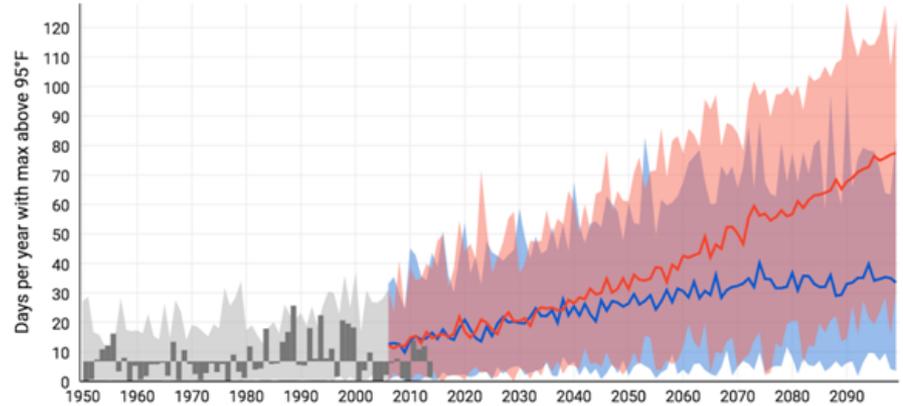
Days w/ min > 90°F ?

Display: Actual

Chart: Baltimore City

Annual Days w/ max > 95°F

How to read this Image Data



1950

2100

The number of $\geq 95^\circ\text{F}$ days in Baltimore is projected to increase from ~8 per year to ~40 per year in 2050; and to ~80 per year by 2100.

Characterizing Urban Heat

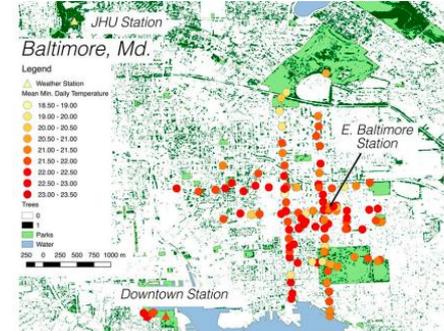
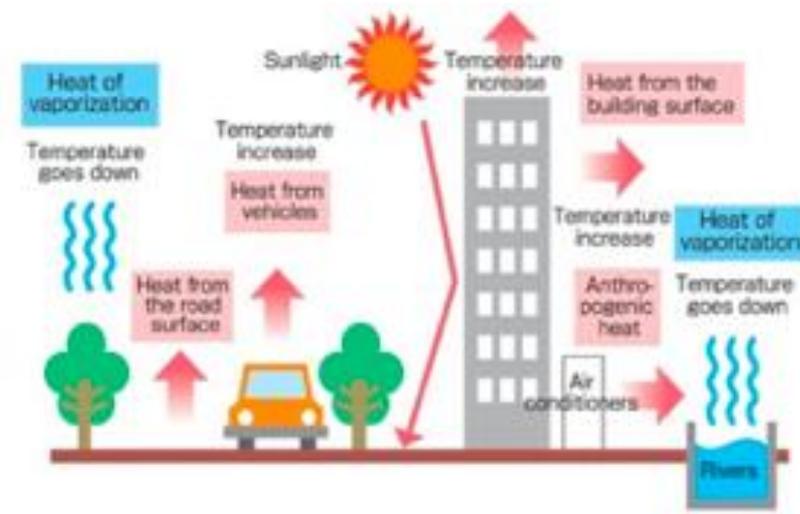
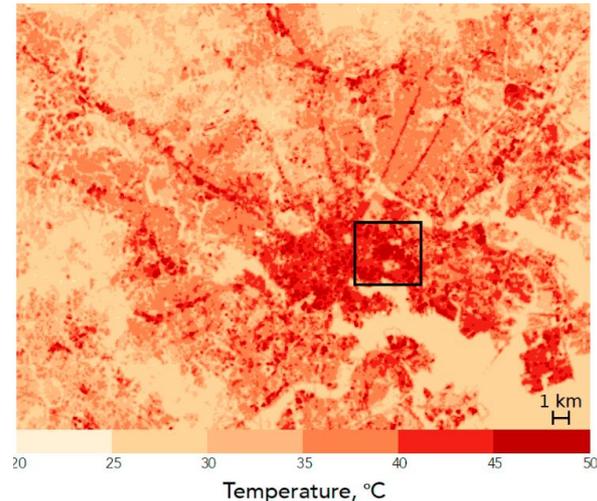


FIG. 3. Locations of the 135 sensors in eastern Baltimore. The color scale shows T_m , the temporal mean of daily minimum temperatures for 1 Jun-15 Sep 2015.



JANUARY 2017

SCOTT ET AL.

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Intraurban Temperature Variability in Baltimore

ANNA A. SCOTT, BEN ZAITCHIK, AND DARRYN W. WAUGH

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KATIE O'MEARA

Architectural Design Department, Maryland Institute College of Art, Baltimore, Maryland

Field Campaign: 29th & 30th August, 2018

URBAN HEAT CAMPAIGN PROCESS CHART

What does **heat distribution** look like in my city? Which areas are most **exposed** during a heat wave? How can this knowledge advance future **adaptation** plans?

PHASE 1: CAMPAIGN ORGANIZERS

Pre-planning and local partnerships are key to success. Begin the process at least one month in advance of your campaign.

PLANNING & PREP.

BUILD PARTNERSHIPS

Collaboration can help with funding, organization & other resources, and increase action potential.

- > Universities & colleges
- > Local gov't agencies
- > Environmental or public health non-profits

RECRUIT VOLUNTEERS

At least 9 volunteer drivers are needed for your campaign.

- > College students or faculty
- > Non-profit mailing lists
- > Family & friends

CREATE POLYGONS

Divide your city into 9 polygons, one for each volunteer driver.

- > Include a variety of land use/land cover types
- > Large enough for a 1-hr drive
- > Try to include as much of the city as possible

PHASE 2: CITIZEN SCIENTISTS

Valuable data are collected by volunteer citizen scientists. Drivers will traverse a route at 3 designated times: 6am, 3pm, 7pm.

DATA COLLECTION

SELECT ROUTES

Citizen scientists use personal knowledge to design driving routes.

- > Cover a variety of land use/land cover types
- > Route types: 1-hour or drive, no backtracking
- > Avoid major, high-speed roads

COMPLETE TRAVERSES

Drivers go on their routes at 6am, 3pm & 7pm on campaign day.

- > Keep speed 10-15 mph
- > Try to drive the same route on all 3 traverses
- > Obey all traffic signals and safety procedures

LOG DATA

As volunteers drive, temperature & coastal data will be automatically logged every 1 second and stored digitally.

- > In-browser mounted heat sensor & data logger
- > GPS tracker

PHASE 3: PSU RESEARCHERS & CITY PLANNERS

Researchers from PSU will produce a visual model of heat in your city. Local planners may use data in climate adaptation planning.

ANALYSIS & MODELING

MODEL HEAT DATA

PSU researchers will model your heat data - you'll receive:

- > 3 maps showing citywide heat distribution throughout the day
- > Raw data files

EXPLORE TRENDS

Compare your city's temperature data with other datasets for a more detailed analysis.

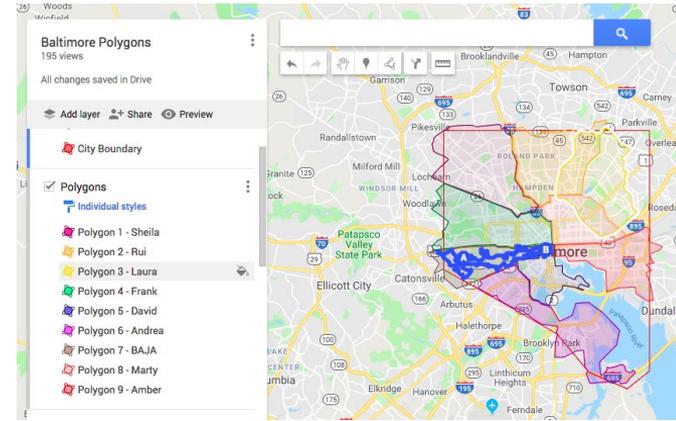
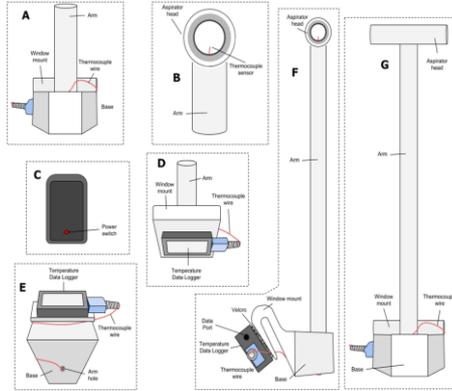
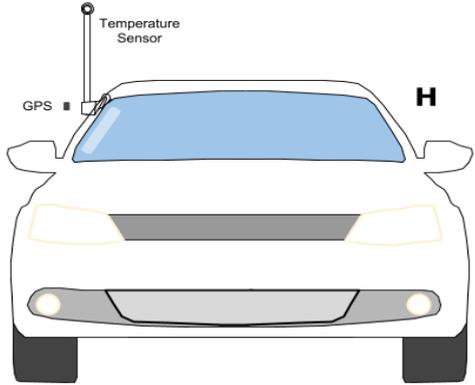
- > Socio-demographic data (US Census/ACS)
- > Land use/land cover

PLAN FOR THE FUTURE

Identify high-priority areas or groups for future adaptation planning interventions.

- > Vulnerable populations with high heat exposure
- > Extreme hot spots
- > Opportunities for green infrastructure

Field Campaign: 29th & 30th August, 2018



Field Campaign: 29th & 30th August, 2018



Some Baltimore blocks could be 15 degrees hotter than others. Mapping them could help address heat hazards.



Volunteers log temperatures while driving through the city in an effort to help NOAA as it is conducting research on urban heat

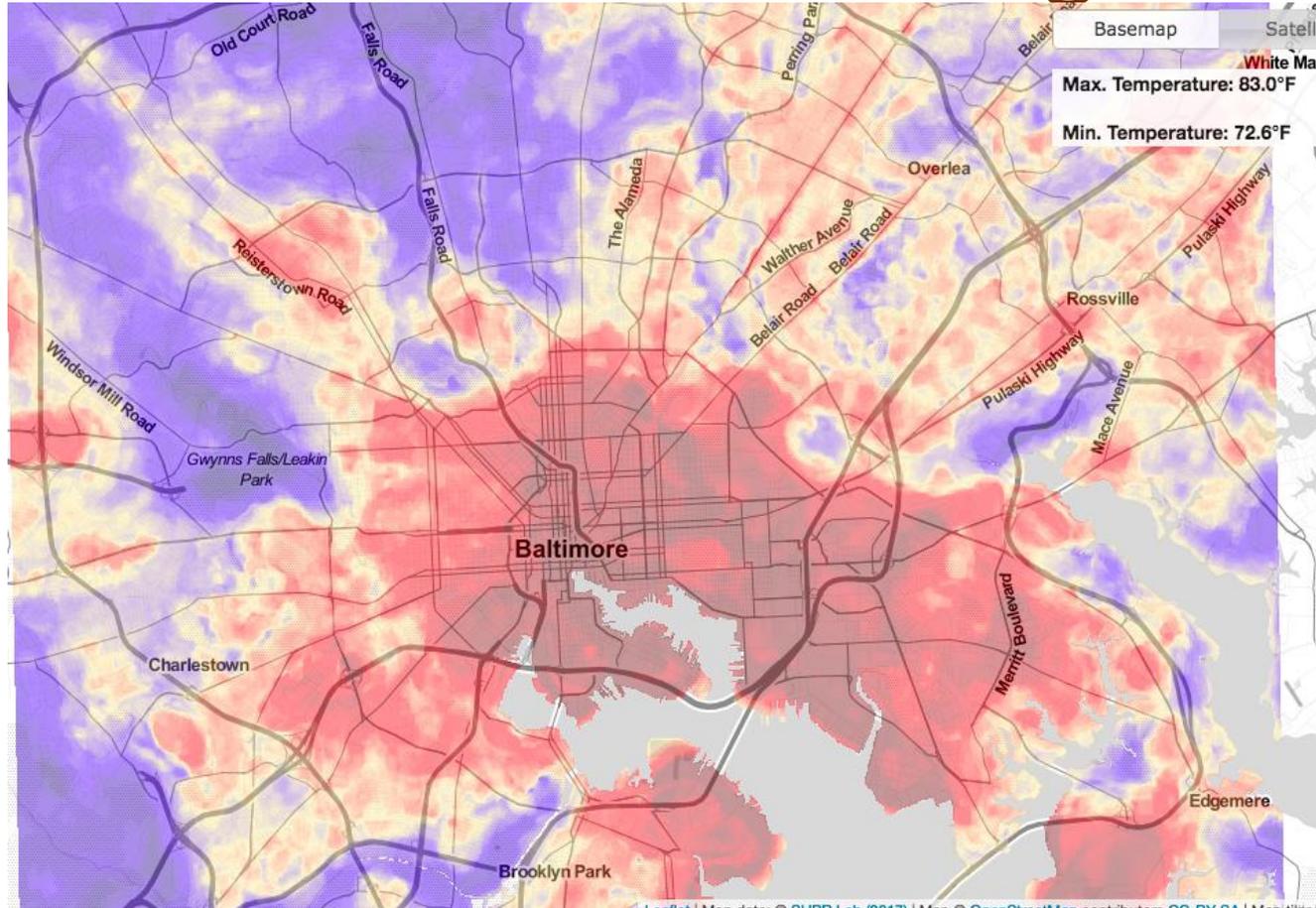


Explaining Variability in Temperatures



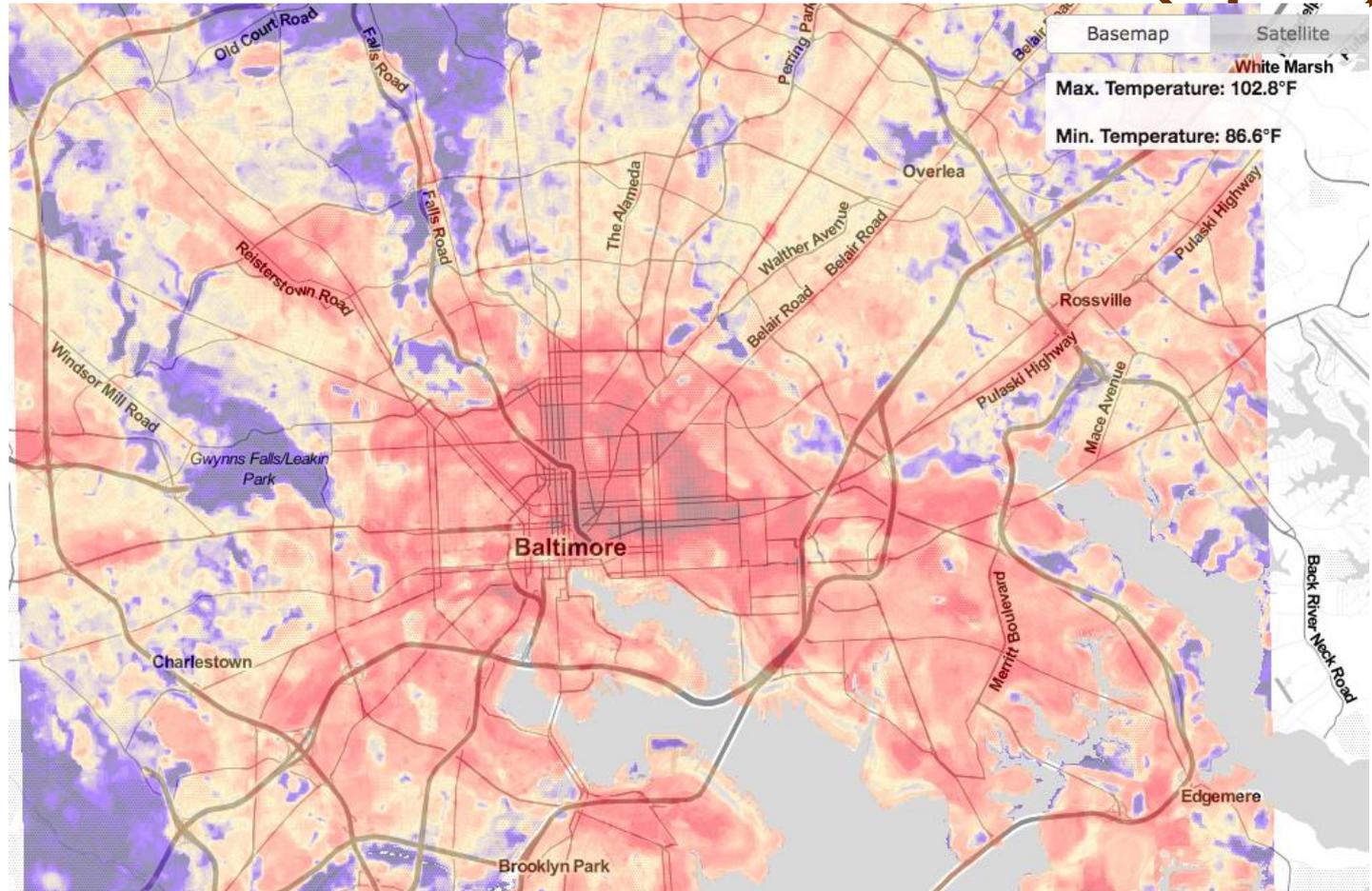
1. Voelkel and Shandas, 2016. Towards Systematic Prediction of Urban Heat Islands: Grounding measurement, assessing modeling techniques. *Climate* 5(2) 41-57.
2. Voelkel J, V Shandas, and B Haggerty 2016. High Resolution Descriptions of Urban Heat Islands: A public health imperative. *Preventing Chronic Disease* 13.

Baltimore UHI – Morning (6am)

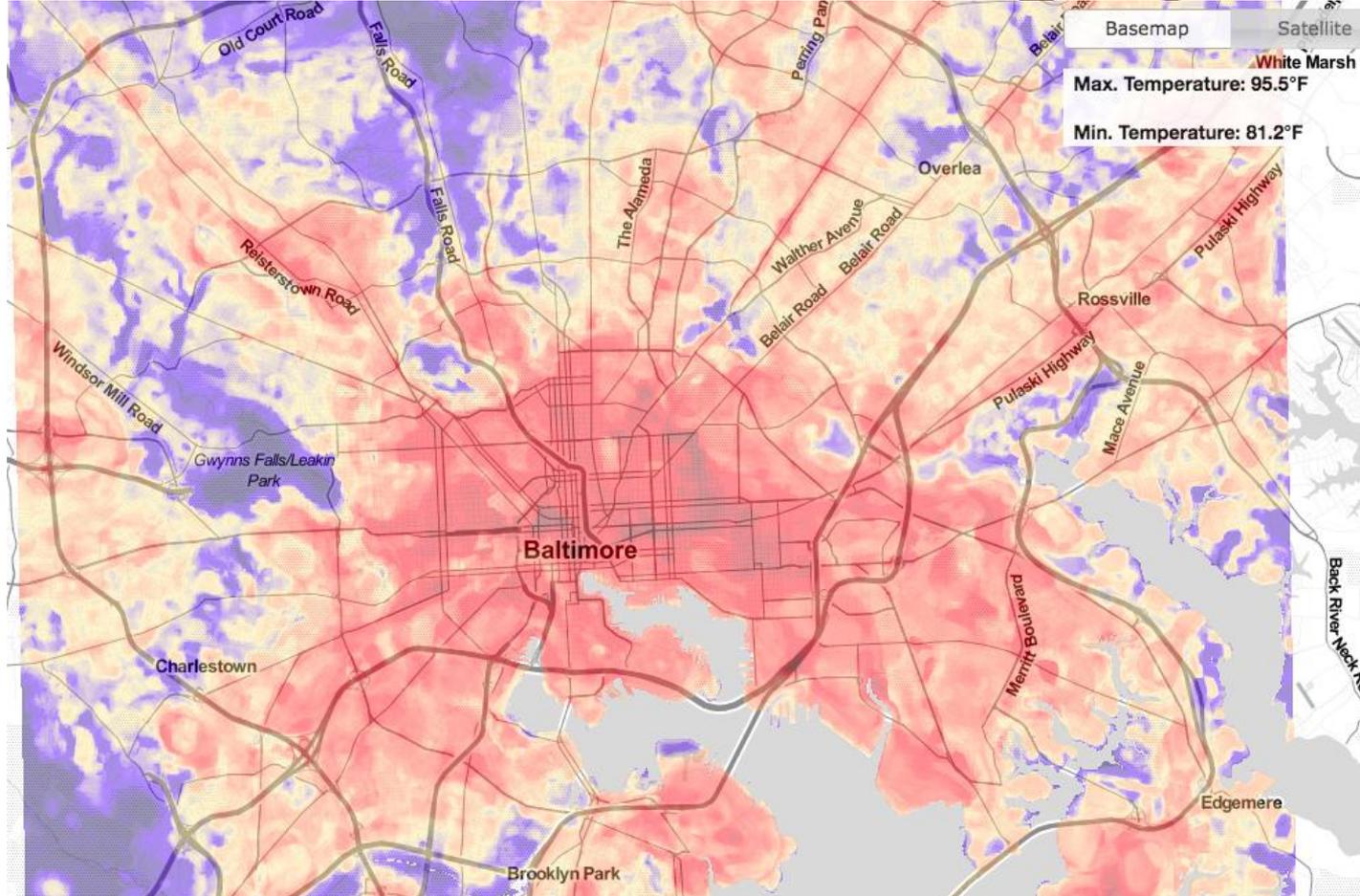


<https://climatecope.research.pdx.edu/baltimore/uhi/>

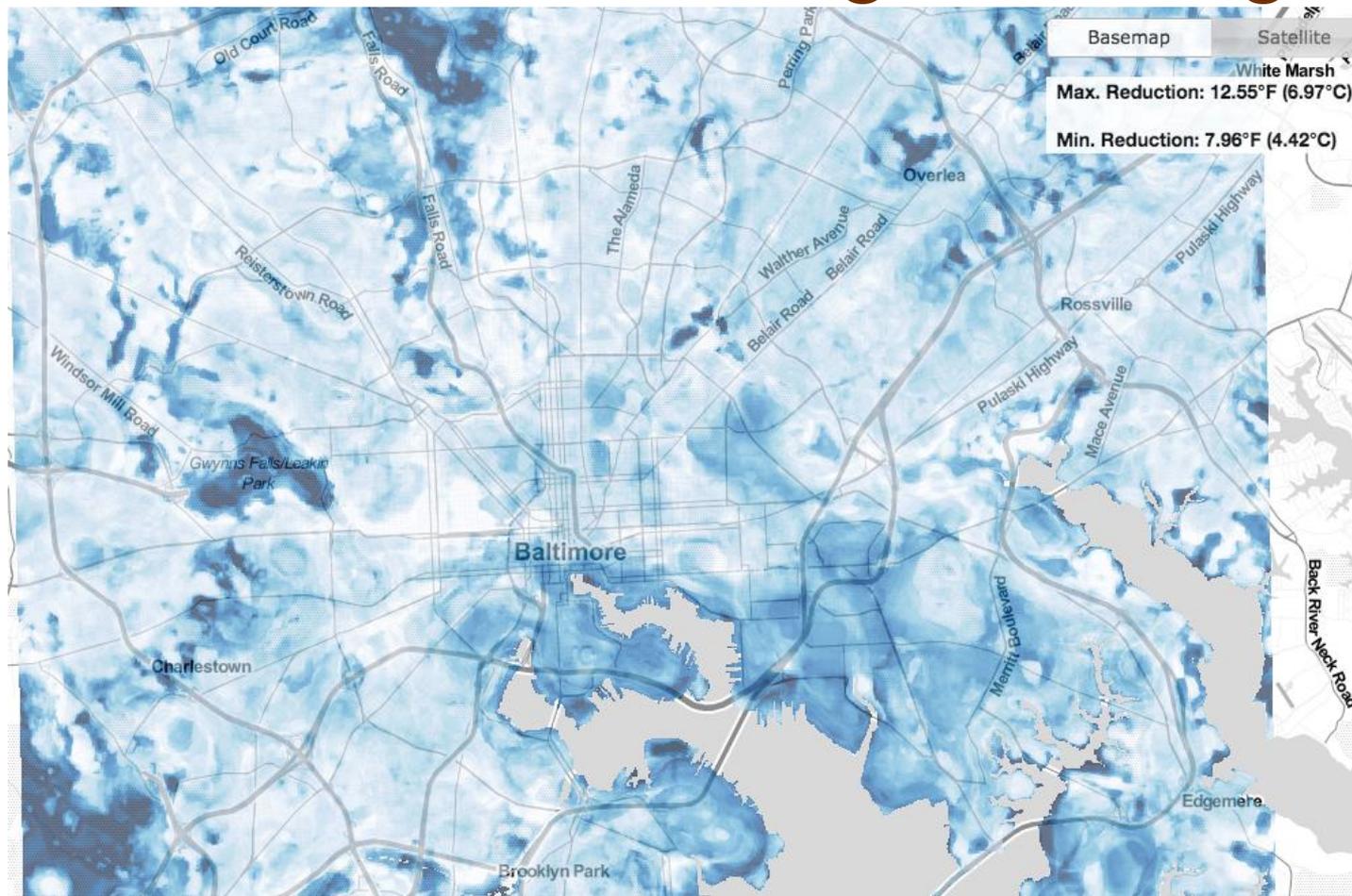
Baltimore UHI – Afternoon (3pm)



Baltimore UHI – Evening (7pm)



Baltimore UHI – Morning to Evening



Considerations for Phase 2....



Article

Integrating Satellite and Ground Measurements for Predicting Locations of Extreme Urban Heat

Vivek Shandas ^{1,*}, Jackson Voelkel ¹ , Joseph Williams ¹ and Jeremy Hoffman ² 

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- Identify potential uses of the heat maps;
- Integrate data with socio-demographics;
- Assess heat implications of alternative development scenario assessments;
- Consider how other communities have applied these findings (i.e. Richmond, Portland, Hermosillo, etc.)
- Others ideas....?



Richmond's Applications



Shelby Lum, RTD

RICHMOND URBAN HEAT ISLAND COLLECTIVE



VCU



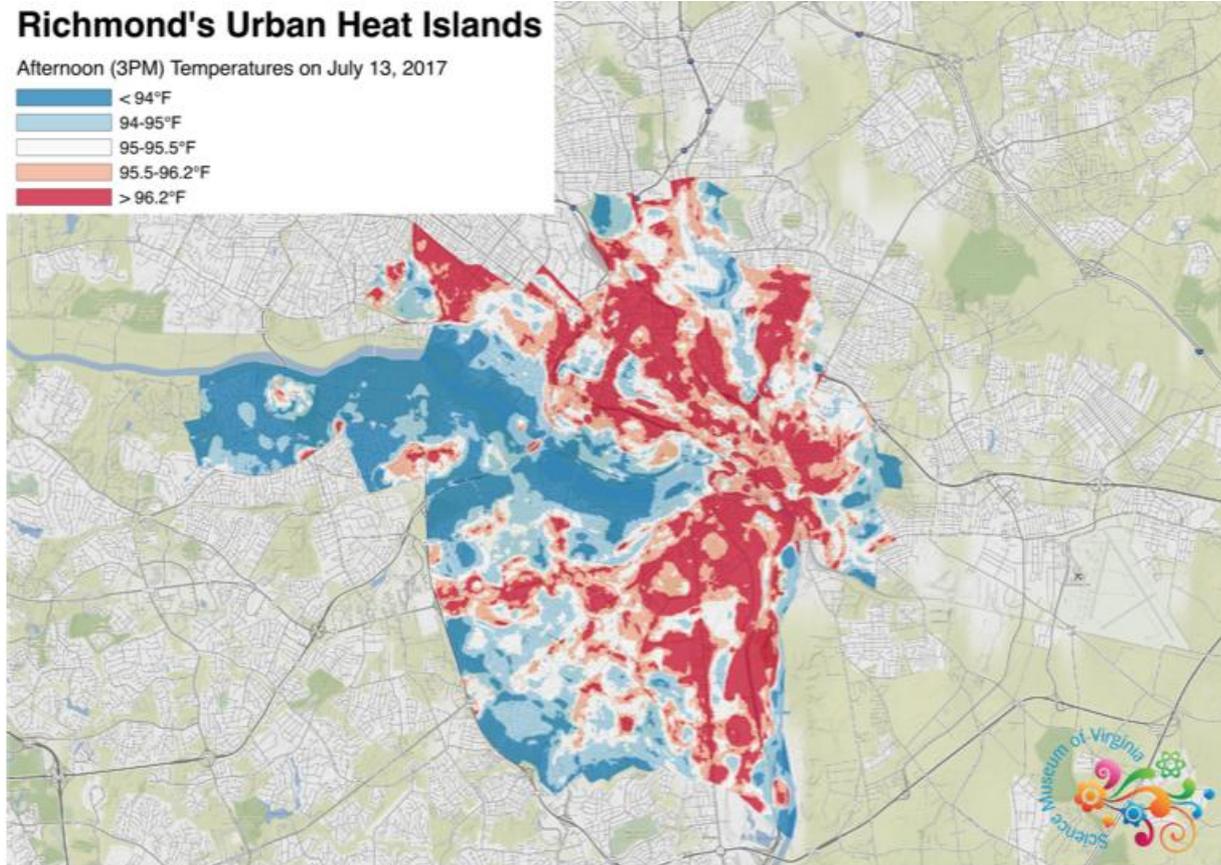
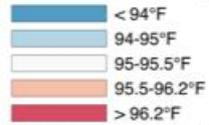
Richmond Times-Dispatch



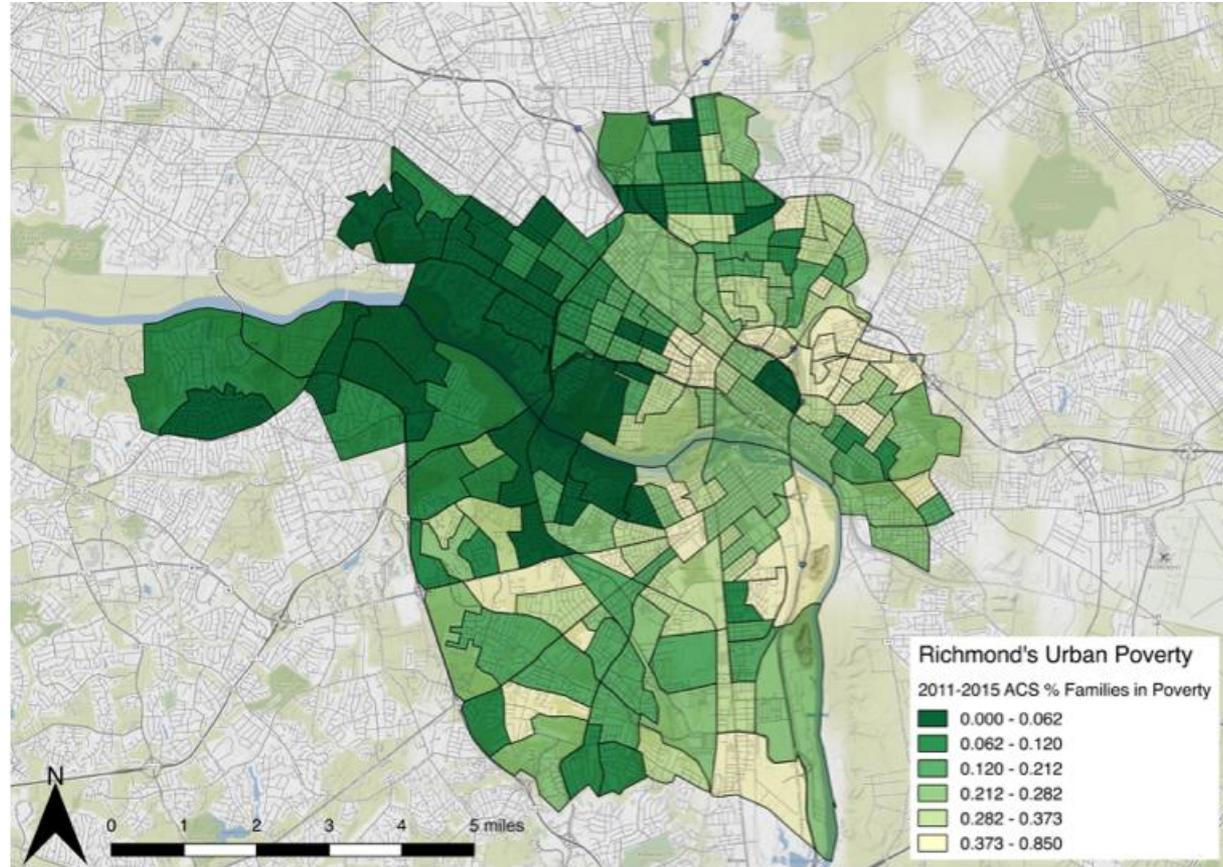
Richmond's Applications

Richmond's Urban Heat Islands

Afternoon (3PM) Temperatures on July 13, 2017

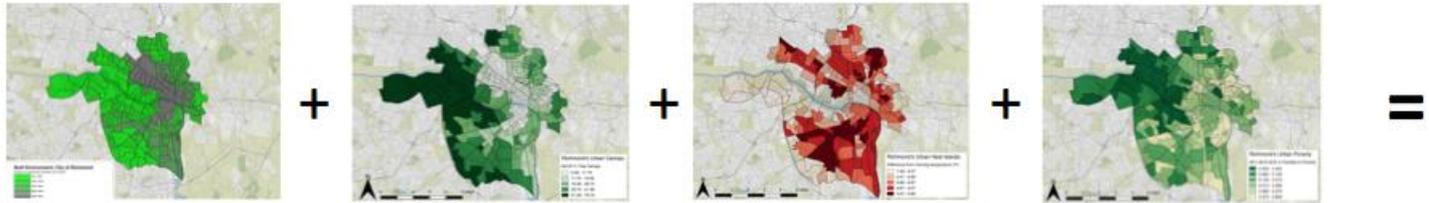


Richmond's Applications

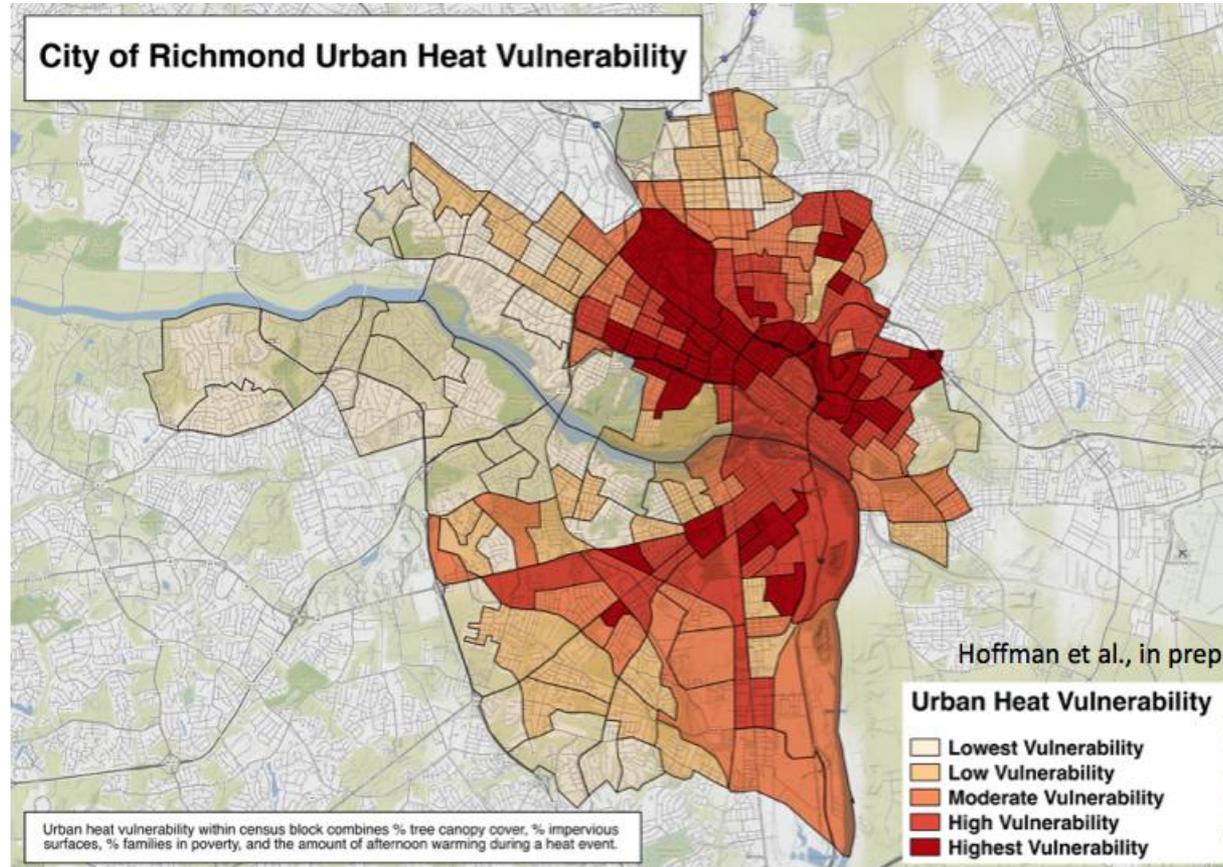


Richmond's Applications

Urban Heat Vulnerability =



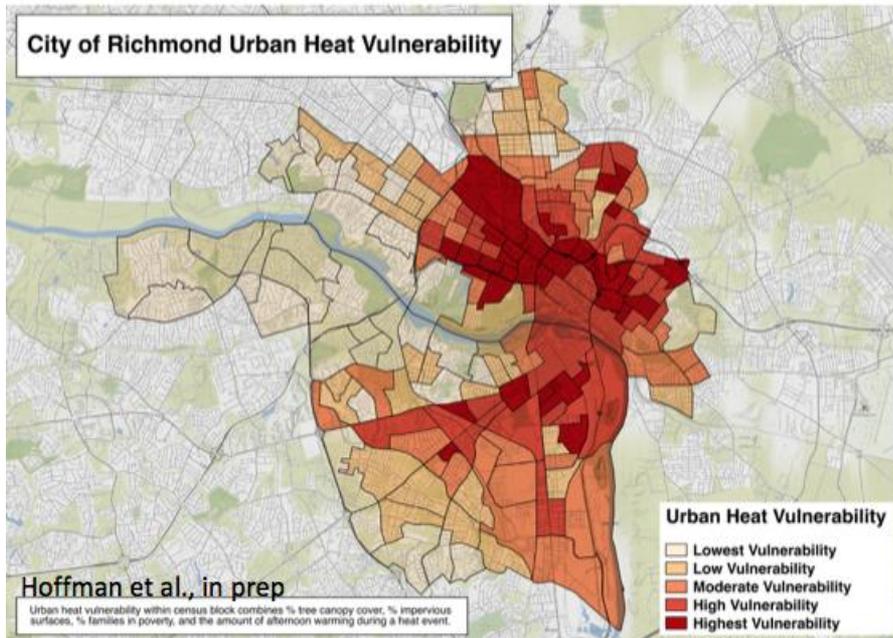
Richmond's Applications



Richmond's Applications

VULNERABILITY

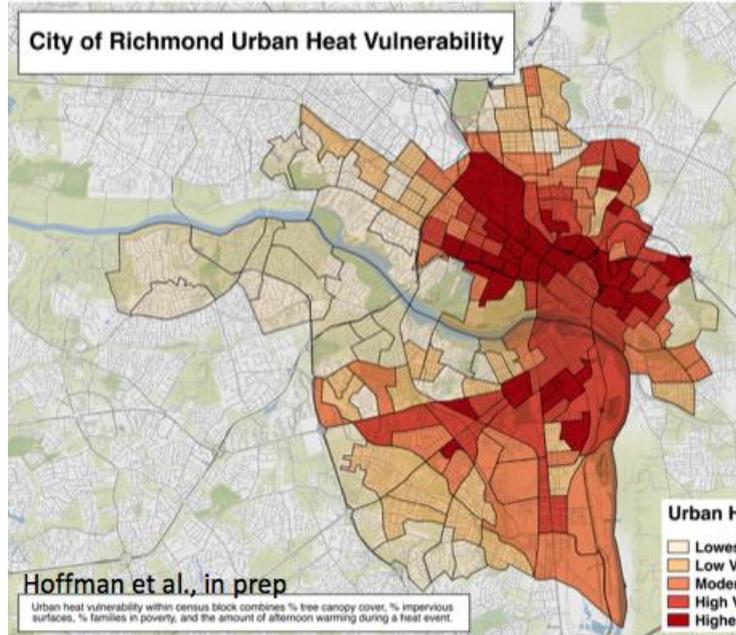
RAA AMBULANCE RESPONSES



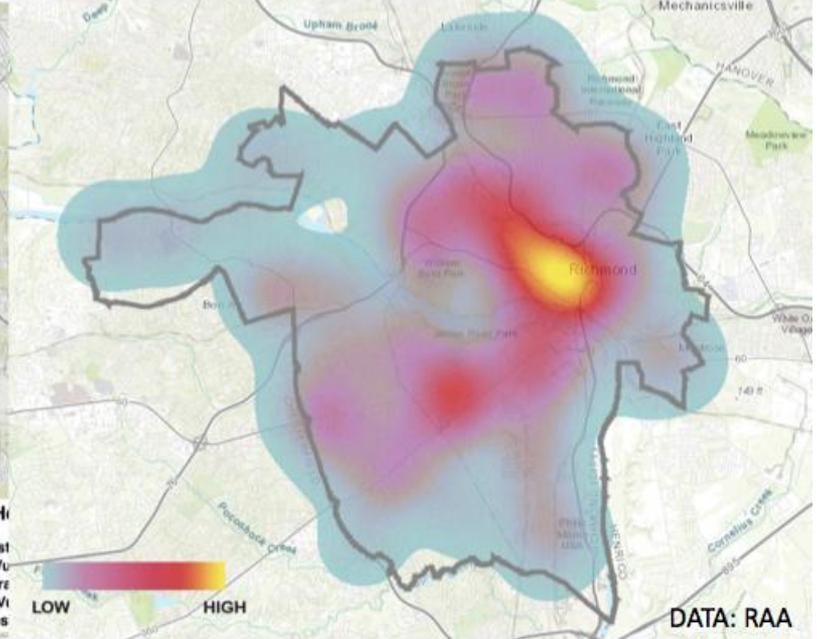
DATA: RAA

Richmond's Applications

VULNERABILITY



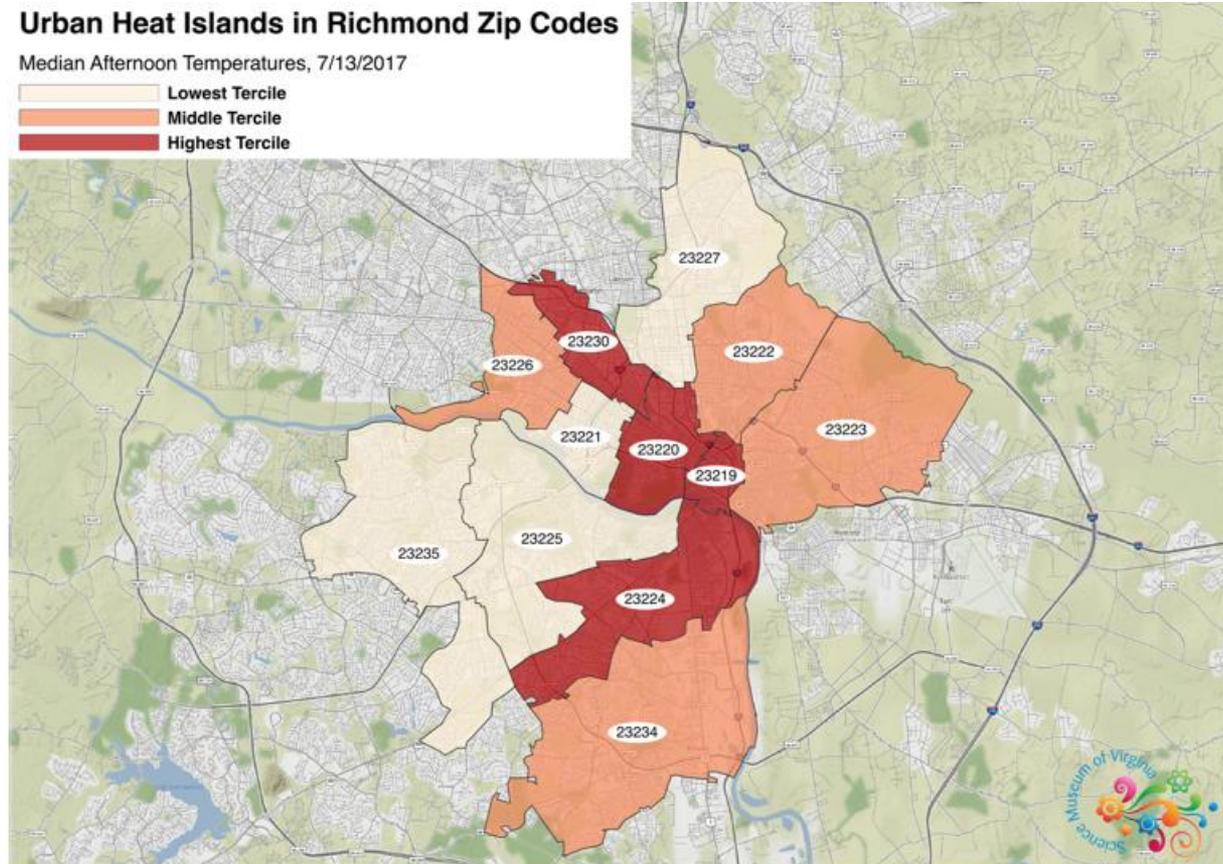
RAA AMBULANCE RESPONSES



Richmond's Applications

Urban Heat Islands in Richmond Zip Codes

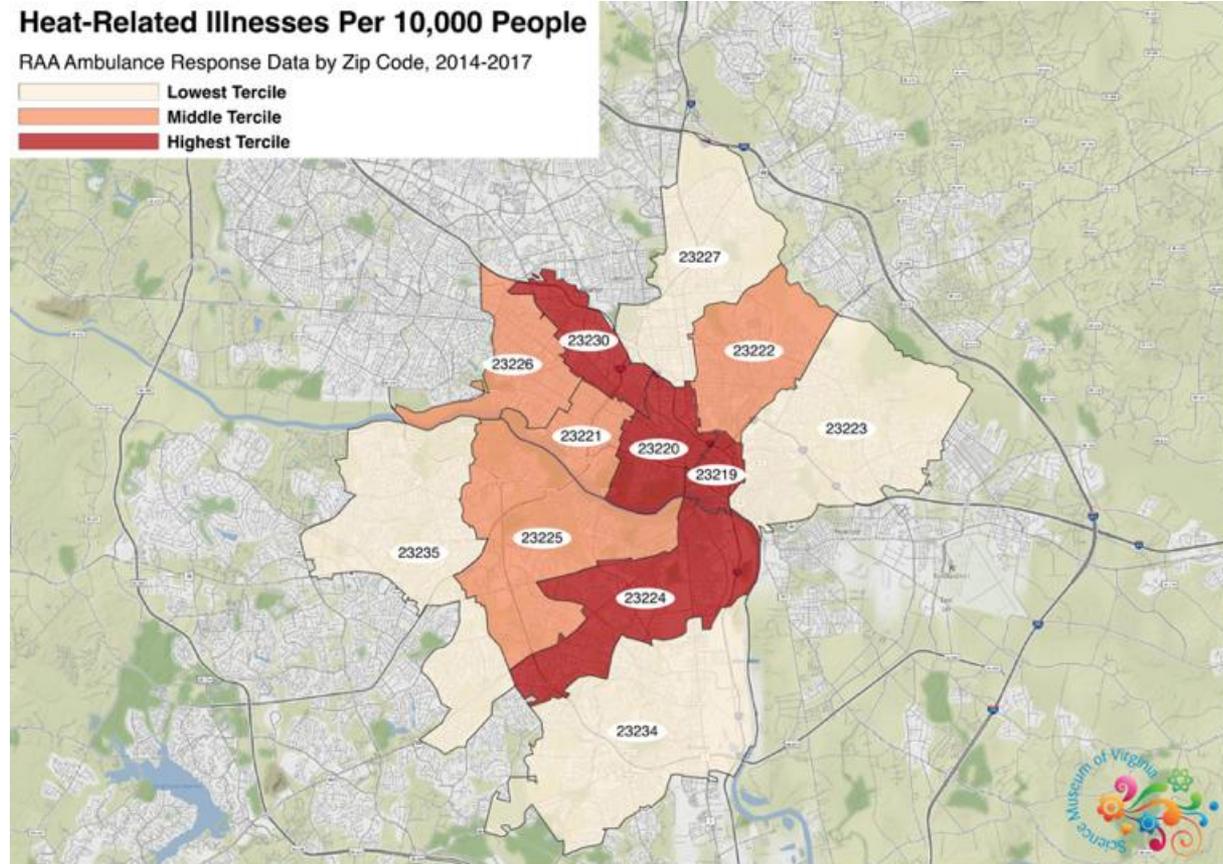
Median Afternoon Temperatures, 7/13/2017



Richmond's Applications

Heat-Related Illnesses Per 10,000 People

RAA Ambulance Response Data by Zip Code, 2014-2017



Richmond's Applications

The Richmond Land Bank

Annual Plan July 2018 — June 2019



Richmond's Applications

c. Community health:

1. **High ambient temperature relative to average.**¹⁷ Different land use and ground cover patterns create “urban heat islands” in Richmond. Because higher temperatures are associated with greater health risks, identifying “hot spots” across the City may help determine where vacant, undevelopable land in those areas can be prioritized for green interventions.
2. **Low food security.** Neighborhoods with limited access to fresh, healthy food can utilize vacant and empty lots for community gardens to promote food justice.

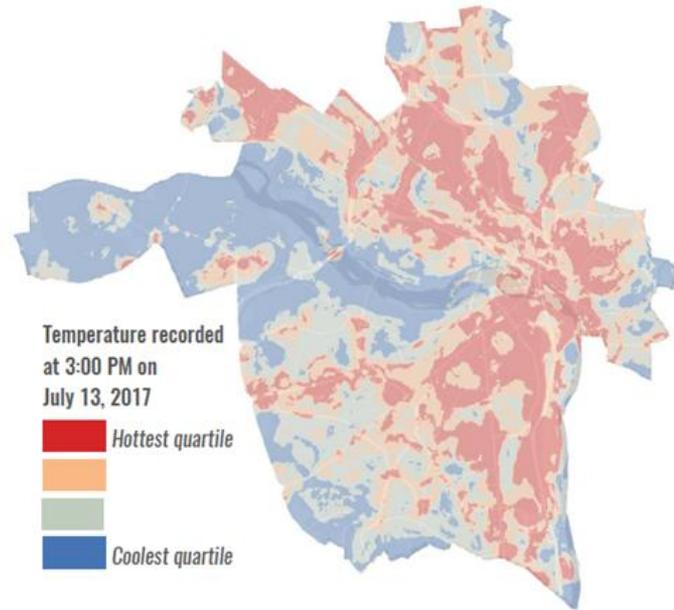


FIGURE 17: Urban heat islands in Richmond

SOURCE: J.S. Hoffman, Science Museum of Virginia, 2017

Richmond's Applications

Insights Report

Background information in preparation
for updating Richmond's Master Plan

September 2018



Richmond's Applications

Sustainability & Resiliency

Preparing and responding to a changing climate

Community Greenhouse Gas emissions have decreased by 15%.

From 2008 to 2015, community GHG emissions decreased by 15%. The City's goal is to decrease community-wide Greenhouse Gas (GHG) emissions by 80% by 2050 using 2008 as the baseline year. *RV4Green 2050* is Richmond's planning process to develop a roadmap of actions to achieve Richmond's 80% reduction by 2050.

63% of GHG emissions are from the residential and commercial sectors.

In 2015, 40% of community GHG emissions were from commercial buildings, 24% from the transportation sector, 23% from residential buildings, and 11% from industrial facilities. 50% of community GHG emissions in 2015 resulted from the use of electricity, 24% from gasoline/diesel and 22% from natural gas. Overall energy consumption in Richmond decreased by 2% between 2008 and 2015.

Renewable energy is changing the Richmond landscape

In 2017, Richmond achieved SolSmart Silver designation for its efforts to provide resources and reduce barriers to make it faster, easier and less expensive for the community to go solar. While only accounting for 0.08% of the total

¹ SolSmart is a program of the Department of Energy and National League of Cities.

energy supply, the production of solar energy has increased by nearly 450 times between 2008 and 2015. Analysis by VCU's Center for Urban and Regional Analysis shows great potential for rooftop solar panels to produce up to 12% of the city's energy demand; however, the electricity distribution and energy storage infrastructure would need to be significantly upgraded to accommodate that much solar energy.

There has been a slight increase in vehicle miles traveled since 2008.

Vehicle miles traveled (VMT) is an indicator that policy makers track to understand how much people are driving and estimate how many greenhouse gases are produced by vehicles. Total VMT increased from 2008 to 2015 by 0.2%.

The number of days over 95° is likely to increase by 30 days annually.

According to the Science Museum of Virginia, the city already experiences 9 more days above 90 degrees annually than surrounding rural areas. Climate models predict that Richmond could experience nearly 30 more days above 95 degrees annually. Per the Science Museum of Virginia, "As extreme summertime temperatures in the City of Richmond have been linked with urban heat vulnerability and visits to urgent care centers and emergency departments for heat-related illnesses in 2016, the urban

heat island effect is not only an infrastructural challenge and an environmental equity issue, but also an important public health issue."

Major rain events are expected to increase by more than 25%.

According to the Science Museum of Virginia, from 1948 to 2011, "Virginia saw a 33% increase in the frequency of extreme rainfall events and an 11% increase in the amount of rain falling in its largest annual storms." The number of extreme rain events is expected to increase by two and a half times. Given the environmental constraints and large amount of paved surface in Richmond, planning for increased intensity and frequency of rain events is critical.

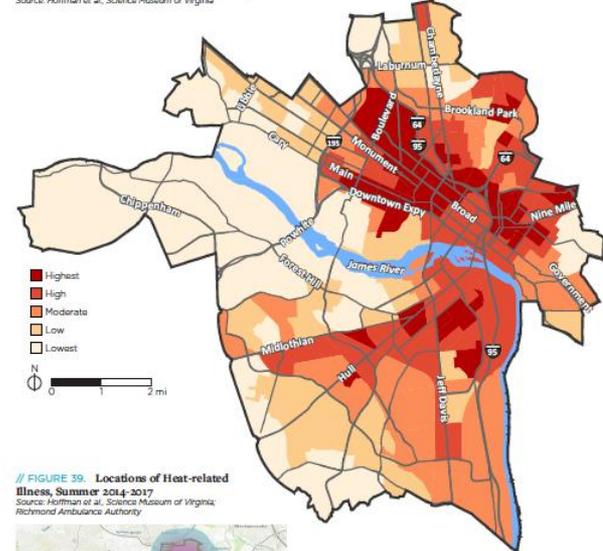
Richmonders are very vulnerable to urban heat.

Urban heat vulnerability is a term used to describe an area's conditions that make it more or less sensitive to heat. Currently, 21.5% of Richmonders live in Census tracts designated as "highest" in terms of urban heat vulnerability, while 19.6% live in Census tracts designated as "high". These areas correspond with some of the densest areas of the city.

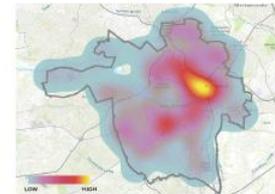
Heat-related illness is highly concentrated.

Heat-related illness in the summer is highly concentrated in areas with "high" and "highest" urban heat vulnerability and areas that are poor.

// FIGURE 38. Urban Heat Vulnerability, 2017
Urban heat vulnerability is a term used to describe an area's conditions that make it heat sensitive using a combination of % tree canopy, % impervious surfaces, % families in poverty, and the amount of afternoon warming during a heat event.
Source: Hoffman et al., Science Museum of Virginia

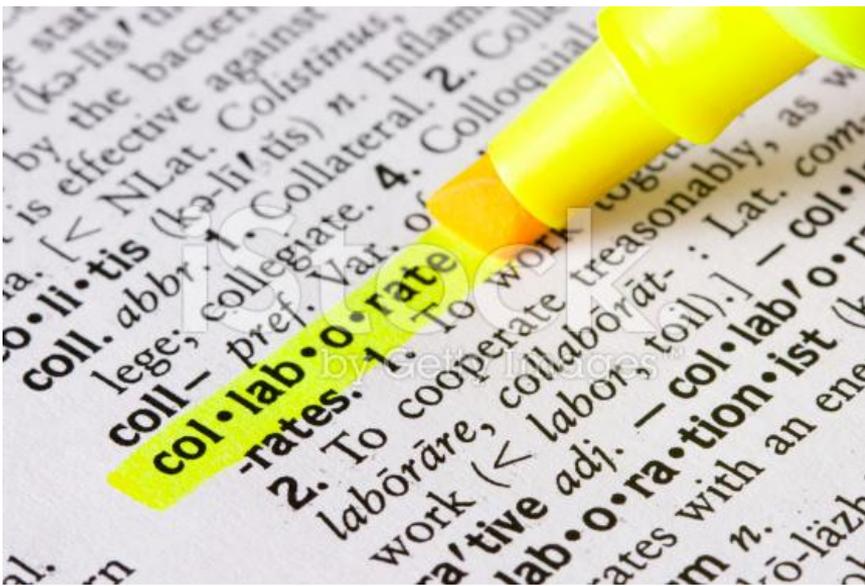


// FIGURE 39. Locations of Heat-related Illness, Summer 2014-2017
Source: Hoffman et al., Science Museum of Virginia; Richmond Ambulance Authority



Consider this:

- How can we prepare for the effects of climate change?
- How do we ensure the most vulnerable populations are included in creating solutions to mitigate the effects of climate change?



Contact

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