# Baltimore, MD, Urban Heat Field Campaign

## *Review of Findings*


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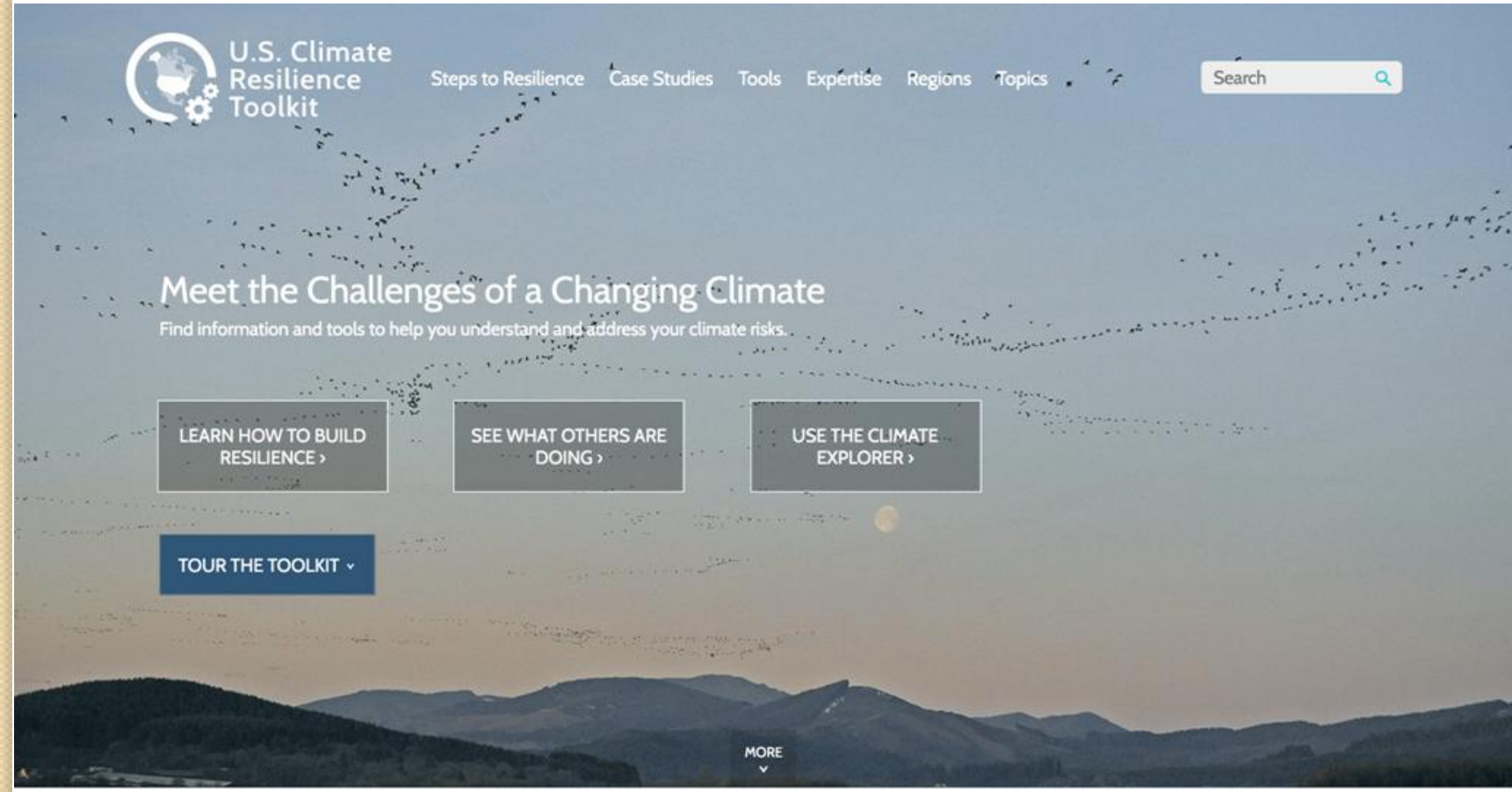



Online at https://toolkit.climate.gov

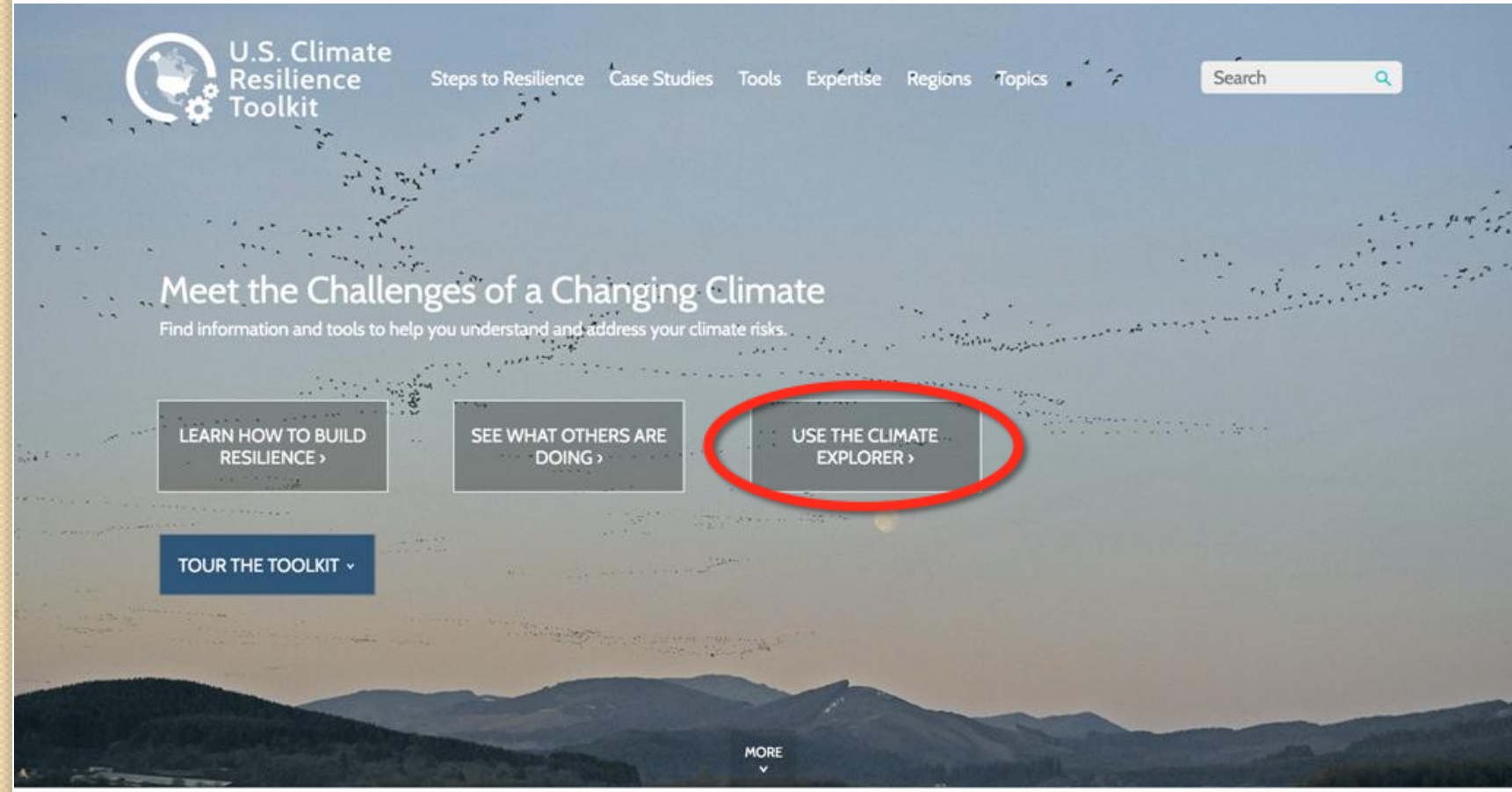
# STEPS TO RESILIENCE

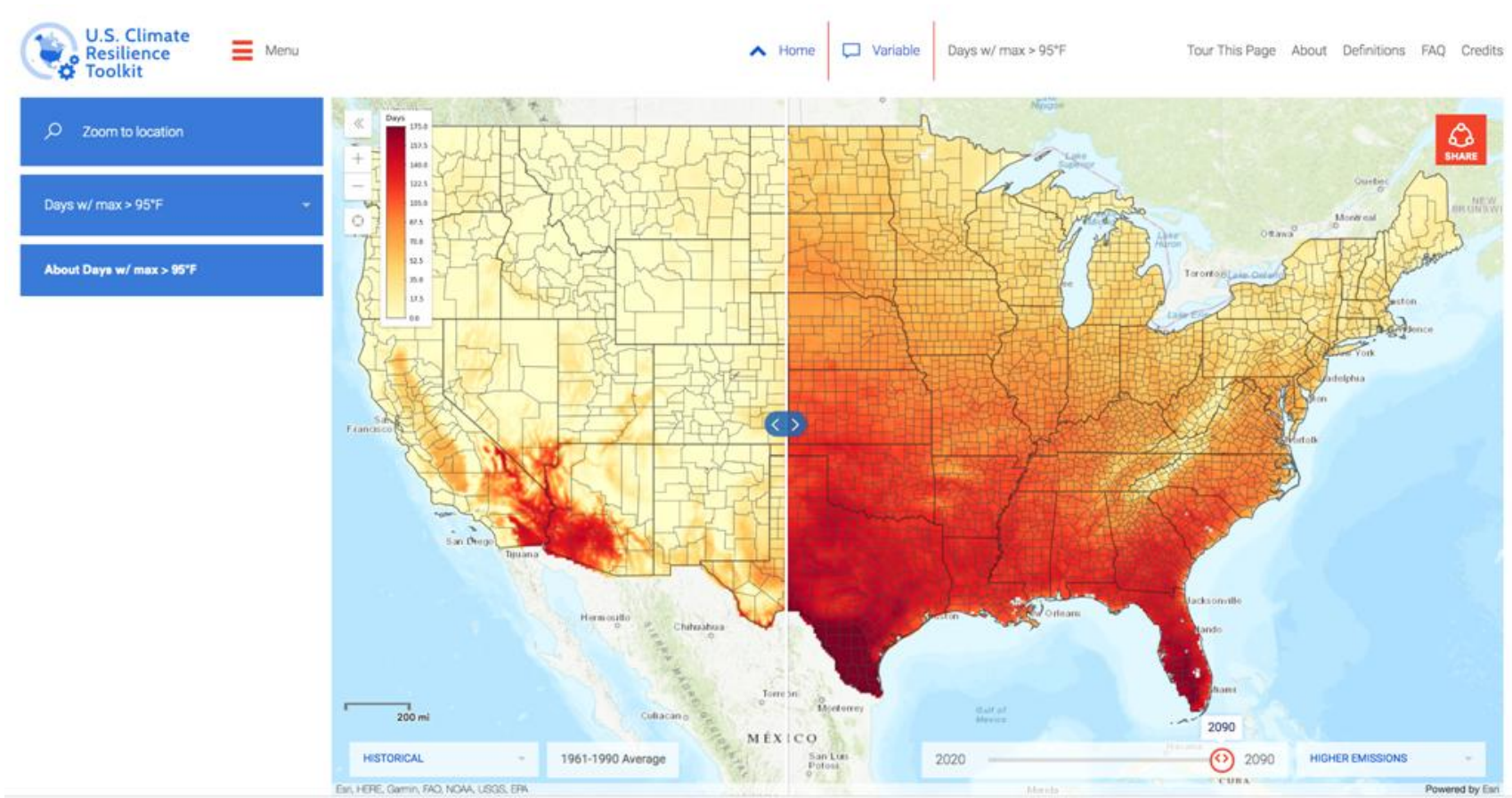
*Use this framework to discover and document climate hazards, then develop workable solutions to lower climate-related risks. Watch the overview video or click any step to learn more.*


Did you know?

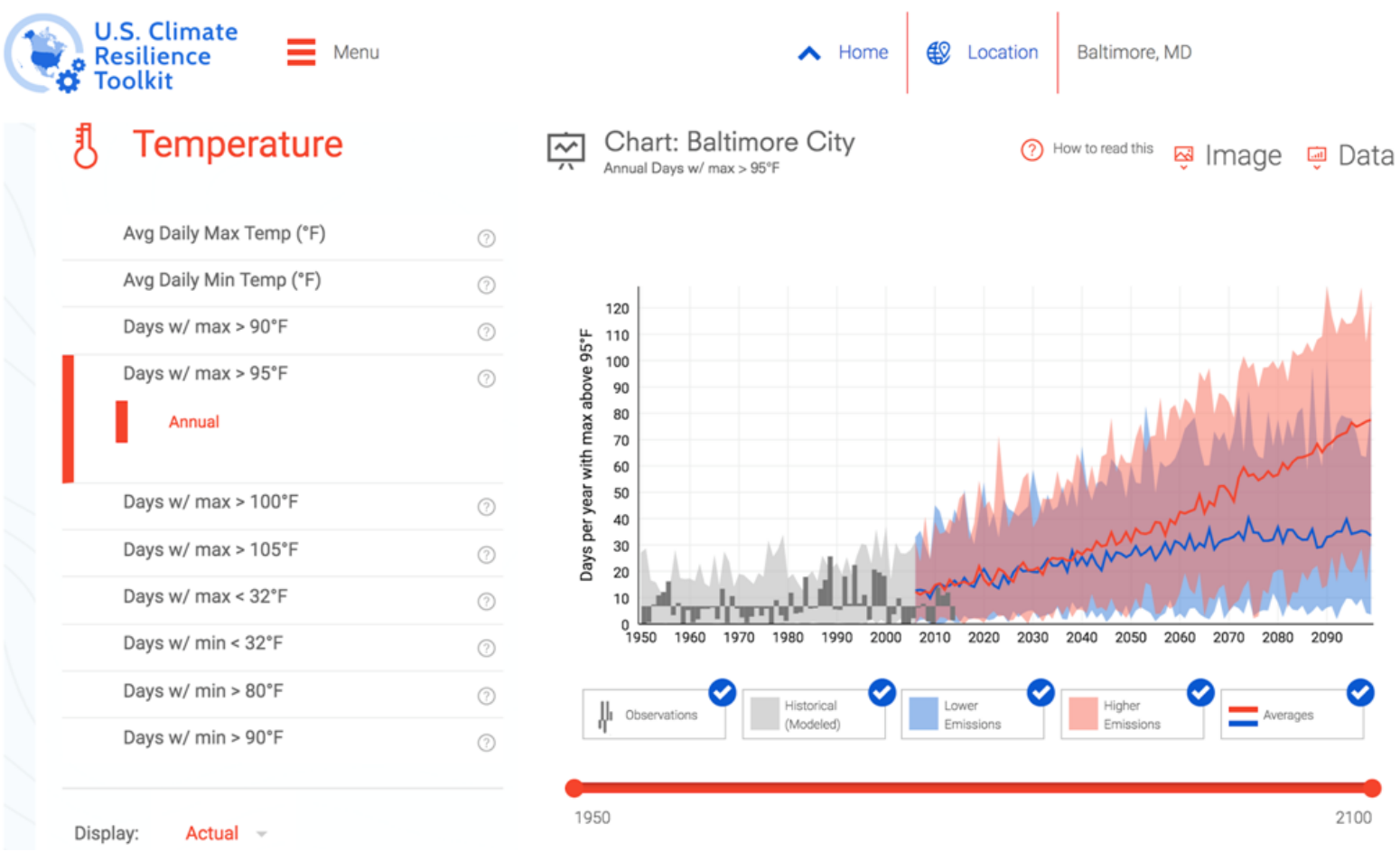
Why should we care?

What can we do about it?


U.S. Climate Resilience Toolkit
Steps to Resilience
Case Studies
Tools
Expertise
Regions
Topics
Search
Meet the Challenges of a Changing Climate
Find information and tools to help you understand and address your climate risks.
LEARN HOW TO BUILD RESILIENCE ›
SEE WHAT OTHERS ARE DOING ›
USE THE CLIMATE EXPLORER ›
TOUR THE TOOLKIT
MORE

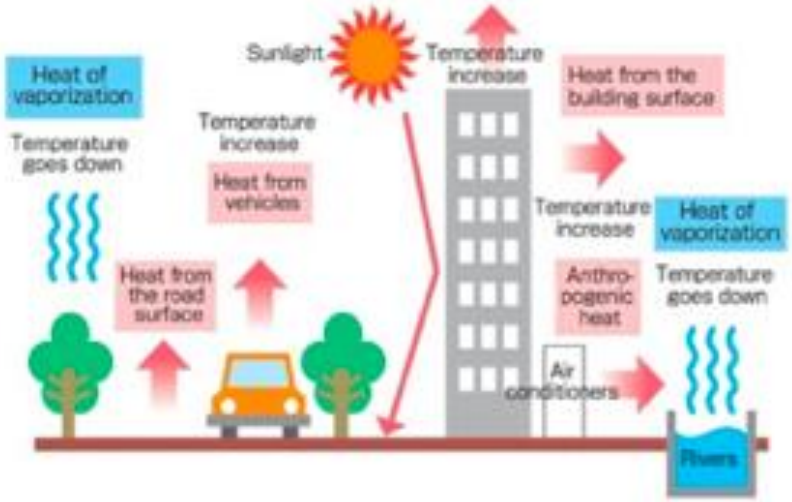



The number of very hot days (≥95°F) across the U.S. is projected to increase dramatically this century compared to last century.




The number of ≥95°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



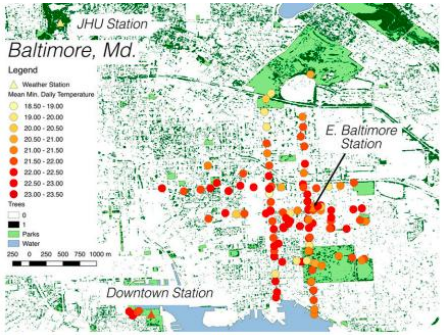




FIG. 3. Locations of the 135 sensors in eastern Baltimore. The color scale shows $\overline{T}$, the temporal mean of daily minimum temperatures for 1 Jun–15 Sep 2015.

JANUARY 2017 SCOTT ET AL. 159

**Intraurban Temperature Variability in Baltimore**

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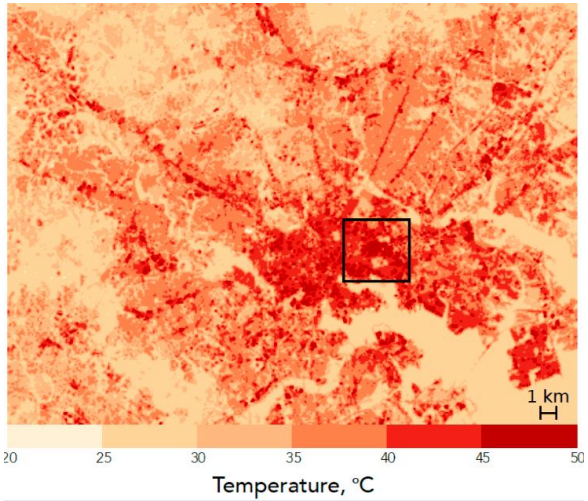
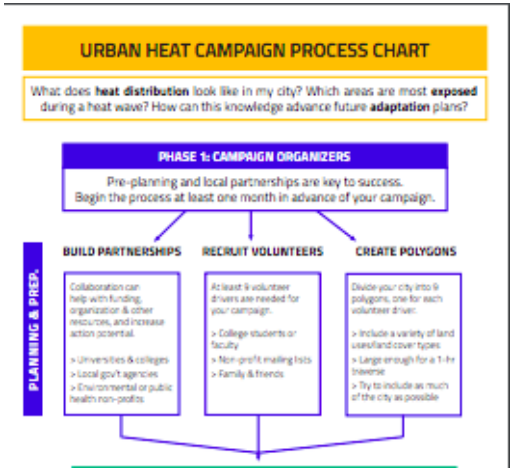
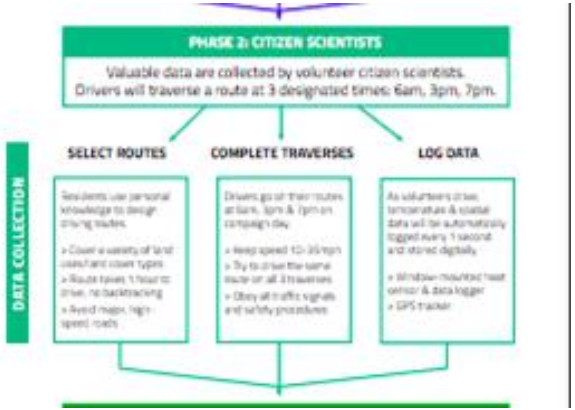


# Field Campaign: 29th & 30th August, 2018

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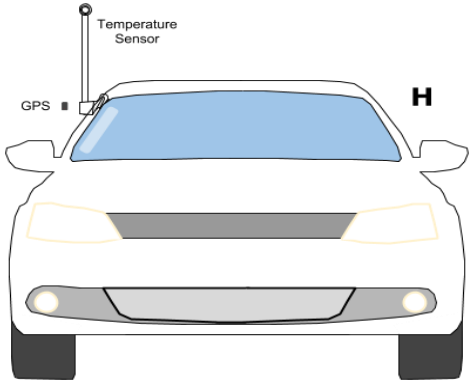
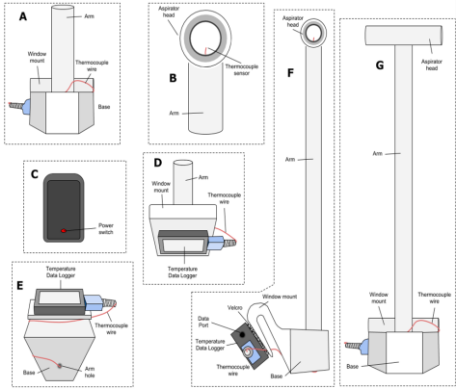
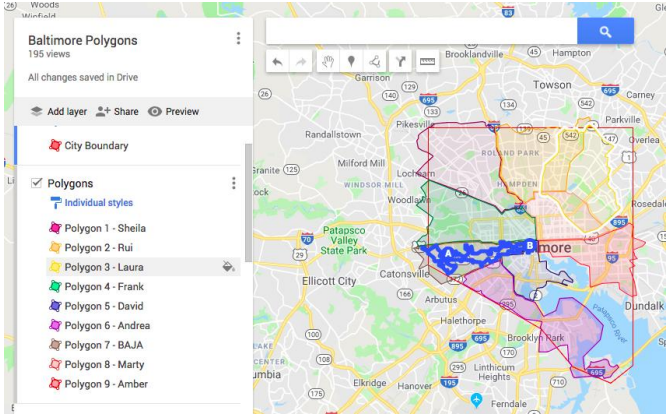
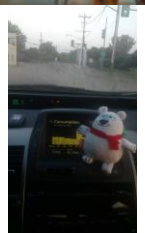


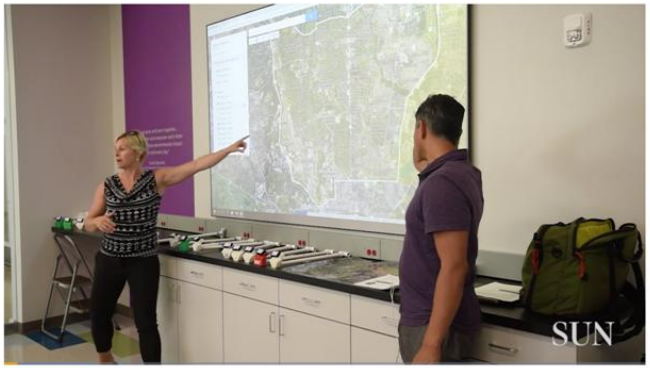



# Field Campaign: 29th & 30th August, 2018

SECTIONS SEARCH THE BALTIMORE SUN SUBSCRIBE 4 weeks for 99¢ LOG IN

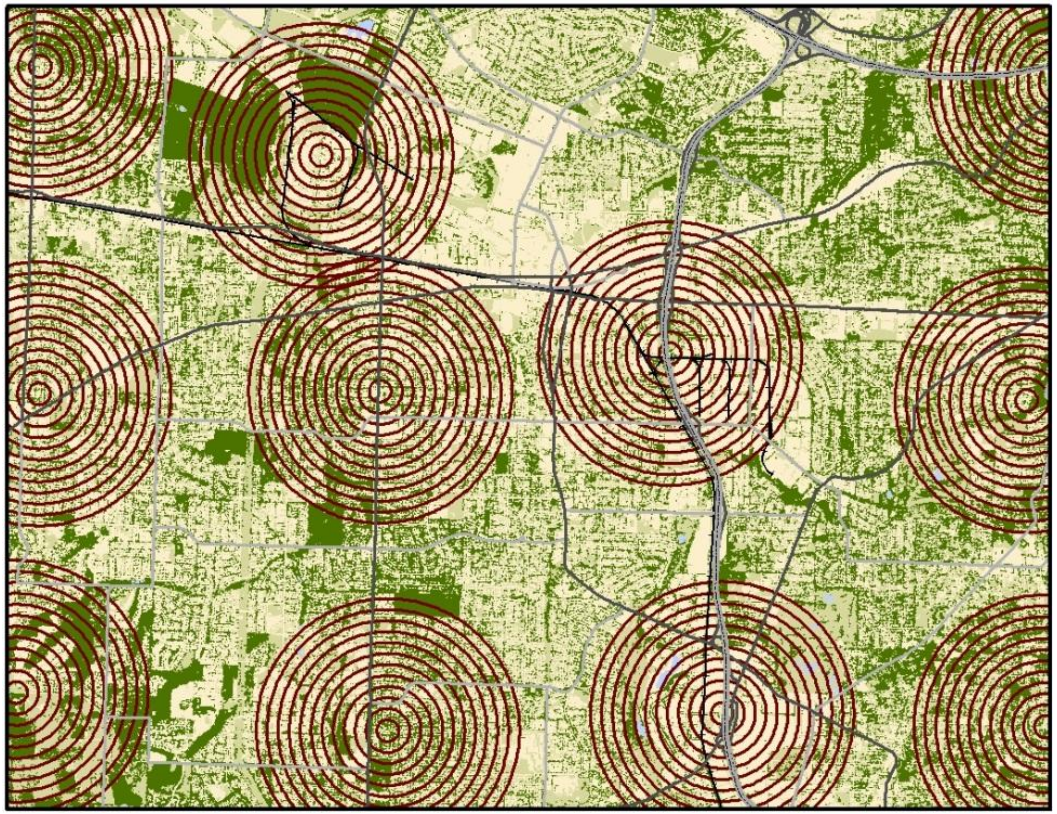
TUESDAY JAN. 8, 2019 LATEST ENEWSPAPER 2018 IN REVIEW SPORTS MARYLAND OBITS ADVERTISING POPULAR 46°

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



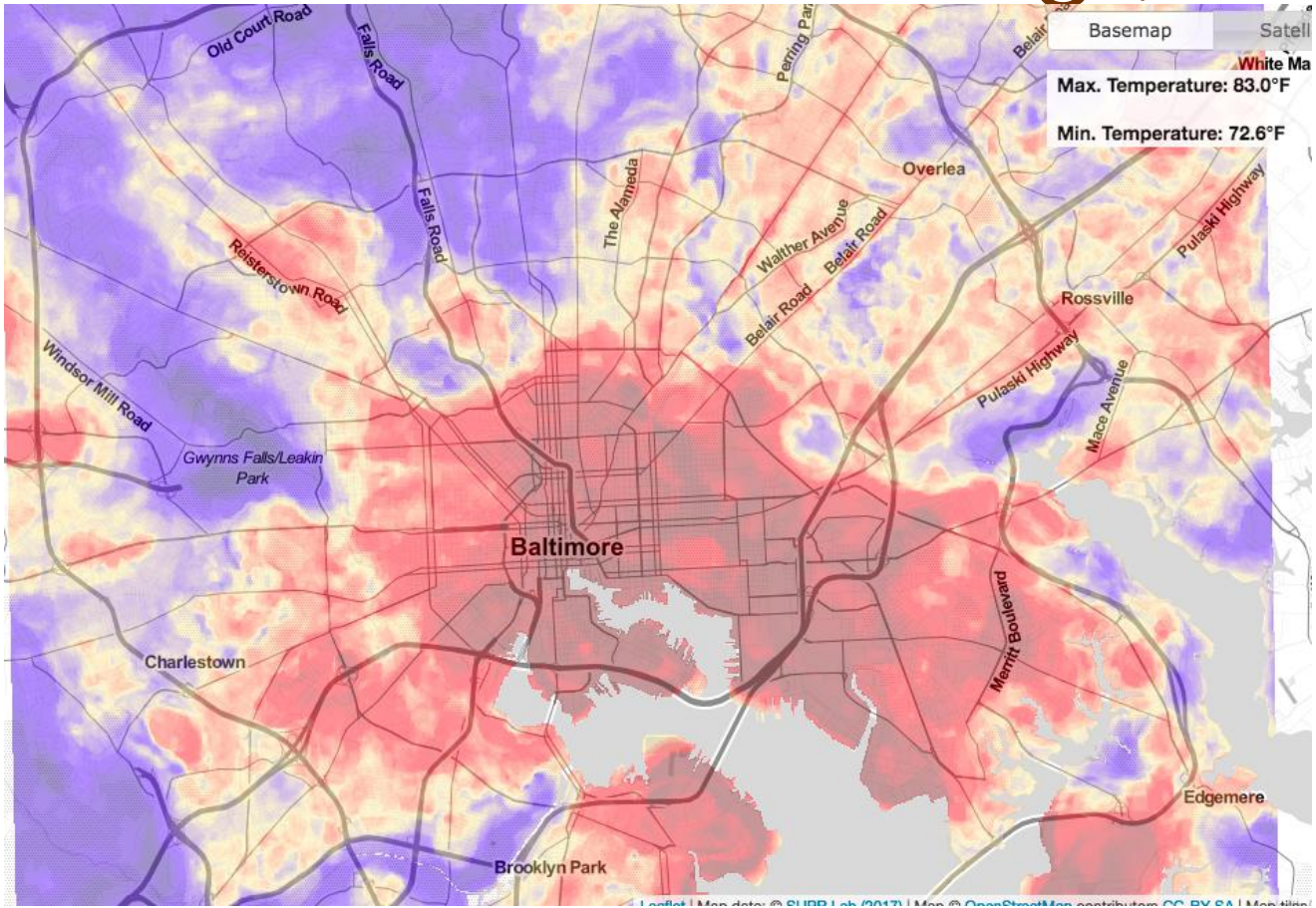

Volunteers log temperatures while driving through the city in an effort to help NOAA as it is conducting research on urban heat

# Explaining Variability in Temperatures



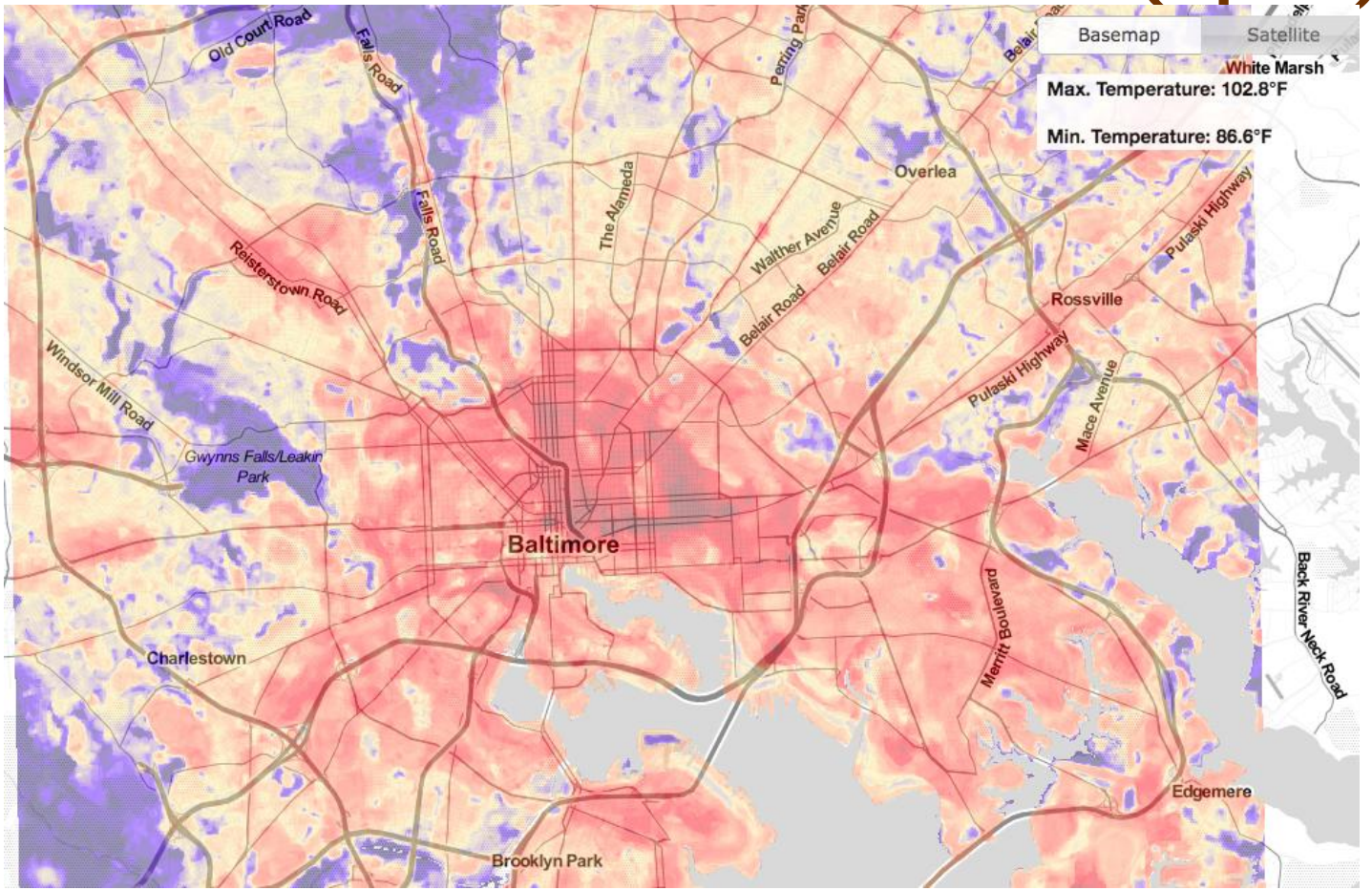

1. Voelkel and Shandas, 2016. Towards Systematic Prediction of Urban Heat Islands: Grounding measurement, assessing modeling techniques. *Climate 5(2) 41-57.*
2. Voelkel J, V Shandas**,** and B Haggerty 2016. High Resolution Descriptions of Urban Heat Islands: A public health imperative. *Preventing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

# Baltimore UHI – Morning (6am)

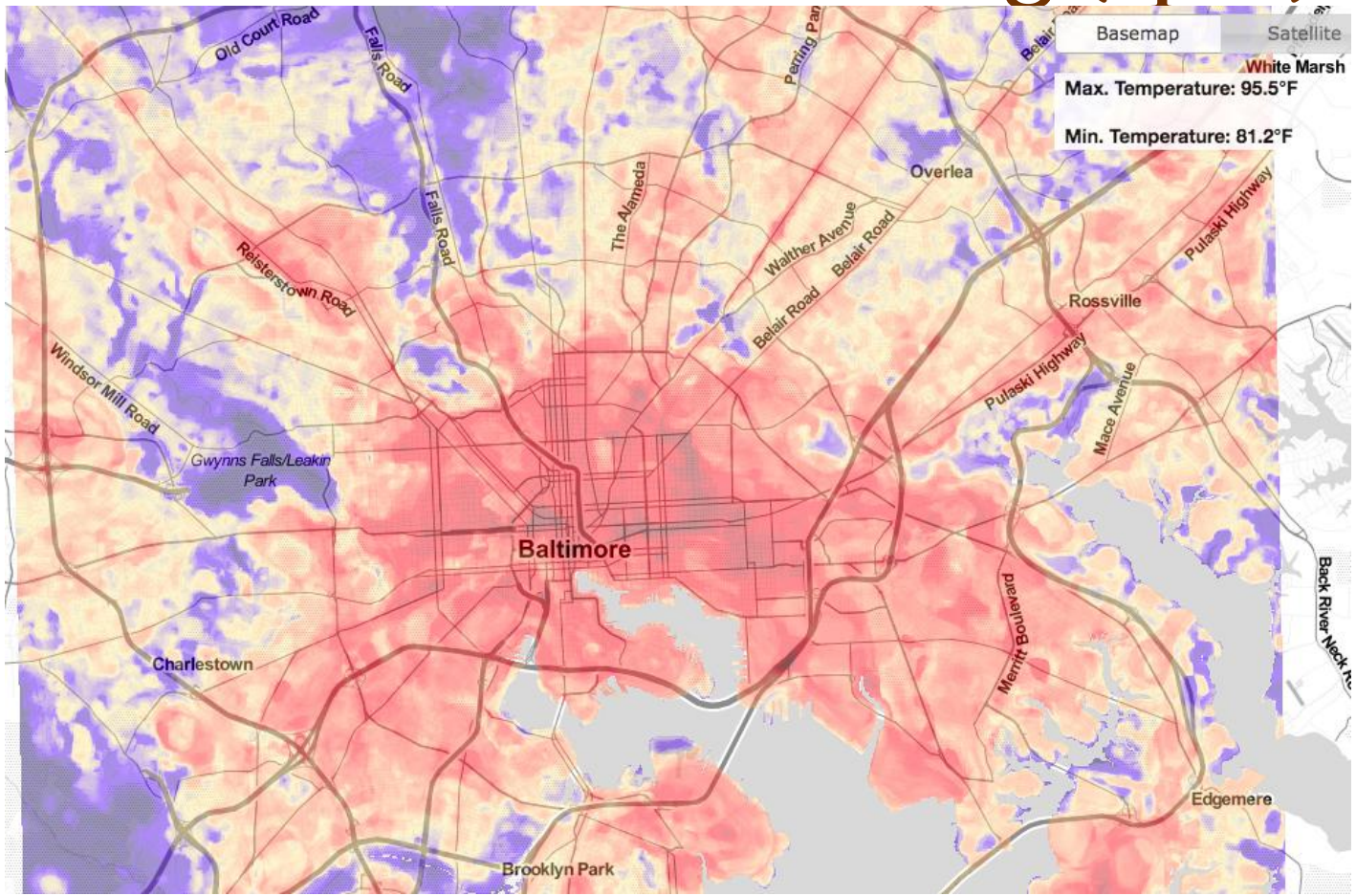



https://climatecope.research.pdx.edu/baltimore/uhi/

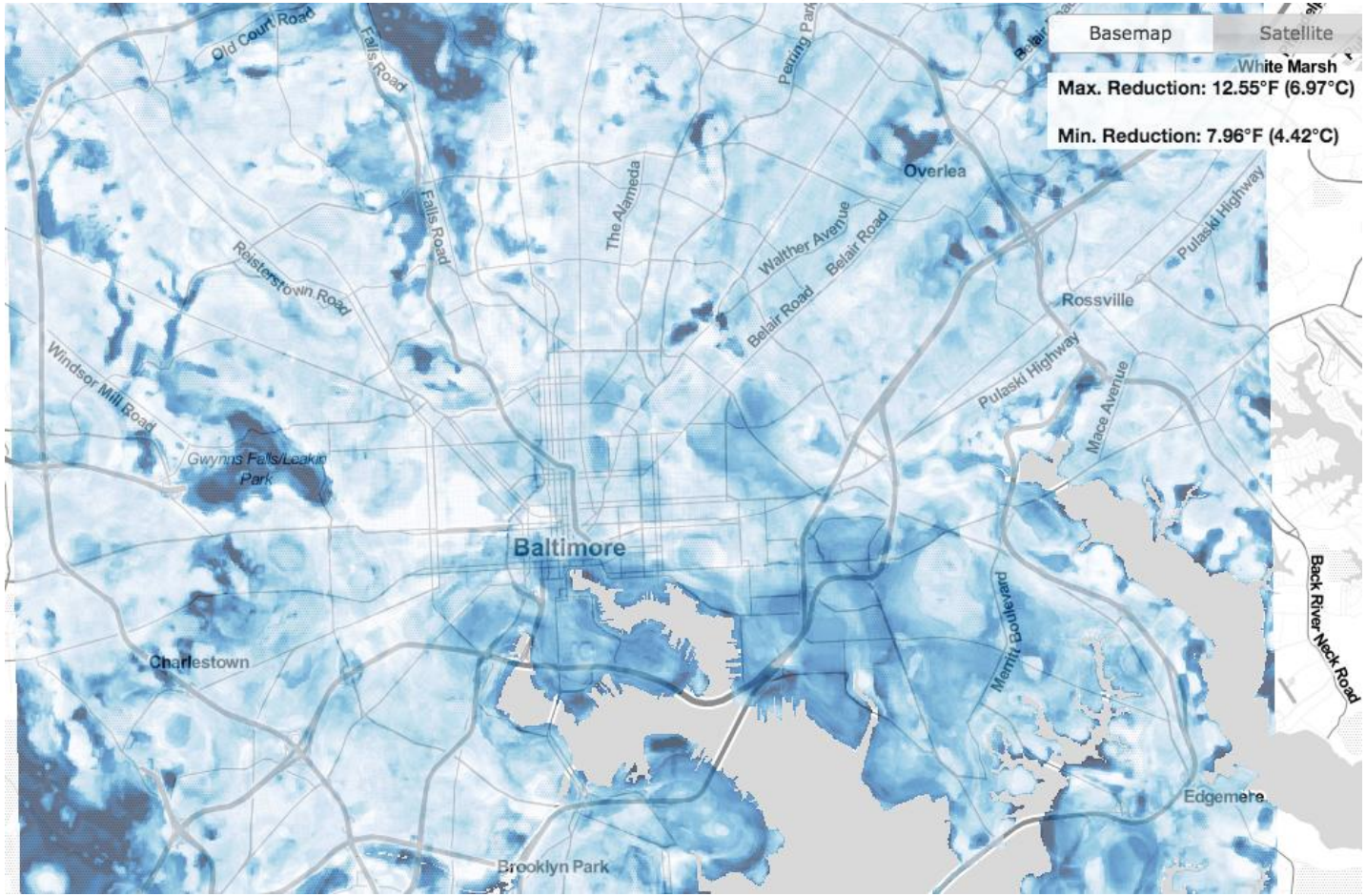
# Baltimore UHI –Afternoon (3pm)



# Baltimore UHI – Evening (7pm)



# Baltimore UHI – Morning to Evening



# Considerations for Phase 2....

climate

MDPI

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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2 Science Museum of Virginia, Richmond, VA 23220, USA; jhoffman@smv.org
* Correspondence: vshandas@pdx.edu; Tel.: +1-503-725-5222


- 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

# RICHMOND URBAN HEAT ISLAND COLLECTIVE

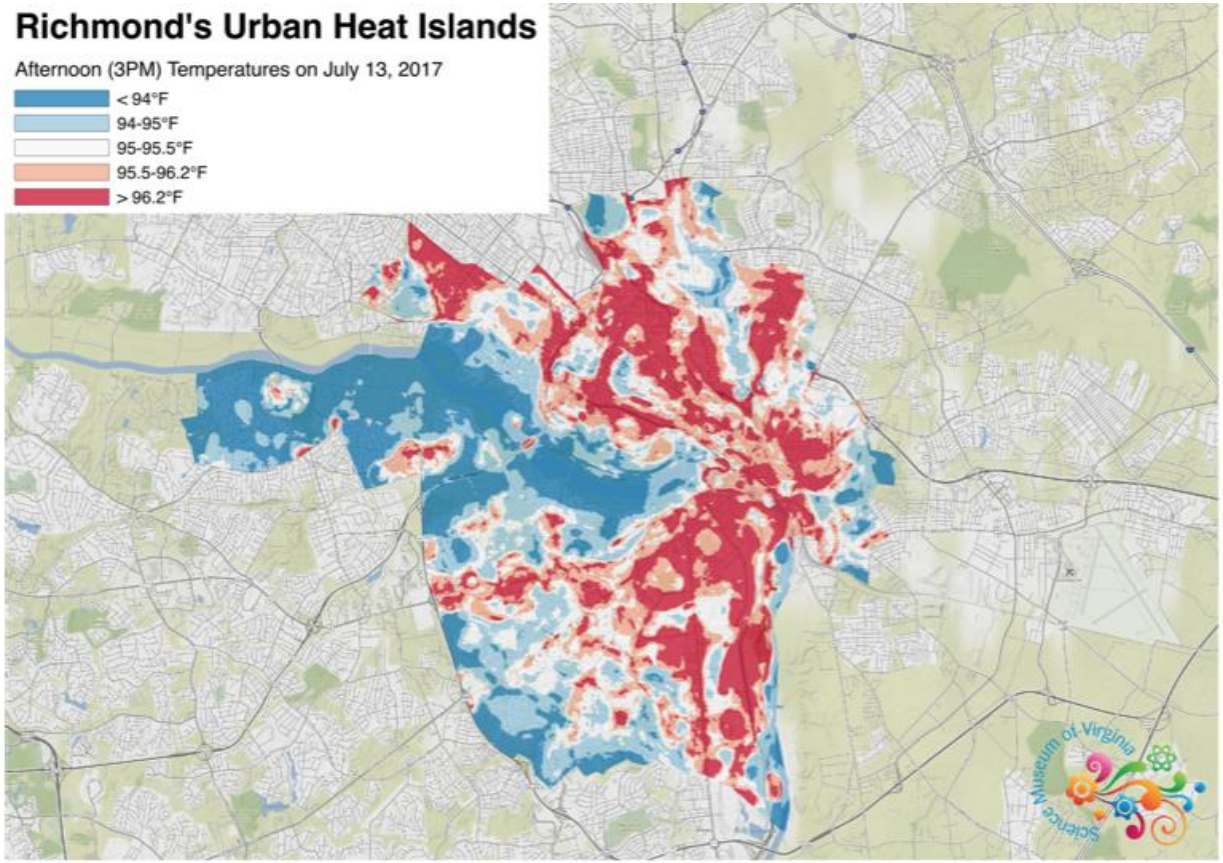


VCU

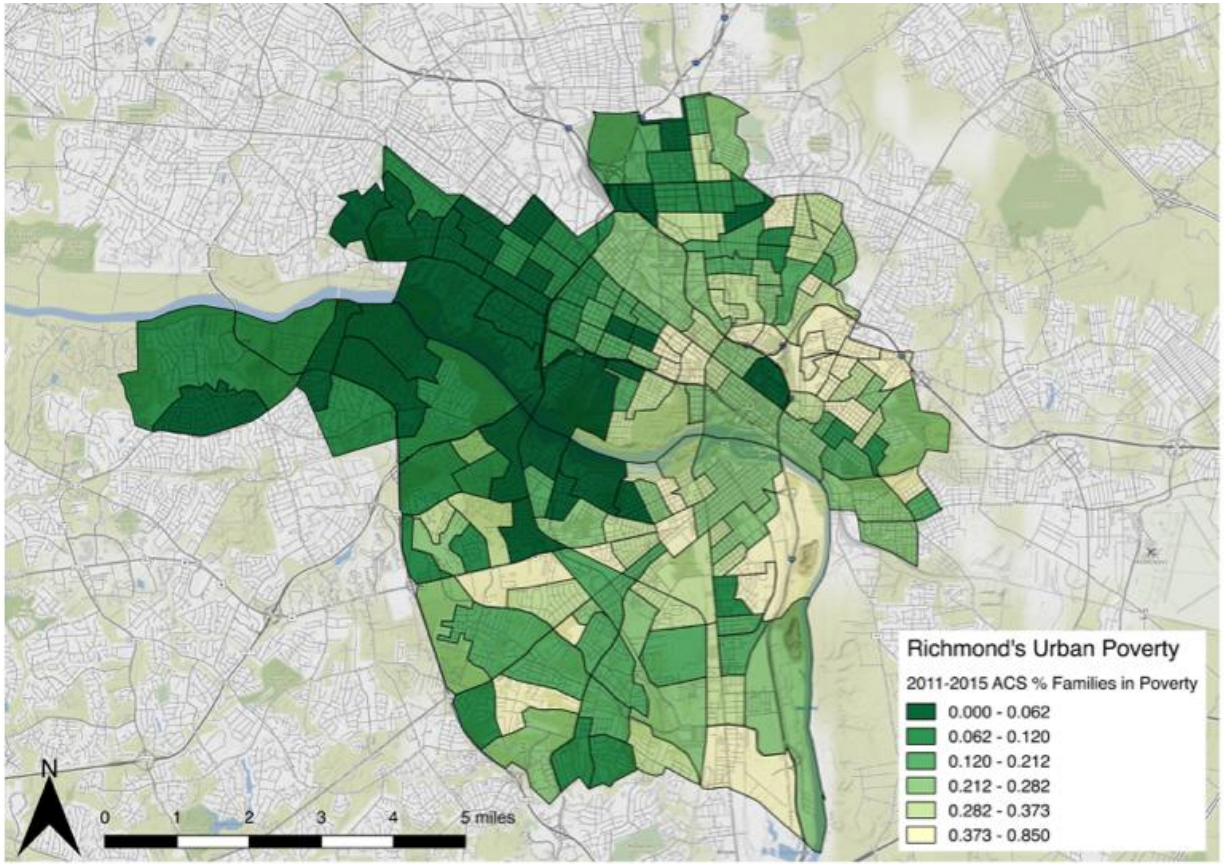

Richmond Times-Dispatch

City of Richmond
RVAgreen
2050


# Richmond's Applications

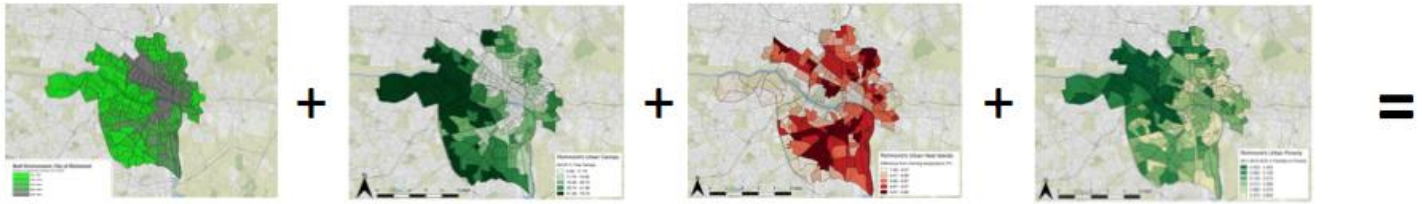


# Richmond's Applications

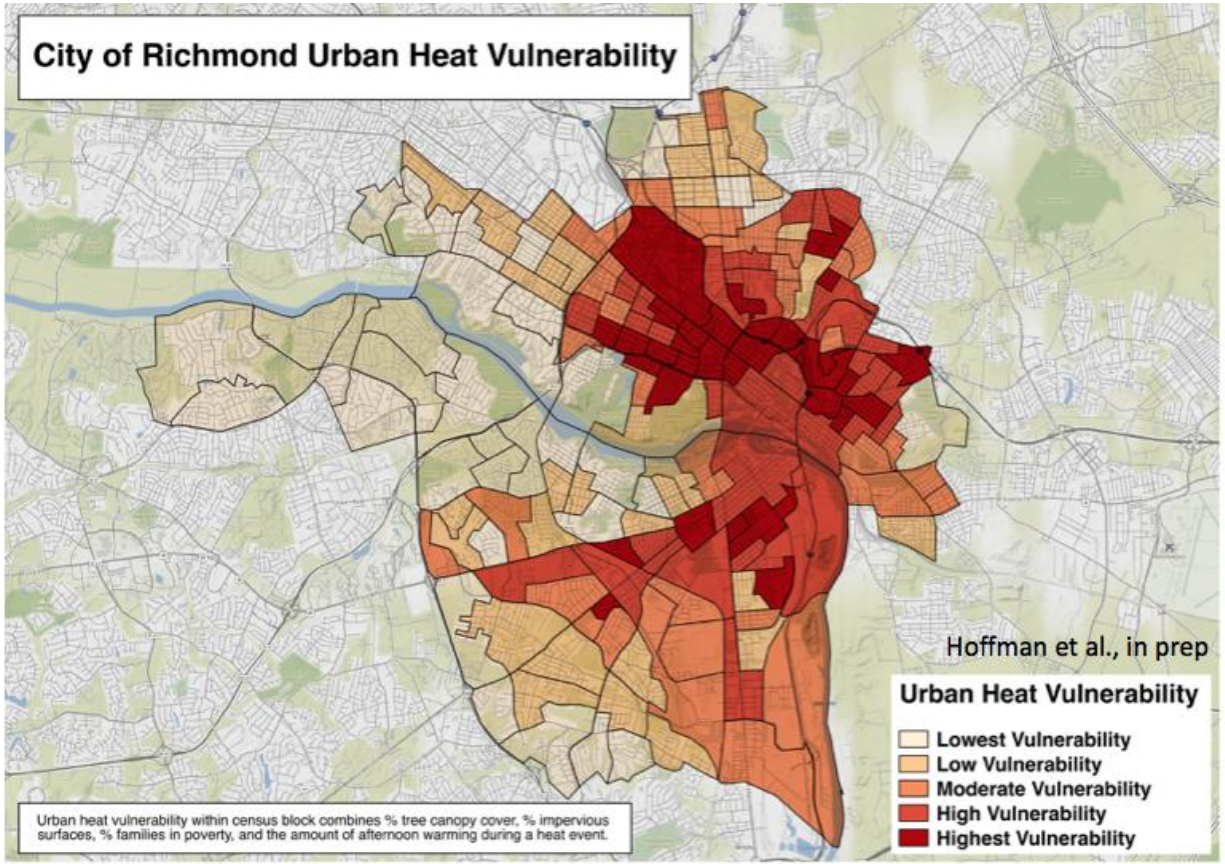


# Richmond's Applications

**Urban Heat Vulnerability =**

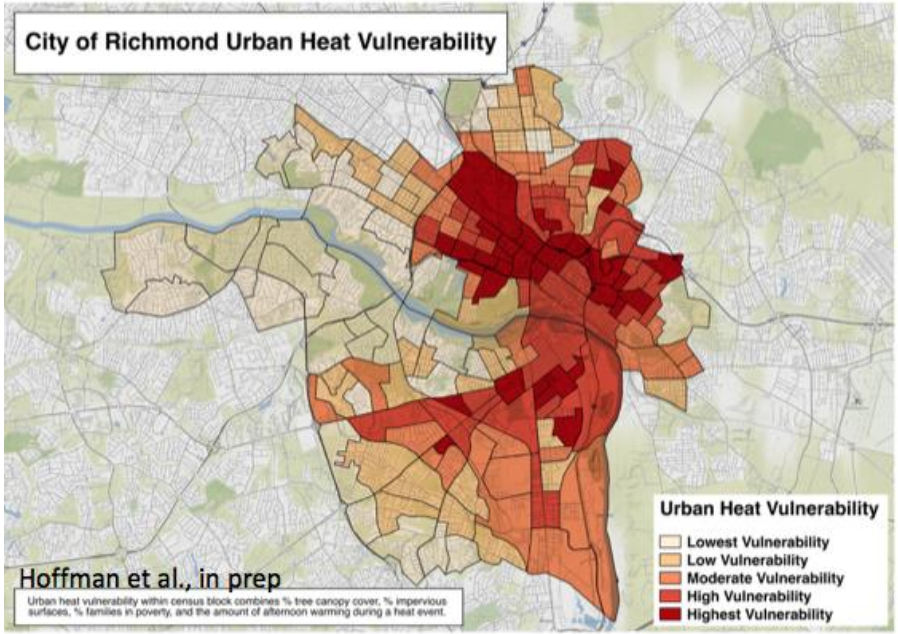


# Richmond's Applications



# Richmond's Applications

## VULNERABILITY

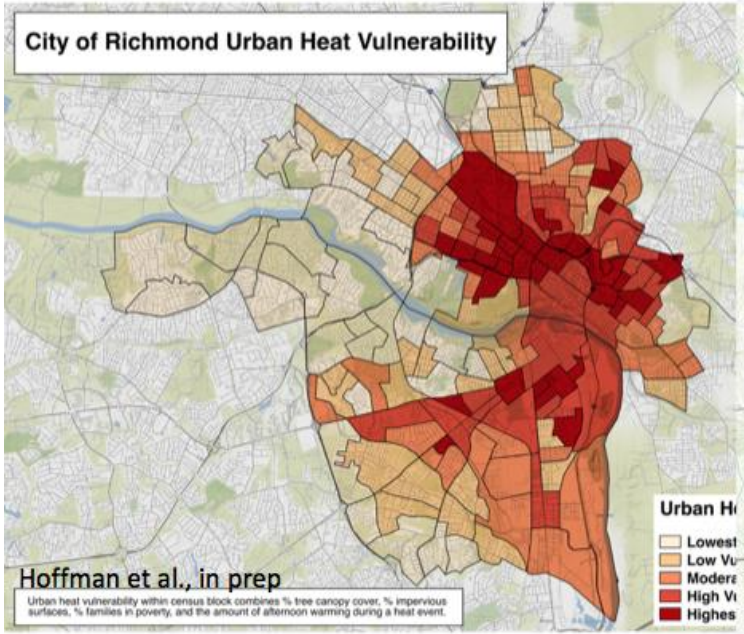



## RAA AMBULANCE RESPONSES

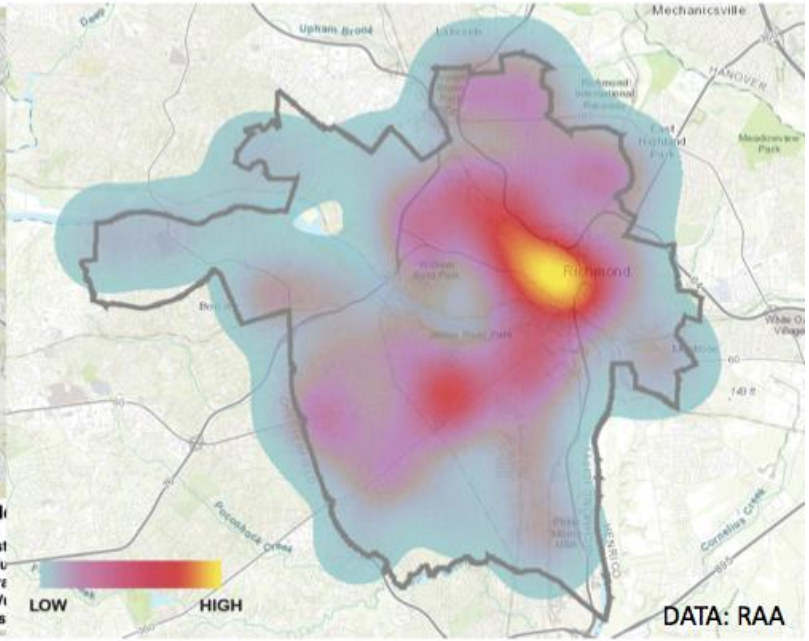
DATA: RAA

# Richmond's Applications

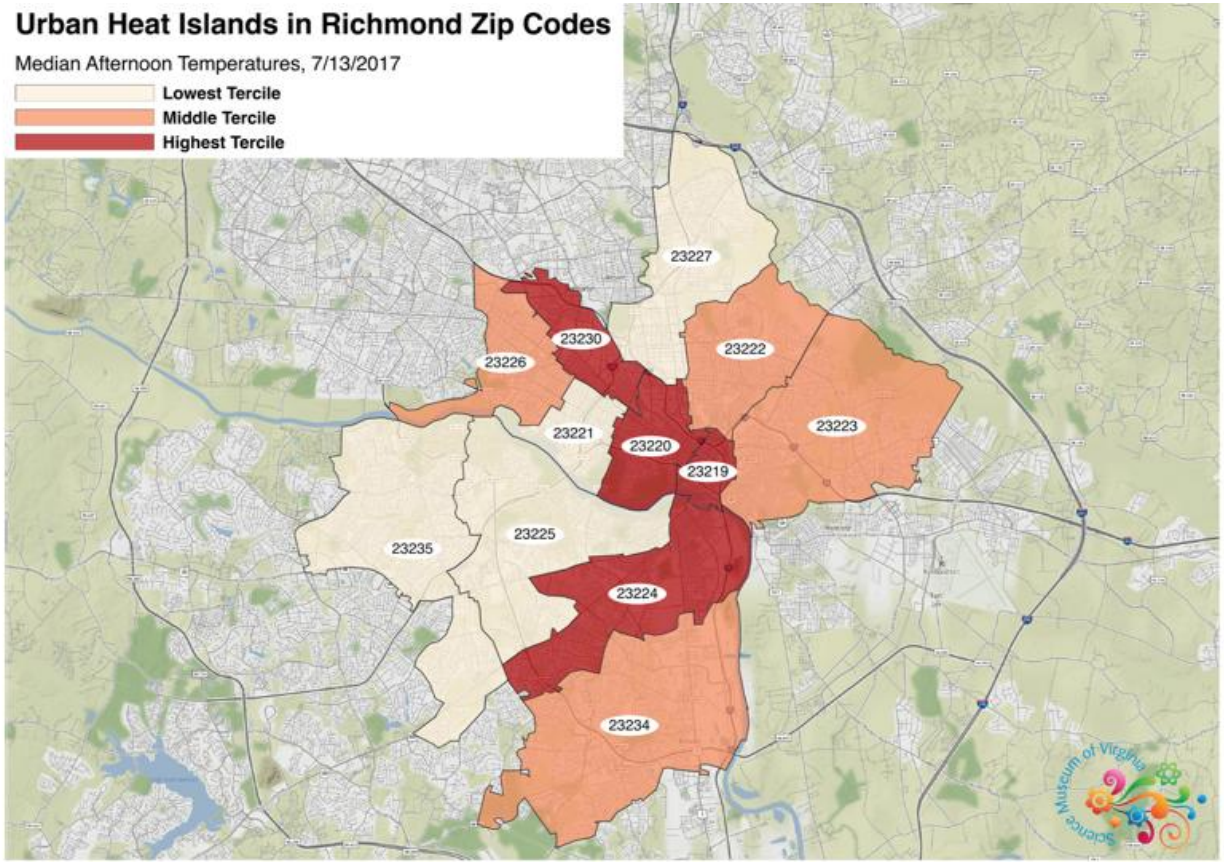
## VULNERABILITY



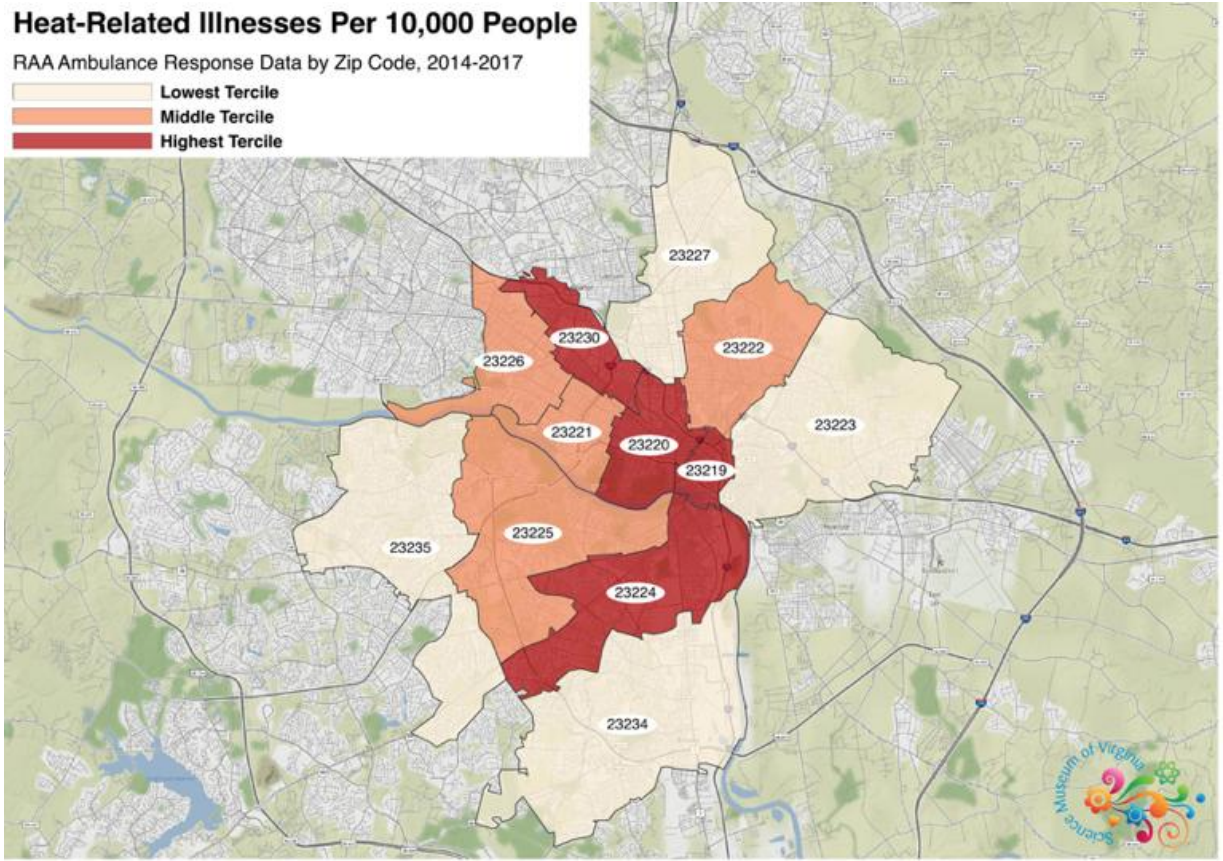

## RAA AMBULANCE RESPONSES



# Richmond's Applications



# Richmond's Applications



# 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.

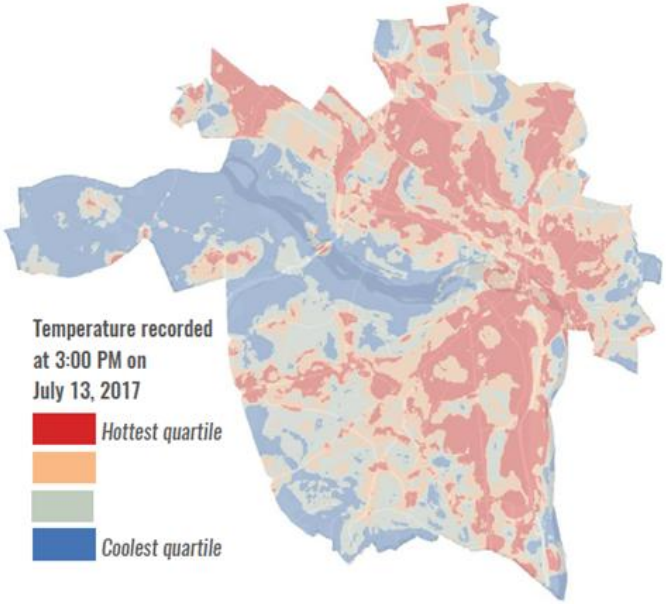



*FIGURE 17: Urban heat islands in Richmond*
*SOURCE: J.S. Hoffman, Science Museum of Virginia, 2017*

# Richmond's Applications

## Insights Report

Background information in preparation for updating Richmond's Master Plan

September 2018

RICHMOND 300 A GUIDE FOR GROWTH | RICHMOND PLANNING & DEVELOPMENT REVIEW PDR

# 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. *RVAgreen 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[1] 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 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.

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

**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.**

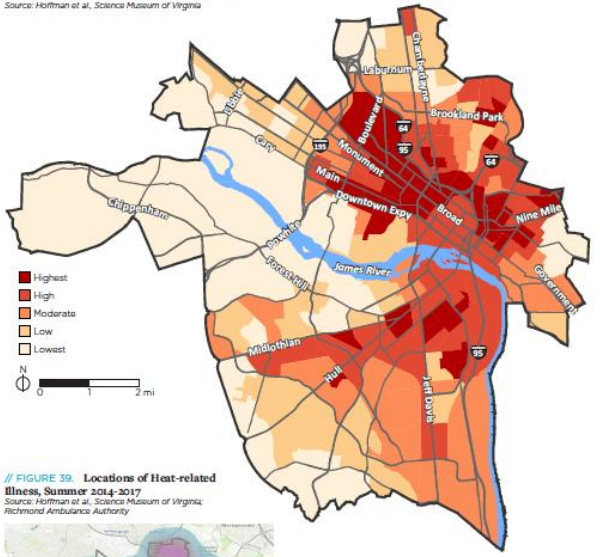
Heat-related illness in the summer is highly concentrated in areas with "high" and "highest" urban heat vulnerability and areas that are poor.



// FIGURE 38. **Urban Heat Vulnerability, 2017**

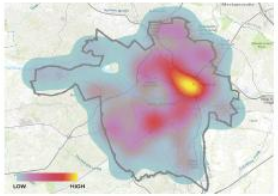
Urban heat vulnerability is a term used to describe an area's conditions that make it heat sensitive using a combination of % tree canopy, % impervious surfaces, % families in poverty, and the amount of afternoon warming during a heat event.

*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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