

Summer in the City: Assessing and communicating the Richmond, VA urban heat island effect with citizen scientists

**Jeremy S. Hoffman, Ph.D.,
Climate and Earth Scientist
Science Museum of Virginia**

With a lot of help from a lot of amazing people



@jer_science



Estimated % of adults who think global warming is happening, 2016

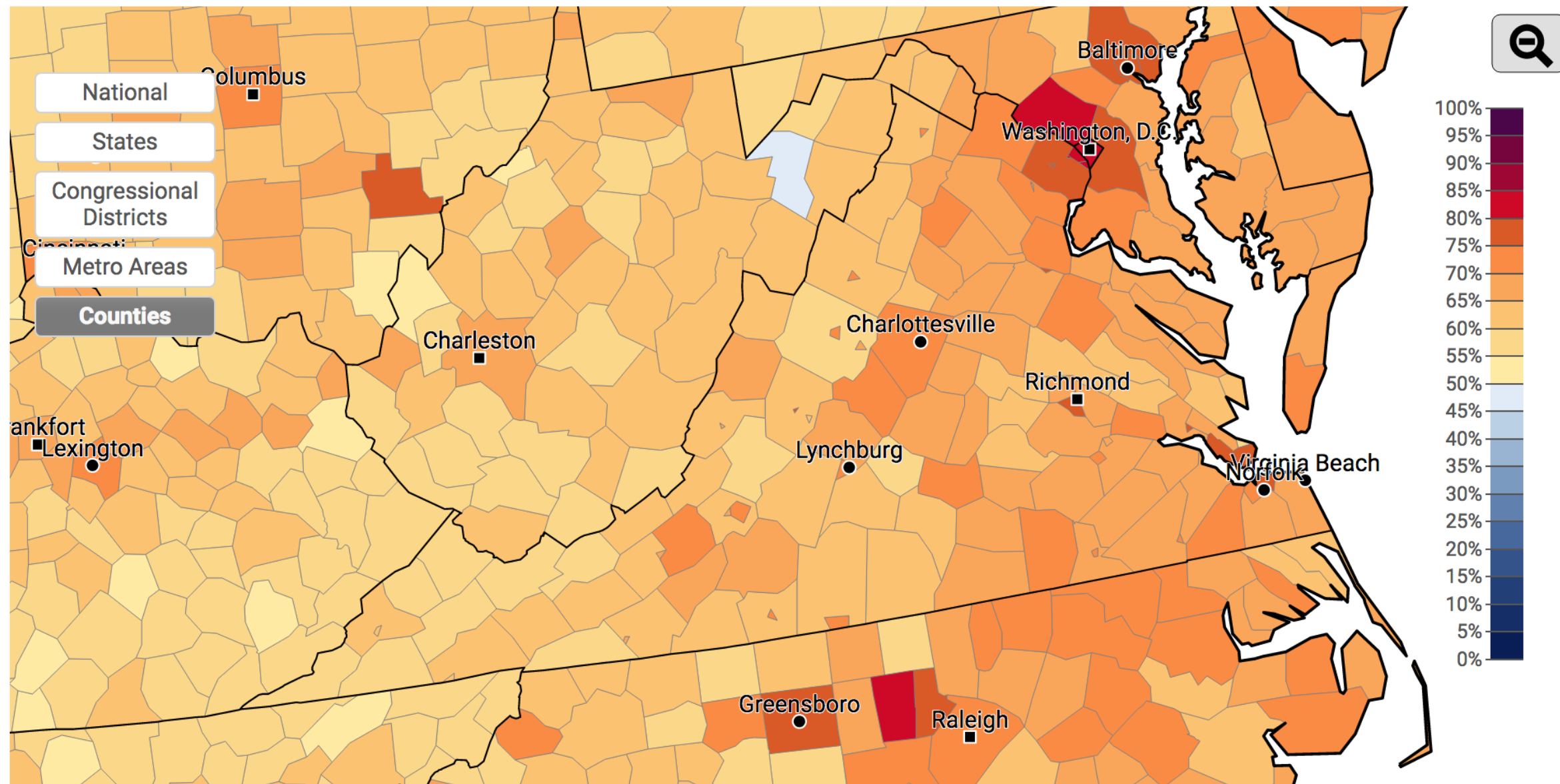
Display model output: Global warming is happening

Absolute Value

Permalink

Click on map to select geography, or: Virginia

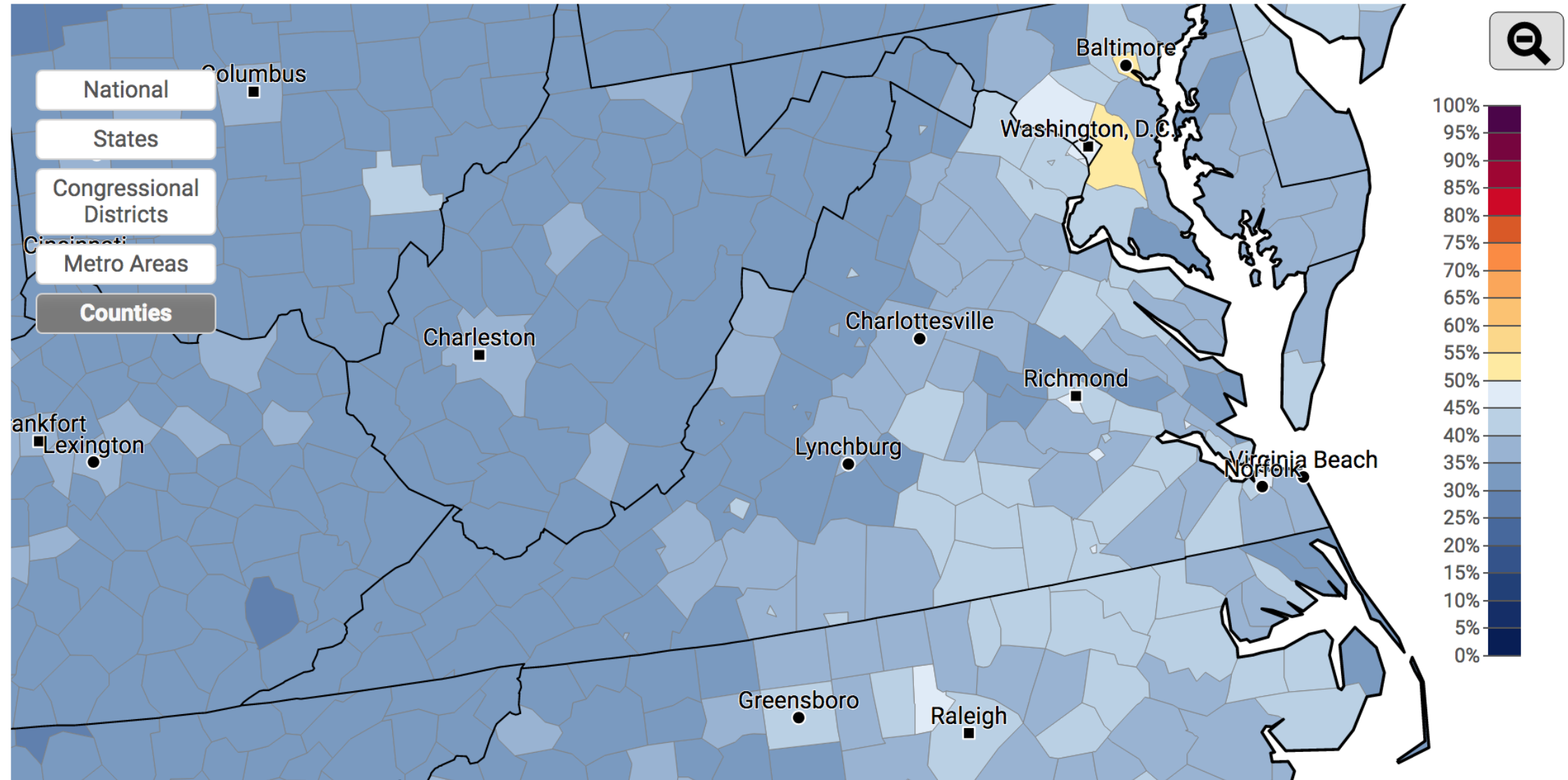
Select a County



Estimated % of adults who think global warming will harm them personally, 2016

Display model output: [Permalink](#)

Click on map to select geography, or:



Estimated % of adults who discuss global warming at least occasionally, 2016

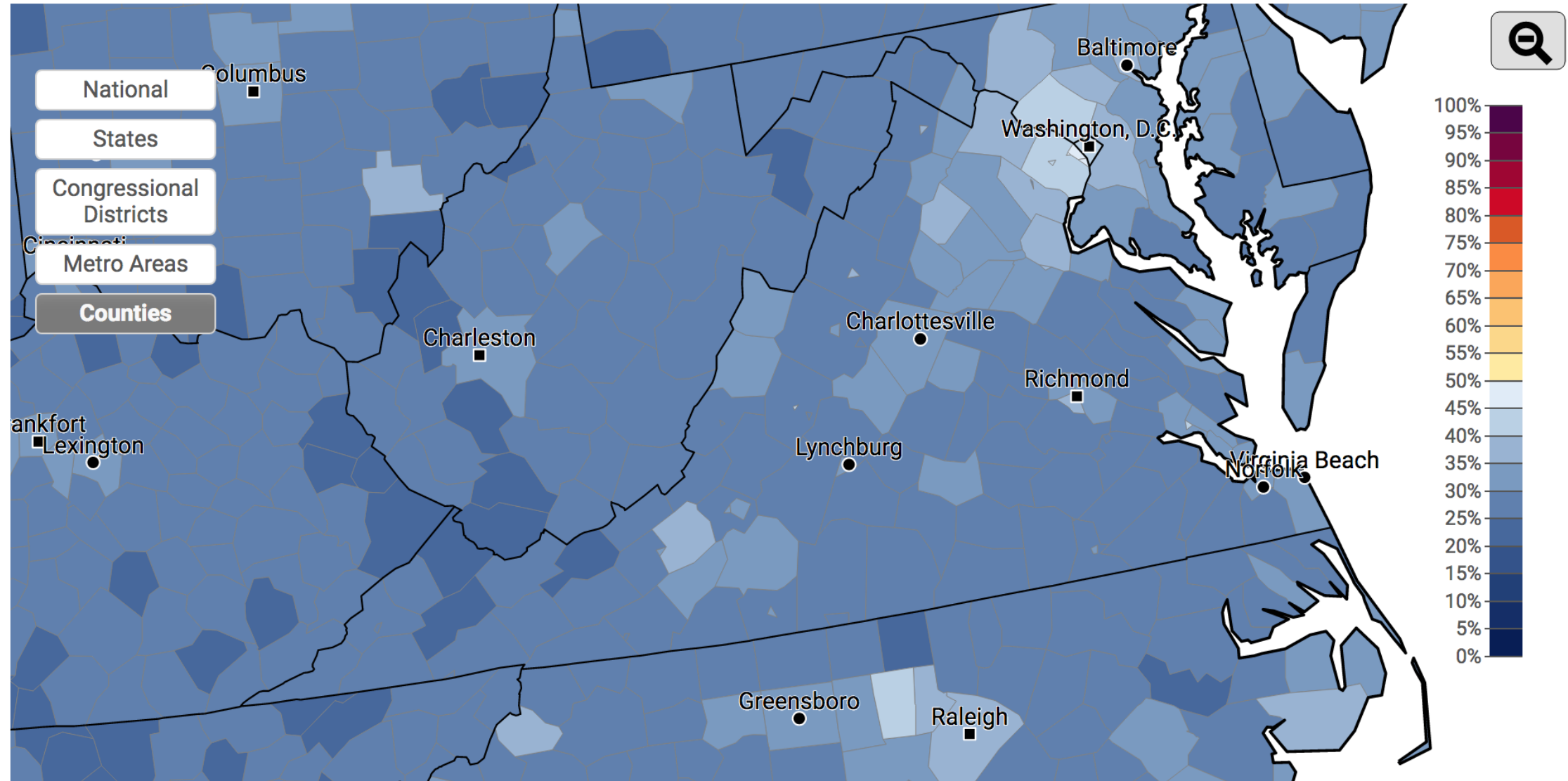
Display model output: Discuss global warming at least occasionally

Absolute Value

[Permalink](#)

Click on map to select geography, or: Virginia

Select a County



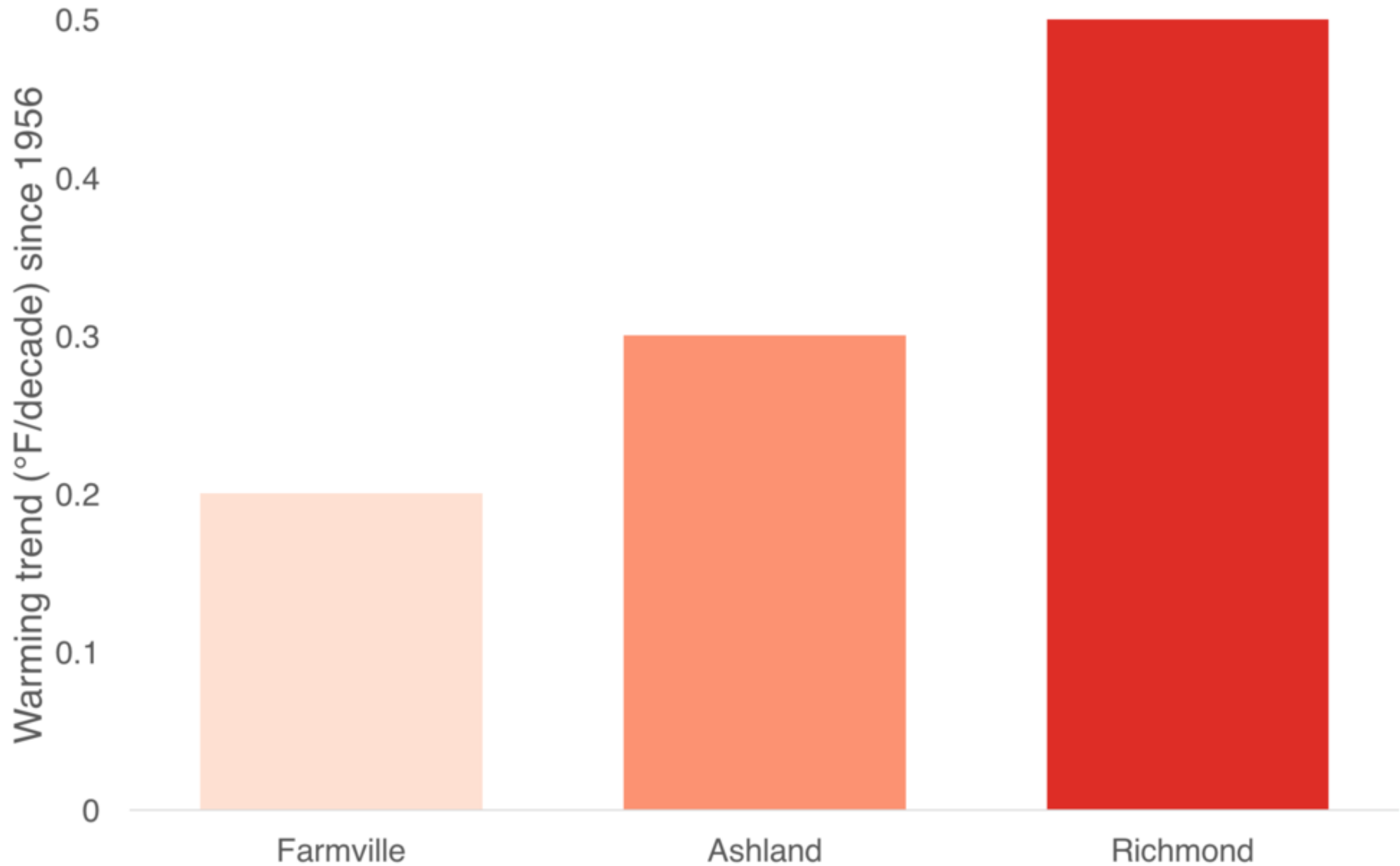
Underestimation of risk and
low preparedness:
lacking resilience?

1 Explore Hazards

- *Gather a team of people who want to protect local assets.*
- *Check past weather events and future climate trends.*
- *List the things you value that could be damaged.*

After this exploration, you'll discover if weather and climate represent a hazard to things you value.

Richmond is warming up faster than its rural neighbors



RICHMOND SUMMERS *FEEL* * 3°F *HOTTER* TODAY THAN THEY DID IN THE 1980s



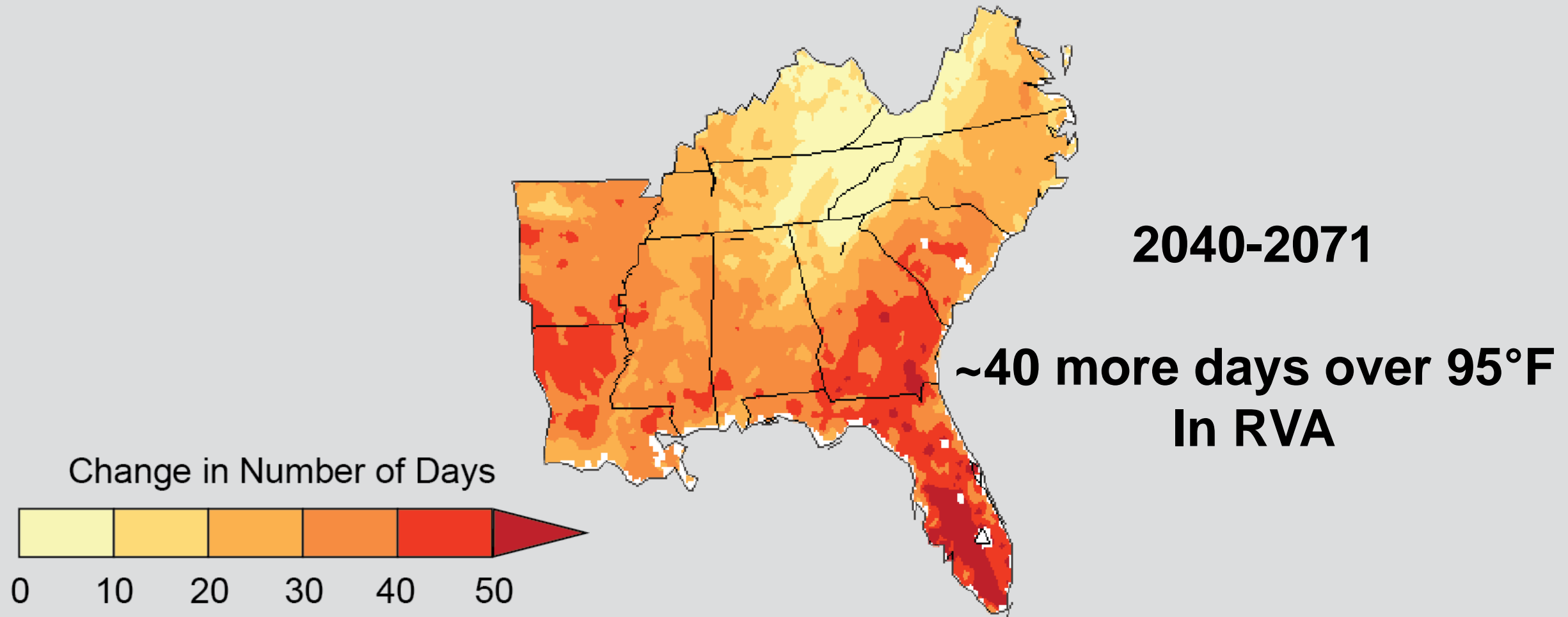
***On average, RVA's summer dew point temperatures have been increasing.**

For a given temperature, the heat index (what heat *feels* like) increases as dew point goes up.

So, a 96°F day in 1980 felt like 98°F – today, it feels more like 101°F.

Projected Change in Number of Days Over 95°F

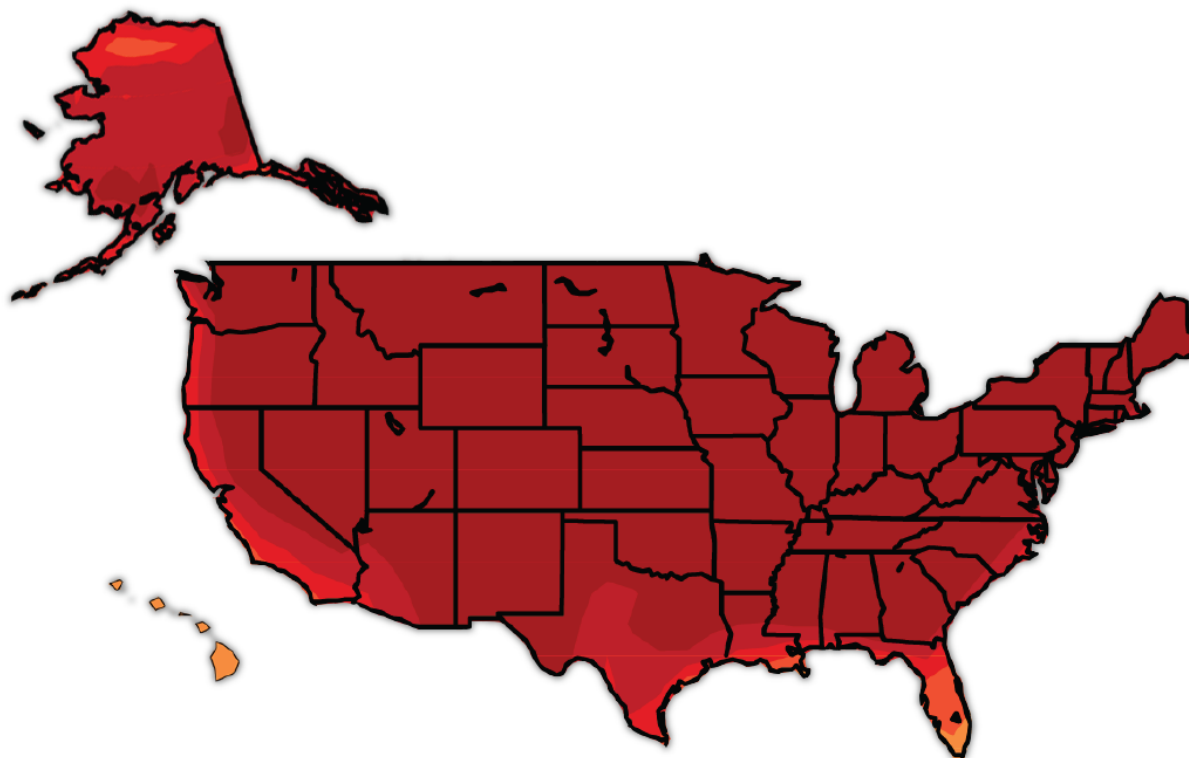
Projected Difference from Historical Climate



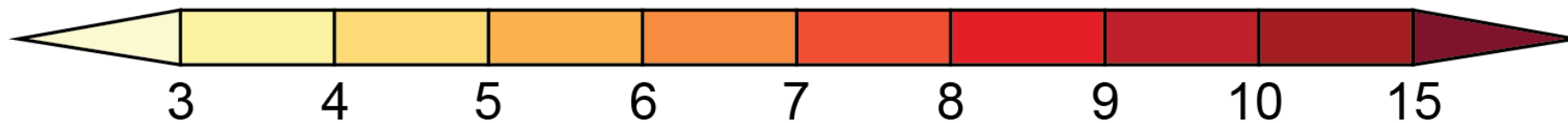
Hottest Days

Getting even hotter in the future

Continued Emissions Increases (RCP 8.5)

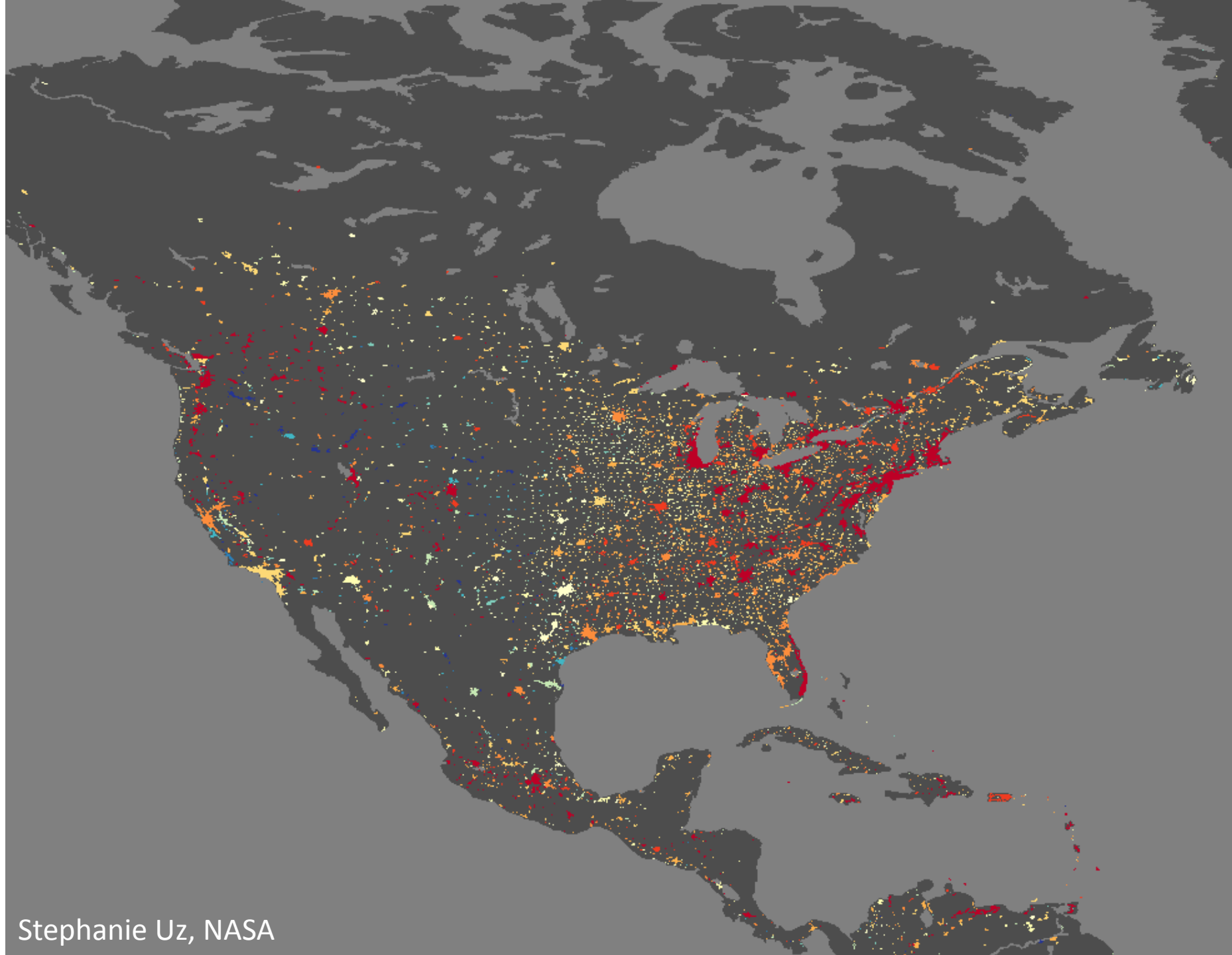


Temperature Change (°F)



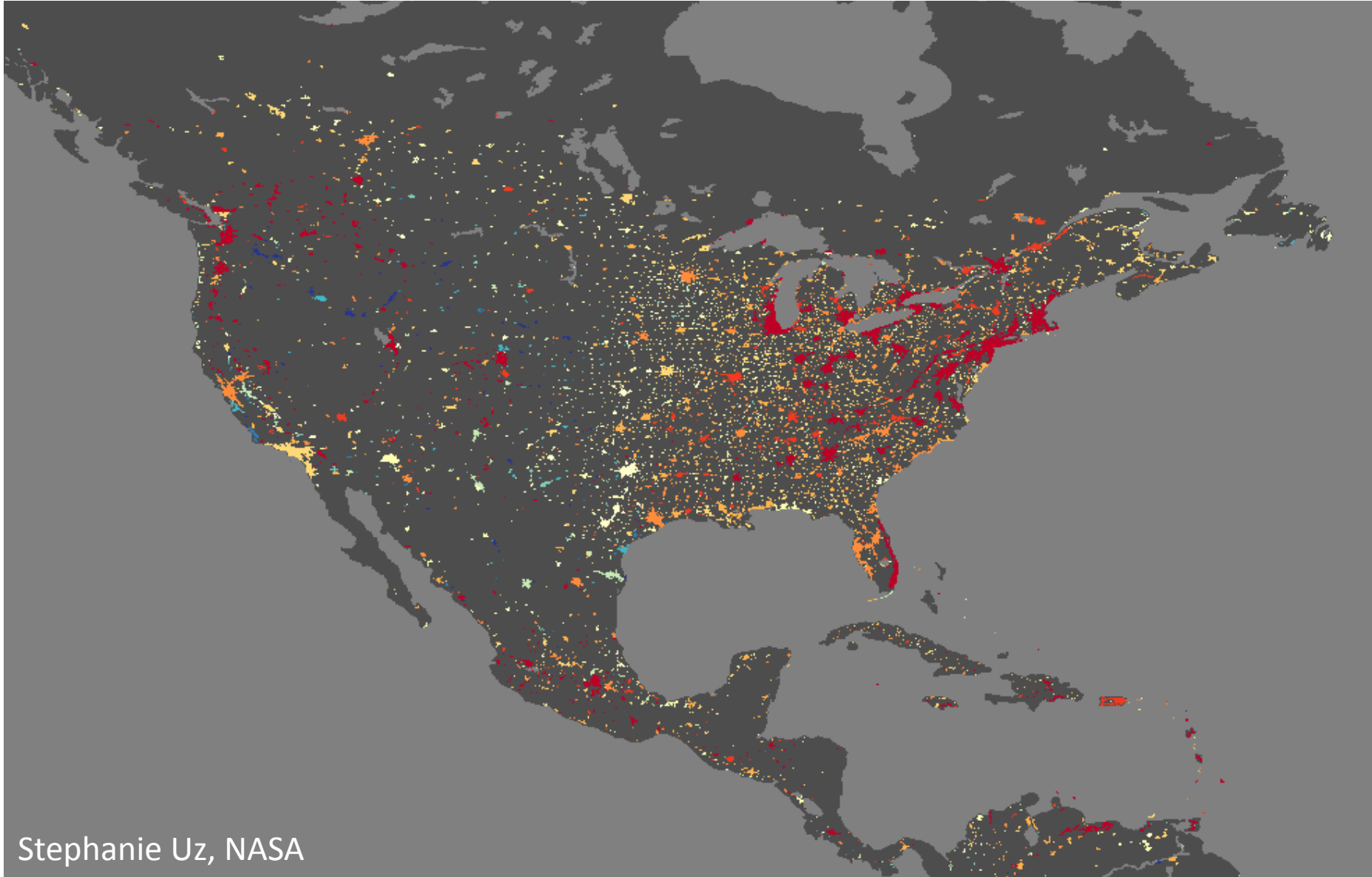






Stephanie Uz, NASA

Urban heat island effect

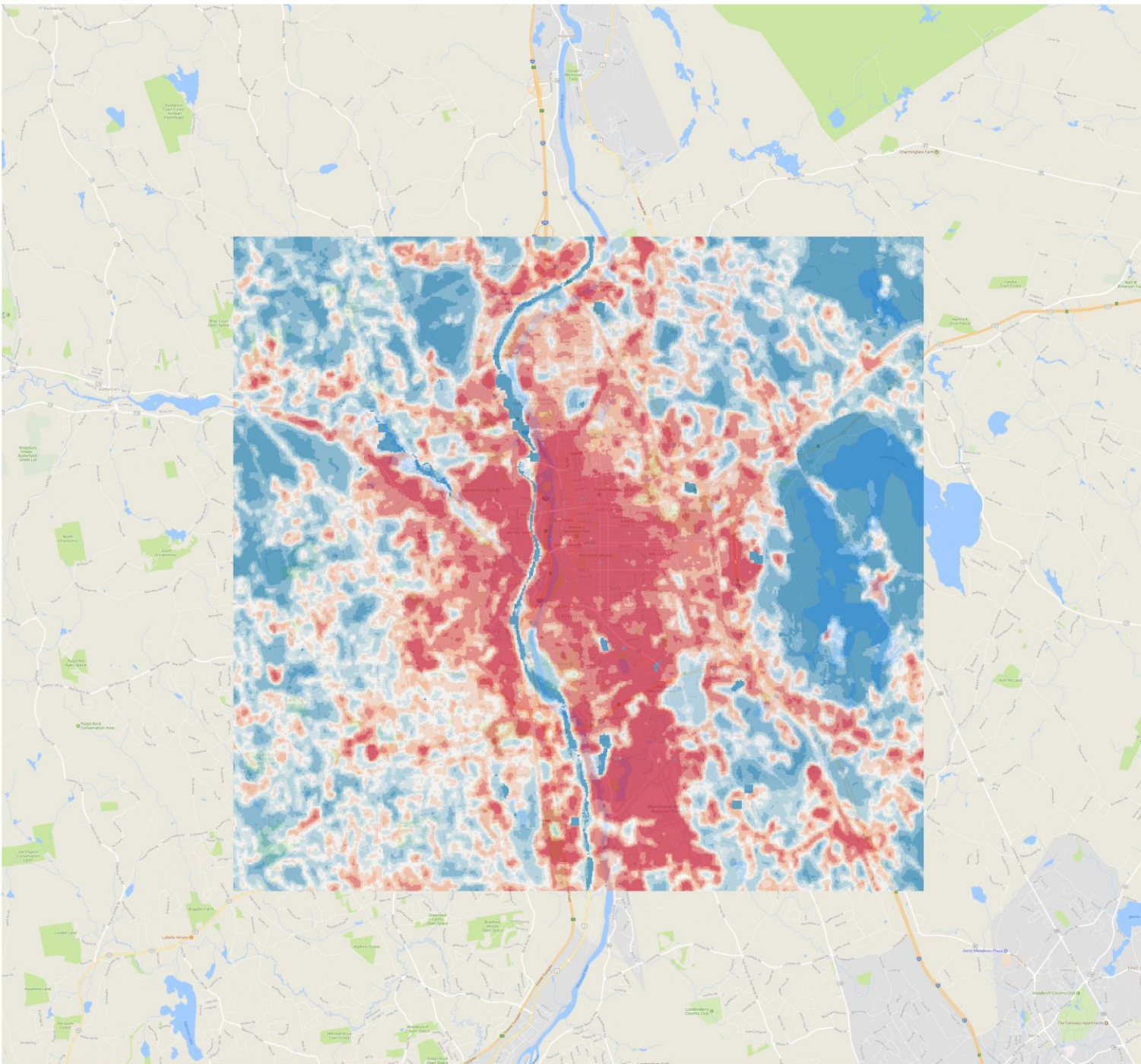
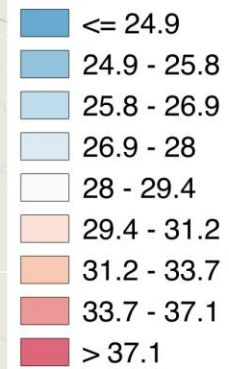


Stephanie Uz, NASA

>50°C max

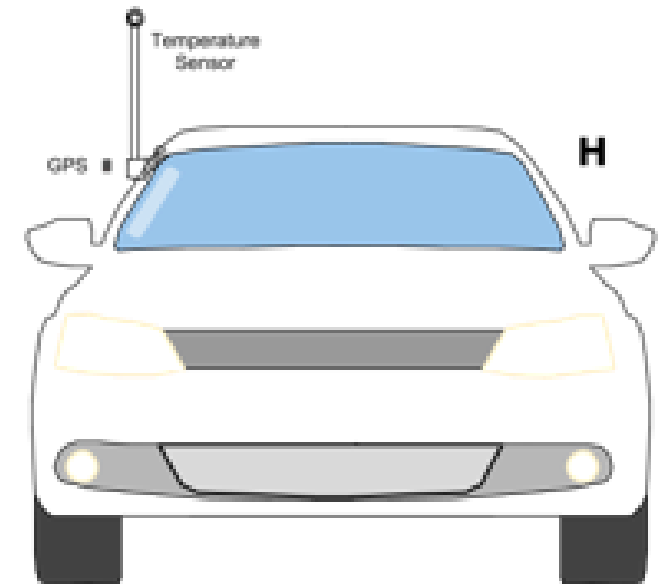
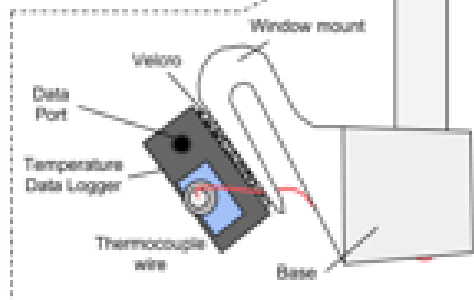
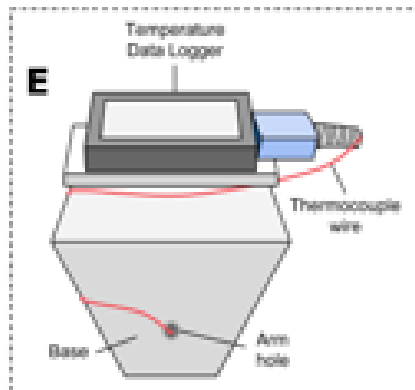
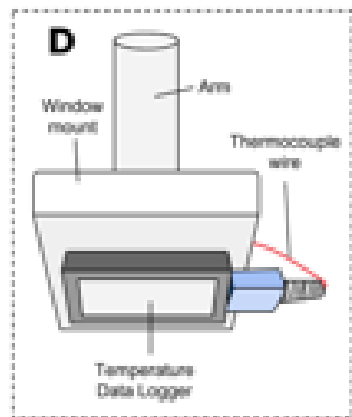
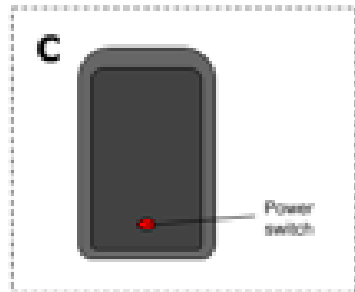
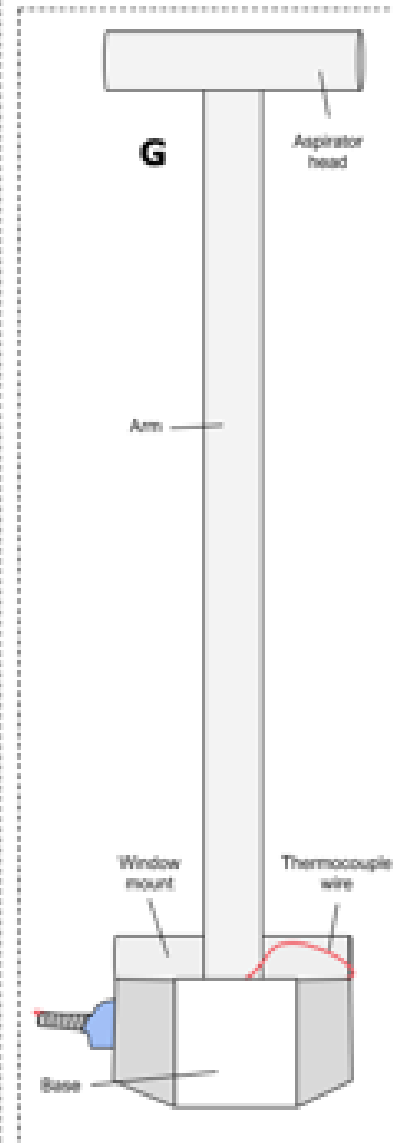
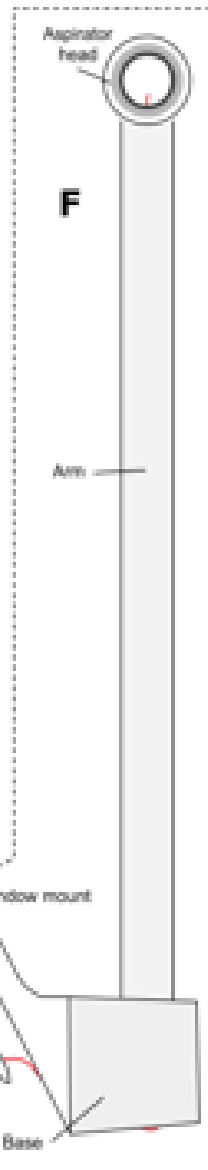
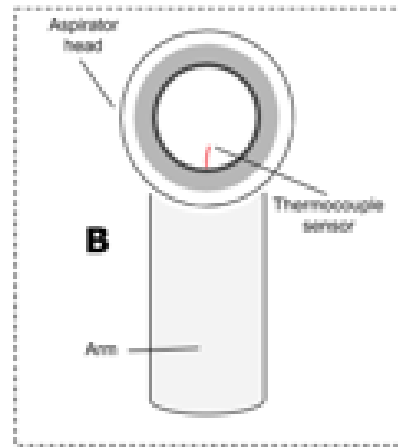
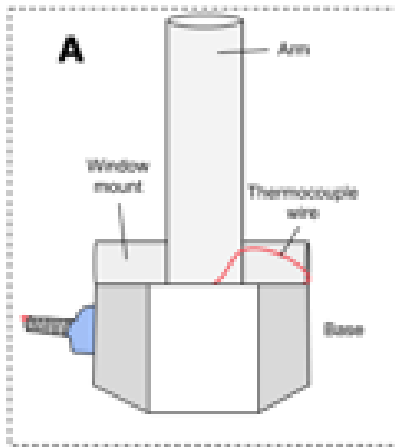
Manchester, NH 6/18/16

Landsat 8 LST (°C)

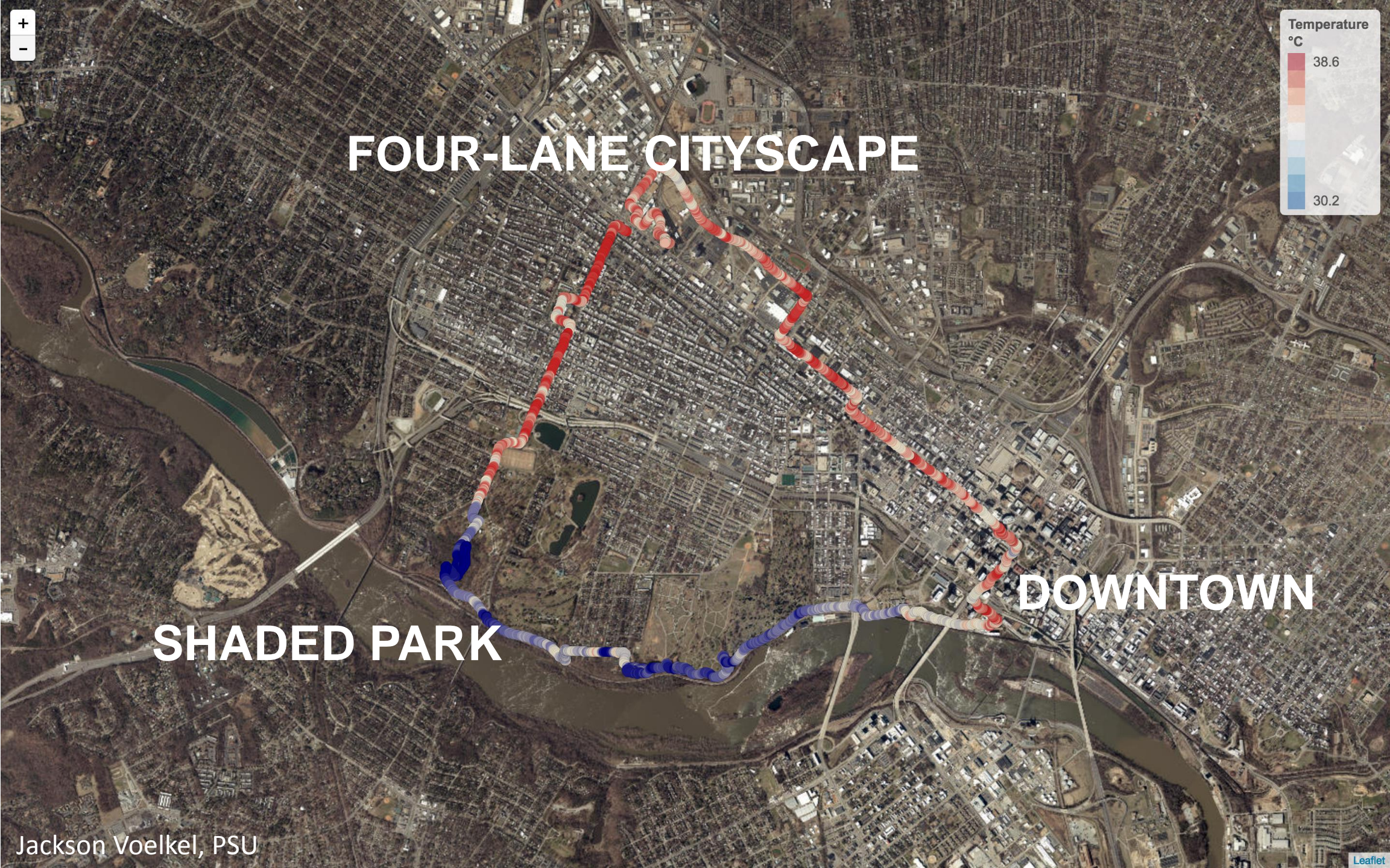


RICHMOND URBAN HEAT ISLAND CONSORTIUM









FOUR-LANE CITYSCAPE



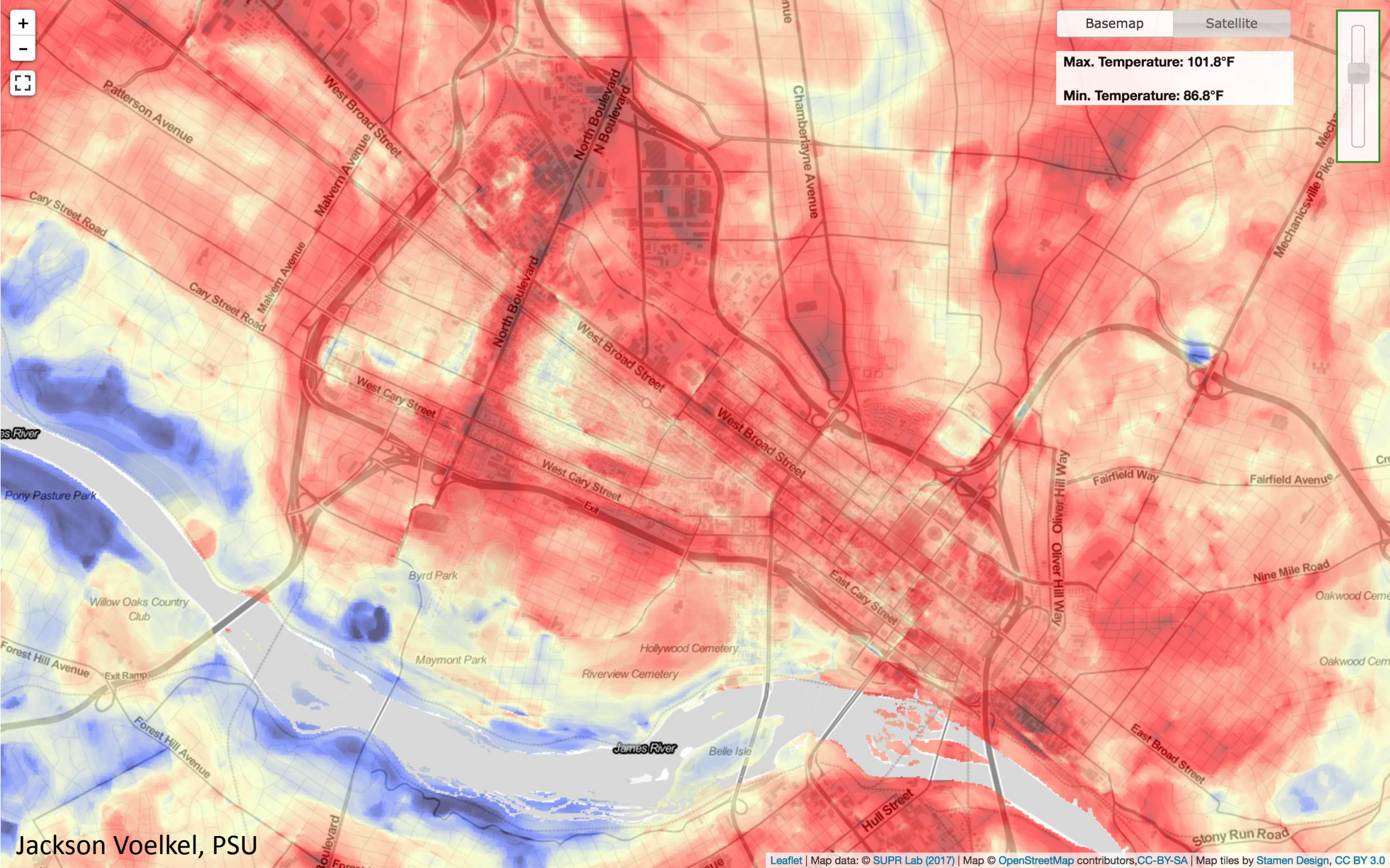
SHADED PARK

DOWNTOWN

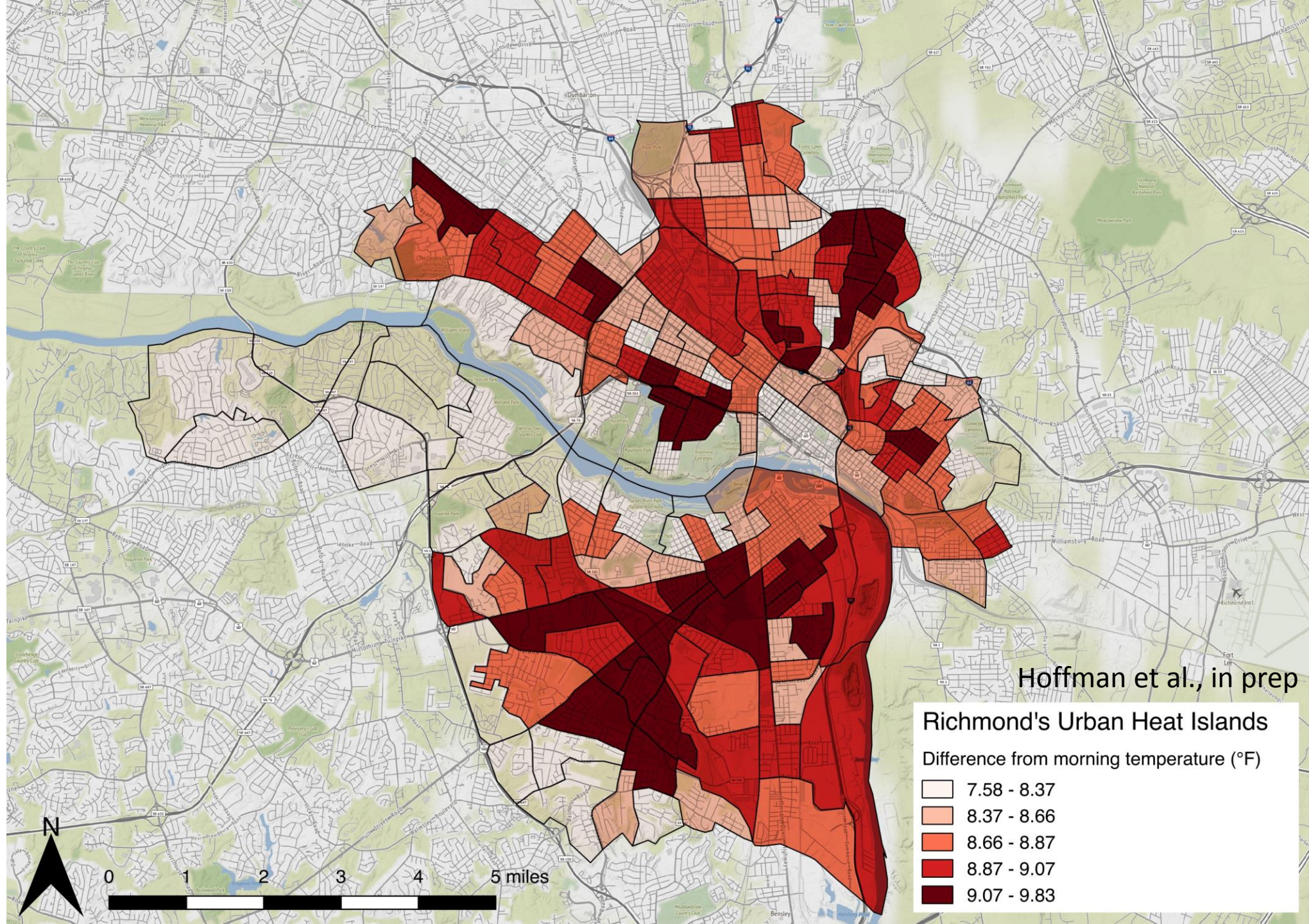


Basemap ☒ Satellite

Max. Temperature: 101.8°F
Min. Temperature: 86.8°F



Jackson Voelkel, PSU



2

Assess Vulnerability & Risks

- *Determine which of your assets are exposed to harm.*
- *Assess each asset's vulnerability.*
- *Estimate the risk to each asset.*

When your assessment is complete, decide if you can accept the risk that climate presents to your assets.

% of all ED/UCC visits for HRI

0.30%

0.20%

0.10%

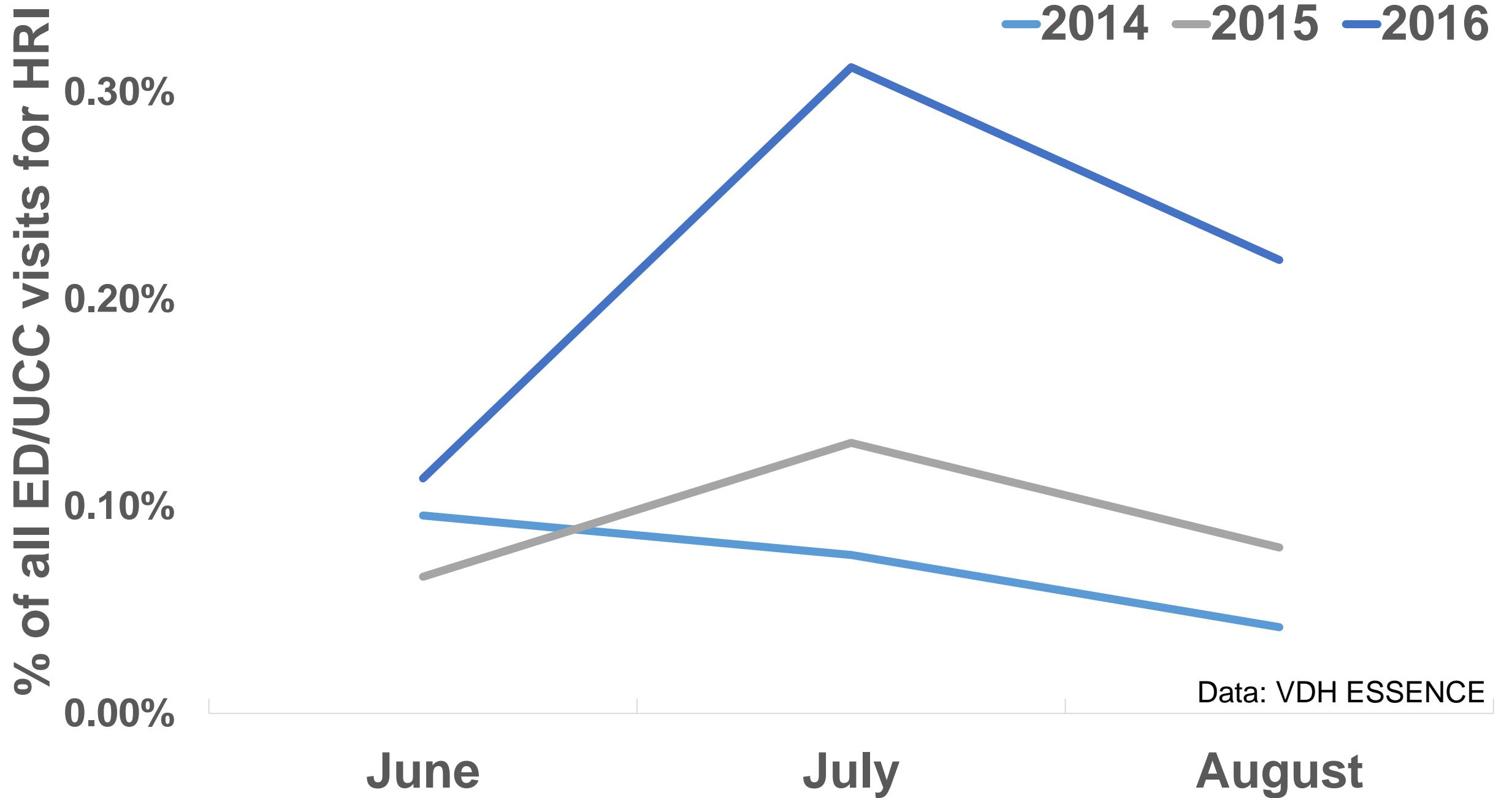
0.00%

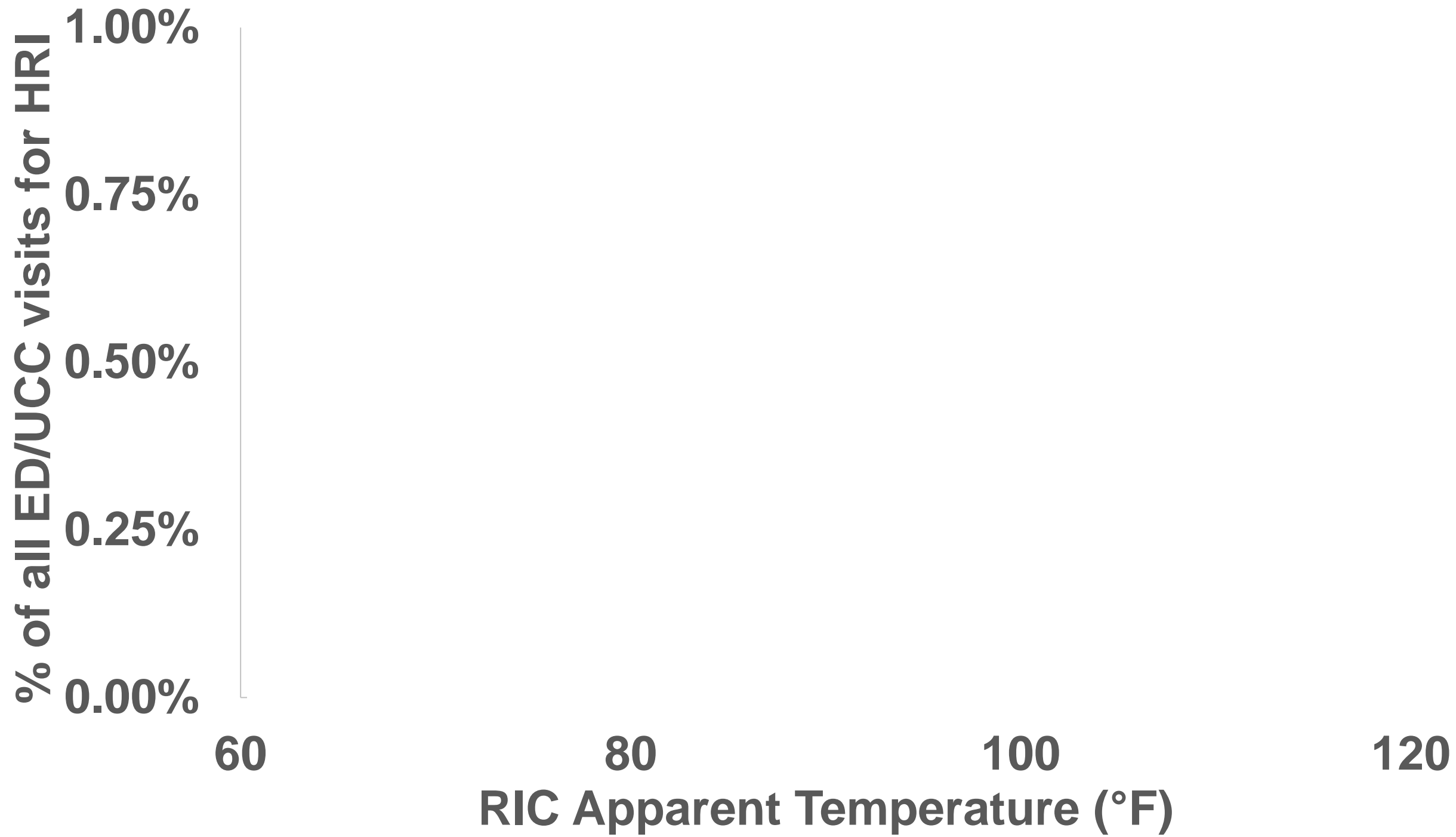
June

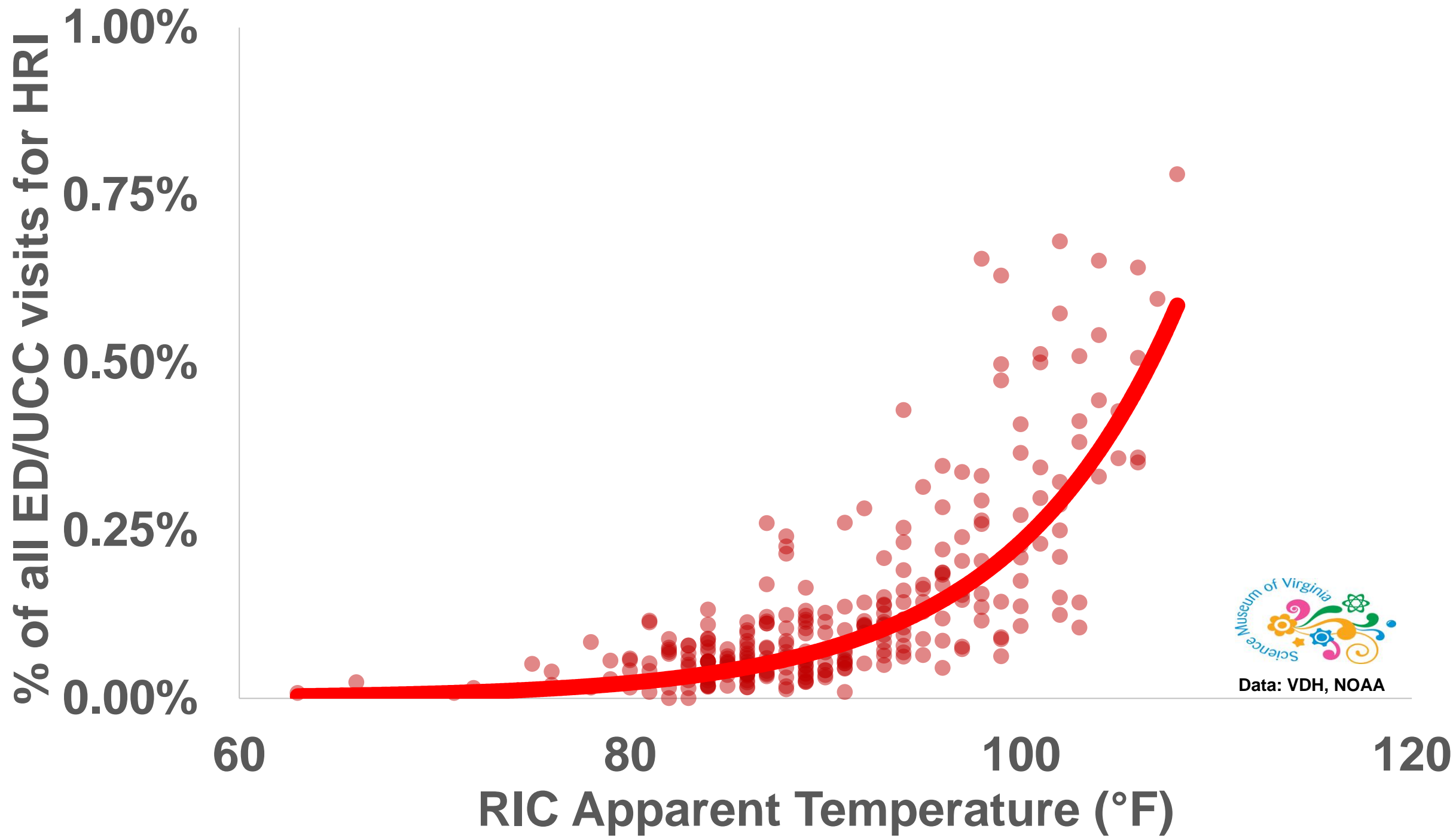
July

August

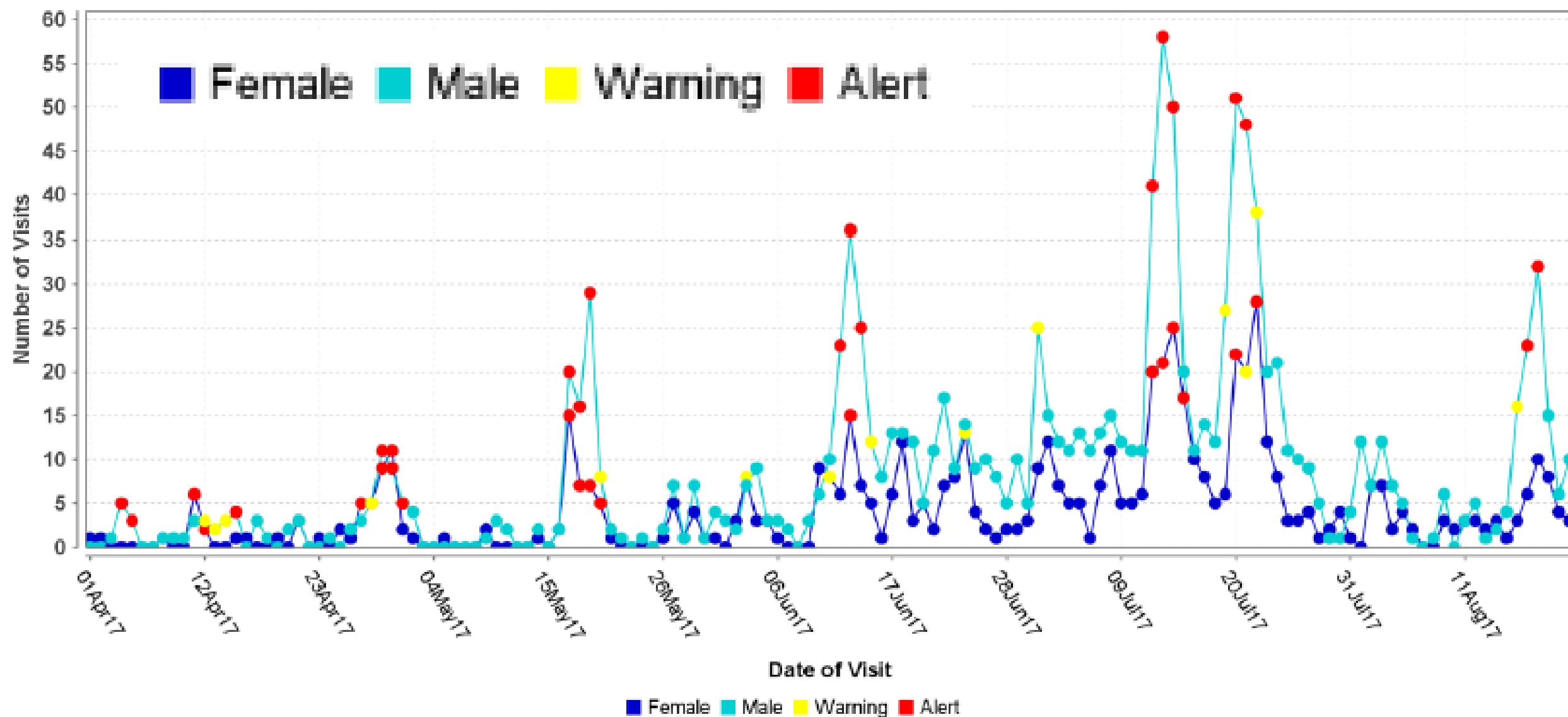
Data: VDH ESSENCE

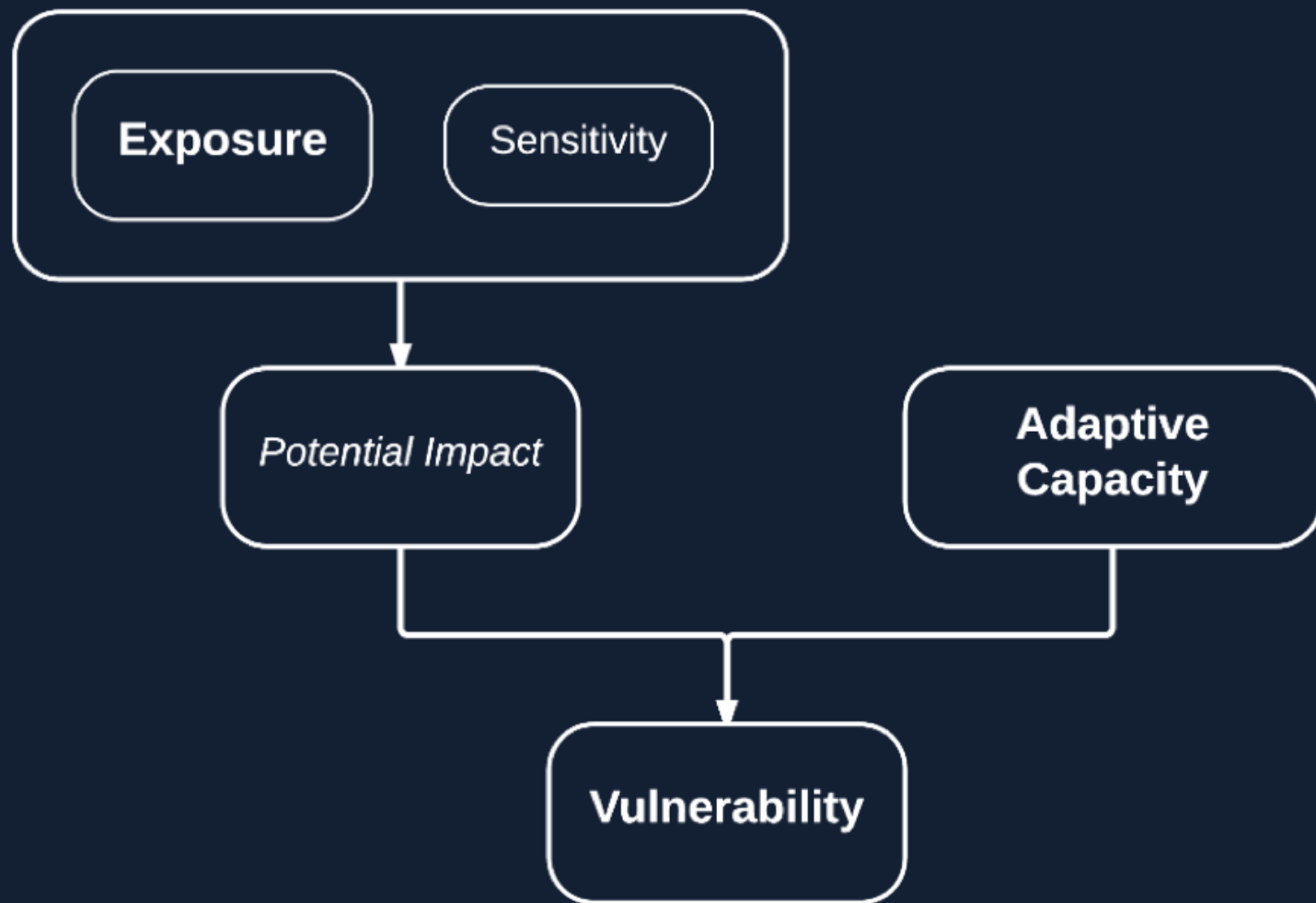




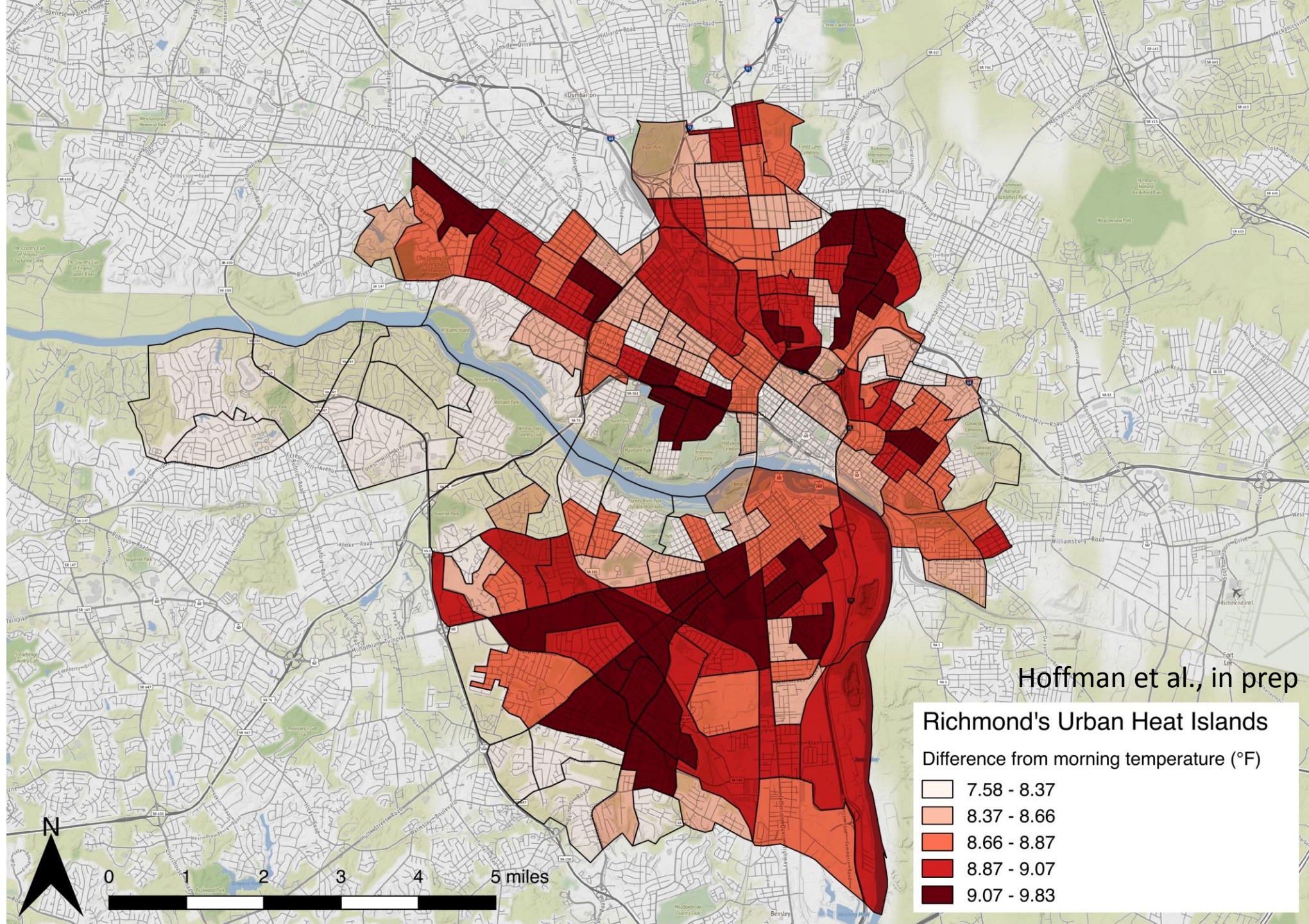


Number of ED and UCC Visits for Heat-Related Illness in Virginia by Sex, April 1 - August 21, 2017

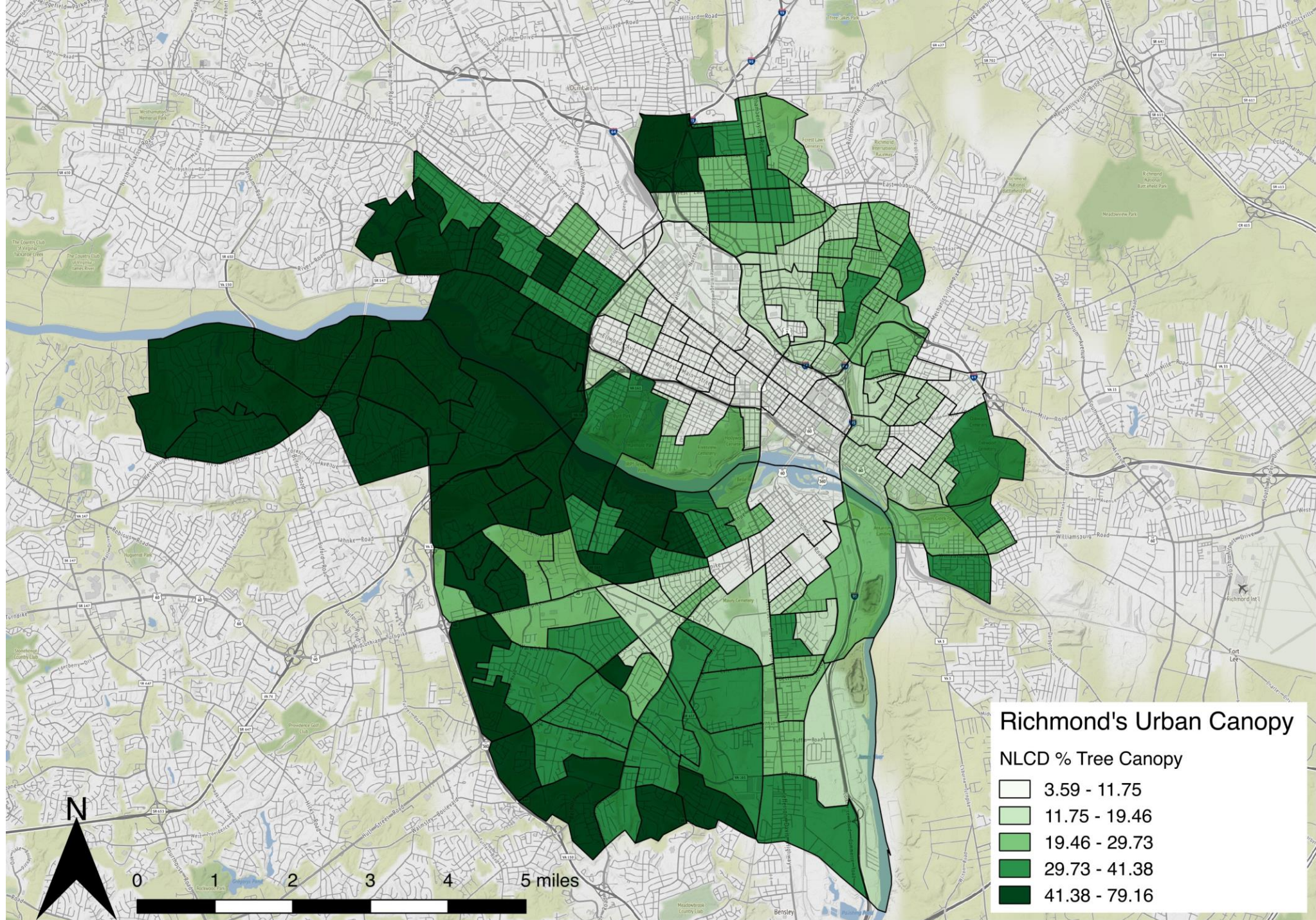




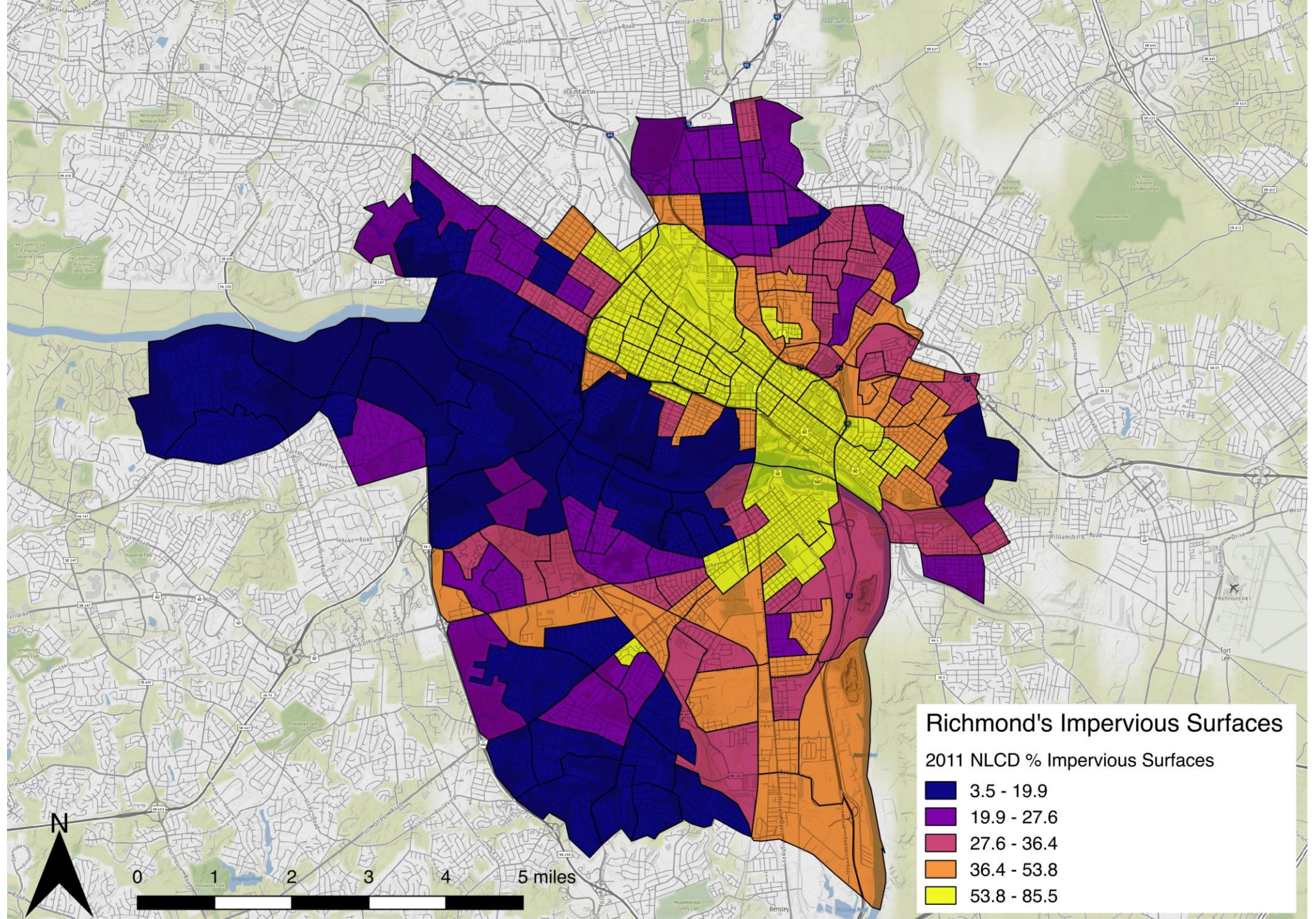
EXPOSURE



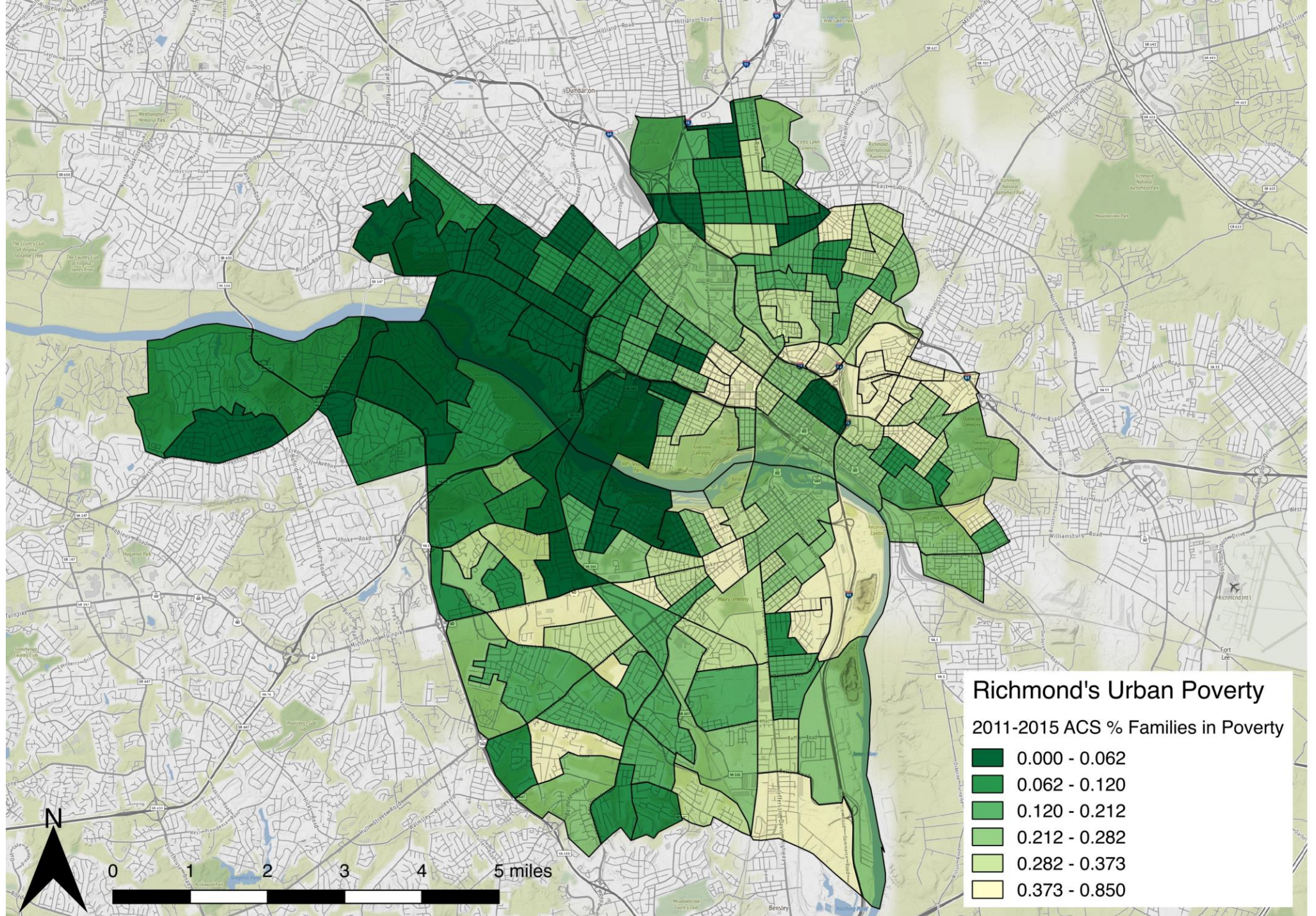
SENSITIVITY



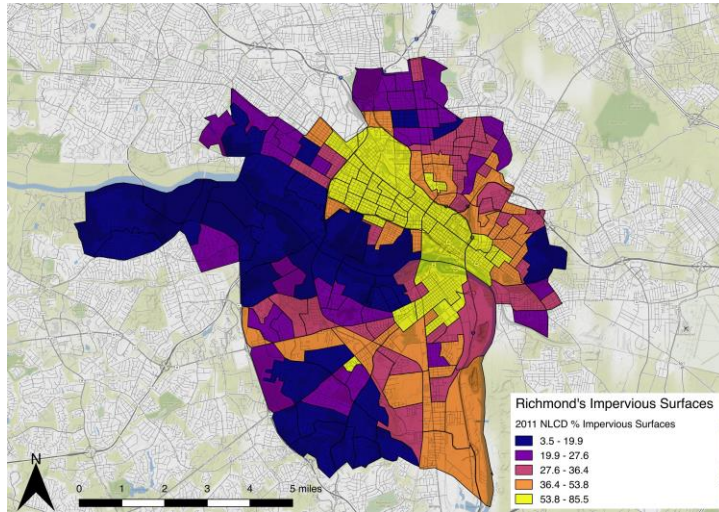
SENSITIVITY



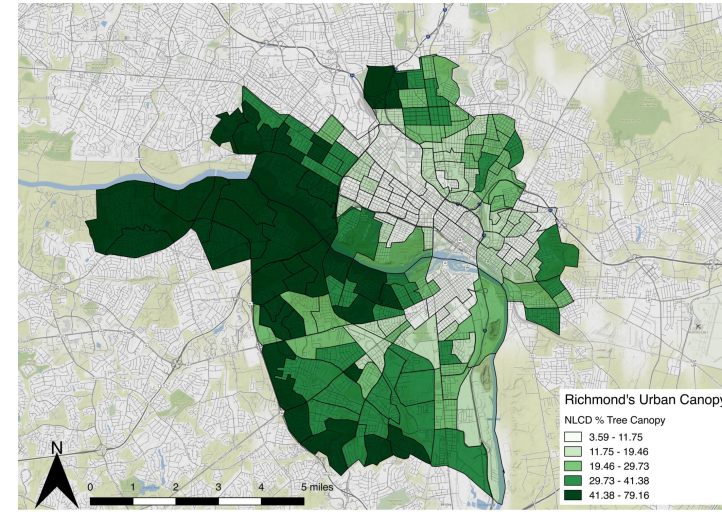
ADAPTIVE CAPACITY



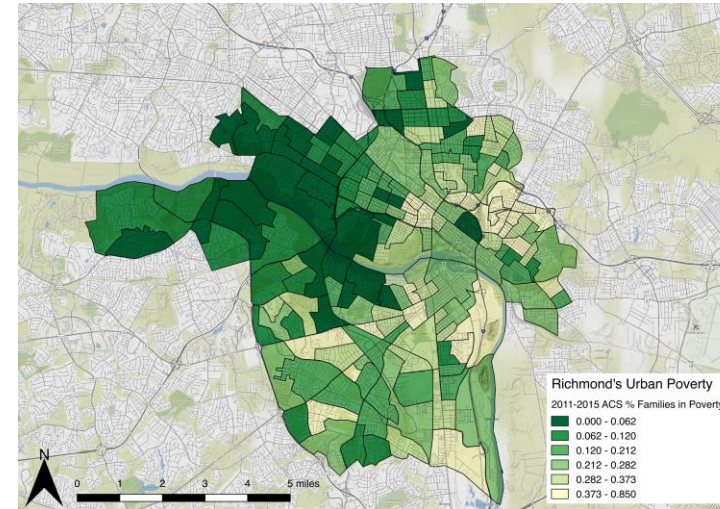
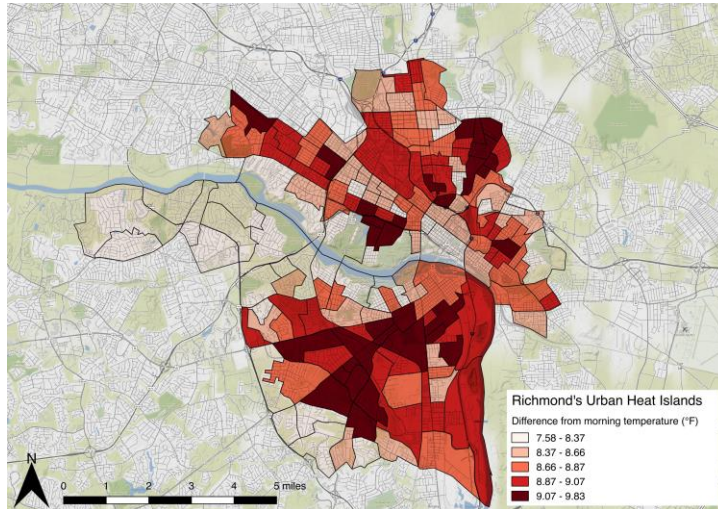
Urban Heat Vulnerability =



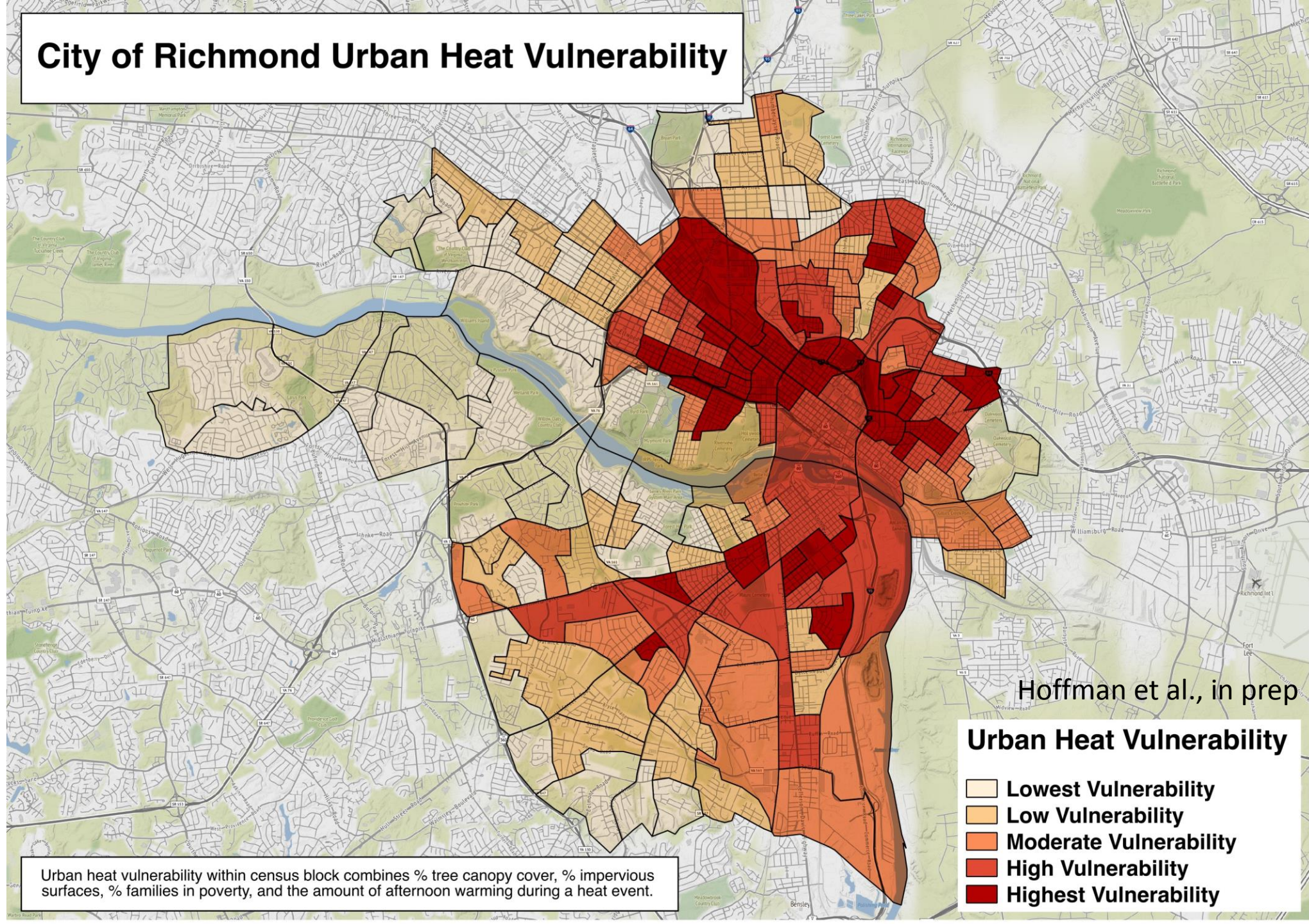
+



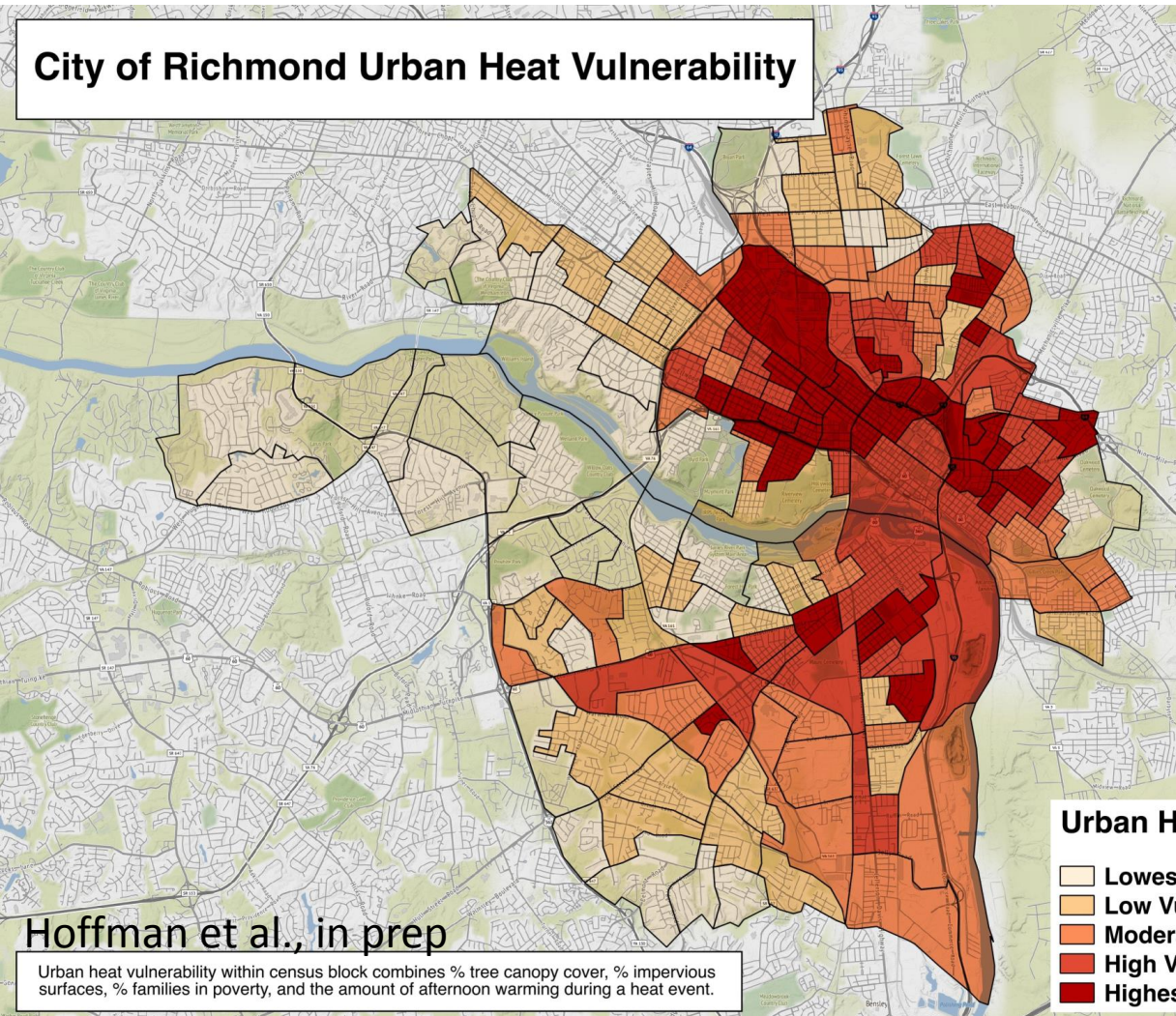
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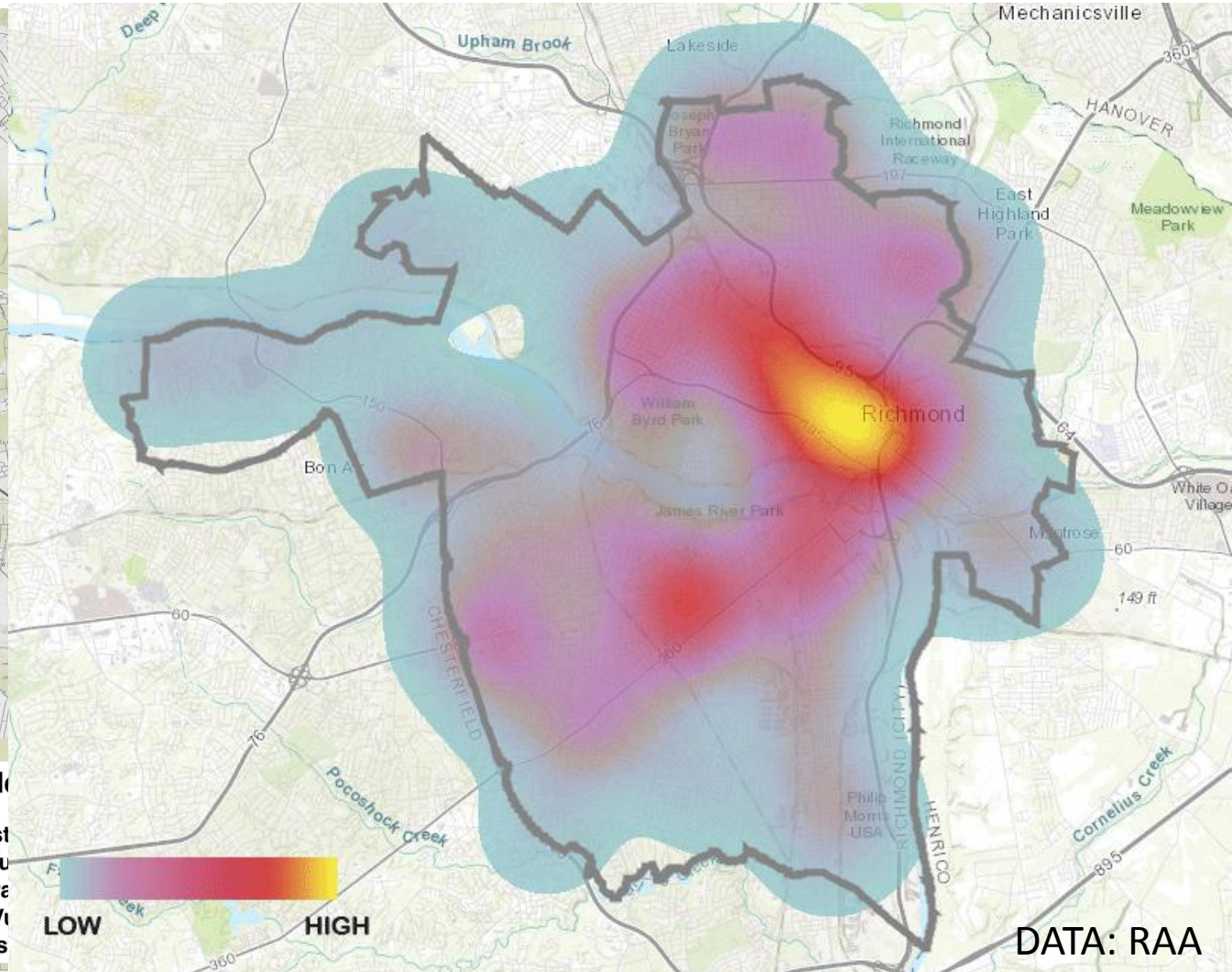
City of Richmond Urban Heat Vulnerability



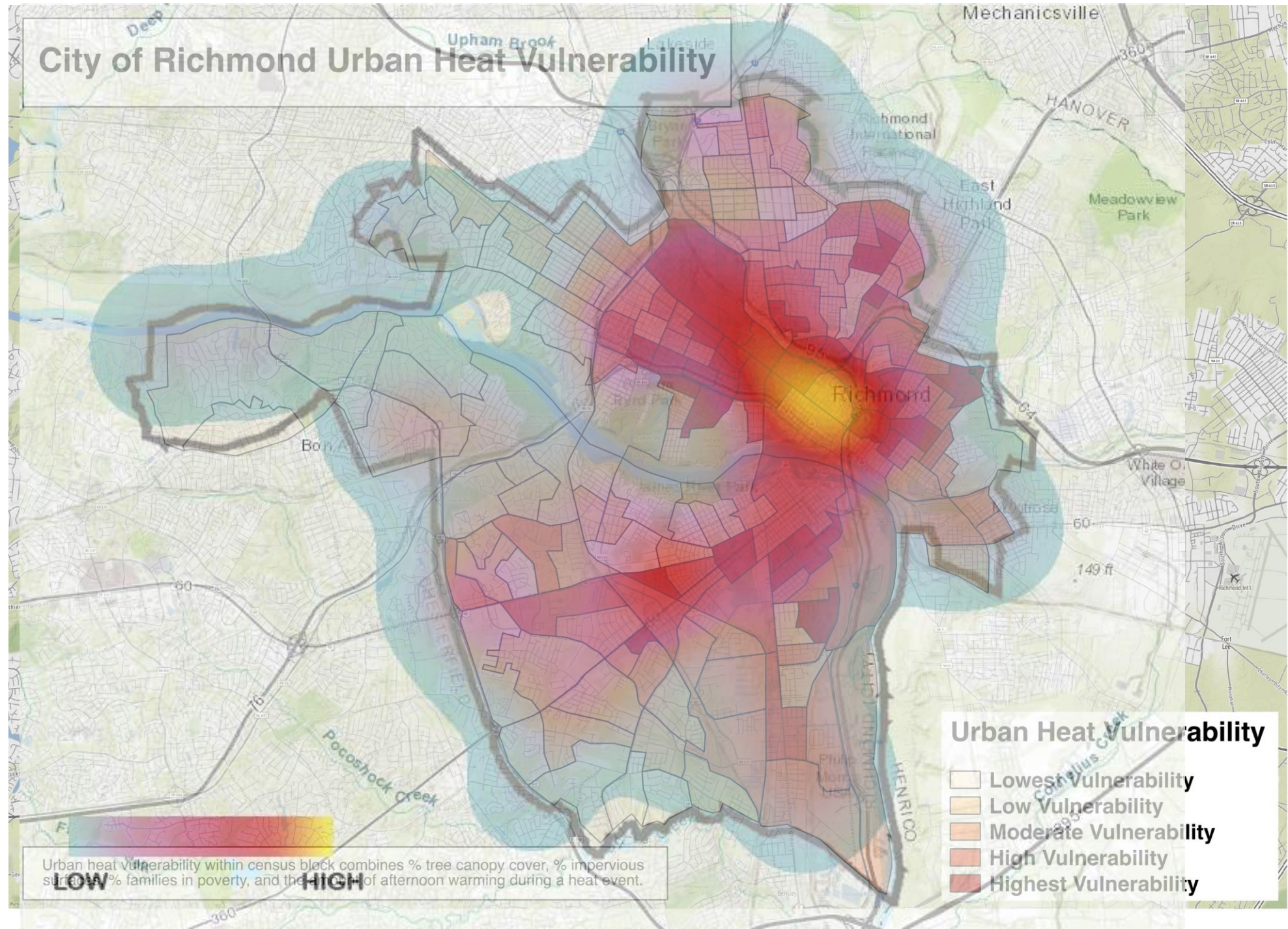
VULNERABILITY



RAA AMBULANCE RESPONSES



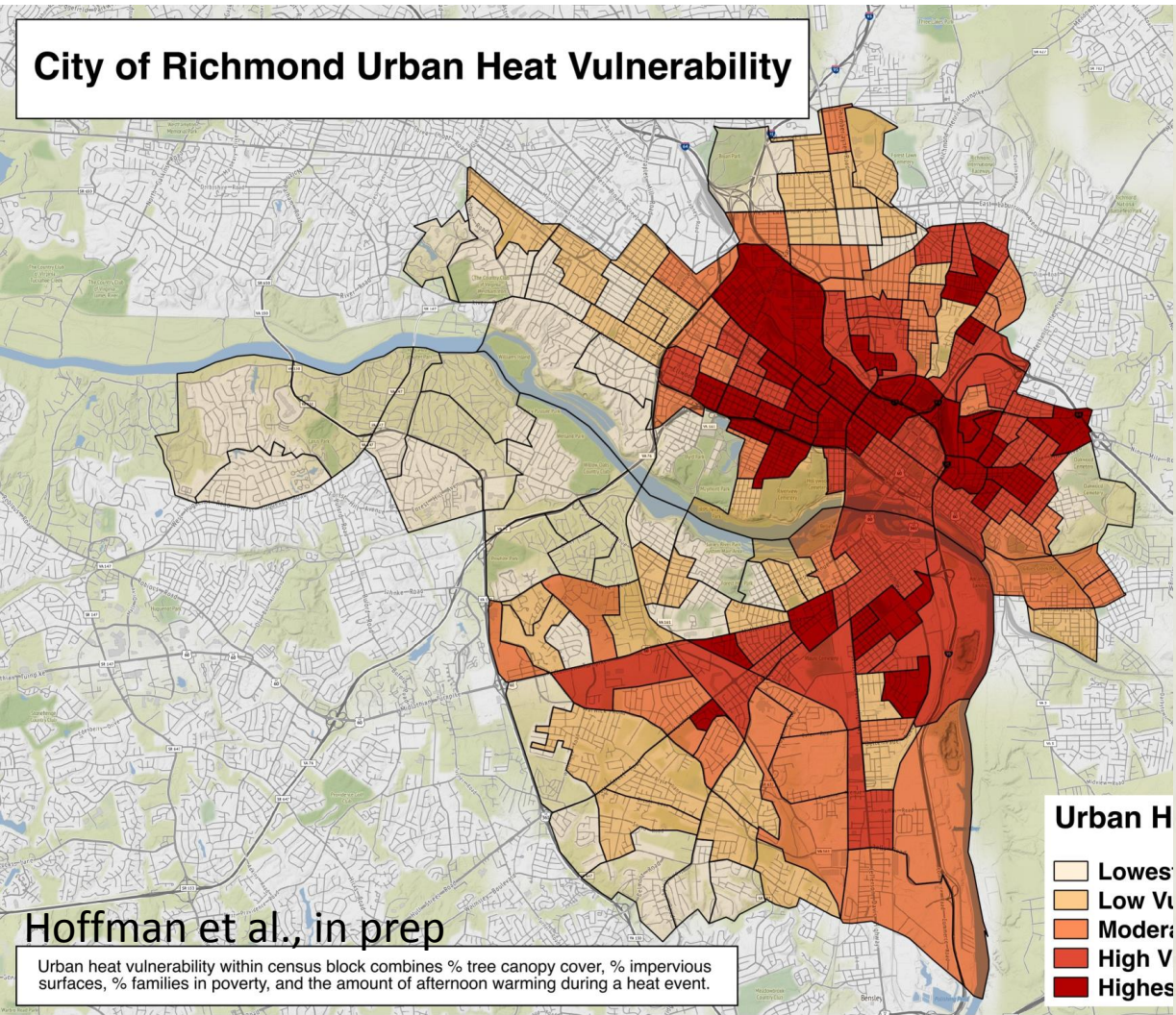
City of Richmond Urban Heat Vulnerability



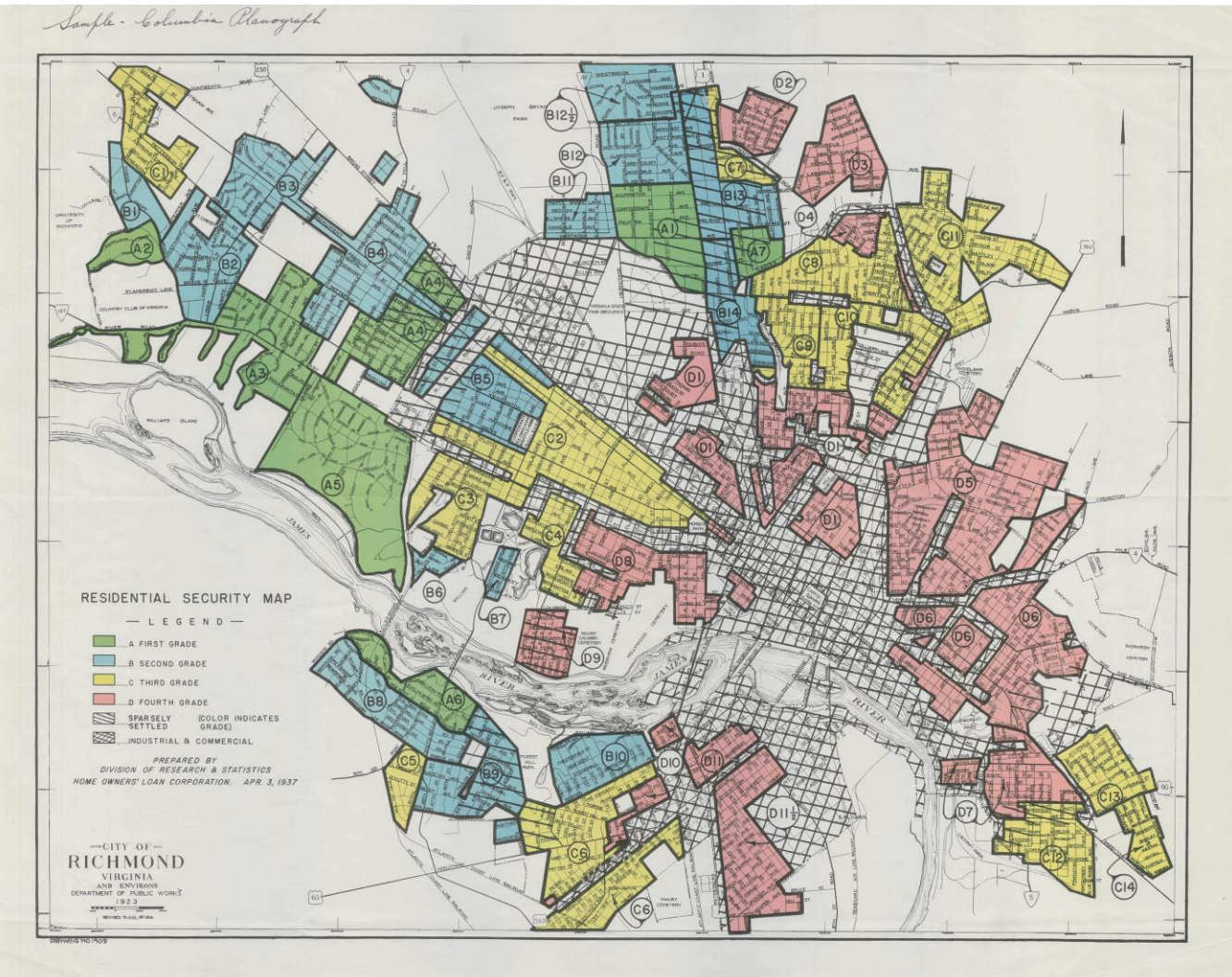
Urban heat vulnerability within census block combines % tree canopy cover, % impervious surface, % families in poverty, and the amount of afternoon warming during a heat event.

VULNERABILITY

City of Richmond Urban Heat Vulnerability

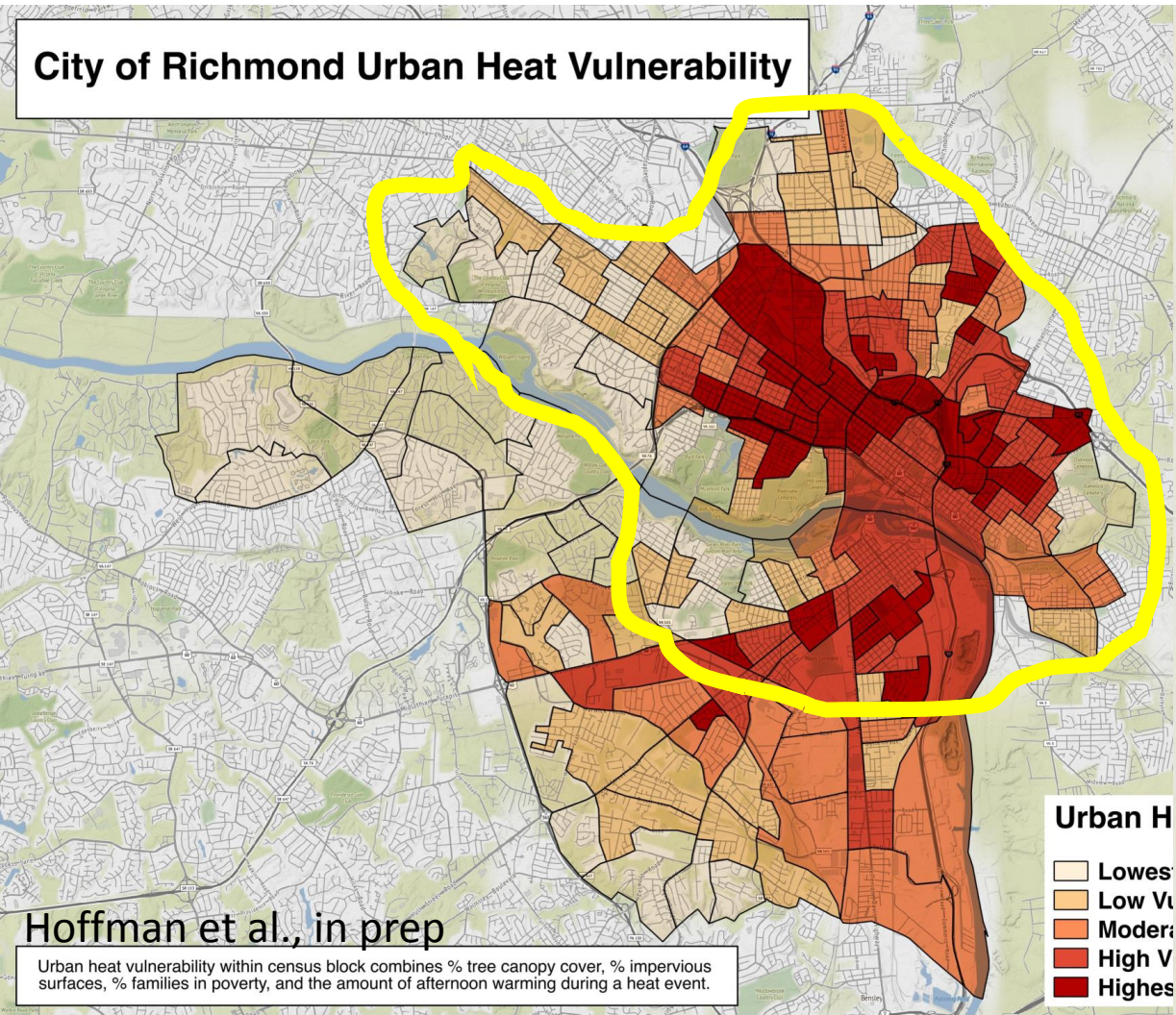


REDLINING MAP (1937)

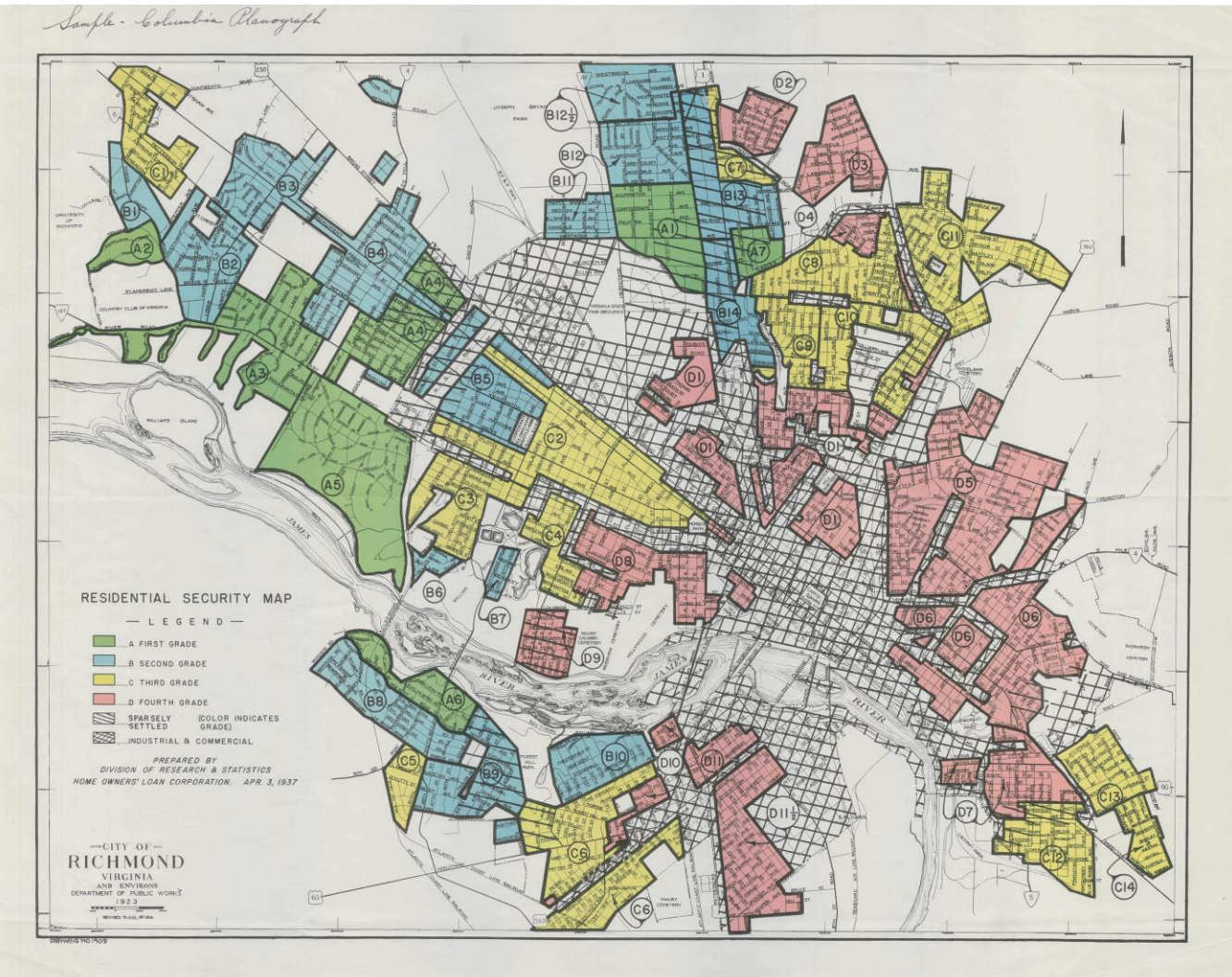


VULNERABILITY

City of Richmond Urban Heat Vulnerability



REDLINING MAP (1937)



LST (°C) in August 2018

31.5
31
30.5
30
29.5
29
28.5
28

A

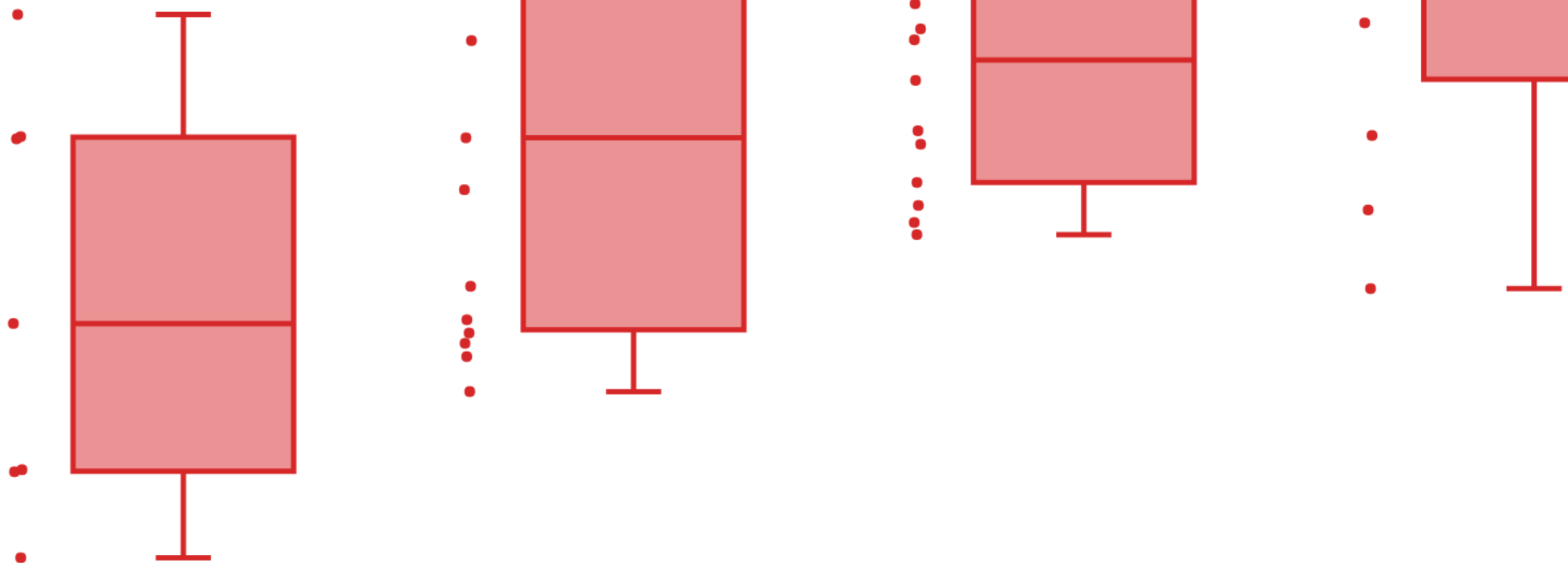
B

C

D

Neighborhood "Grade"

Data: Landsat 8, UR Digital Scholarship Lab
@jer_science



3 Investigate Options

- *Consider possible solutions for your highest risks.*
- *Check how others have responded to similar issues.*
- *Reduce your list to feasible actions.*

At the end of your investigation, you'll have a list of solutions stakeholders are willing to support.

Heat-related illness interventions?

Reduce *exposure*

Criteria for a Recommended Standard

Occupational Exposure to Heat and Hot Environments

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



City of Richmond cooling shelters open Wednesday

POSTED 6:05 PM, MAY 16, 2017, BY [VERNON FREEMAN JR.](#), UPDATED AT 06:19PM, MAY 16, 2017

News

Cooling stations open in Richmond through Friday

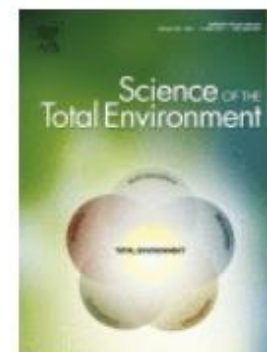
Changes to city structure?

Reduce *sensitivity*



Science of The Total Environment

Volumes 584–585, 15 April 2017, Pages 1040-1055



Utilising green and bluespace to mitigate urban heat island intensity

K.R. Gunawardena ^a, M.J. Wells ^b, T. Kershaw ^a  

 **Show more**

<https://doi.org/10.1016/j.scitotenv.2017.01.158>

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Highlights

- The influence of green and bluespace on urban canopy/boundary-layer temperatures.
- Tree-dominated greenspace offers greater heat stress relief when most required.
- Badly designed bluespace, may exacerbate heat-stress during oppressive conditions.
- Boundary-layer cooling is attributed to greenspace increasing surface roughness.
- The influence of geometry and diversity of green/bluespaces requires more research.

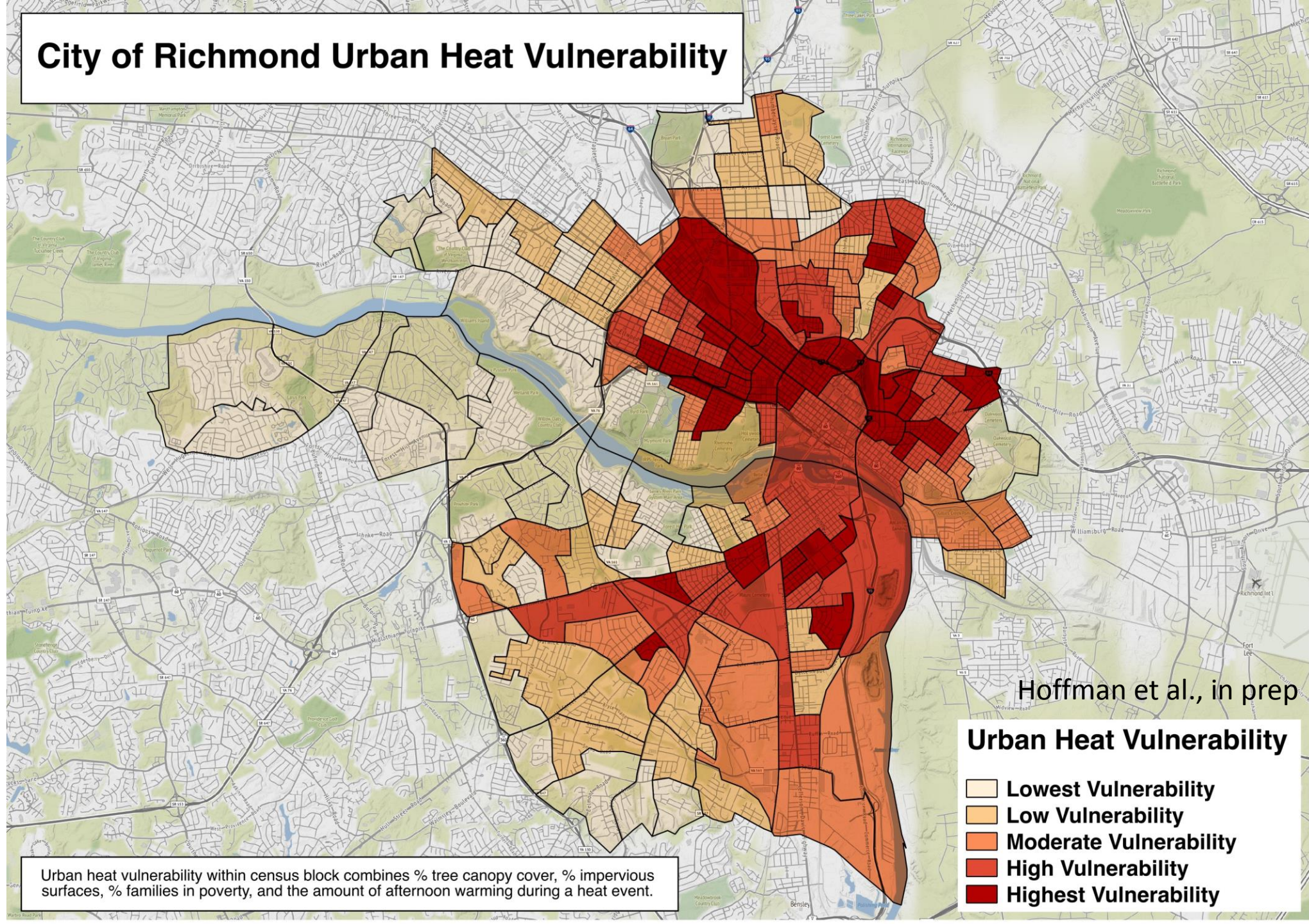
4

Prioritize & Plan

- *Evaluate costs, benefits, and your team's capacity to accomplish each action.*
- *Rank the expected value of each action.*
- *Integrate the highest-value actions into a stepwise plan.*

The result will be a comprehensive plan to implement your favored solutions.

City of Richmond Urban Heat Vulnerability

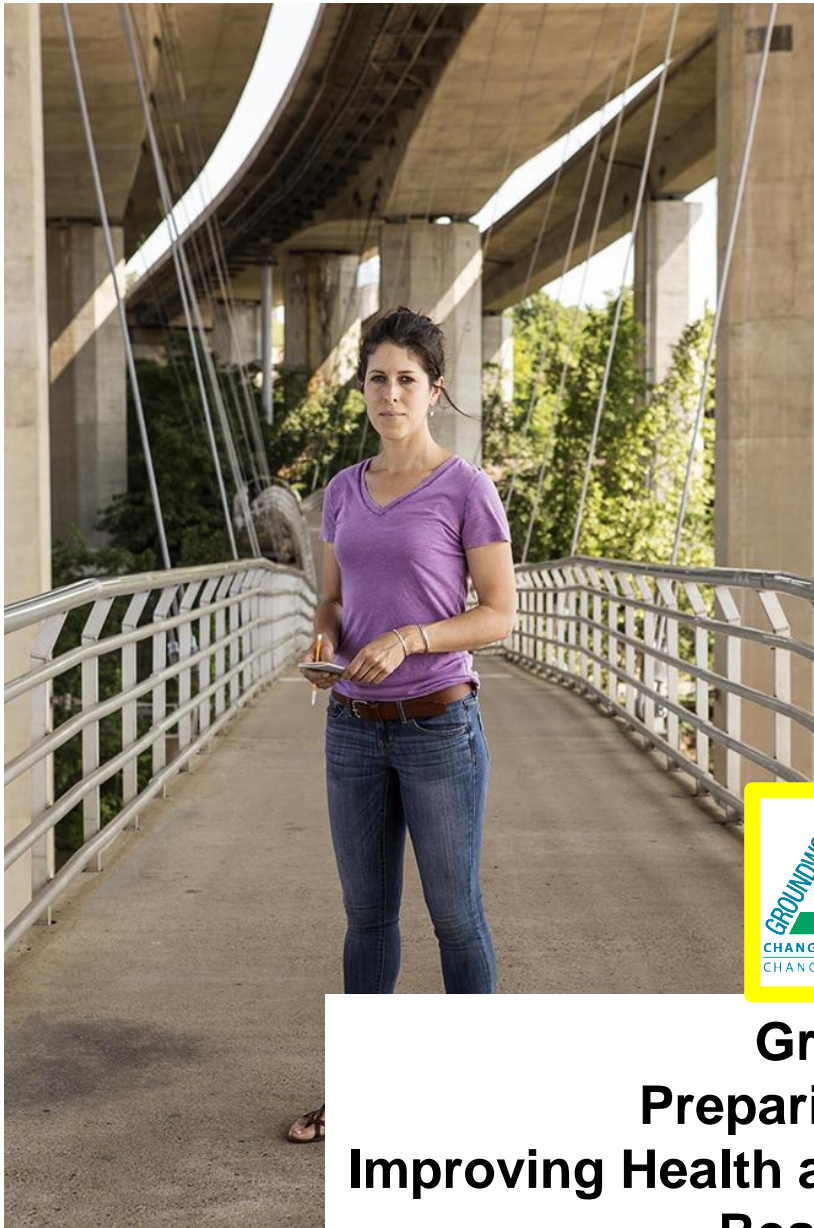


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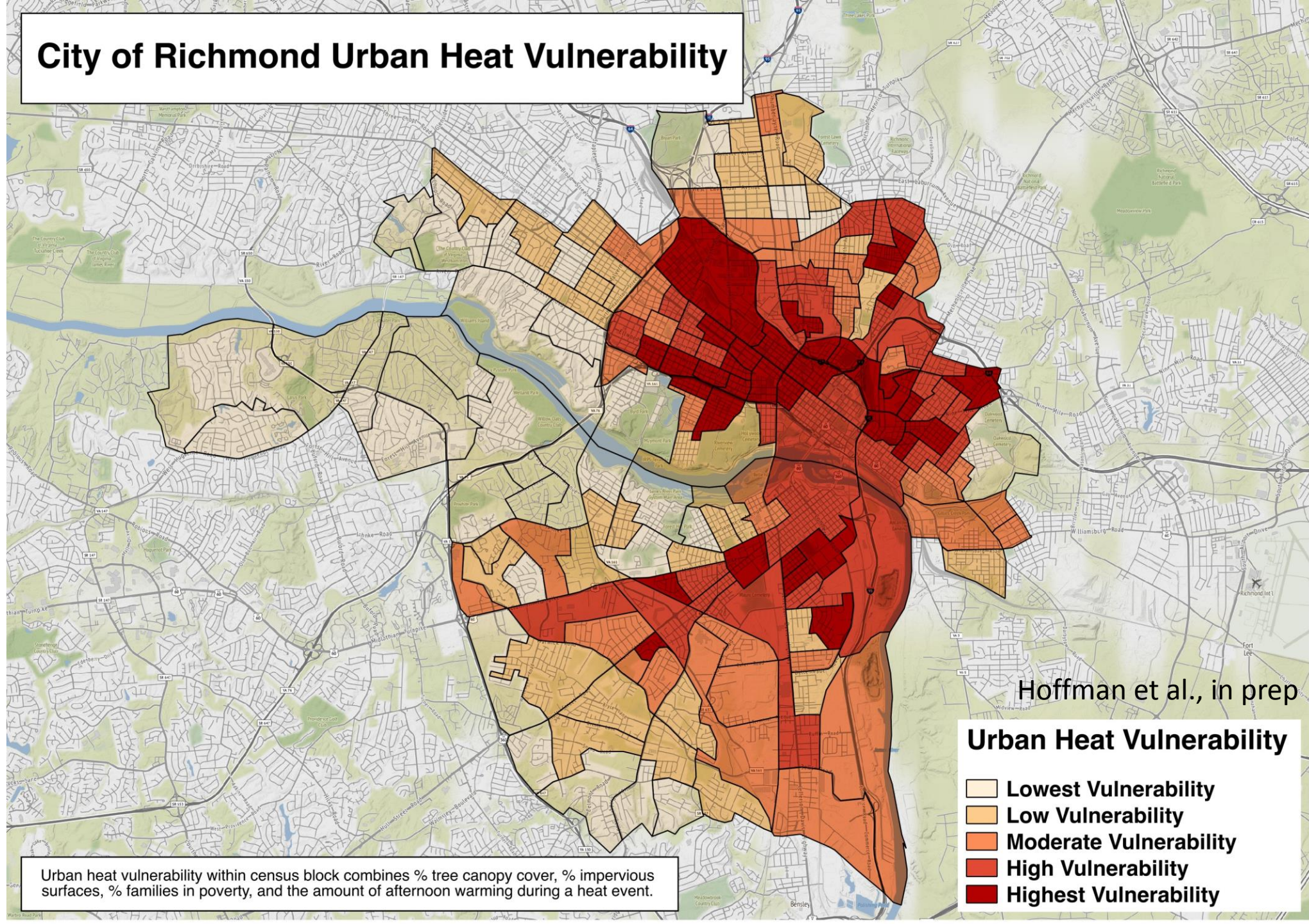
Richmond Times-Dispatch



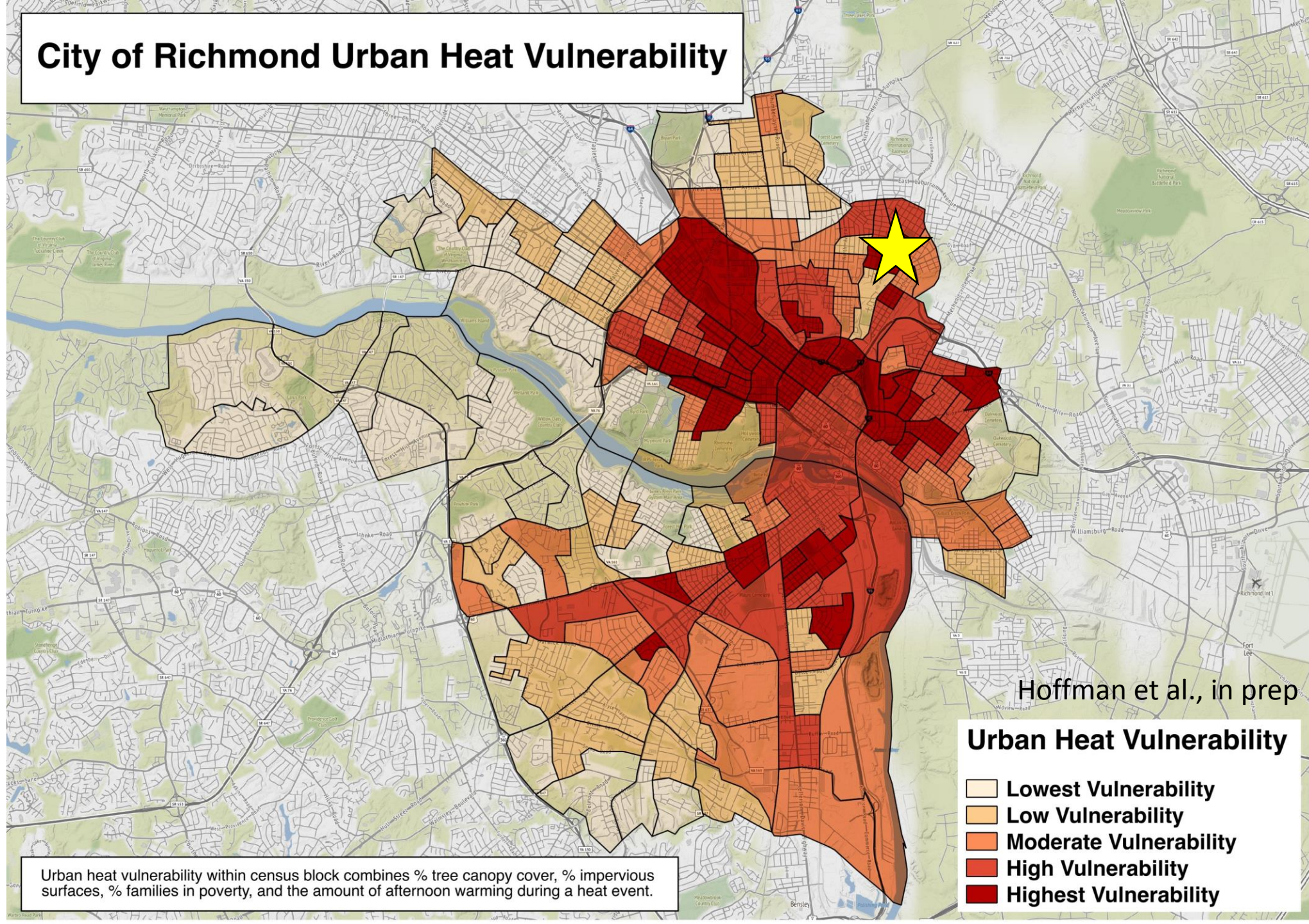


**Greening Richmond
Preparing Youth for Success
Improving Health and Quality of Life of all Residents
Realizing Racial Equity**

City of Richmond Urban Heat Vulnerability

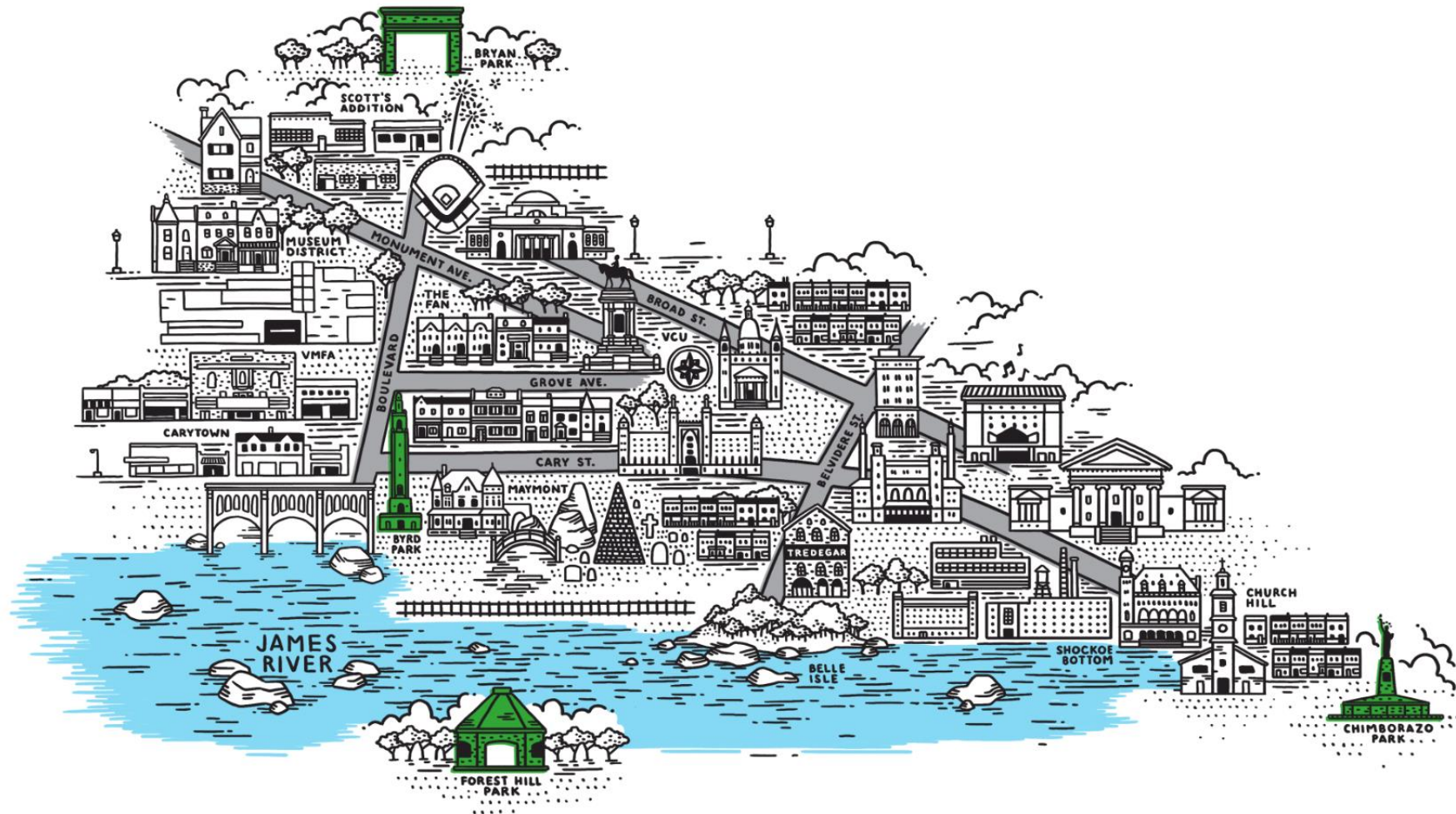


City of Richmond Urban Heat Vulnerability



It starts with a park.

Explore four City parks that will benefit from trees grown at Enrichmond's TreeLab.



5 Take Action

- *Move forward with the stakeholders who accept responsibility and bring resources to take action.*
- *Check to see if your actions are increasing your resilience.*

As you move forward, you'll monitor, review, and report on your project.

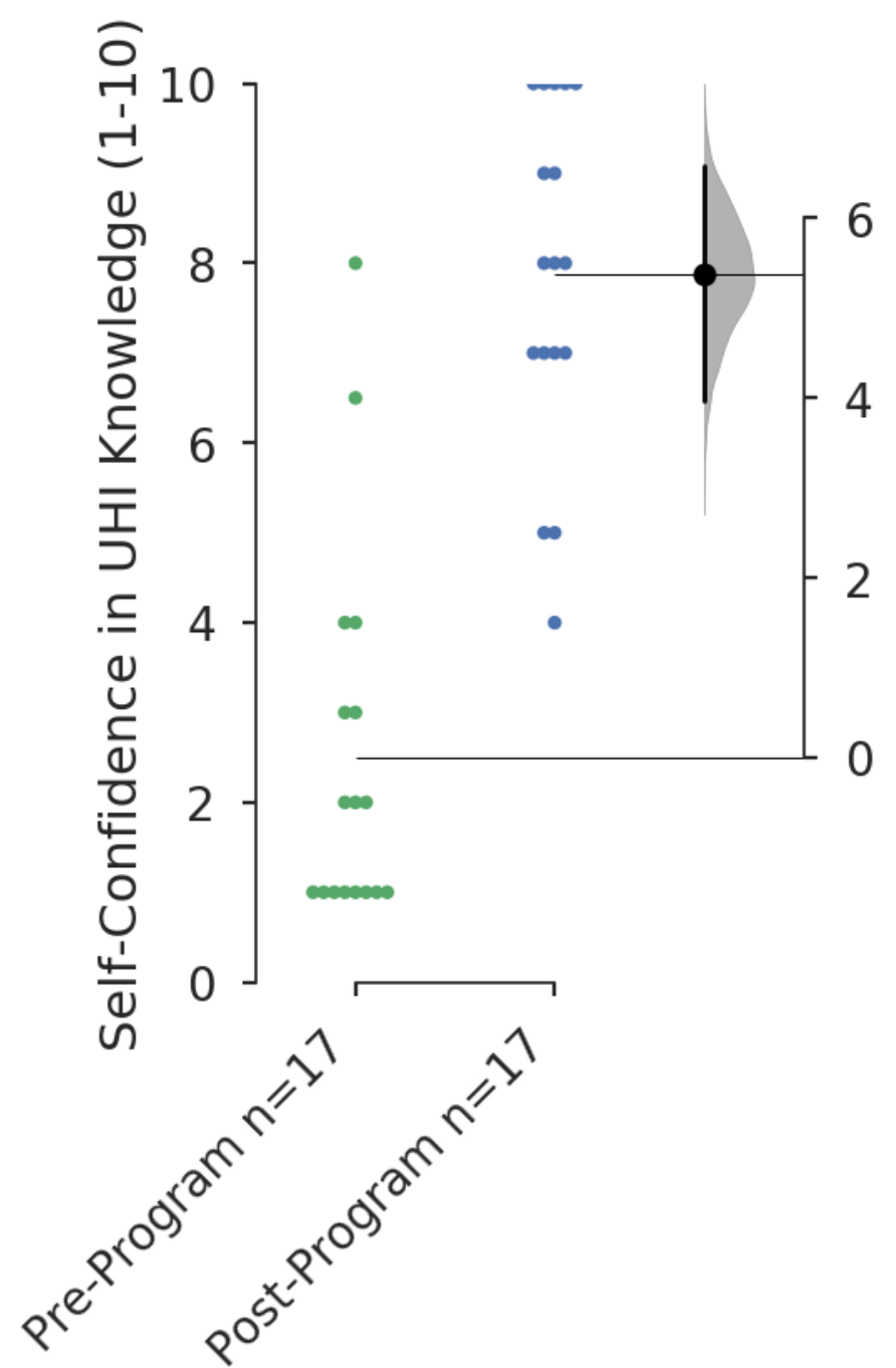
“Throwing Shade in RVA”

- <https://toolkit.climate.gov/case-studies/where-do-we-need-shade-mapping-urban-heat-islands-richmond-virginia>

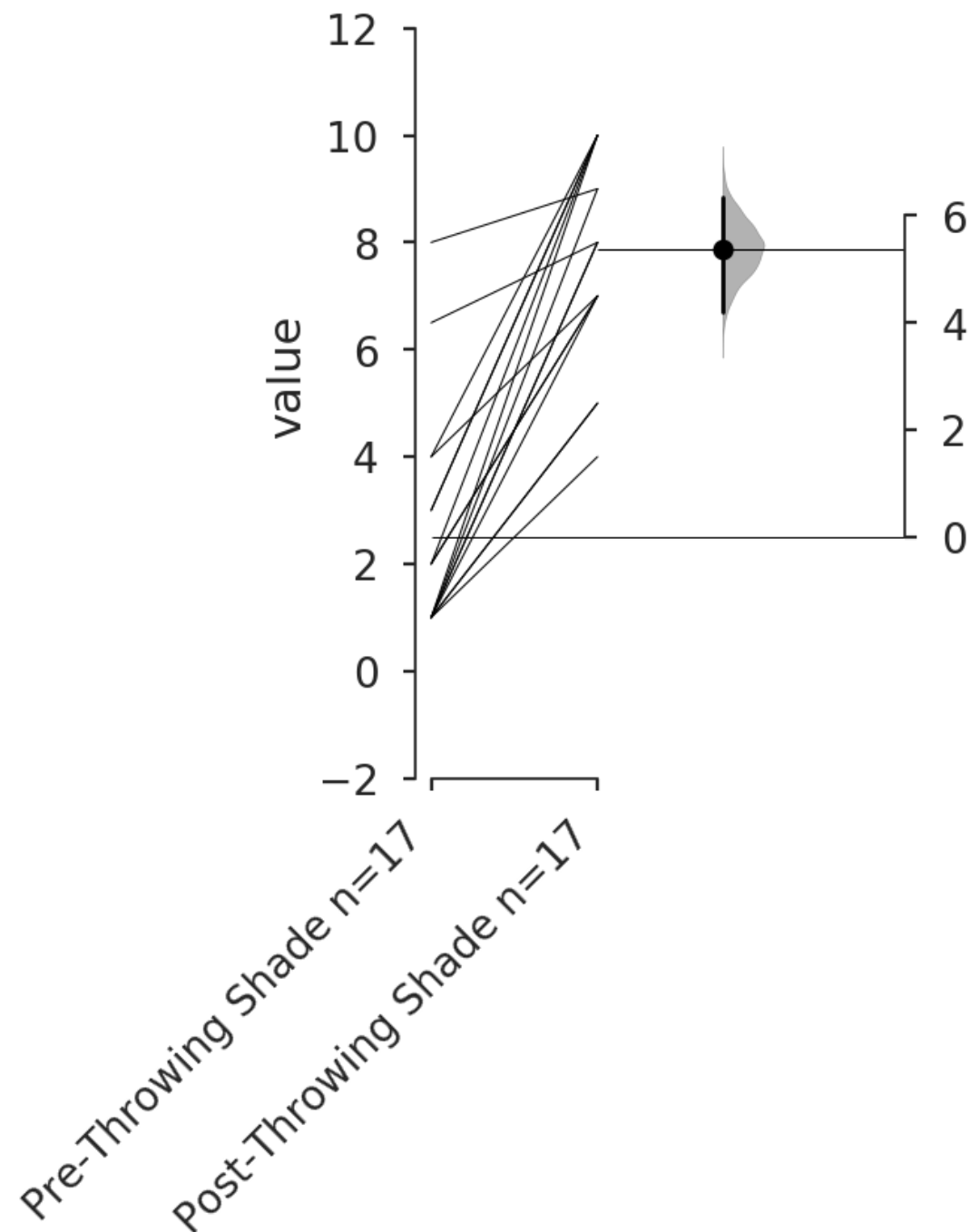


Students use model homes to investigate differential heating in various surfaces.

We saw significant change in our participants



**We saw
significant change
in our participants**



stays
places
lostways
heat
idea
idk
know
trap
keepspotcool
hotone
man
hopepeople
hotter





Thanks!

- @jer_science
- Check out our recent case study on climate.gov:
<https://goo.gl/cW1q2u>
- jhoffman@smv.org