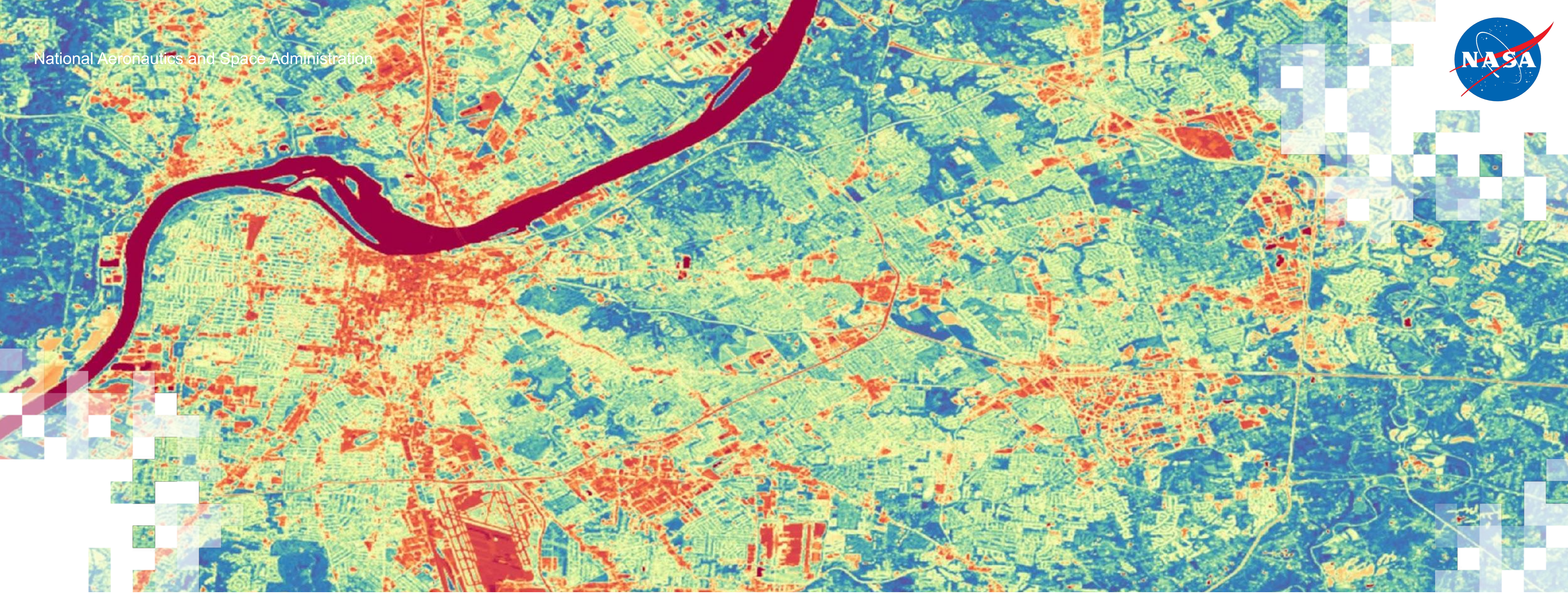
National Aeronautics and Space Administration



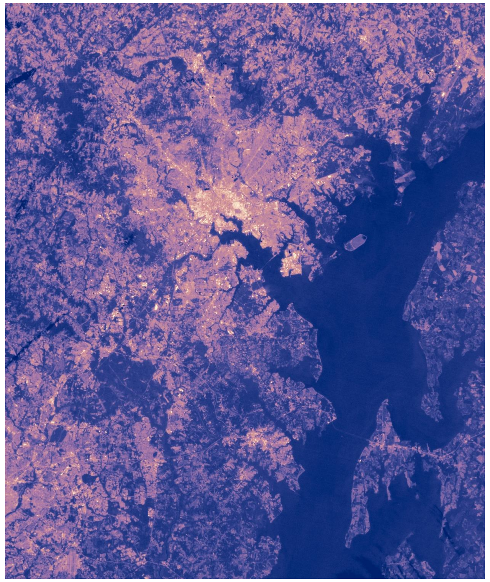
Satellite Remote Sensing for Measuring Urban Heat Islands and Constructing Heat Vulnerability Indices

Part 2: Integrating Socioeconomic Data with Satellite Imagery for Constructing Heat Vulnerability Indices (Session 1)

Kathryn Conlon, PhD, MPH & Evan Mallen, PhD, MUP – August 4, 2022

Training Outline

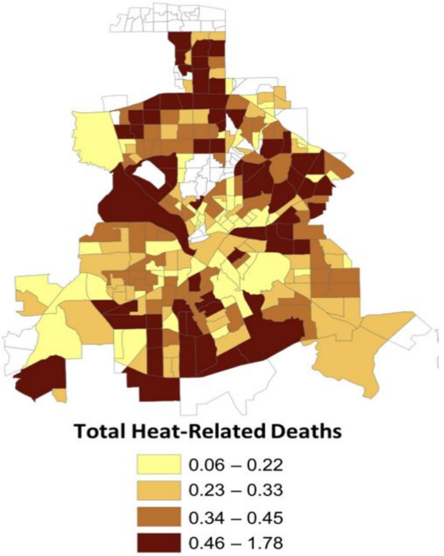
2 August 2022



Credit: NASA

Land Surface Temperature-based Urban Heat Island Mapping

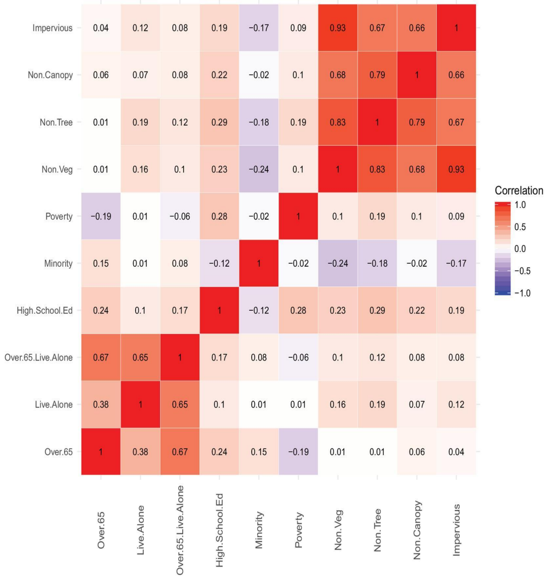
4 August 2022



Credit: Mallen et al., 2019

Integrating Socioeconomic Data with Satellite Imagery for Constructing Heat Vulnerability Indices - Session 1

9 August 2022

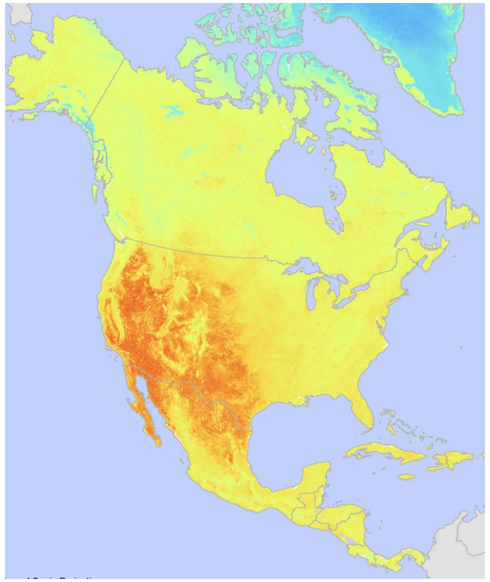


	Over.65	Live.Alone	Over.65.Live.Alone	High.School.Ed	Minority	Poverty	Non.Veg	Non.Tree	Non.Canopy	Impervious
Impervious	0.04	0.12	0.08	0.19	−0.17	0.09	0.93	0.67	0.66	1
Non.Canopy	0.06	0.07	0.08	0.22	−0.02	0.1	0.68	0.79	1	0.66
Non.Tree	0.01	0.19	0.12	0.29	−0.18	0.19	0.83	1	0.79	0.67
Non.Veg	0.01	0.16	0.1	0.23	−0.24	0.1	1	0.83	0.68	0.93
Poverty	−0.19	0.01	−0.06	0.28	−0.02	1	0.1	0.19	0.1	0.09
Minority	0.15	0.01	0.08	−0.12	1	−0.02	−0.24	−0.18	−0.02	−0.17
High.School.Ed	0.24	0.1	0.17	1	−0.12	0.28	0.23	0.29	0.22	0.19
Over.65.Live.Alone	0.67	0.65	1	0.17	0.08	−0.06	0.1	0.12	0.08	0.08
Live.Alone	0.38	1	0.65	0.1	0.01	0.01	0.16	0.19	0.07	0.12
Over.65	1	0.38	0.67	0.24	0.15	−0.19	0.01	0.01	0.06	0.04

Credit: Conlon et al., 2020

Integrating Socioeconomic Data with Satellite Imagery for Constructing Heat Vulnerability Indices - Session 2

11 August 2022



Credit: CIESIN

Using High-Resolution, Satellite Derived Hot-Humid Heat Estimates and Gridded Population Data to Map Extreme Heat Exposure Worldwide

Course Structure and Materials

- Webinar recordings, presentations, and homework assignment can be accessed from the training page:
  - https://appliedsciences.nasa.gov/join-mission/training/english/arset-satellite-remote-sensing-measuring-urban-heat-islands-and

TRAINING

ARSET - Satellite Remote Sensing for Measuring Urban Heat Islands and Constructing Heat Vulnerability Indices

PROGRAM AREA: DISASTERS

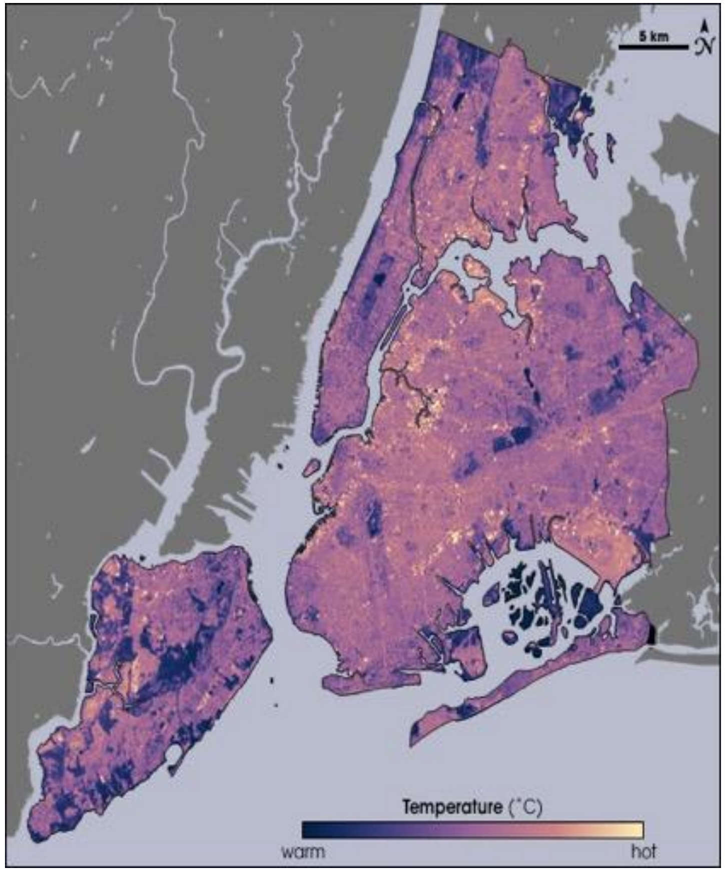
Homework and Certificate

- Homework Assignment:
  - There will be one homework assignment for this webinar series
  - Answers must be submitted via instructions found on the [training page]
  - Due date: August 25, 2022
- A certificate of completion will be awarded to those who:
  - Attend all live webinars
  - Complete the homework assignment by the deadline
  - You will receive a certificate approximately two months after the completion of the course from: marines.martins@ssaihq.com

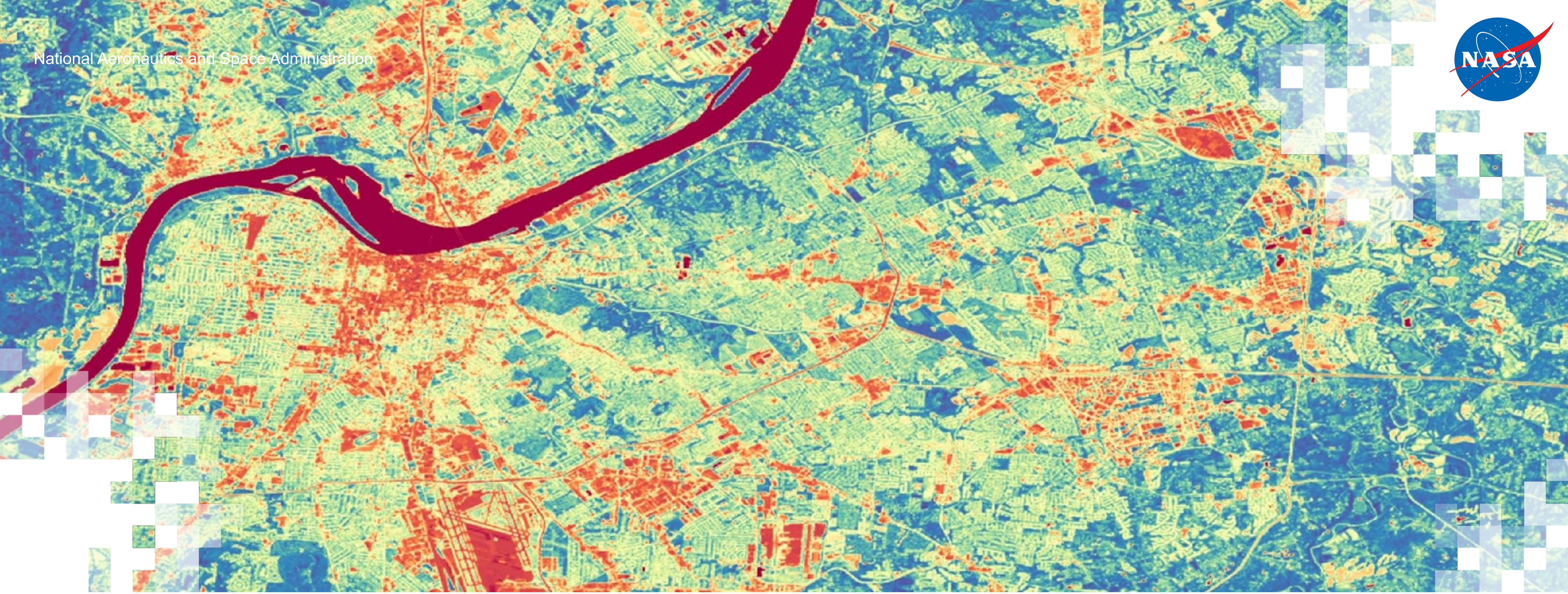
Learning Objectives

After participating in today's training, attendees will be able to:

- Give examples of common methods used to create heat vulnerability indices (HVI)
- Recognize techniques for effectively using HVI results to inform exposure and mitigation efforts
- Identify case studies showing how heat vulnerability mapping informed urban planning



Credit: NASA Earth Observatory

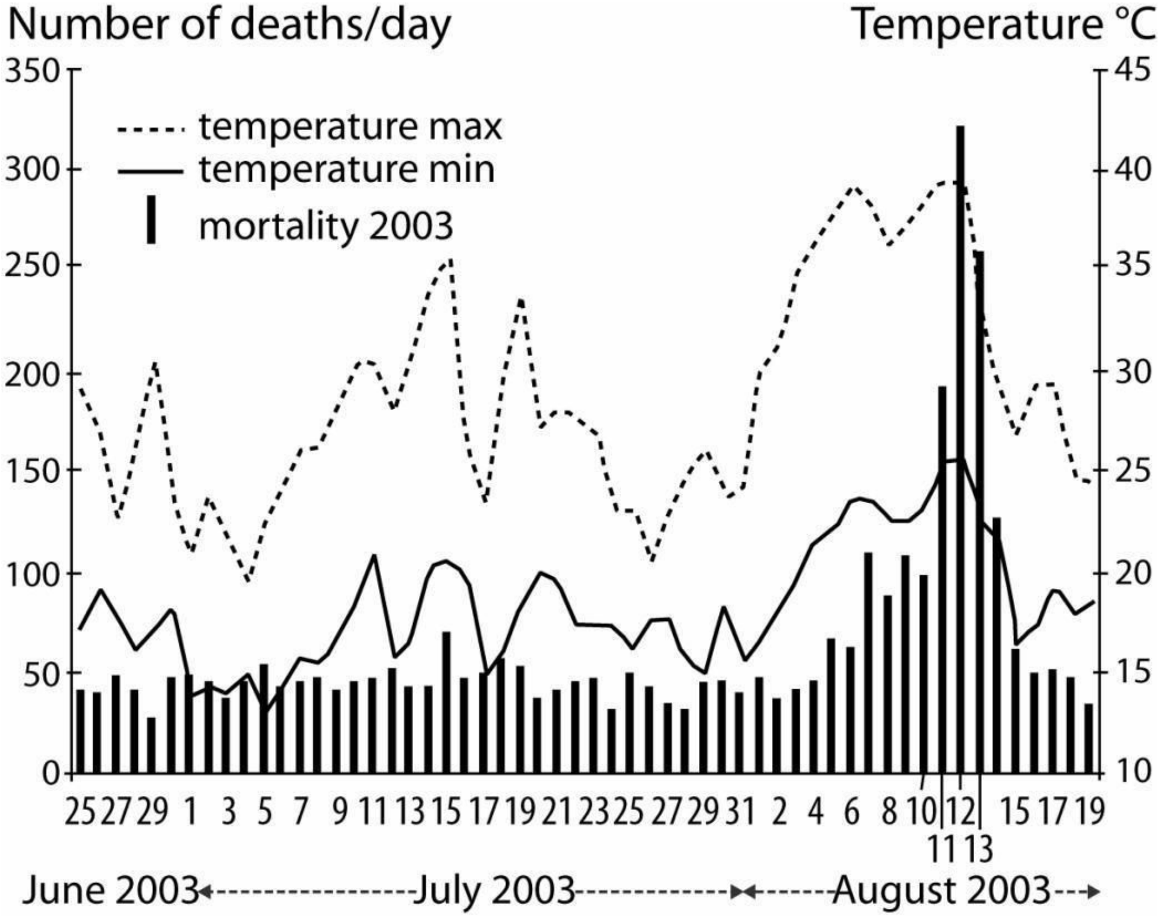


Background on Urban Heat & Heat Vulnerability Indices

Heat & Human Health

- Exposure to high temperatures can cause[1,2,3]
  - Heat stroke
  - Heat exhaustion
  - Heat syncope
  - Heat cramps
  - Death

- Annual US heat-related mortality may increase by up to 34,000[4]



Dousset et al. (2010)

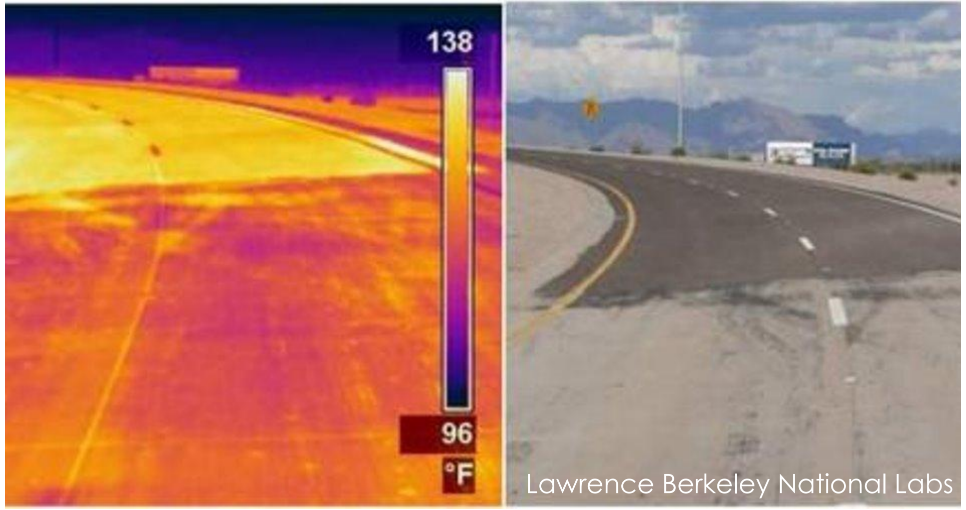
[1] Bouchama et al. (2002); [2] Kovats et al. (2008); [3] USGCRP (2016); [4] Voorhees et al. (2011)

Drivers of the Urban Heat Island

Loss of Vegetation

National Geographic Society

Impervious Materials



Lawrence Berkeley National Labs

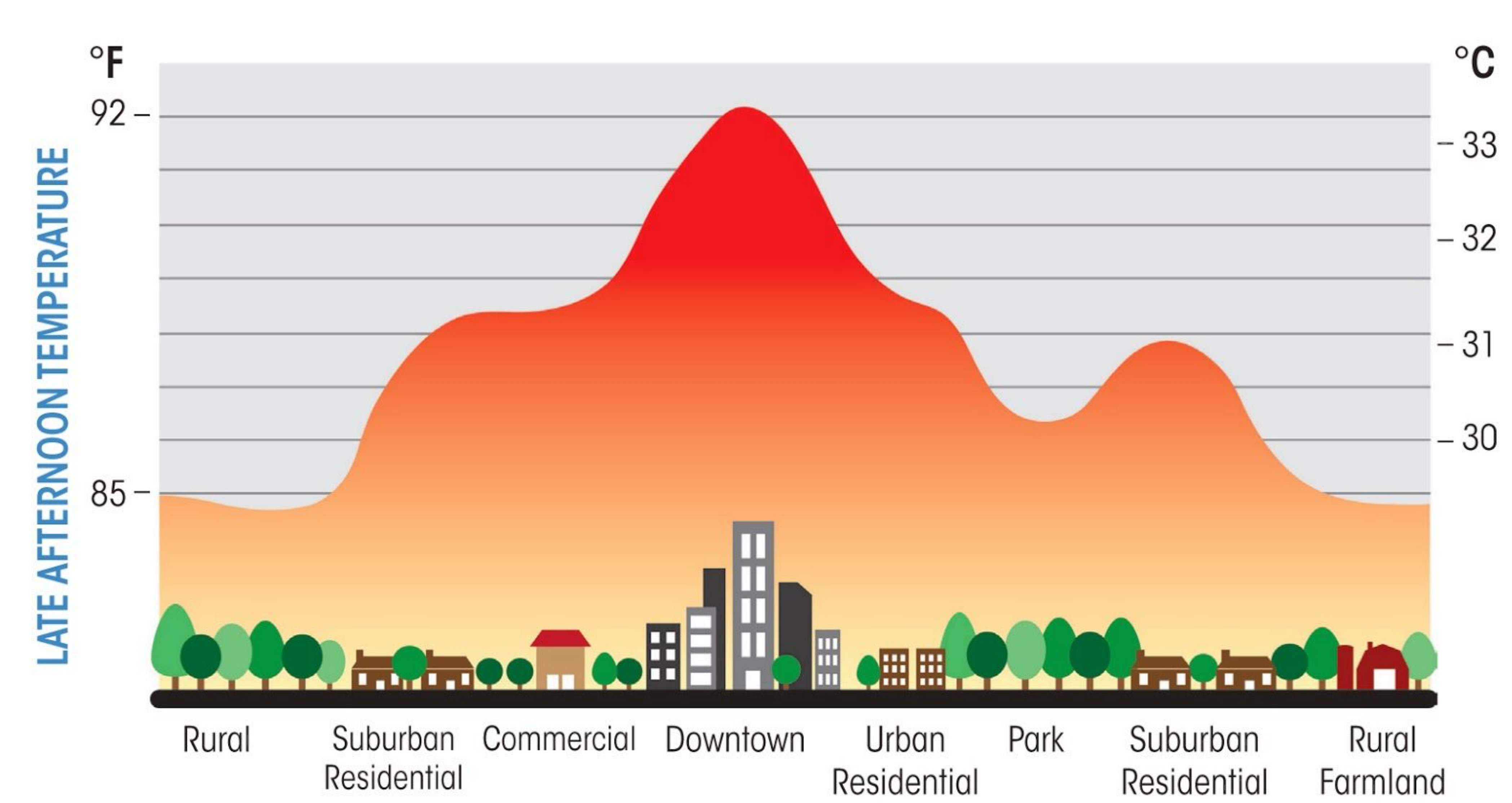
Atlanta Journal Constitution

Waste Heat

polis

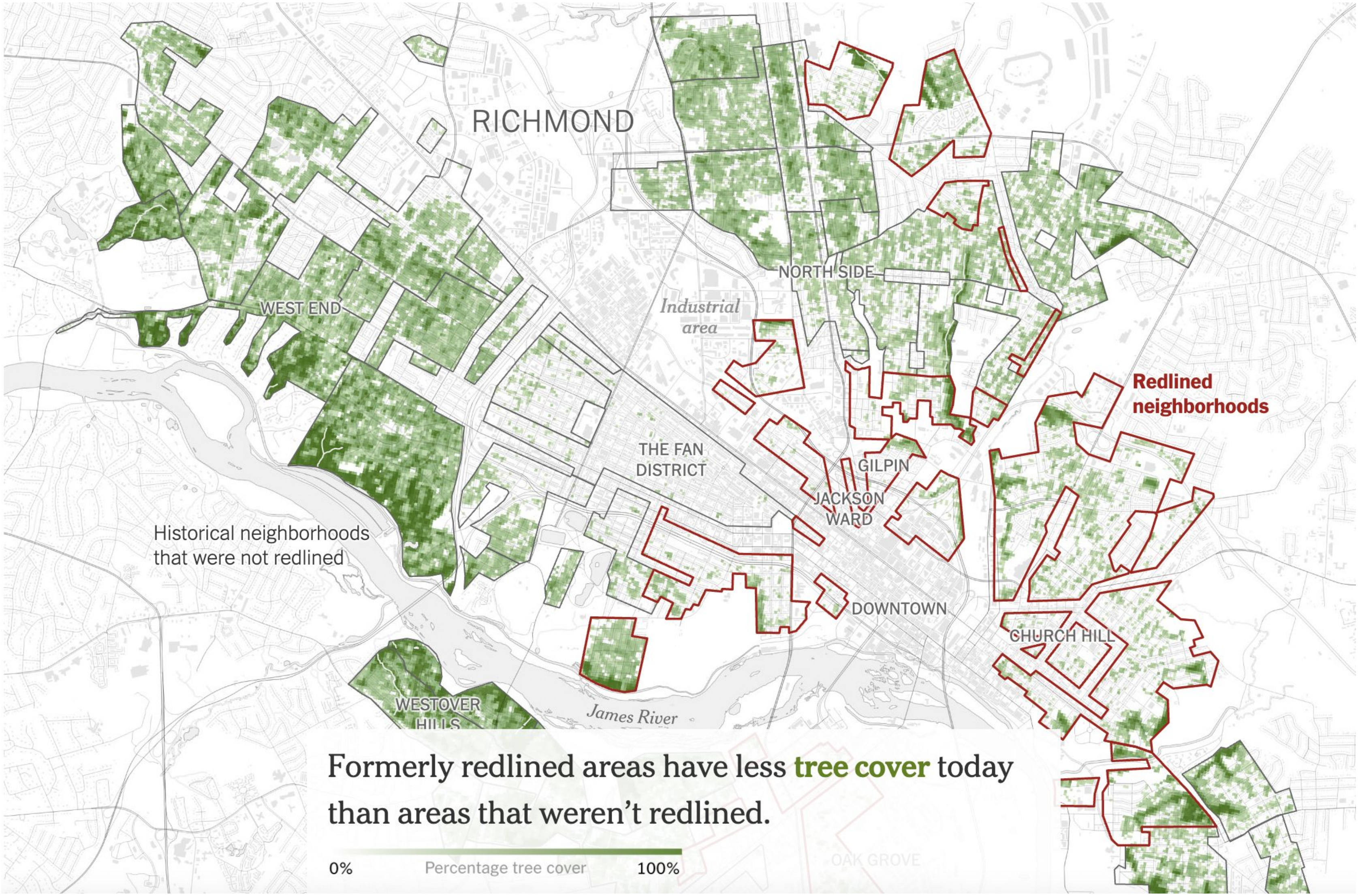
Urban Morphology

Drivers of the Urban Heat Island



Credit: Tunza Eco Generation

Inequities in Urban Heat Exposure



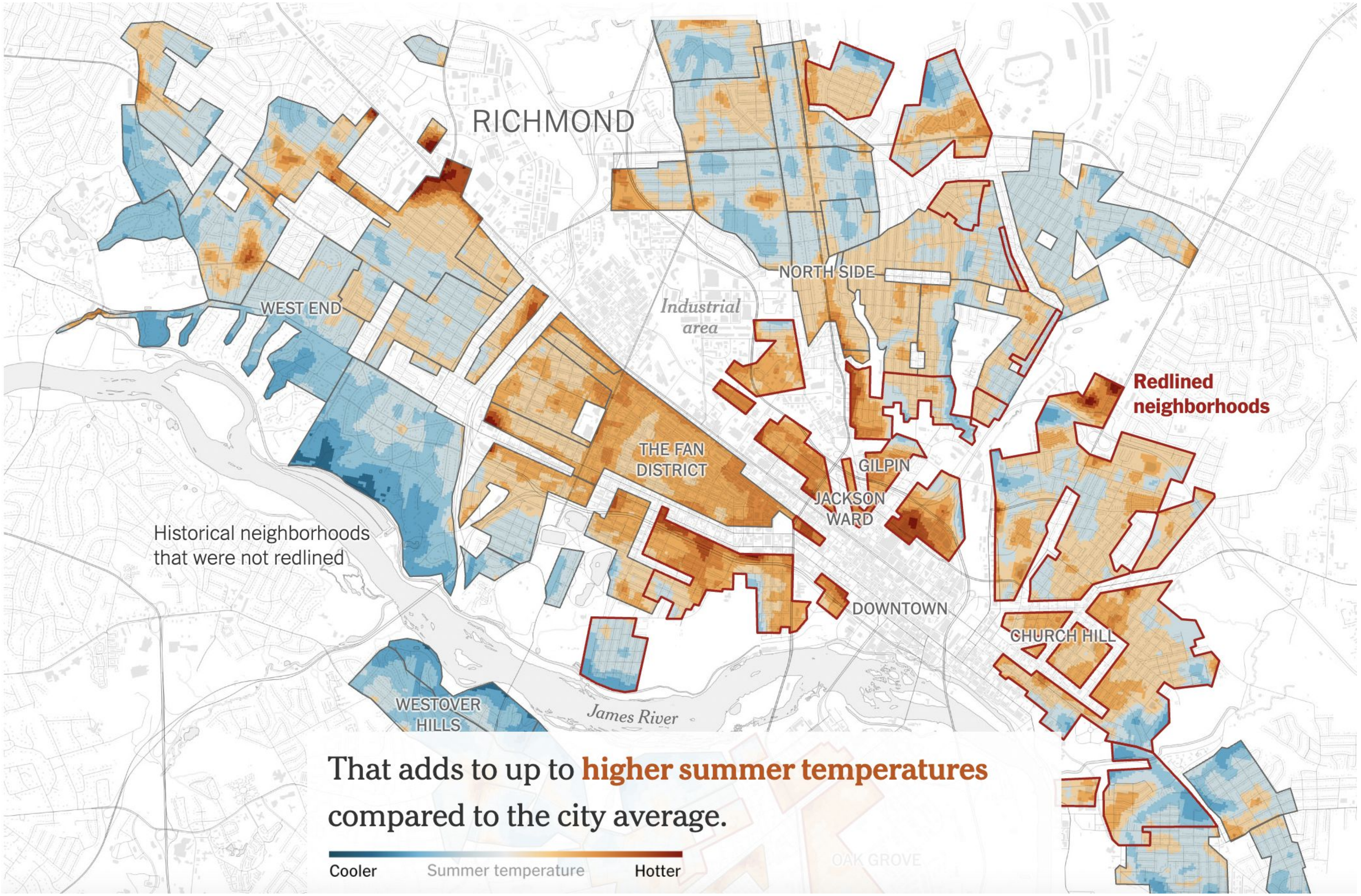
Hoffman et al., 2020; New York Times

Inequities in Urban Heat Exposure

They have more **paved surfaces**, like roads and parking lots, that absorb and radiate heat.

Hoffman et al., 2020; New York Times

Inequities in Urban Heat Exposure

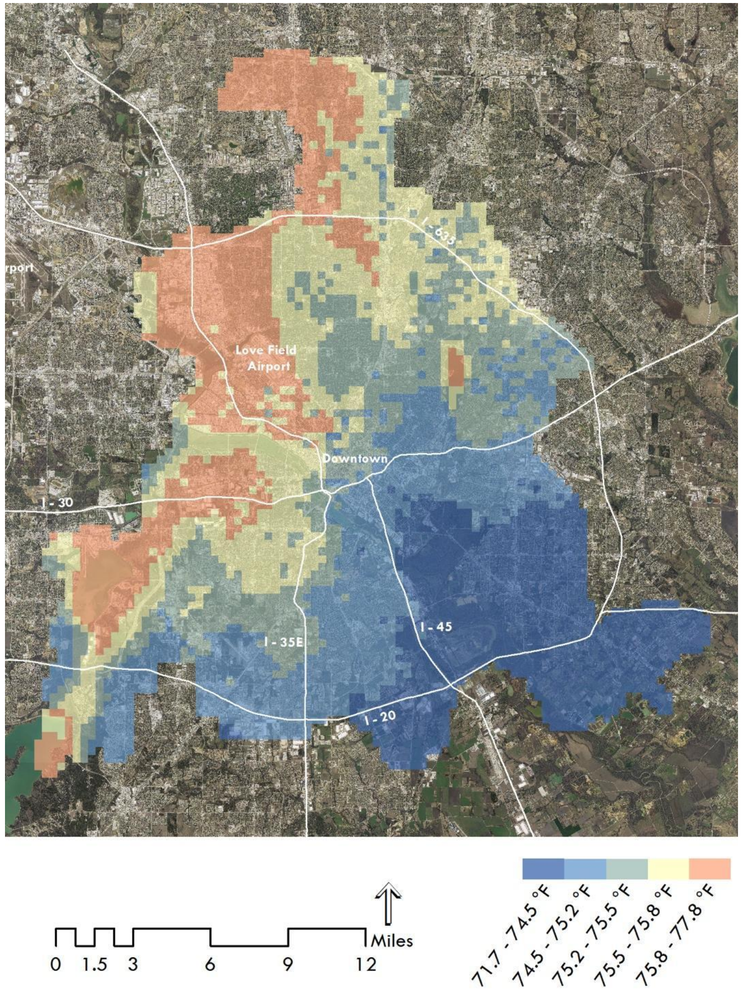


That adds to up to **higher summer temperatures** compared to the city average.

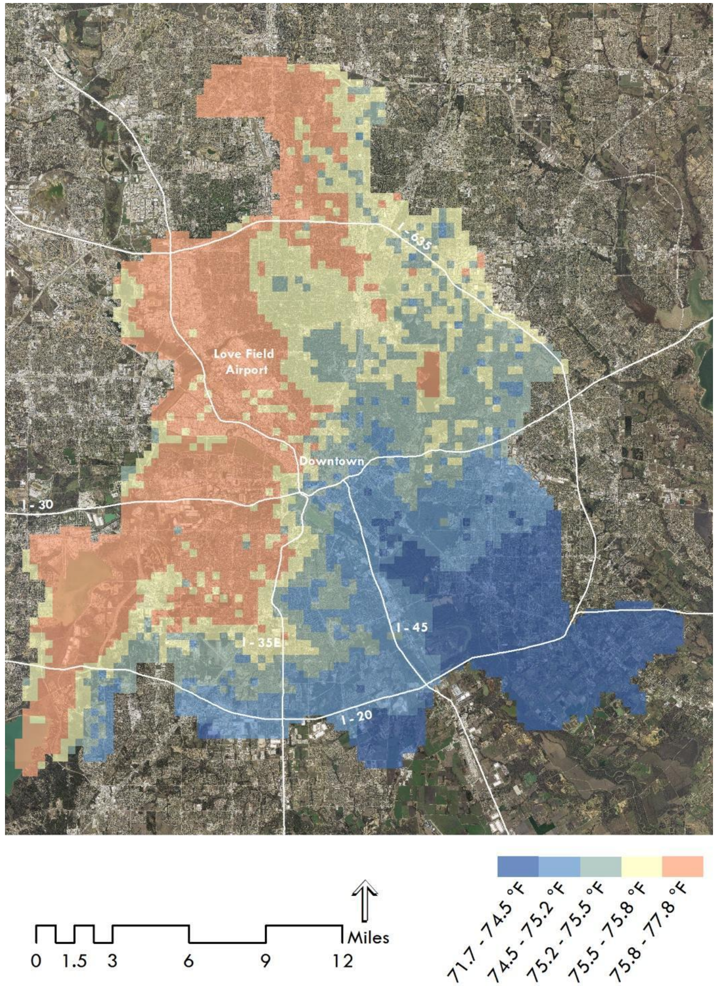
Hoffman et al., 2020; New York Times

Air Temperature Data: Regional Climate Modeling

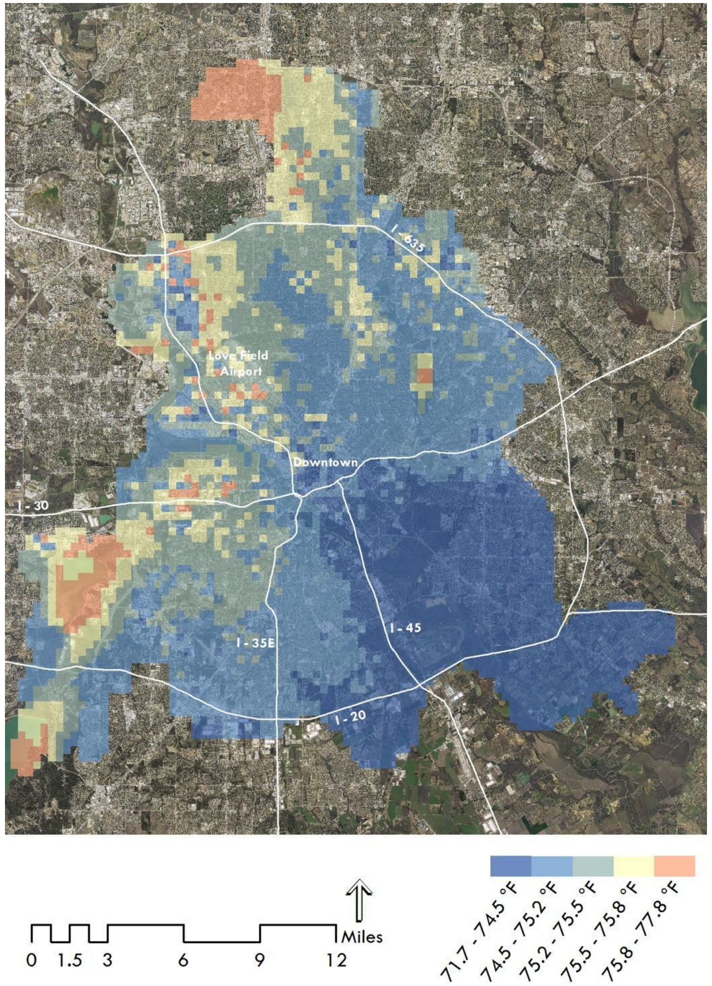
Current Conditions



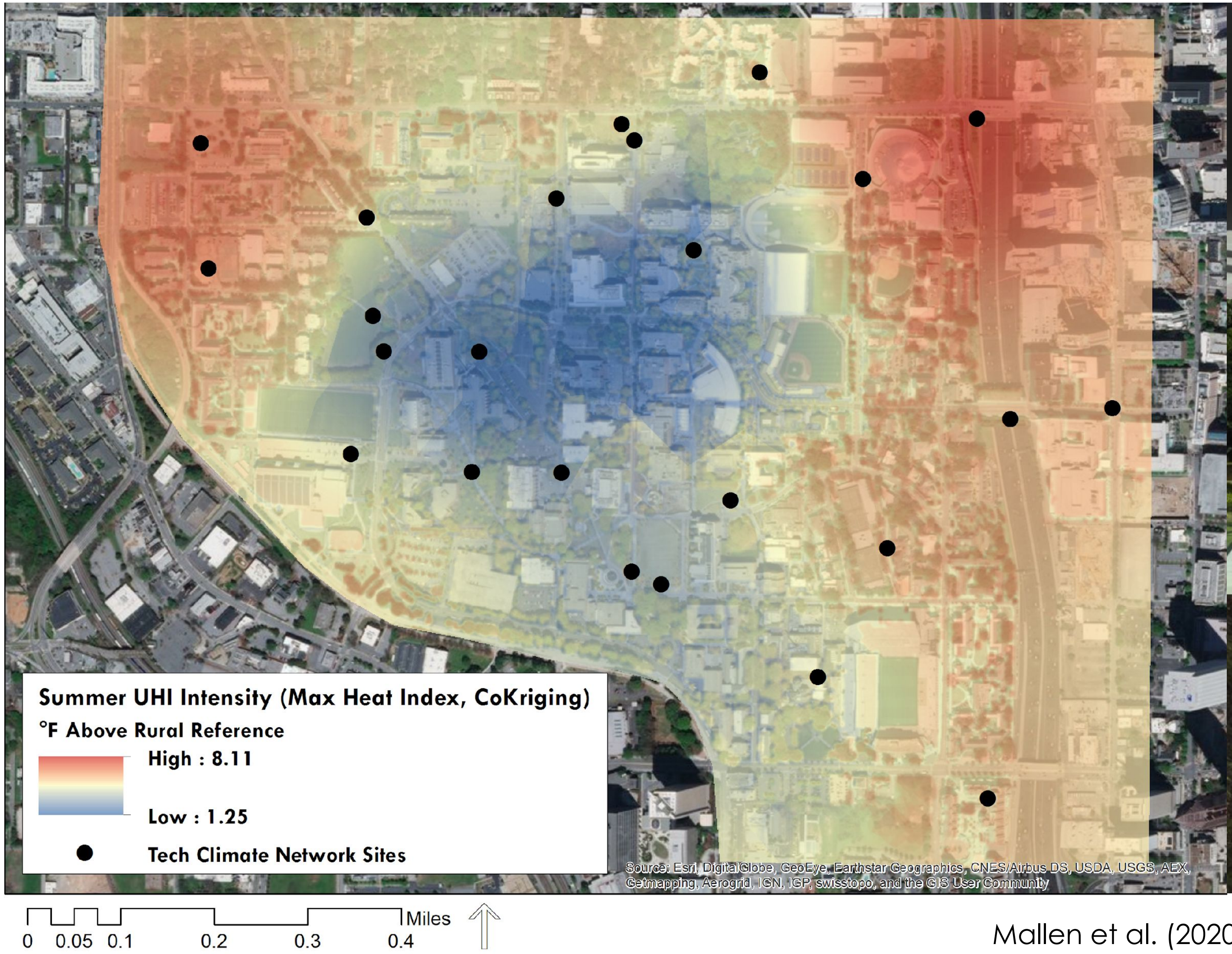
Tree Loss Scenario



Greening Scenario



Air Temperature Data: Field Measurements



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

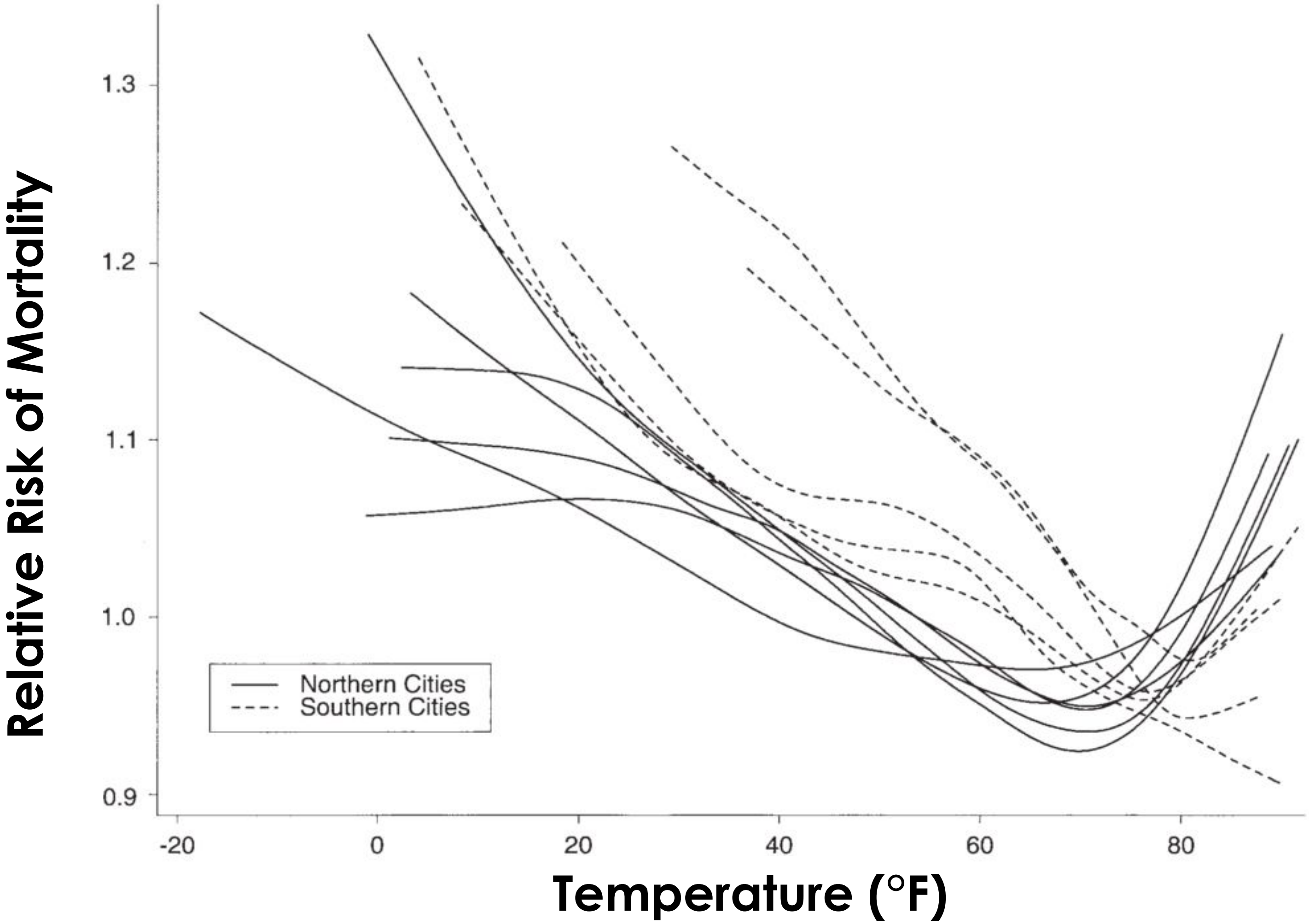
Mallen et al. (2020)

Heat Epidemiology

	Direct Attribution	Statistical Attribution
Definition	Direct observations, but heat mortality/morbidity by proxy • Hospital visits, 911 calls, cardio-pulmonary or renal failure during period of extreme heat[1]	• Uses statistical relationships between temperature and mortality • Often used in mortality projections[3]
Limitation	• Rarely attributes death specifically to heat[2]	• Difficult to obtain spatially comprehensive air temperature data[1]

[1]USGCRP (2016) ;[2]Anderson et al. (2011); [3]Voorhees et al. (2011)

Heat Epidemiology



Temperature-mortality relative risk functions for 11 US cities, 1973–1994. Northern cities: Boston, Massachusetts; Chicago, Illinois; New York; Philadelphia, Pennsylvania; Baltimore, Maryland; and Washington, DC. Southern cities: Charlotte, North Carolina; Atlanta, Jacksonville, Florida; Tampa, Florida; and Miami, Florida. ˚C = 5/9 × (˚F – 32).

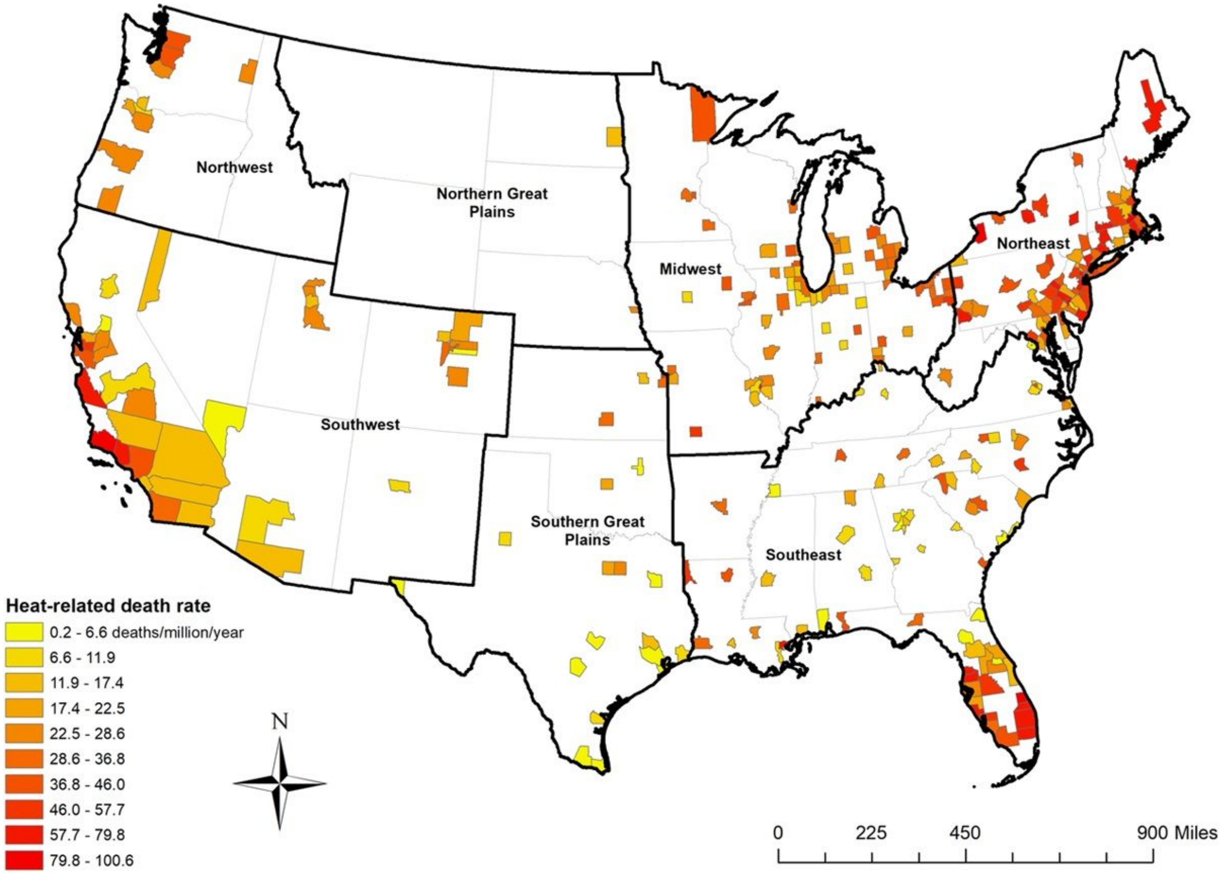
Curriero et al. (2002)

Filling in the Gaps

- Heat epidemiologic model is the gold standard
    - Can be resource-intensive
    - Exposure and health data are required

- In absence of epidemiologic data, heat vulnerability indices (HVIs) can display spatial patterns of heat-related risk

Excess Deaths Attributable to Heat in 297 US Counties

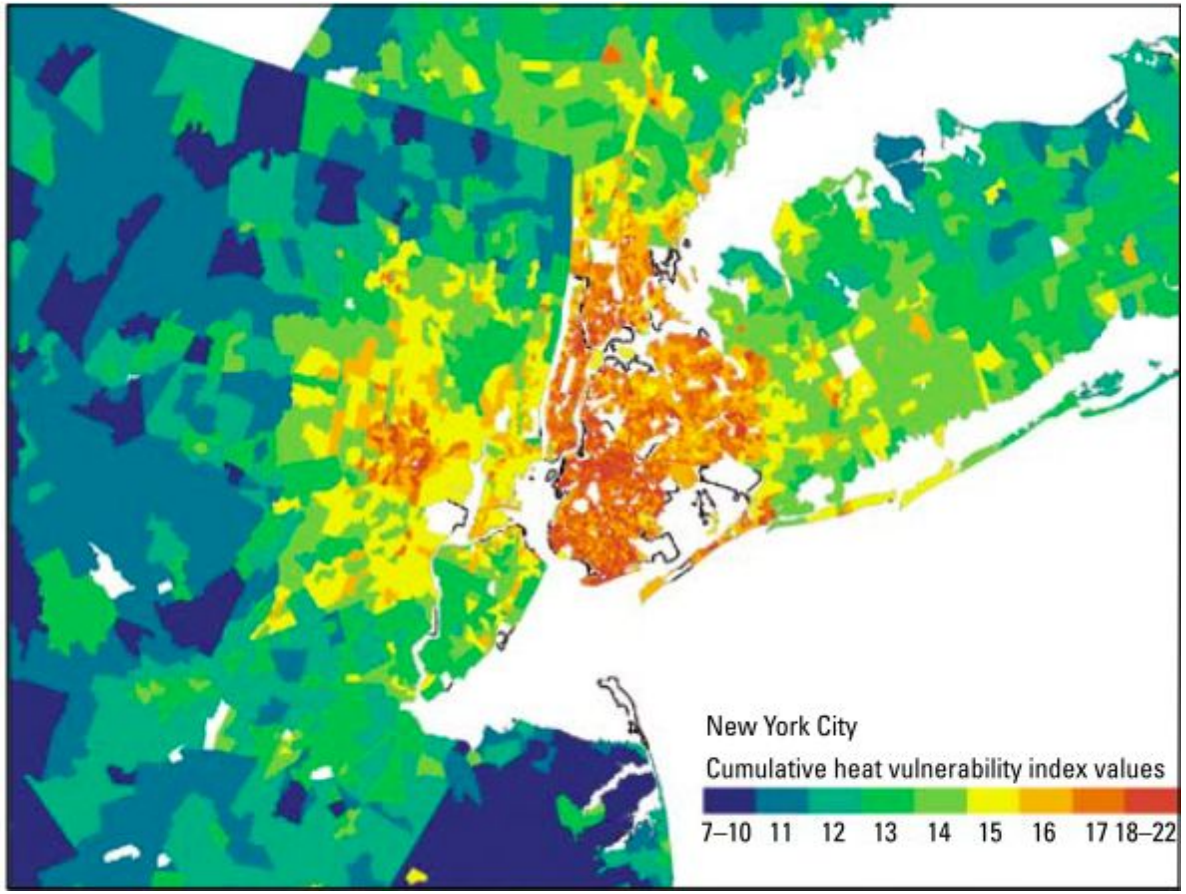


Weinberger, et al. 2020

Why Use HVIs?

- Urban heat is exacerbated by the **urban heat island** and varies by microclimate, but can be mitigated via neighborhood-specific interventions[1]
- Interventions should be located in areas where they will be most **effective, efficient, and equitable**
- Heat-related health outcomes and comprehensive, high-resolution air temperature data are difficult to obtain and model
- Practitioners are increasingly using **heat vulnerability indices** (HVI) to identify high-priority areas for intervention[2]

[1] Stone et al., 2014; [2] Bao et al., 2015,



Reid et al., 2009

CDC'S Health Equity Guiding Principles for Inclusive Communication

CDC's Health Equity Guiding Principles for Inclusive Communication are intended to help public health profession ensure their communication work, including communication of public health science, meets the specific needs and priorities of the populations they serve and addresses all people inclusively, accurately, and respectfully. These princip are designed to adapt and change as both language and cultural norms change.

Why do words matter for health equity?

Language in communication products should reflect and speak to the needs of people in the audience of focus, using non-stigmatizing language. This means:

- Using a health equity lens when framing information about health disparities
- Using person-first language and avoiding unintentional blaming
- Using preferred terms for select population groups while recognizing that there isn't always agreement on these terr
- Considering how communications are developed and looking for ways to develop more inclusive health communications products
- Exploring other resources and references related to health equity communications.

How can I help?

CDC encourages all public health professionals at the federal, state, and local levels to look for opportunities to apply these ***Guiding Principles*** across their public health communication work, including when creating information resourc such as scientific publications and public health recommendations, and when engaging with communities, partners, and staff.

Learn more: https://www.cdc.gov/healthcommunication/Health_Equity.html.

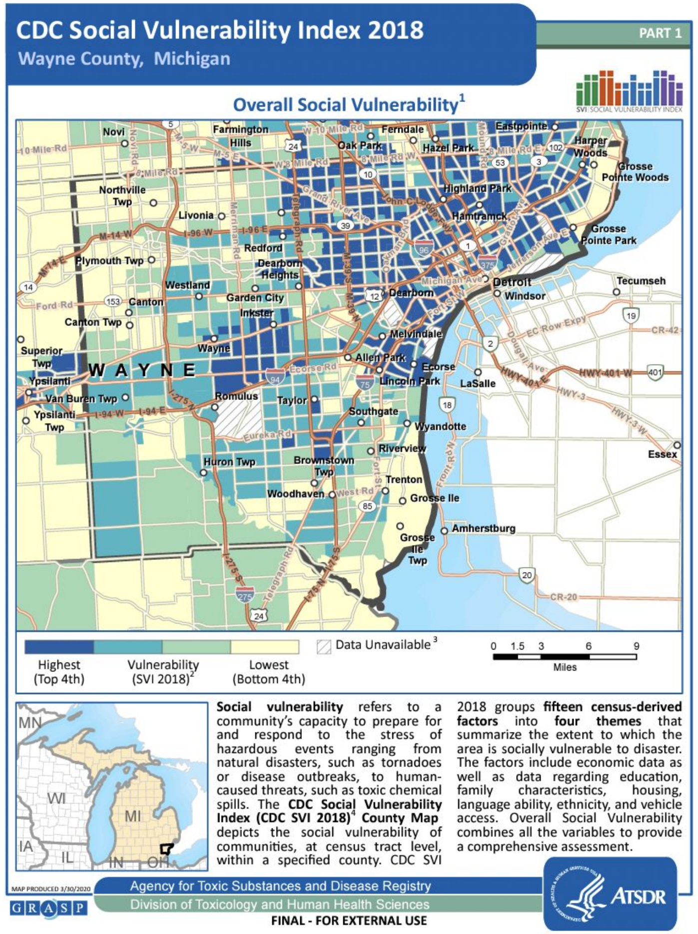
U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

CS 328419-A December 07,

What is Meant by "Vulnerability"?

- Colloquially describes being at-risk to some hazard
  - Seen as dehumanizing
- Modern use of *vulnerability* should consider health equity framing
  - Social determinants of health that contribute to unequal risks
  - Systemic social and health inequities
- Layered inequities
- Rather, use: "people/communities who experience vulnerability"
- For this training we will use vulnerability terminology, but ...
  - Think about this retrospective vs prospective terminology
  - Critical to remember that people ***experience*** vulnerability, rather than embody it

Social Vulnerability Index (SVI)



CDC Social Vulnerability Index 2018
Wayne County, Michigan

PART 1

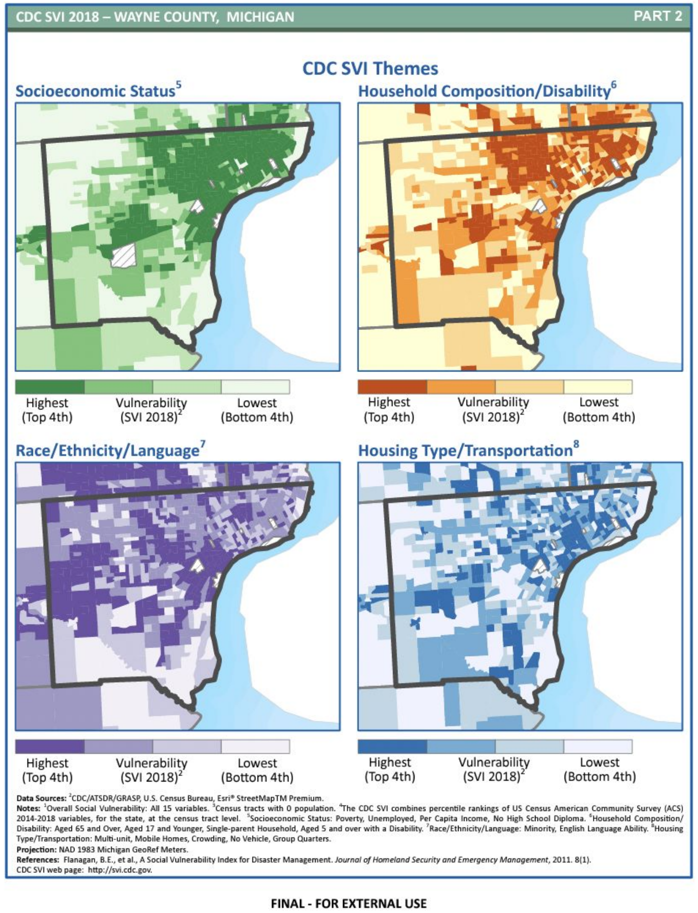
Overall Social Vulnerability[1]

Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters, such as tornadoes or disease outbreaks, to human-caused threats, such as toxic chemical spills. The **CDC Social Vulnerability Index (CDC SVI 2018)[4] County Map** depicts the social vulnerability of communities, at census tract level, within a specified county. CDC SVI 2018 groups **fifteen census-derived factors** into **four themes** that summarize the extent to which the area is socially vulnerable to disaster. The factors include economic data as well as data regarding education, family characteristics, housing, language ability, ethnicity, and vehicle access. Overall Social Vulnerability combines all the variables to provide a comprehensive assessment.

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences

ATSDR

FINAL - FOR EXTERNAL USE



CDC SVI 2018 – WAYNE COUNTY, MICHIGAN

PART 2

CDC SVI Themes

Data Sources: [2]CDC/ATSDR/GRASP, U.S. Census Bureau, Esri® StreetMapTM Premium.

Notes: [1]Overall Social Vulnerability: All 15 variables. [3]Census tracts with 0 population. [4]The CDC SVI combines percentile rankings of US Census American Community Survey (ACS) 2014-2018 variables, for the state, at the census tract level. [5]Socioeconomic Status: Poverty, Unemployed, Per Capita Income, No High School Diploma. [6]Household Composition/Disability: Aged 65 and Over, Aged 17 and Younger, Single-parent Household, Aged 5 and over with a Disability. [7]Race/Ethnicity/Language: Minority, English Language Ability. [8]Housing Type/Transportation: Multi-unit, Mobile Homes, Crowding, No Vehicle, Group Quarters.

Projection: NAD 1983 Michigan GeoRef Meters.

References: Flanagan, B.E., et al., A Social Vulnerability Index for Disaster Management. *Journal of Homeland Security and Emergency Management*, 2011. 8(1).

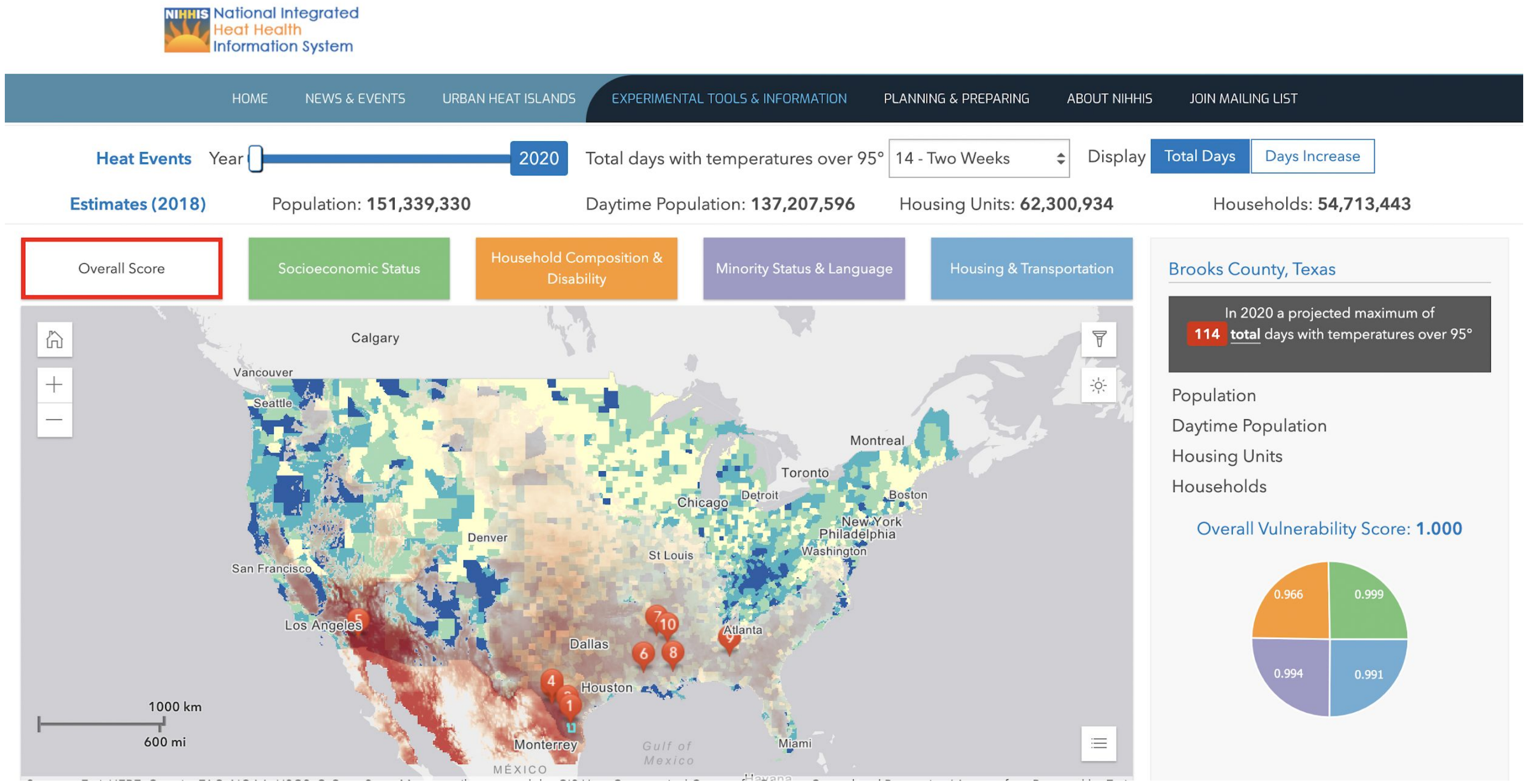
CDC SVI web page: http://svi.cdc.gov.

FINAL - FOR EXTERNAL USE

- Unitless characterization of social factors that contribute to a communities' capability to respond to hazards
- Socioeconomic, Household Composition and Disability, Race/Ethnicity/Language, and Housing & Transportation
- Singular value to indicate RELATIVE experience/condition or area in greater need of intervention or response
- HVI is a sub-type of the SVI

https://svi.cdc.gov/Documents/CountyMaps/2016/Michigan/Michigan2016_Wayne.pdf

Decision Support Tools: Vulnerability Mapping



Heat Events Year 2020 Total days with temperatures over 95° 14 - Two Weeks Display **Total Days** Days Increase

Estimates (2018) Population: **151,339,330** Daytime Population: **137,207,596** Housing Units: **62,300,934** Households: **54,713,443**

Brooks County, Texas

In 2020 a projected maximum of **114** **total** days with temperatures over 95°

Population
Daytime Population
Housing Units
Households

Overall Vulnerability Score: **1.000**

https://nihhis.cpo.noaa.gov/vulnerability-mapping

Understand spatial distribution of heat-related vulnerabilities to identify areas for risk reduction

There is no one method for mapping vulnerability

Gamble et al. (2018)

Defining Vulnerability

Exposure

Sensitivity

Adaptive Capacity

Vulnerability

Exposure

Exposure

Exposure refers to the intensity of the heat risk, or how hot it gets in a particular location. Heat exposure is often driven by the urban heat island and is measured directly or by proxy through UHI drivers.

[1] Oke, 1987; [2] Bao et al., 2015

Exposure

Exposure

Hot/heatwave days
Consecutive hot days
Min/Mean/Max temp.
Land surface temp.
Impervious surfaces
Vegetation
Urban density
Land cover
Land use
Homes w/o AC
Population density

Exposure

Exposure

Hot/heatwave days
Consecutive hot days
Min/Mean/Max temp.
Land surface temp.
Impervious surfaces
Vegetation
Urban density
Land cover
Land use
Homes w/o AC
Population density

Direct Measures

Exposure

Exposure

Hot/heatwave days
Consecutive hot days
Min/Mean/Max temp.
Land surface temp.
Impervious surfaces
Vegetation
Urban density
Land cover
Land use
Homes w/o AC
Population density

→ Indirect or Proxy Measures

Sensitivity

Sensitivity

Sensitivity refers to the level to which an individual may be impacted by heat exposure given pre-existing physiological conditions that may help or hinder these impacts. Often these conditions involve difficulty regulating body temperature, salt and water balance, or other internal stressors that increase heat risk.

[1] Bouchama & Knochel, 2002; [2]Reid et al., 2009; [3]Robinson, 2001

Sensitivity

Sensitivity

Older adults
Infants, young age
Sex
Diabetes
Cardiopulmonary
Renal
Respiratory
Obesity

Adaptive Capacity

Adaptive Capacity

Adaptive Capacity refers to the abilities or resources available to an individual or group to help them cope with exposure to high temperatures. These are often socioeconomic factors, such as the ability to afford and operate air conditioning to reduce personal exposure.

[1] Cutter et al., 2008; [2]Kuras et al., 2015; [3]Sheridan et al., 2007

Adaptive Capacity

Adaptive Capacity

Air conditioning access
Living alone
Income / wealth
Rental / homeowner
Unhoused
Education
Ethnicity
Language
Foreign-born
Cognitive impairment
Mobility /Transportation

Defining Vulnerability

Exposure

- Hot/heatwave days
- Consecutive hot days
- Min/Mean/Max temp.
- Land surface temp.
- Impervious surfaces
- Vegetation
- Urban density
- Land cover
- Land use
- Homes w/o AC
- Population density

Sensitivity

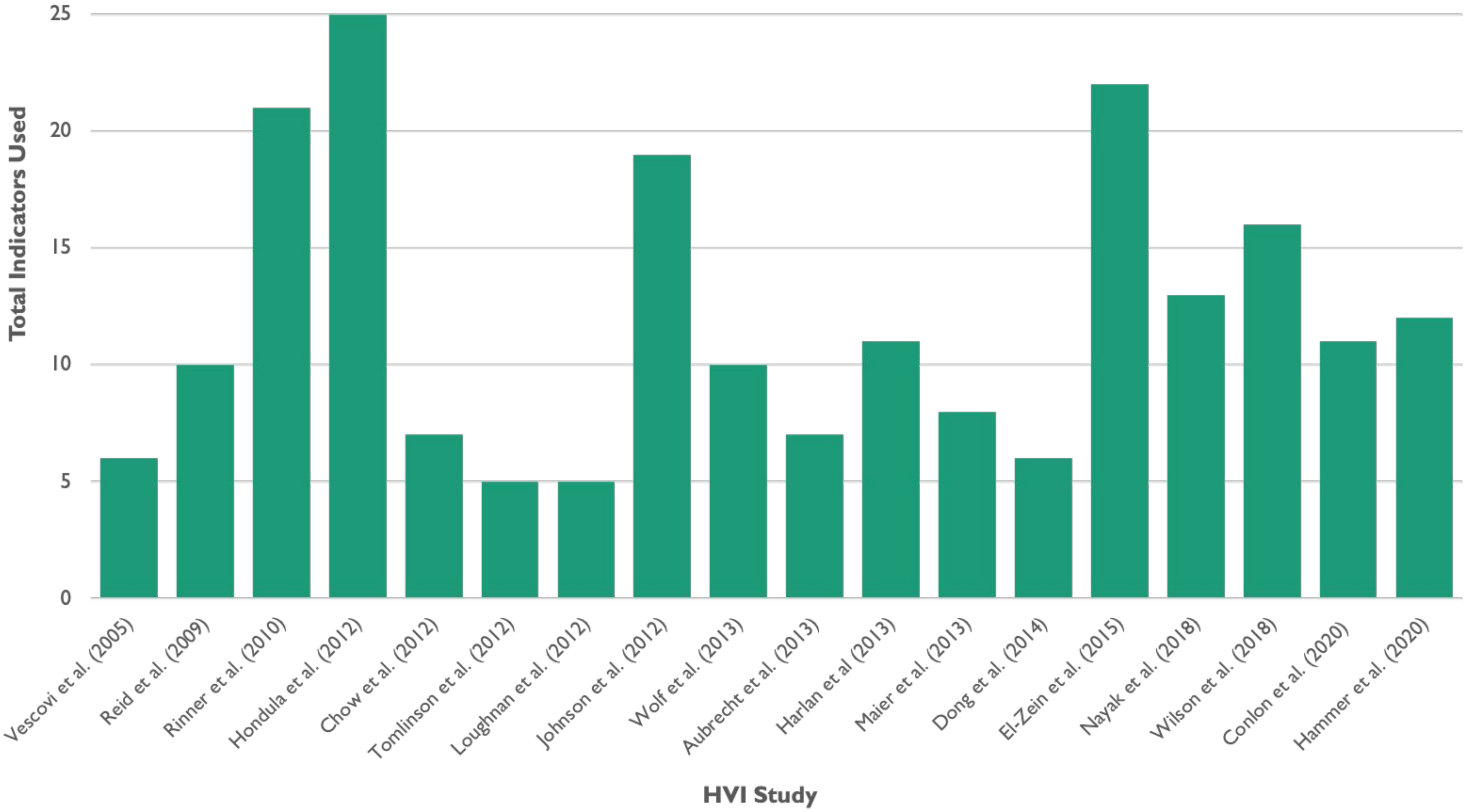
- Older adults
- Infants, young age
- Sex
- Diabetes
- Cardiopulmonary
- Renal
- Respiratory
- Obesity

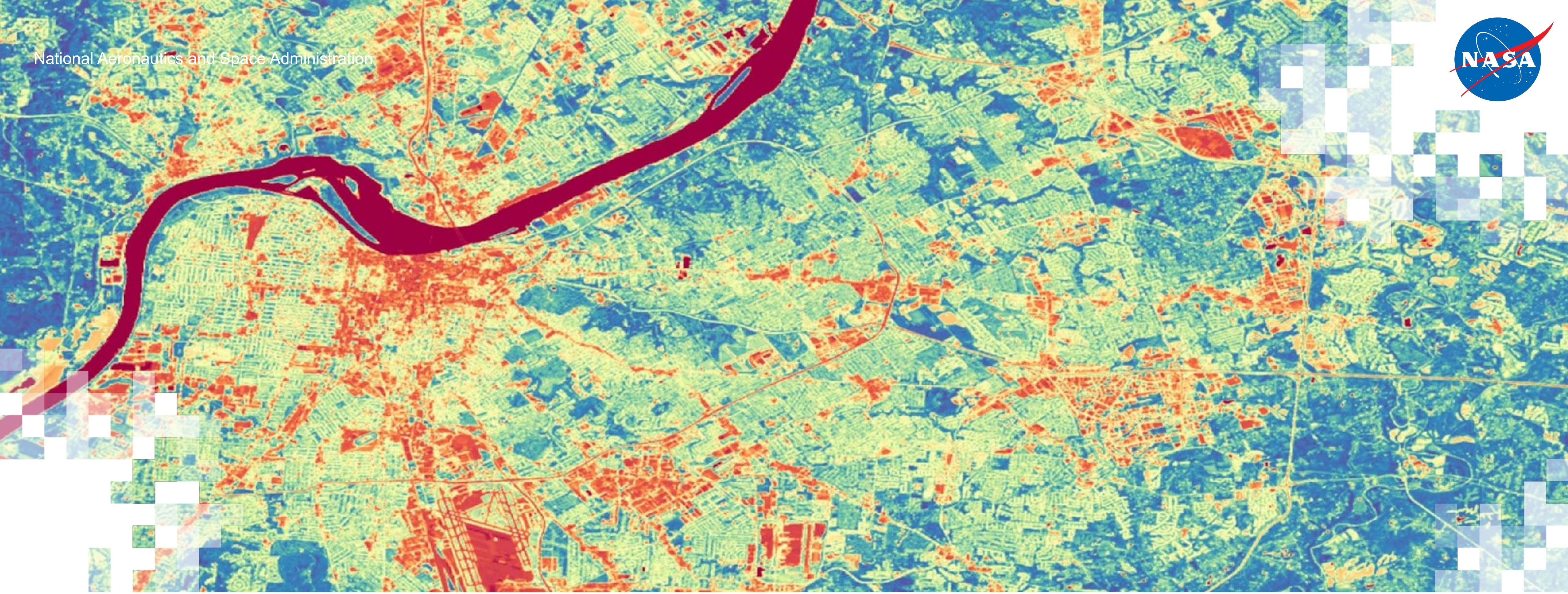
Adaptive Capacity

- Air conditioning access
- Living alone
- Income / wealth
- Rental / homeowner
- Unhoused
- Education
- Ethnicity
- Language
- Foreign-born
- Cognitive impairment
- Mobility / Transportation

Vulnerability

Heat Vulnerability Indicators

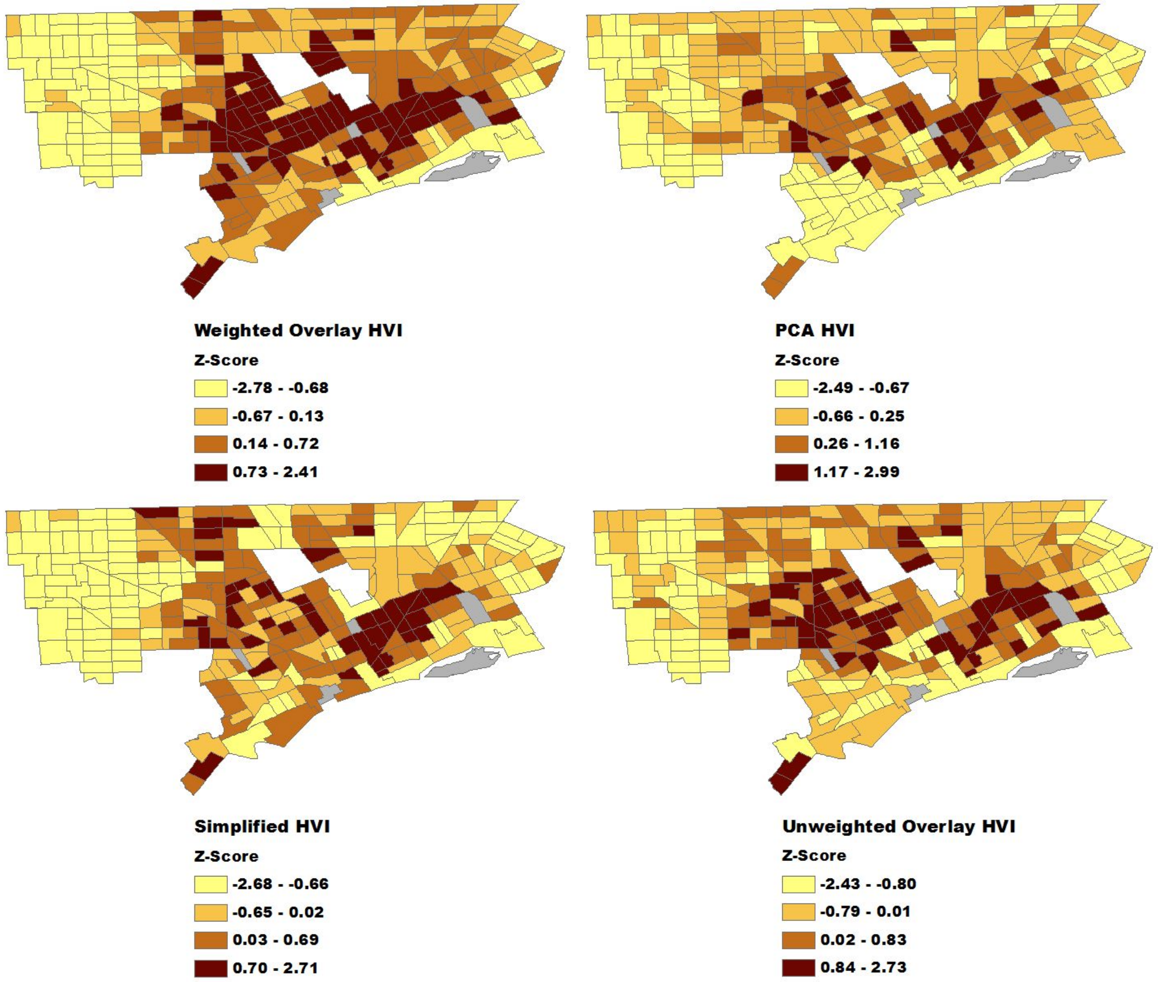




Constructing Heat Vulnerability Indices

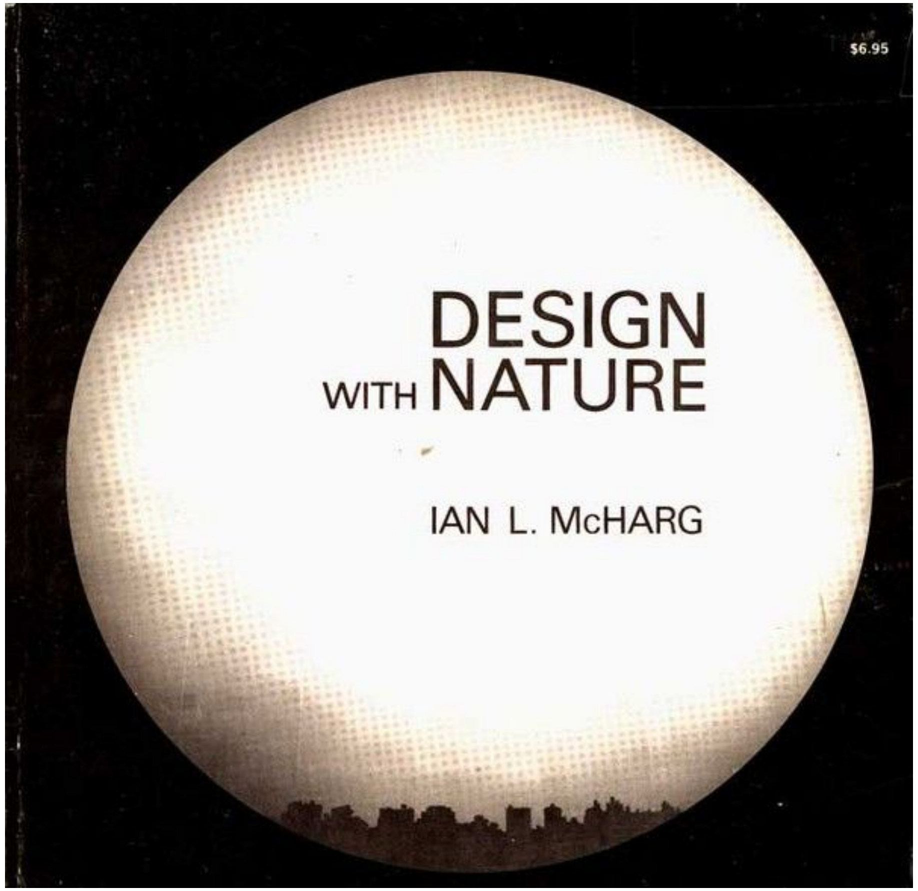
HVI Construction Methods

- Origins in the "Ecological Method"
- Common construction techniques
- HVI sensitivities

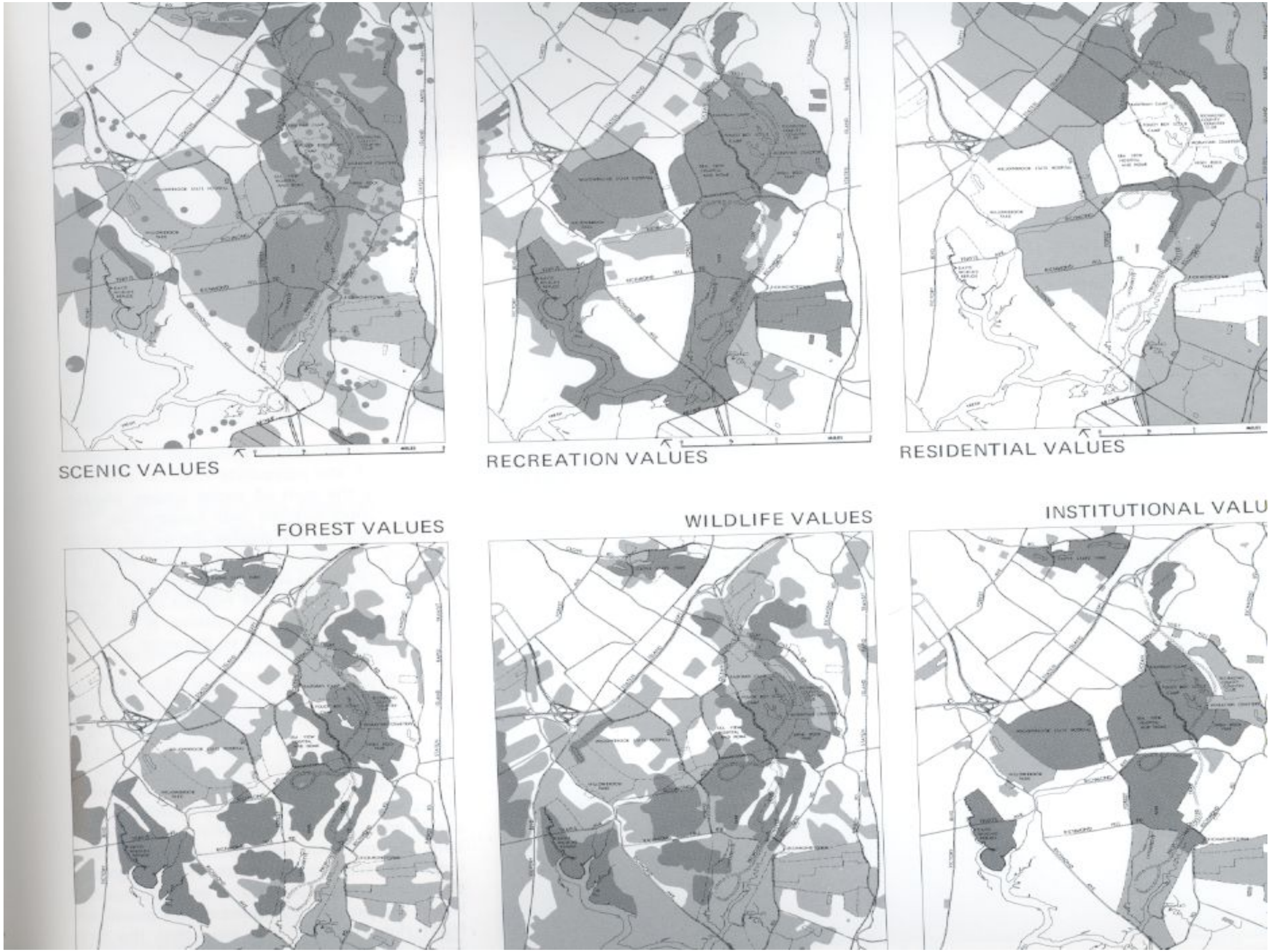


Mallen, 2019b

McHarg's "Ecological Method"

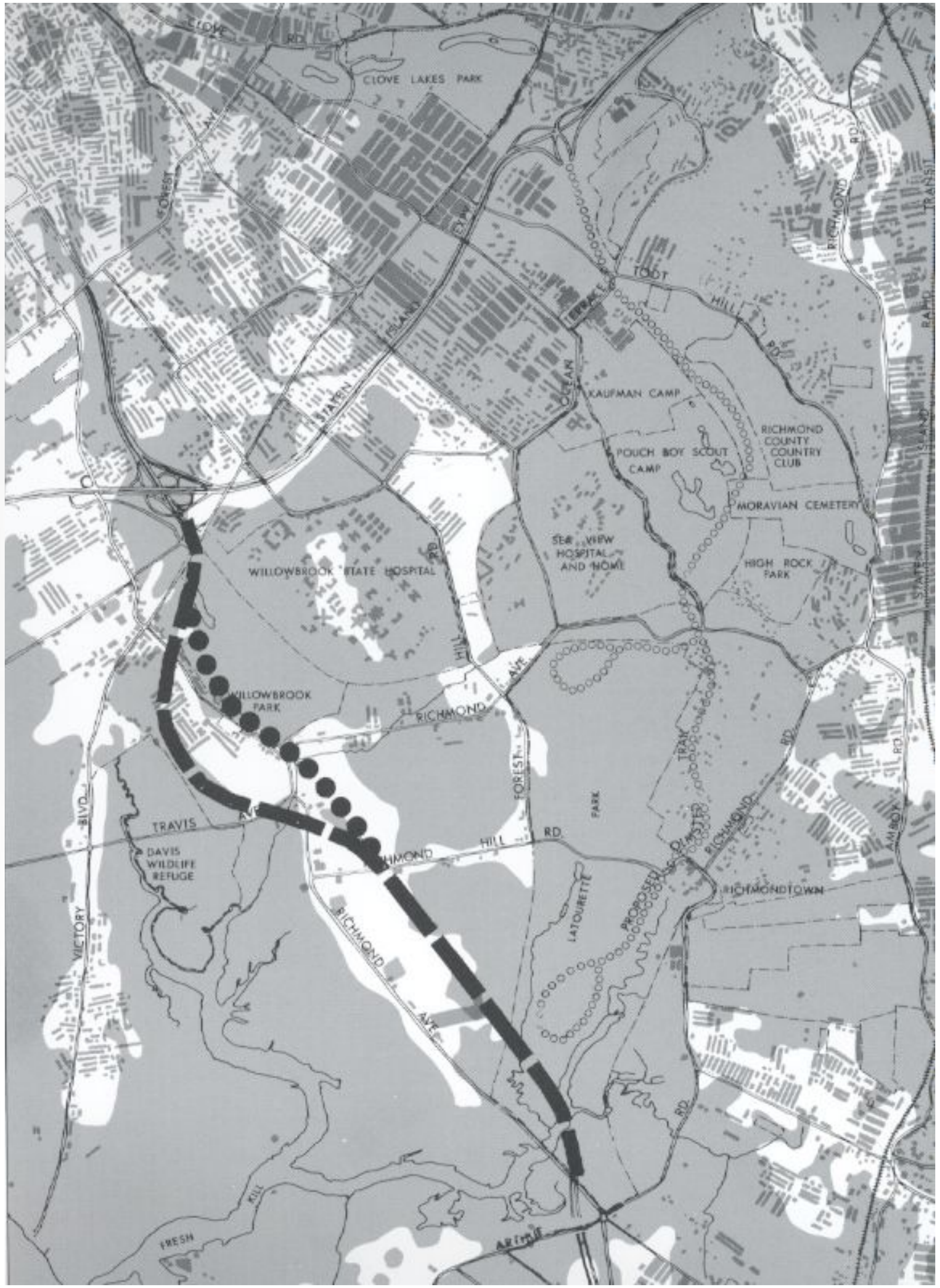


1. Select site for land use project
2. Identify range of known impacts, both market and non-market
3. Create a separate layer for each impact, identifying areas of high, medium, and low value
4. Overlay the various layers to identify zones of minimum total social impacts


SCENIC VALUES
RECREATION VALUES
RESIDENTIAL VALUES
FOREST VALUES
WILDLIFE VALUES
INSTITUTIONAL VALU

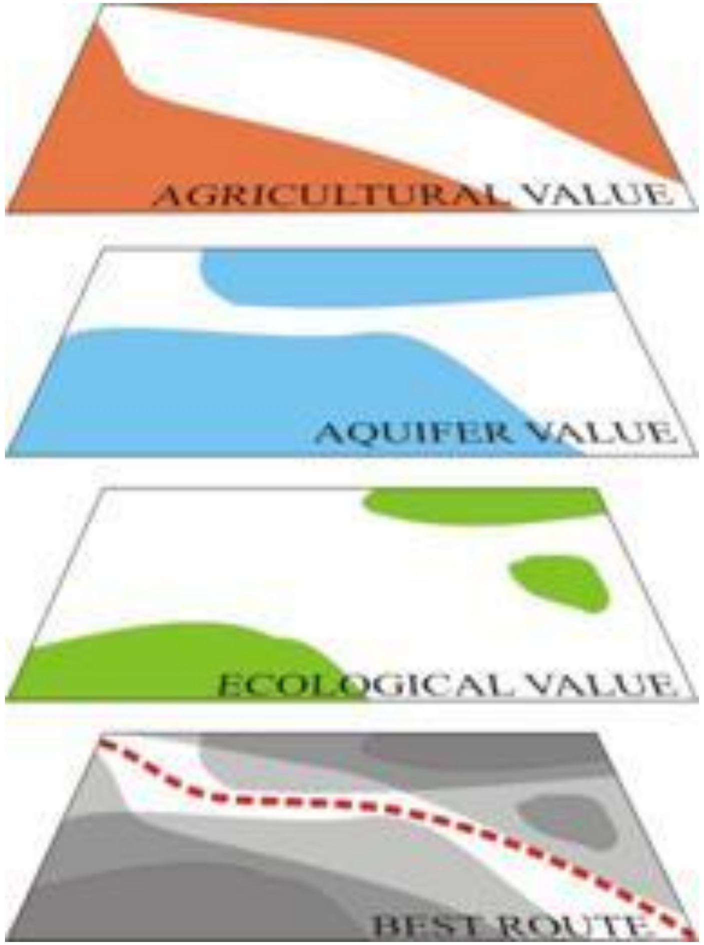
McHarg (1969)

EVALUATION OF ALIGNMENTS



McHarg (1969)

McHarg's "Ecological Method"



Randolph, 2012

Until GIS came into use for many of the combination procedures, this hand drawn overlay technique was the most used land suitability method. It has two inherent problems, however.

First, it adds together factors influencing land suitability, assuming they are of equal importance, when in fact one may be more important to a particular use than another.

Second, this method assumes that individual factors are completely independent.

Independent Factors?

Exposure

Hot/heatwave days
Consecutive hot days
Min/Mean/Max temp.
Land surface temp.
Impervious surfaces
Vegetation
Urban density
Land cover
Land use
Homes w/o AC
Population density

Sensitivity

Older adults
Infants, young age
Sex
Diabetes
Cardiopulmonary
Renal
Respiratory
Obesity

Adaptive Capacity

Air conditioning access
Living alone
Income / wealth
Rental / homeowner
Unhoused
Education
Ethnicity
Language
Foreign-born
Cognitive impairment
Mobility / Transportation

Vulnerability

HVI Construction Methods

- Normalization and aggregation
  - Normalize individual indicators, e.g. proportions 0 to 1
  - Aggregated with increasing vulnerability to generate score
- Equal weight
  - HVI indicators left unweighted, assumed equal contributions to vulnerability
- Weighted
  - Weight HVI indicators differently based on expert judgment or "bottom-up" approach
- Principal Components Analysis
  - Dimension reduction technique to reduce potential for autocorrelation
  - Produces statistically independent factors associated with vulnerability components

Range of Z-Score	HVI Component Score
-2 or lower	1
-2 to -1	2
-1 to 0	3
0 to 1	4
1 to 2	5
2 or higher	6

Reid et al. (2009)

Considerations in Weighting

Vulnerability

=

Exposure

- Land Surface Temperature

+

Sensitivity

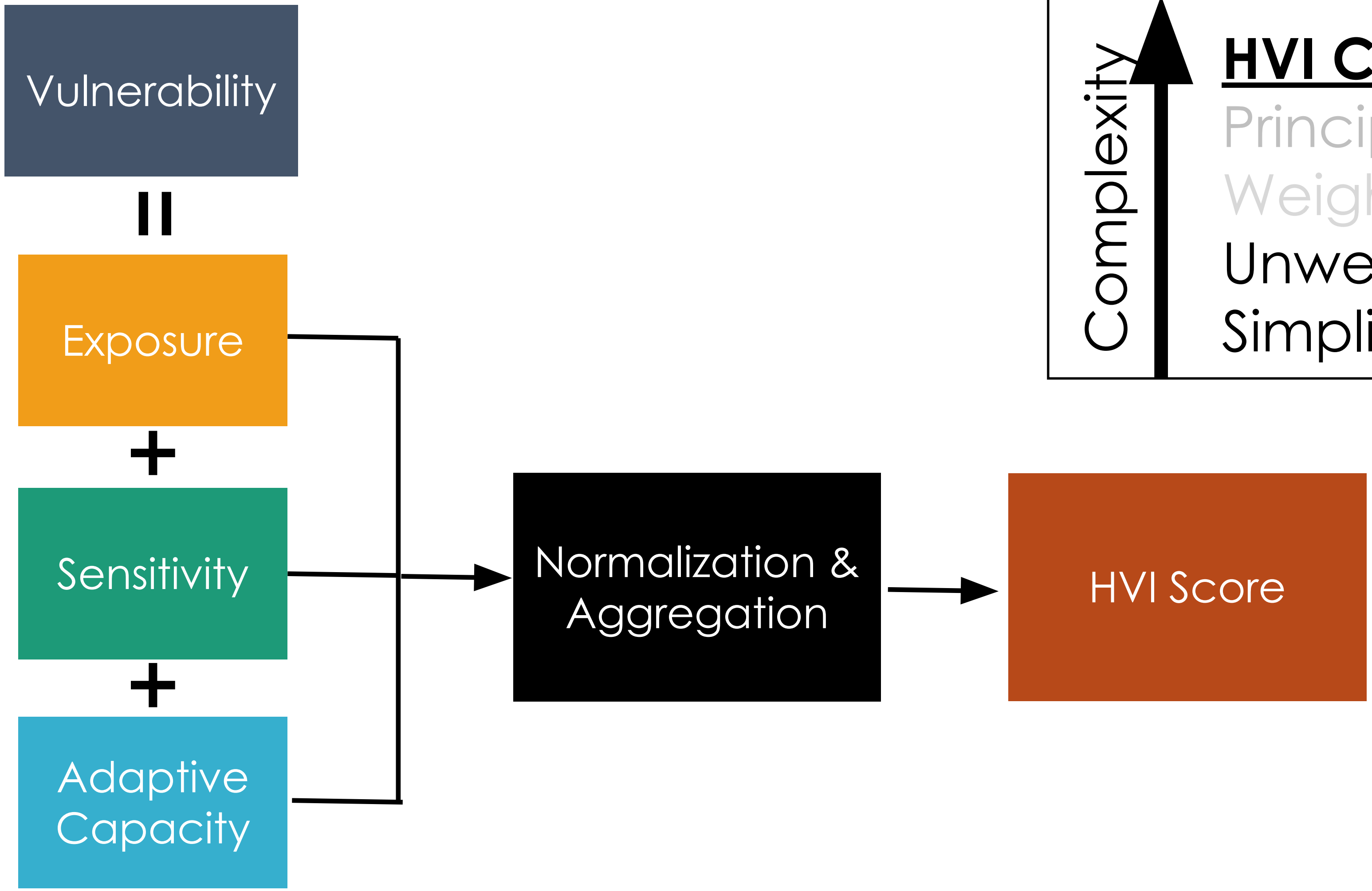
- Diabetes Prevalence
- Nonwhite
- Over Age 65
- Living Alone
- Over 65 & Living Alone

+

Adaptive Capacity

- Living Below Poverty Line
- Less than High School Education
- No Air Conditioning Access
- No Central Air Conditioning Access

HVI Construction



Vulnerability

=

Exposure

+

Sensitivity

+

Adaptive Capacity

Normalization & Aggregation

HVI Score

Complexity

HVI Construction Method

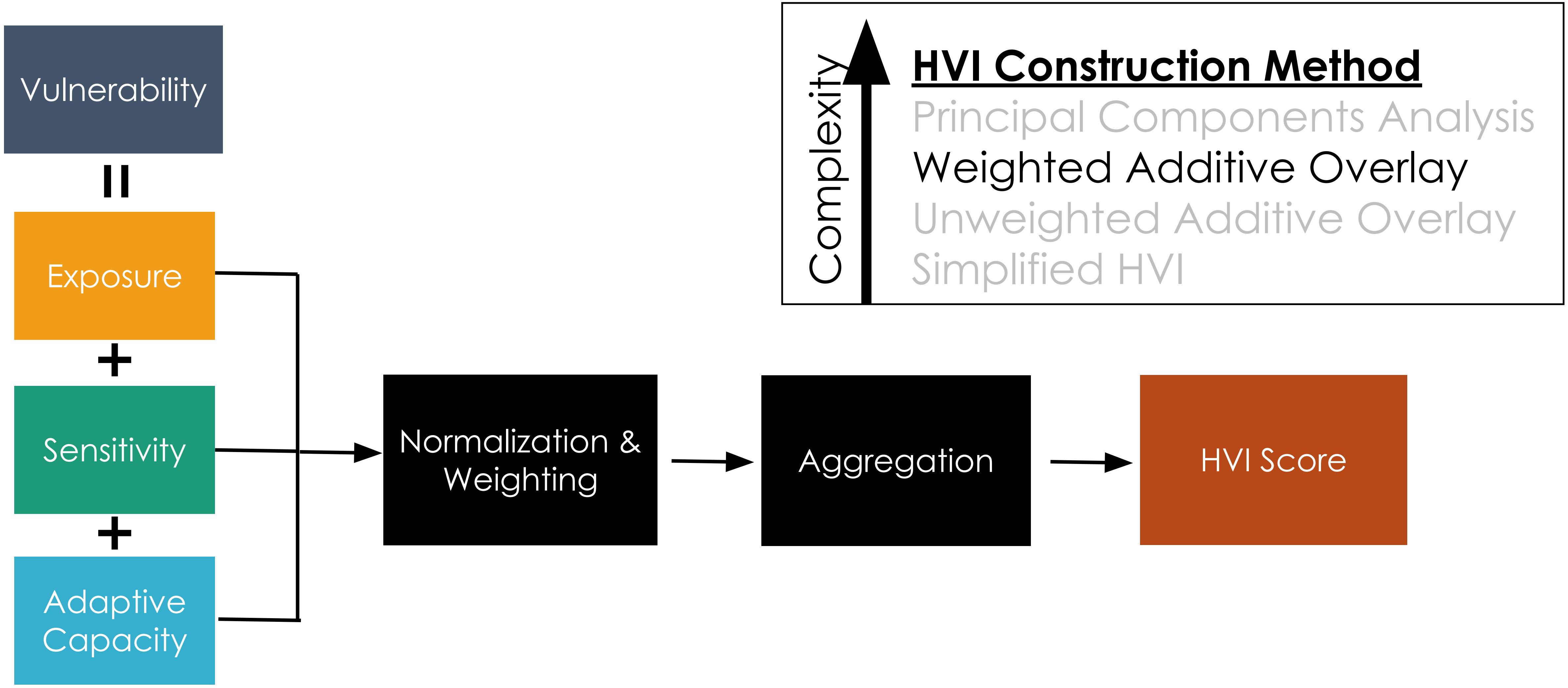
Principal Components Analysis

Weighted Additive Overlay

Unweighted Additive Overlay

Simplified HVI

HVI Construction



Vulnerability

=

Exposure

+

Sensitivity

+

Adaptive Capacity

Normalization & Weighting

Aggregation

HVI Score

Complexity

HVI Construction Method

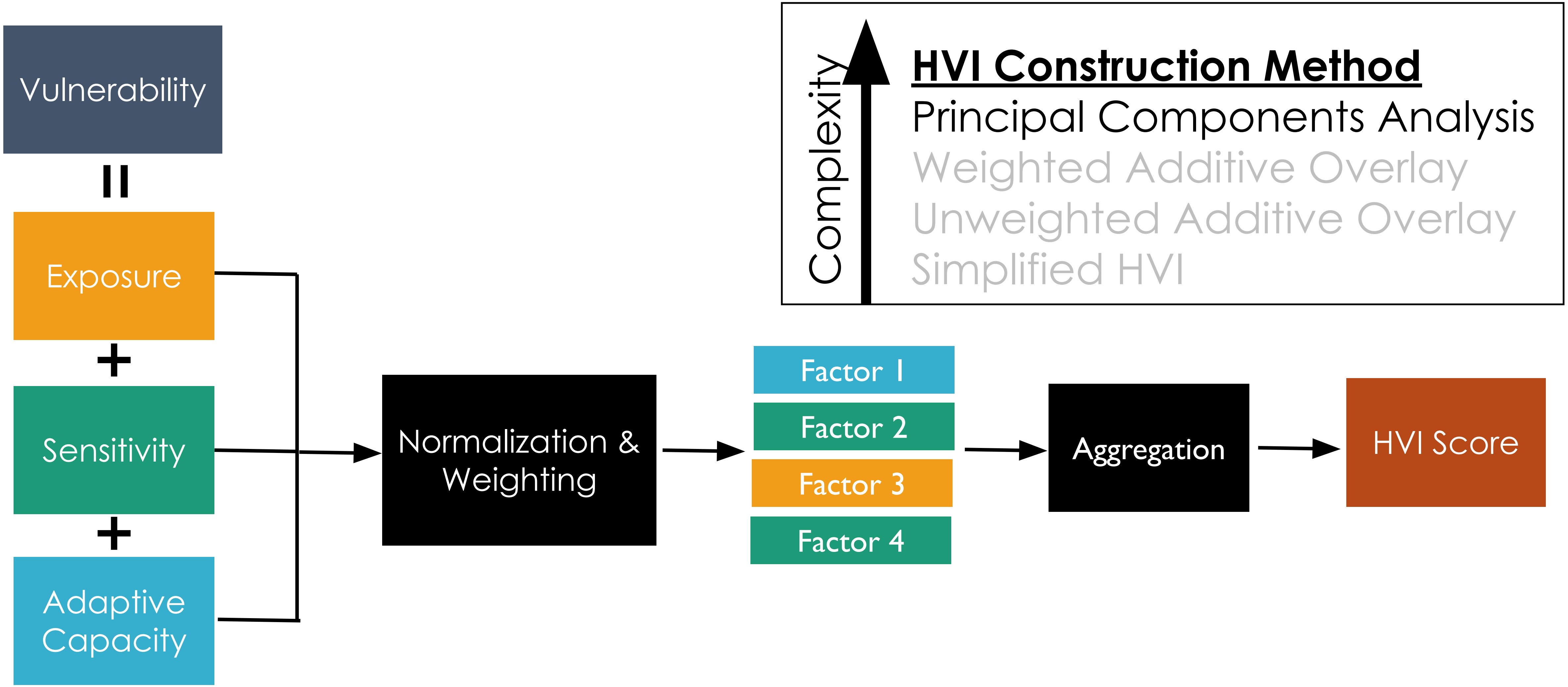
Principal Components Analysis

Weighted Additive Overlay

Unweighted Additive Overlay

Simplified HVI

HVI Construction



Vulnerability

=

Exposure

+

Sensitivity

+

Adaptive Capacity

Normalization & Weighting

Factor 1

Factor 2

Factor 3

Factor 4

Aggregation

HVI Score

Complexity

HVI Construction Method

Principal Components Analysis

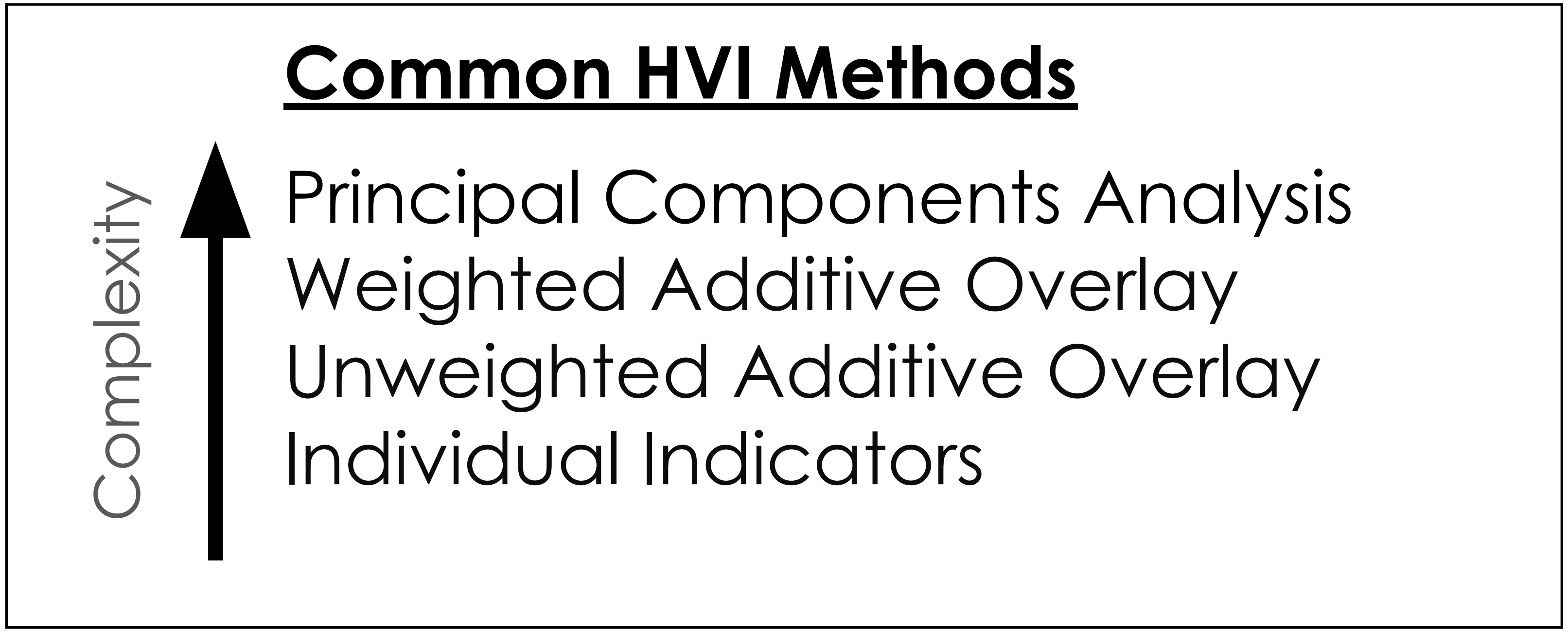
Weighted Additive Overlay

Unweighted Additive Overlay

Simplified HVI

HVI Construction

Important! Input variables:
- Unidirectional
- Confer vulnerability



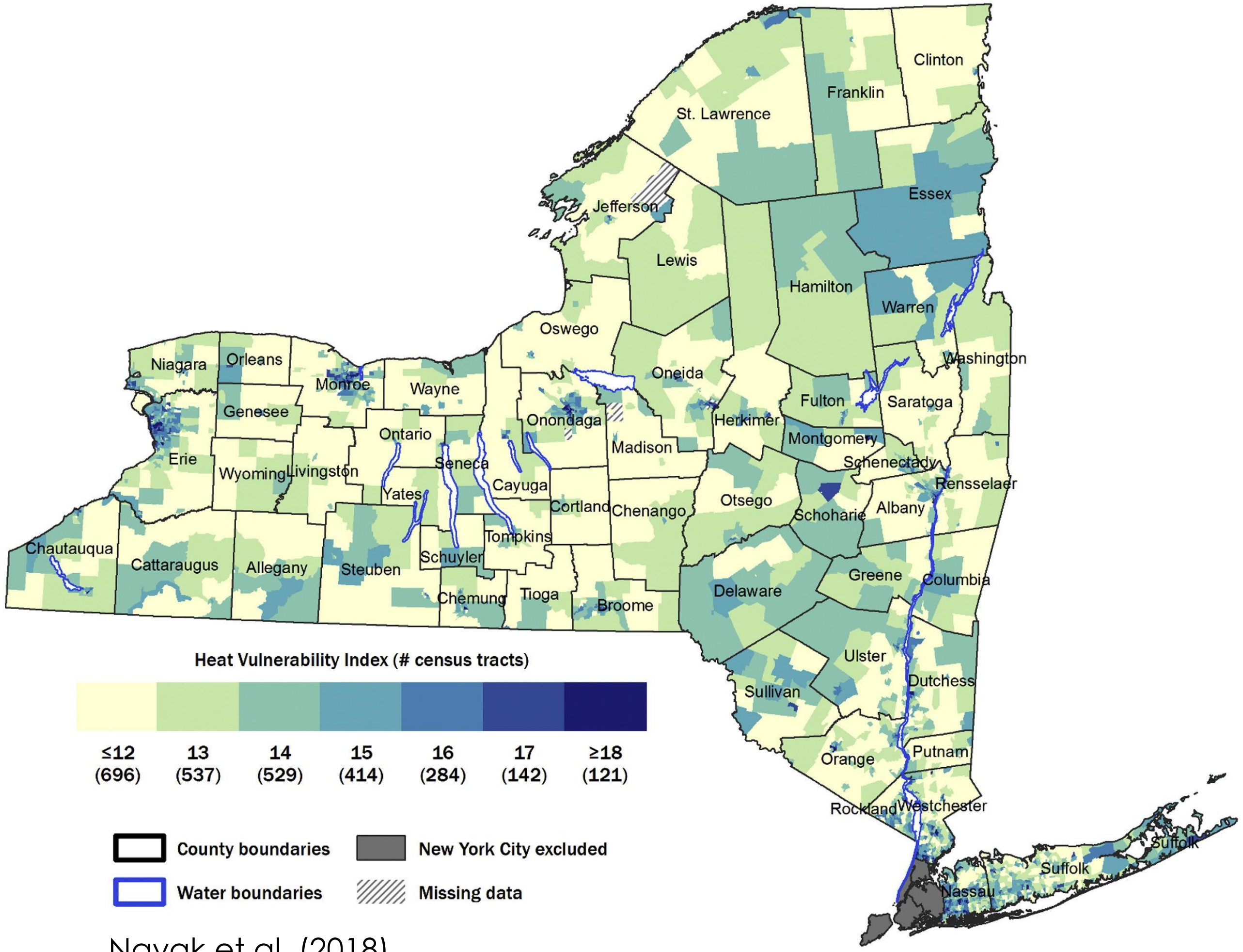
Common HVI Methods

Complexity

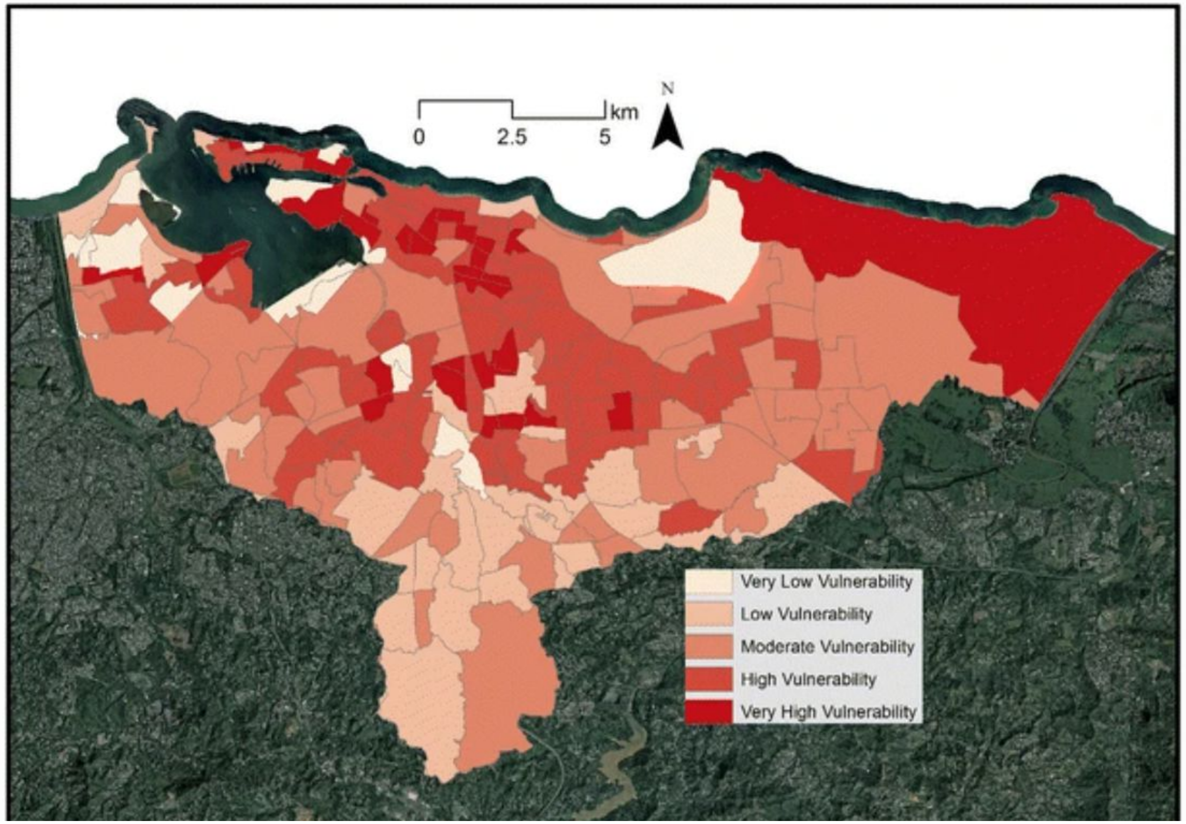
Principal Components Analysis
Weighted Additive Overlay
Unweighted Additive Overlay
Individual Indicators

Remember: An increase in your indicators should lead to an increase in vulnerability

HVIs Show Relative Priority at Any Scale



Nayak et al. (2018)



Méndez-Lázaro et al. (2018)

HVI Sensitivity

HVIs are sensitive to:

- Inputs
- Construction Method
- Scale

Pure Detroit

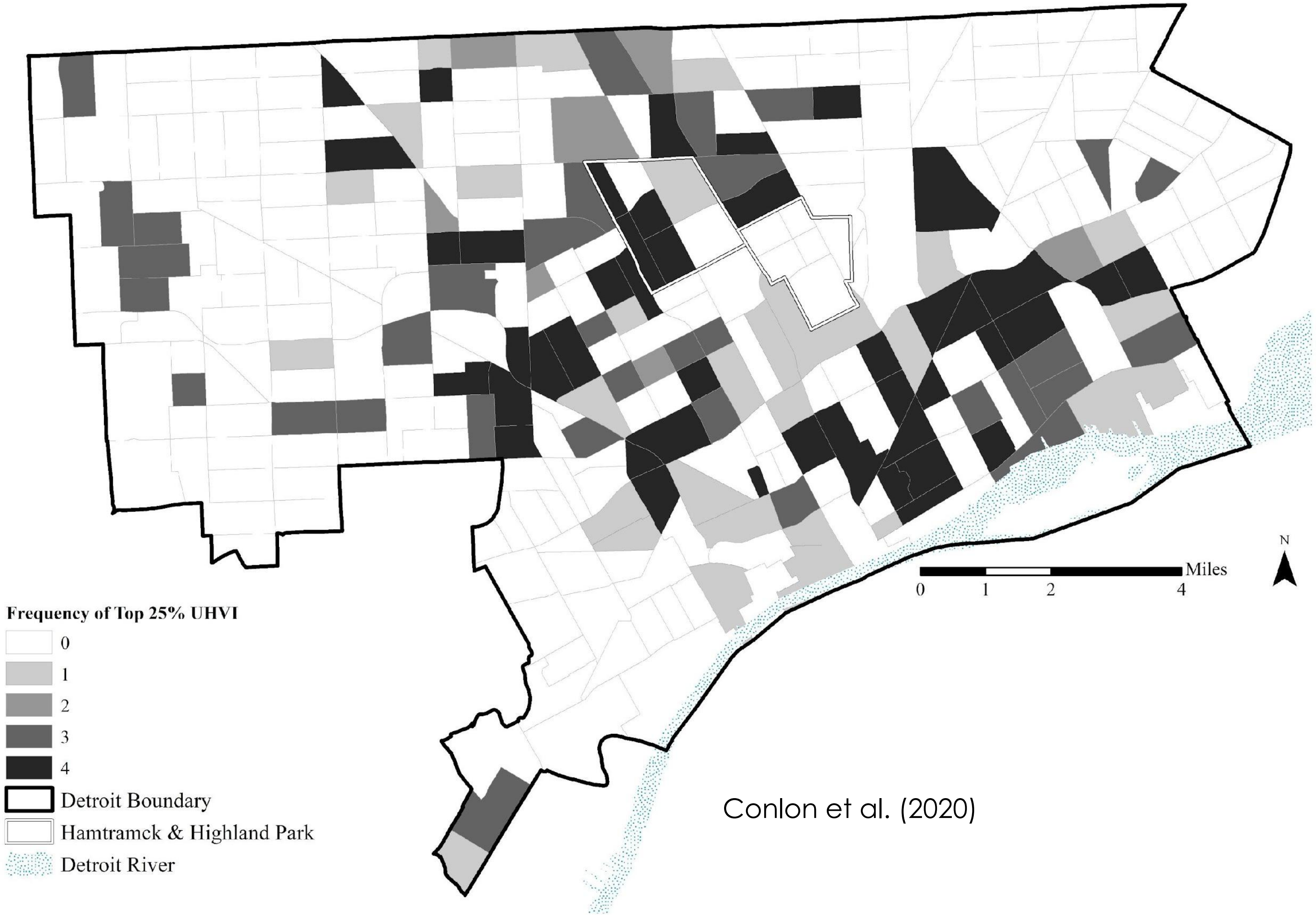
HVI Sensitivity to Inputs

Select your inputs carefully.

Indicator selection will impact your outcomes.

Recommendation:

Use indicators relevant to your selected intervention.



Conlon et al. (2020)

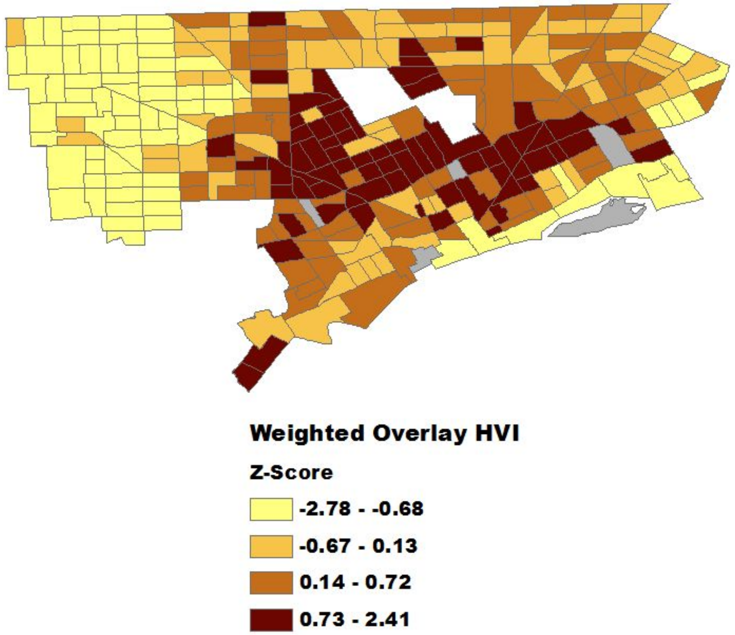
HVI Sensitivity to Construction Method

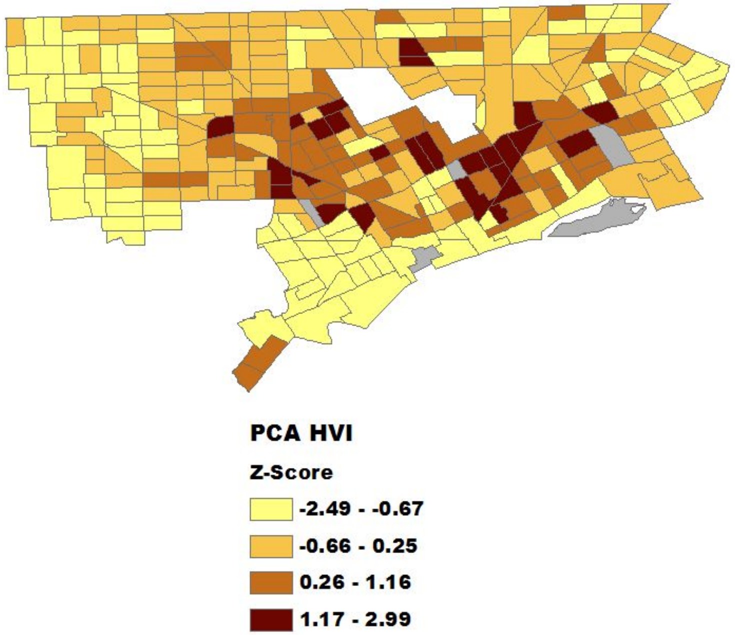
Complexity

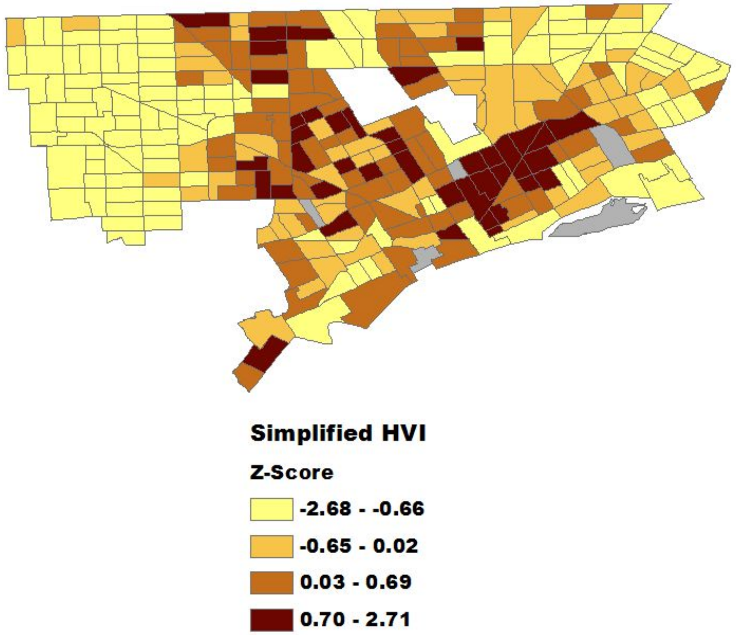
Common HVI Methods

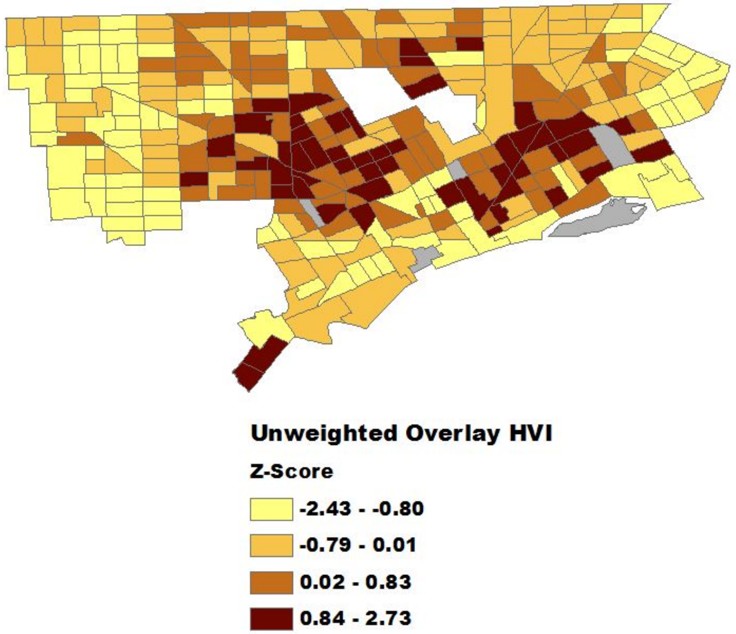
Principal Components Analysis
Weighted Additive Overlay
Unweighted Additive Overlay
Simplified HVI

Even with common indicators, method selection will impact your outcomes.









Mallen, 2019b

HVI Sensitivity to Scale

Conlon et al. (2020)

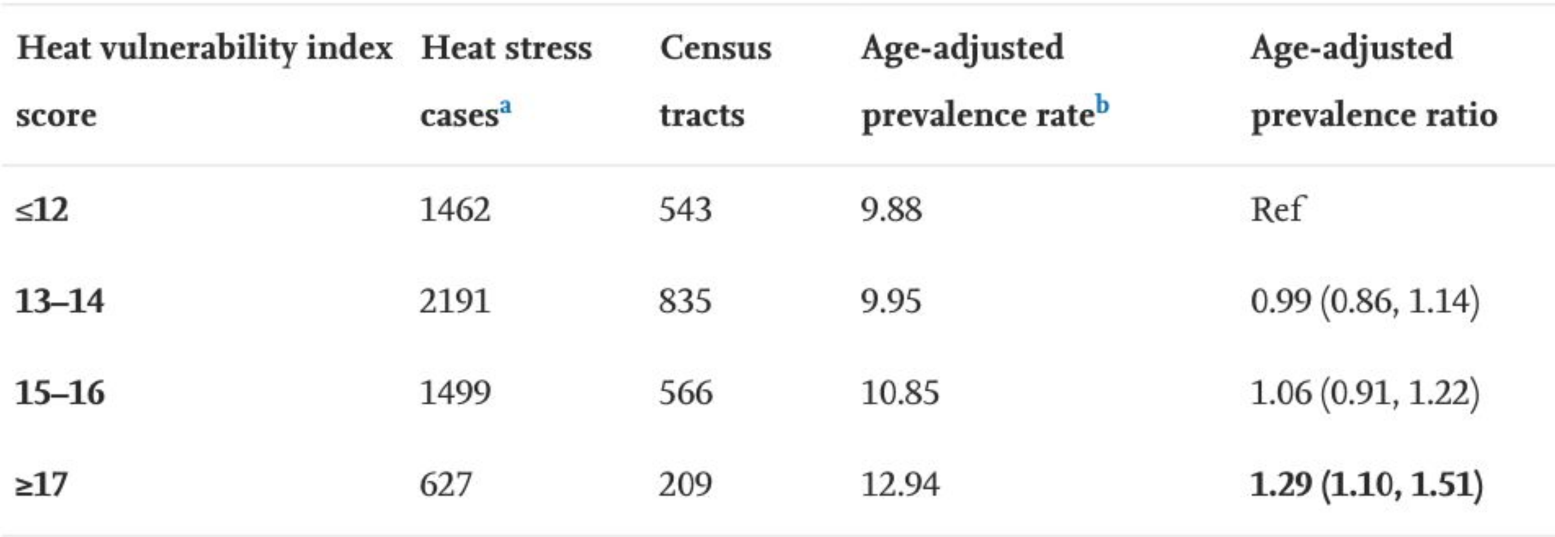
Scale of analysis may substantially impact your results, even with common methods and indicators.

HVI Validation

Research evaluating HVI effectiveness to predict heat mortality is <u>mixed</u>.

Studies have found positive correlation between HVI score and mortality, but this is method-dependent.

Bao et al., 2015; Maier et al., 2014; Wolf et al., 2015

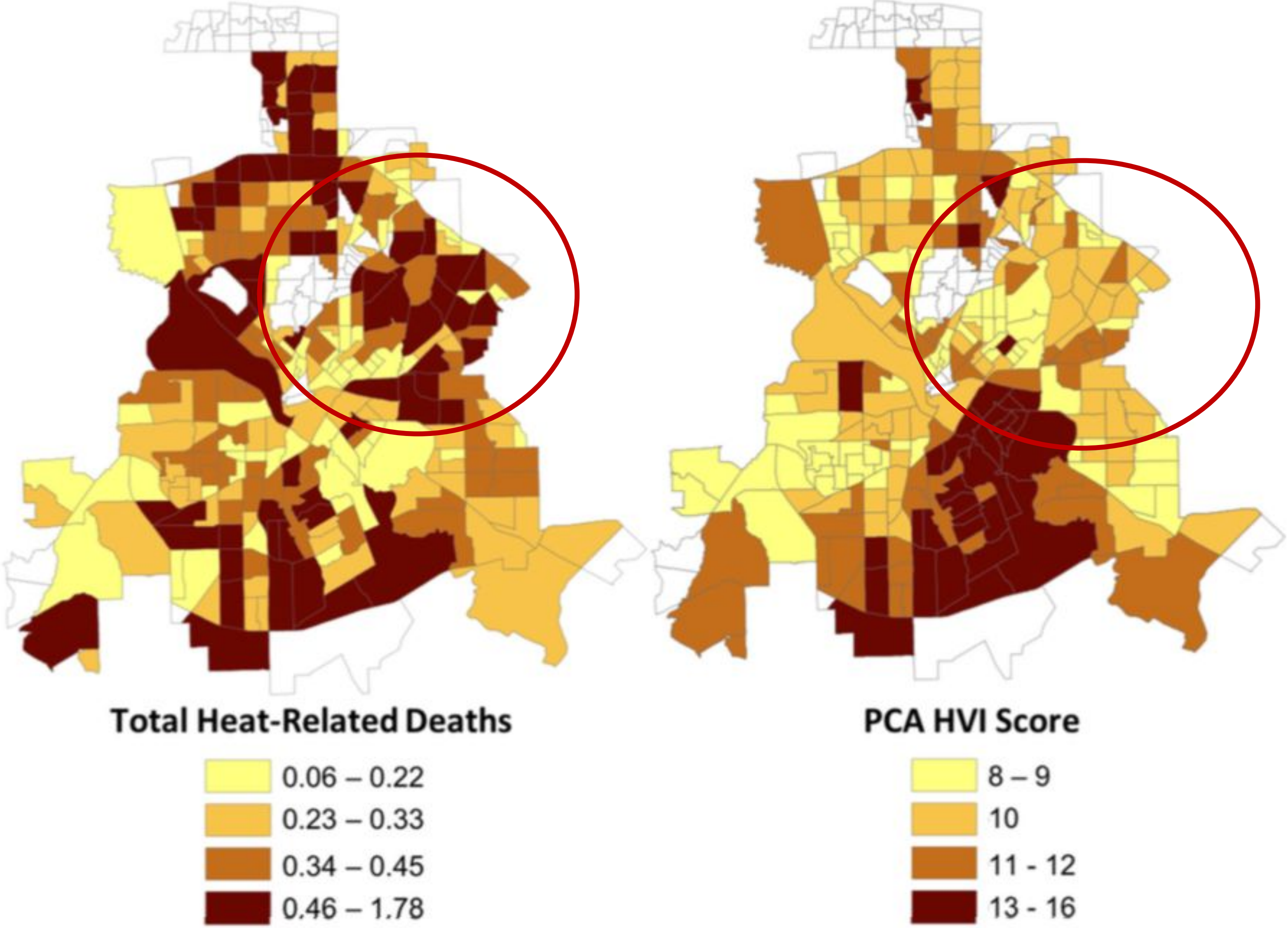


Heat vulnerability index score	Heat stress cases[a]	Census tracts	Age-adjusted prevalence rate[b]	Age-adjusted prevalence ratio
≤12	1462	543	9.88	Ref
13–14	2191	835	9.95	0.99 (0.86, 1.14)
15–16	1499	566	10.85	1.06 (0.91, 1.22)
≥17	627	209	12.94	**1.29 (1.10, 1.51)**

Nayak et al., 2018

Model Comparison: Dallas, TX

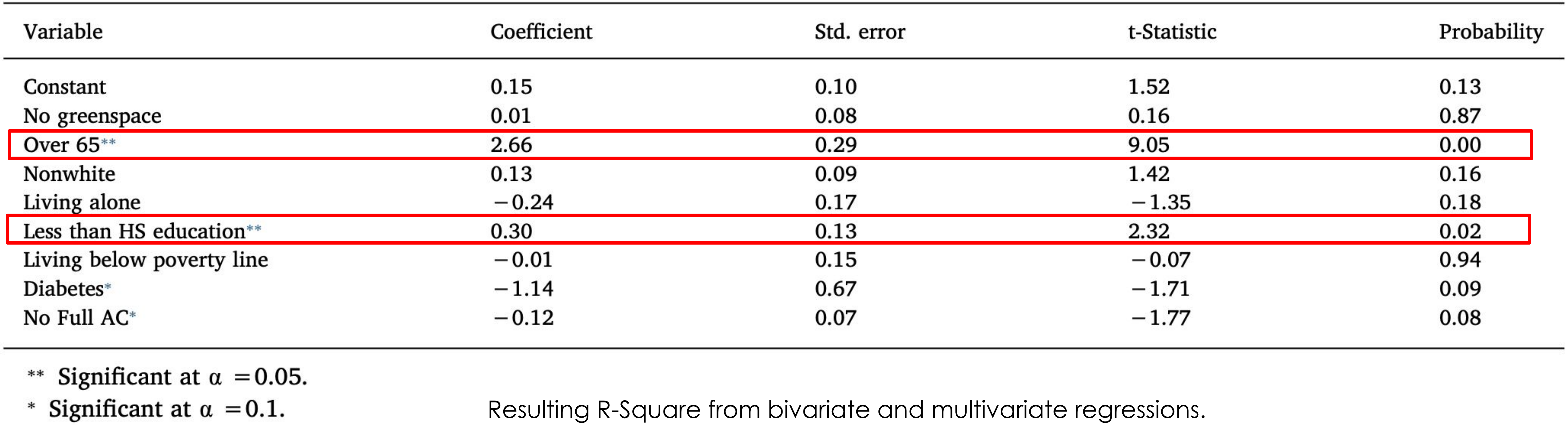
R-Square: 0.04



Mallen et al. (2019a)

Model Comparison: Dallas, TX

Multivariate spatial regression results between total deaths (dependent) and individual HVI indicators.

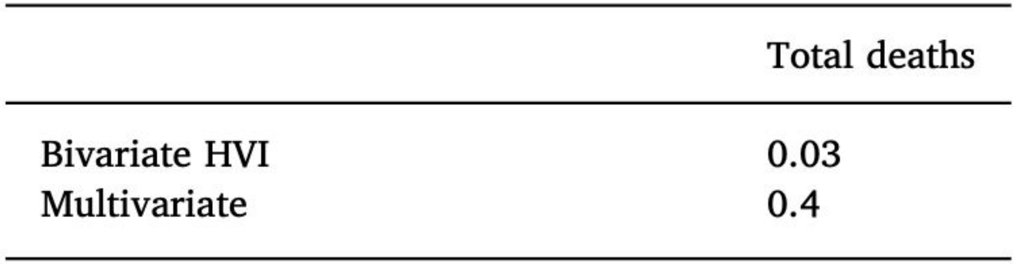


Variable	Coefficient	Std. error	t-Statistic	Probability
Constant	0.15	0.10	1.52	0.13
No greenspace	0.01	0.08	0.16	0.87
Over 65**	2.66	0.29	9.05	0.00
Nonwhite	0.13	0.09	1.42	0.16
Living alone	−0.24	0.17	−1.35	0.18
Less than HS education**	0.30	0.13	2.32	0.02
Living below poverty line	−0.01	0.15	−0.07	0.94
Diabetes*	−1.14	0.67	−1.71	0.09
No Full AC*	−0.12	0.07	−1.77	0.08

** Significant at $\alpha = 0.05$.

* Significant at $\alpha = 0.1$.

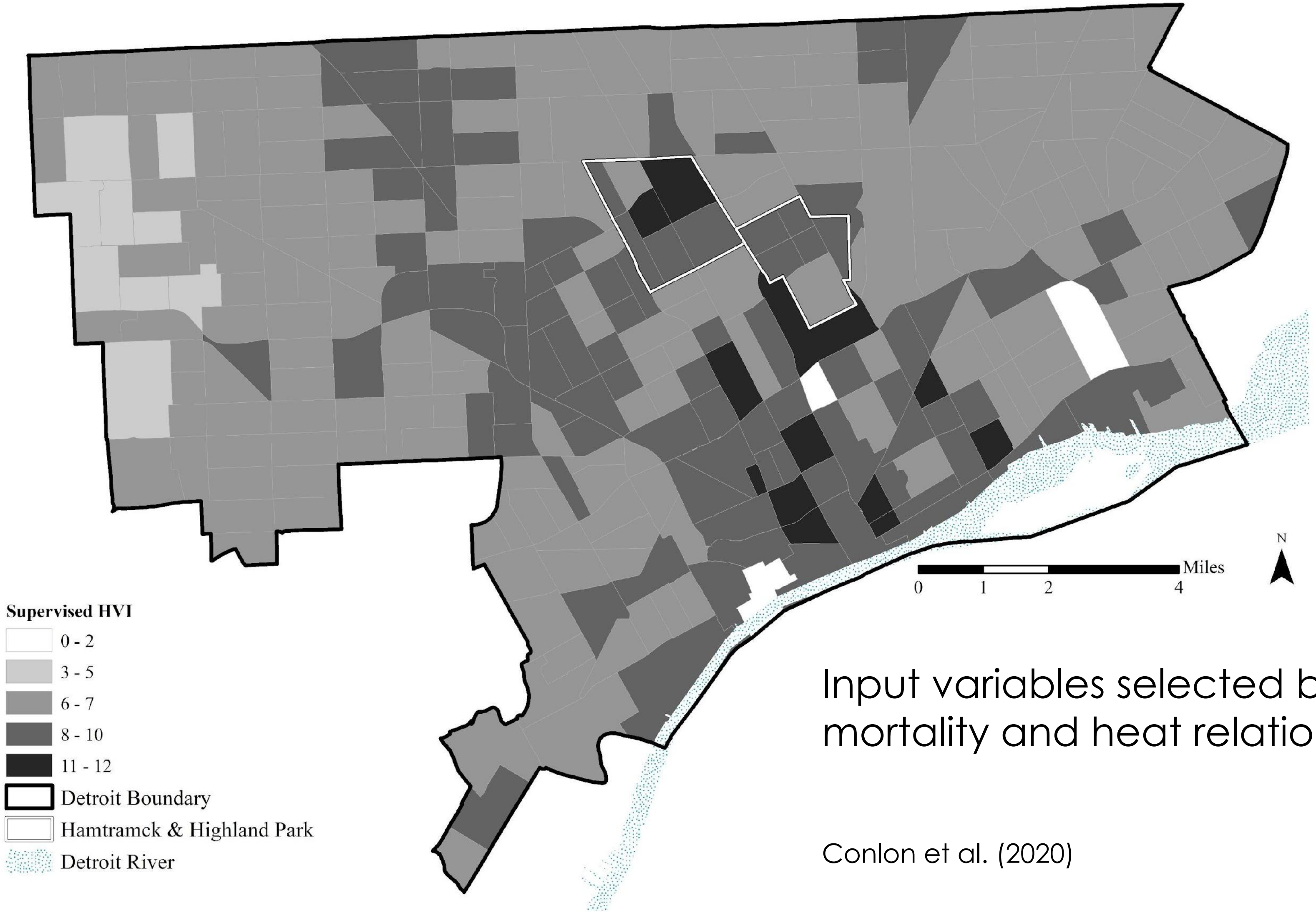
Resulting R-Square from bivariate and multivariate regressions.



	Total deaths
Bivariate HVI	0.03
Multivariate	0.4

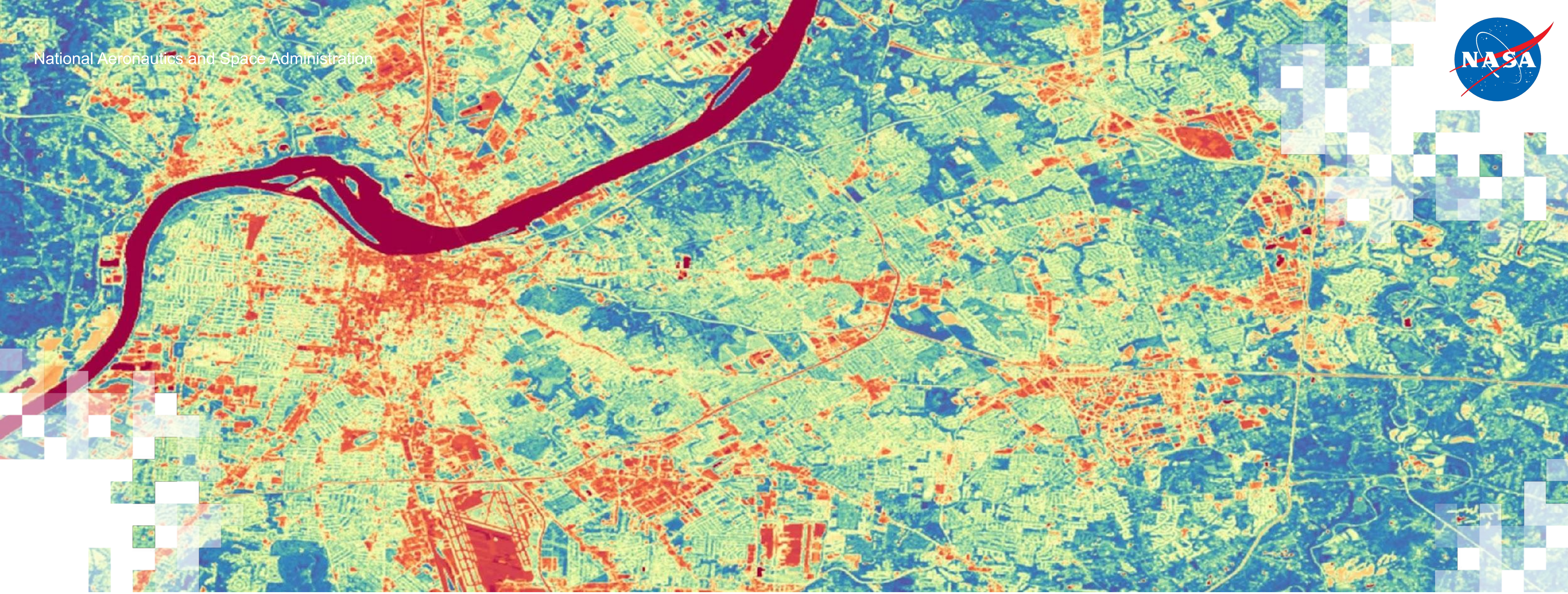
Mallen et al. (2019a)

Supervised HVI



Input variables selected based on mortality and heat relationship

Conlon et al. (2020)



Putting Heat Vulnerability Indices Into Practice

HVIs in Practice


Las Vegas Review-Journal

Cooling Centers

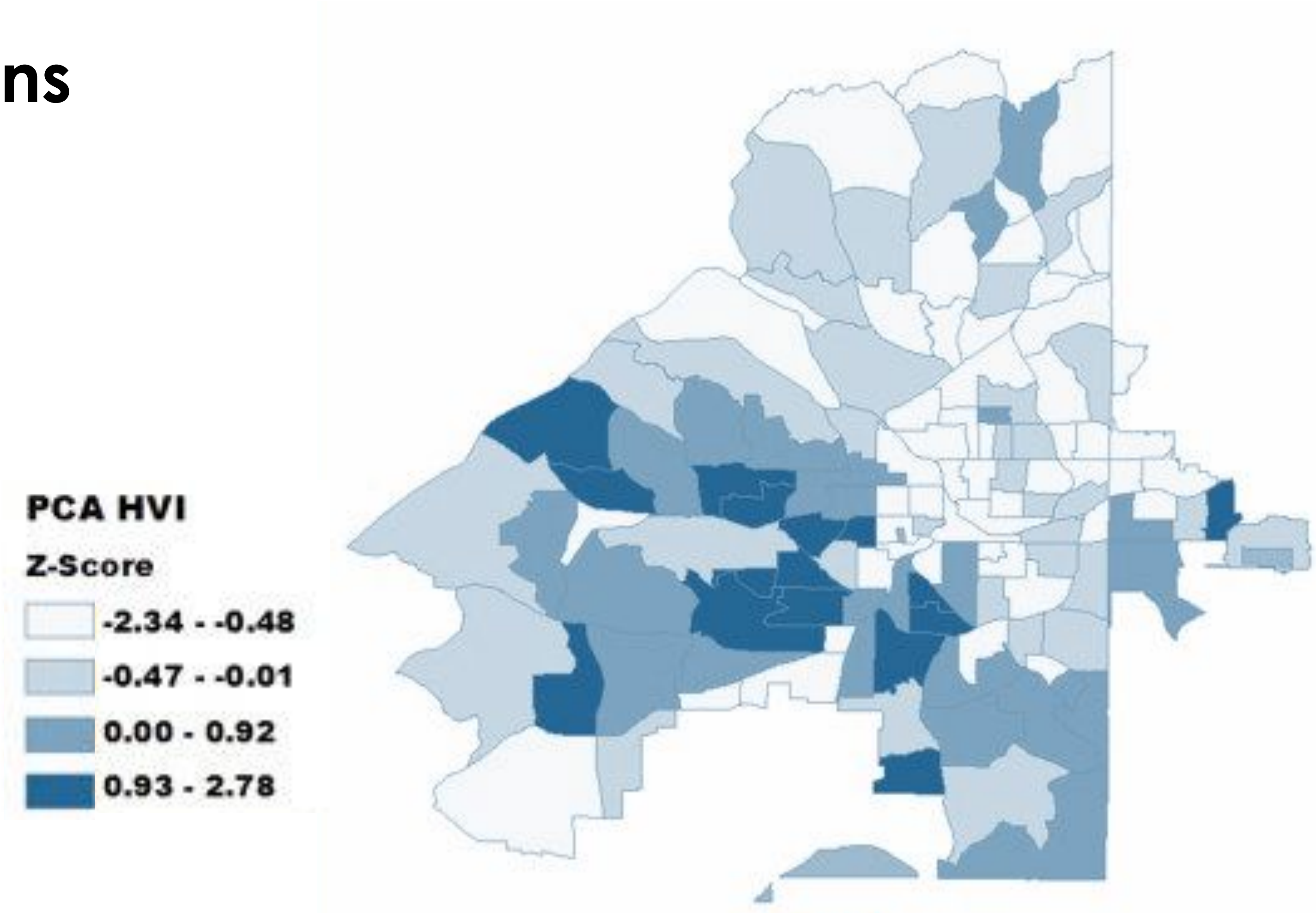

Trees Atlanta

Tree Planting

Informing Interventions

Indicators

Land Surface Temperature
Over 65
Living Alone
Over 65 and Living Alone
Living Below Poverty Line
Nonwhite Population
Less than High School
Diabetes Prevalence
No Central AC Access
No AC Access



Exposure

Sensitivity

Adaptive Capacity

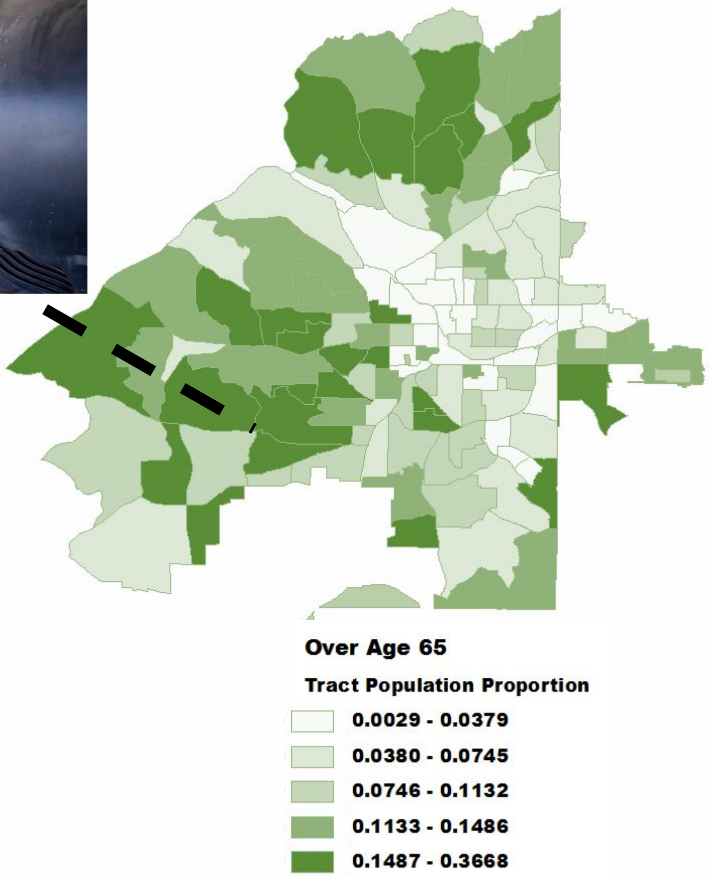
Vulnerability

Intervention Design

Sensitivity


Las Vegas Review-Journal

Cooling Centers



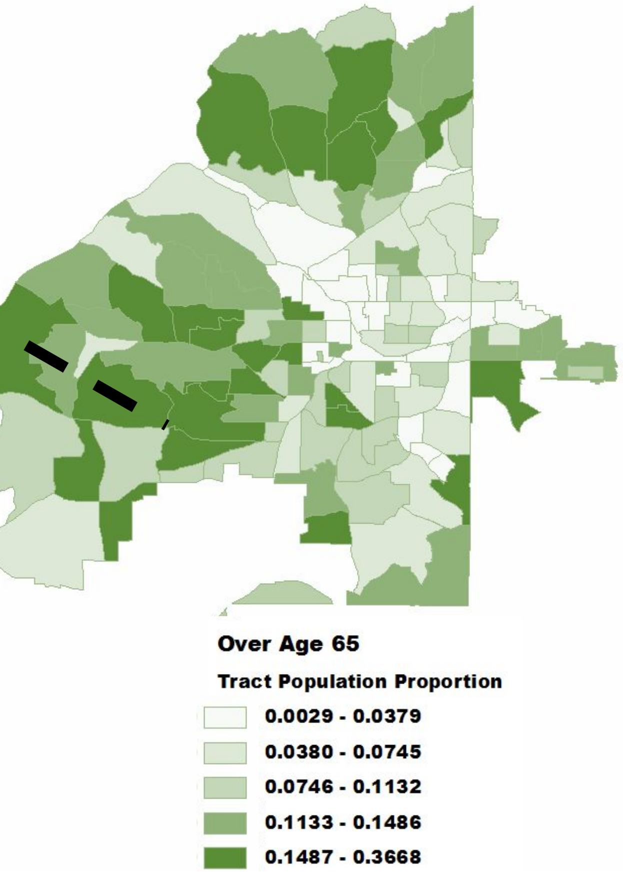
Intervention Design

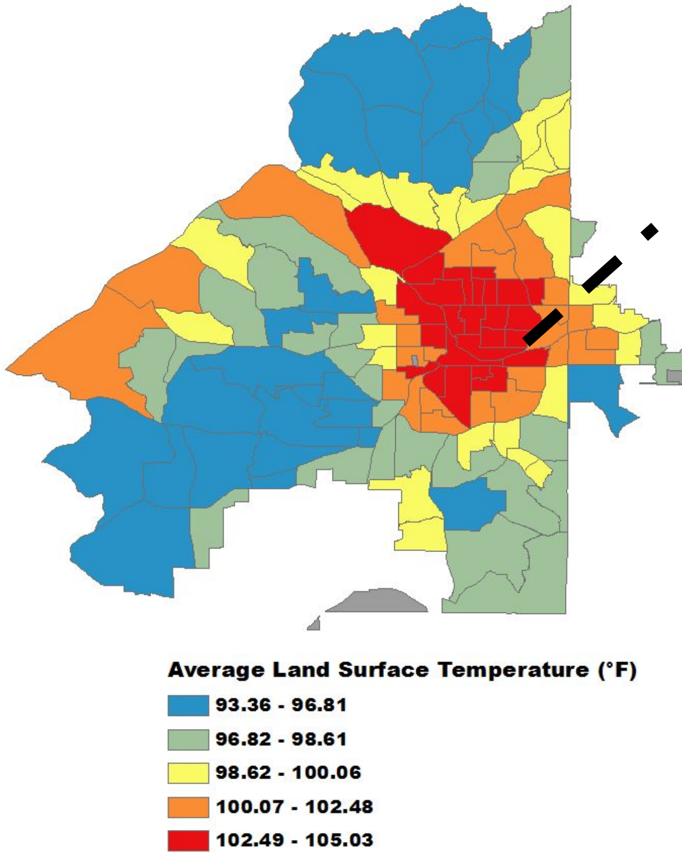
Sensitivity

Exposure


Las Vegas Review-Journal

Cooling Centers






Trees Atlanta

Tree Planting

Intervention Design

Sensitivity / Adaptive Capacity

- Shorter-term, emergency response
- Community-based adaptations
- Cooling centers, phone trees

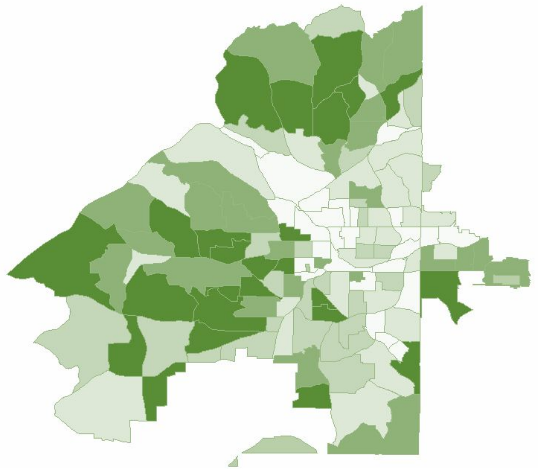
Exposure

- Longer-term, heat mitigation response
- Tree-planting priority
- Cool materials

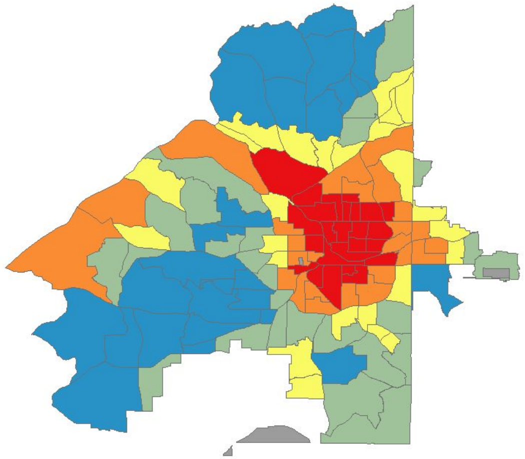
Vulnerability

- All-of-the-above response
- Highest priority, pilot projects here
- Identify local stakeholders / champions

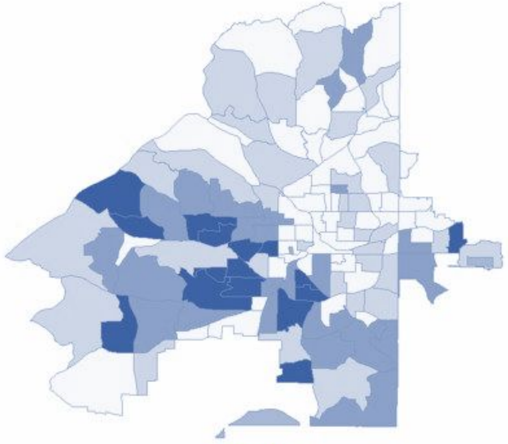
Sensitivity



Exposure



Vulnerability

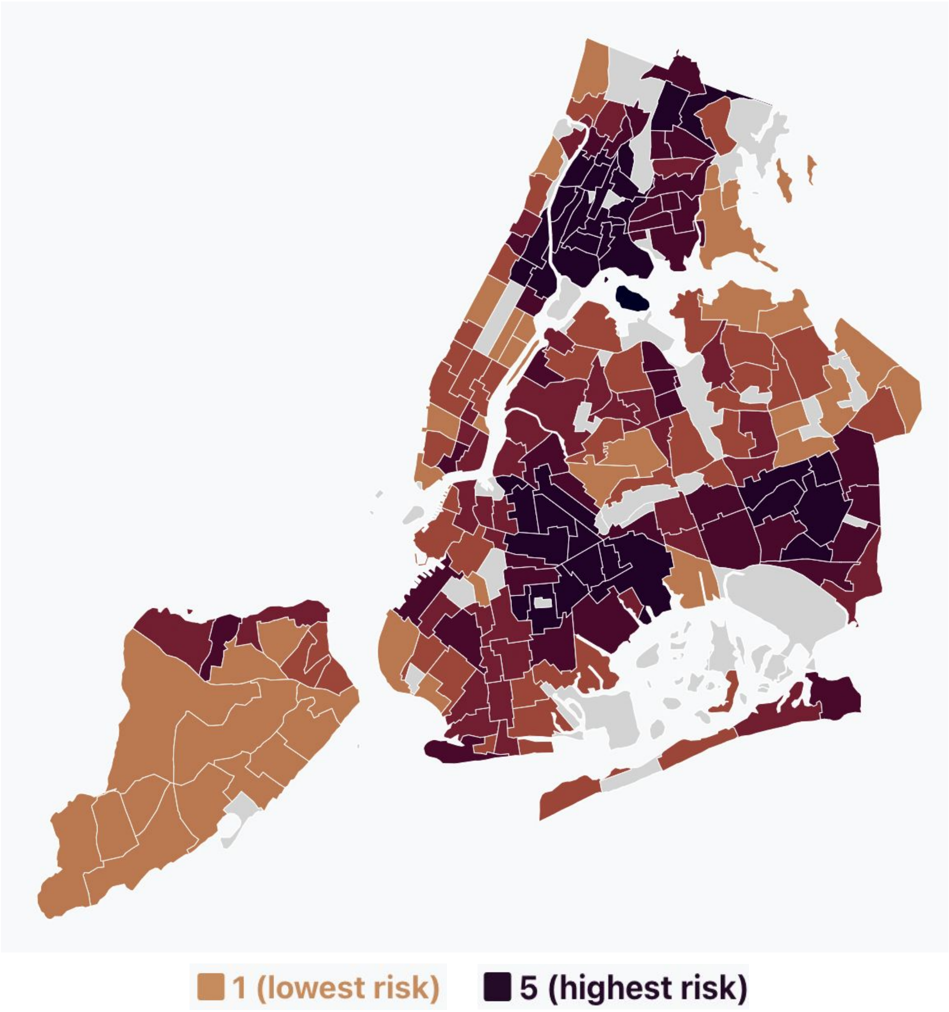


Intervention Design

- Community engagement can help inform local needs, concerns, and barriers to adaptation.
- Use mapping techniques as communication tool
- Co-produce strategies with community members to encourage behavioral change and build social capital

Beltline.org

New York City, NY – Be A Buddy



https://a816-dohbesp.nyc.gov/IndicatorPublic/HeatHub/hvi.html

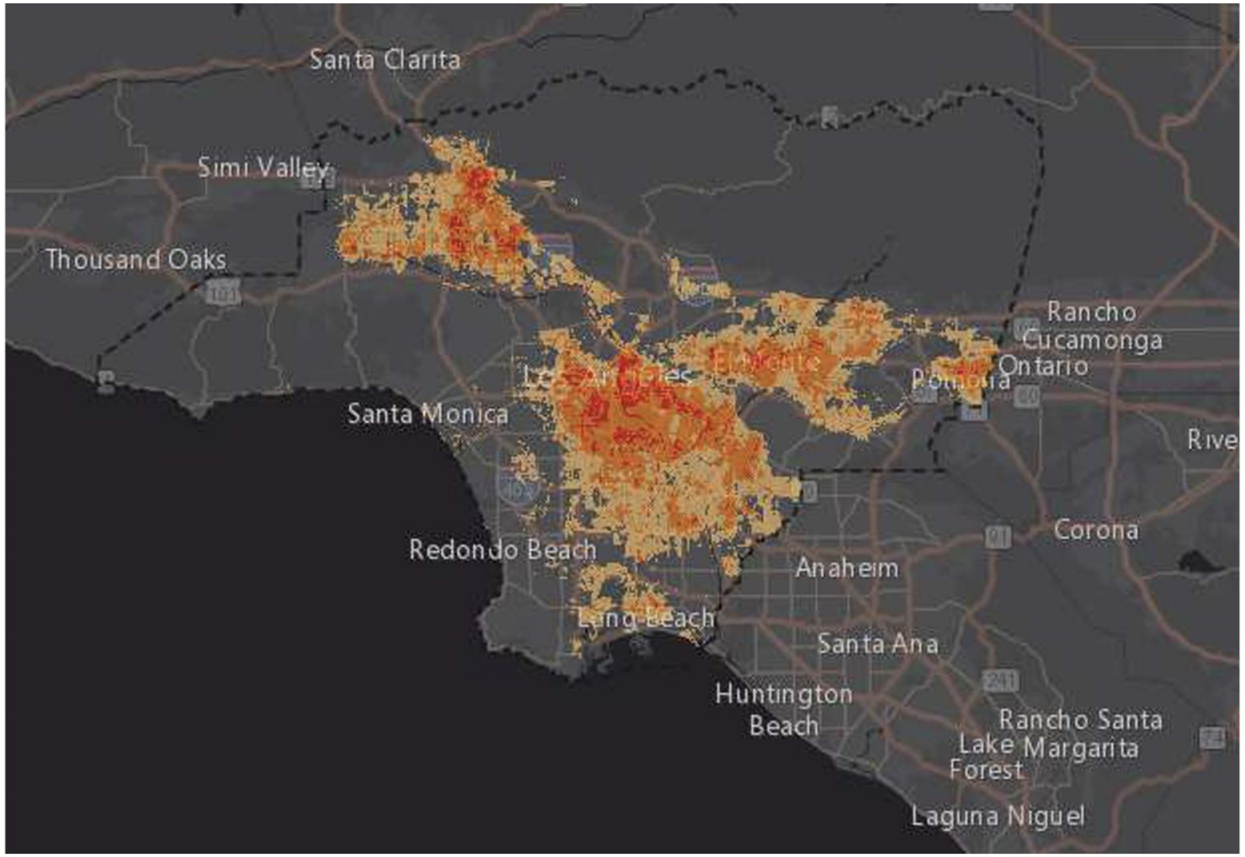
Connects climate-susceptible residents with local volunteer "buddies" to foster intercommunity relationships

- Partnering neighborhood-based organizations
- Volunteers conduct wellness checks on 'high-risk' neighbors.
- HVI comprised of:
  - Surface temperature, green space, access to home AC, % of residents who are low-income or non-Latinx Black.
- Initial findings:
  - Increased community connectivity
  - Increased community capacity

Los Angeles County, CA – Climate Smart LA

Decision Map for Prioritizing Green Infrastructure Investment to:

- Connect
- Cool
- Absorb
- Protect



Credit: County of Los Angeles

Considerations for HVI Implementation

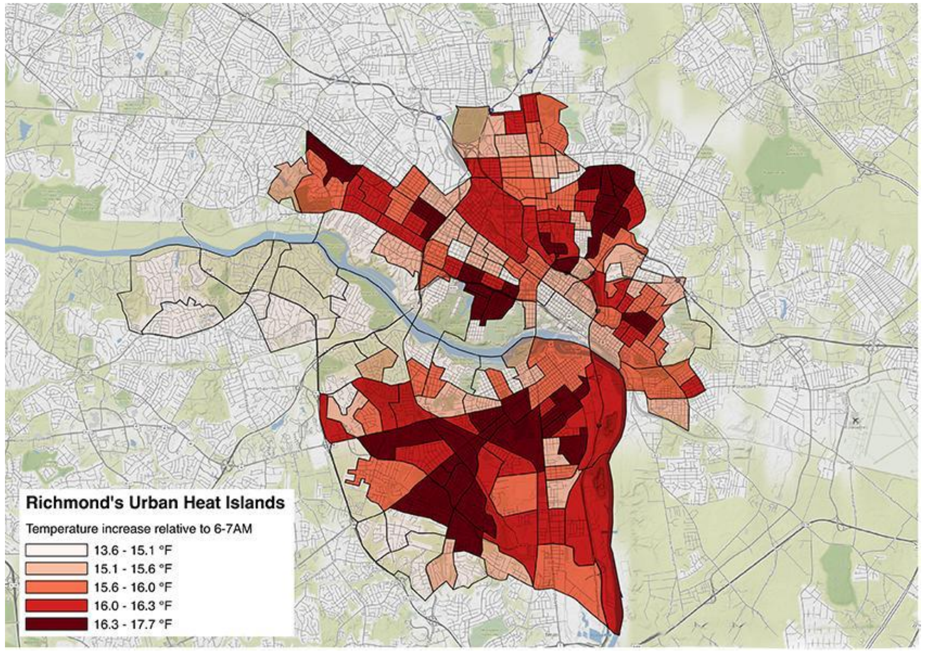
HVI results may significantly vary depending on:

- Inputs Selected
- Construction Method
- Scale

Carefully selected methods and indicators can inform effective and efficient heat interventions

- HVIs are a balancing act between inputs, interpretation, and implementation

HVIs are communication tools – engage and iterate



Credit: Jeremy Hoffman

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Questions?

- Please enter your questions in the Q&A box. We will answer them in the order they were received.
- We will post the Q&A to the training website following the conclusion of the webinar.

Credit: NASA

Contacts

- Trainers
  - Kathryn Conlon, PhD, MPH: kcconlon@ucdavis.edu
  - Evan Mallen, PhD, MUP: emallen3@gatech.edu

- Training Webpage:
  - https://appliedsciences.nasa.gov/join-mission/training/english
    arset-satellite-remote-sensing-measuring-urban-heat-islands-a
    d

- ARSET Website:
  - https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset

APPLIED REMOTE SENSING TRAINING PROGRAM

TRAIN - EMPOWER - ADVANCE

Thank You!