Thermal Extremes Vulnerability and Management

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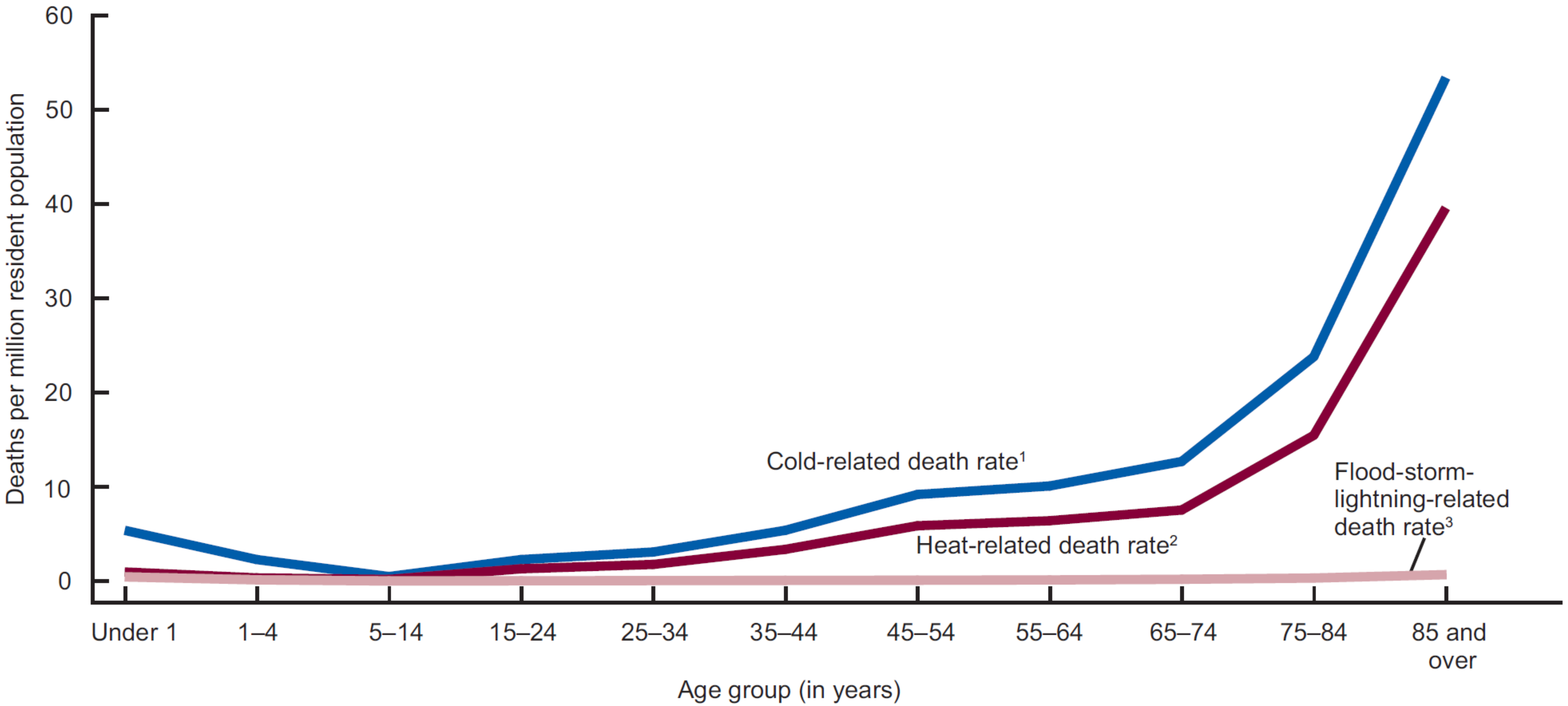


[1]Deaths attributed to exposure to excessive natural cold (X31) (underlying or contributing cause of death or both), to hypothermia (T68) (contributing cause of death), or to both, according to the *International Classification of Diseases, 10th Revision*.

[2]Deaths attributed to exposure to excessive natural heat (X30) (underlying or contributing cause of death or both), to heat stroke or sunstroke (T67) (contributing cause of death), or to both, according to the *International Classification of Diseases, 10th Revision*.

[3]Deaths attributed to floods (X38), cataclysmic storms (X37), or lightning (X33) (underlying or contributing cause of death or both), according to the *International Classification of Diseases, 10th Revision*.

SOURCE: CDC/NCHS, National Vital Statistics System, 2006–2010.

Figure 1. Crude death rates for weather-related mortality, by age: United States, 2006–2010

Berko J, Ingram DD, Saha S, Parker JD. Deaths attributed to heat, cold, and other weather events in the United States, 2006– 2010. National health statistics reports; no 76. Hyattsville, MD: National Center for Health Statistics. 2014.

Timing Matters

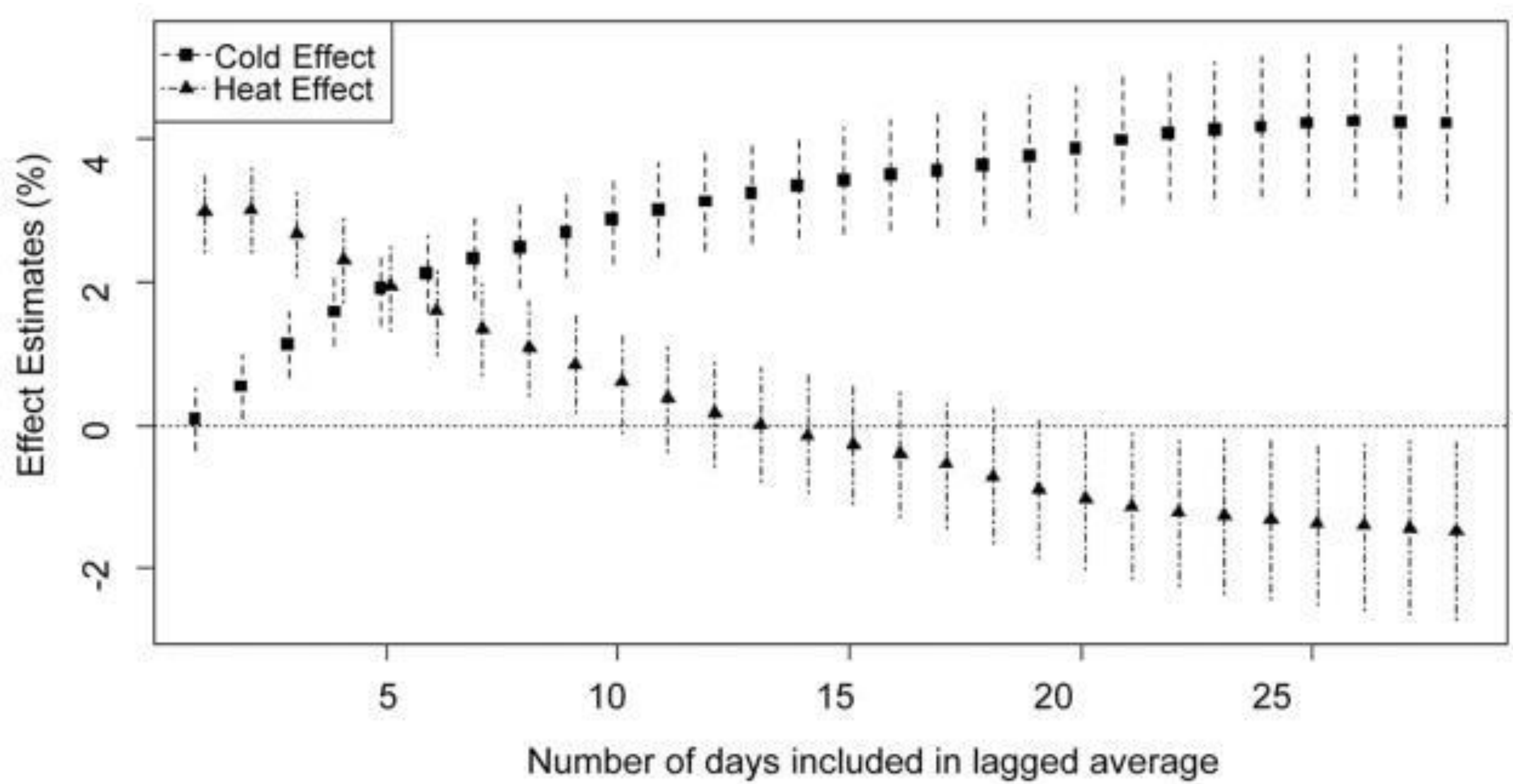
Table 4. Average mortality effects of the first heat wave in a summer versus later heat waves (1987–2005).

Region	Average percentage of heat waves that were first in season	Average effect of heat waves (95% PI)	
		First in season	Not first in season
National (*n* = 43)	40%	5.04% (3.06 to 7.06%)	2.65% (1.14 to 4.18%)
Northeast (*n* = 7)	40%	11.08% (4.05 to 18.58%)	3.45% (–1.16 to 8.28%)
Midwest (*n* = 12)	38%	5.29% (1.76 to 8.94%)	5.42% (2.46 to 8.46%)
South (*n* = 19)	38%	3.29% (0.12 to 6.56%)	0.68% (–1.60 to 3.02%)

The heat wave effect is the increase in nonaccidental mortality risk for heat wave days compared with non-heat wave days, controlling for daily temperature [the added heat wave effect described by Hajat et al. (2006)].

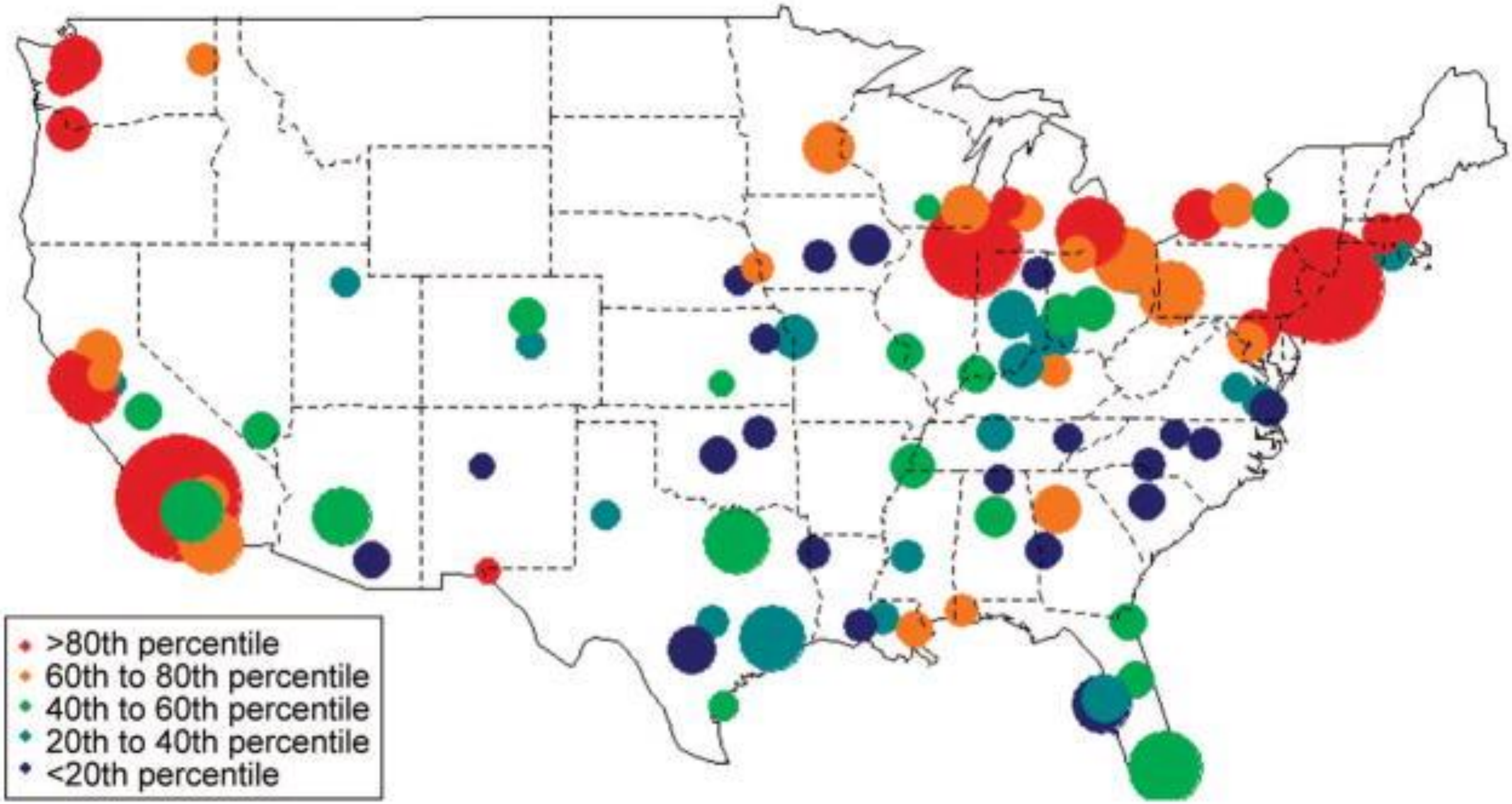
Anderson, G Brooke, and Michelle L Bell. 2009. Weather-related mortality: how heat, cold, and heat waves affect mortality in the United States. Epidemiology. 20(2):205-13. doi: 10.1097/EDE.0b013e318190ee08

Timing Matters



Anderson, G Brooke, and Michelle L Bell. 2009. Weather-related mortality: how heat, cold, and heat waves affect mortality in the United States. Epidemiology. 20(2):205-13. doi: 10.1097/EDE.0b013e318190ee08

Place Matters



Anderson, G Brooke, and Michelle L Bell. 2011. Heat Waves in the United States: Mortality Risk during Heat Waves and Effect Modification Environmental Health Perspectives. 119: 210–218. doi:10.1289/relationships.temperature-mortality.`

Place Matters

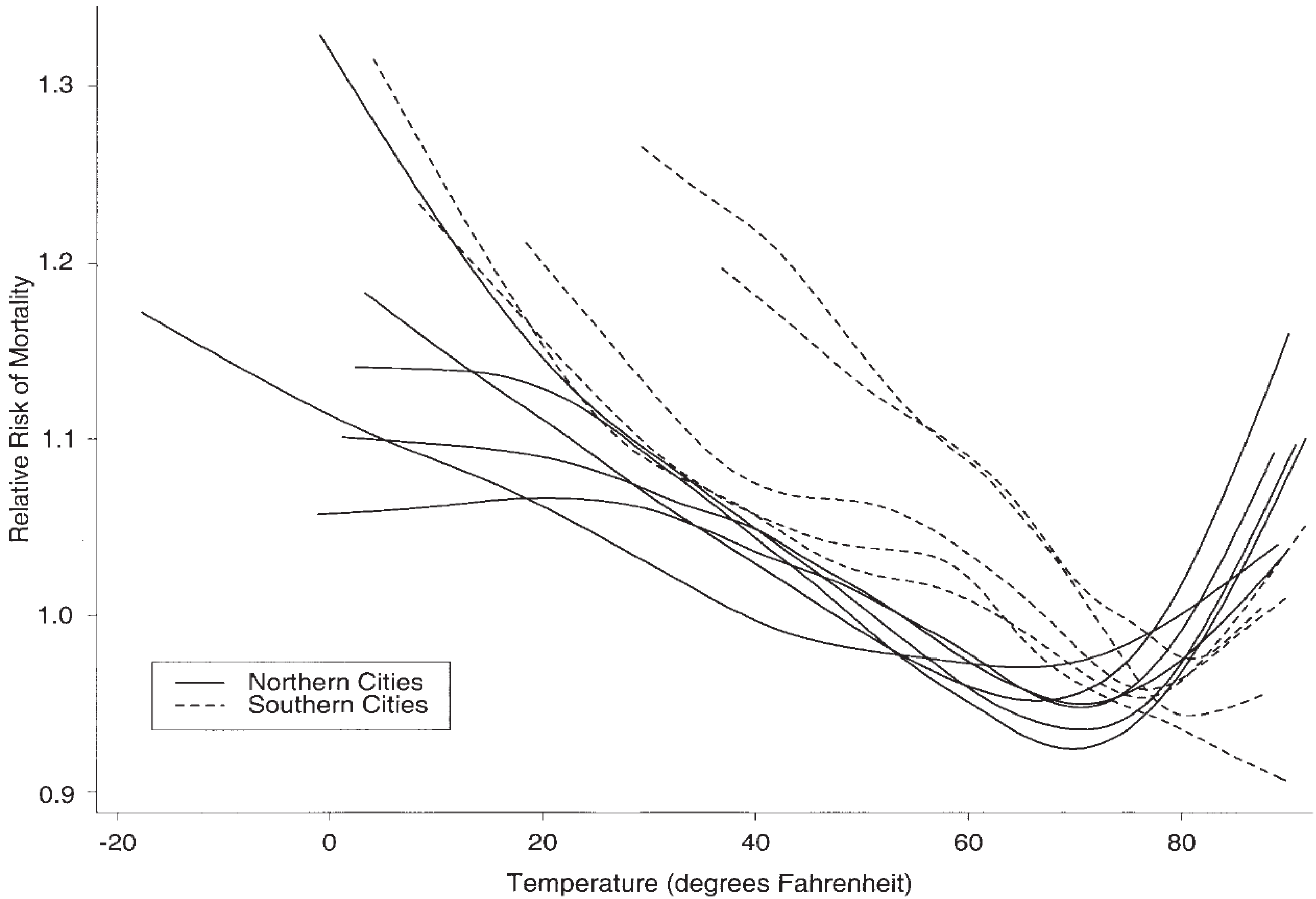
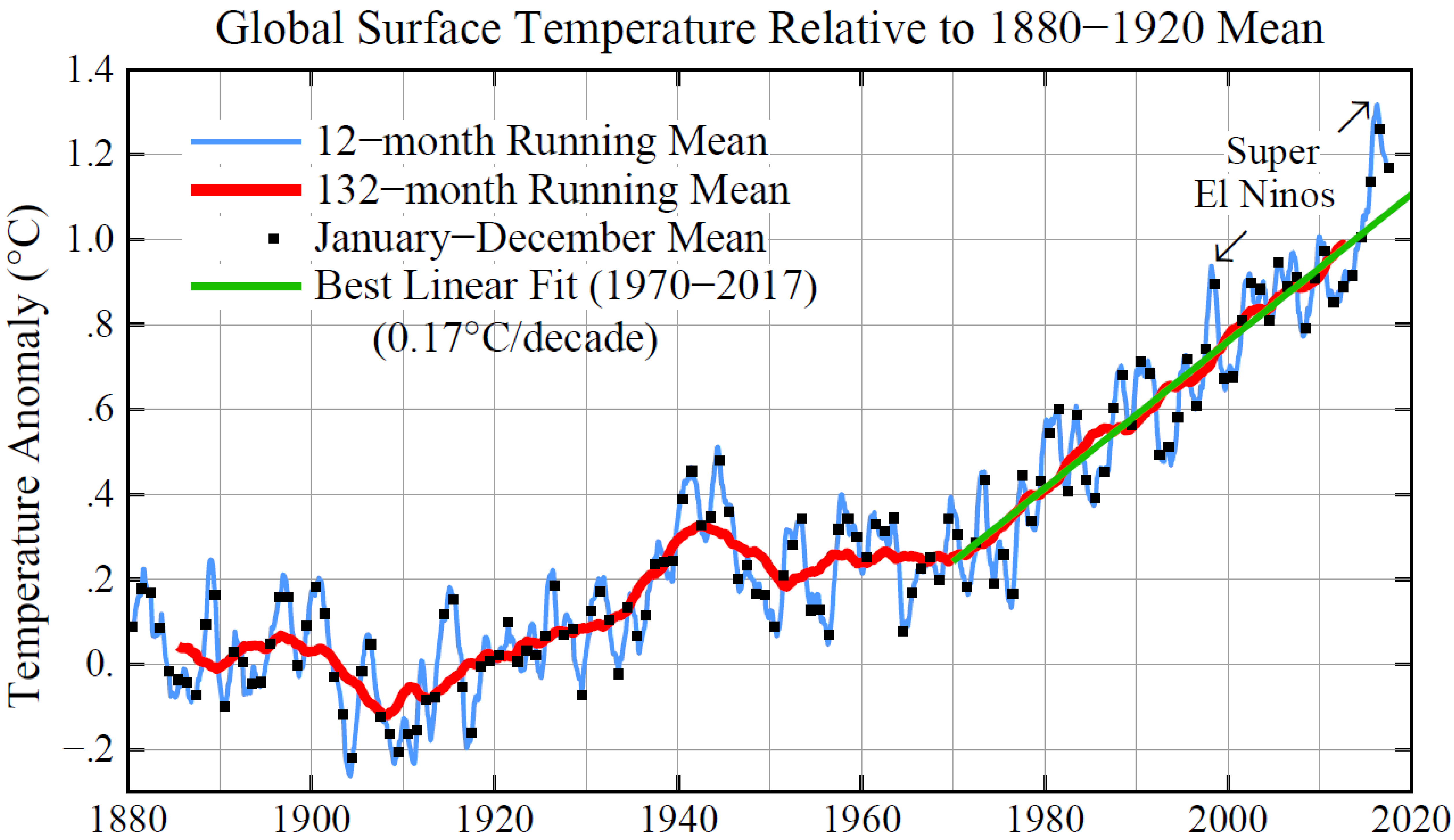
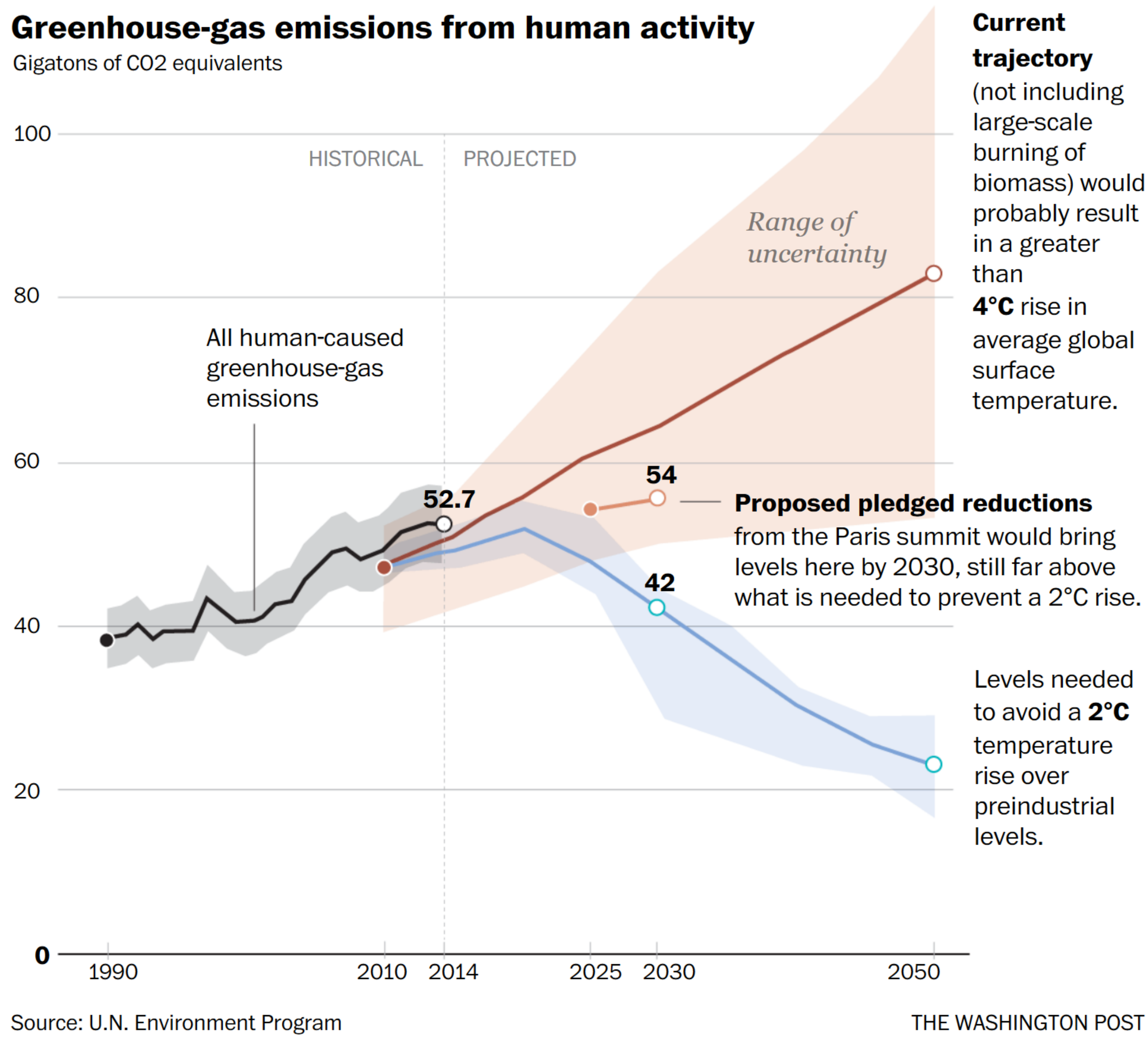


FIGURE 1. Temperature-mortality relative risk functions for 11 US cities, 1973–1994. Northern cities: Boston, Massachusetts; Chicago, Illinois; New York, New York; Philadelphia, Pennsylvania; Baltimore, Maryland; and Washington, DC. Southern cities: Charlotte, North Carolina; Atlanta, Georgia; Jacksonville, Florida; Tampa, Florida; and Miami, Florida. °C = 5/9 × (°F – 32).

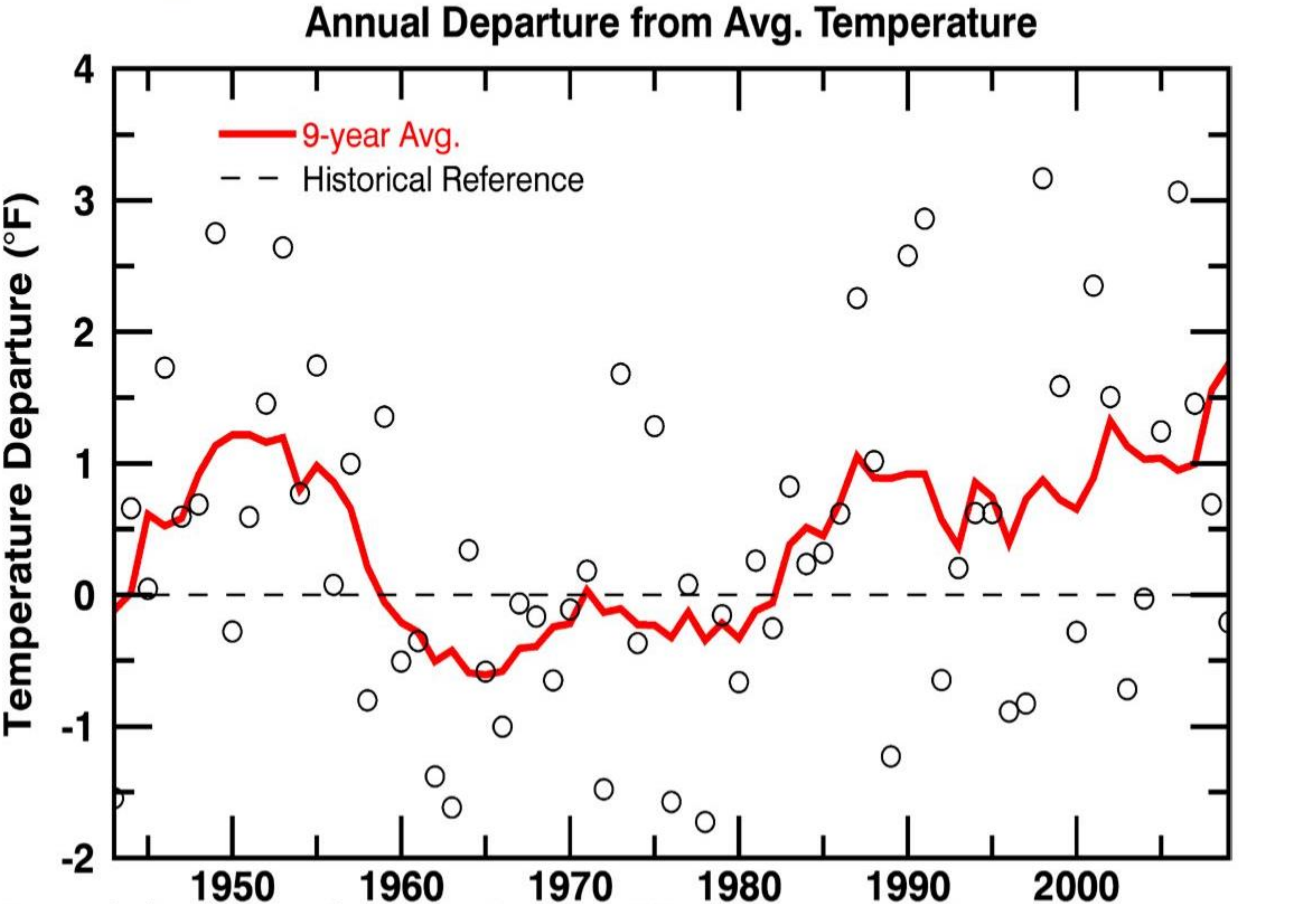
Curriero, F. C., et al. (2002). Temperature and mortality in 11 cities of the eastern United States. *Am J Epidemiol*, *155*(1), 80–87.



Hansen, J. et al. (2018) Global temperature in 2017.



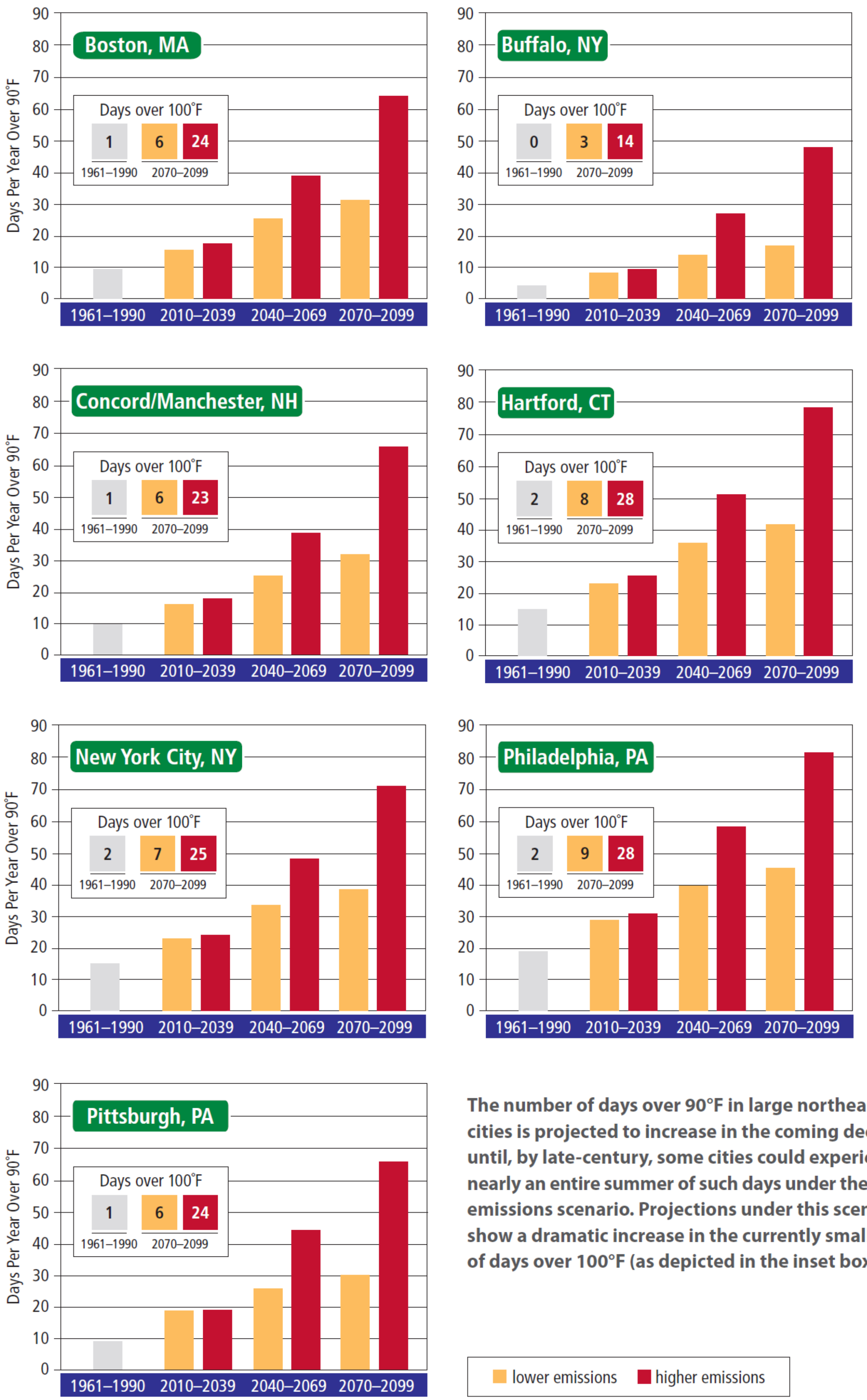
Greenhouse-gas emissions from human activity
Gigatons of CO2 equivalents
100
80
60
40
20
0
HISTORICAL
PROJECTED
Range of uncertainty
All human-caused greenhouse-gas emissions
52.7
54
42
Current trajectory (not including large-scale burning of biomass) would probably result in a greater than 4°C rise in average global surface temperature.
Proposed pledged reductions from the Paris summit would bring levels here by 2030, still far above what is needed to prevent a 2°C rise.
Levels needed to avoid a 2°C temperature rise over preindustrial levels.
1990
2010
2014
2025
2030
2050
Source: U.N. Environment Program
THE WASHINGTON POST



NCDC GHCN-Daily dataset

Frumhoff et al. 2007. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions.* Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

FIGURE 12: Increases in Extreme Heat in Northeast Cities



The number of days over 90°F in large northeastern cities is projected to increase in the coming decades until, by late-century, some cities could experience nearly an entire summer of such days under the higher-emissions scenario. Projections under this scenario also show a dramatic increase in the currently small number of days over 100°F (as depicted in the inset boxes).

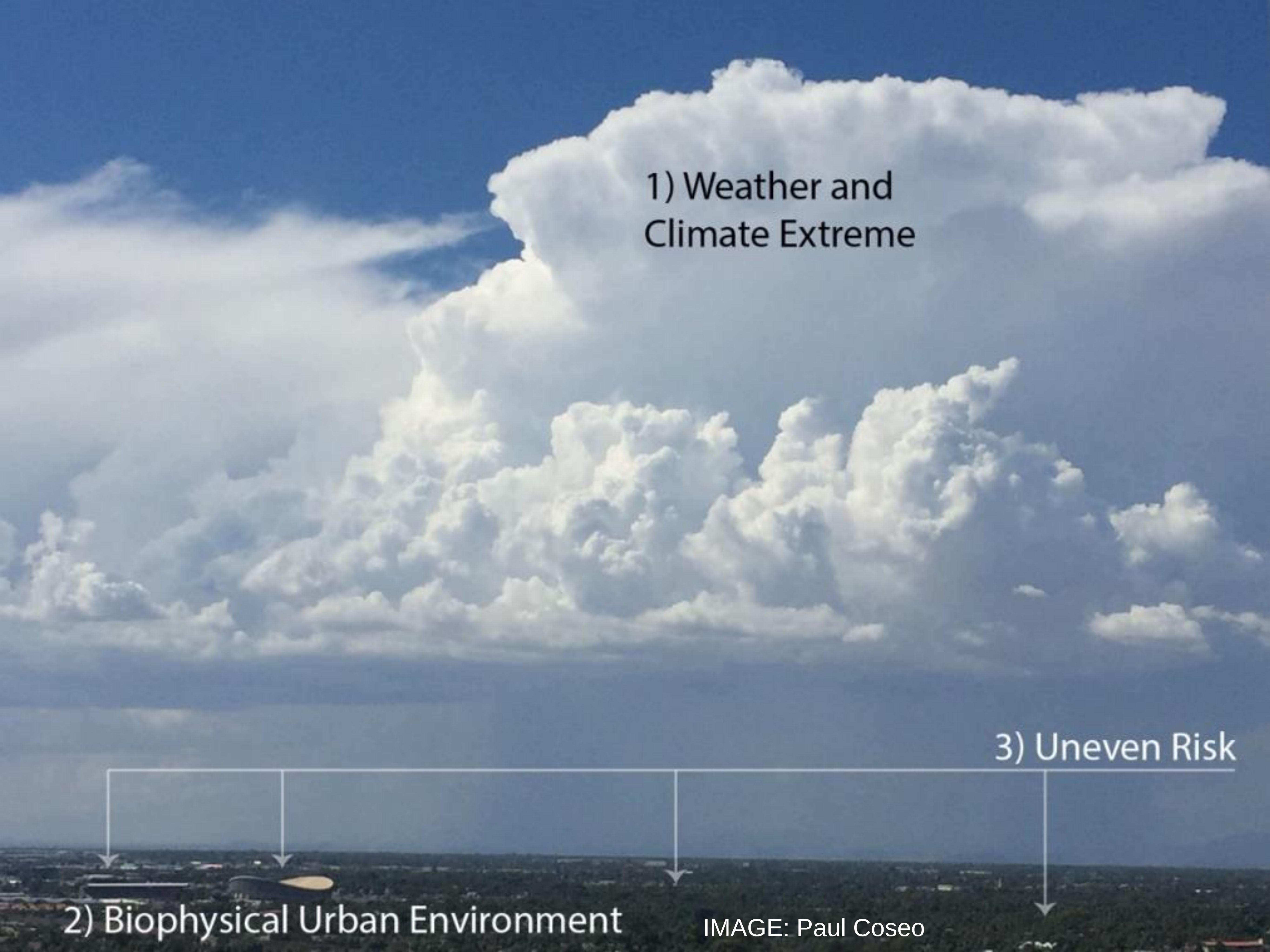
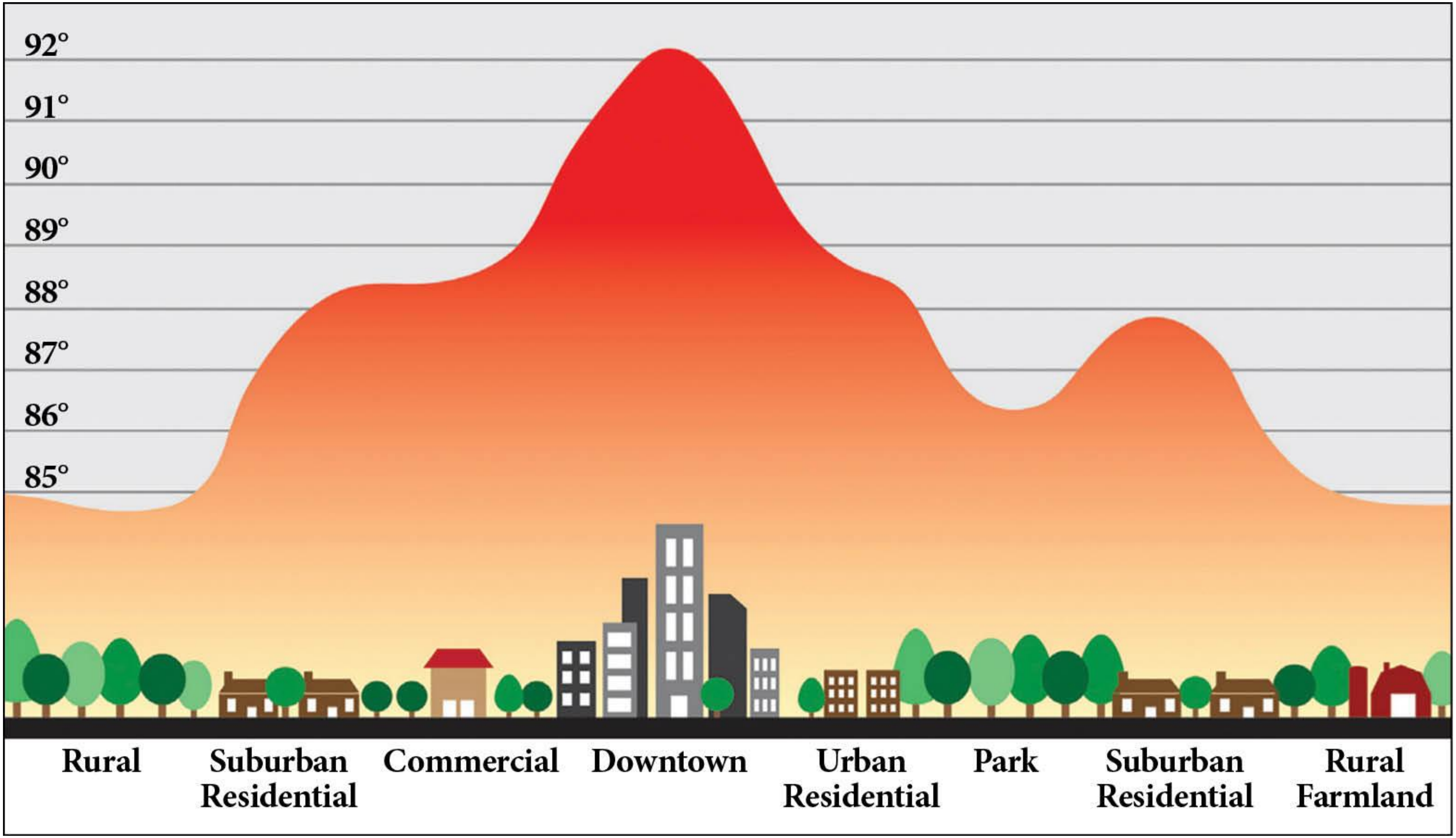
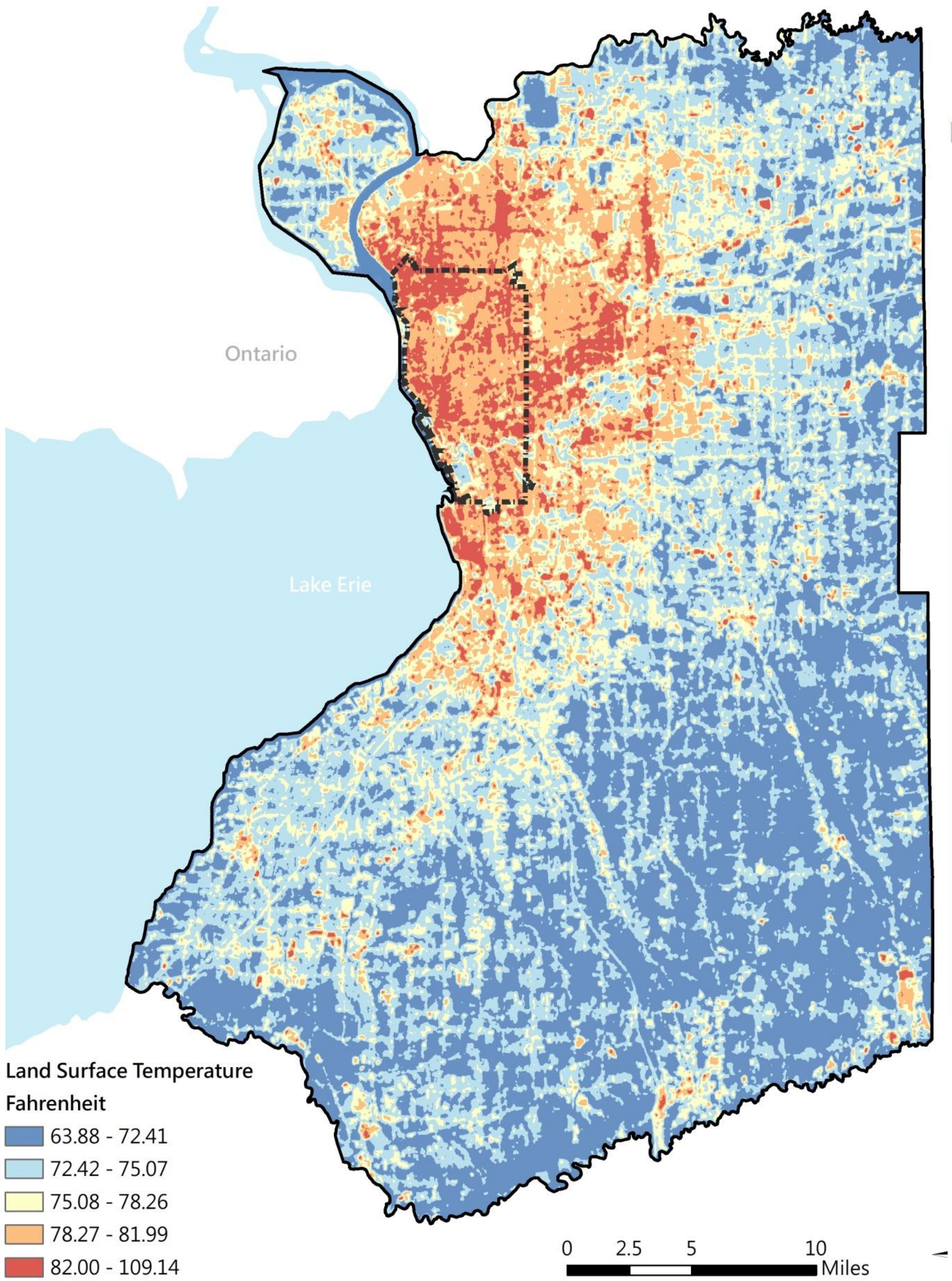
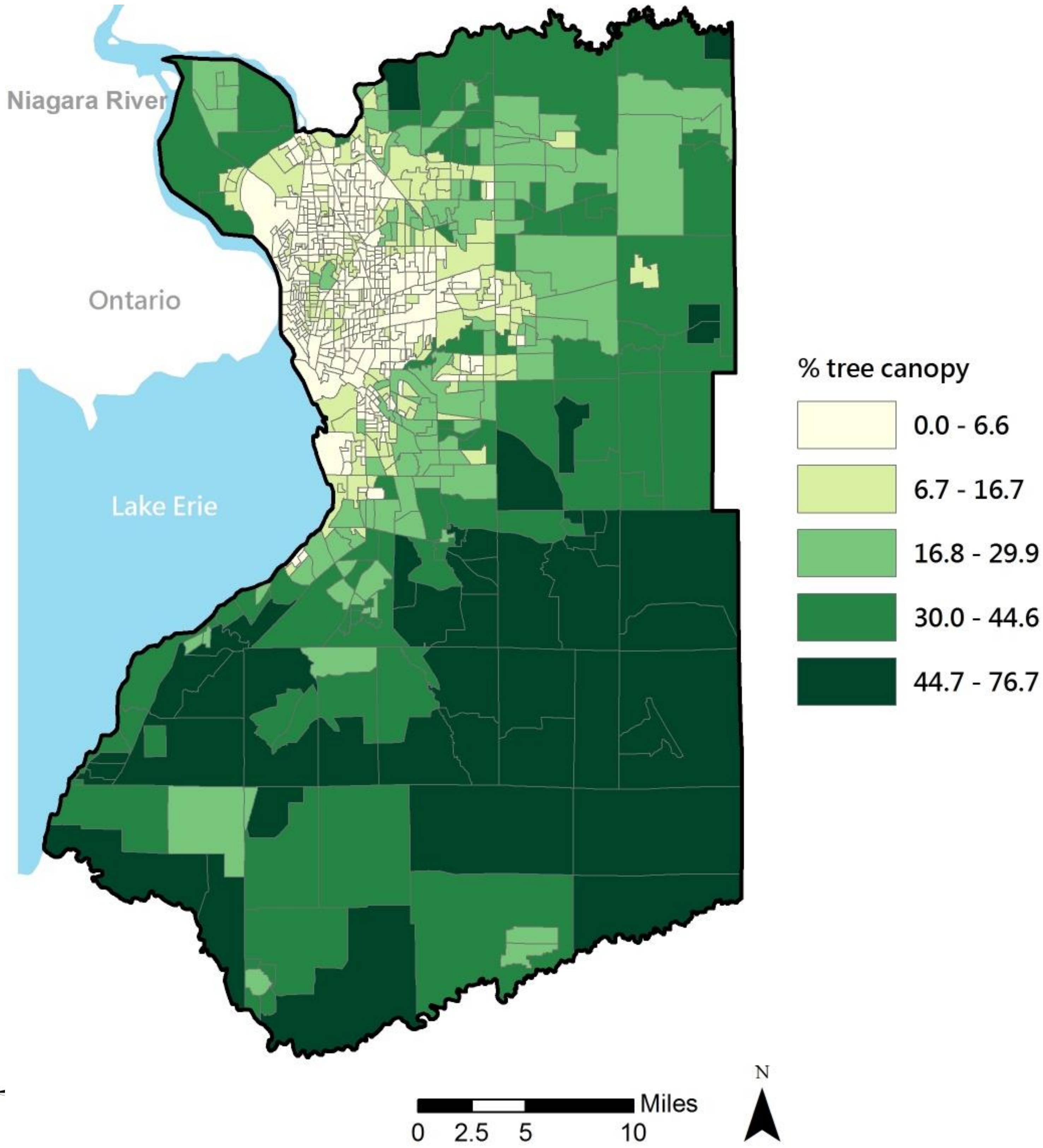


IMAGE: Paul Coseo

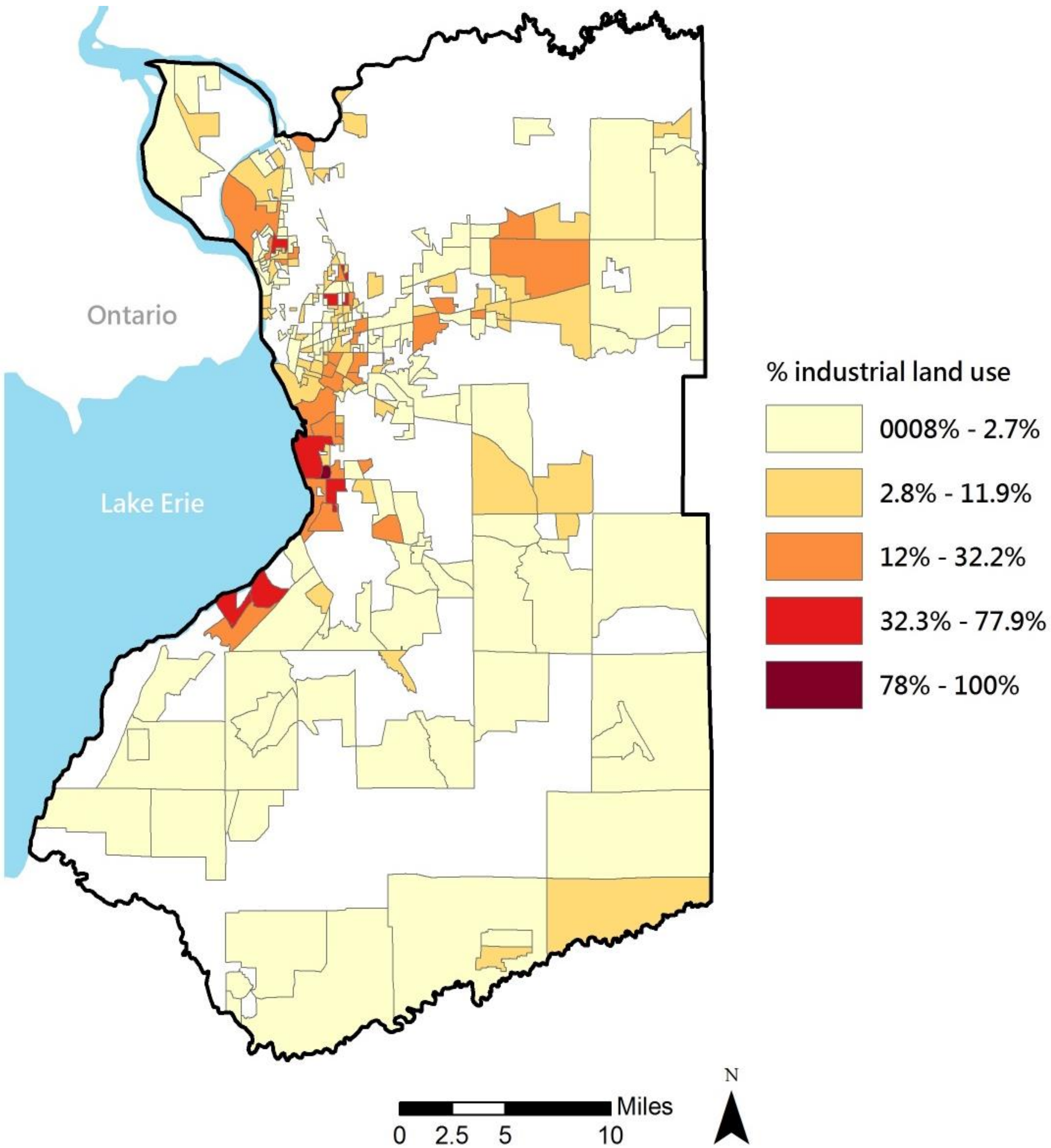


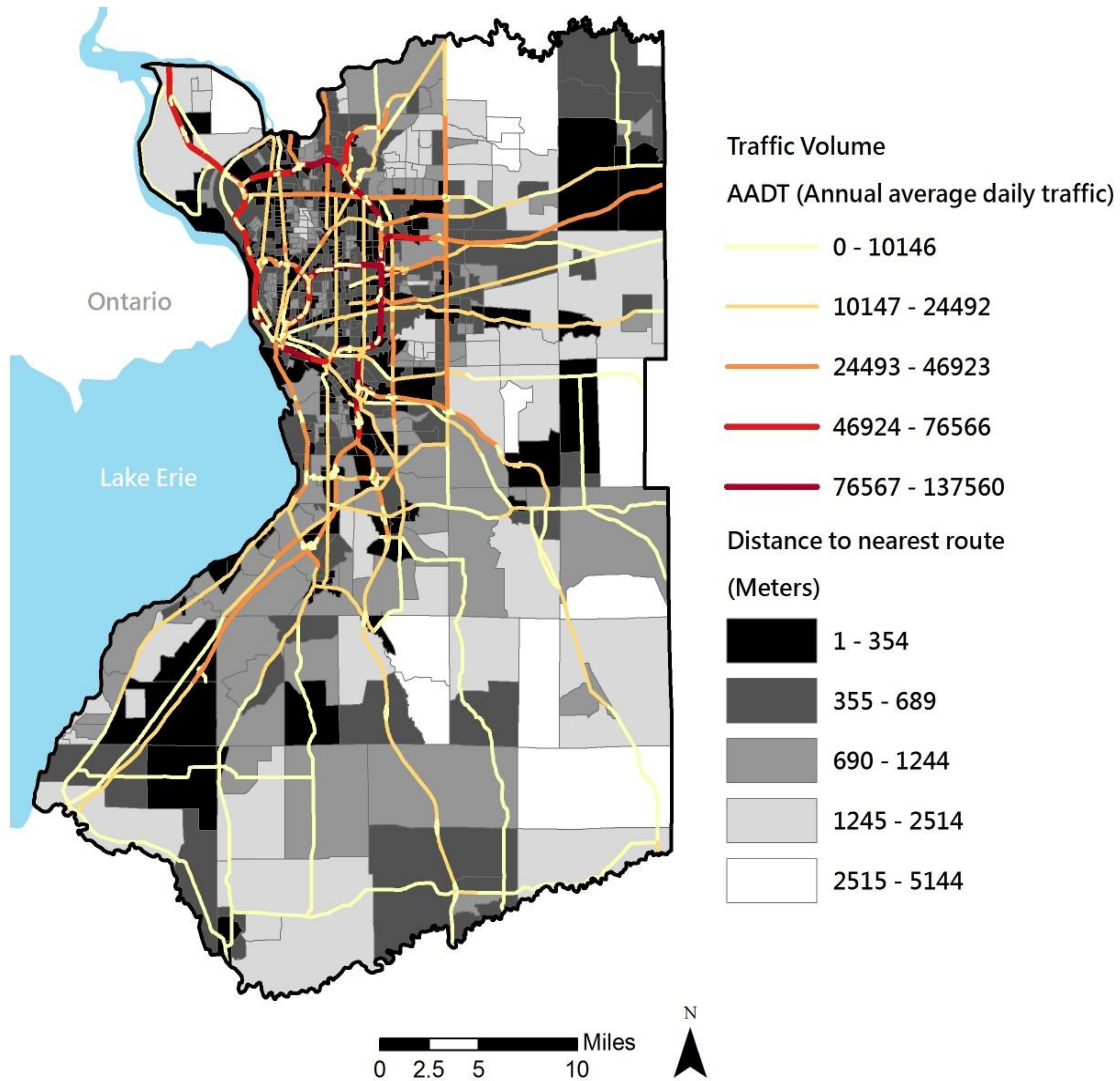
Bay Area Monitor, 2017 http://bayareamonitor.org/summer-in-the-city-seeking-relief-from-urban-heat-islands/



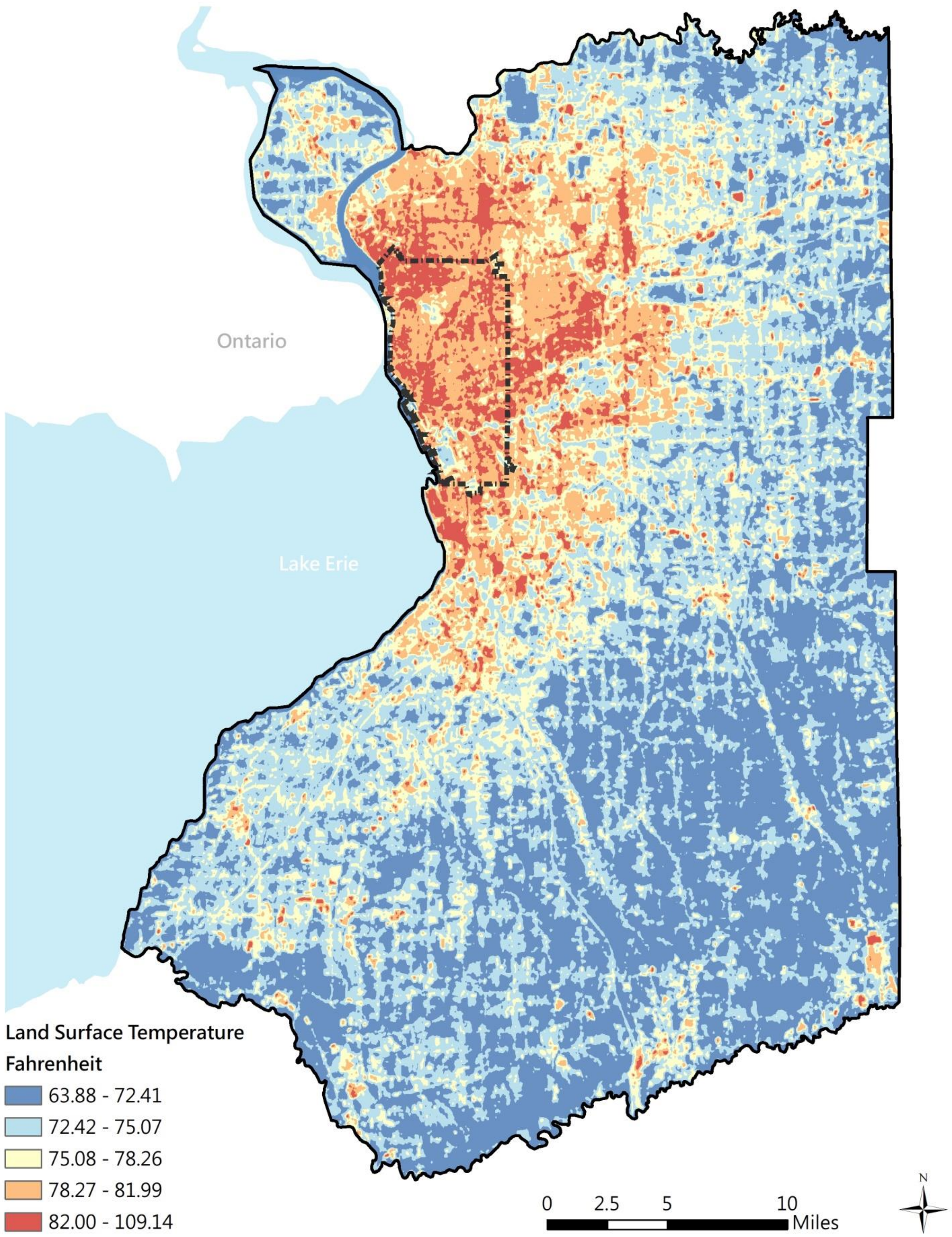


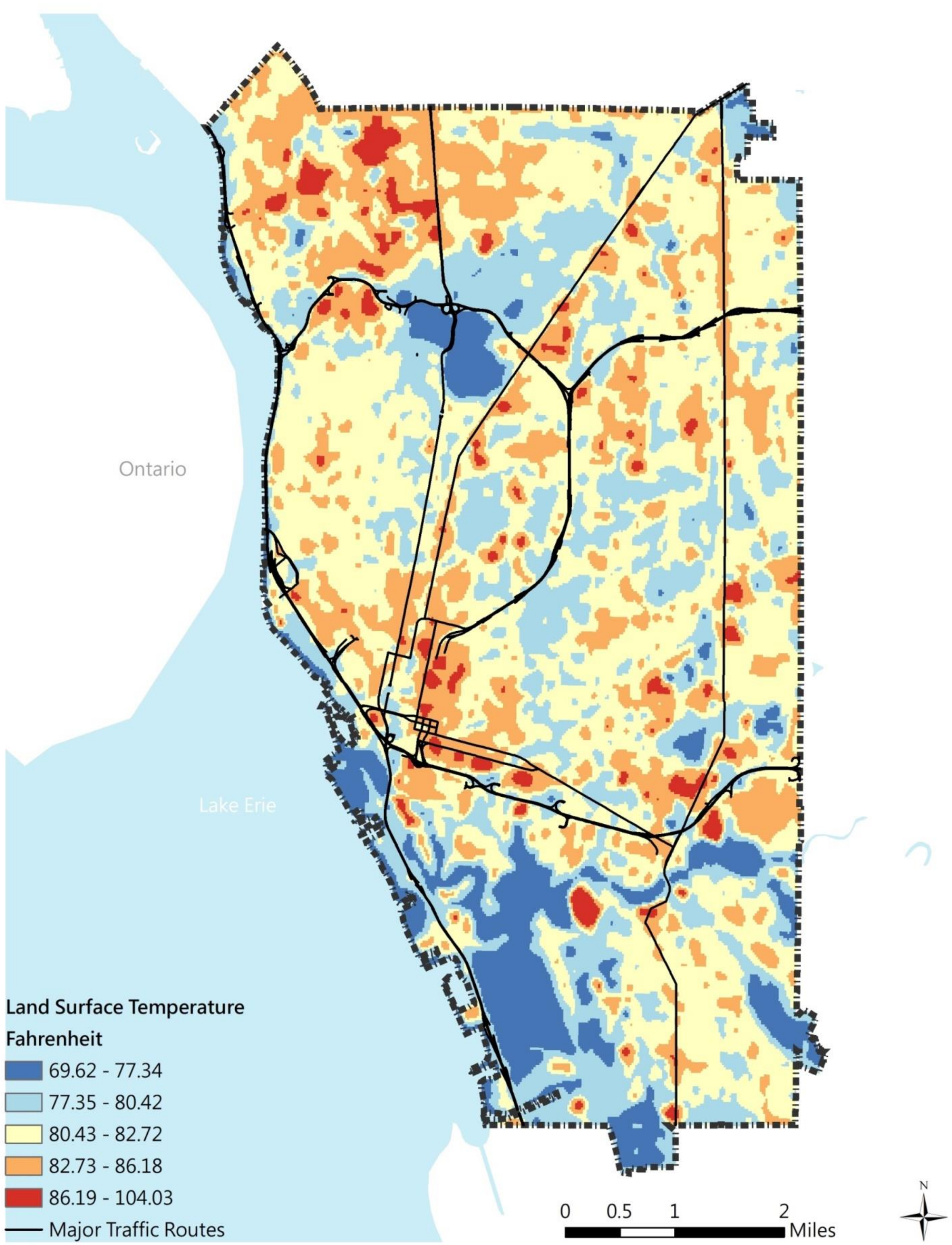
Will Siegner





Will Siegner





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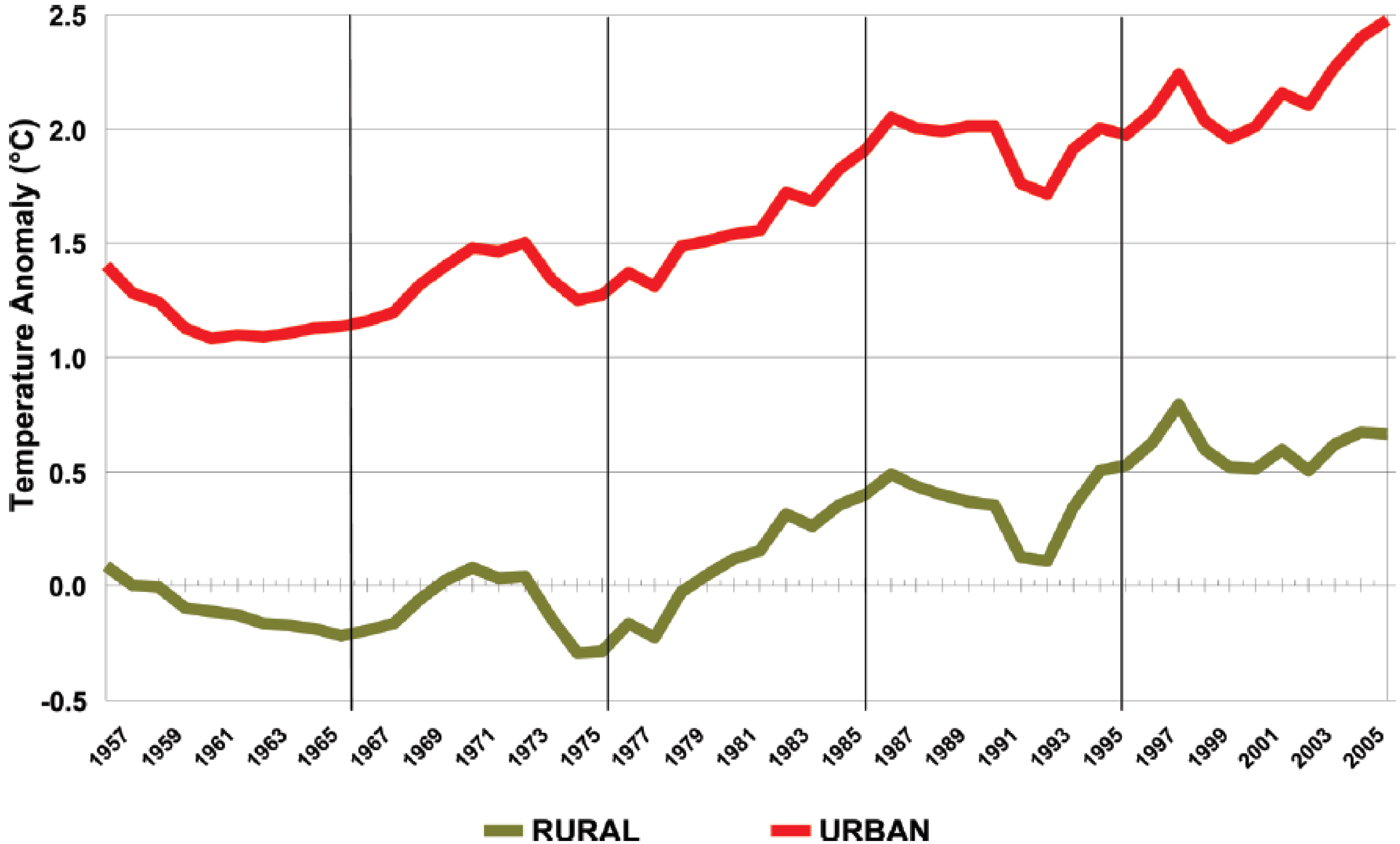
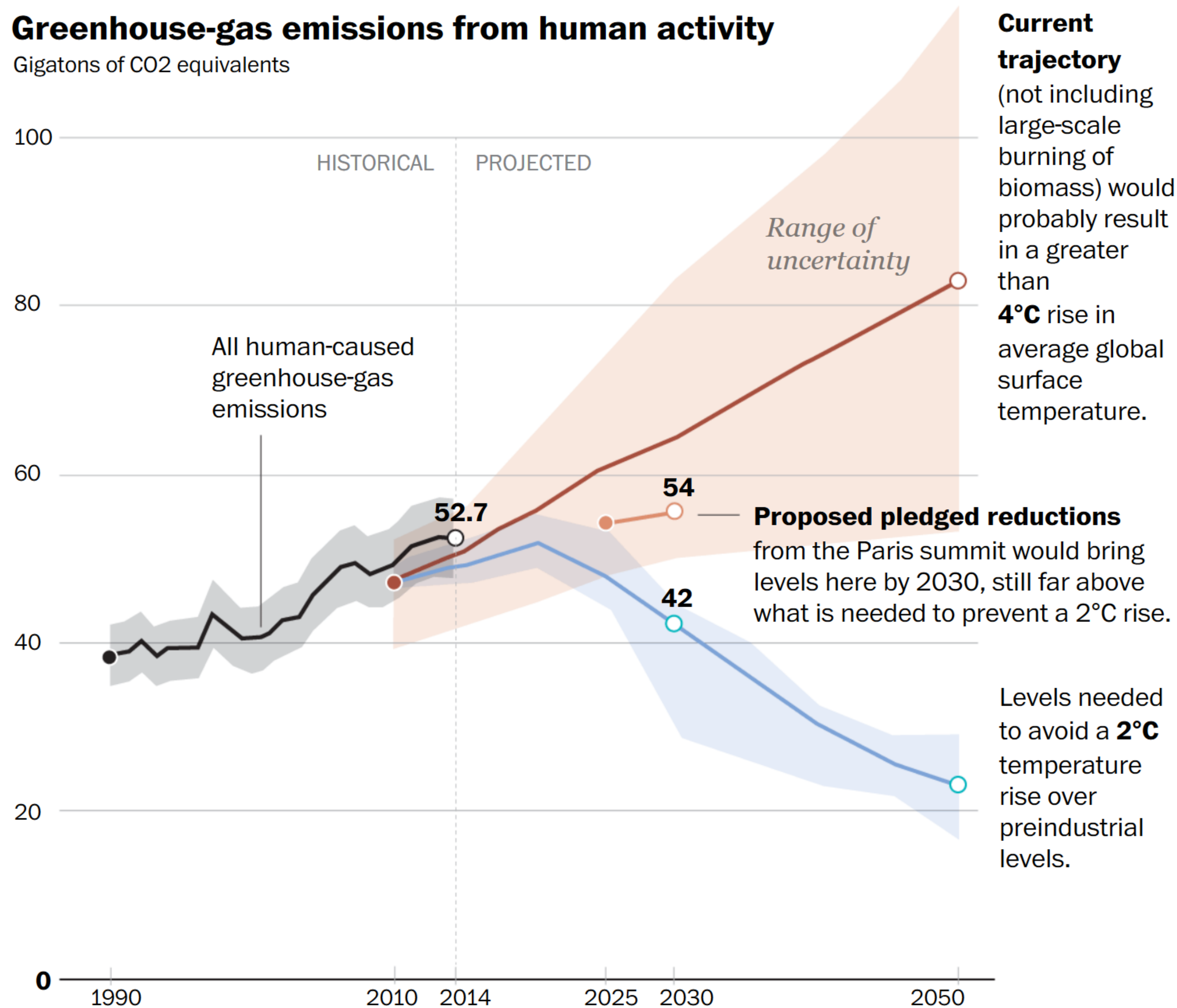


FIGURE 1. Urban and rural temperature anomalies (5 year means) for 50 large U.S. metropolitan regions over the period of 1957–2006. These data are updated from an earlier analysis covering the period of 1951–2000 (*17*) and include first-order weather stations from GHCN (v2). Each urban station is paired with three proximate rural stations. Urban and rural stations were selected based on population thresholds and night light intensities and have been fully corrected for standard inhomogeneities, with the exception of an urban correction. Note that average anomalies computed for years following 2002 reflect less than five years of observations (*19*). These data were obtained from the NASA Goddard Institute of Space Studies. For a complete description of this analysis, see ref *17*.

Stone, Brian. 2009. Land Use as Climate Change Mitigation. *Environmental Science & Technology* 43: 9052–9056.

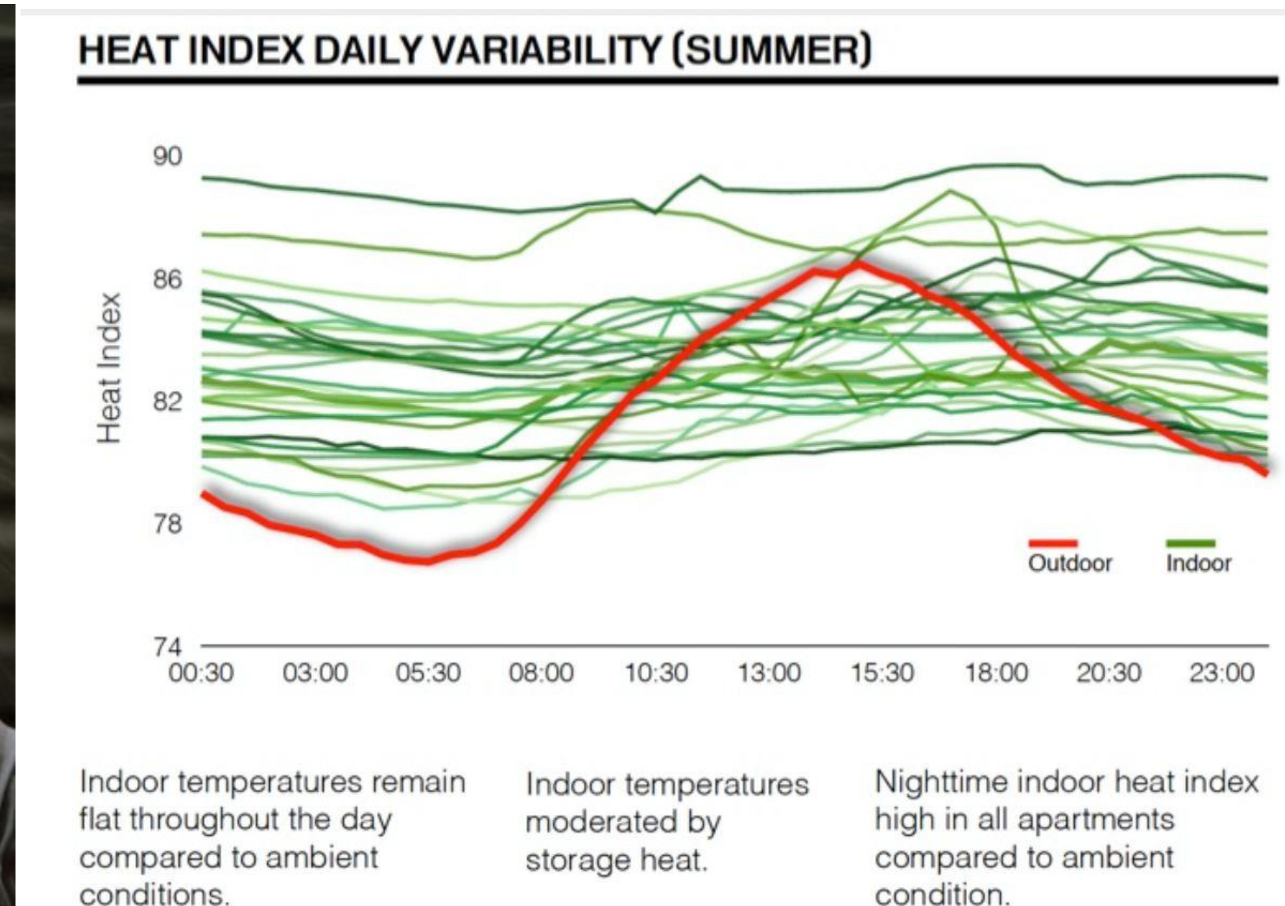


Source: U.N. Environment Program

THE WASHINGTON POST

Many old homes in Buffalo, N.Y., are abandoned and targeted for demolition. Through the city's Urban Homestead program, preservation activists are getting residents to buy such homes for $1 each and promise to renovate and move into them. (Alana Semuels / Los Angeles Times)

Flickr Creative Commons, GuianBolisay, Suck It Heat Wave! NYC



Brian Vant-Hull & Prathap Ramamurthy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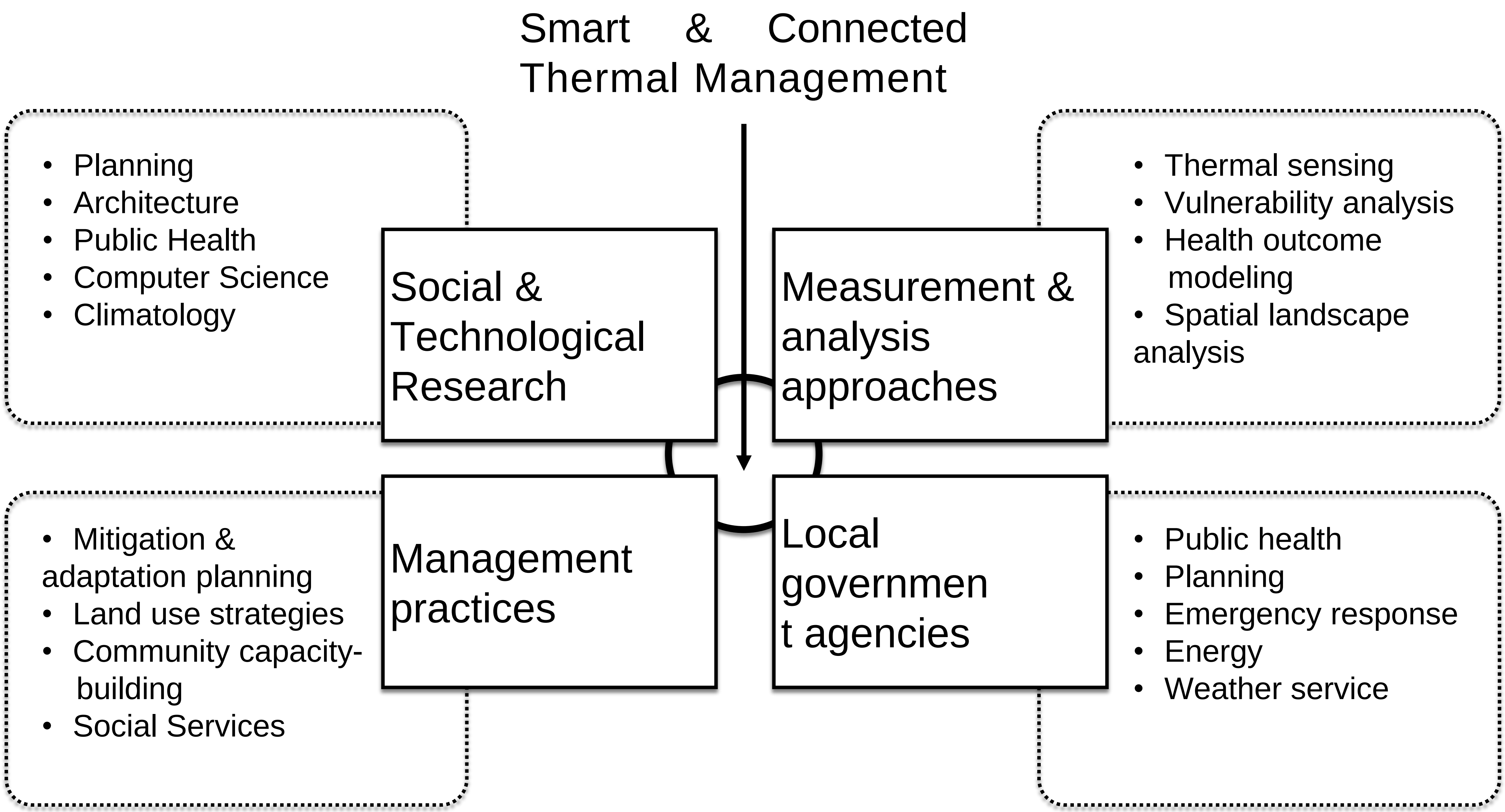
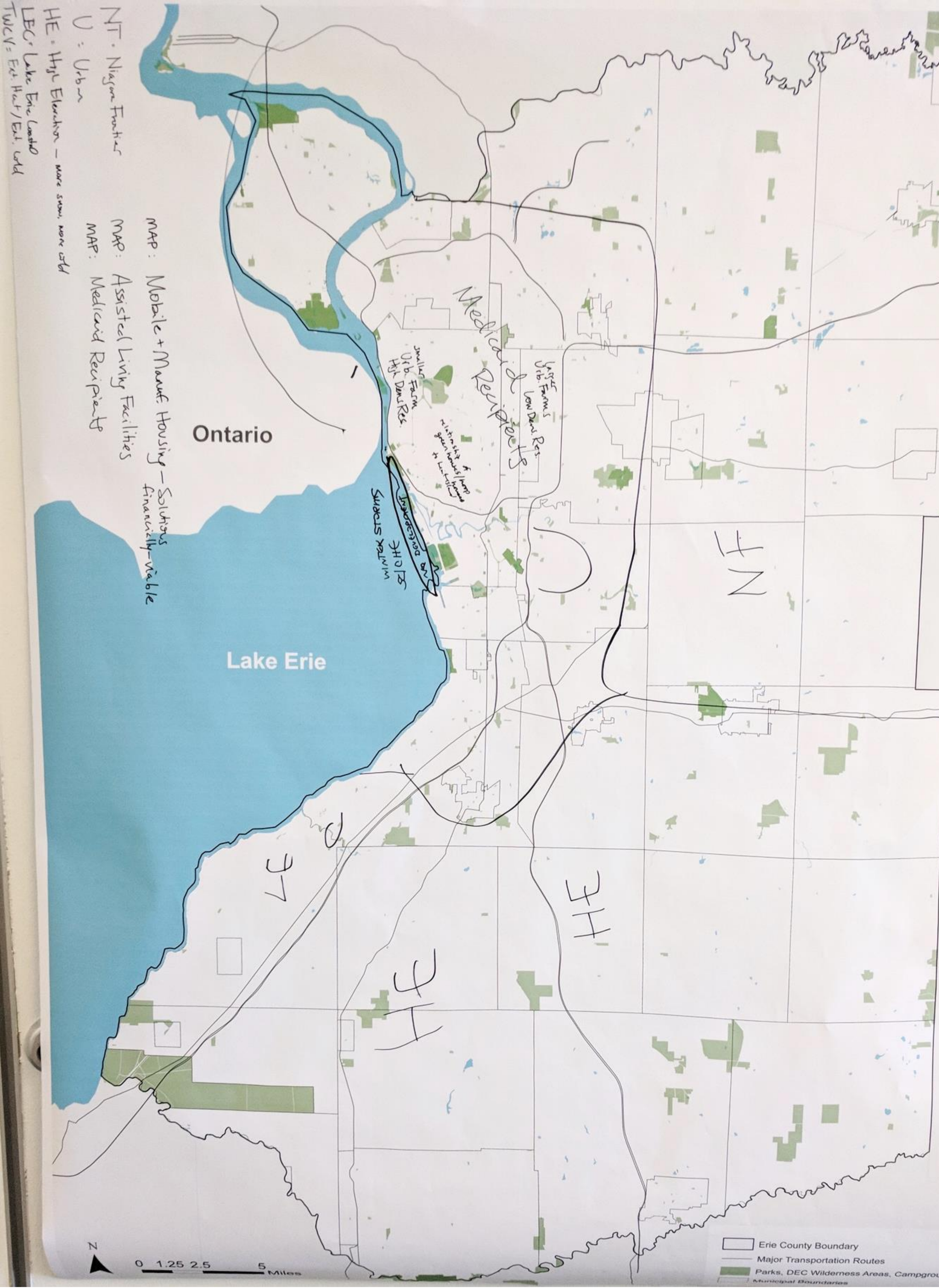
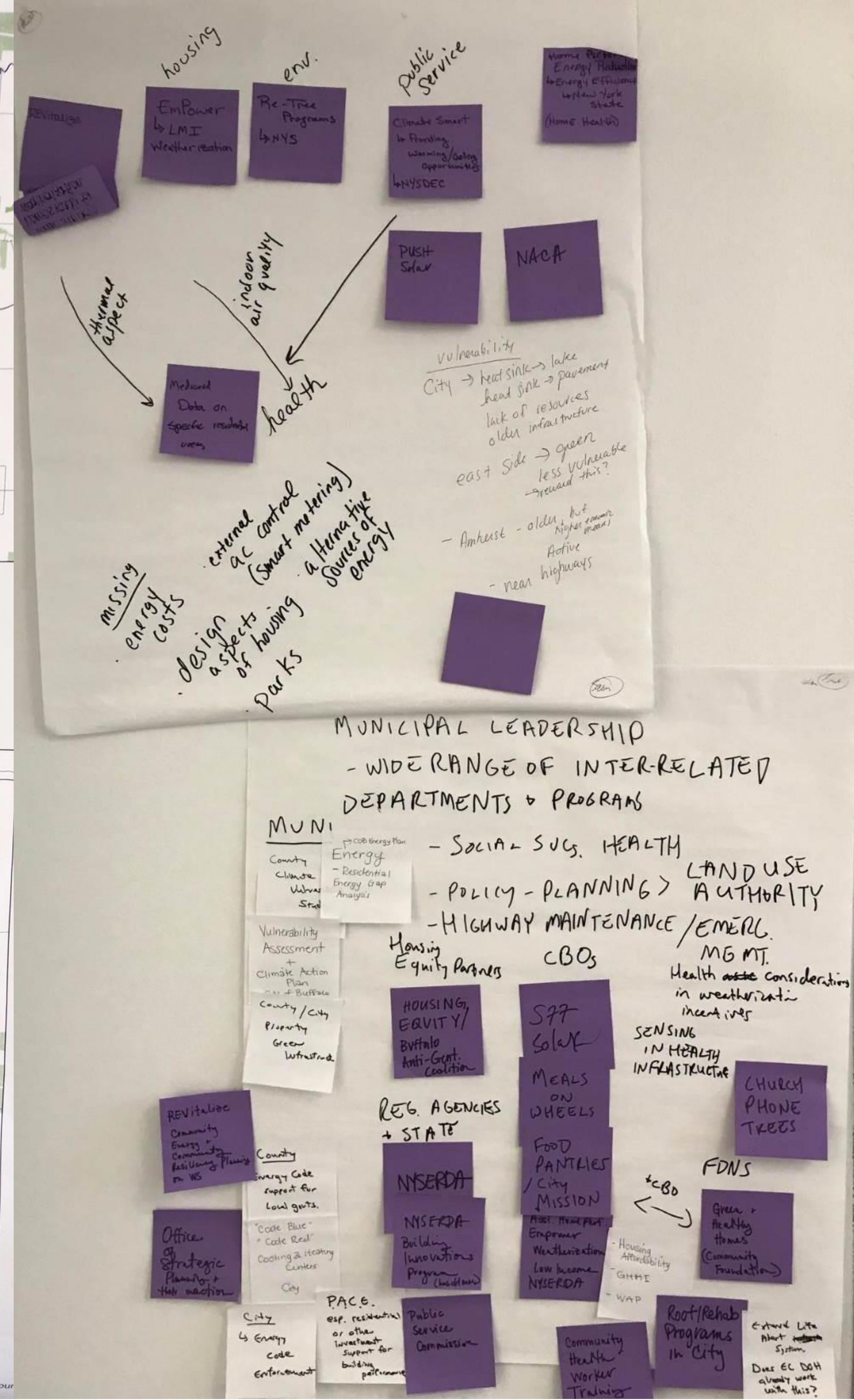

Smart & Connected Thermal Management
Planning
Architecture
Public Health
Computer Science
Climatology
Social & Technological Research
Measurement & analysis approaches
Thermal sensing
Vulnerability analysis
Health outcome modeling
Spatial landscape analysis
Mitigation & adaptation planning
Land use strategies
Community capacity-building
Social Services
Management practices
Local governmen t agencies
Public health
Planning
Emergency response
Energy
Weather service

Dave Hondula


NT: Niagara Frontier
U: Urban
HE: High Elevation – more snow more cold
LEC: Lake Erie Coastal
MAP: Mobile + Manuf Housing – Solutions financially viable
MAP: Assisted Living Facilities
MAP: Medicaid Recipients
Ontario
Lake Erie
Medicaid Recipients
NT
U
HE
LEC
Erie County Boundary
Major Transportation Routes
Parks, DEC Wilderness Areas, Campgrounds
Municipal Boundaries
0 1.25 2.5 5 Miles
N


housing
env.
public service
EmPower LMI Weatherization
Re-Tree Programs NYS
Climate Smart Flooding Warming/Cooling Opportunities NYSDEC
PUSH Solar
NACA
thermal aspect
indoor air quality
health
Medicaid Data on specific residential areas
vulnerability
City → heat sink → lake
heat sink → pavement
lack of resources
older infrastructure
east side → green
less vulnerable
– Amherst – older, but
Active
– near highways
external ac control (smart metering)
alternative sources of energy
missing energy costs
design aspects of housing
parks
MUNICIPAL LEADERSHIP
– WIDE RANGE OF INTER-RELATED DEPARTMENTS + PROGRAMS
– SOCIAL SVC. HEALTH
– POLICY – PLANNING > LANDUSE AUTHORITY
– HIGHWAY MAINTENANCE / EMERG. MGMT.
Housing Equity Partners
CBOs
Health considerations in weatherization incentives
SENSING IN HEALTH INFRASTRUCTURE
HOUSING EQUITY / Buffalo Anti-Gent. Coalition
S77 Solar
MEALS ON WHEELS
CHURCH PHONE TREES
REG. AGENCIES + STATE
FOOD PANTRIES / City MISSION
FDNS
NYSERDA
NYSERDA Building Innovations Program
Green + Healthy Homes (Community Foundation)
Office of Strategic Planning
PACE
City
Public Service Commission
Community Health Worker Training
Roof/Rehab Programs in City

Introduce yourself.

How does the problem of thermal vulnerability matter to your organization?

5 minutes

What programmatic gaps stand in the way of addressing the problem of thermal vulnerability?

What information would be useful for improving these programs to address thermal vulnerability?

10 minutes

What technological or programmatic innovations could help address thermal vulnerability in the community?

What role could your organization play in those innovations?

10 minutes

Thanks!

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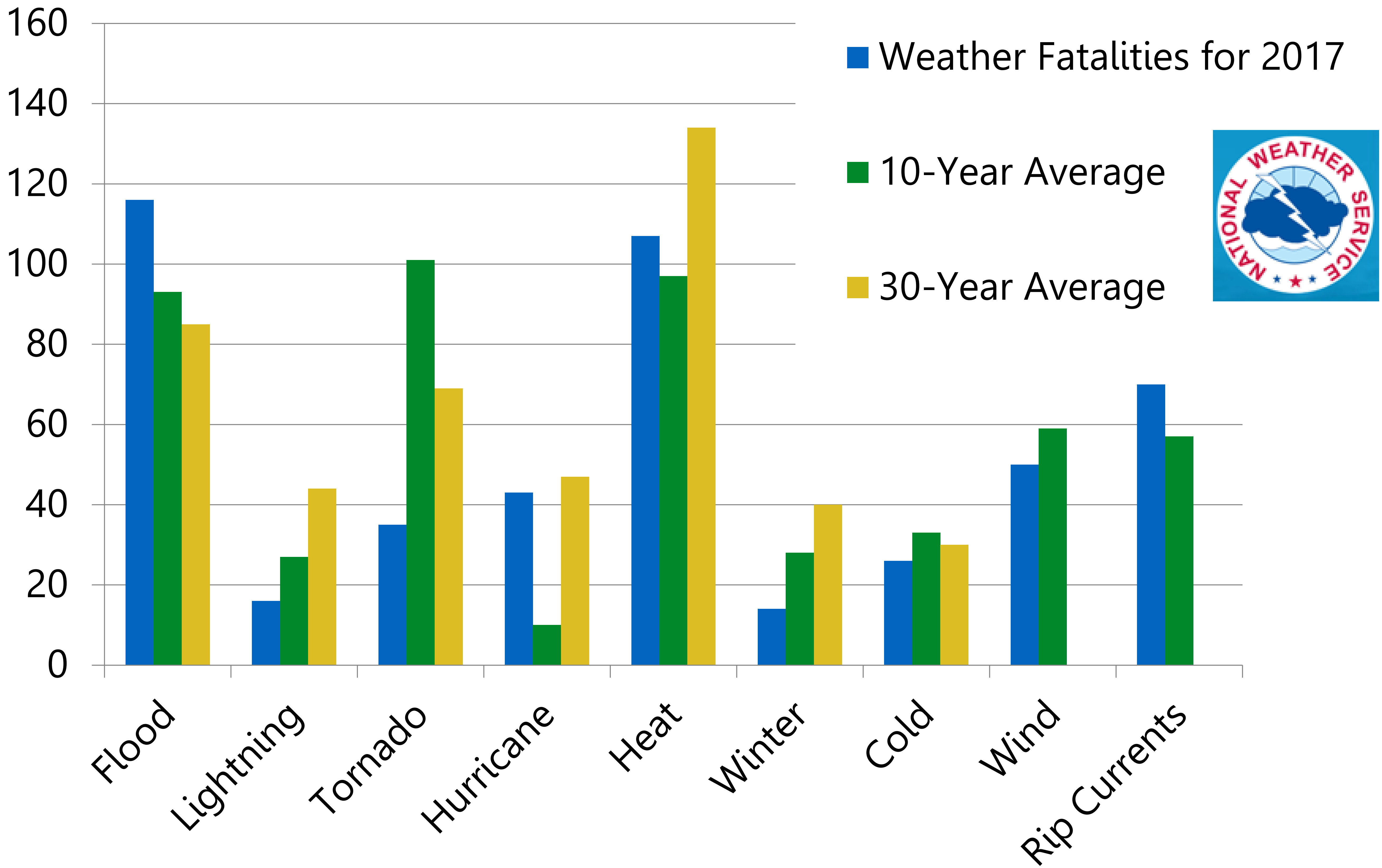
community-resilience-lab.com


Weather Fatalities for 2017
10-Year Average
30-Year Average
160
140
120
100
80
60
40
20
0
Flood
Lightning
Tornado
Hurricane
Heat
Winter
Cold
Wind
Rip Currents