

Health Effects of Exposure to Extreme Heat

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Overview of Heat-related Illness

- Heat Rash. A skin irritation caused by excessive sweating during hot, humid weather; most common in young children.
- Heat Cramps: Affect people who sweat heavily during strenuous activity depleting the body's salt and fluids.
- Heat Exhaustion: A milder form of heat-related illness that can develop after several days of exposure to high temperatures.
 - Characterized by paleness, fatigue, muscle cramps, dizziness, headache, nausea or vomiting, and fainting. The skin is typically cool and moist.
- Heat Stroke: A severe form of hyperthermia where the body is unable to regulate its temperature.
 - The sweating mechanism fails, and the body is unable to cool down.
 - Characterized by red, hot, and dry skin (no sweating); rapid, strong pulse; throbbing headache; dizziness; nausea; confusion; and unconsciousness.

Heat Waves

■ High mortality

- More deaths than hurricanes, lightning, tornadoes, floods, and earthquakes combined.
- From 1999–2003, total of 3,442 reported heat-related deaths. Annual mean of 688 (MMWR 2006)

■ Lack of public recognition

- No damage to infrastructure (silent killer)
- Many deaths go unreported or unattributed

■ Every death is preventable



Silent Killer

Heat Wave Studies

1980 St. Louis

- 1st to highlight the magnitude of mortality from heat waves
- All cause mortality increased 57%

1993 Philadelphia

- Identified cardiovascular mortality as a major cause of death associated with extreme heat

1995 Chicago

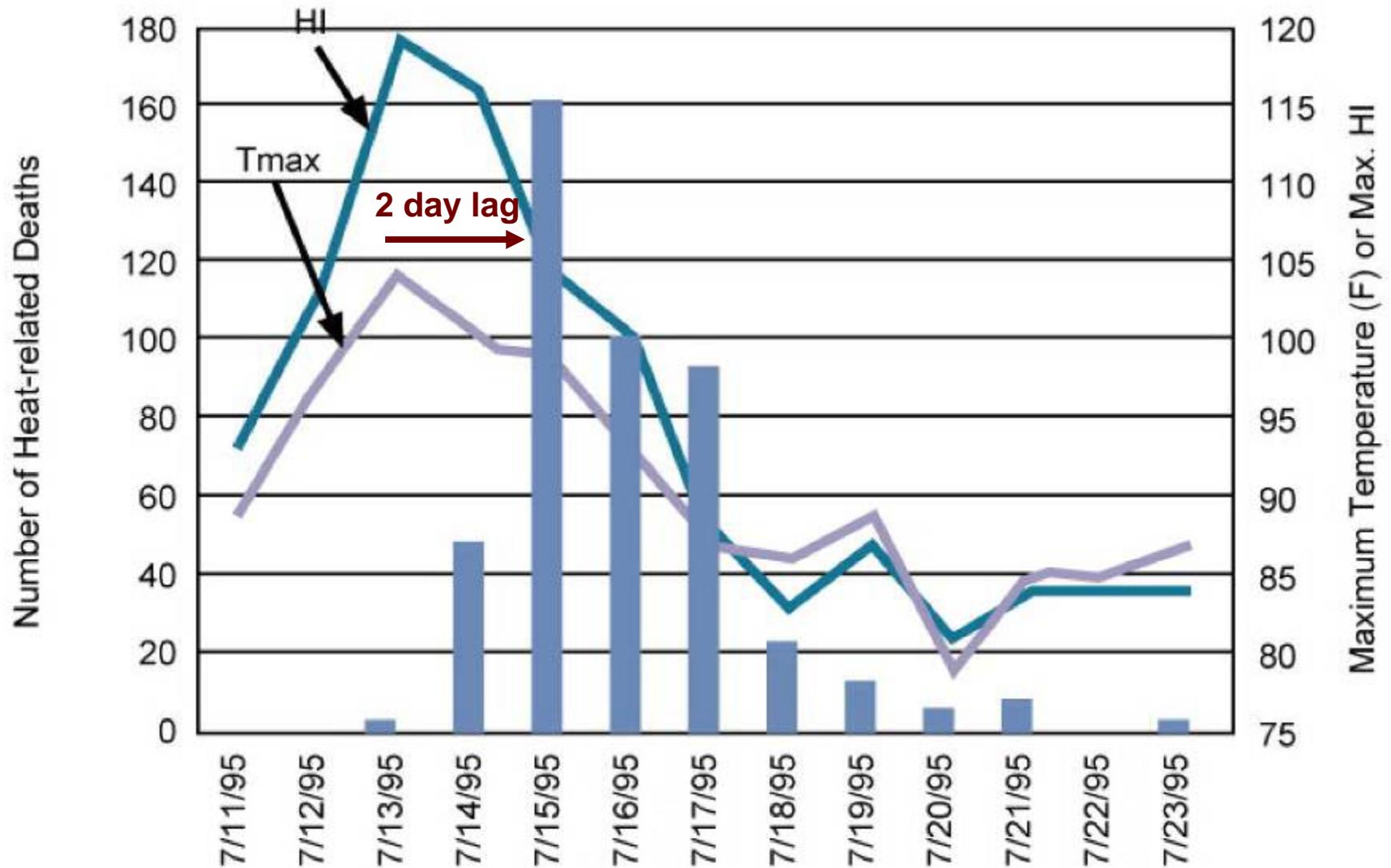
- Redefined heat-related death as used by medical examiners
- Assisted with the development of a Heat Wave Response Plan

U. S. Agents in Chicago Track a Subtle Health Hazard: Heat



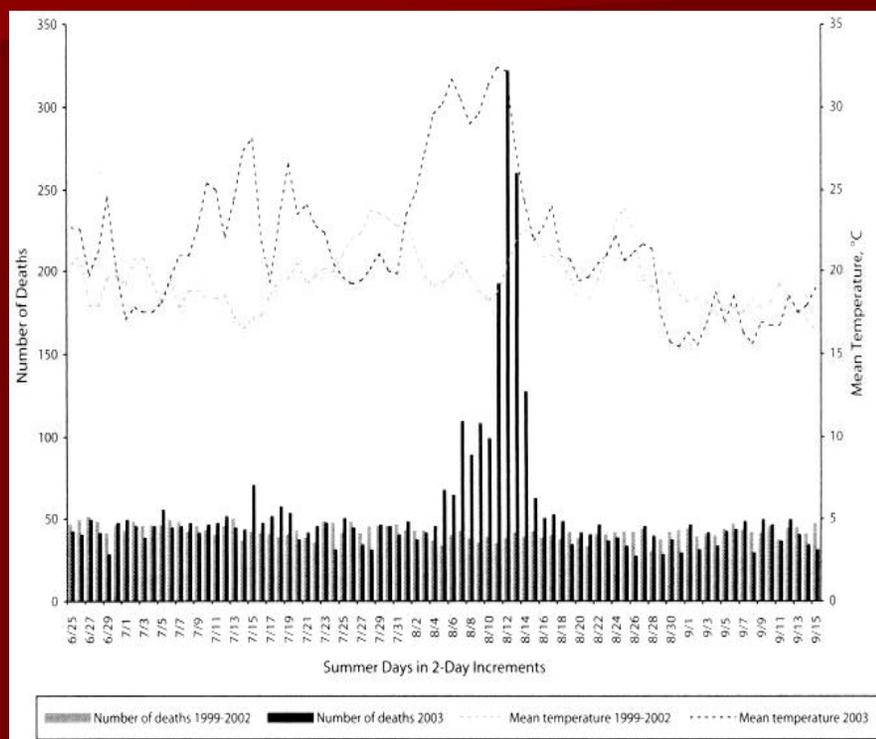
Federal health agents are in Chicago trying to determine the contributing factors to the more than 500 deaths related to the heat in July. Coffins containing the bodies of unclaimed victims were loaded on a truck by a Cook County morgue worker this summer for a mass burial.

Heat Related Deaths in Chicago in July 1995



European heat wave, 2003

TIME LINE (FRANCE)



Vandendorren et al. Mortality in 13 French cities during the August 2003 heat wave. *Am J Public Health* 2004; 94(9):1518-20.

CONFIRMED MORTALITY

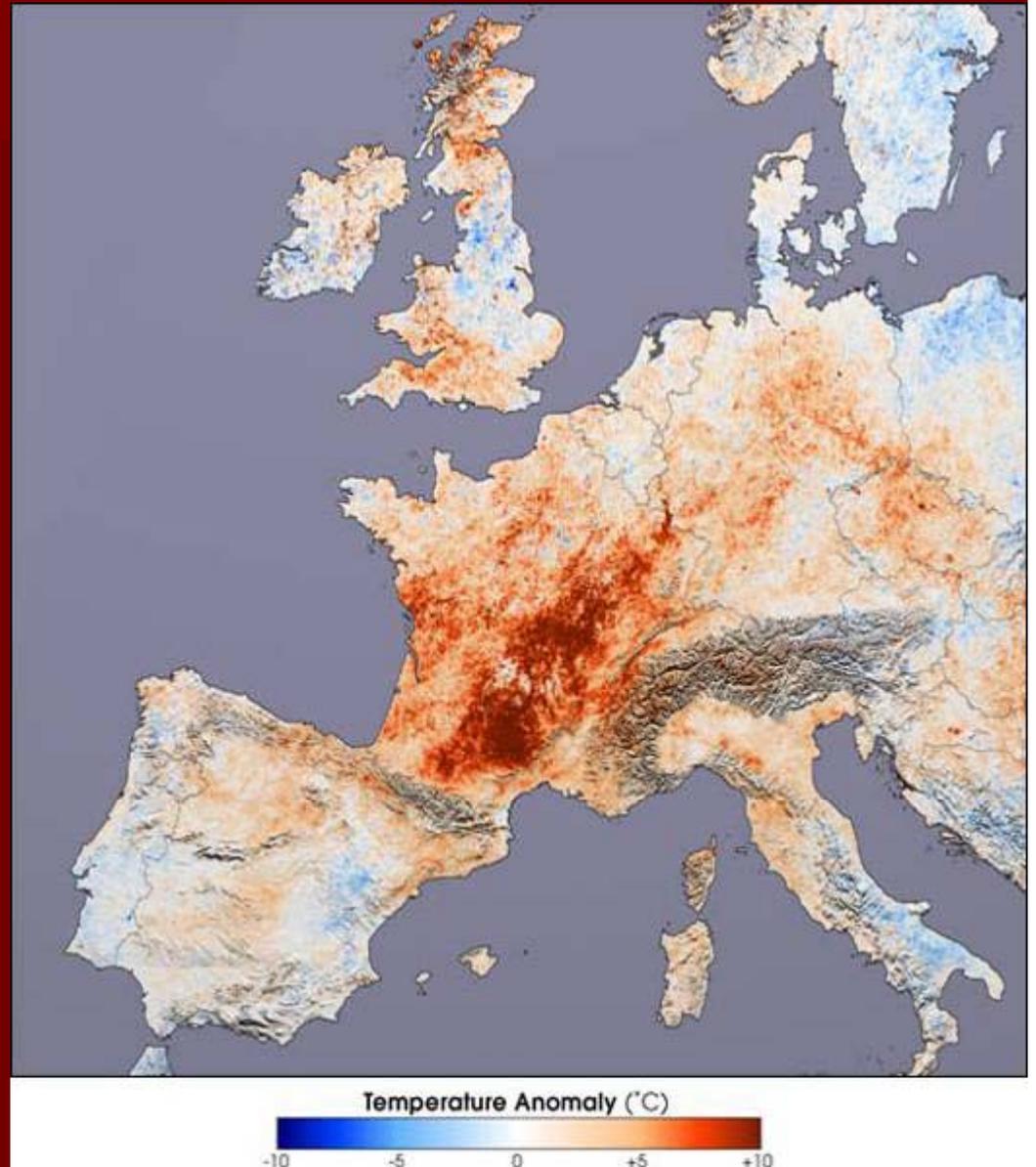
UK	2,091
Italy	3,134
France	14,802
Portugal	1,854
Spain	4,151
Switzerland	975
Netherlands	1,400-2,200
Germany	1,410
TOTAL	29,817-30,617

Haines et al. Climate change and human health: Impacts, vulnerability and public health. *Public Health* 2006;120:585-96.

Heat Wave Studies

2003 France

- 34,000+ dead in Europe
- 14,000+ dead in France
- Many were elderly in nursing homes
- No effective method to cool



Lessons Learned

Risk factors for hyperthermia:

Individual

- Age
- Underlying medical conditions / mental illness
- Income and poverty status
- Homelessness
- Social isolation
- Access to health care and cooling facilities
- Neighborhood characteristics: land use/ land cover, crime rate, housing type, urban heat island

Community Characteristics



Risk Factor: Building Type

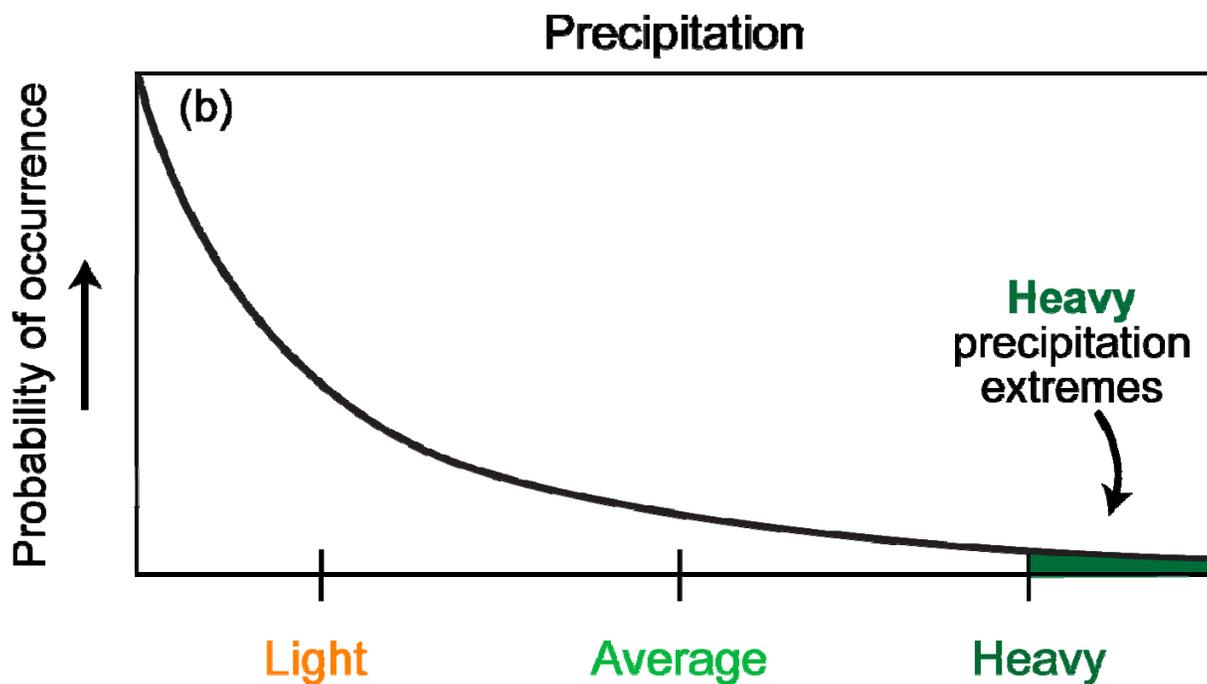
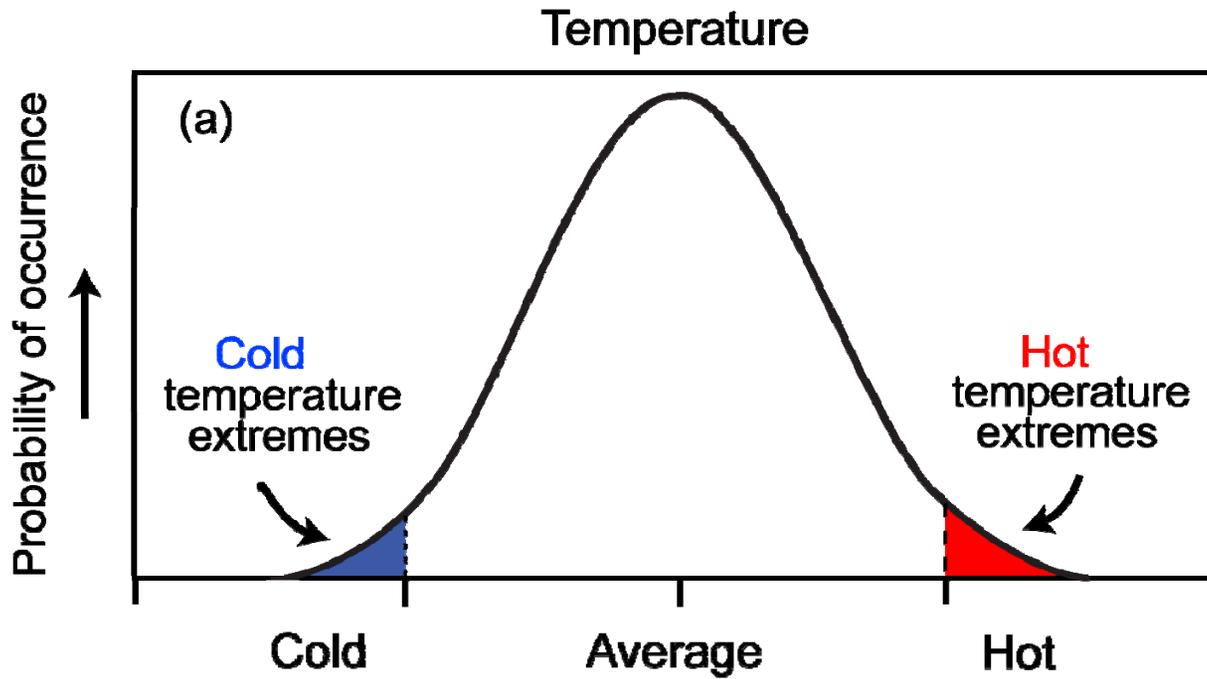


Risk Factor: Crime



Risk Factor: Energy Costs?

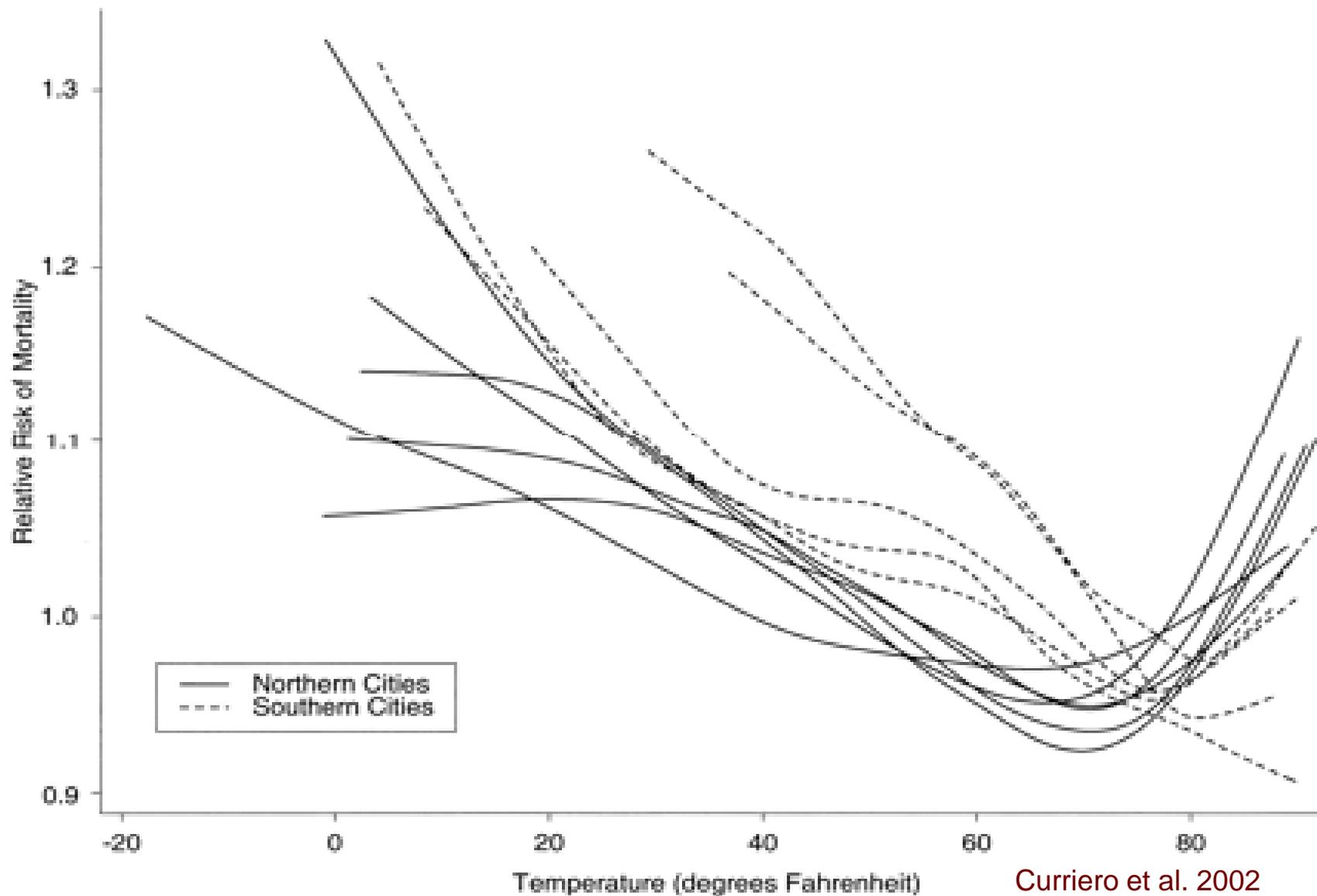
- Fear of using air conditioning
 - 2006 Heat Wave decedents with a functional AC unit
 - NYC: 2/40 (5%)
 - Missouri 1/25 (4%)
 - California: 18/140 (13%)



Extremes
impact
people more
than mean

Peterson et al., 2007b

Temperature-mortality relation for 11 US cities, 1973–1994



Curriero et al. 2002

Climate Change Predictions

Intergovernmental Panel on Climate Change (IPCC):

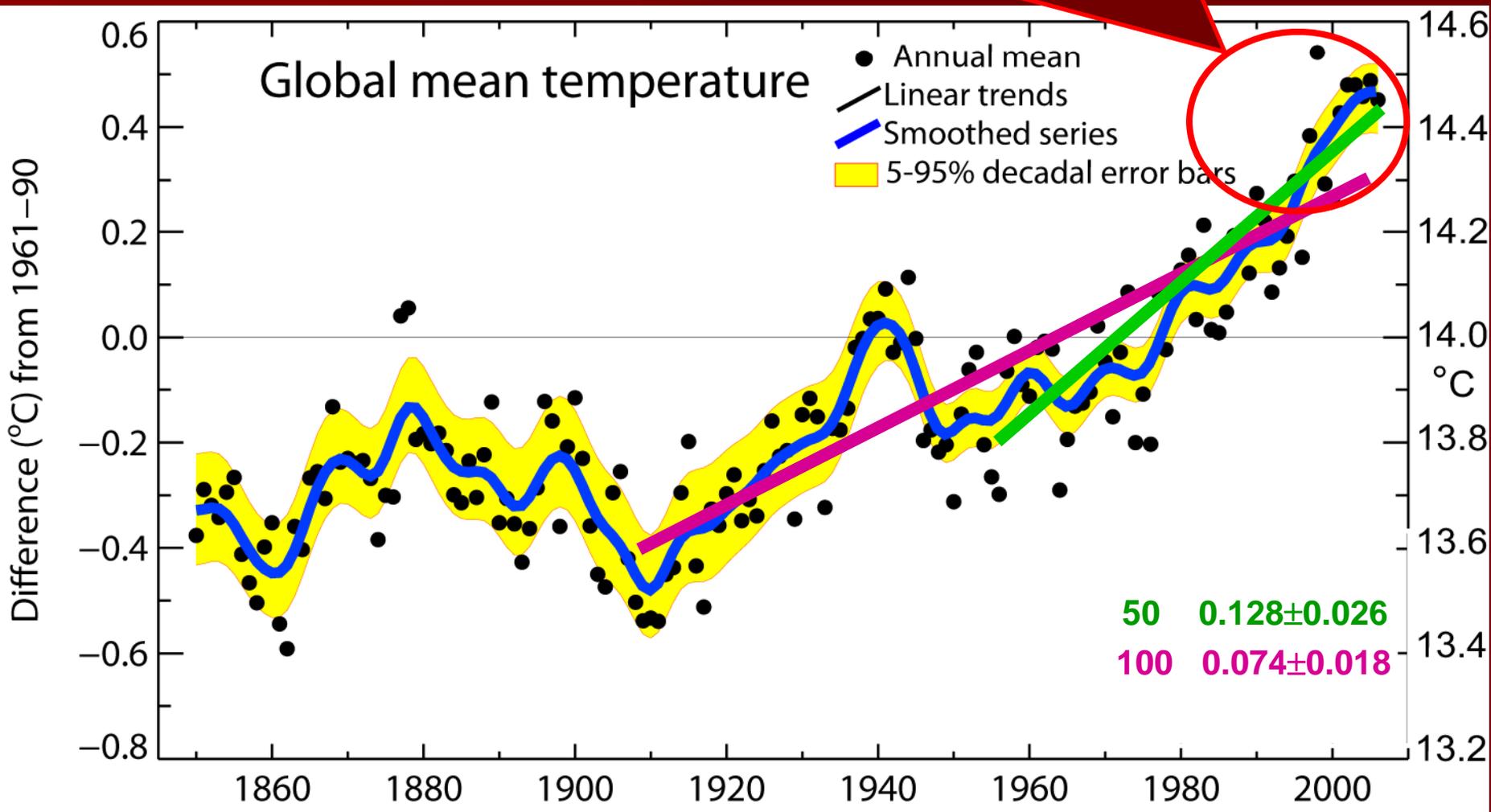
“Cities that currently experience heat waves are expected to be further challenged by an increased number, intensity and duration of heat waves during the course of the century.”
[very high confidence]



Observations:

Global mean

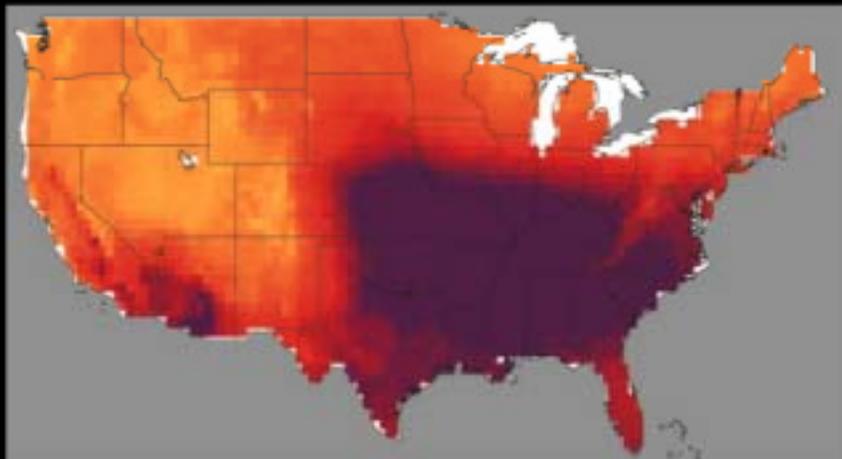
Warmest 12 years:
1998, 2005, 2003, 2002, 2004, 2006,
2001, 1997, 1995, 1999, 1990, 2000



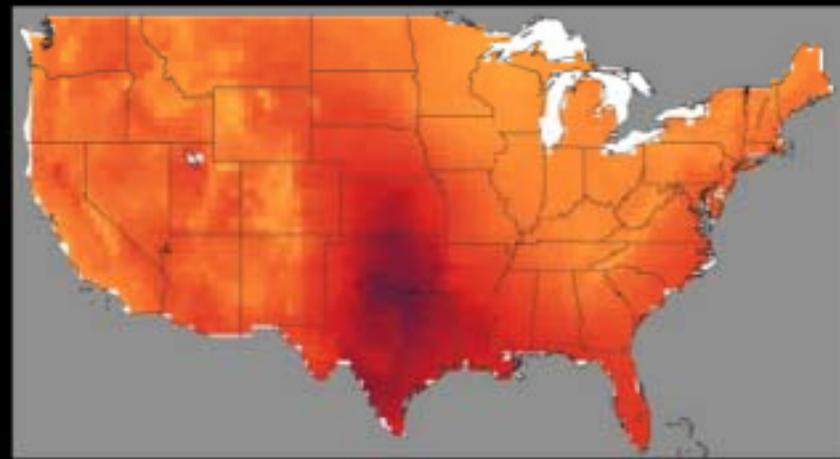
July Heat Index Change -- 21st Century

July Heat Index Change - 21st Century

Canadian Model



Hadley Model



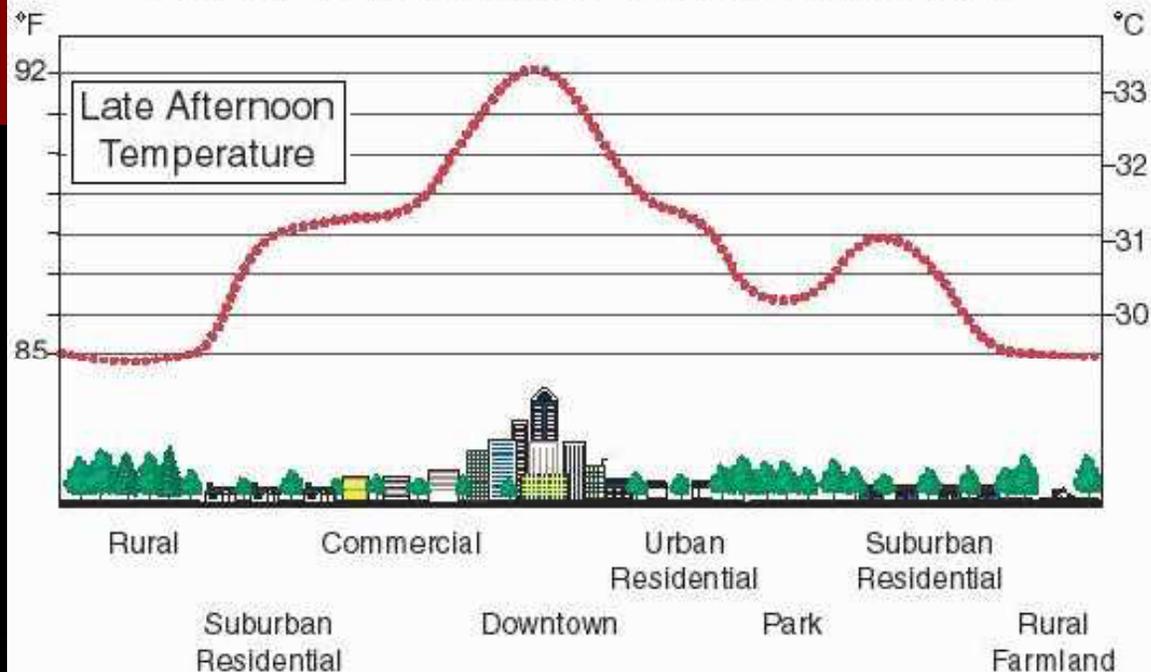
Map by B. Felzer, UCAR, based on data from Canadian and Hadley modeling centers.

- A July day in Atlanta that now reaches a heat index of 105°F would reach a heat index of 115°F in the Hadley model, and 130°F in the Canadian model.

Urban “built” environments

- Cities and climate are coevolving in a manner that will place more populations at risk.
- Increase in vulnerable populations:
 - Today, more than half of the world’s population lives in cities, up from 30% in 1950.
 - By 2100 there will be 100 million more people > 65 years old (relative to 2000) (Ebi et al. 2006).
- Urban heat islands

Sketch of an Urban Heat-Island Profile



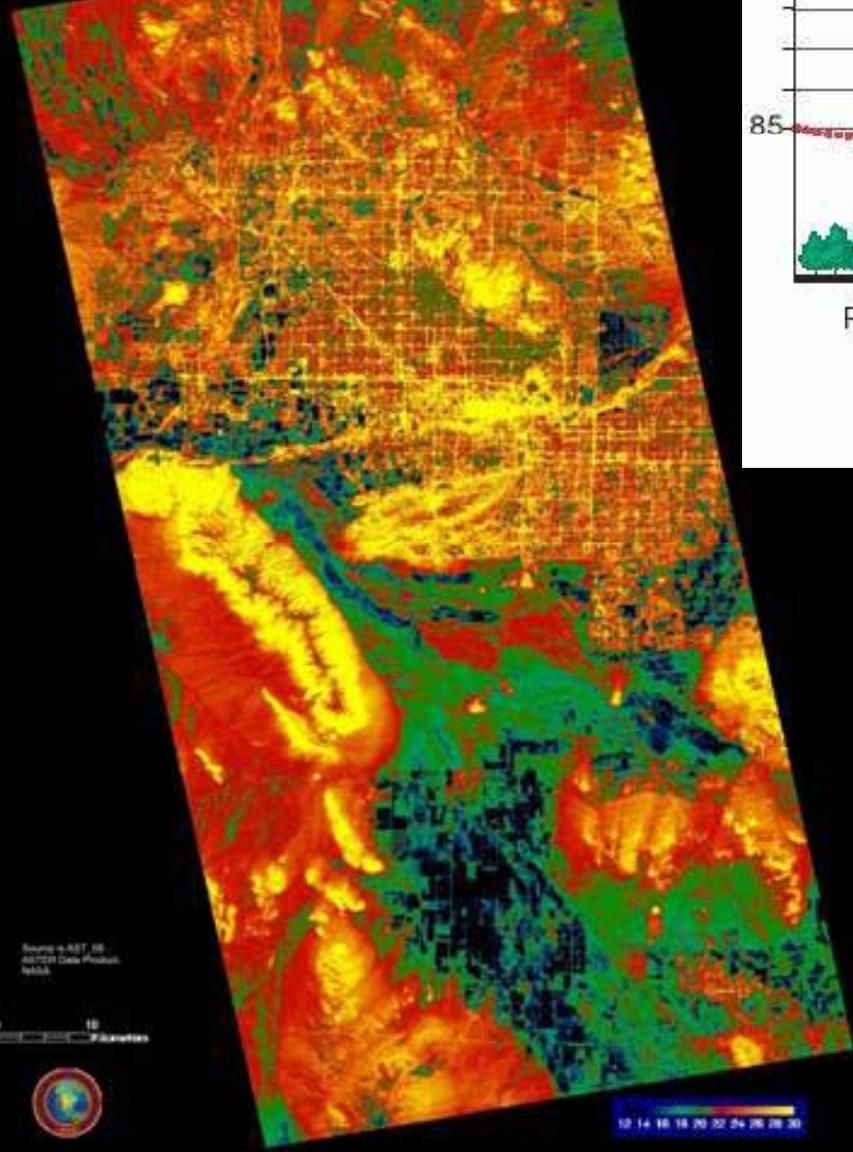
Urban Heat Island
can add 7° – 12° F

Thermal Satellite Image of
Phoenix, AZ Night Surface
Temperature

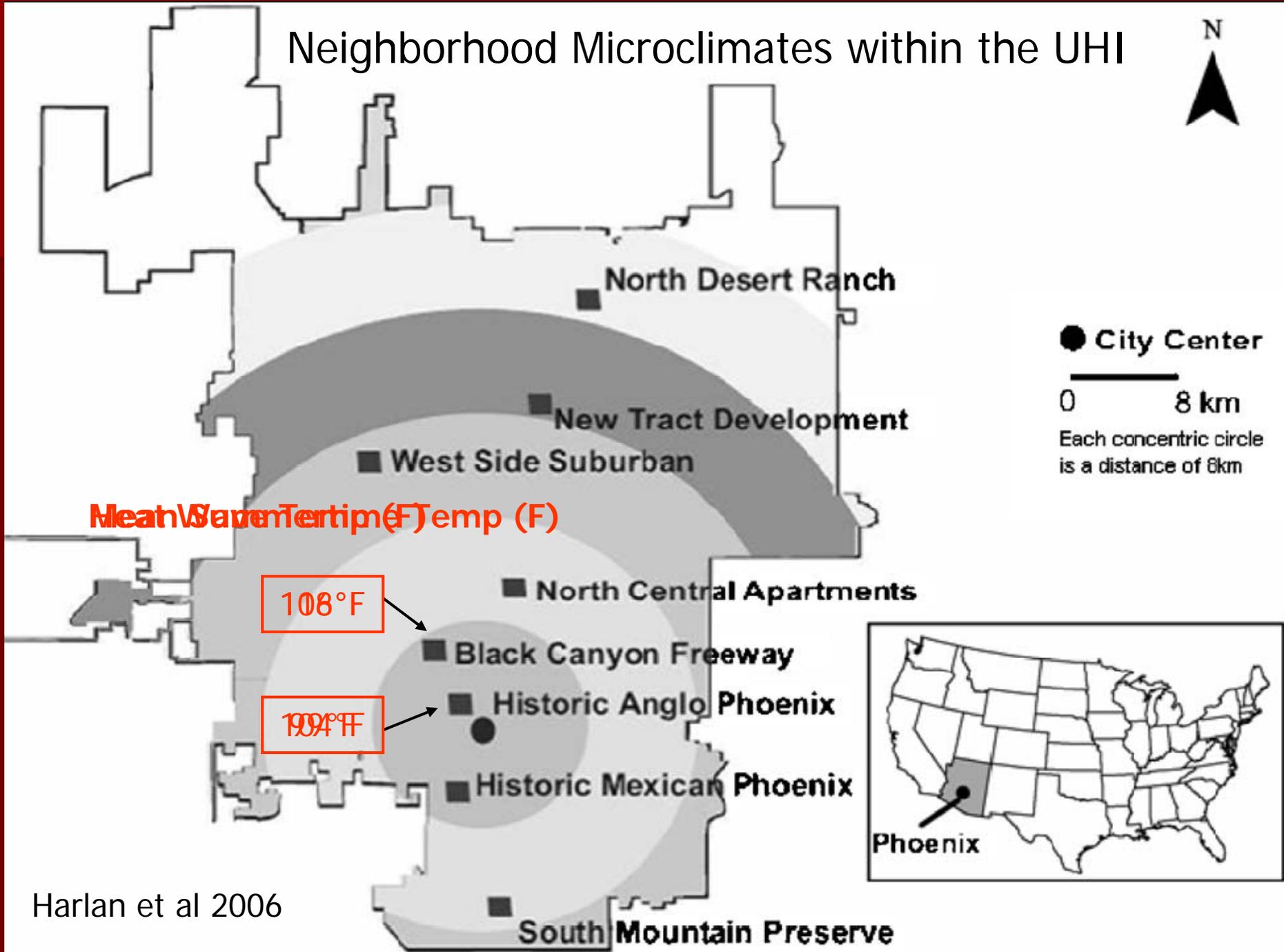


Night Surface Temperature (C), Phoenix Area, AZ

3-October-2003, - 22:39:00



Neighborhood Microclimates within the UHI



Harlan et al 2006

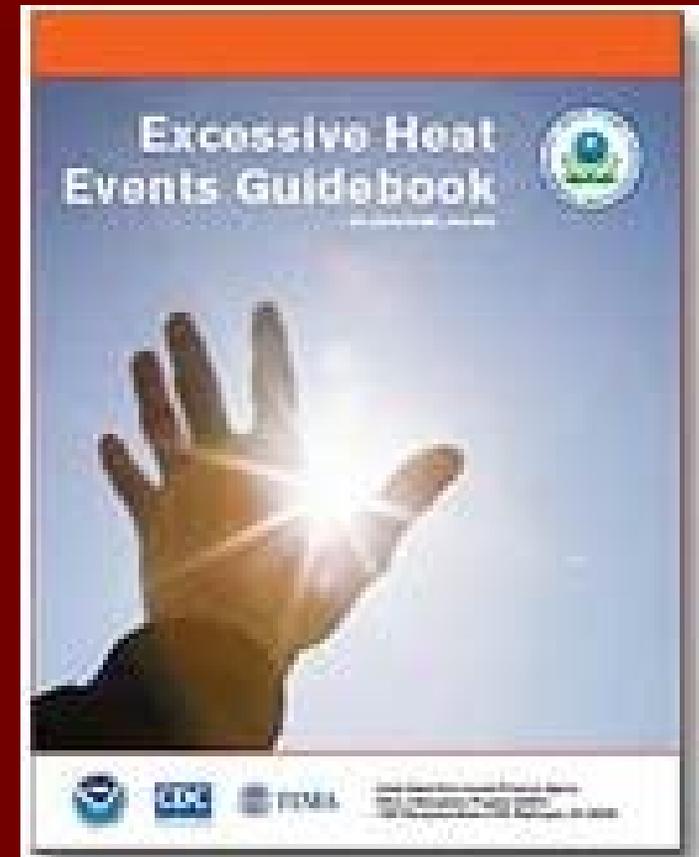
CDC activities

- Guidance on the development of city-specific heat response plans
- Methodology for mapping vulnerability using remote sensing
- Improve Heat Wave messaging and Risk Communication

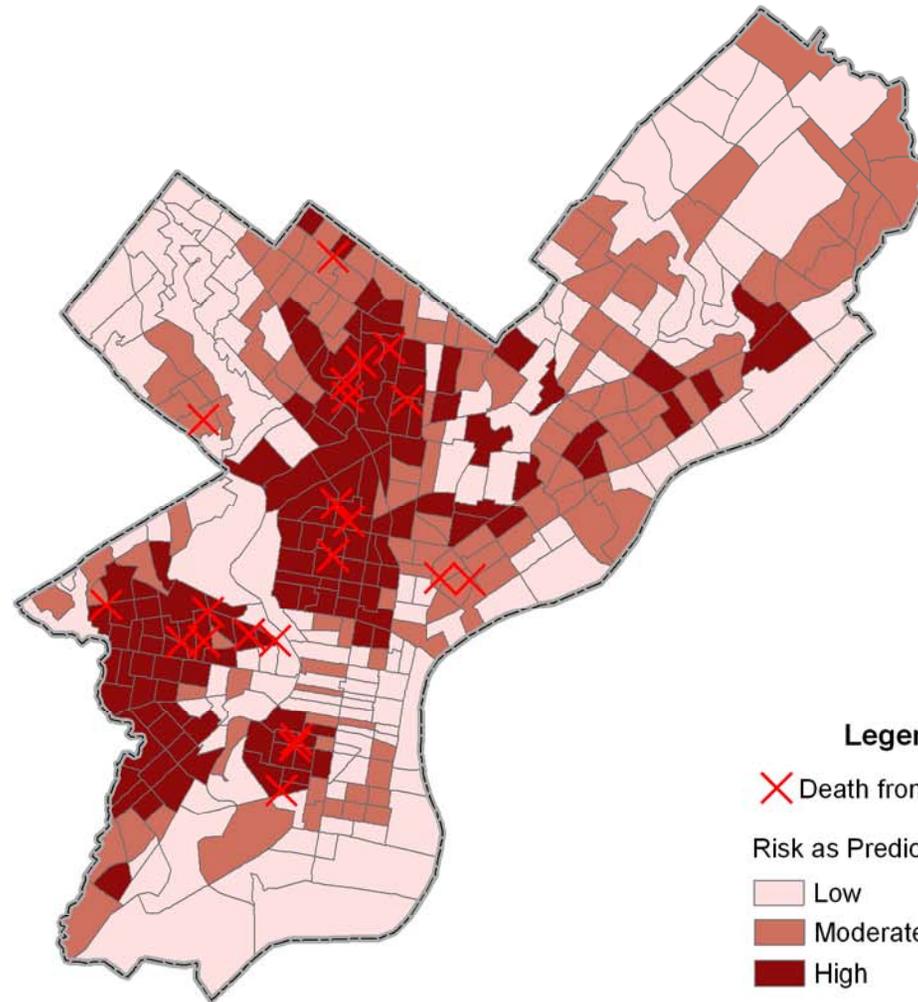


Excessive Heat Events (EHE) Guidebook

- City-specific heat response plans
- The guidebook:
 - EPA, NOAA, CDC, FEMA collaboration
 - Options for defining EHE conditions
 - How to assess local vulnerability
 - EHE notification and response actions that work



Risk for Hyperthermia: Thermal & Census Model



Legend

✕ Death from Hyperthermia (Primary Cause)

Risk as Predicted from Neural Network

Low

Moderate

High



0 2.5 5 10 Kilometers

Death Locations are in Assigned Census Tracts
but are Randomly Offset to Protect Privacy

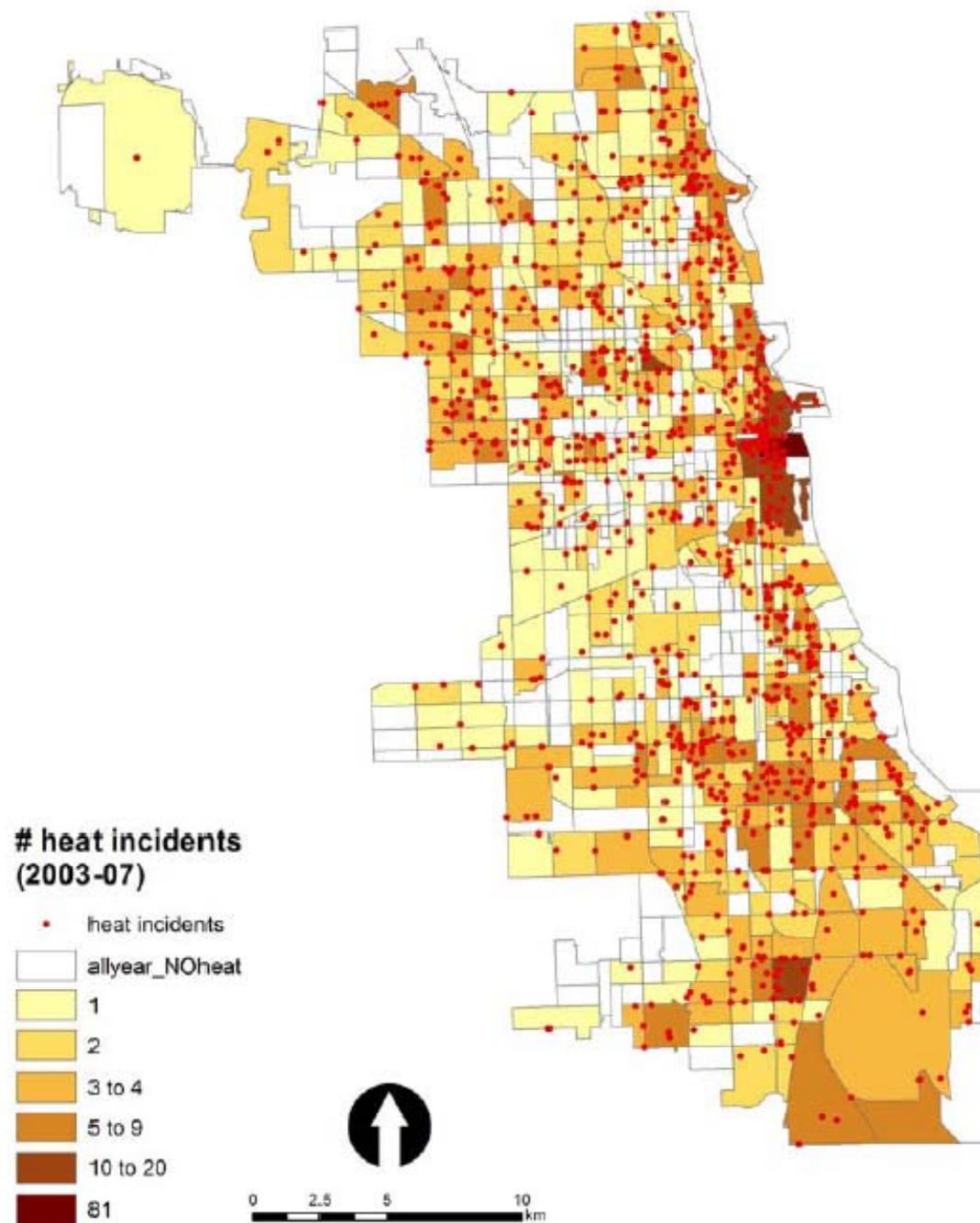


Figure 4.3: Locations of heat-related emergency dispatches recorded from 2003 to 2007.

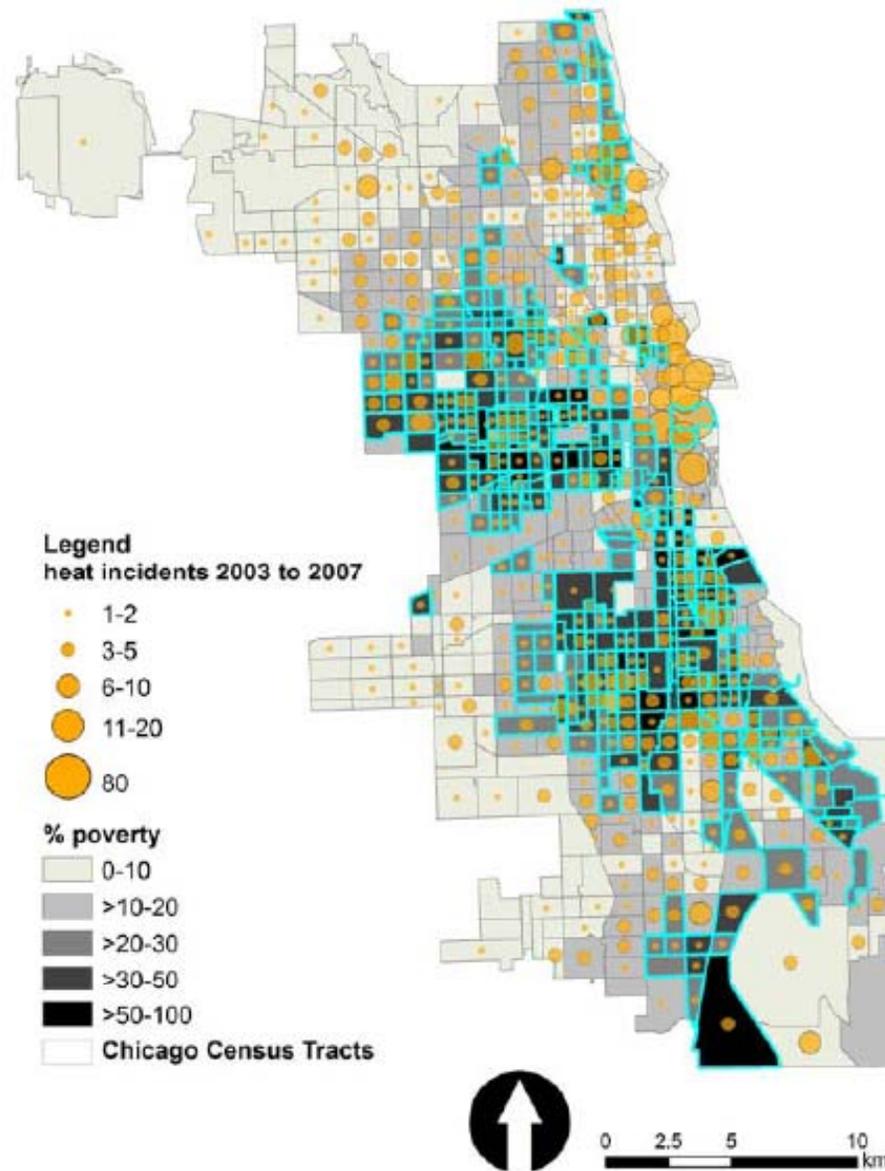
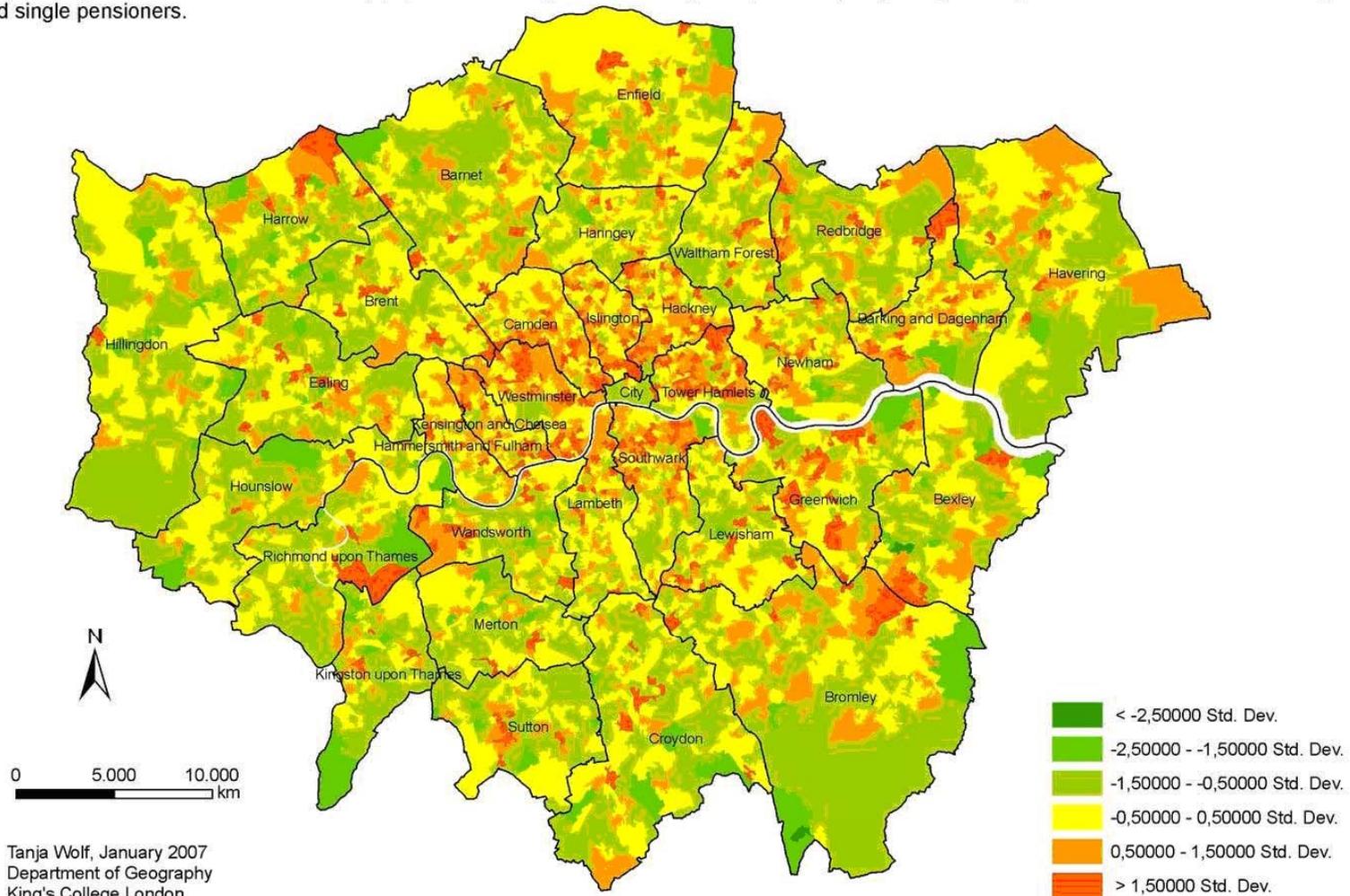


Figure 4.6: Proportion of households below the Federal poverty threshold in the City of Chicago (as of Census 2000) overlaid with 2003 to 2007 heat incident data. Census tracts with >20% households below poverty level are highlighted in blue.

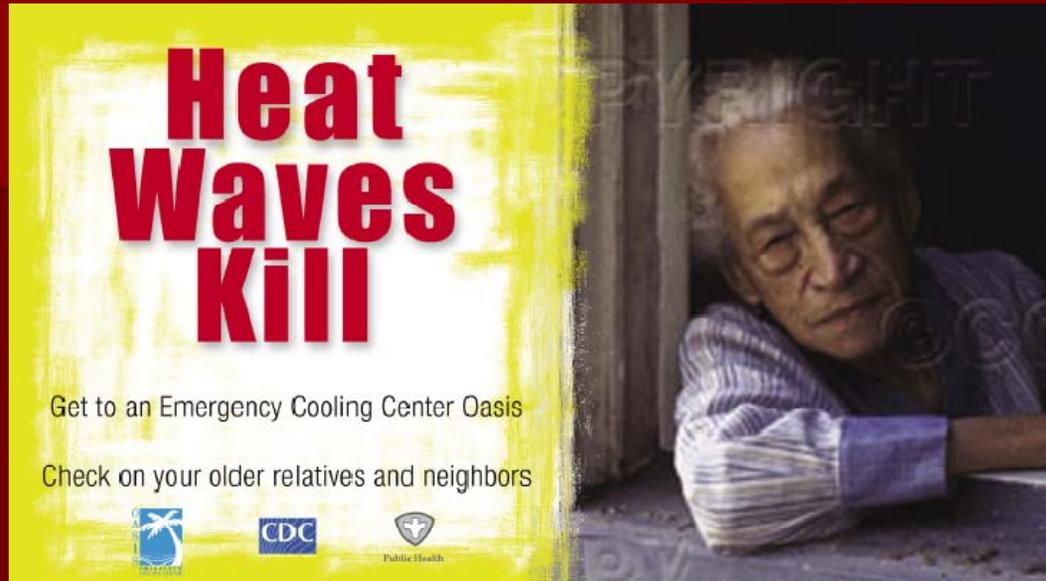
Composite Vulnerability Map

Sensitivity to heat stress in London

sensitivity index based on percentages per district (Lower Level Output Area) on high age, preexisting illness, people living in communal establishments, population density, Index of multiple deprivation (IMD), living in flats, households on 5th floor and higher and single pensioners.



Heat Wave Messaging



Heat Waves Kill

Get to an Emergency Cooling Center Oasis
Check on your older relatives and neighbors



Health Warning

Heat Wave

Go to an air conditioned place during a heat wave.

Heat waves can kill you. A heat wave is when the temperature is over 90 degrees for 3 days or longer. During heat waves, many people die or get very sick. Your body may not be able to stay cool if you do not have air conditioning or your electricity goes off. People who are over 65 with other health problems are in the most danger. Going to a cooler place, even for 2 or 3 hours a day, gives your body a chance to cool down. **This can save your life.**



If you are over 65, you may be in danger even if you do not feel hot.

- Look at a thermometer to see the temperature in your home or apartment.
- Some prescription drugs make it harder to stay cool or know when you are too hot.
- Check on your older neighbors and relatives to make sure their home is cool.



Spend two to three hours in air conditioning during the hottest part of the day. Cool places include:

- public libraries
- malls
- senior centers
- air-conditioned homes of friends/relatives
- emergency cooling centers



If you need a ride,

- Ask for help. Call your local bus service or health department for information on getting to an Emergency Cooling Center.
- You may also ask a friend, relative, or church for help.
- In an emergency, always call 911.

Protect Yourself and Your Family



Final thoughts:

- **As a result of Climate Change, heat waves will pose a significant challenge for urban populations**
- **Morbidity and mortality related to extreme heat exposure can be prevented.**
- **Adaptation measures such as city-specific Heat Response Plans are essential for prevention.**

Thank You

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