Thank you for joining. We will start in a few minutes.

Climate and Heat
Trends, Health Impacts, and Risks

Three audio options:

1. Listen via computer
2. Receive an automated call from WebEx
3. Call in to 1-415-655-0002 or 1-855-797-9485

Event number: 161 616 1987

EPA

HEAT ISLAND REDUCTION PROGRAM

State and Local Climate and Energy Program

Climate and Heat
Trends, Health Impacts, and Risk

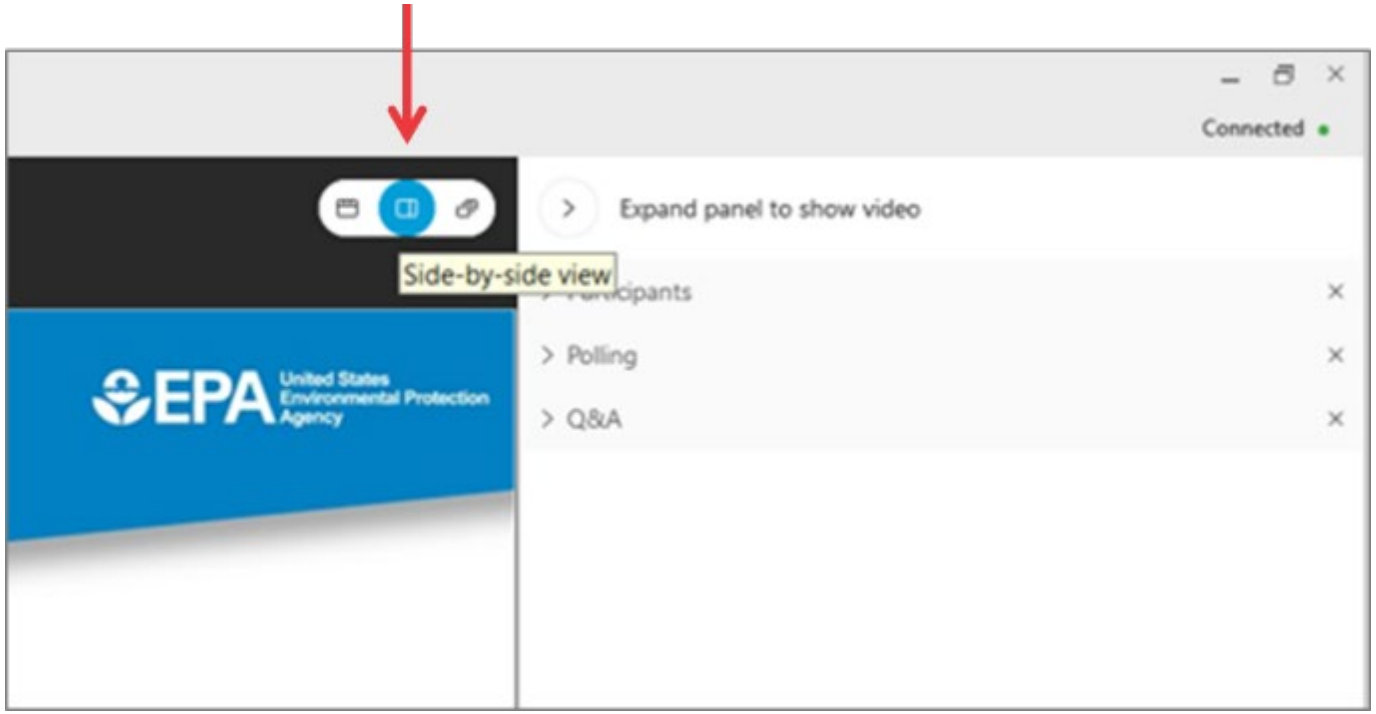
June 24, 2021

Hosted by:

U.S. EPA Heat Island Reduction Program

Screen View

- There are several layout options
- We recommend the side-by-side view



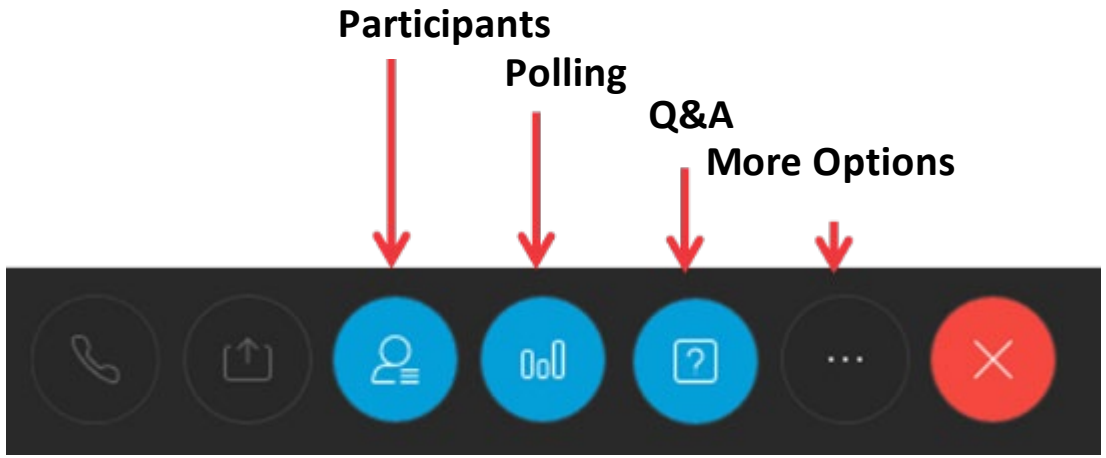
Webinar Panels

We'll use three panels

- Participants, Polling, and Question & Answer (Q&A)
- Use the arrow to expand or collapse the panels

Adding panels

- If some panels don't appear, hover over the bottom of the screen and select the desired panels
- Select More Options (…) for additional panels
- Blue icons indicate active panels

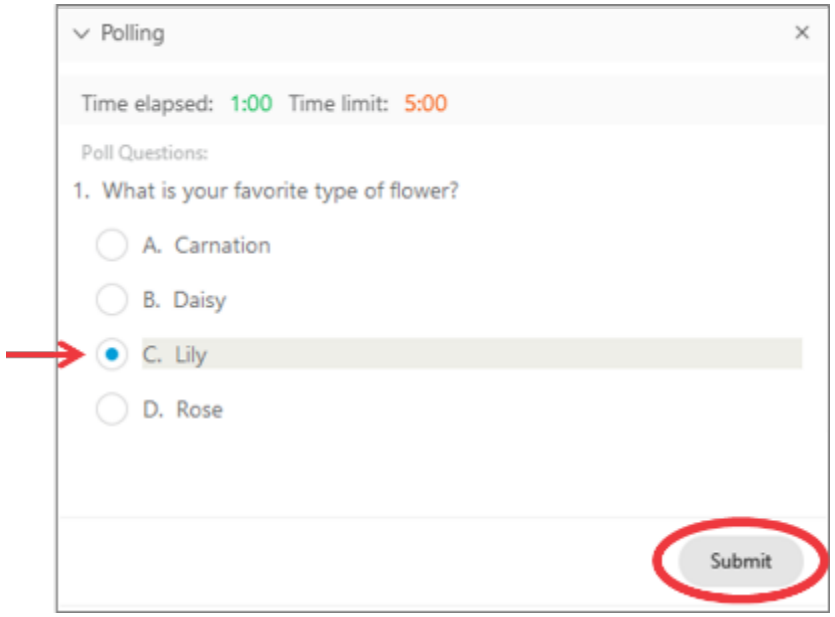


HEAT ISLAND REDUCTION PROGRAM

Polling and Feedback

Polling

- We'll ask several poll questions during the webinar
- The polling panel will appear when we open the first poll
- Select your desired response and hit "Submit"



Webinar feedback

- A feedback form will pop-up when you exit today's webinar

Q&A

- Participants are muted
- Questions will be moderated at the end
  - To ask a question:
    1. Select “All Panelists” from the menu
    2. Enter your question in the Q&A box
    3. Hit “Send”

- EPA will post responses on the Webcast page: www.epa.gov/heat-islands/heat-island-webcasts

HEAT ISLAND REDUCTION PROGRAM

Webinar Agenda

- **Mike Kolian,** Physical Scientist/Climate Analyst, U.S. Environmental Protection Agency(EPA)
- **Marcus Sarofim,** Physical Scientist/Climate Analyst, U.S. EPA
- **Victoria Ludwig,** National Program Manager, Heat Island Reduction Program, U.S. EPA
- Questions and Answers

Poll 1

Has the area where you live experienced changes in the frequency of heat waves in recent years? (select one)

- Yes, more heat waves
- Yes, fewer heat waves
- No, about the same number of heat waves
- Not sure

EPA

HEAT ISLAND REDUCTION PROGRAM

State and Local Climate and Energy Program

Climate and Heat

Trends, Health Impacts, and Risks

Mike Kolian
Physical Scientist/Climate Analyst

Marcus Sarofim
Physical Scientist/Climate Analyst

EPA

HEAT ISLAND REDUCTION PROGRAM

State and Local Climate and Energy Program

Climate and Heat: Trends, Health Impacts, and Risks

U.S. EPA Heat Island Reduction Program Webinar Series

June 24th, 2021

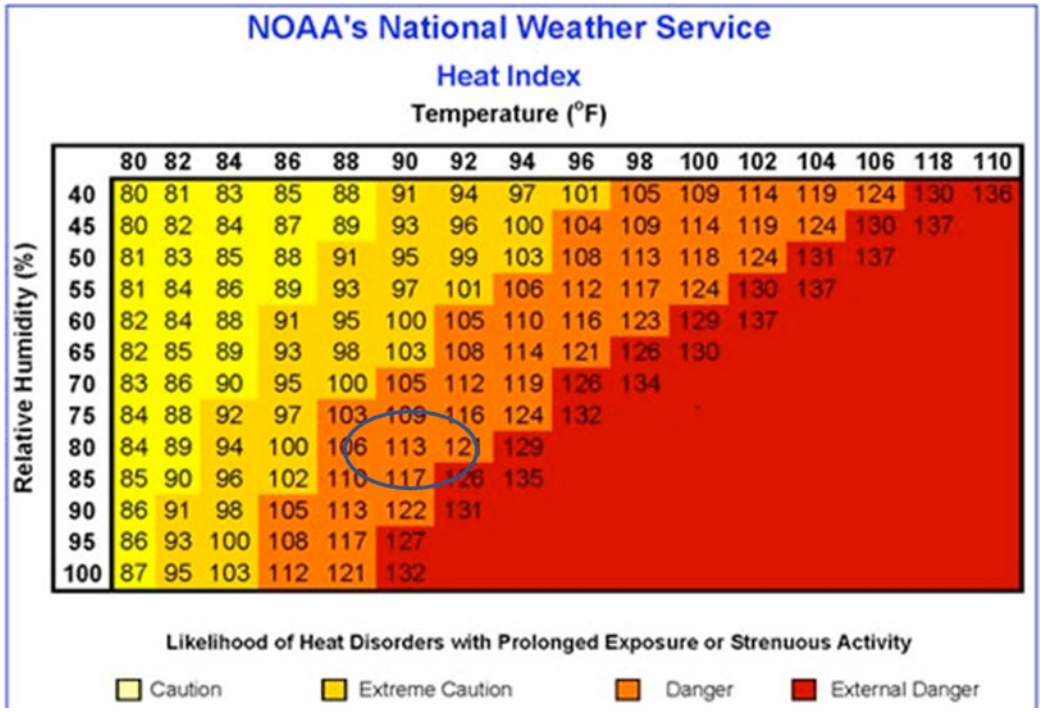
Overview

- Heat Background and Quick Facts
- Observed Temperature Trends
- Vulnerability and Extreme Heat
- Anatomy of a Heat Wave
- Future of Heat Waves
- Projections (damages)
- COVID and Temperature
- EPA's Heat Island Program
- Resources

Quick Facts: Extreme Heat and Heat Waves

- Heat is the leading weather-related killer in the United States (more than hurricanes and floods combined)
- Heat waves are increasing in frequency, severity, size, and duration (based on attribution studies)
- In fact, scientific evidence now suggests we can attribute single weather events (i.e., heat) to climate change
- No single definition for heat waves. The World Meteorological Organization, defines a heat wave as:
  A marked unusual hot weather (max, min, and daily average) over a region persisting at least two consecutive days during the hot period of the year based on local climatological conditions, with thermal conditions recorded above given thresholds
- Humidity is also rising in some regions like the eastern United States. This takes an extra toll on health because humidity interferes with the body's ability to cool itself through the evaporation of sweat
- Urban areas are subject to even higher surface temperatures because of the Urban Heat Island effect

A temperature of 90° Fahrenheit (F) with 80 percent humidity feels like 113°F

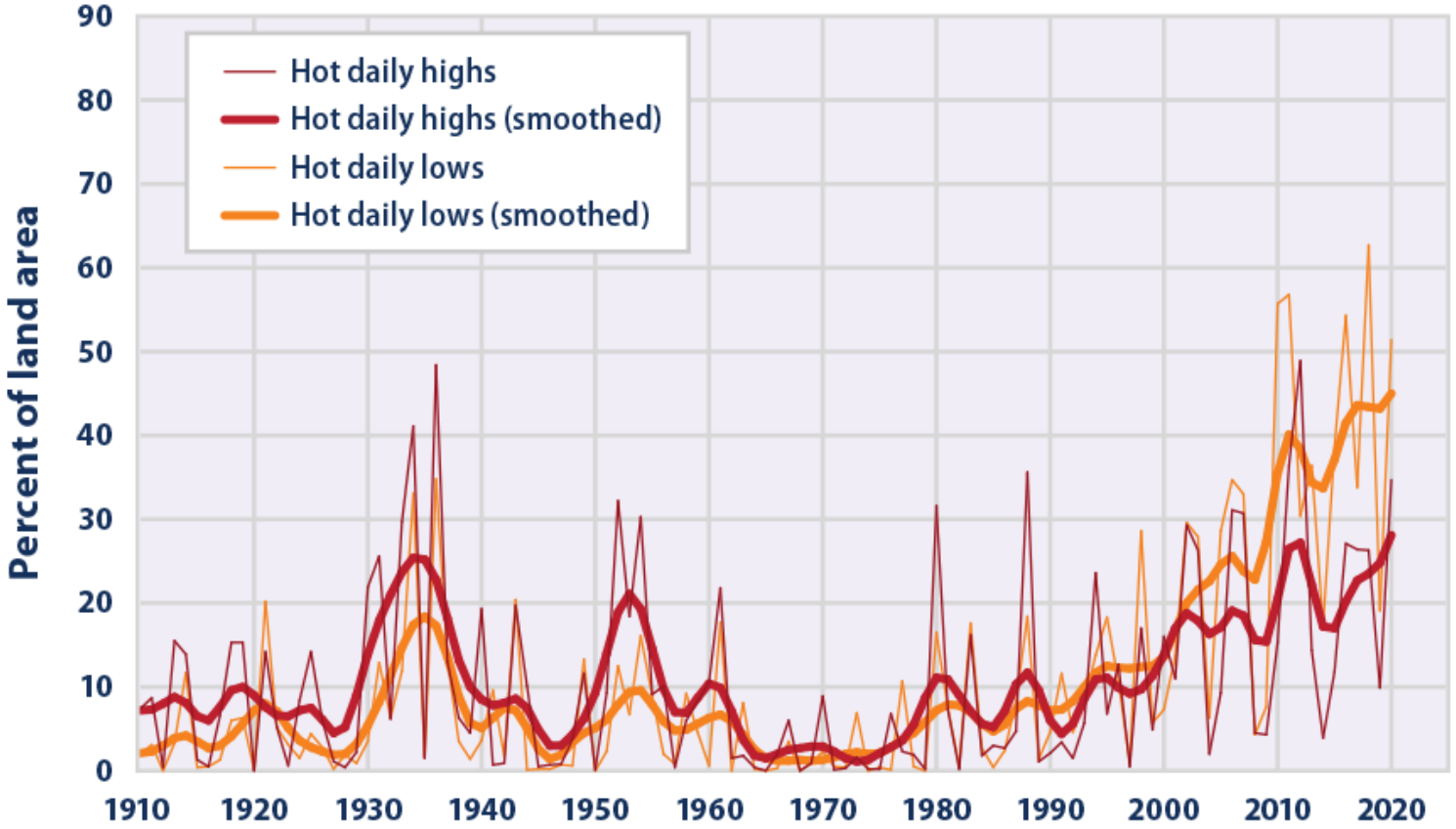


www.weather.gov/hazstat/
www.wmo.int/pages/prog/wcp/ccl/opace/opace2/documents/DraftversionoftheGuidelinesontheDefinitionandMonitoringofExtremeWeatherandClimateEvents.pdf

Temperature and Observed Trends

Hot Days and Nights are Increasing 1910-2020

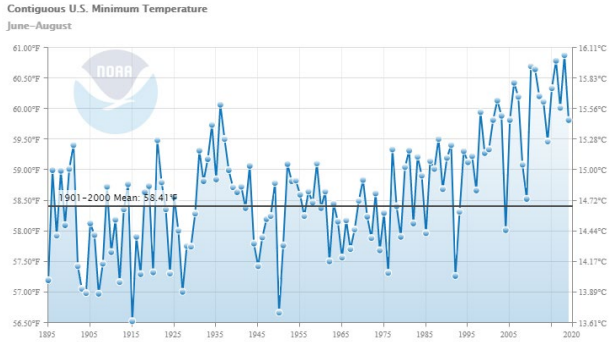
Area of the Contiguous 48 States with Unusually Hot Summer Temperatures



Source: EPA 2021; Data Source National Oceanic and Atmospheric Administration (NOAA) 2021

This graph shows the percentage of the land area of the contiguous 48 states with unusually hot daily high and low temperatures during the months of June, July, and August. The thin lines represent individual years, while the thick lines show a nine-year weighted average. Red lines represent daily highs, while orange lines represent daily lows. The term "unusual" in this case is based on the long-term average conditions at each location..

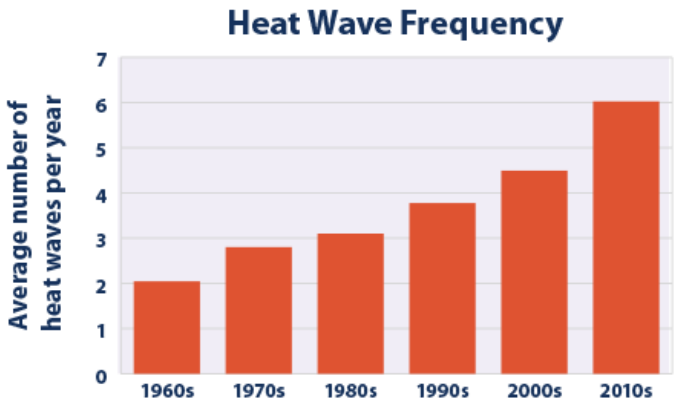
- Average temperatures have risen across the U.S. with an increased rate evident in the last 30 years
- Hot summer days (highs) have become more common over the last few decades
- Record setting daily high temperatures have become more common than record lows

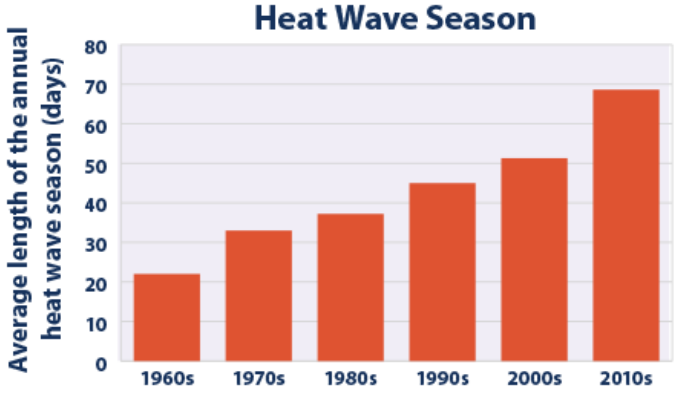


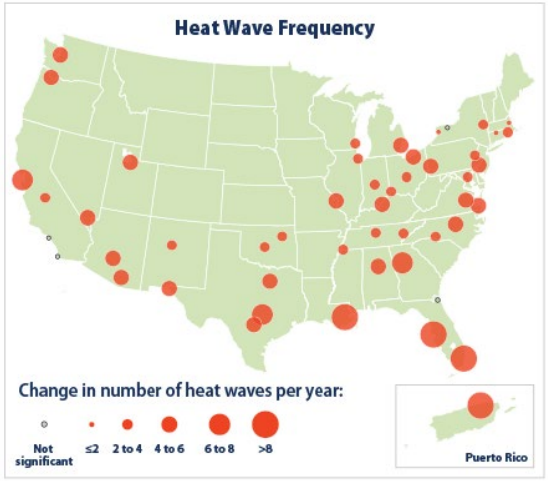
Follow to plot your own minimum temperatures:
www.ncdc.noaa.gov/extremes/cei/graph/us/2/01-12

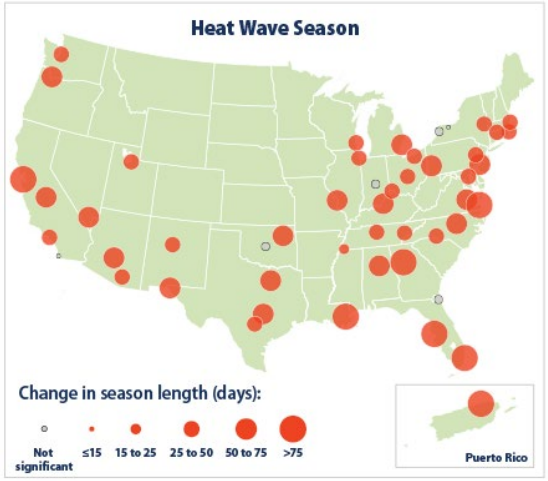
Temperature and Observed Trends

Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2019









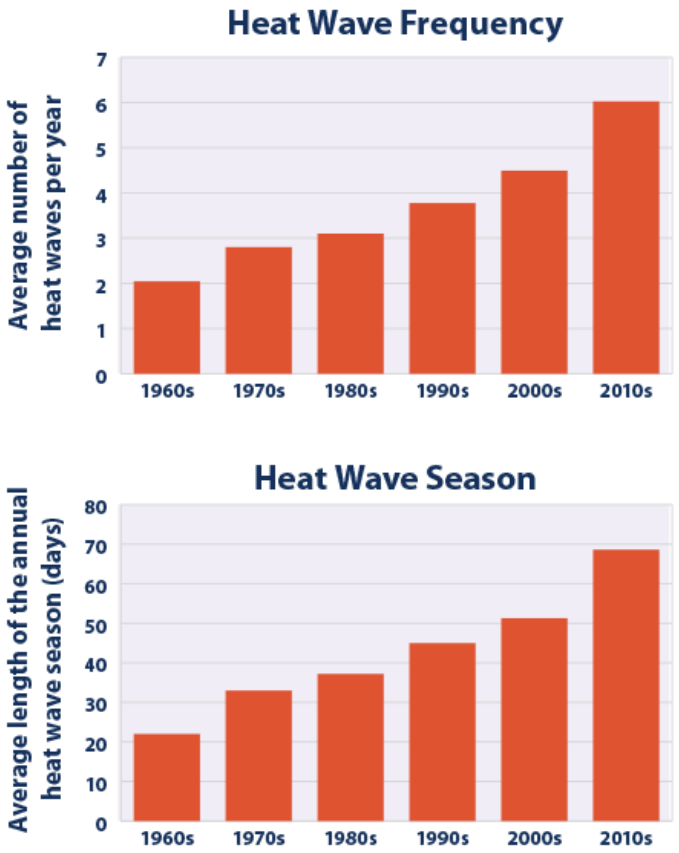
Source: EPA 2021

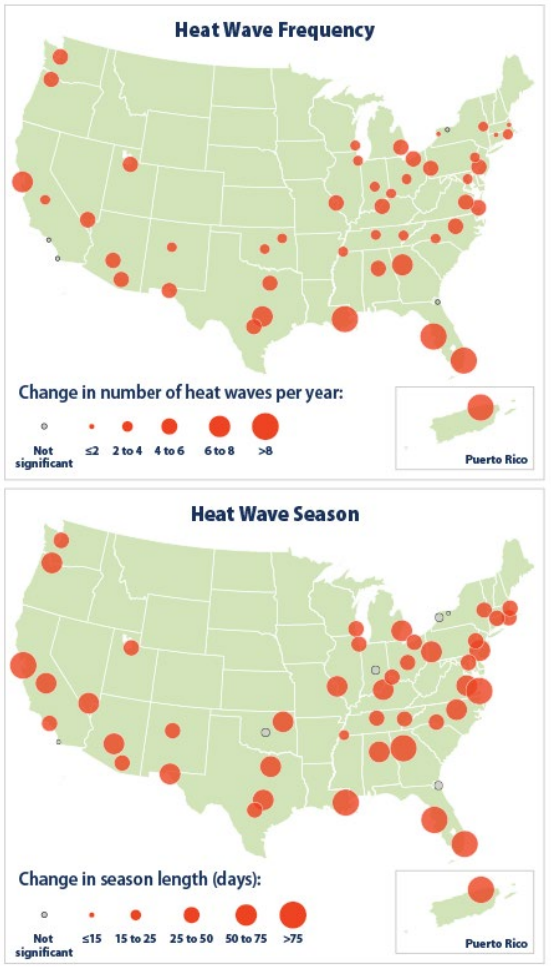
This figure shows changes in the number of heat waves per year (frequency) and the number of days between the first and last heat wave of the year (season length) from 1961 to 2018 for 50 large U.S. metropolitan areas. The graphs show averages across all 50 metropolitan areas by decade.

- Heat waves defined as: Two or more consecutive days in which the coolest temperature (adjusted for humidity) at night is warmer than that of 85 percent of July and August nights averaged over a 30-year period
- Heat waves are occurring three times more often than they did in the 1960s—about six per year compared to two per year. The average season length is 47 days longer

Temperature and Observed Trends

Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2019



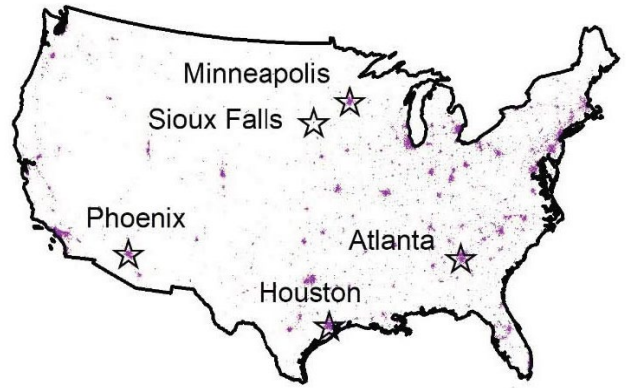


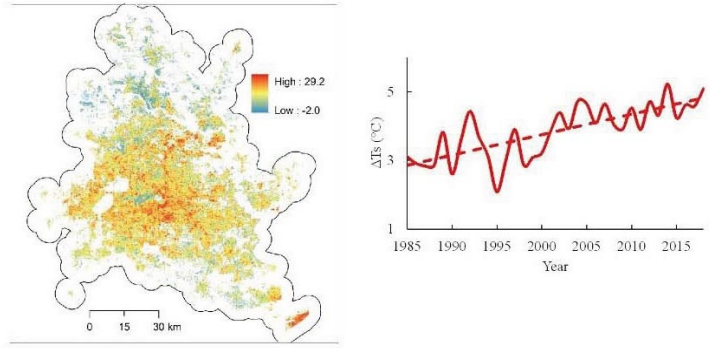
Source: EPA 2021

This figure shows changes in the number of heat waves per year (frequency) and the number of days between the first and last heat wave of the year (season length) from 1961 to 2018 for 50 large U.S. metropolitan areas. The graphs show averages across all 50 metropolitan areas by decade.

Urban Heat Island Effects

(intensity and temporal trends)





(satellite Landsat+ National Land Cover Database) United States Geological Survey (George Xian) and EPA project factsheet https://pubs.er.usgs.gov/publication/fs20213031

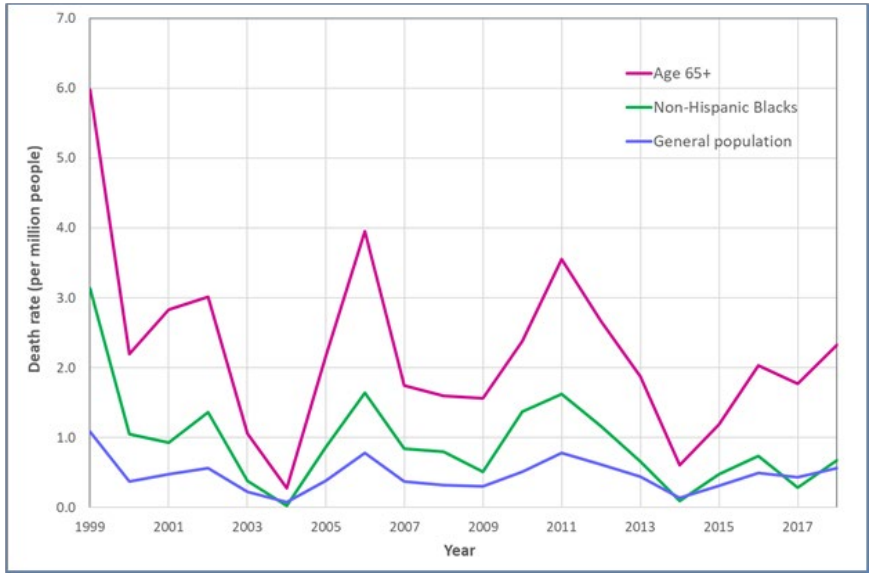
Extreme Heat and Vulnerability

Some groups are disproportionately vulnerable to health impacts

Factors that increase heat health risks:

- Have chronic health conditions or are taking certain medications that increase sensitivity to heat (i.e., diabetes, heart, and lung conditions)
- Live in a home with poor insulation or no air conditioning, or cannot afford to use air conditioning
- Work outdoors
- Do not have access to emergency healthcare
- Do not have access to emergency public health warnings in native language

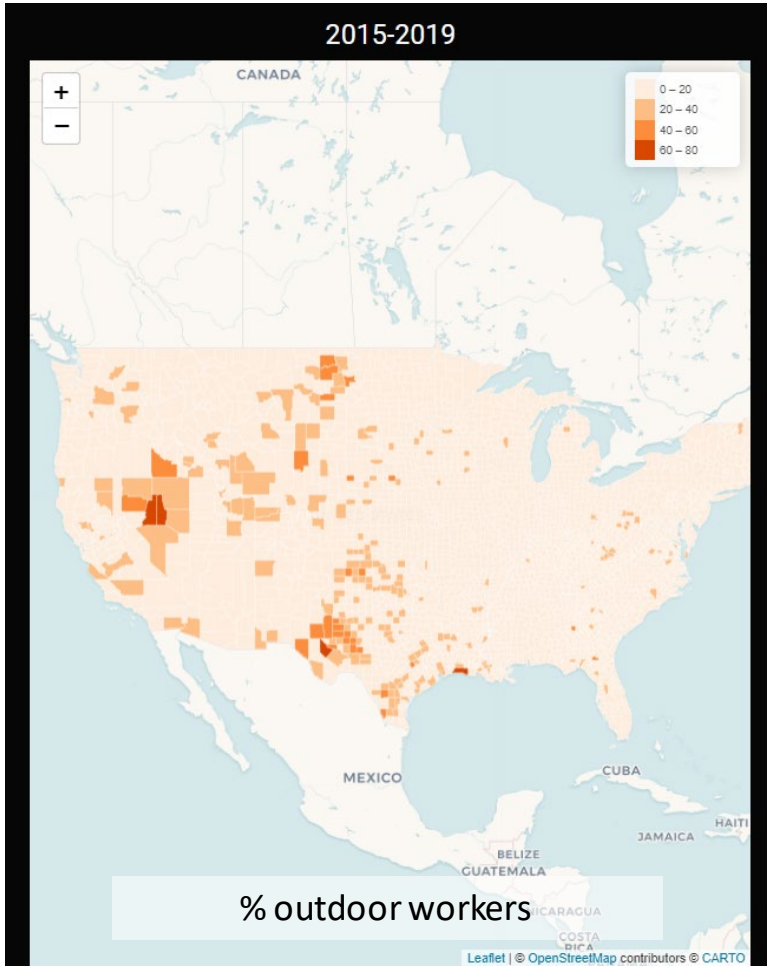
Summer Deaths Due to Heat and Cardiovascular Disease in the United States, 1999–2018

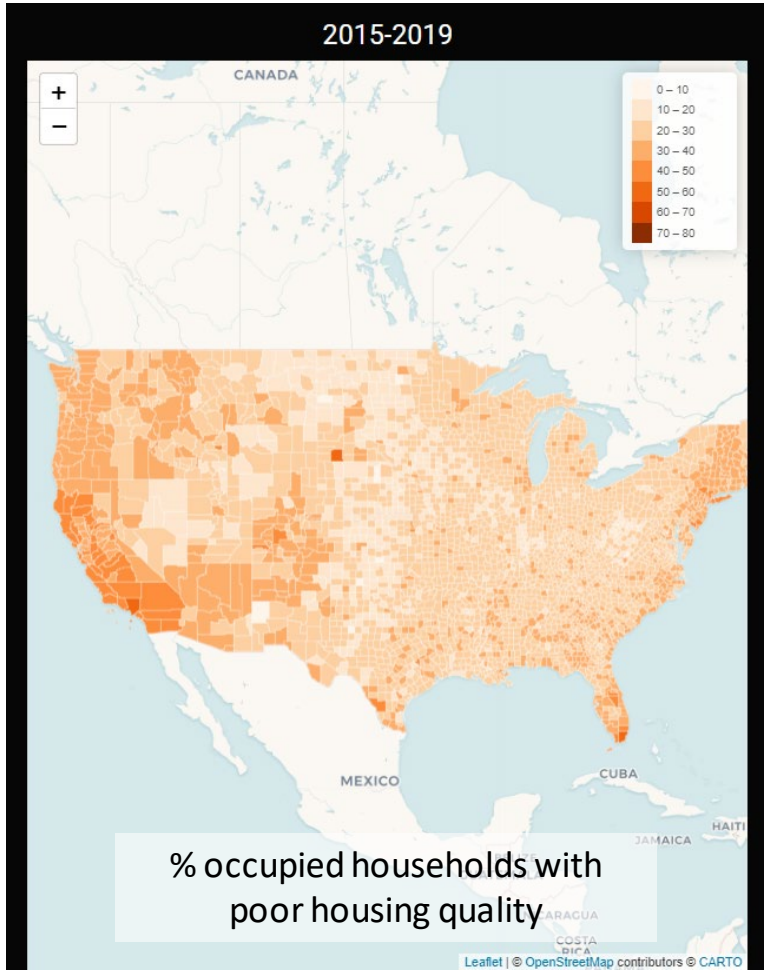


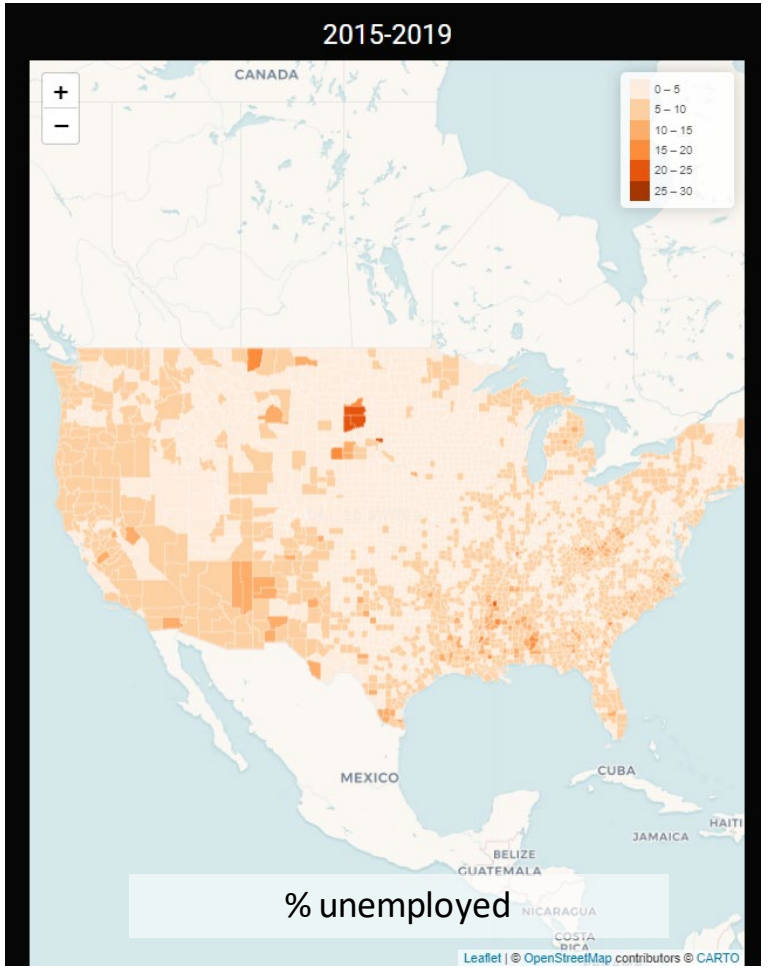
Source: EPA 2020

Need to examine across: Social economic + Health + Built Environment + Occupation

Examples for Built Environment & Occupational Determinants







Source Data – United States Department of Housing and Urban Development, U.S. Bureau of Labor Statistics

Heat Waves and Mortality

The 1995 heat wave in Chicago was one of the deadliest single weather events of the last 50 years in the US. Refrigerated trucks were needed to hold the excess dead at morgues. Poor, elderly, and Black Chicago residents were particularly vulnerable. Mayor Daley initially doubted and downplayed the death toll.

179 Dead in Chicago Heat Wave As National Toll Reaches 360

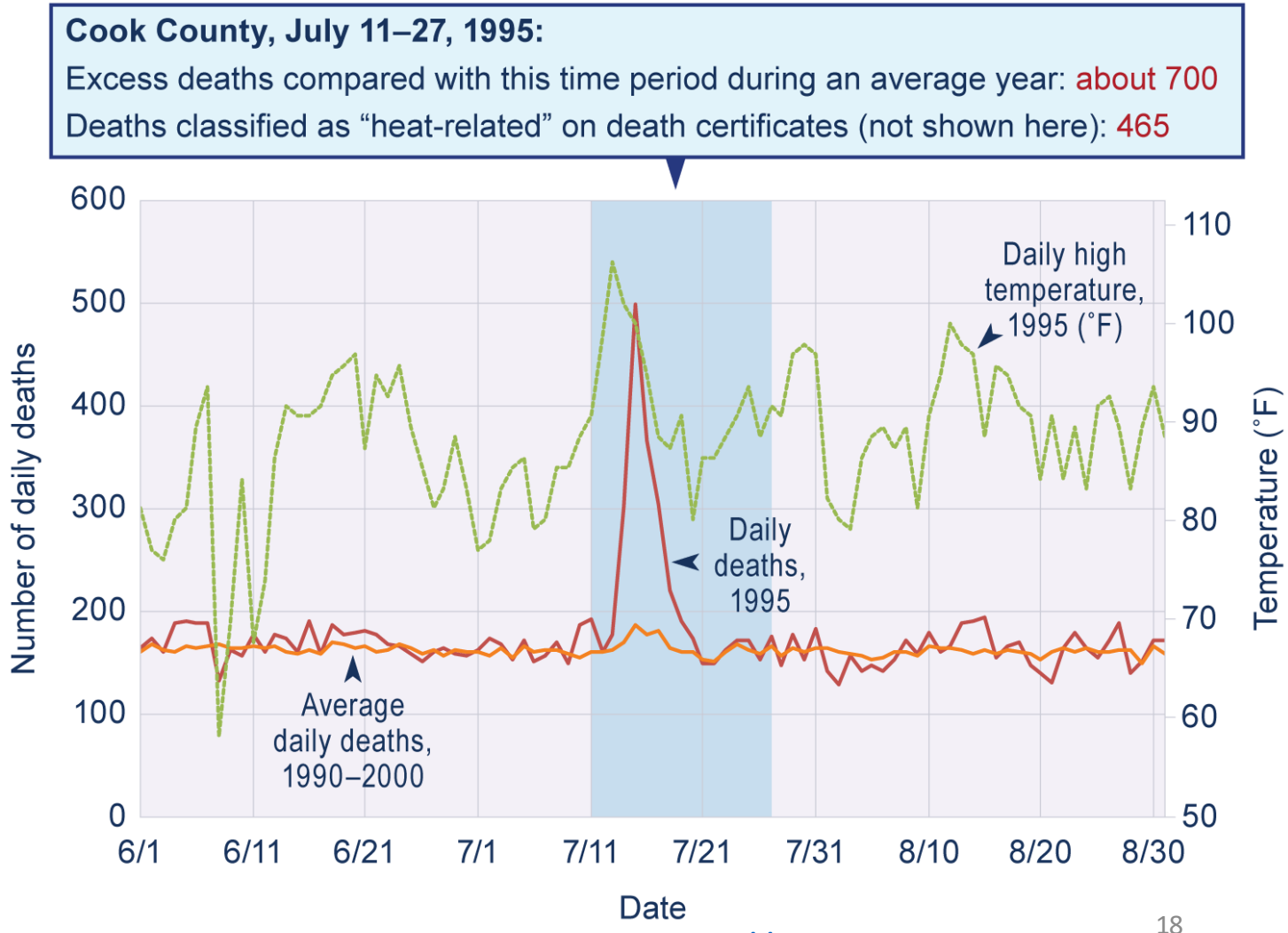
By DIRK JOHNSON

CHICAGO, July 17 — The confirmed death toll exacted by a brief but brutal heat wave here increased

"There is some indication the problem is abating," Dr. Donoghue said, adding, however, that more victims would surely be found locked

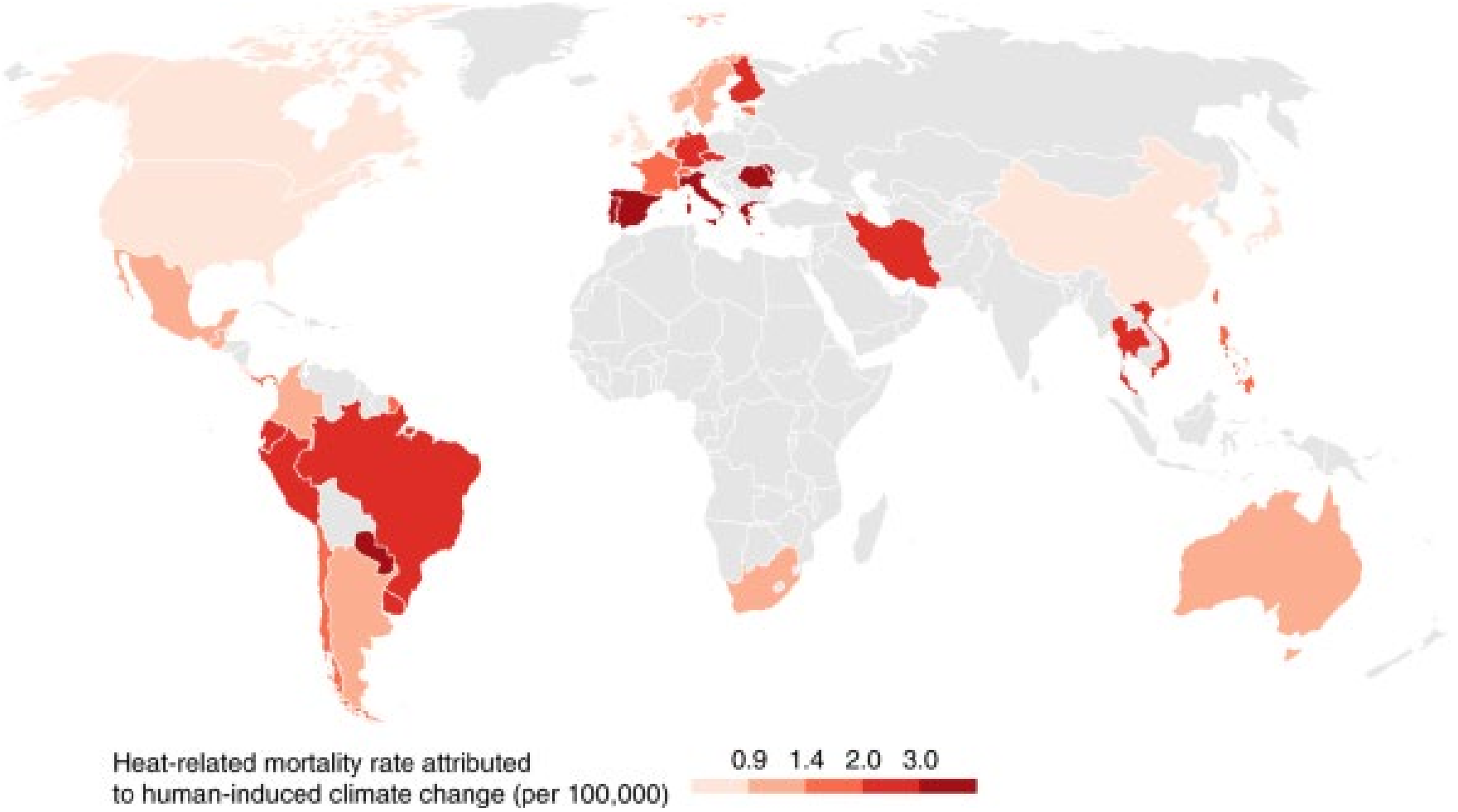
New York Times headline, July 17, 1995

Heat-Related Deaths During the 1995 Chicago Heat Wave



Climate and Health Assessment (2016): https://health2016.globalchange.gov/

Climate Change Has Already Contributed to Heat Mortality

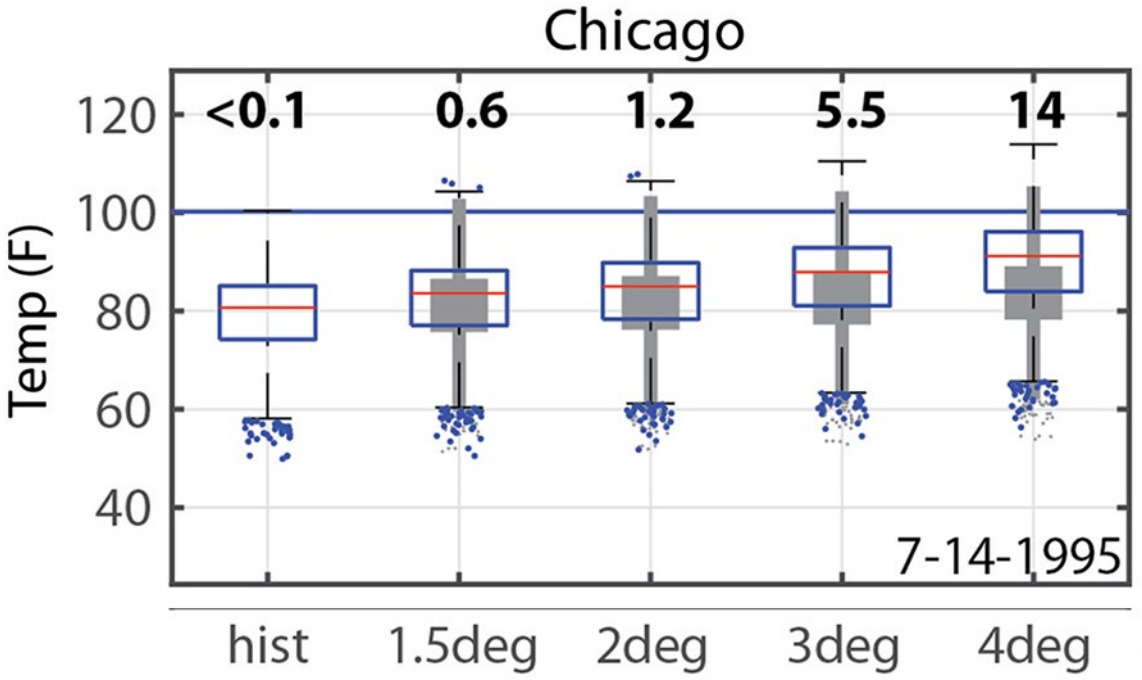


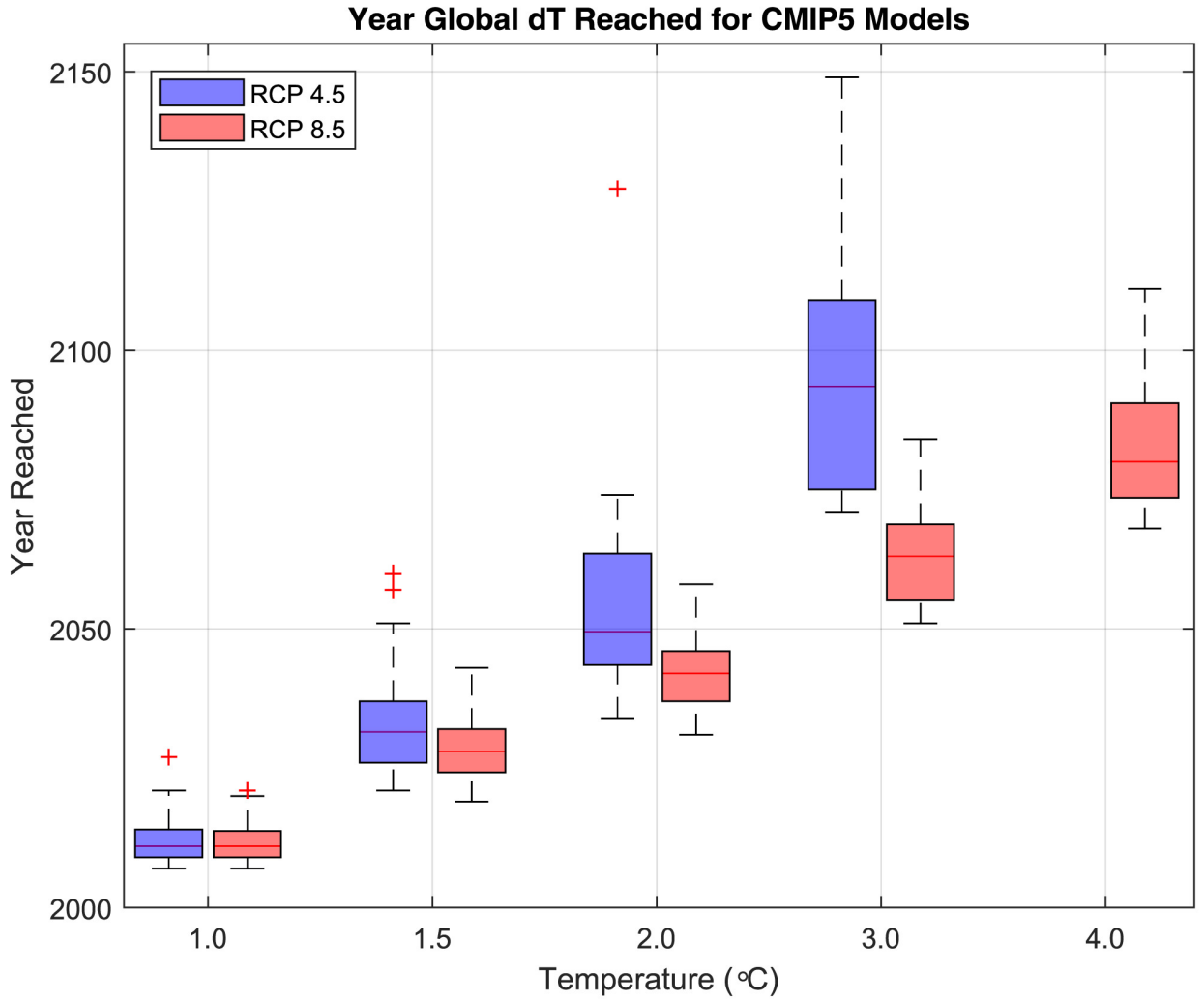
An estimated 37% of warm-season heat-related deaths can be attributed to climate change, according to "The burden of heat-related mortality attributable to recent human-induced climate change", Vicedo-Cabrera et al., Nature Climate Change, 2021

https://doi.org/10.1038/s41558-021-01058-x

Re-Framing Risk: The Future of Heat Waves

According to a climate model analysis, the 1995 Chicago heat wave was a once in a decade event…but under a future climate of 3 degrees warming we may be seeing 5 or more such heat events each summer toward the end of the century [Representative Concentration Pathway (RCP) 4.5]

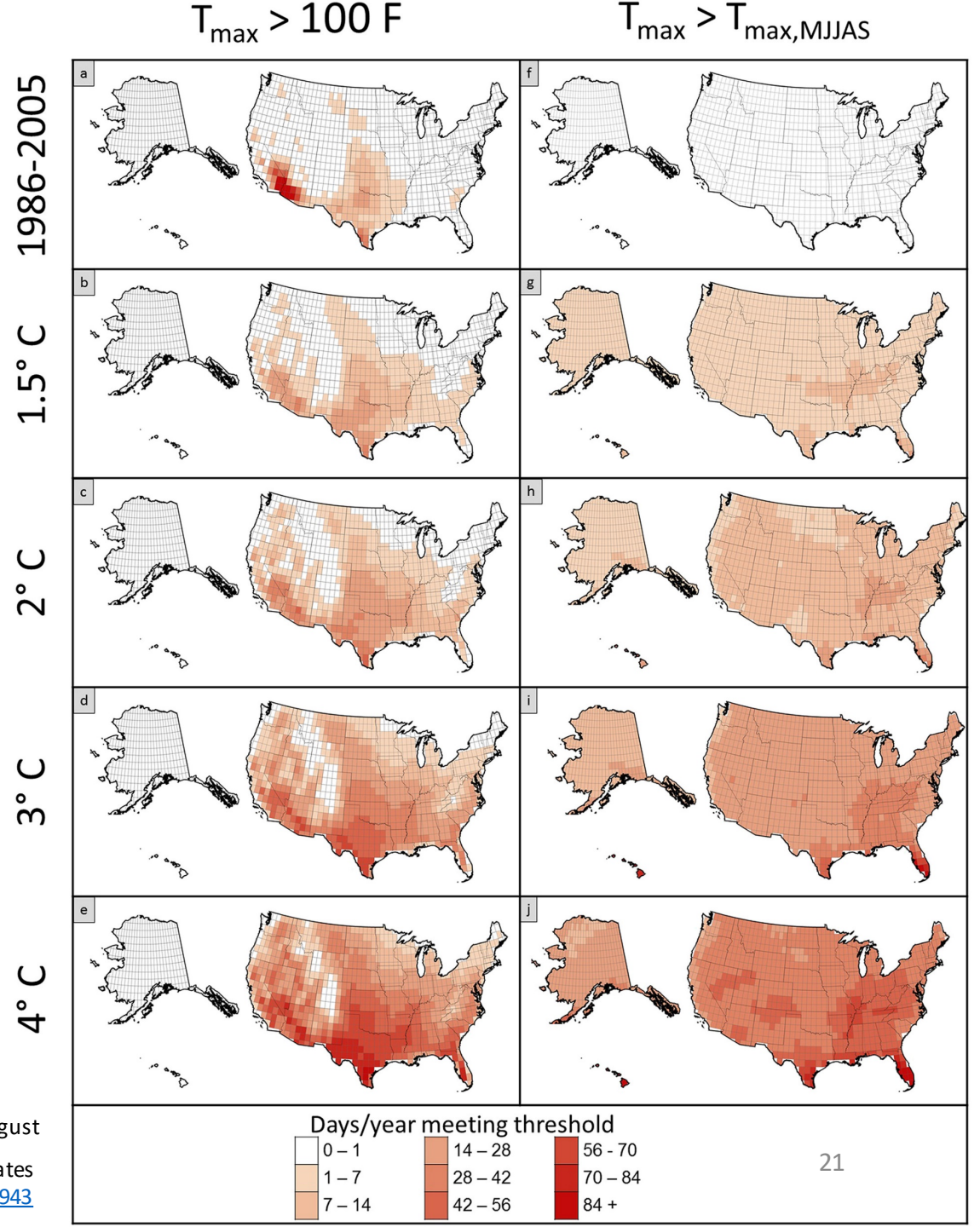




Source: Wobus et al 2018: Reframing Future Risks of Extreme Heat in the United States Earth's Future, https://doi.org/10.1029/2018EF000943

Re-Framing Risk: The Future of Heat Waves

This chart shows two different ways of thinking about future heat waves: on the left, it shows the number of days exceeding 100°F, and on the right, the number of days exceeding the historical average hottest day in the year for that region



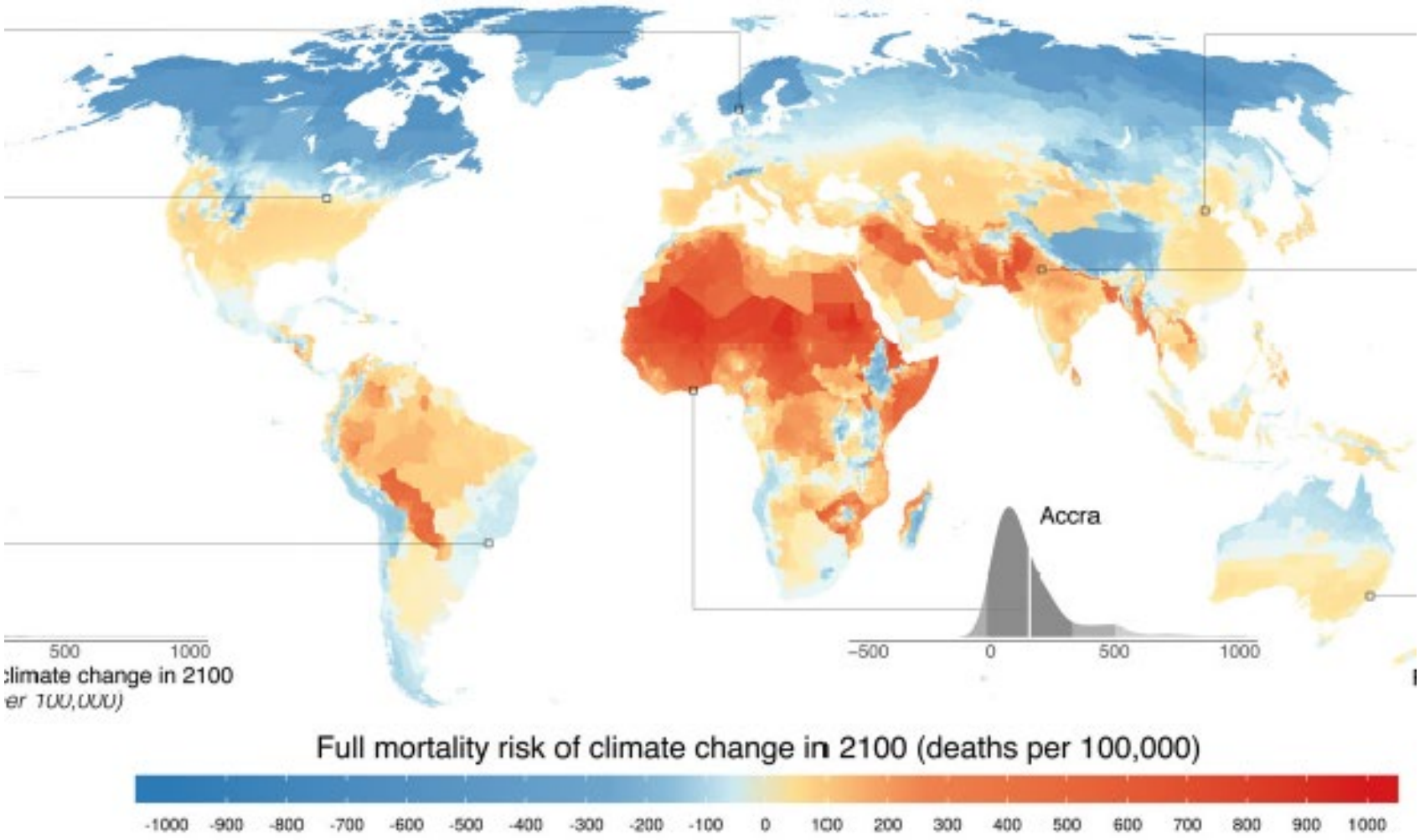
MJJAS: May, June, July, August

Source: Wobus et al 2018: Reframing Future Risks of Extreme Heat in the United States Earth's Future, https://doi.org/10.1029/2018EF000943

Mortality Risks

According to the Climate and Health Assessment, "Based on present-day sensitivity to heat, an increase of thousands to tens of thousands of premature heat-related deaths in the summer… are projected each year as a result of climate change by the end of the century." However, vulnerability to heat has been decreasing over time, due to changes in both individual and societal responses, which may ameliorate that increase

The figure to the right is one recent study that looks at heat, cold, and adaptation to estimate future mortality changes



Carleton et al., "Valuing the Global Mortality Consequences of Climate Change Account for Adaptation Cost and Benefits," National Bureau of Economic Research working paper, 2020: https://www.nber.org/papers/w27599.

Labor Analysis

- Under RCP8.5, labor hours in the U.S. are projected to decrease due to increases in extreme temperatures. Approximately 1.9 billion labor hours are projected to be lost annually by 2090, costing an estimated $160 billion in lost wages
- Counties in the South, especially in Texas and Florida, are estimated to lose more than 5% of high-risk labor hours under RCP8.5 (e.g., for outdoor industries whose workers are exposed to the elements)
- RCP4.5 avoids the loss of more than 900 million labor hours and nearly $75 billion in wages in 2090 compared to RCP8.5

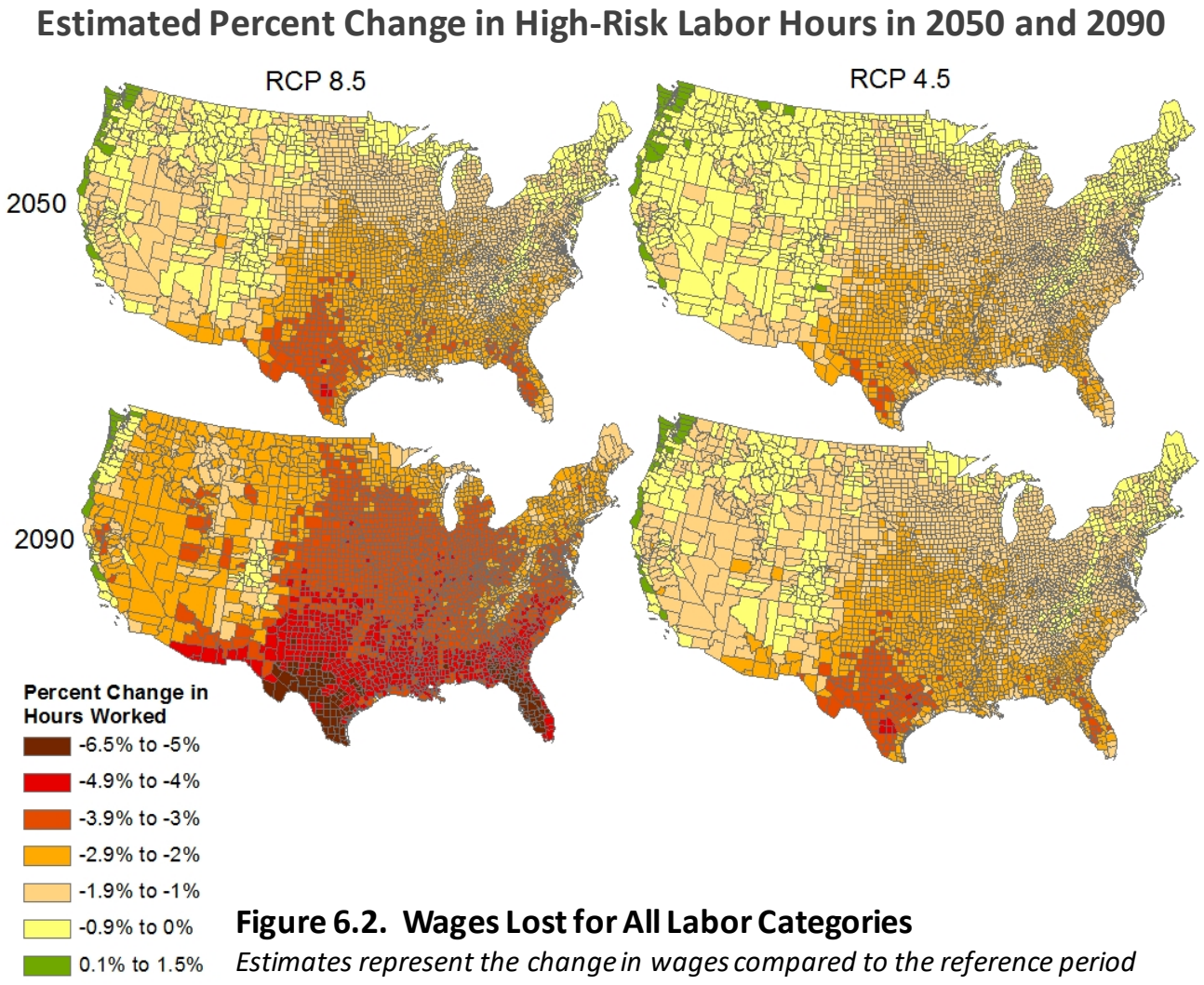


Figure 6.2. Wages Lost for All Labor Categories
Estimates represent the change in wages compared to the reference period (2003-2007) for the contiguous U.S.

Extreme Heat and COVID-19

- Common Risk Factors: Older adults, socioeconomically disadvantaged populations, those with chronic illnesses, and some communities of color are potentially vulnerable to both Extreme Heat and COVID-19
- Adaptive measures for one problem can be disadvantageous for the other:
  - Cooling centers and air conditioners are adaptive measures for heat. However, use of these cooling measures could lead to more crowded conditions indoors, thereby increasing transmission of COVID
  - Masks are a means to reduce COVID transmission, but are more uncomfortable to wear in the heat
- Simultaneous disasters (heat waves, COVID, hurricanes, etc.) can put additional stress on health care systems
- Analysis of the relationship between temperature and spread is still ongoing

Resources

EPA/Centers for Disease Control and Prevention- Extreme Heat Guidebook (2016)
www.cdc.gov/climateandhealth/pubs/extreme-heat-guidebook.pdf

EPA's Urban Heat Island Program website
www.epa.gov/heatislands

Association for the Advancement of Science – Quick Facts on Heat Waves and Climate Change
www.sciline.org/quick-facts/heat-waves

NOAA's Heat Vulnerability Index
www.nesdis.noaa.gov/content/noaa-releases-new-tool-help-prepare-and-protect-vulnerable-populations-extreme-heat

U.S. Global Change Research Program's Climate and Health Assessment (2016)
https://health2016.globalchange.gov/

Forecasts and Outlooks:
National Integrated Heat Health Information System (NIHHIS)
https://nihhis.cpo.noaa.gov/

National Integrated Heat Health Information System Tool
https://nihhis.cpo.noaa.gov/vulnerability-mapping

Learn the answers to key questions about extreme heat in a changing climate:

- Why is extreme heat on the rise?
- How might it affect you?
- What can you do before and during an extreme heat event to reduce your health risk?

Thank You for Attending!

Contact

Mike Kolian
Kolian.Michael@epa.gov

Marcus Sarofim
Sarofim.Marcus@epa.gov

Summer in the City

Introduction to Heat Island Impacts and Solutions

Victoria Ludwig
National Program Manager
Heat Island Reduction Program
U.S. EPA

EPA

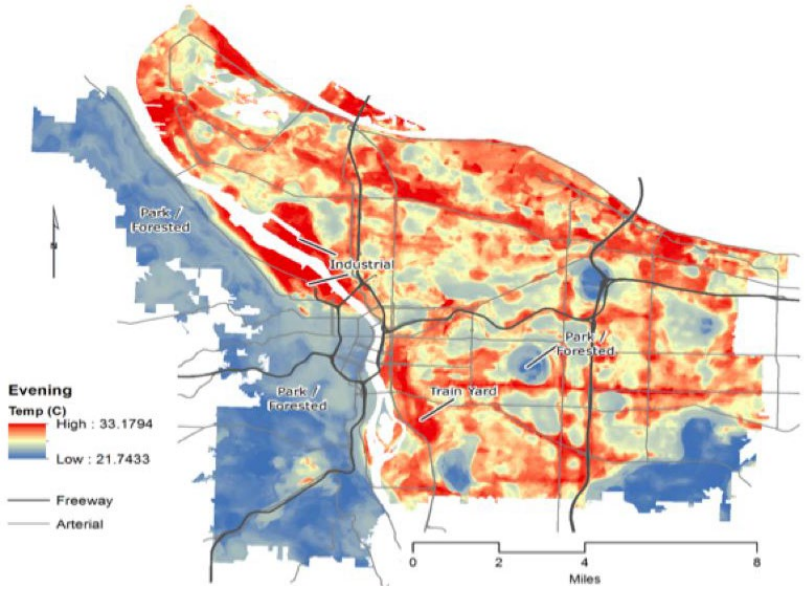
HEAT ISLAND REDUCTION PROGRAM

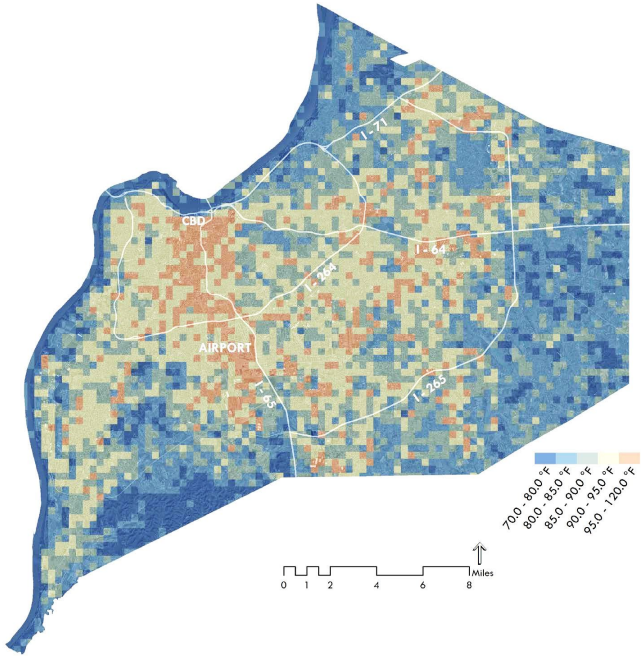
State and Local Climate and Energy Program

What is a Heat Island?

- Urbanized areas experience higher temperatures than outlying areas
- Structures such as buildings and roads, absorb and re-emit the sun's heat more than natural landscapes
- Areas where structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas

Portland, OR temperatures on a hot day in 2014





Distribution of surface temperatures in Louisville, KY

HEAT ISLAND REDUCTION PROGRAM

Heat Island Effect and Heat Waves Strengthening

- According to the U.S. Global Change Research Program:
  - Surface temperatures in urban areas in the U.S. are about 1-7°F higher during the day than those in outlying areas, and nighttime temperatures are about 2-5°F higher
  - The heat island effect will strengthen in the future due to population density and land use changes
  - Climate change will exacerbate heat islands
- EPA's Climate Indicators show an observed trend of heat waves increasing in frequency, intensity, and duration in major metropolitan areas in the U.S.

What Causes Heat Islands to Form?

- Reduced vegetation
- Urban geometry (dense development)
- Weather and geography

- Materials commonly used to build urban infrastructure (impermeable, heat absorbing)
- Generation of waste heat (e.g., air conditioners, cars)

HEAT ISLAND REDUCTION PROGRAM

Heat Island Impacts

- Higher energy use
- Reduced air quality
- Higher risks to public health
- Increased greenhouse gas and air pollutant emissions
- Degraded water quality

HEAT ISLAND REDUCTION PROGRAM

Heat Islands and Equity

- Cities are not uniformly hot – intra-urban heat islands
- Historical development patterns and municipal policies cause unequal distribution of green and built-up areas
- People more at risk to heat impacts typically live in hotter areas of cities
- Higher temperatures compound factors that make at-risk individuals even more vulnerable – air quality/asthma, inefficient housing, lack of resources for air conditioning

How Can Local Governments Address Heat Equity?

- Collect relevant data
- Provide information in multiple languages
- Engage community members
- Use effective messaging
- Structure programs to be widely accessible
- Design programs to benefit renters

HEAT ISLAND REDUCTION PROGRAM

Cooling Heat Islands

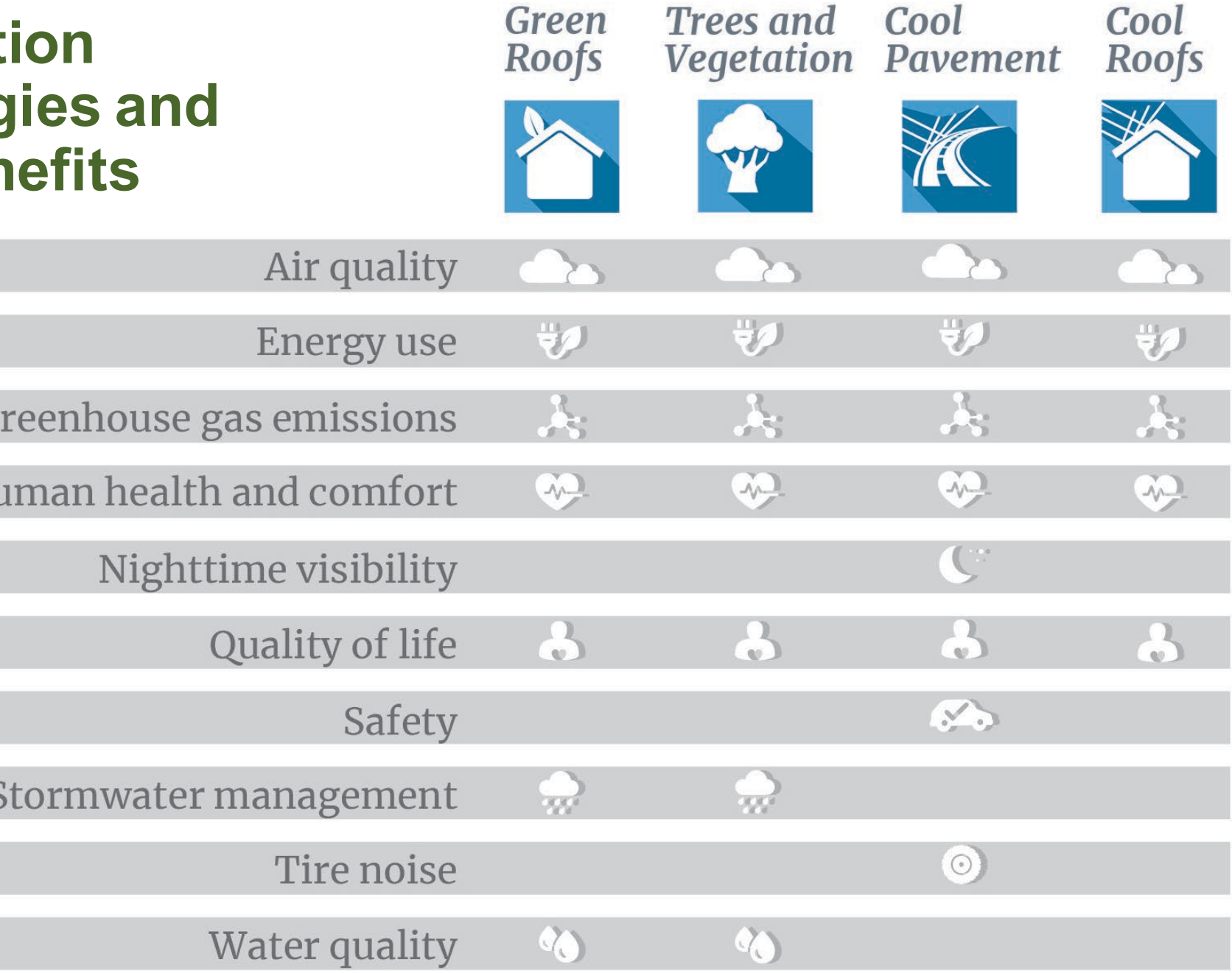
Four main strategies:

1. Planting trees and vegetation
2. Green roofs
3. Cool roofs
4. Cool pavements

Smart growth and other green infrastructure strategies can also provide heat island mitigation benefits

HEAT ISLAND REDUCTION PROGRAM

Mitigation Strategies and Co-benefits



City Example – Washington, DC

- Offers stormwater utility-fee reductions for green infrastructure (as part of stormwater management efforts)
- Offers green roof rebates
- Private buildings larger than 50,000 square feet must be Leadership in Energy and Environmental Design (LEED) certified (points for cool/green roofs)
- Urban canopy management plan

HEAT ISLAND REDUCTION PROGRAM

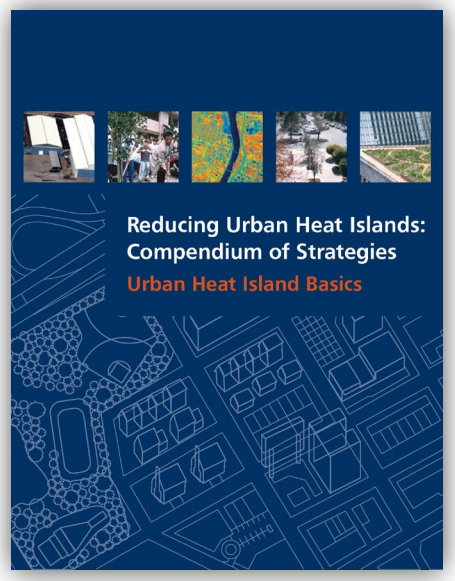
EPA Heat Island Reduction Program

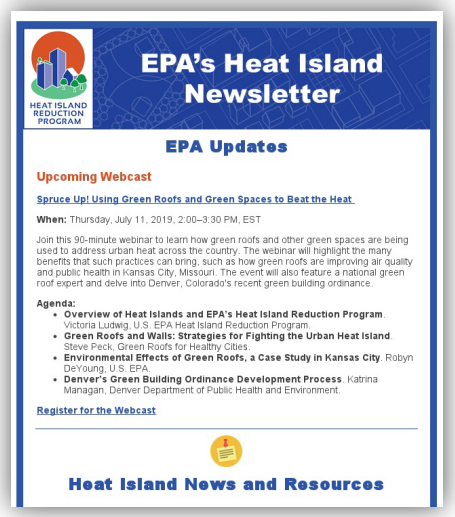
Mission: Through outreach and technical resources, raise awareness of heat islands and the co-benefits of mitigation measures; build capacity of local governments to implement effective mitigation measures

Program Resources

- **Compendium of Strategies:** Heat island science, detailed info on mitigation strategies, local examples, policy options
- **Website:** Basic information on heat island topics, calendar of events, newsroom, links to other resources
- **Examples**: Database of more than 75 local and state initiatives
- **Webinars**: Topics include local case studies, public health, advances in mitigation strategies
- **Newsletter**

www.epa.gov/heat-islands





HEAT ISLAND REDUCTION PROGRAM

Cool Your Community!
Summer Outreach Campaign

Cool Your Community Toolkit:

- Suite of six downloadable and customizable social media messages and graphics, available in English and Spanish. More to come!
- Proactive messages focusing on heat island cooling strategies, heat safety, cool roofs, trees, and more
- Download the graphics and messages and share them today! www.epa.gov/heatislands/cool-your-community-social-media-toolkit
- Follow EPA's social media platforms to easily like and share Cool Your Community posts:

Facebook @EPA | Twitter @EPA @EPAair | Instagram @EPAGov | EPA's State and Local Climate and Energy LinkedIn Group

Local actions can reduce exposure and vulnerability to heat

- Plant trees and vegetation
- Plant green roofs
- Install cool roofs and cool pavements
- Implement smart growth

EPA epa.gov/heatislands

Excessive heat events are a risk to everyone's health

- Stay hydrated
- Wear loose fitting, light-colored clothing
- Minimize direct sun exposure
- Take a cool bath or shower

EPA epa.gov/heatislands

Check on those at greater risk for heat illness. Ensure they are cool and comfortable.

- Older adults
- People with medical conditions
- People without air conditioning
- Children

EPA epa.gov/heatislands

Cool roofs have so many benefits that some localities offer installation rebates and incentives

- Improve human health and comfort
- Save energy
- Improve air quality
- Reduce city temperatures

EPA epa.gov/heatislands

HEAT ISLAND REDUCTION PROGRAM

Question and Answer Session

Upcoming Webinar

June 29, 1 PM (ET)
Estimating the Public Health Benefits of Clean Energy: Using EPA's COBRA Web Edition and Public Health Benefits per kWh Values

Register Today!
www.epa.gov/statelocalenergy/state-local-and-tribal-webinar-series

EPA

HEAT ISLAND REDUCTION PROGRAM

State and Local Climate and Energy Program

Connect with the Heat Island Program

Victoria Ludwig
U.S. Environmental Protection Agency
202-343-9291
ludwig.victoria@epa.gov

Heat Island Program Website

www.epa.gov/heat-islands

EPA Heat Island Newsletter Sign-Up

www.epa.gov/heat-islands/forms/heat-island-newsletter-signup

Follow EPA on Social Media

@EPA @EPA @EPAair @EPAGov EPA State and Local Group

HEAT ISLAND REDUCTION PROGRAM