Climate Change

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University of Nebraska System

COLLEGE OF AGRICULTURAL SCIENCES AND NATURAL RESOURCES

University of Nebraska Medical Center

Weather vs. Climate

Climate is what you expect, weather is what you get.

What is climate?

- **Weather** is the current conditions of the atmosphere
  - Extremely variable
  - What is it like outside?

- **Climate** is the behavior of the atmosphere over long time periods
  - Is a Nebraska summer warmer than a Nebraska winter?
  - Florida vs. Nebraska
  - This year vs. a previous year

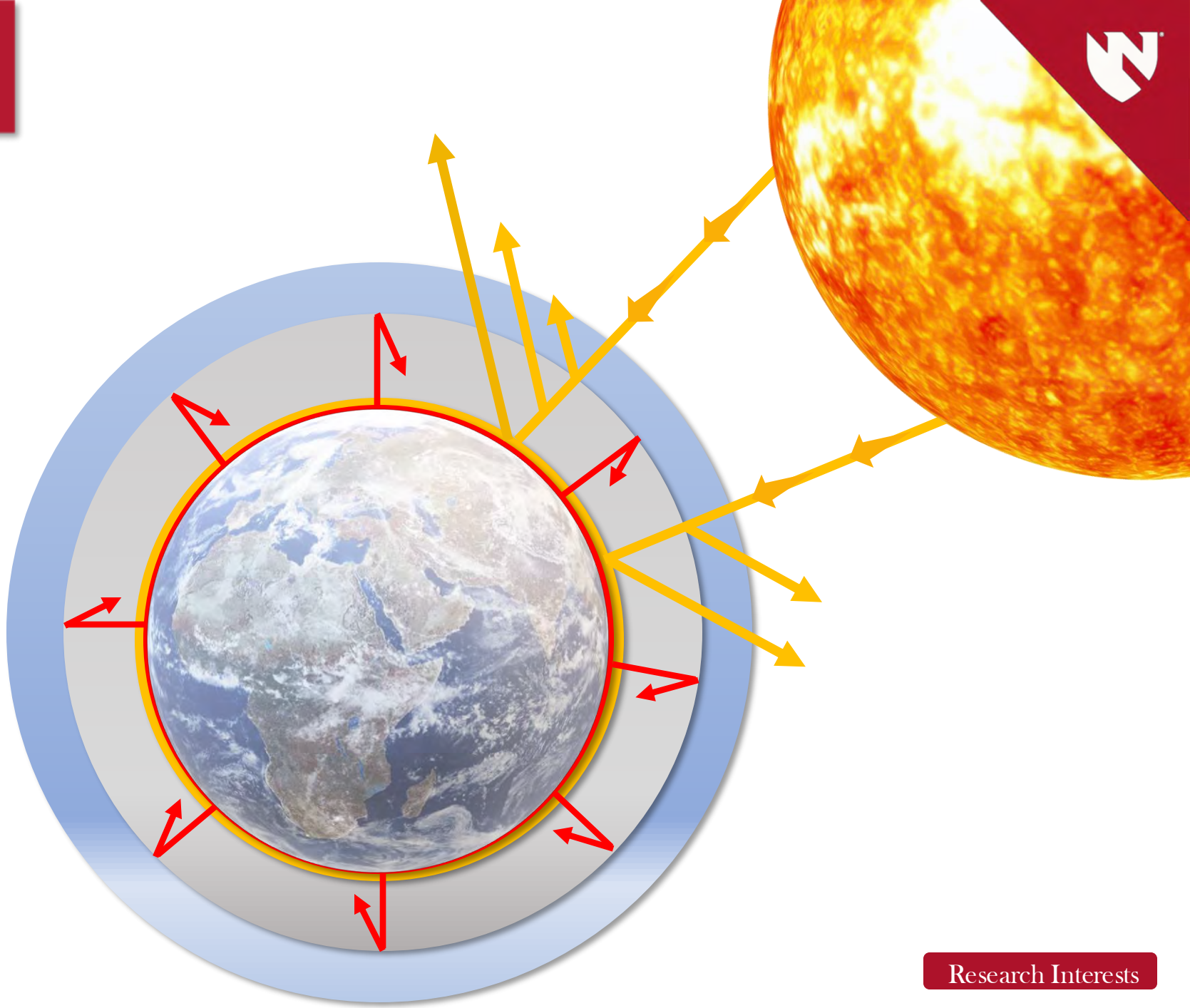
If I have seen further, it is by standing upon the shoulders of giants.

~Isaac Newton

Greenhouse Gases

Earth's surface absorbs solar radiation, the surface increases in temperature and emits infrared radiation.

Atmospheric gases absorb this infrared radiation: water vapor, ozone, carbon dioxide, nitrous oxide, and methane



Linking Our Climate & Greenhouse Gasses

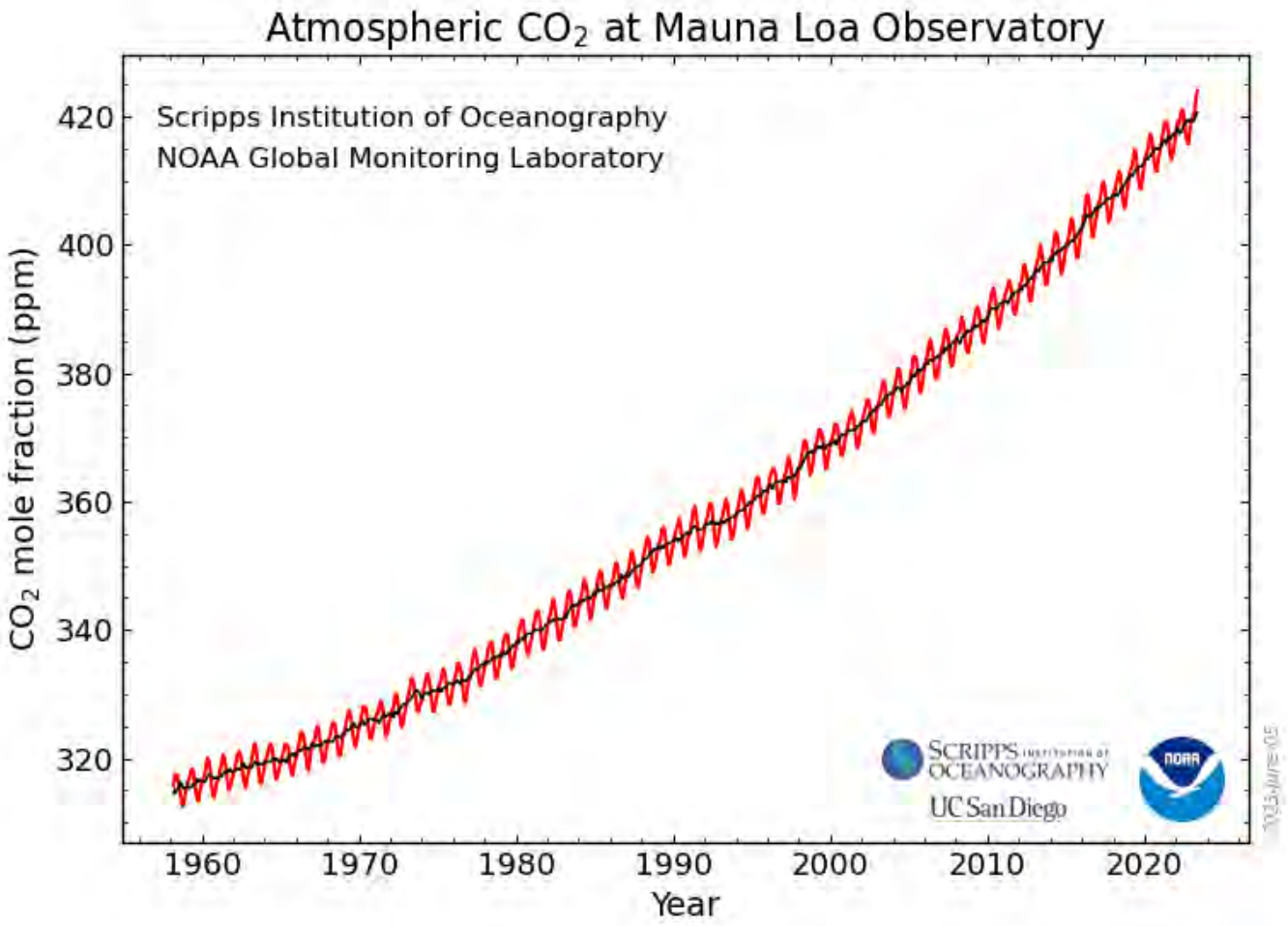
Fourier, 1766-1830

Tyndall, 1820-1893

Arrhenius, 1859-1927

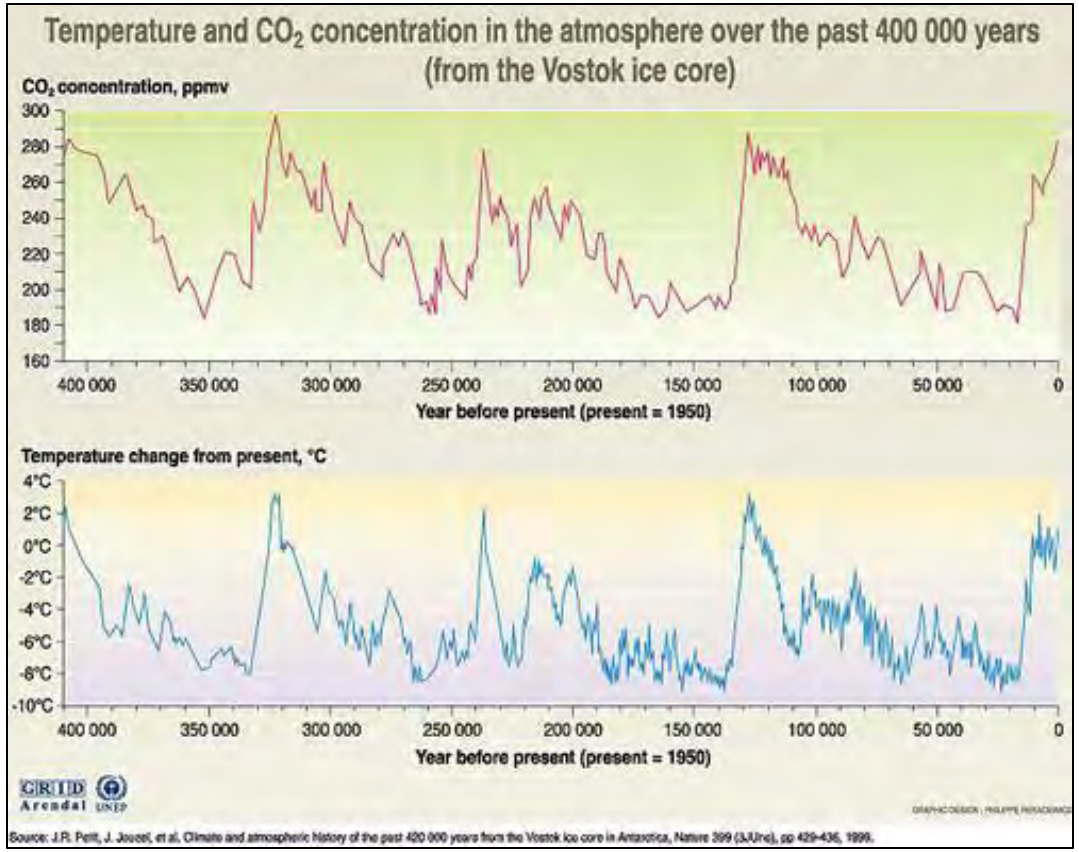
Eunice Foote

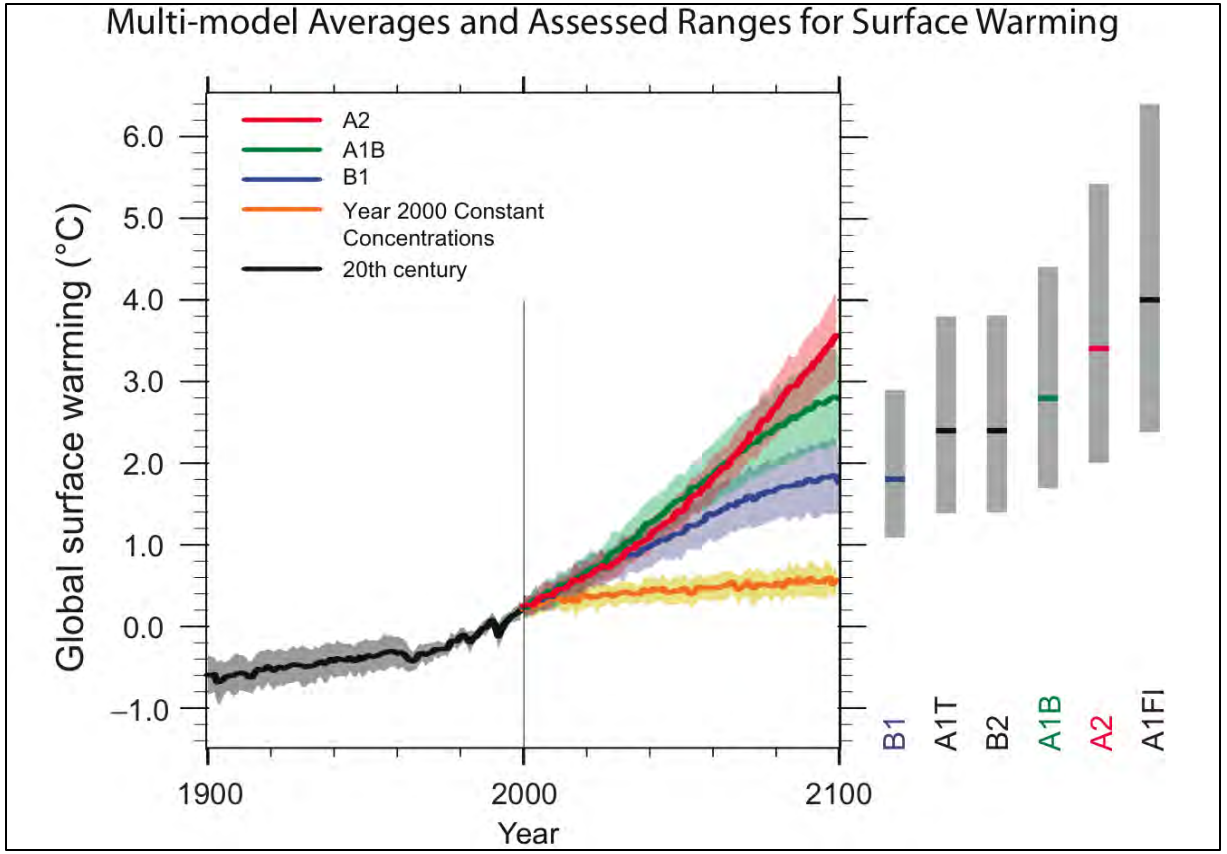
July 2024: 425.55 ppm



Research Interests

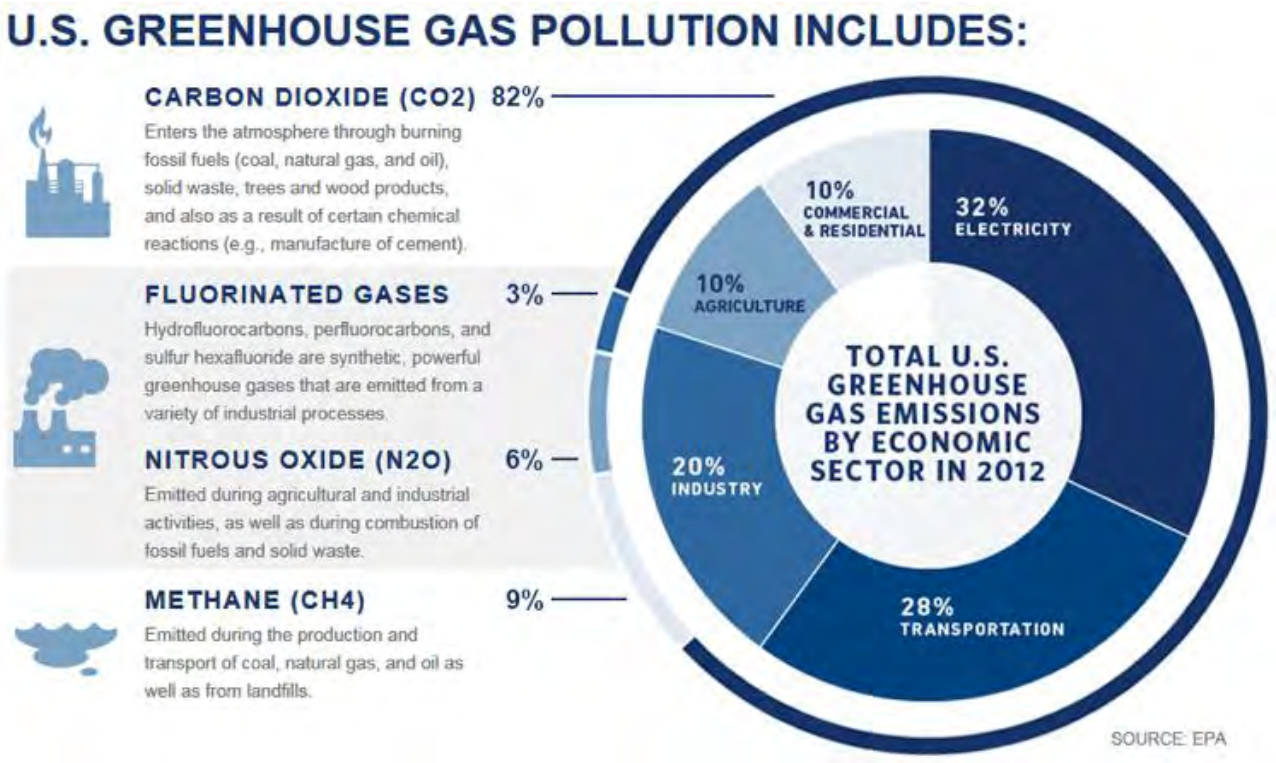
Links to Temperature





Figures from IPCC

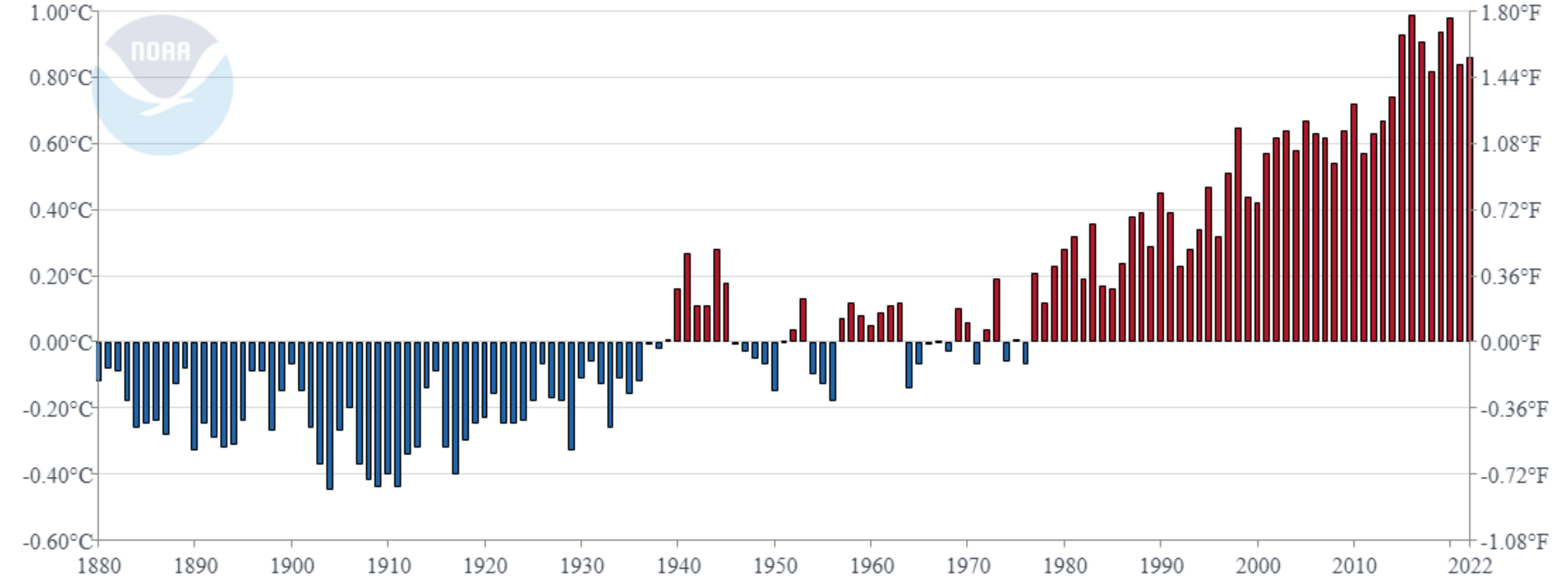
Fossil Fuels



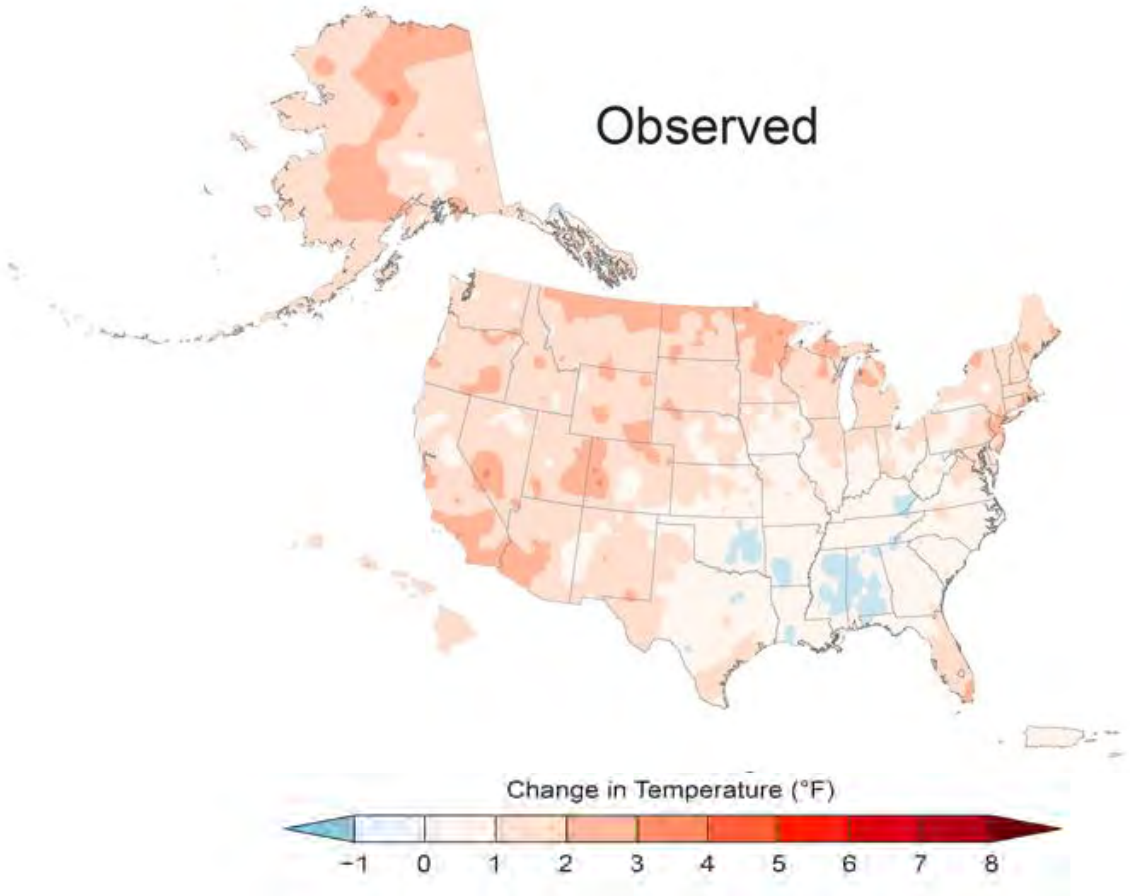
What Do We Know?

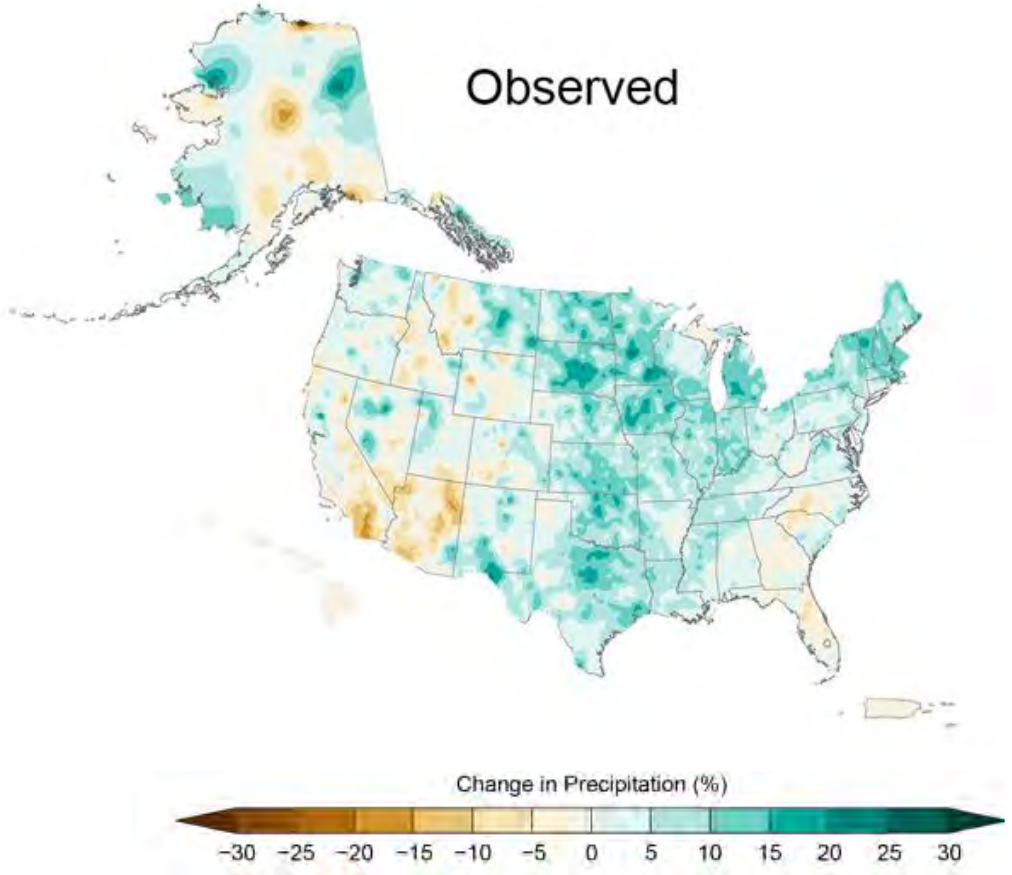
Global Land and Ocean

January-December Temperature Anomalies



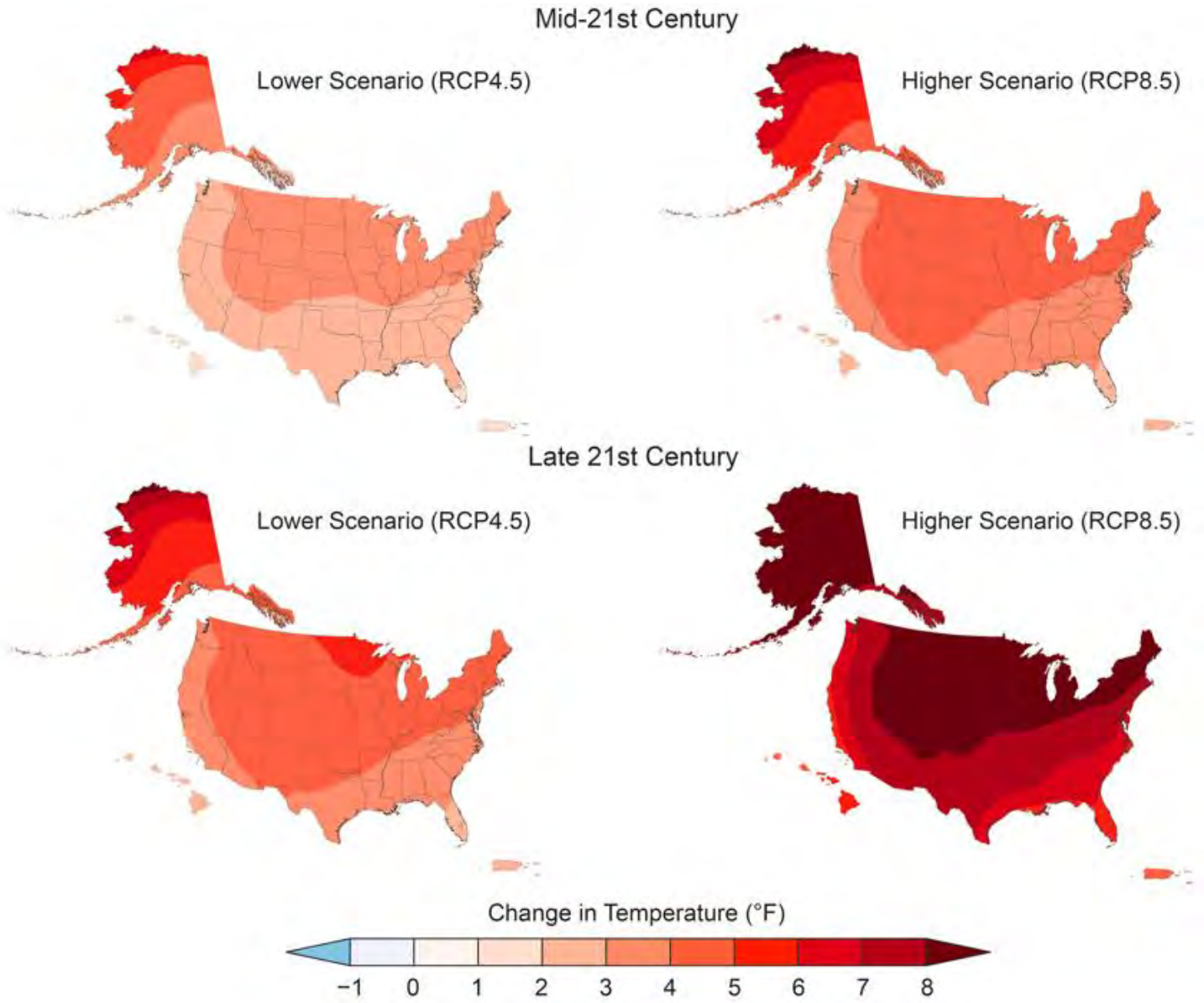
Historical Temperature and Precipitation Changes





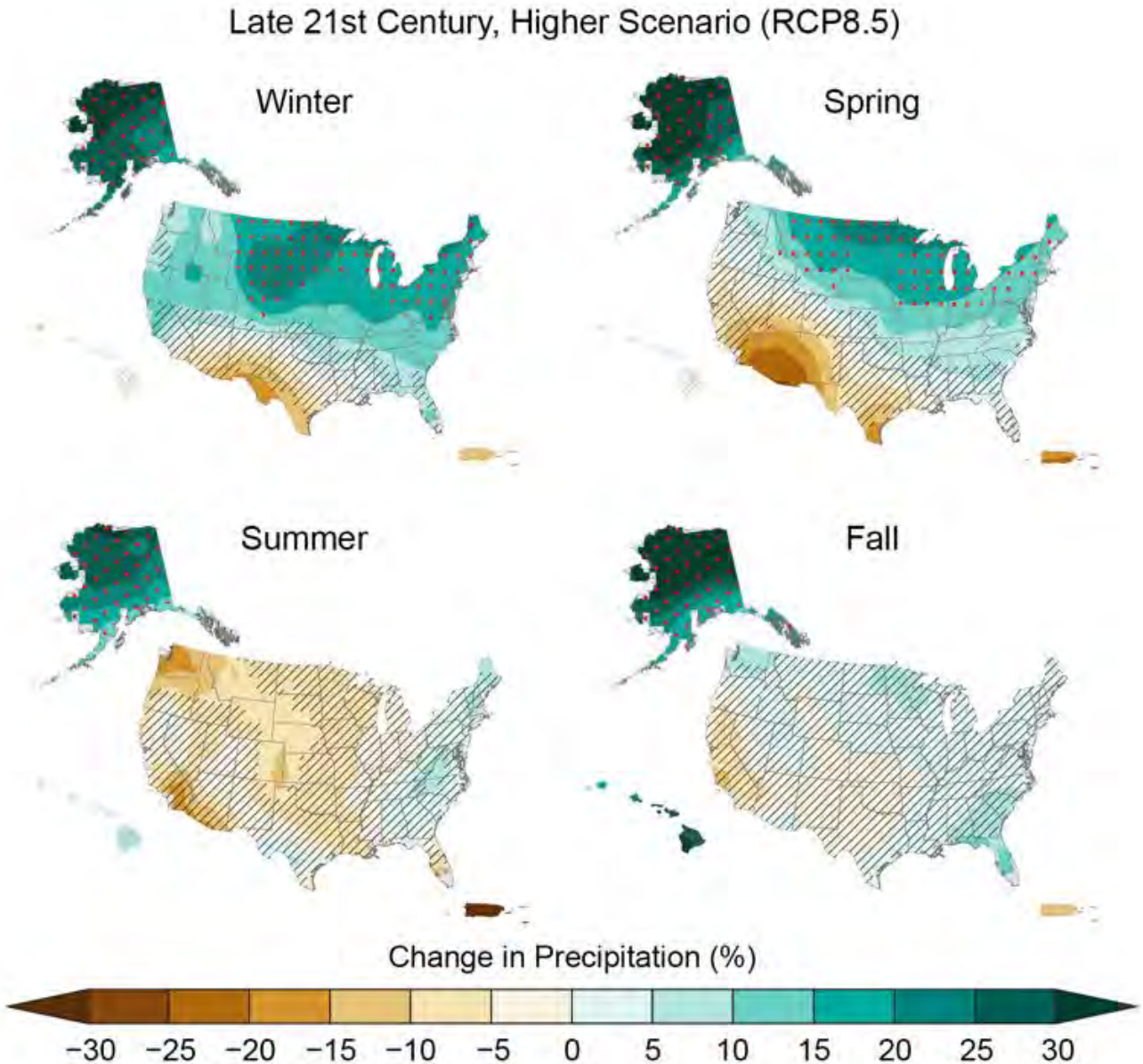
NCA 2018

Future Temperature Change



NCA 2018

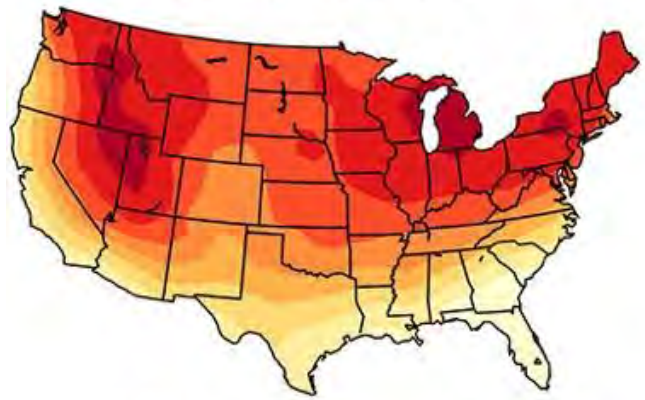
Future Precipitation Change



NCA 2018

Projected Changes in the Hottest/Coldest and Wettest/Driest Day of the Year

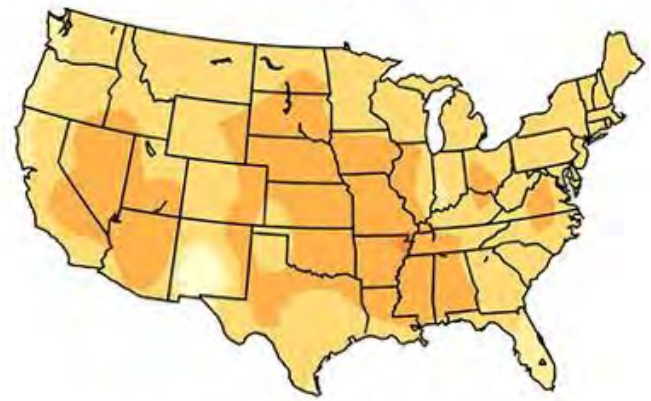
Coldest Night of Year



Temperature Change (°F)

3 4 5 6 7 8 9

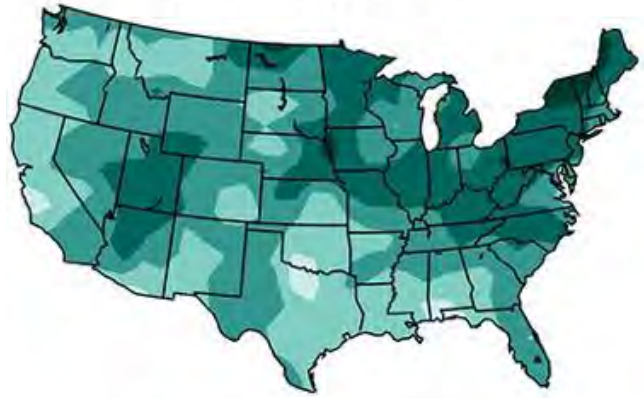
Hottest Day of Year



Temperature Change (°F)

3 4 5 6 7 8 9

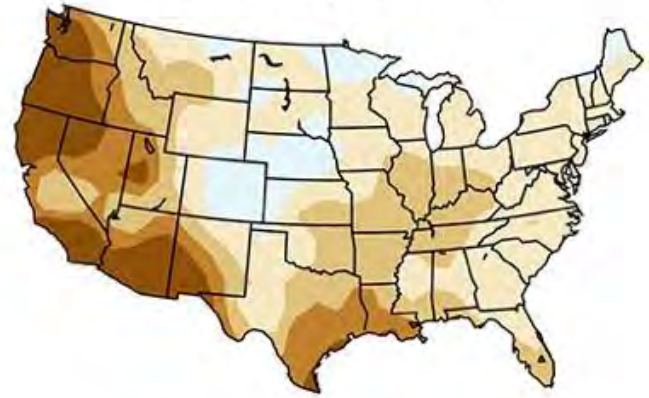
Wettest Day of Year



Precipitation Change (%)

3 6 9 12

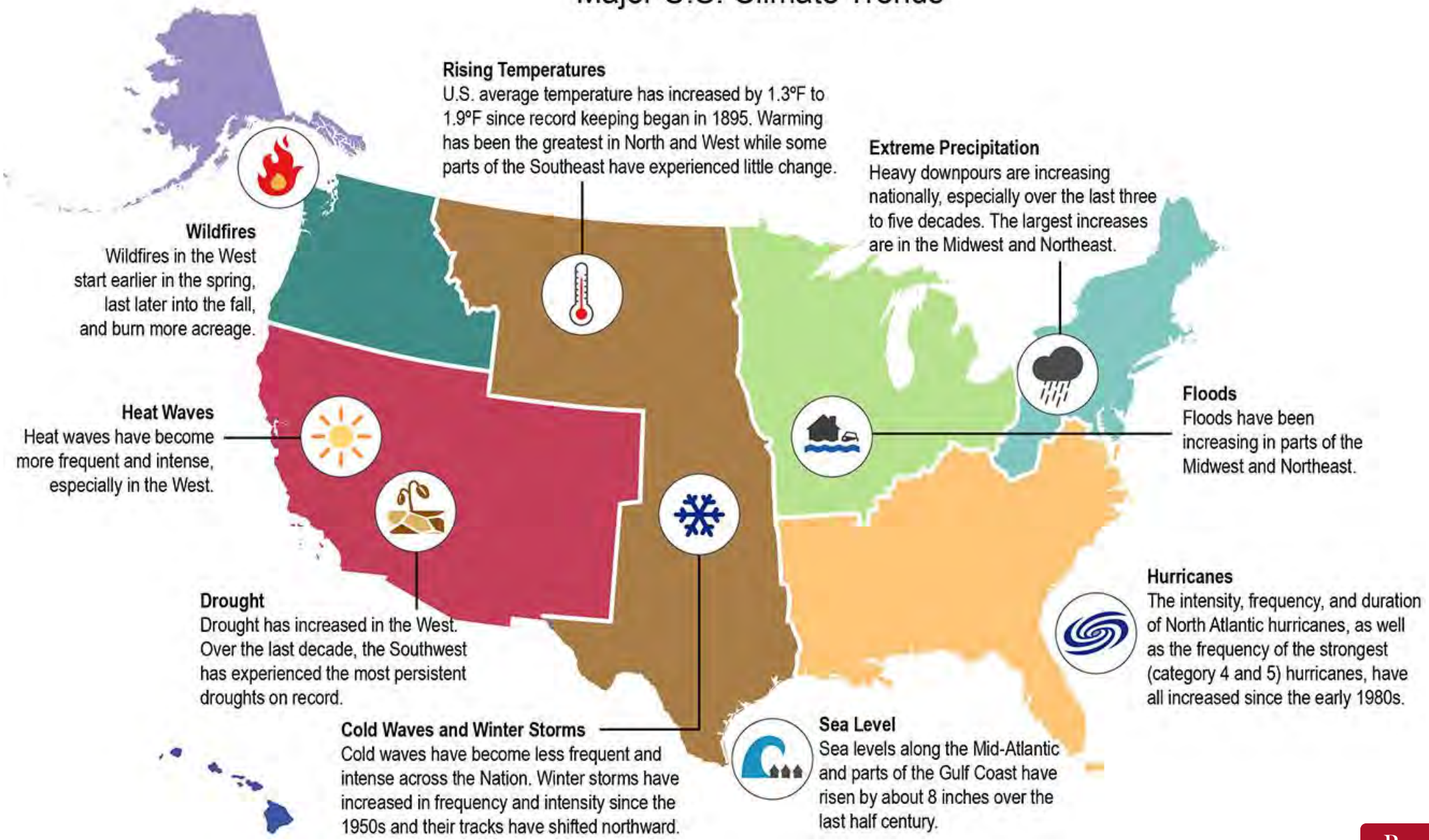
Annual Longest Dry Spell



Change in Number of Days

0 1 2 3

Major U.S. Climate Trends



Rising Temperatures
U.S. average temperature has increased by 1.3°F to 1.9°F since record keeping began in 1895. Warming has been the greatest in North and West while some parts of the Southeast have experienced little change.

Wildfires
Wildfires in the West start earlier in the spring, last later into the fall, and burn more acreage.

Extreme Precipitation
Heavy downpours are increasing nationally, especially over the last three to five decades. The largest increases are in the Midwest and Northeast.

Heat Waves
Heat waves have become more frequent and intense, especially in the West.

Floods
Floods have been increasing in parts of the Midwest and Northeast.

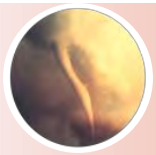
Drought
Drought has increased in the West. Over the last decade, the Southwest has experienced the most persistent droughts on record.

Hurricanes
The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of the strongest (category 4 and 5) hurricanes, have all increased since the early 1980s.

Cold Waves and Winter Storms
Cold waves have become less frequent and intense across the Nation. Winter storms have increased in frequency and intensity since the 1950s and their tracks have shifted northward.

Sea Level
Sea levels along the Mid-Atlantic and parts of the Gulf Coast have risen by about 8 inches over the last half century.

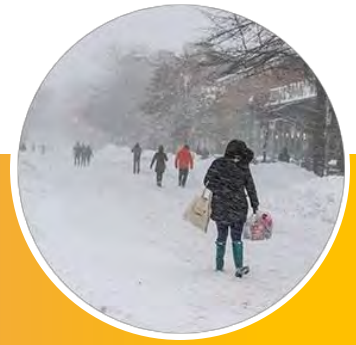
Extremes are Changing in a Warmer World



Tornadoes

Hurricanes

Severe Droughts



Winter Storms

Extreme Precipitation Events

Coastal Flooding

Heat Waves

Limited Evidence

Moderate Evidence

Strong Evidence

Strongest Evidence

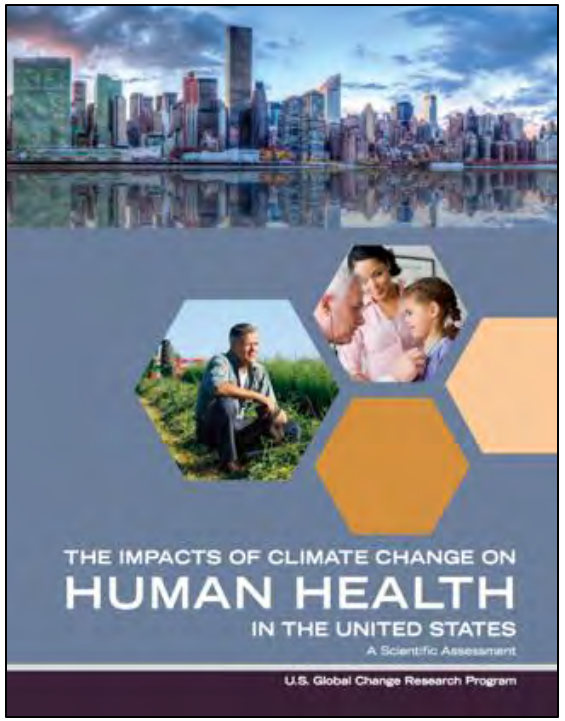

Climate Change & Health

United States Global Change Research Program

Executive Summary

Climate change is a significant threat to the health of the American people.

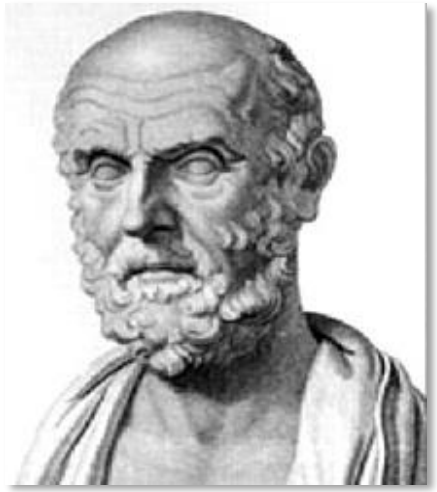
Every American is vulnerable to the health impacts associated with climate change



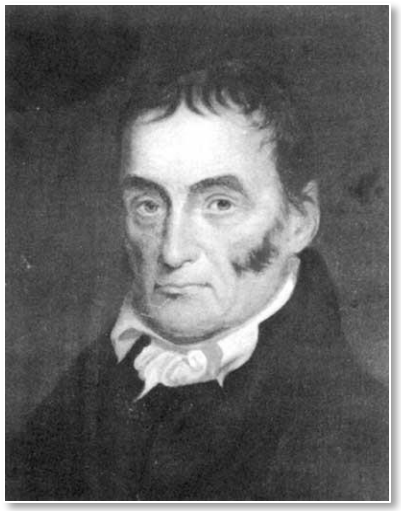
health2016.globalchange.gov


When did scientists first link climate to human health?

A Long History of Climate & Health

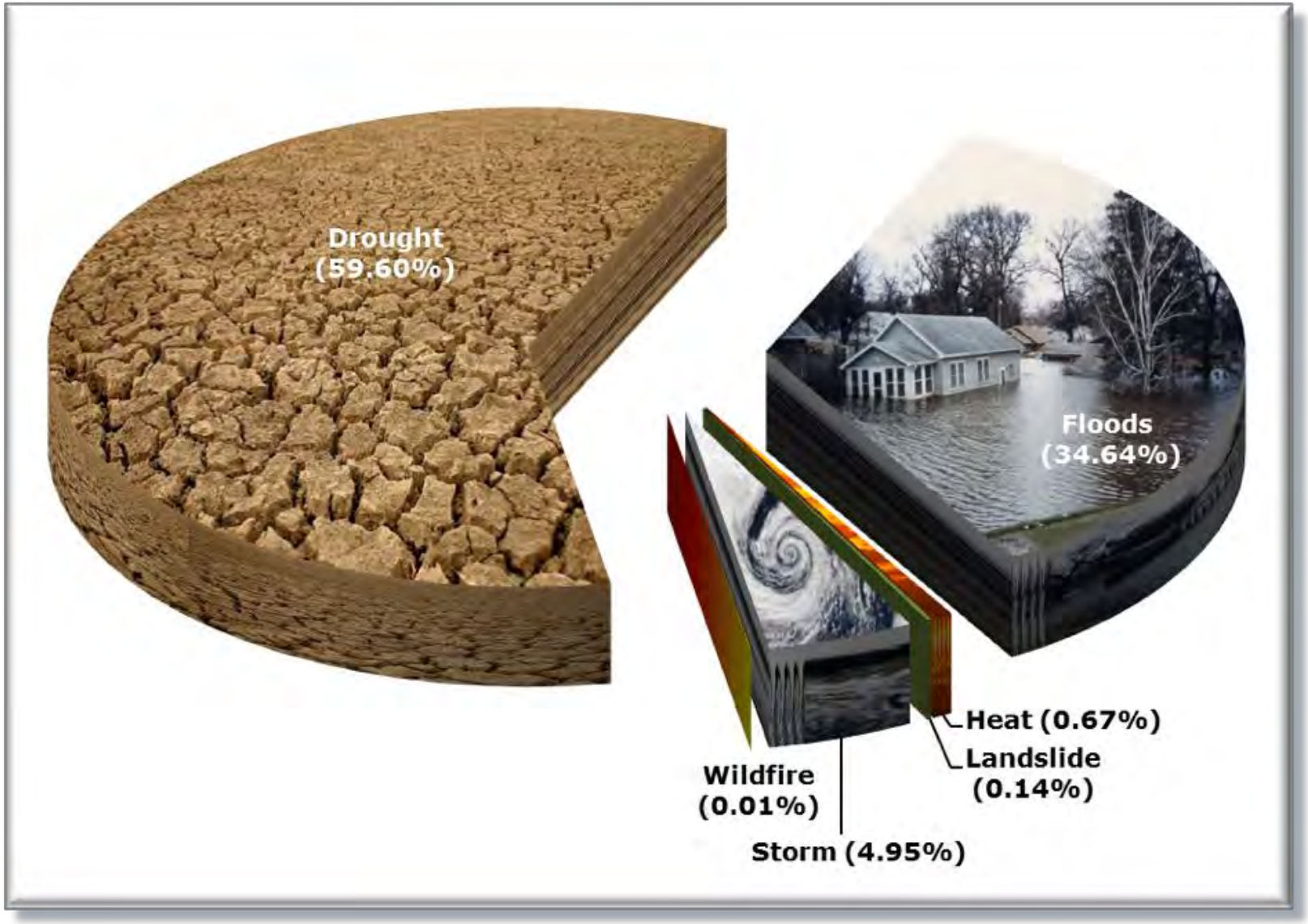


Hippocrates wrote about epidemics in 400 B.C.E. and noted the change in weather



1814 Dr. James Tilton, Surgeon General of the Army, directed all hospital surgeons to keep weather records

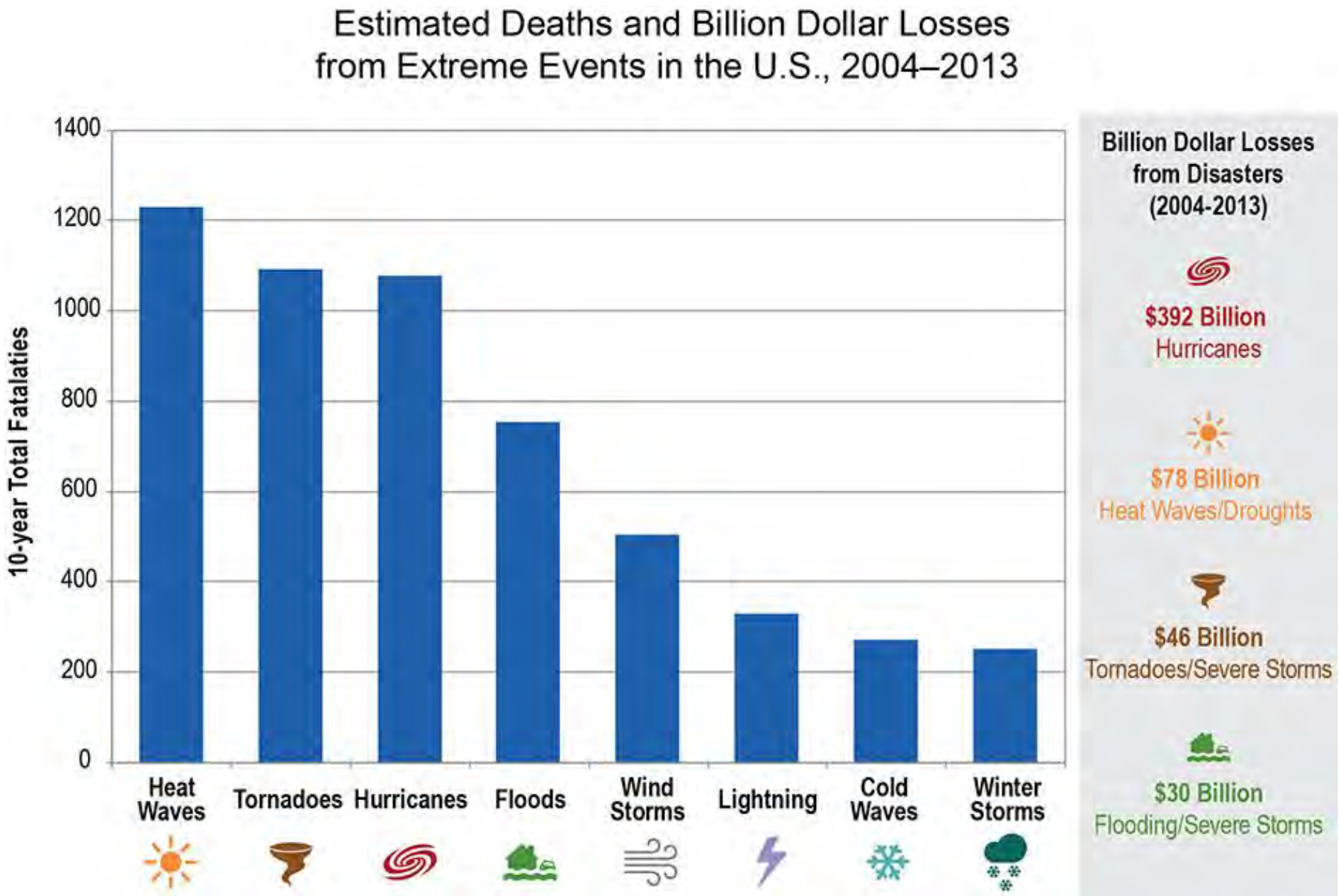
Percentage of disaster-deaths worldwide according to each category of climate-related hazard, (1900-2013)



Source: Adapted from EM-DAT: The OFDA/CRED International Database, Belgium 2012
Keim, ME Extreme Weather Events: the role of public health


What climate event likely results in the most fatalities?

Costs of Extreme Events



Climate is Affecting Your Health

https://www.cnn.com/2018/08/29/us/puerto-rico-growing-death-toll/index.html

How Puerto Rico's death toll climbed from 64 to 2,975 in Hurricane Maria

By Ray Sanchez, CNN

Updated 2:56 PM ET, Wed August 29, 2018

Puerto Rico revises Hurricane Maria death toll 01:39

(CNN) — Puerto Rico's true death toll from Hurricane Maria remains elusive as the storm's one-year anniversary approaches.

The island government raised the **official death toll to 2,975** on Tuesday after maintaining for months that 64 people had died as a result of the storm.

More from CNN

Watch Hurricane Michael's 155 mph winds

Cleveland Parade to Celebrate Tristan Thompson Punching Draymond...

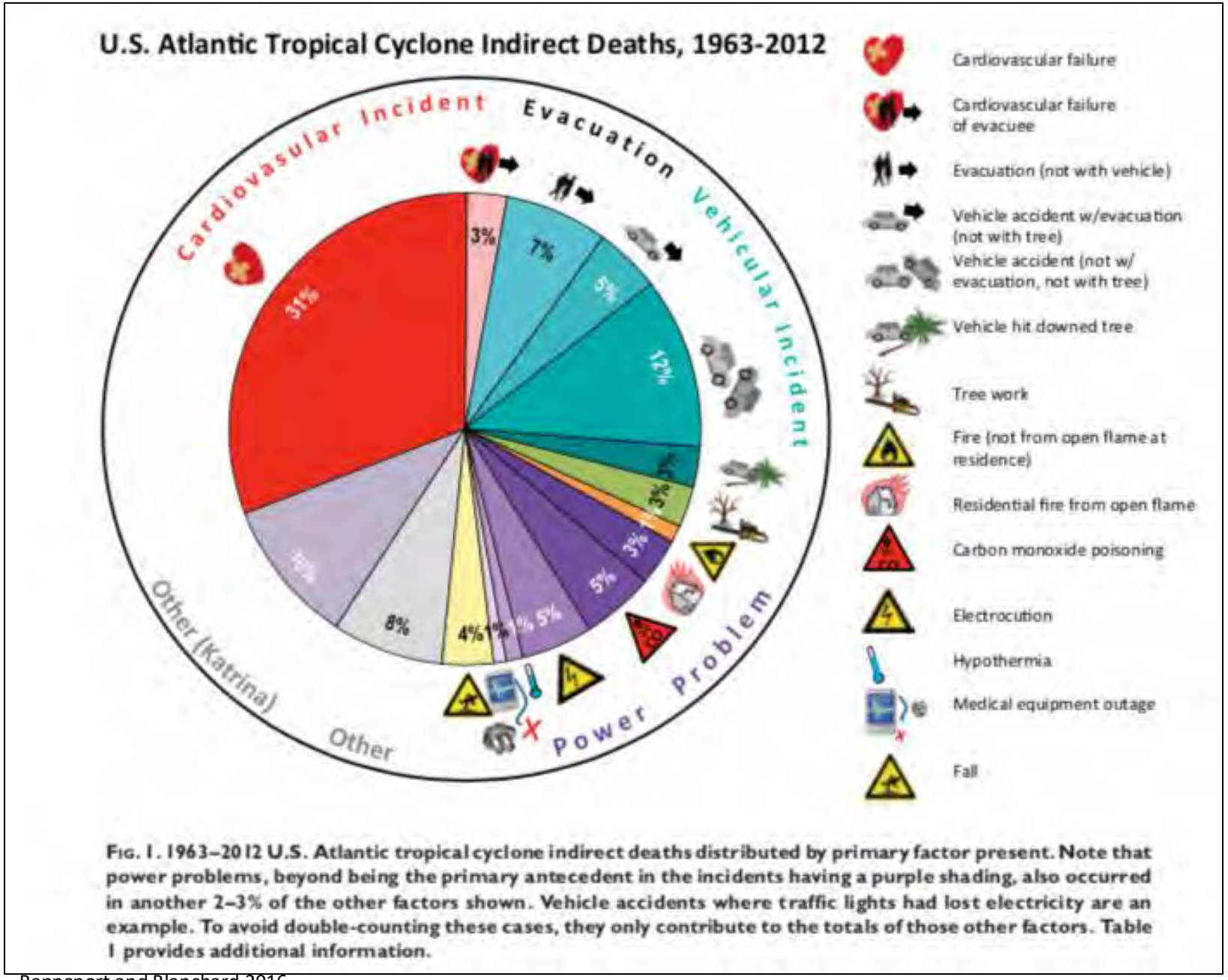
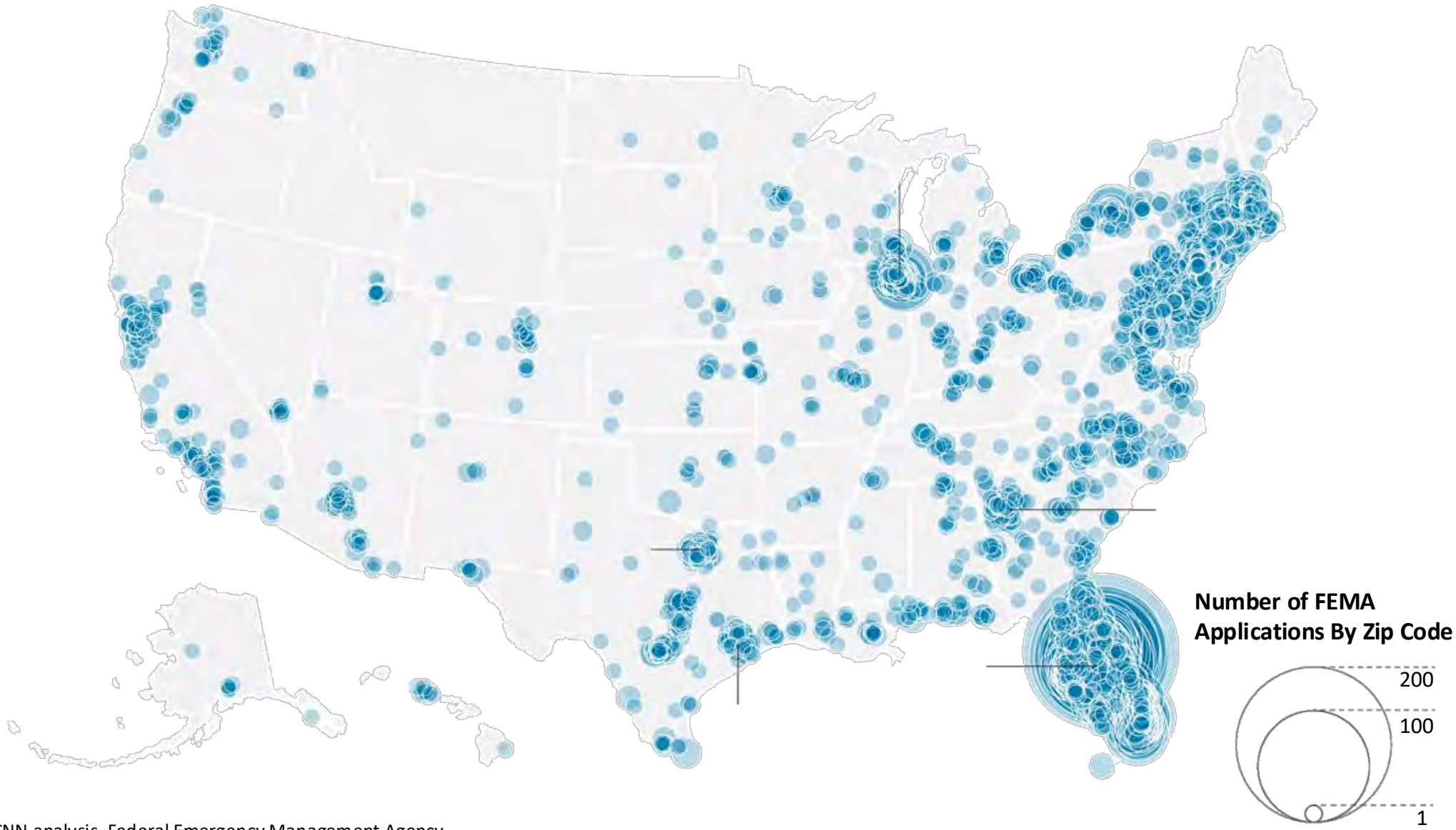


FIG. 1. 1963–2012 U.S. Atlantic tropical cyclone indirect deaths distributed by primary factor present. Note that power problems, beyond being the primary antecedent in the incidents having a purple shading, also occurred in another 2–3% of the other factors shown. Vehicle accidents where traffic lights had lost electricity are an example. To avoid double-counting these cases, they only contribute to the totals of those other factors. Table 1 provides additional information.

Rappaport and Blanchard 2016

Estimate of People Displaced by Hurricane Maria



Source: CNN analysis, Federal Emergency Management Agency

What are some pathways for climate change to impact health?

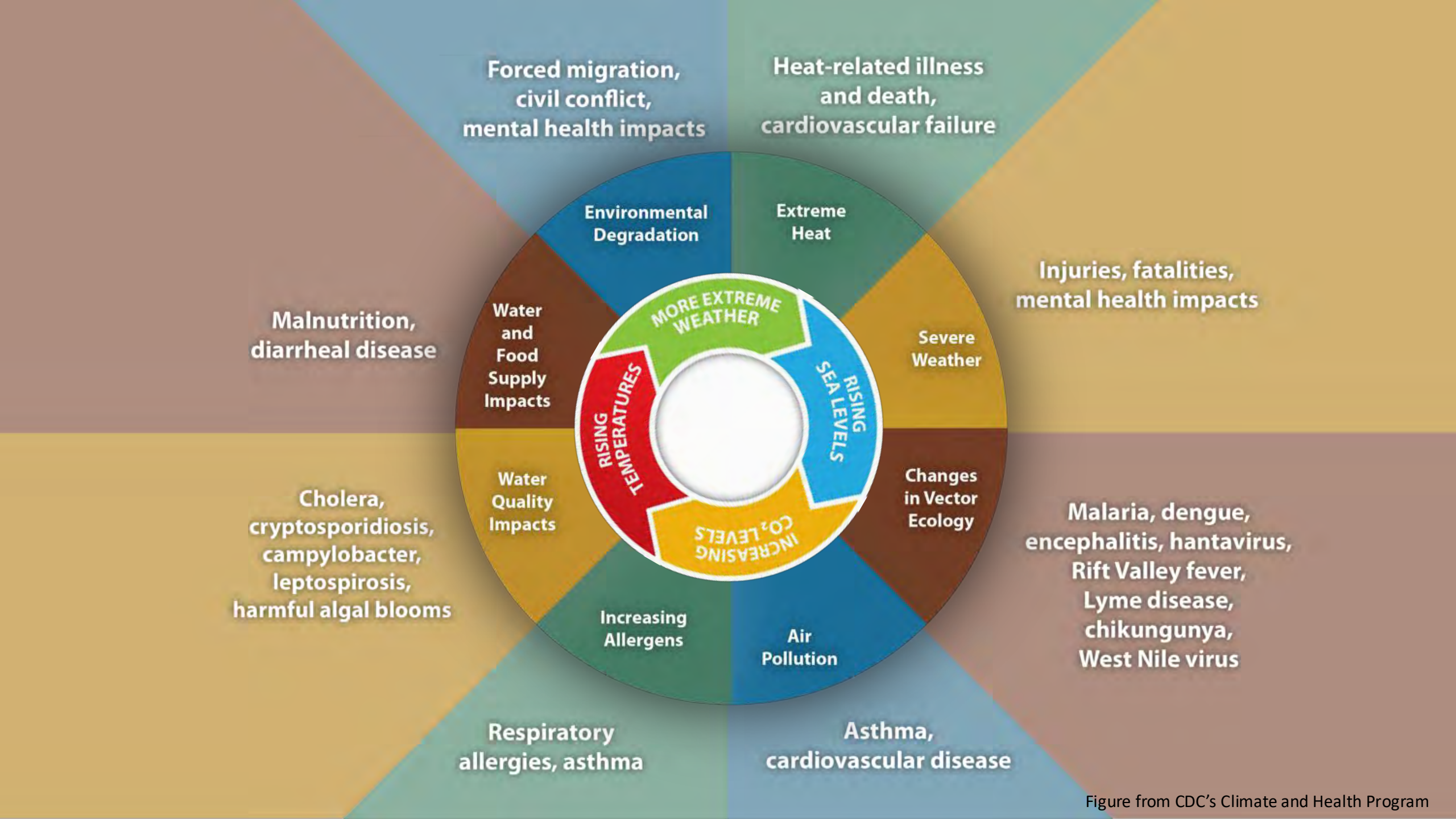
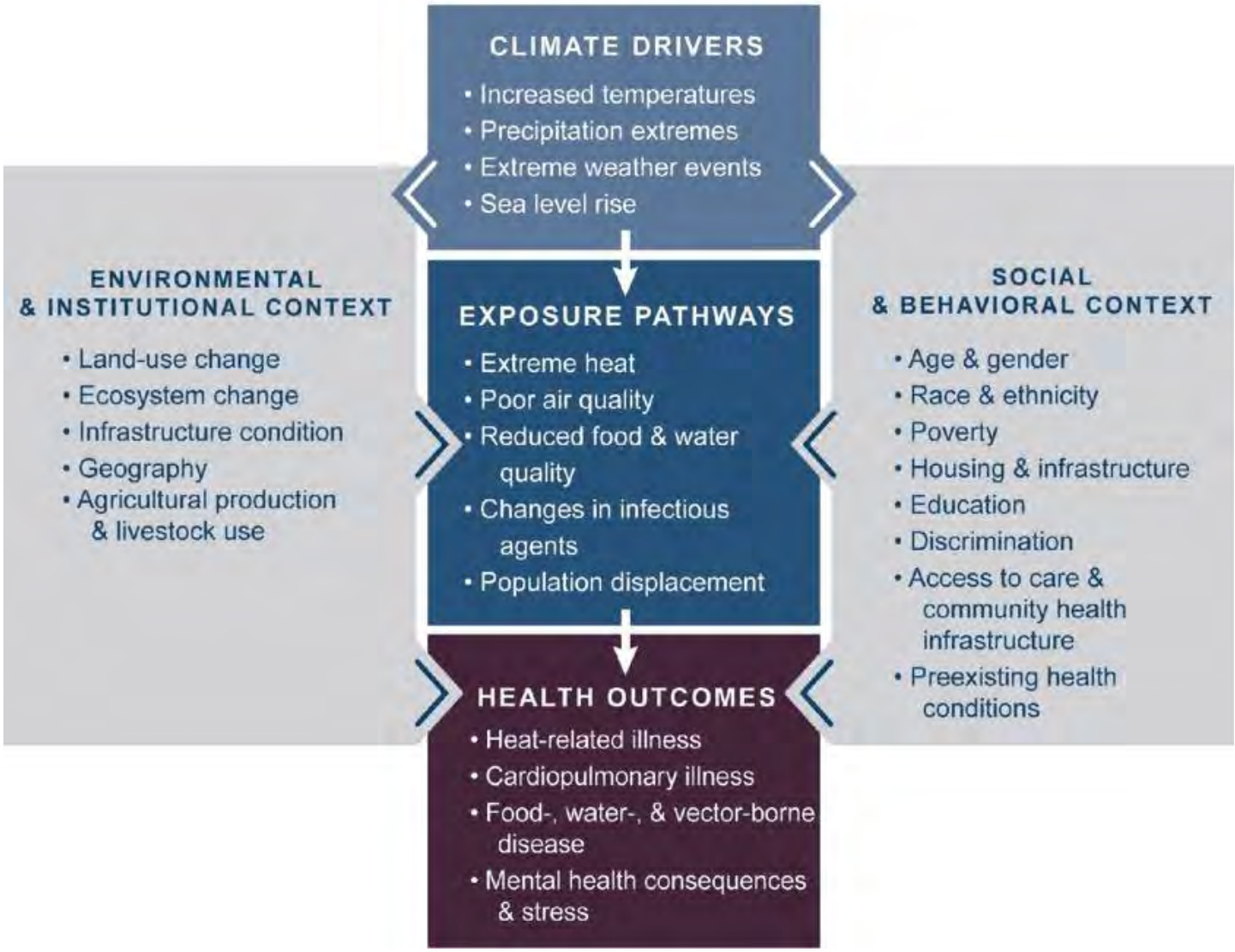


Figure from CDC's Climate and Health Program

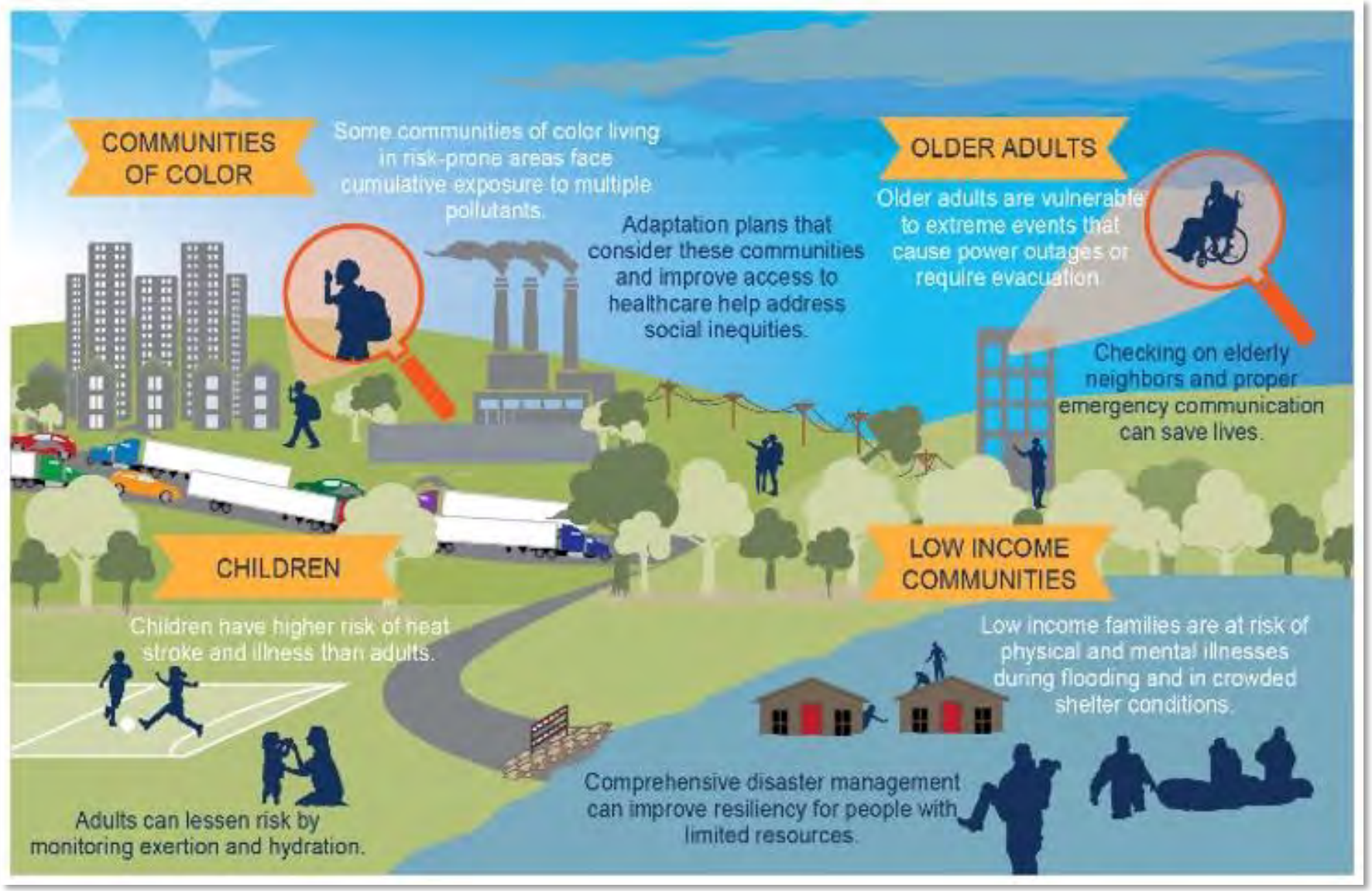
Climate Change and Health



How we prepare and respond influences the outcomes


Are all populations impacted by climate change the same?

Populations of Concern



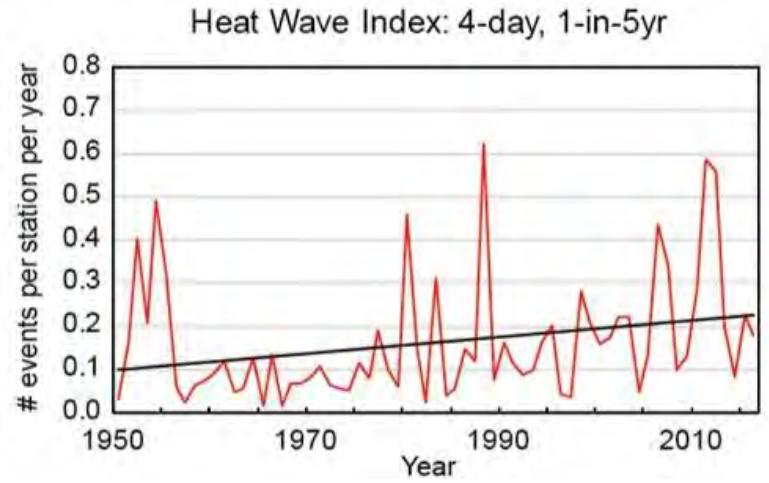
Extreme Heat

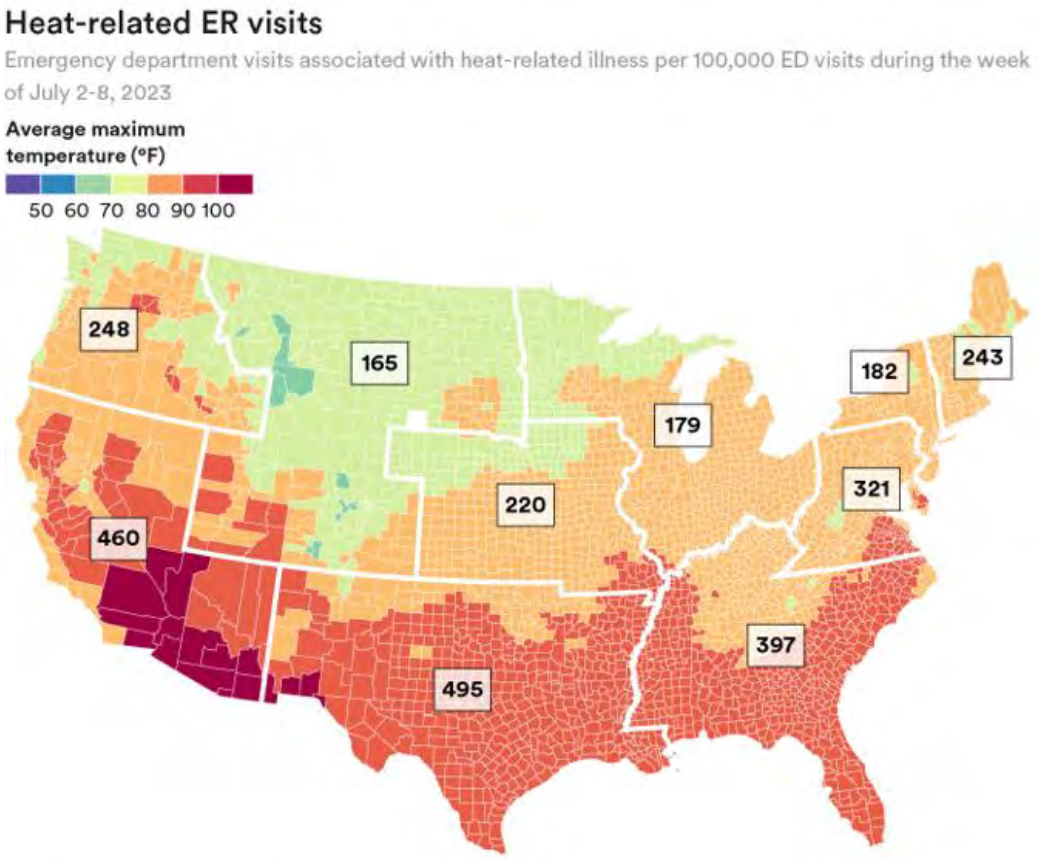
Extreme Heat

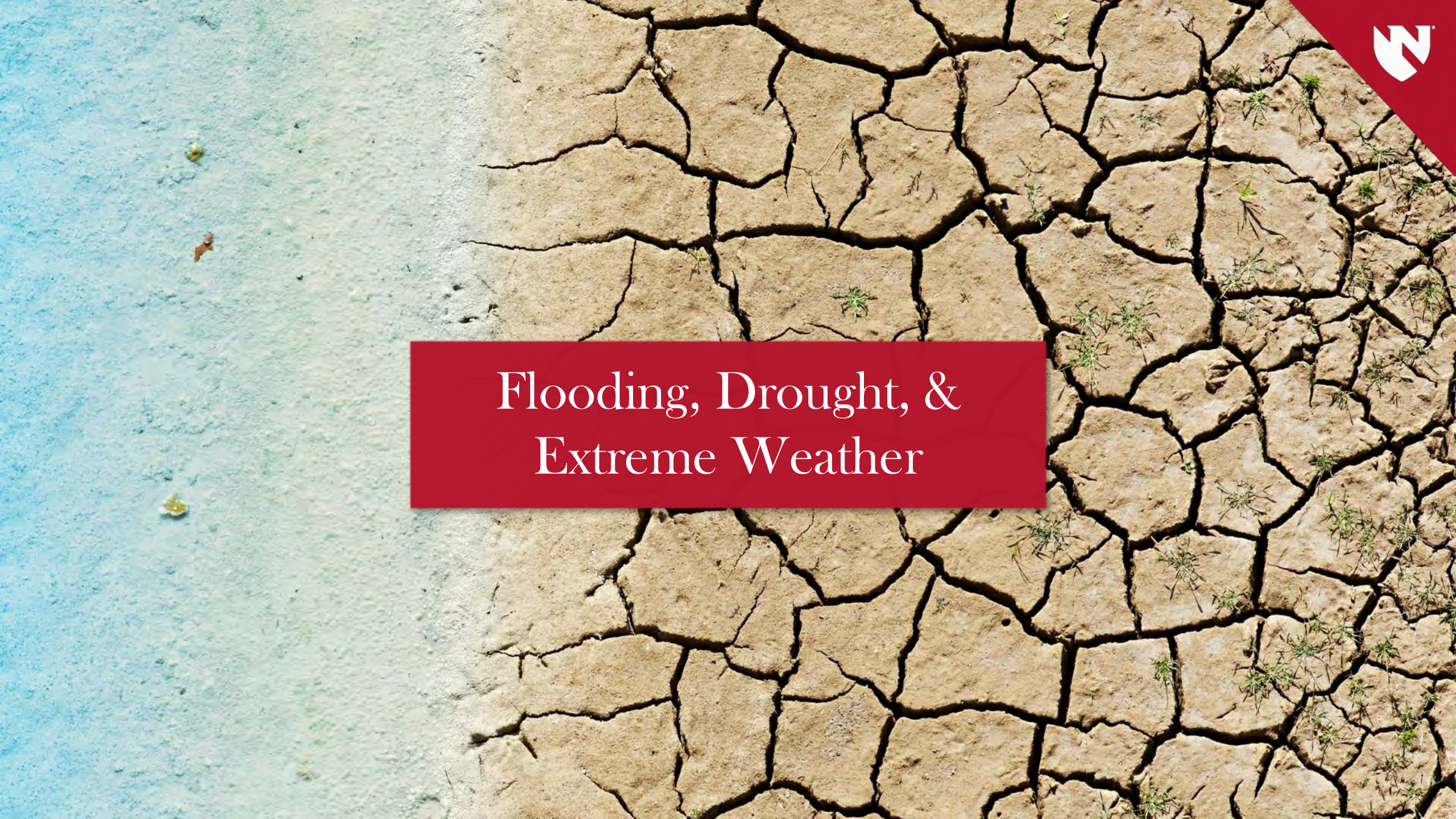
Increased temperatures, higher humidity, longer and more frequent heat waves

Heat stroke, dehydration, and heat-related illness

At-risk populations: Outdoor workers, student athletes, people in cities, people without air conditioning, people with chronic diseases, pregnant women, older adults, and young children







Flooding, Drought, & Extreme Weather

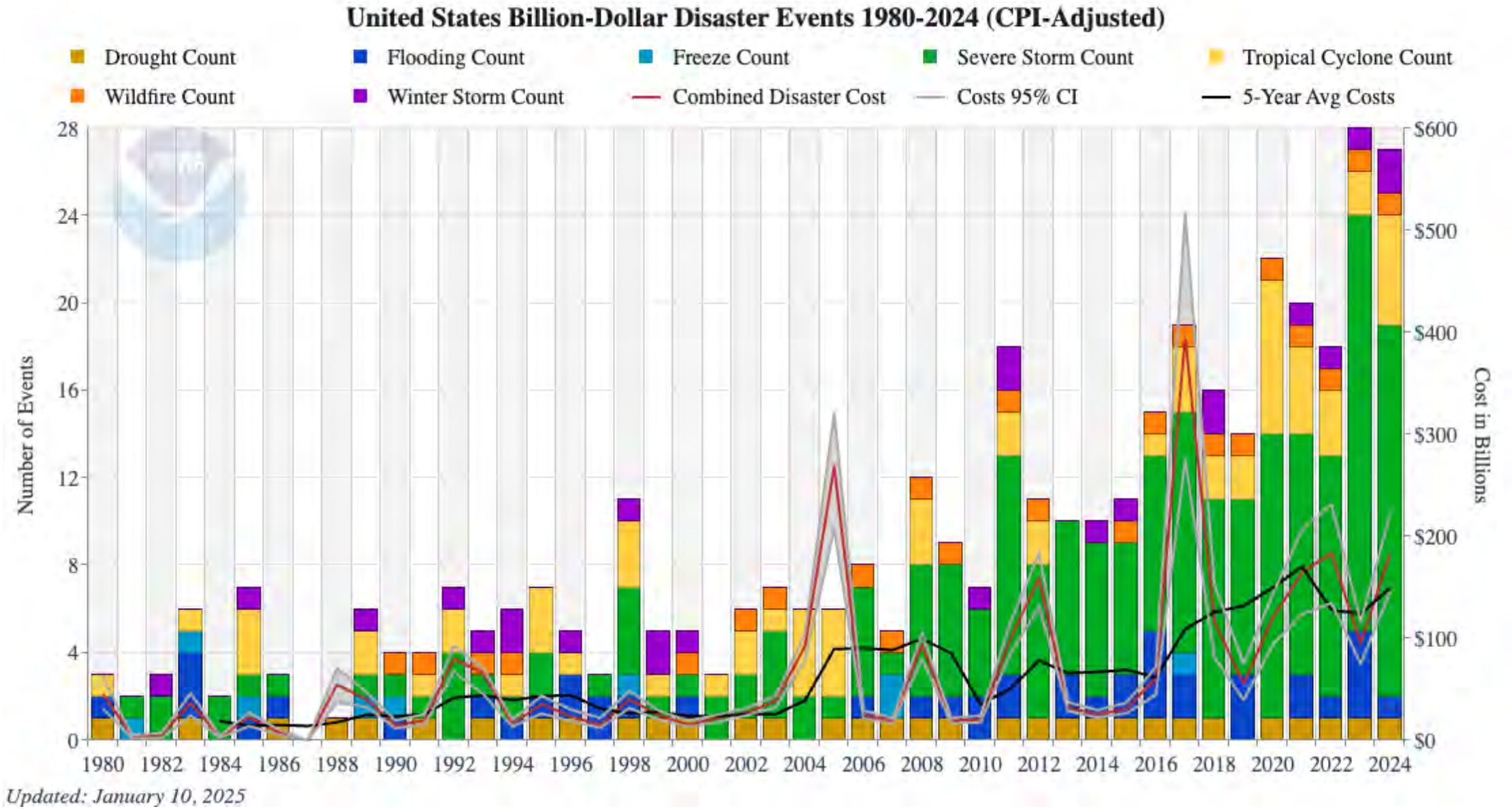
Extreme Weather

Increased frequency and severity of heavy downpours, floods, droughts, and major storms

Injury, illness, displacement, and death

At-risk populations: People who lack access to evacuation routes and people who can't use stairs when elevators are out of service, people in wheelchairs, older adults, the poor, and people with disabilities, particularly if they are unable to access elevators and evacuation routes

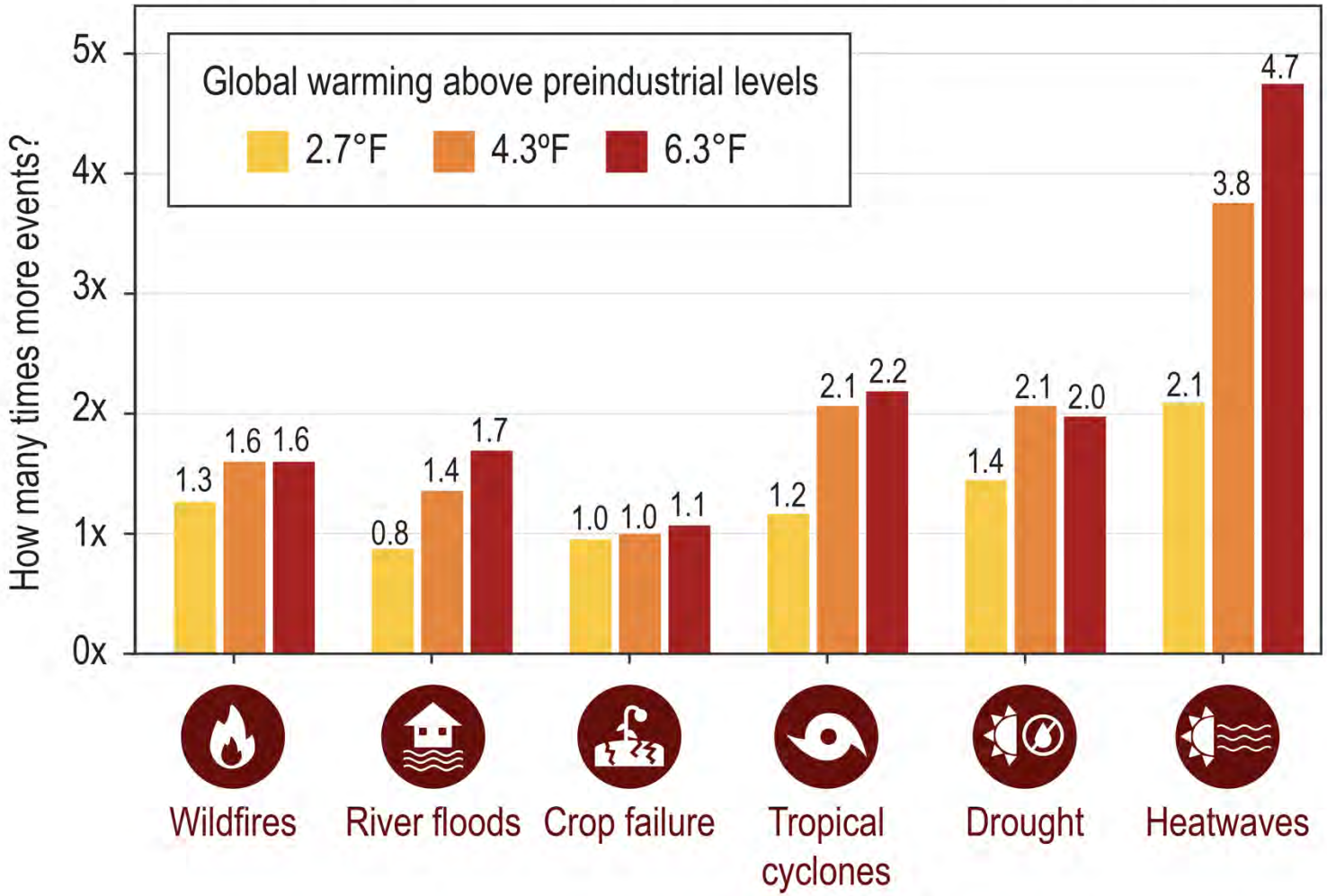
Billion Dollar Disasters are Increasing



Living in a Changed Climate

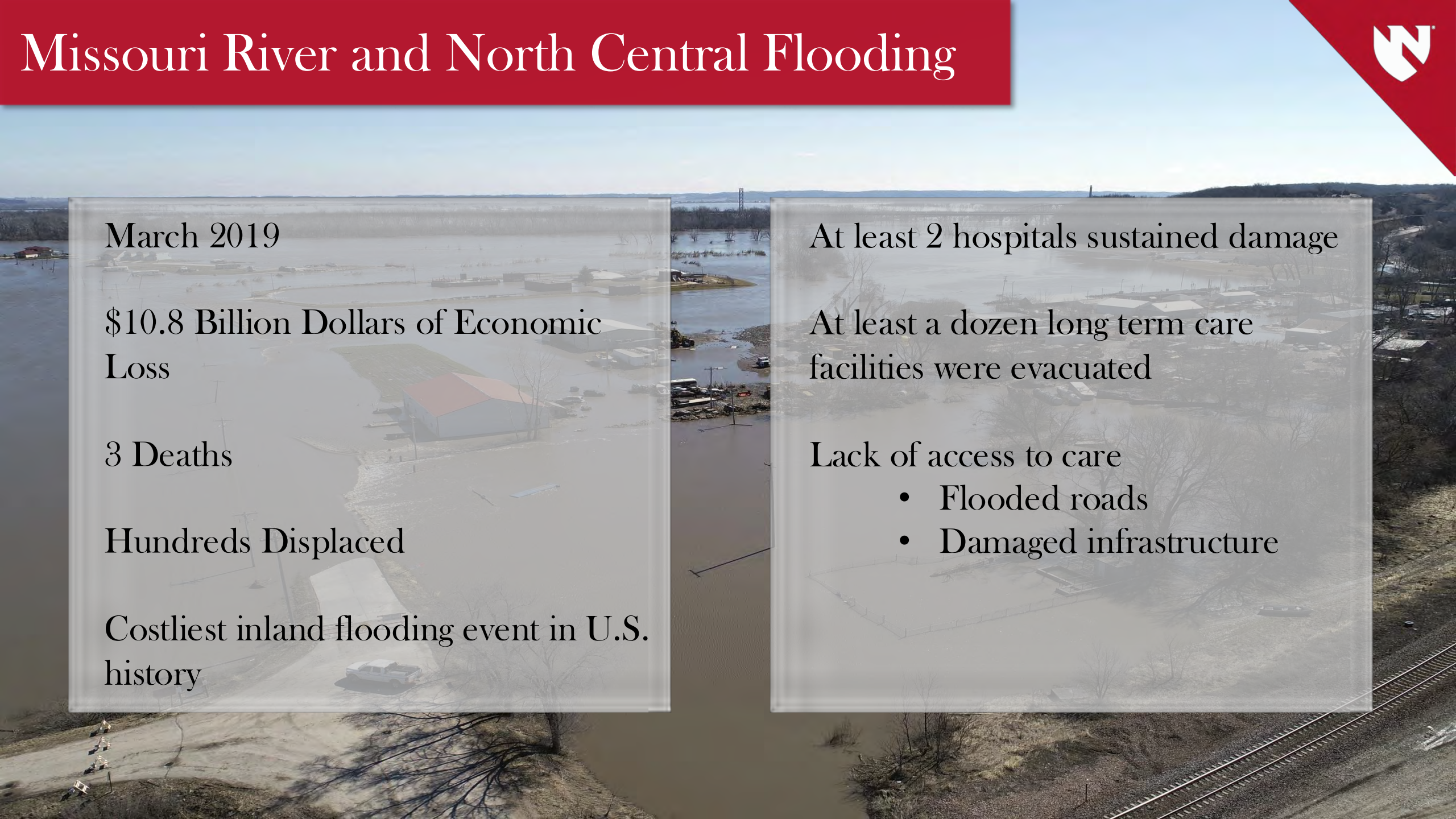
Intergenerational Inequity

A person born in 2020 will experience more climate hazards during their lifetime, on average, than a person born in 1965.



U.S. Global Change Research Program
National Climate Assessment

Missouri River and North Central Flooding



March 2019

$10.8 Billion Dollars of Economic Loss

3 Deaths

Hundreds Displaced

Costliest inland flooding event in U.S. history

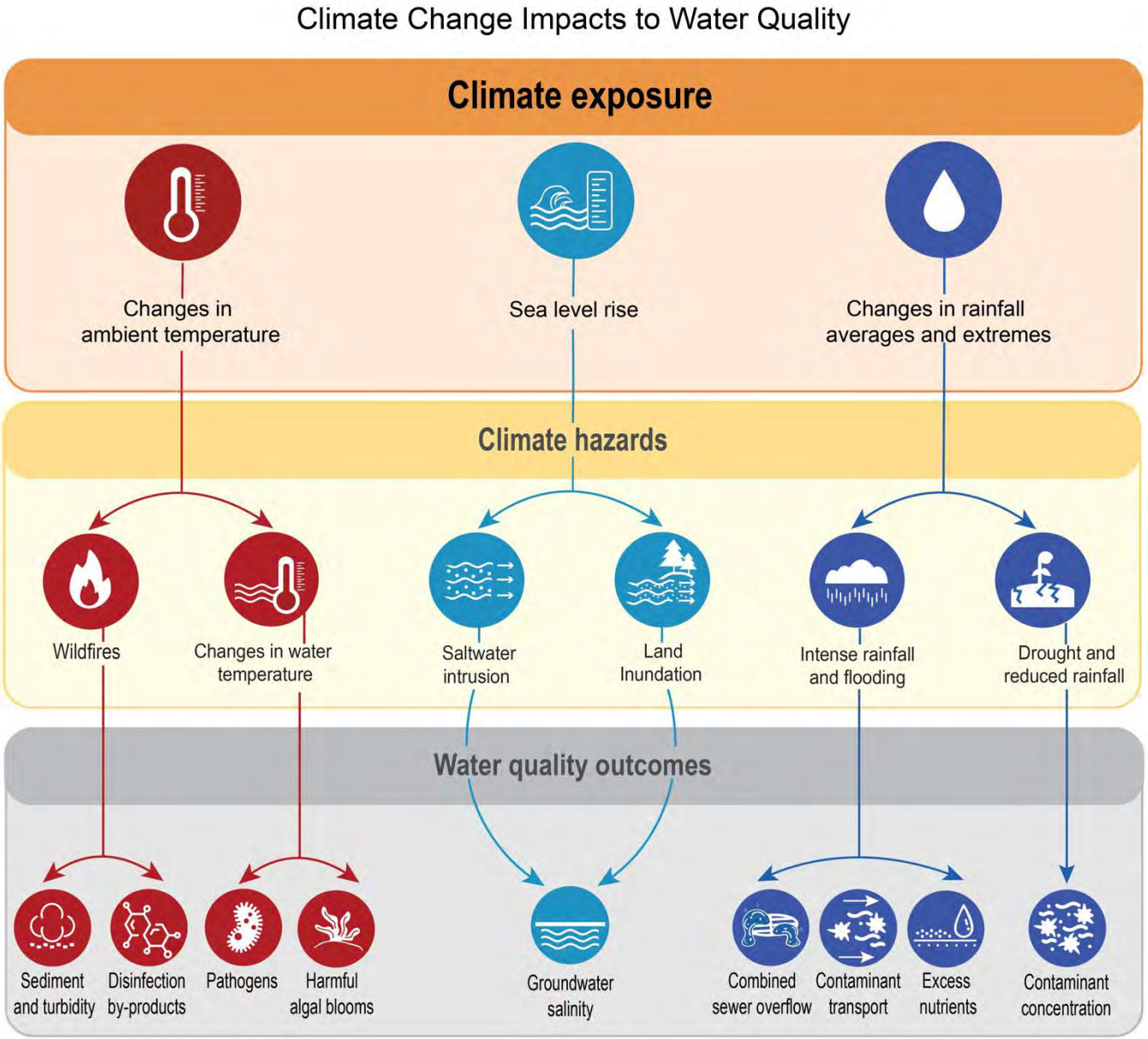
At least 2 hospitals sustained damage

At least a dozen long term care facilities were evacuated

Lack of access to care

- Flooded roads
- Damaged infrastructure

Compromised Quality & Quantity of Water



USGS science for a changing world

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Drought May Lead to Elevated Levels of Naturally Occurring Arsenic in Private Domestic Wells

Release Date: MARCH 18, 2021

An estimated 4.1 million people in the lower 48 states are potentially exposed to arsenic levels that exceed EPA's drinking water standards

A new U.S. Geological Survey study highlights the importance of homeowners testing their well water to ensure it is safe for consumption, particularly in drought-prone areas. The first-of-its-kind national-scale study of private well water, conducted in collaboration with the Centers for Disease Control and Prevention, showed that drought may lead to elevated levels of naturally occurring arsenic and that the longer a drought lasts, the higher the probability of arsenic concentrations exceeding U.S. Environmental Protection Agency's standard for drinking water.

Researchers estimate that during drought conditions, 4.1 million people in the lower 48 states who use private domestic wells are potentially exposed to unsafe levels of arsenic. This is an increase of 54% from the estimated 2.7 million people exposed to unhealthy arsenic levels in private wells during normal, non-drought conditions.

Arsenic is a metal that can occur naturally in bedrock and sediments around the world and is commonly reported in drinking-water supply wells. However, chronic exposure to arsenic from drinking water is associated with an increased risk of several types of cancers, including bladder, lung, prostate and skin cancers. Other adverse effects include developmental impairments, cardiovascular disease, adverse birth outcomes and impacts on the immune and endocrine systems.

The study's findings can help public health officials and emergency managers notify well owners in areas potentially affected and further refine their strategies for addressing the issue. The EPA regulates public water supplies, but maintenance, testing and treatment of private water supplies are the

Jacks Pond in Hancock, New Hampshire. Groundwater from this area supplies nearby private wells. (Credit: Melissa Lombard, USGS.

Contacts

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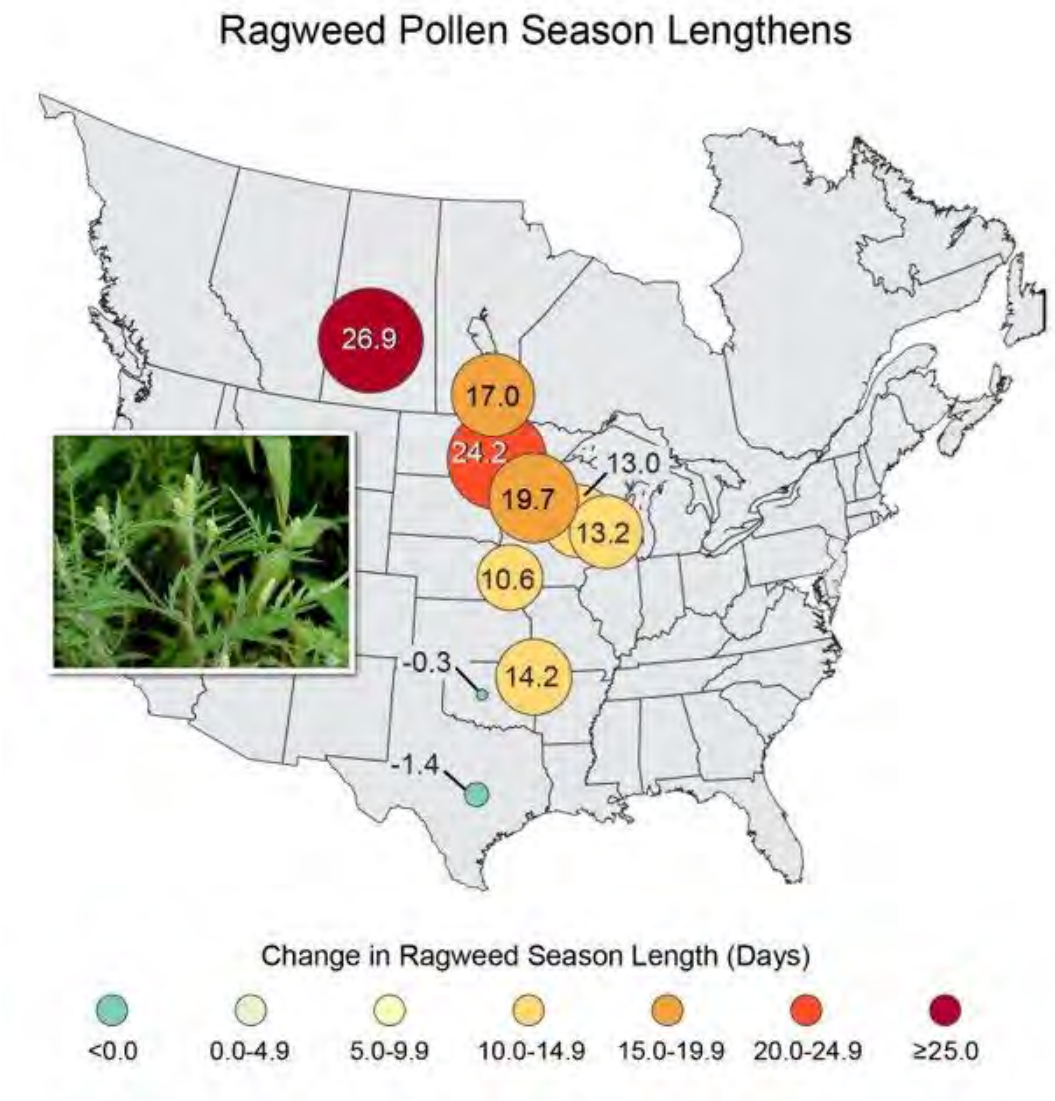
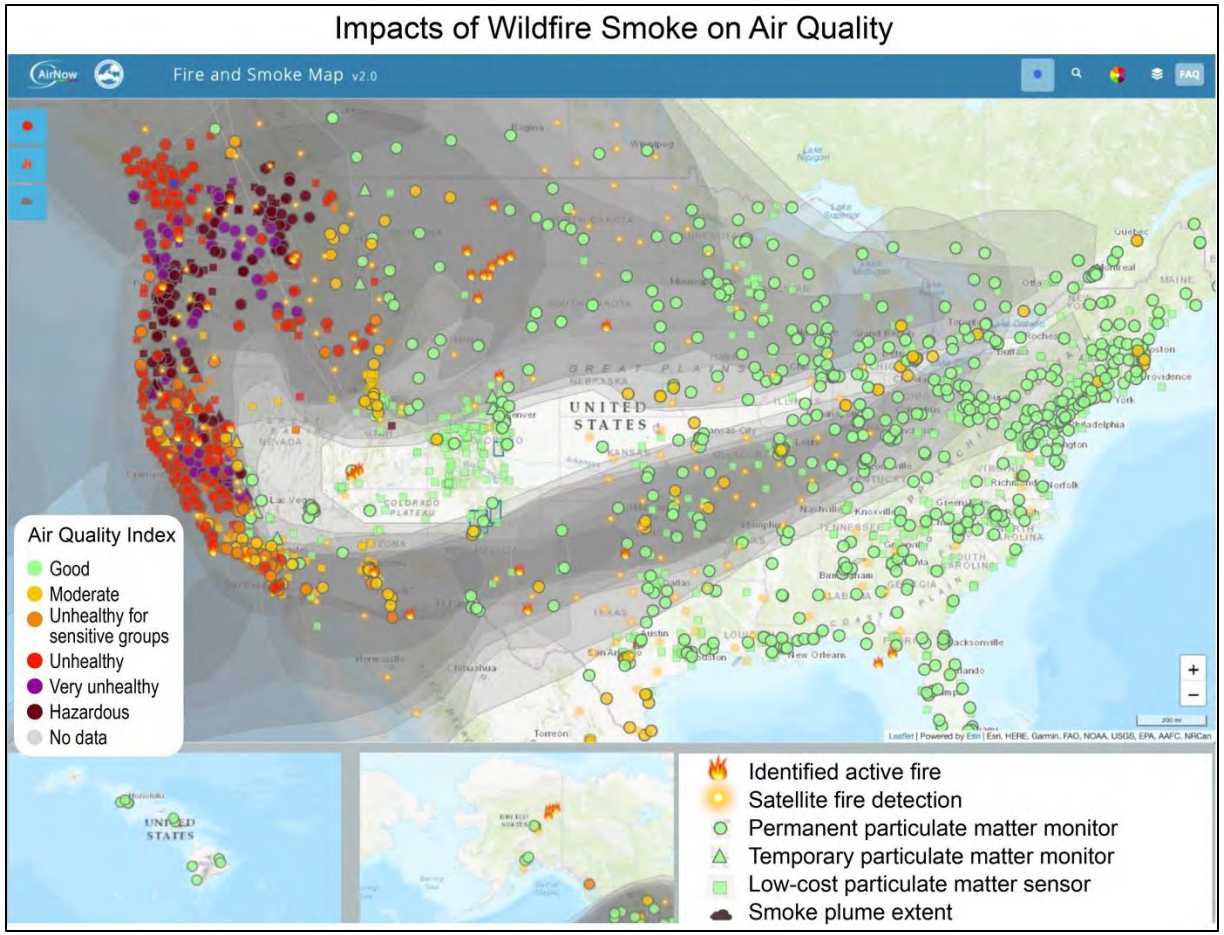
Phone: 603-226-7816

Air Quality

- Increased wildfires, smog, pollen, and mold
- Asthma, respiratory, and allergy issues
- At-risk populations: People with heart and respiratory conditions such as heart disease, asthma, or chronic lung disease

Changes in Air Quality with Climate Change



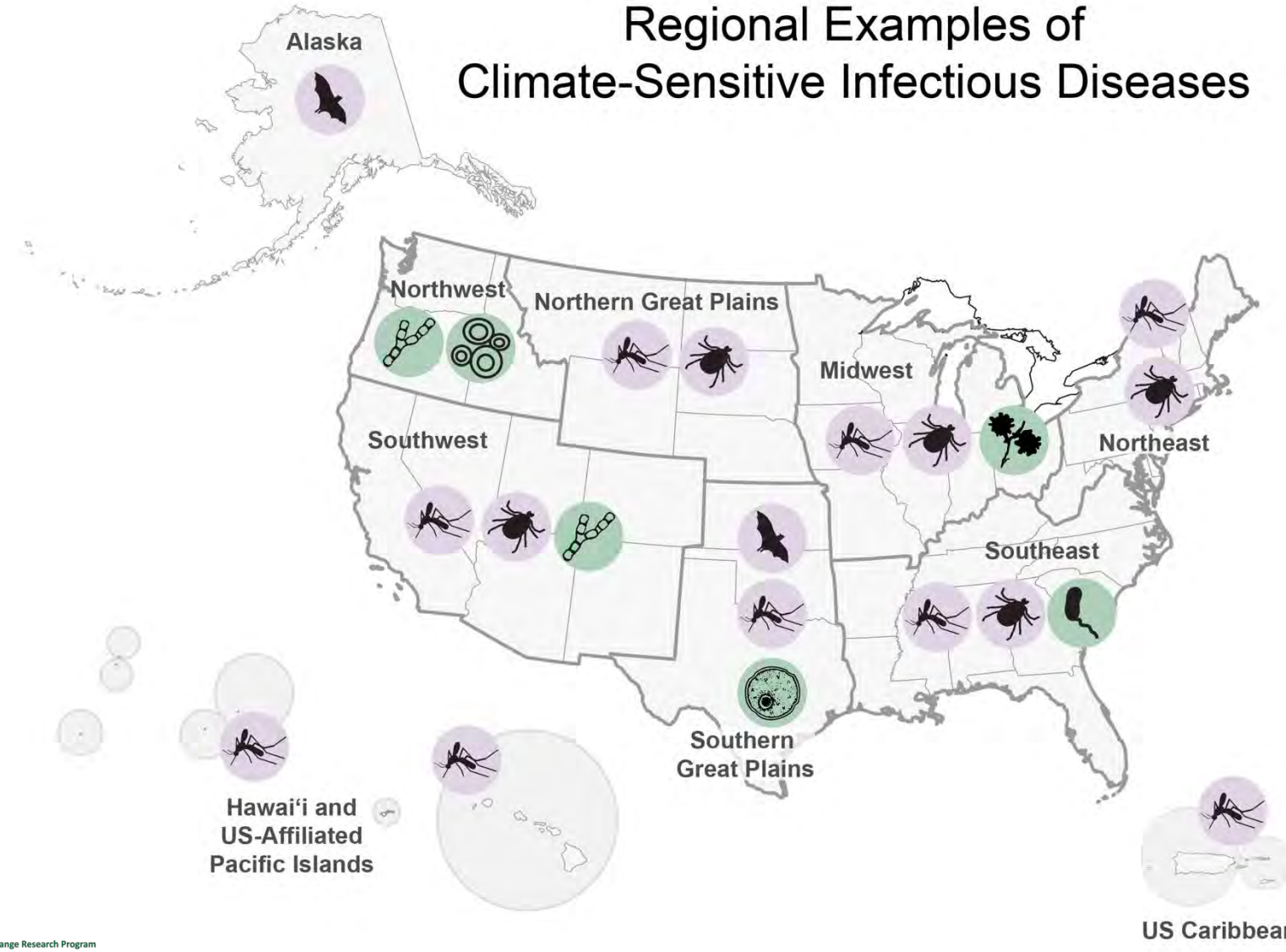


United States Global Change Research Program

Spreading Disease: Insects, Ticks, and Rodents

- Higher temperatures, changes in rain patterns, and disrupted ecosystems
- Lyme disease, West Nile disease, etc.
- At-risk populations: People who spend more time outdoors in places where these insects and other disease-carriers live

U.S. Infectious Diseases are Sensitive to Climate



Disease vectors and hosts (associated diseases)

- Mosquitoes (e.g., West Nile virus encephalitis, dengue fever)
- Ticks (e.g., Lyme disease, Rocky Mountain spotted fever)
- Bats, cattle, other animals (e.g., rabies, brucellosis, other zoonotic diseases)

Environmental pathogens (associated diseases)

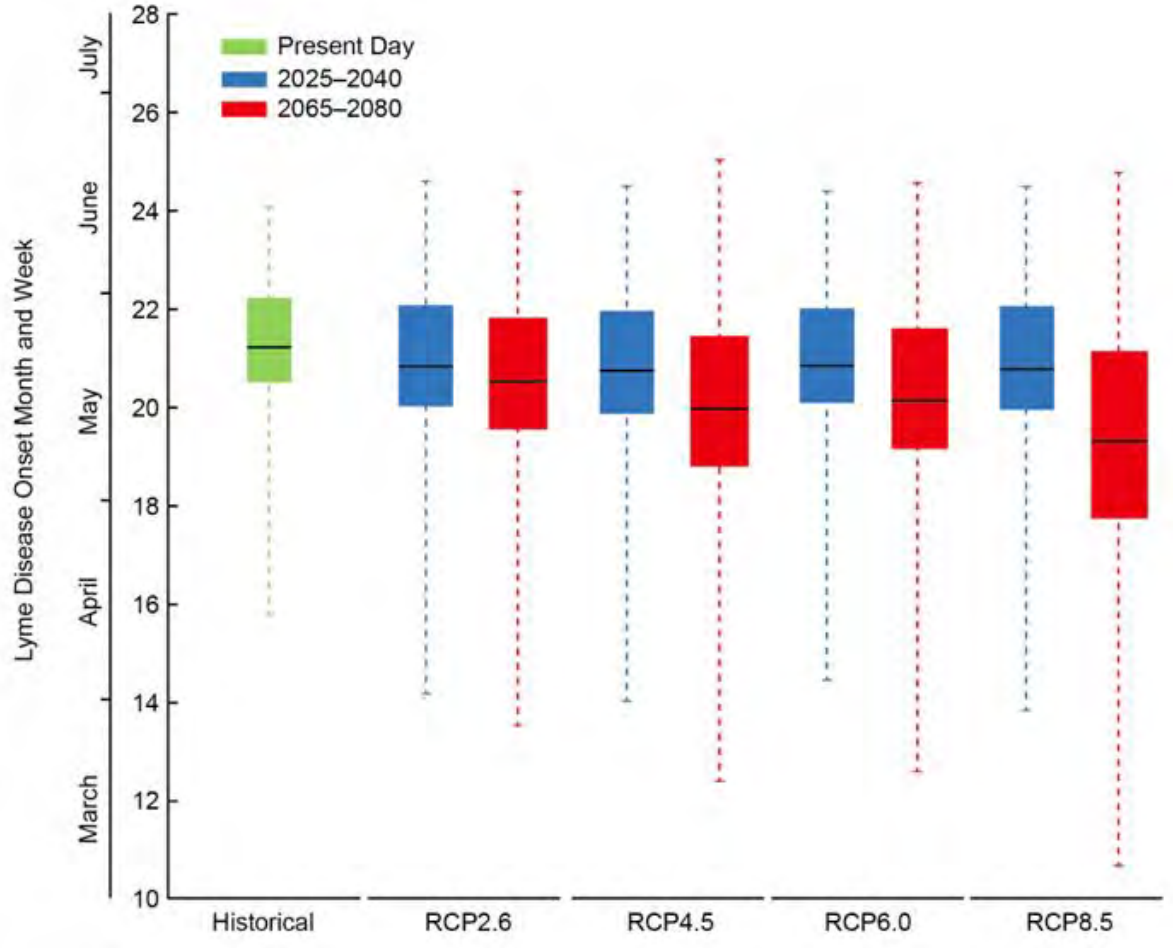
- *Vibrio* bacteria (vibriosis)
- *Coccidioides* fungus (Valley fever)
- *Histoplasma* fungus (histoplasmosis)
- *Cryptococcus* fungus (cryptococcosis)
- *Naegleria fowleri* amoeba (primary amebic meningoencephalitis)

U.S. Global Change Research Program
National Climate Assessment

Lyme Disease Could Come Earlier with Climate Change

Spread of Lyme disease factors

- Climate
- Ecological
- Social



United States Global Change Research Program

Source: Beard, C.B., R.J. Eisen, C.M. Barker, J.F. Garofalo, M. Hahn, M. Hayden, A.J. Monaghan, N.H. Ogden, and P.J. Schramm, 2016: Ch. 5: Vectorborne Diseases. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. U.S. Global Change Research Program, Washington, DC, 129–156.

Mental Health

- Increased frequency and severity of extreme weather events
- Stress, depression, anxiety, PTSD, and suicidal thoughts
- At-risk populations: Children, older adults, pregnant and postpartum women, people with mental illnesses, the poor, homeless people, first responders, and people who rely on the environment for their livelihood


What do you think can be done?

Opportunities for Engagement

Public health spending is estimated to be between 1.5% and 3% of all U.S. health spending.

Closing thoughts

- Climate Change is a Significant Health Threat
- All people are vulnerable… some more than others
- Costs are Increasing
- Multiple relationships between climate and health
- Lots to be gained by combining expertise
- Multiple opportunities to address this issue
- **Lack of preparedness, planning, and understanding can increase the severity of a disaster**

The Water, Climate and Health Program pioneers interdisciplinary research, education, and collaborative solutions to public health challenges associated with water and climate in Nebraska and around the world.


Research


Education


Engagement


Policy
Development

Our Research Areas

Water Quality & Health

Climate Change & Health

Extreme Heat & Health

Flooding, Drought, & Extreme Weather

Air Quality & Health

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Yeongjin Gwon, PhD

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Kristina Kintziger, PhD

Assistant Professor

Yunju Im, PhD

Program Manager

Christine Allmon

Research Assistant Professor

Babak Fard, PhD

Postdoctoral Researcher

Sarah Scales, PhD

Postdoctoral Researcher

Harshanee Jayasekera, PhD

Postdoctoral Researcher

Kelli Gribben, PhD

Postdoctoral Researcher

Jabeen Taiba, PhD

NCI Postdoc.

Richard Remigio, PhD

Research Data Analyst

Siddhi Munde, MS

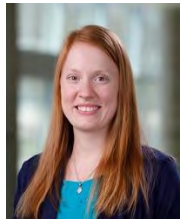
Research Data Analyst

Arianna Li, MS

Extension Educator

Laura Nagengast, MPH

GCHS Associate



Lisa Willard, BA

NE Tracking Consultant

Sue Dempsey, MS, CPH

Communications & Outreach

Summer Woolsey, MPH

Our Students

PhD Students

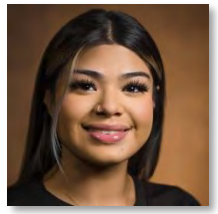
Adily Abdoulaye Abdoulaziz

Ryan Cannady

Hunter Jones

Qianting Li

Raheleh Mohammadi



Ruth Mencia

Kyei Afari

EMET Medical Students

Anna Barent

Bailey Anderson

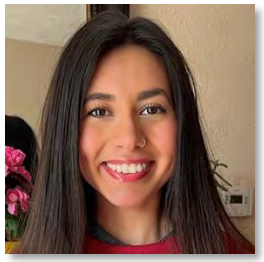
Morgan Penry

Denise Torres

Bryson Lewis

Hillary Mantone

MPH Students



Jessenia Hincapie

Undergraduate Students

Liz Cole

Ally Barry

Healthy Earth Alliance (HEAL)

Our Impact & Reach

Harnessing the Heartland

WCHP in 2024

PurpleAir Sensors

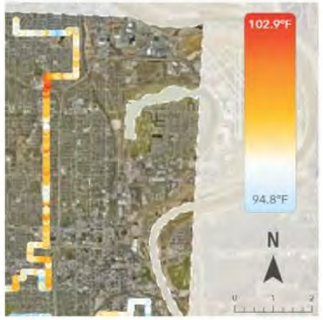
Post-Tornado Rapid Needs Assessments

Drought & Health Response Training

Mapping Heat in Omaha

Aug. 6, 2022	80 mi²	68	8	43,714	102.9°	9.4°
Study Date	Study Area	Volunteers	Routes	Measurements	Max Temp.	Temperature Differential

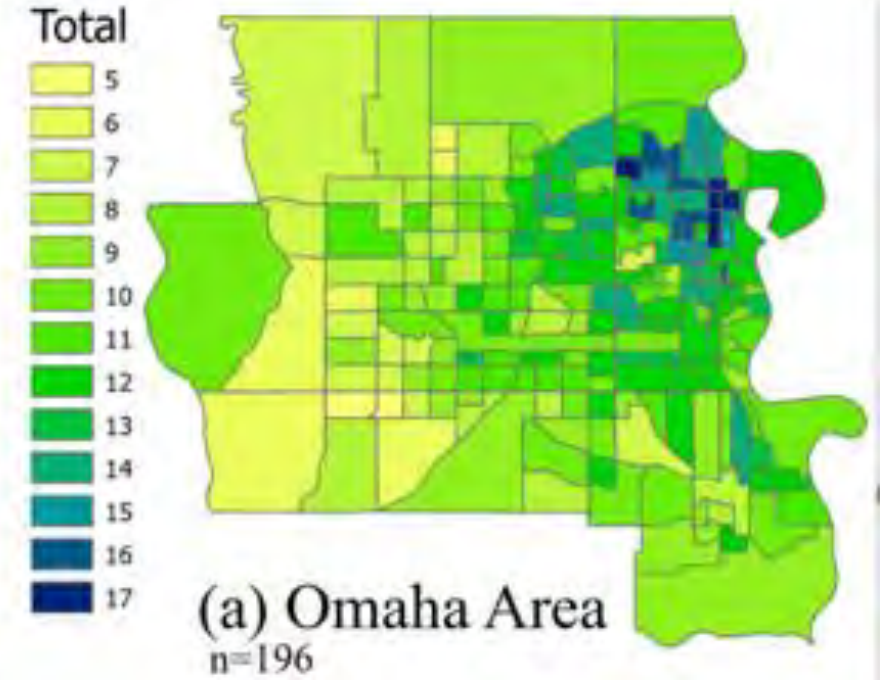
Morning Routes (6–7 a.m.)
Over 14,000 unique temperature measurements are displayed on this portion of our study area. Temperatures vary from coolest (77.4°F) to warmest (81.4°F).

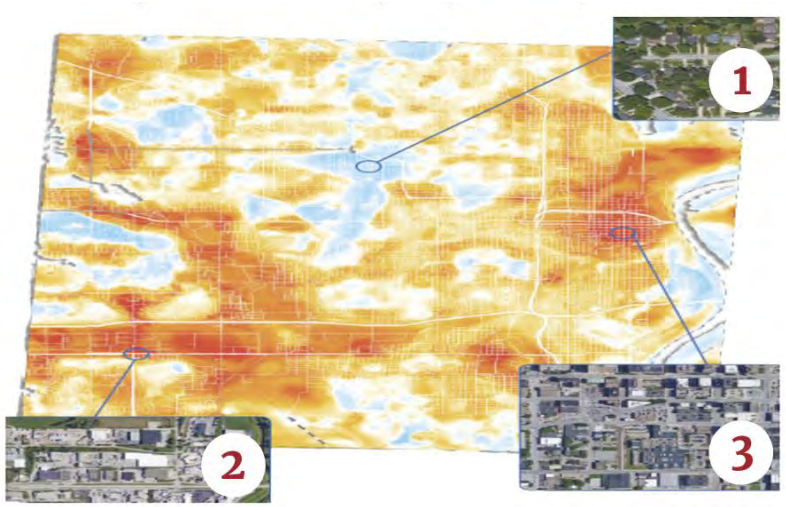


Afternoon Routes (1–2 p.m.)
Over 13,000 unique temperature measurements are displayed on this portion of our study area. Temperatures vary from coolest (94.8°F) to warmest (102.9°F).

Evening Routes (7 - 8 p.m.)
Over 15,000 unique temperature measurements are displayed on this portion of our study area. Temperatures vary from coolest (93.8°F) to warmest (102.9°F).

Heat Vulnerability





1. Residential areas with a high tree cover retain less heat throughout the day and have cooler temperatures.

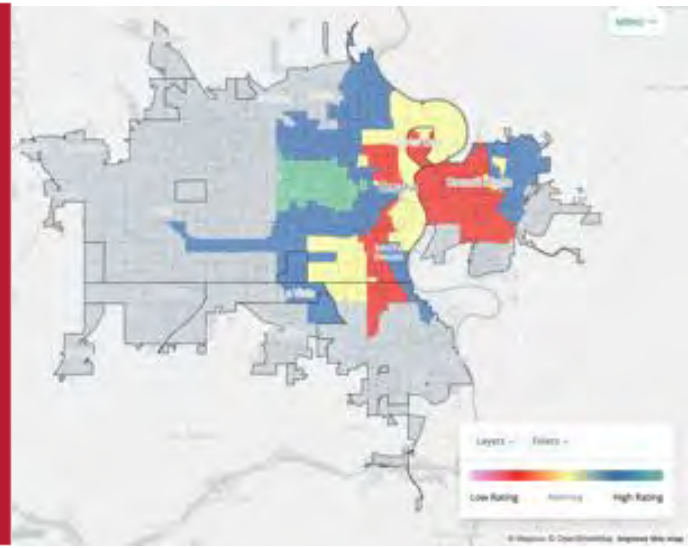
2. Areas with a high density of industrial land use can retain more heat.

3. Large swaths of asphalt in commercial areas can retain more heat and result in higher temperatures.

Nebraska Public Media PBS npr

Omaha Study Examines Heat Differences in City

Redlining



The Water Climate and Health Program is made possible by:

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THE DAUGHERTY WATER *for* FOOD GLOBAL INSTITUTE
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