

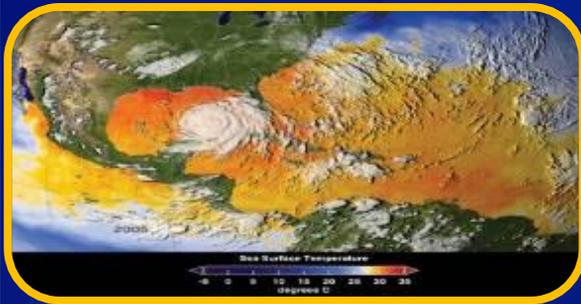
Moderator and Presenter



George Luber, PhD
Chief
Climate and Health Program
US Centers for Disease Control and Prevention

Climate Changes Health

Tools to Communicate the Problem

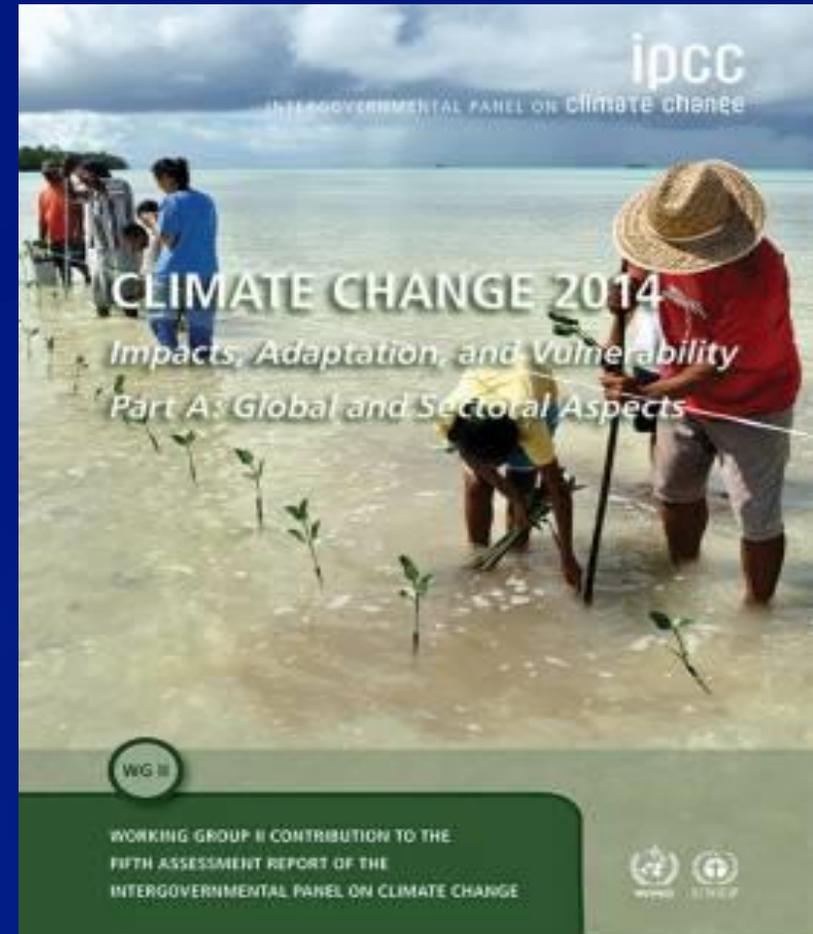
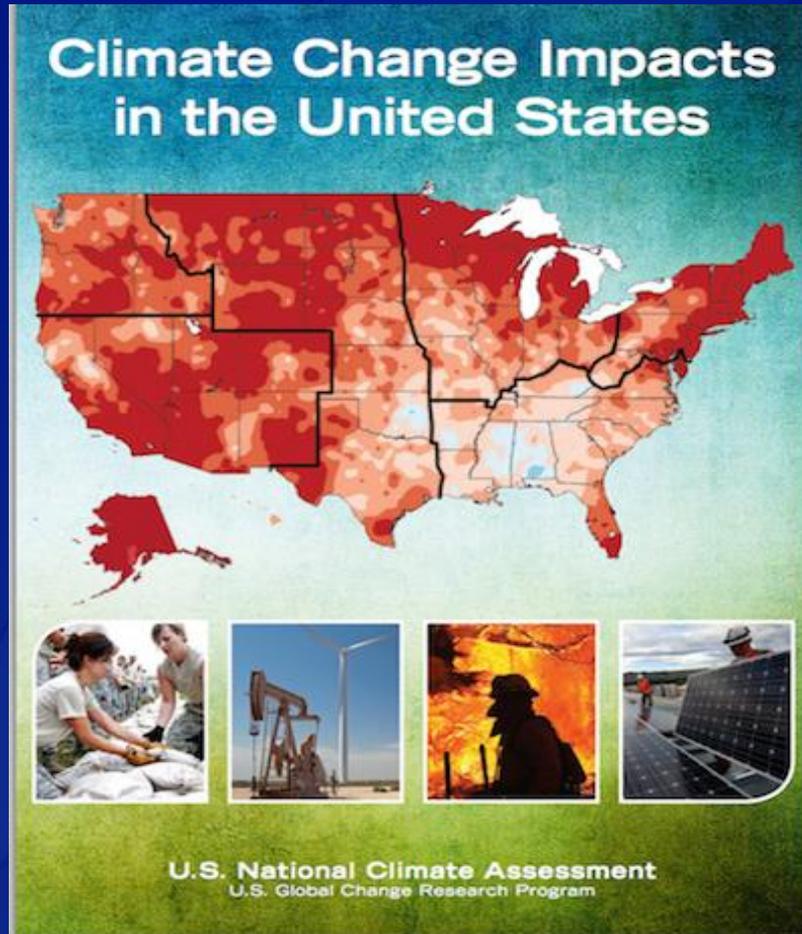


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**National Center for Environmental Health
Centers for Disease Control and Prevention**

2014: Two Major Reports



3rd National Climate Assessment

Key Findings

Increasing Strength of the Evidence

- ❑ Average US temperature has increased by about 1.5°F since 1895 ; more than 80% of this increase has occurred since 1980.
- ❑ Extreme weather events, including heat waves, floods, and droughts, have become more frequent and intense.
- ❑ Sea level has risen by about 8 inches since 1880, projected to rise another 1 to 4 feet by 2100.
- ❑ Frost-free season has been increasing since 1980s.
- ❑ Heavy downpours have increased in most US regions.

Climate Change Science: Key Findings

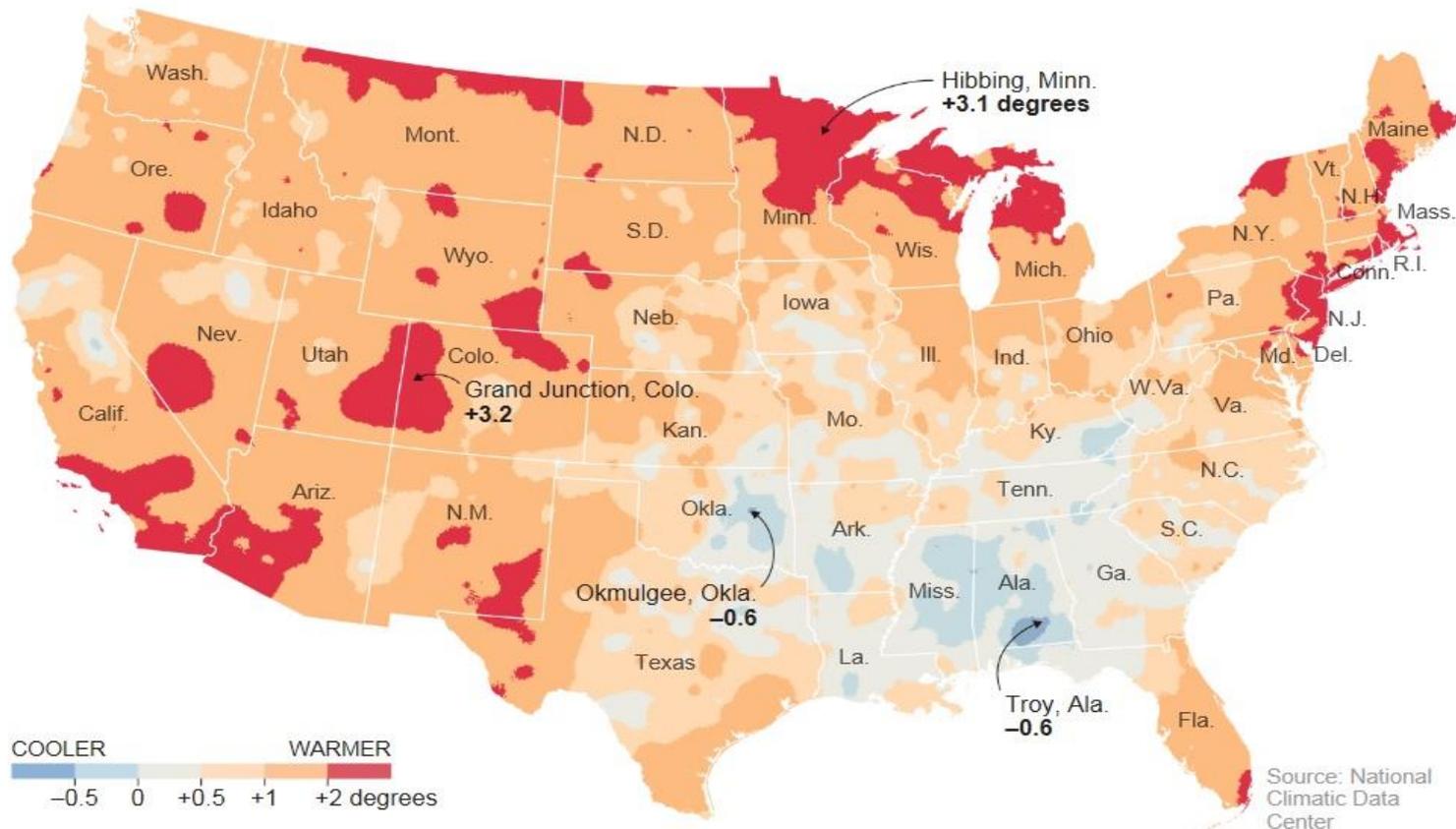
- ❑ Climate change is altering both the average (mean) global temperature *and* the global frequency of extremely hot temperatures (variance)
- ❑ The impacts of climate change will vary significantly by region; some places are warming faster than others.



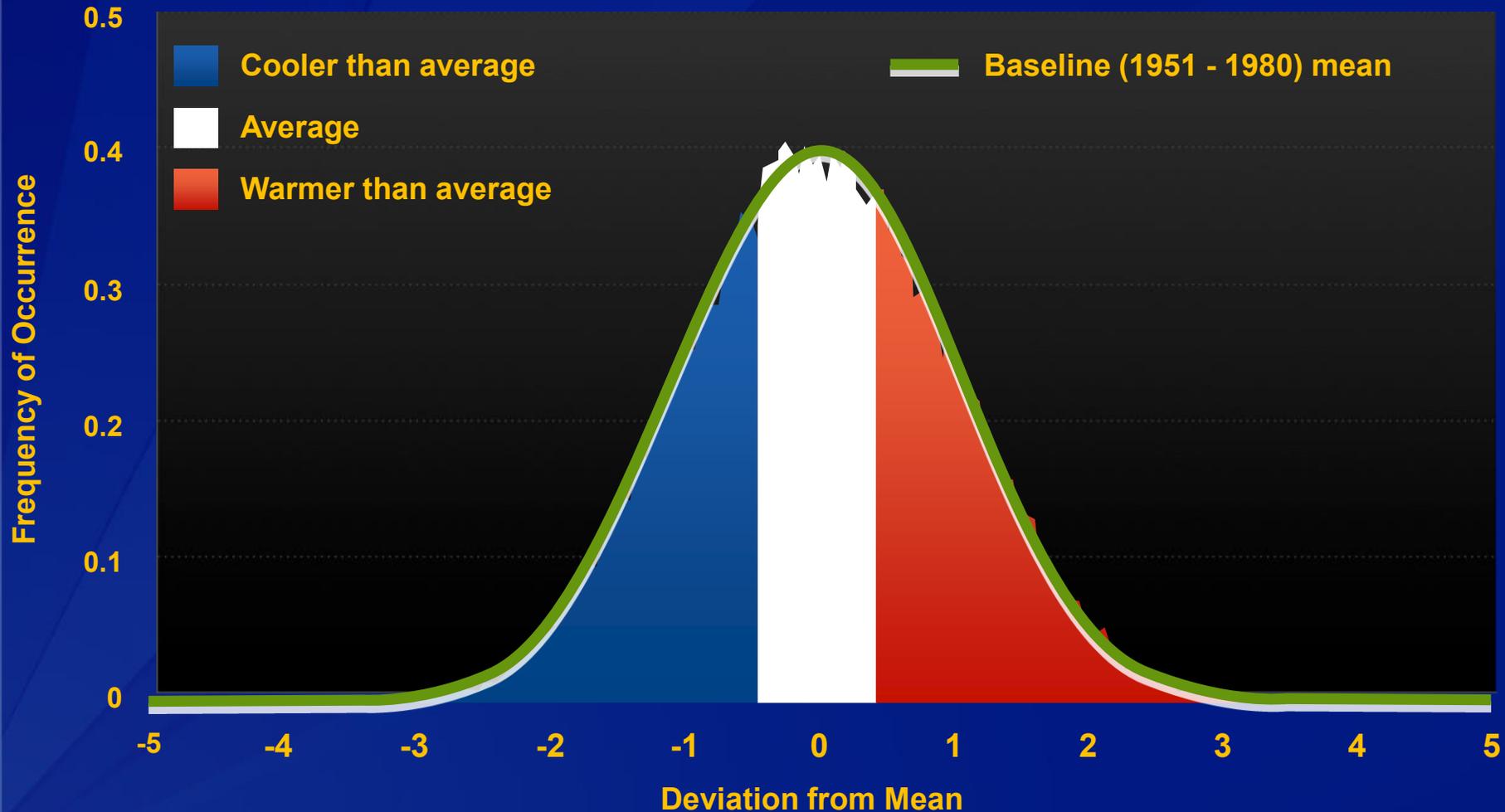
Warming has varied significantly by region (observed record)

Rising Temperatures

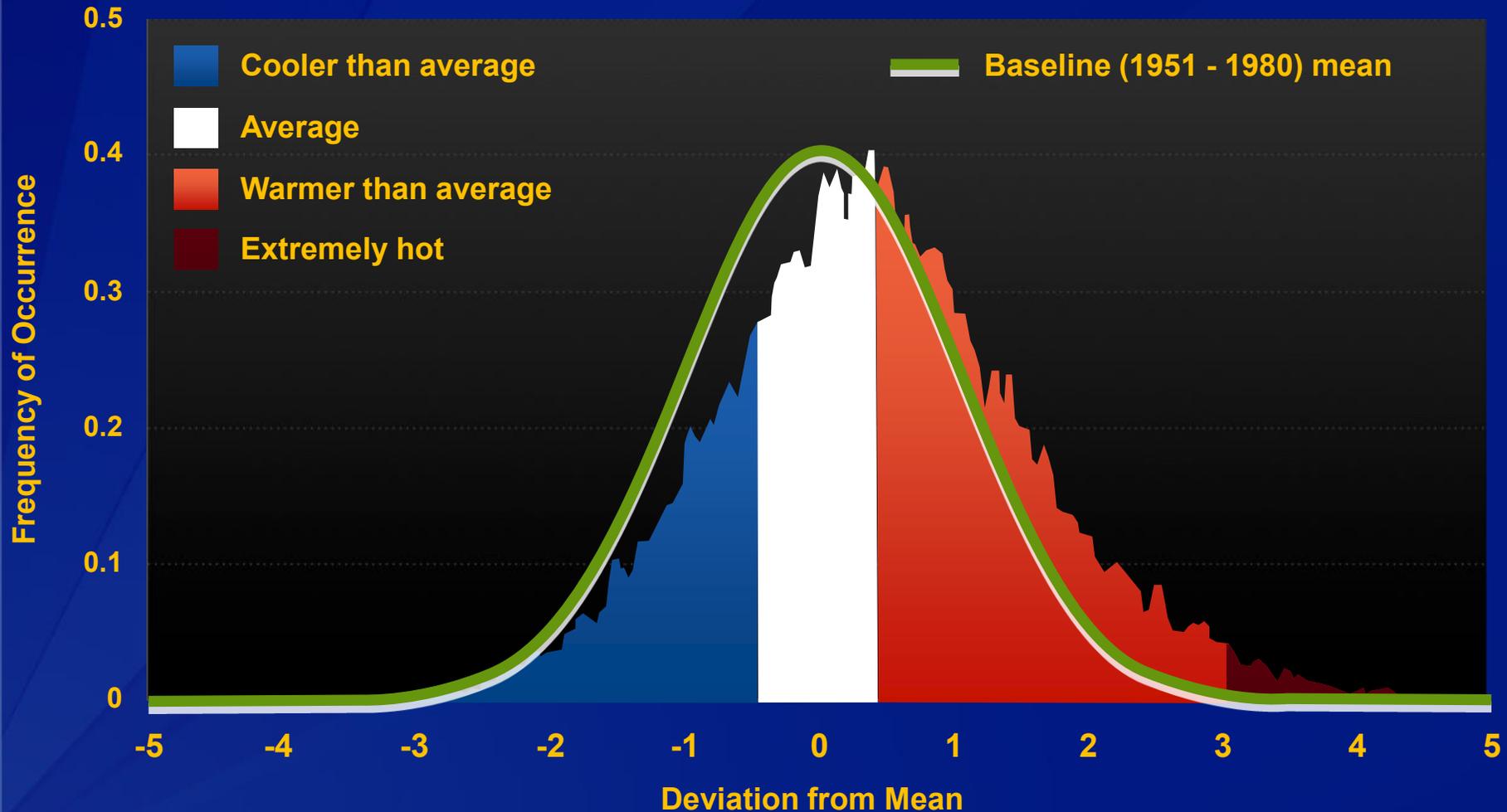
1991-2012 average temperature compared with 1901-1960 average MAY 6, 2014



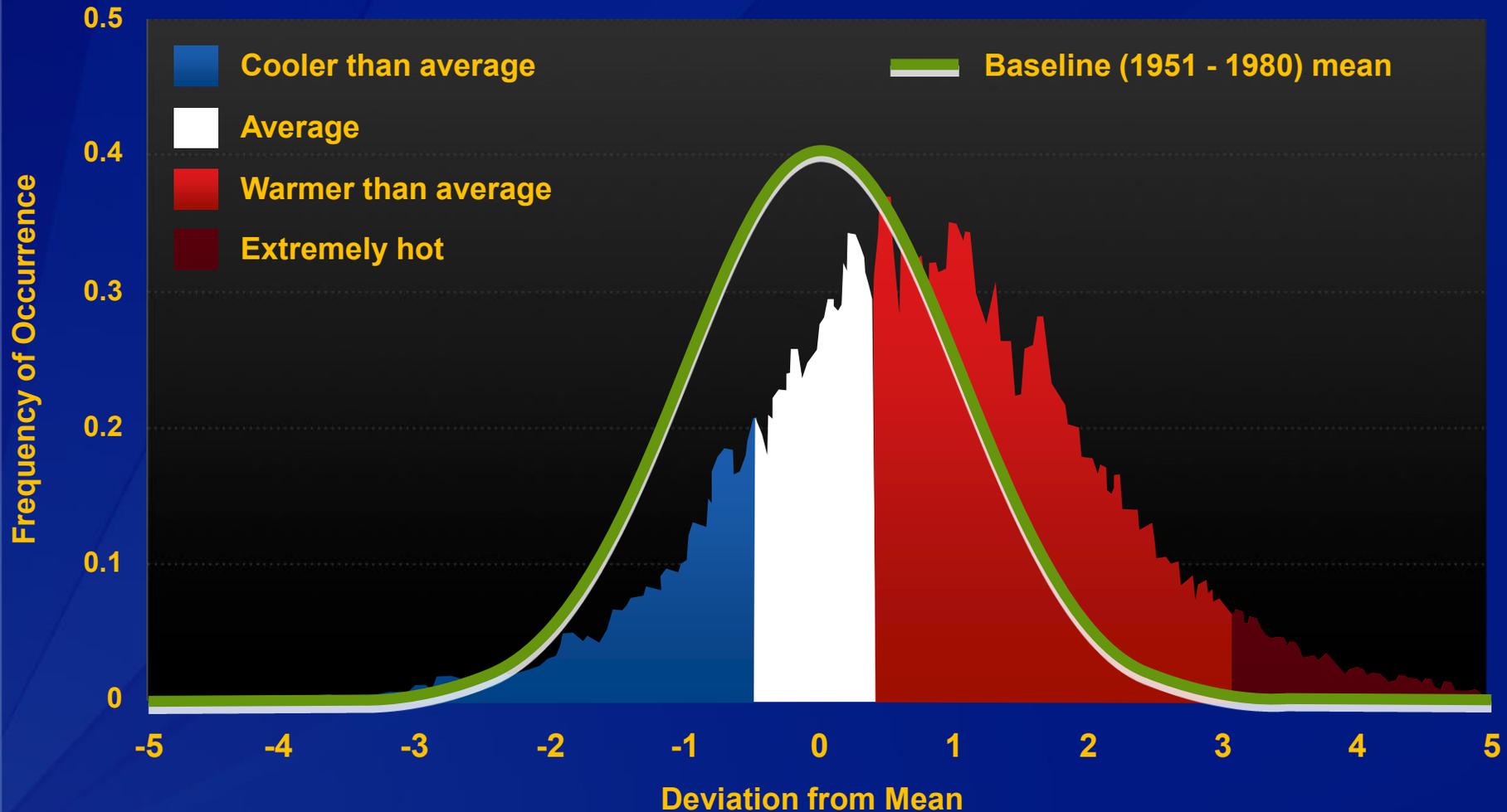
Summer Temperatures Have Shifted 1951 – 1980



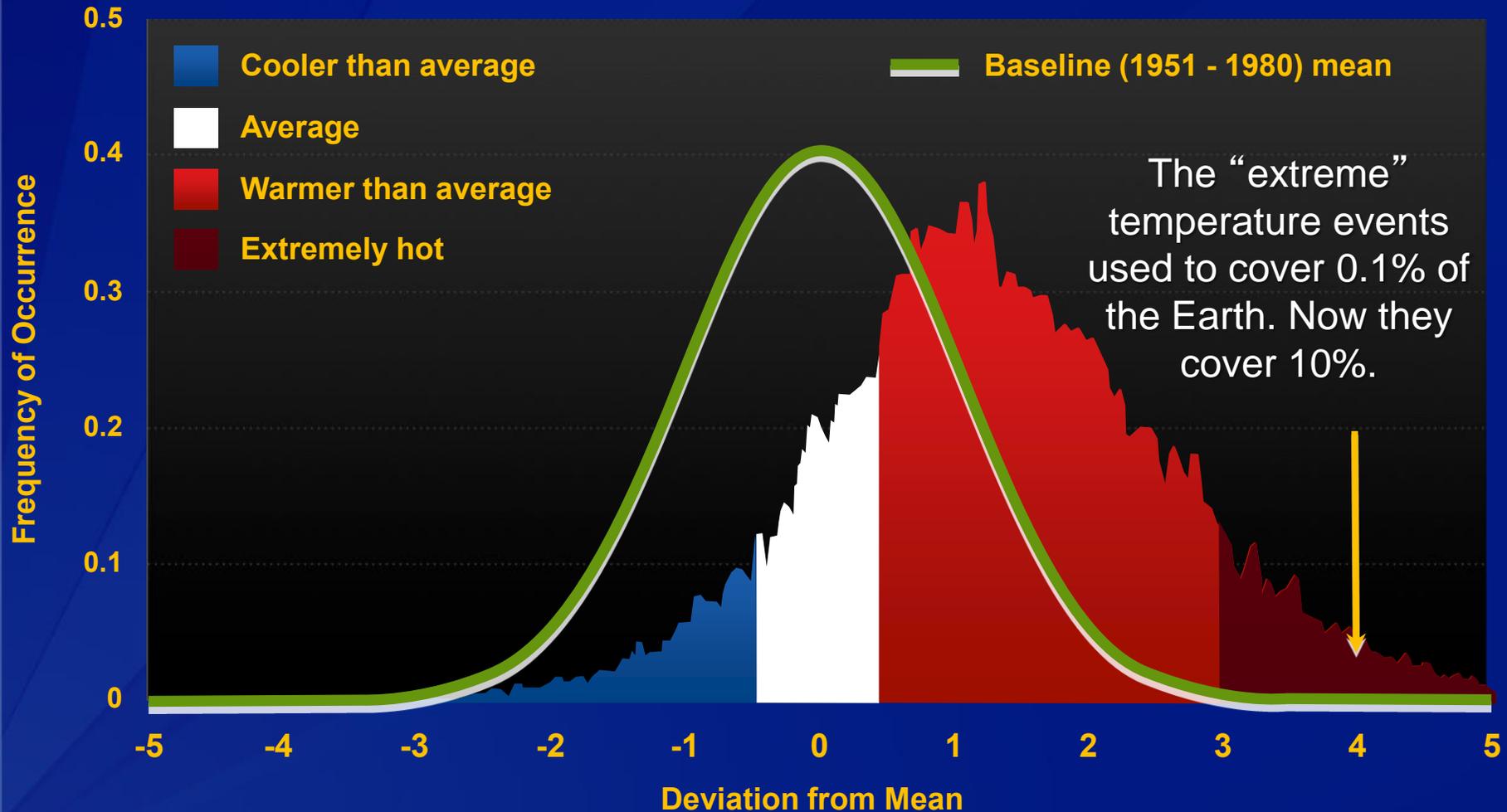
Summer Temperatures Have Shifted 1981 – 1991



Summer Temperatures Have Shifted 1991 – 2001

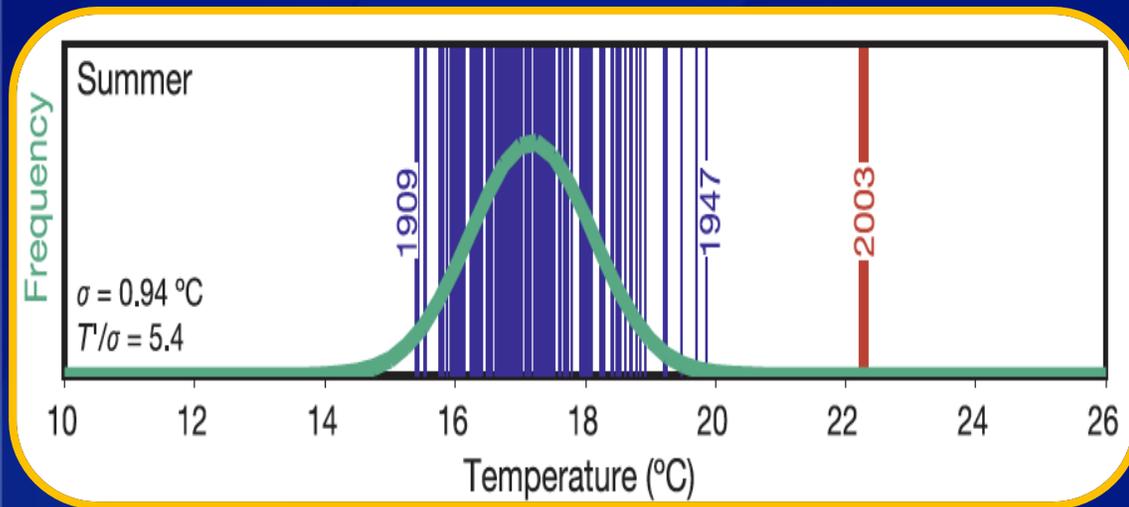


Summer Temperatures Have Shifted 2001 – 2011



Extreme Heat Can Impact Our Health in Many Ways

European Heat Wave of 2003



Haines et al. *Public Health* 2006;120:585-96.

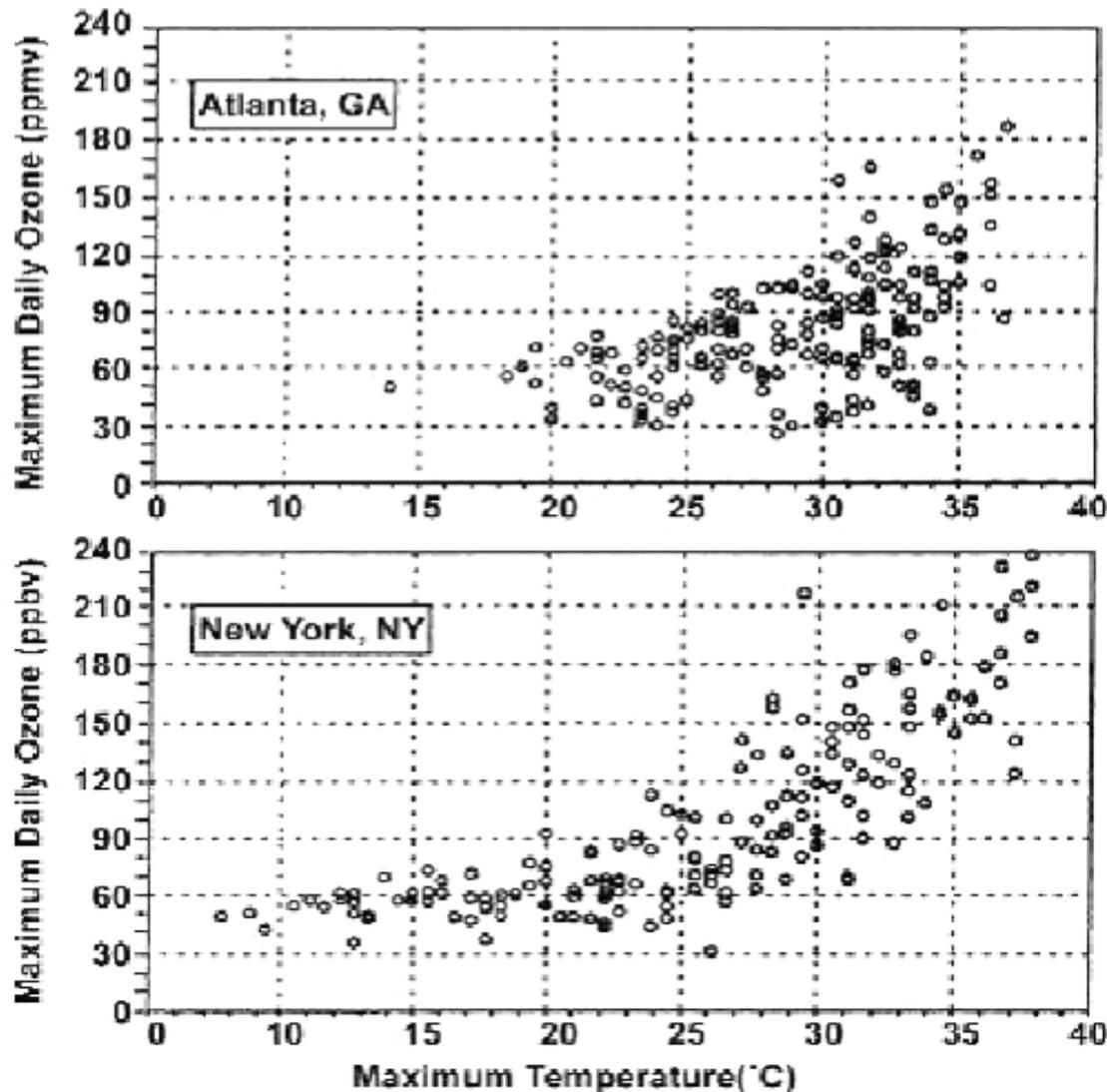
Vandentorren et al. *Am J Public Health* 2004; 94(9):1518-20.

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

Extreme Heat Can Impact Our Health in Many Ways: Ozone

Maximum Daily Ozone Concentrations vs. Maximum Daily Temperature

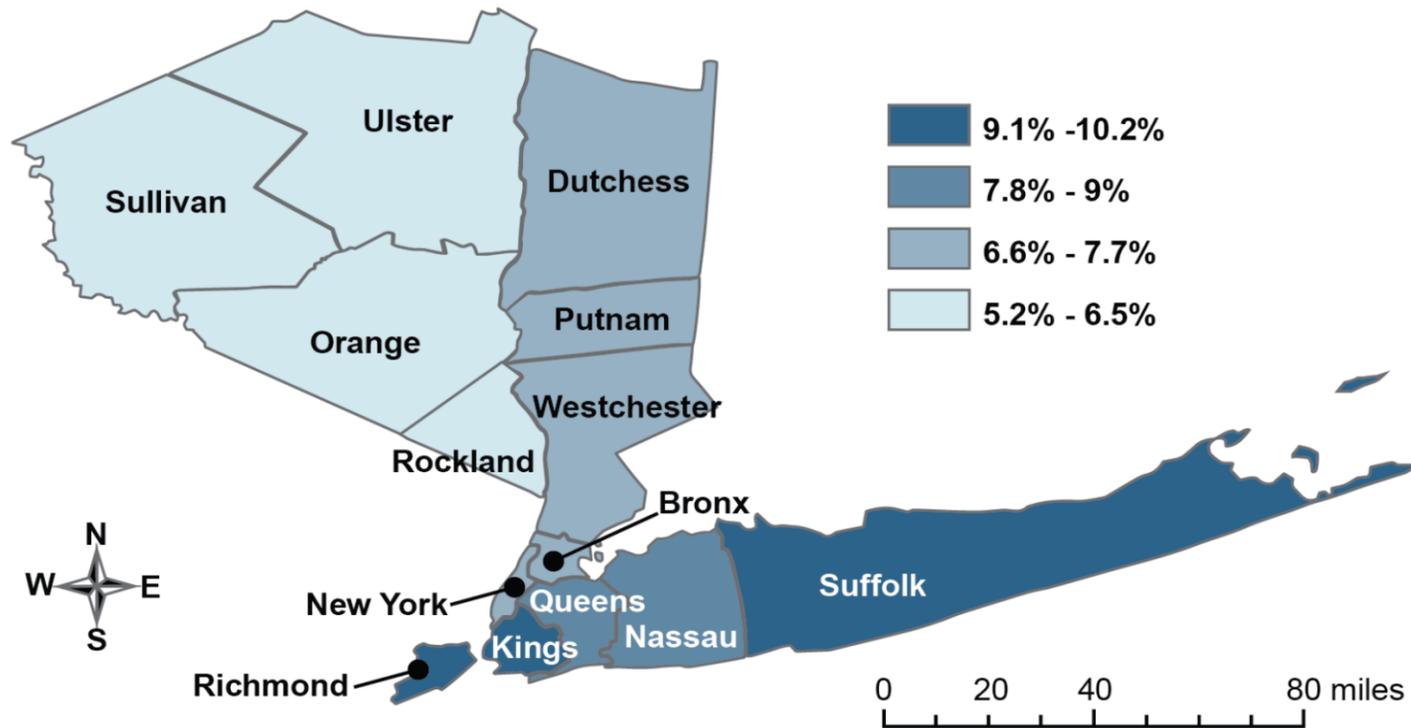


Atlanta

New York

Increased Pediatric Emergency Department Visits for Asthma, 2020s

Projected Climate Change Worsens Asthma



Source: Sheffield PE, Knowlton K, Carr JL, Kinney PL. 2011. Modeling of Regional Climate Change Effects on Ground-Level Ozone and Childhood Asthma. *American Journal of Preventive Medicine* 41(3):251-257

Climate Change Decreases the Quality of the Air We Breathe: Pollen

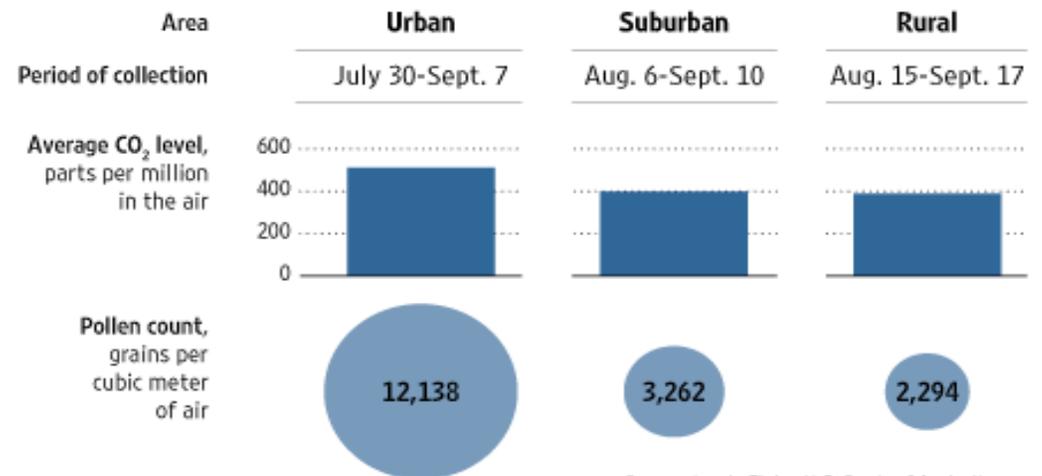
□ Ragweed

- ↑ CO₂ and temperature
- ↑ Pollen counts, longer growing season



Something in the Air

Researchers at the U.S. Dept. of Agriculture planted ragweed in and around Baltimore in 2001 to test how the plant responds to different concentrations of CO₂. The results:



Source: Lewis Ziska, U.S. Dept. of Agriculture

Source: Ziska et al., *J Allerg Clin Immunol* 2003;111:290-95;
Graphic: *Wall Street Journal*, 3 May 2007.

Climate Change and Pollen

- ❑ Ragweed pollen seasons are lengthening in the northern latitudes (Ziska et al., 2012)
- ❑ Increased CO₂ and Temp. associated with increased ragweed pollen production and an earlier pollen season. (Ziska et al., 2003)



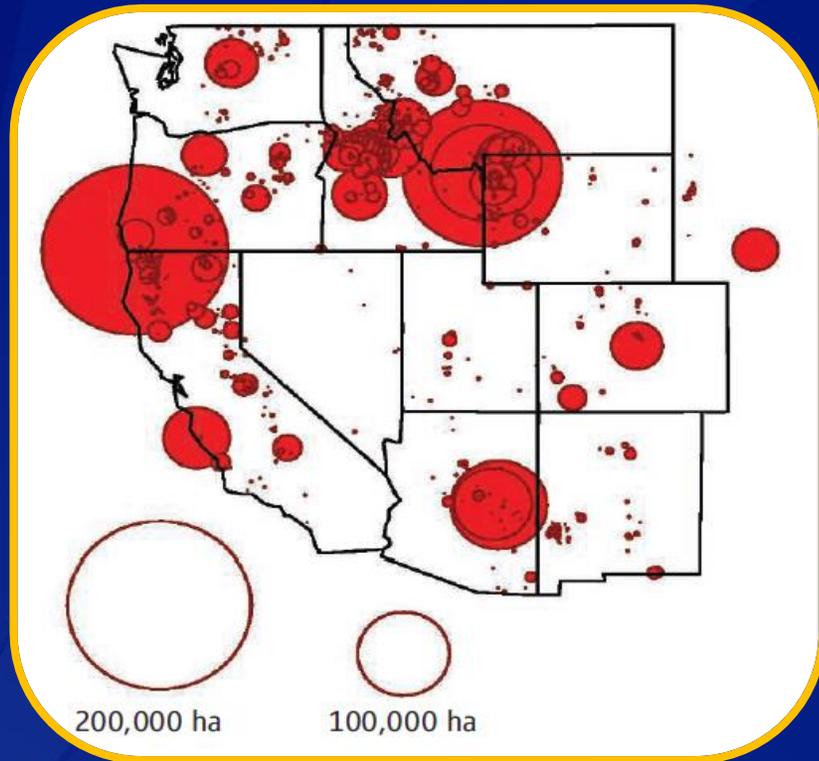
Pollen and Health

- ❑ **Outdoor allergenic pollen and mold are the primary cause for allergic rhinitis or hay fever** (Grammer, Greenberger, 2009).
- ❑ **Annual treatment costs for allergic rhinitis are \$11.2B (Blaiss, 2010) ; annual economic costs \$5.4B (Kessler et al., 2001).**
- ❑ **As pollen count increases, allergy-related illnesses also increase** (Heguy et al. 2008, Darrow et al., 2011).



Climate Change Decreases the Quality of the Air We Breathe: Wildfire Smoke

Wildfire Activity Since 1970



□ Since 1970

- Western US wildfire season increased by 78 days
- Average duration of fires increased five fold

Mortality and morbidity from wildfire smoke

- An increase of $10\mu\text{g}/\text{m}^3$ in PM_{10} from wildfires results in approximately 1% increase in non-accidental mortality.^(1,2,3)

- During Australian bushfires:

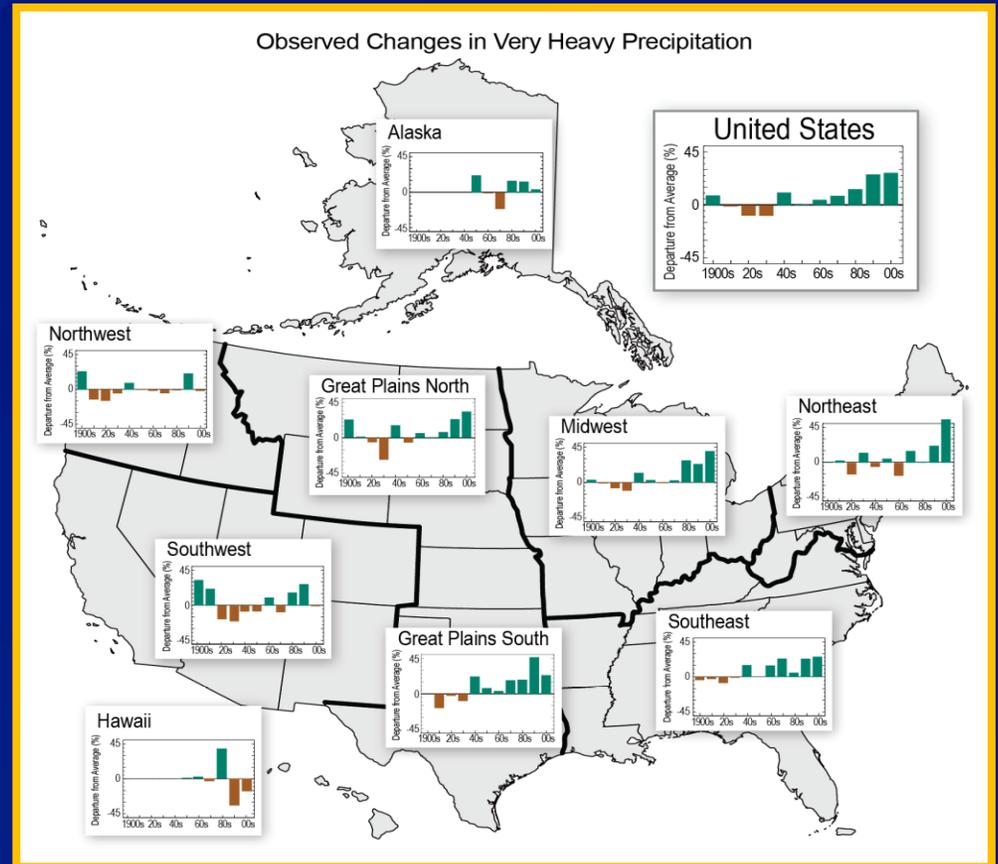
- Overall mortality rose 5%
- Hospital admissions for respiratory illnesses increased from 3-5%.⁴



1. Morgan G et al. Effects of bushfire smoke on daily mortality and hospital admissions in Sydney, Australia. [Epidemiology](#). 2010 Jan;21(1):47-55.
2. Sastry N. Forest fires, air pollution, and mortality in southeast Asia. [Demography](#). 2002 Feb;39(1):1-23.
3. Hanninen OO. Population exposure to fine particles and estimated excess mortality in Finland from an East European wildfire episode. [J Expo Sci Environ Epidemiol](#). 2009 May;19(4):414-22
4. Johnston F et al. Extreme air pollution events from bushfires and dust storms and their association with mortality in Sydney, Australia 1994-2007. [Environ Res](#). 2011 Aug;111(6):811-6.

Extreme Rainfall and Drought Can Impact our Health: Waterborne Disease

- 67% of waterborne disease outbreaks preceded by precipitation above 80th percentile (across 50 year climate record)
- Heavy precipitation events projected to occur more frequently



Observed Increases in Very Heavy Precipitation (heaviest 1% of all events) 1901 to 2011

Curriero, Patz, et al, 2001.

Source: Walsh et al. 2013: *Draft NCA Report*, Chapter 2

Heavy Precipitation and Water-borne Disease:

Milwaukee 1993

Cryptosporidiosis epidemic

405,000 cases, 54 deaths

Preceded by heaviest rainfall in 50 years (Curriero et al., 2001)

\$31.7 million in medical costs

\$64.6 million in lost productivity

(Corso et al., 2003).

Investigation Continues Into Outbreak

Lake Michigan



Extreme Rainfall and Drought Can Impact our Health: Dust Storms

- ❑ Greater likelihood of injuries from motor vehicle accidents.
- ❑ Increased risk of asthma related hospitalizations.
- ❑ Increased Indoor and Outdoor Air Pollution ($PM_{2.5}$ and PM_{10})



Kanatani, et al., 2010. Desert dust exposure is associated with increased risk of asthma hospitalization in children. *Am J Respir Crit Care Med*.
Kuo, H. , 2009. Indoor and outdoor $PM_{2.5}$ and PM_{10} concentrations in the air during a dust storm. *Building and Environment*.
Chen, et al., 2010. Ambient Influenza and Avian Influenza Virus during Dust Storm Days and Background Days. *Environ Health Perspect*.

Dust Storms and Health - Coccidioidomycosis (Valley Fever)

- ❑ *Coccidioides immitis* primarily dispersed by wind and dust storms.
- ❑ *C. immitis* thrives during wet periods following droughts
- ❑ Infections occur during dry season



Source:

Pappagianis and Einstein, 1978. Epidemiology of coccidioidomycosis. Current Topics in Mycology.

Zender and Talamantes, 2006. Climate controls on valley fever incidence in Kern County, California. Int J Biometeorol.

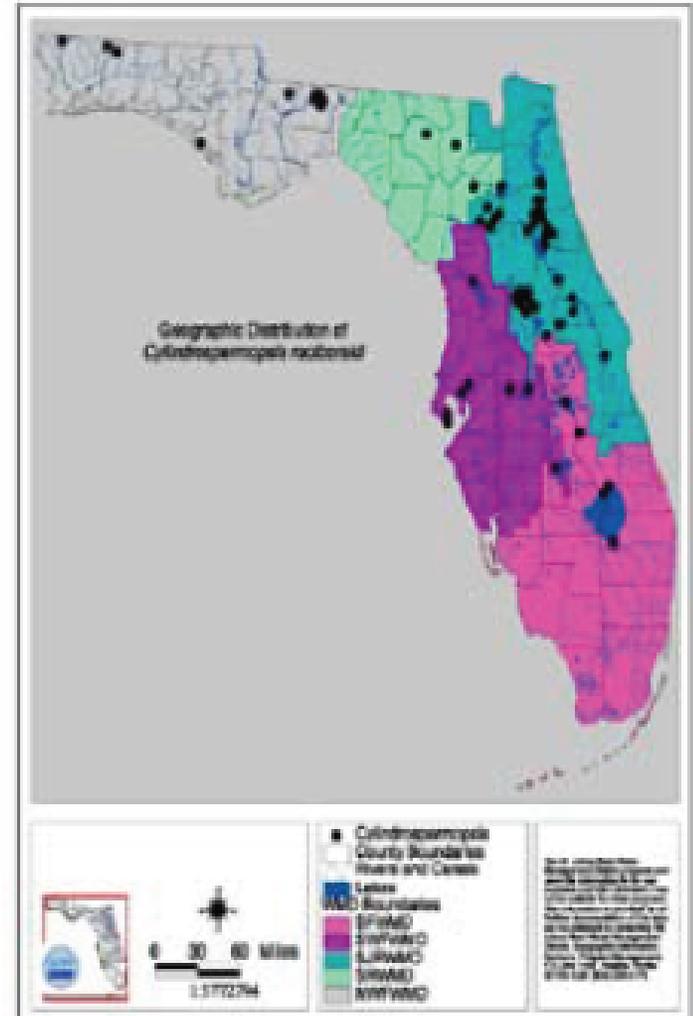
Warmer Water and Flooding Increase the Risk of Illness or Injury: Harmful Algal Blooms

Enhanced by:

- Increased water temps
- Nutrient runoff
- Upwelling events



Figure 2. Distribution of the CyanoHAB, *Cylindrospermopsis raciborskii*, in Florida (Williams 2001, Fristachi et al. 2007). *C. raciborskii*, which produces potent hepatotoxins (Table 2), was originally found only in tropical areas but has recently spread to cooler regions.

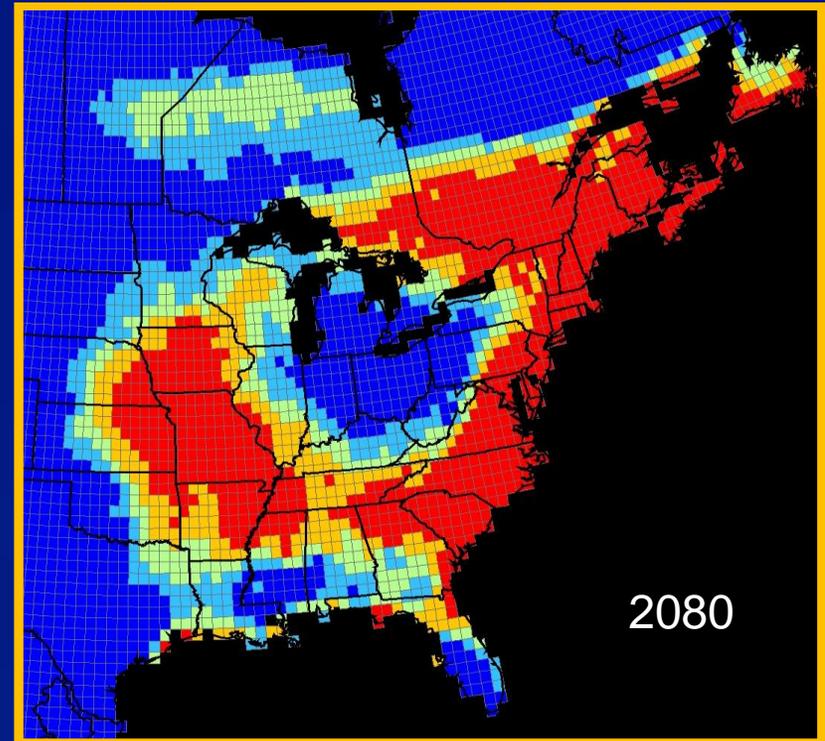


Climate Change Increases the Risk of Vector-Borne Diseases

□ Spread of Lyme disease factors

- Climate
- Ecological
- Social

Range of suitable conditions for
Ixodes scapularis, the
Lyme disease tick

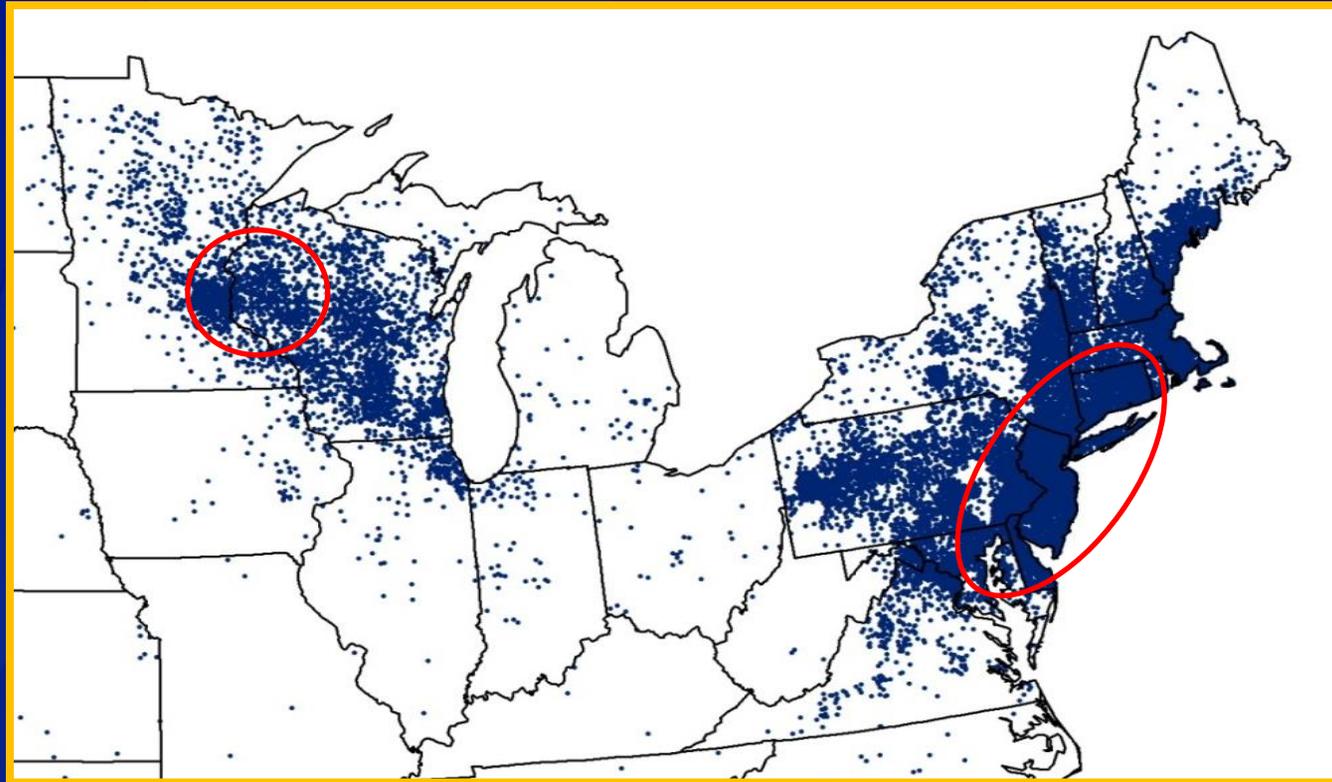


● Constant suitability

● Expanded suitability

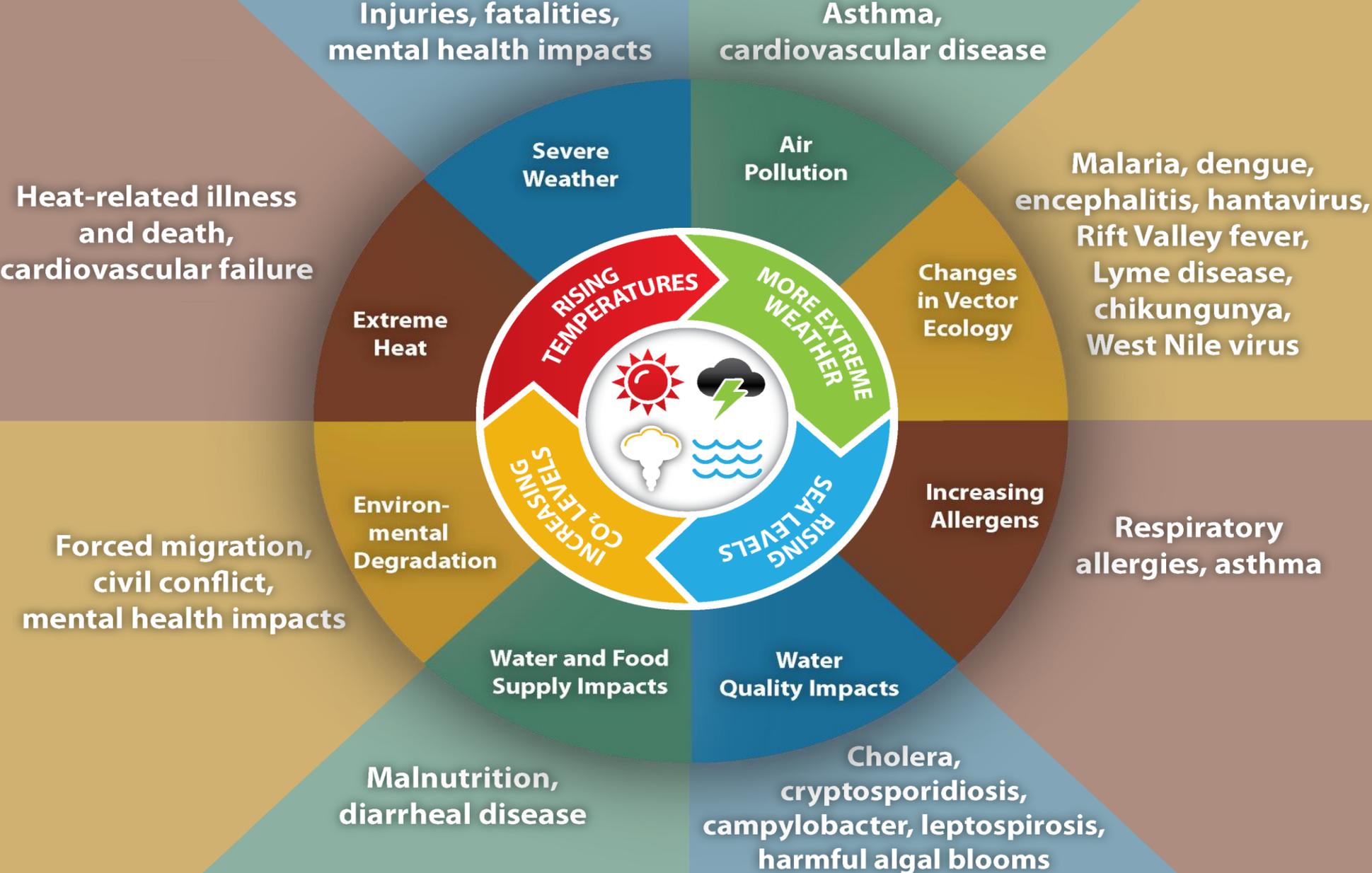
Source: Brownstein JS, Holford TR, Fish D. A climate-based model predicts the spatial distribution of the Lyme Disease vector *Ixodes scapularis* in the United States. *Environ Health Persp* 2003;111(9):1152-57.

Lyme Disease Case Distribution Change in the United States



2096

Impact of Climate Change on Human Health



CDC APHA Fact Sheets

EXTREME RAINFALL AND DROUGHT

Climate change poses many risks to human health. Some health impacts of climate change are already being felt in the United States. We need to safeguard our communities by protecting people's health, wellbeing, and quality of life from climate change impacts. Many communities are already taking steps to address these public health issues and reduce the risk of harm.

BACKGROUND

When we burn fossil fuels, such as coal and gas, we release carbon dioxide (CO₂). CO₂ builds up in the atmosphere and causes Earth's temperature to rise, much like a blanket traps in heat. This extra trapped heat disrupts many of the interconnected systems in our environment.

Increases in precipitation extremes, either heavy rain or drought, cause more water to evaporate and stage for heavier downpours. At the same time, around the planet, meaning drier conditions.

THE CLIMATE-HEALTH CONNECTION

Precipitation extremes create many safety hazards.

- Over the last several decades, we have a number of heavy precipitation events in the United States that have contributed to more severe flooding in certain areas, including the deadliest weather-related hazards in the United States.
- Other hazards can appear after a storm has passed. Mold affects indoor air quality. Living in areas with increased health problems. These health respiratory tract symptoms such as cough, lower respiratory tract infections like pneumonia.
- People living in drought conditions may be exposed to dust storms that can range from dust storms to flash flood conditions. This poor air quality affects people's health. Increases respiratory and cardiovascular health. Increases the need for treatments for asthma.

EXTREME HEAT CAN IMPACT OUR HEALTH IN MANY WAYS

Climate change poses many risks to human health. Some health impacts of climate change are already being felt in the United States.

We need to safeguard our communities by protecting people's health, wellbeing, and quality of life from climate change impacts. Many communities are already taking steps to address these public health issues and reduce the risk of harm.



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Climate change also affects human health by increasing the frequency and intensity of extreme heat events. Increases in the overall temperature of the atmosphere and oceans associated with climate change, and heat circulation contribute to shifts in extreme weather events.

THE CLIMATE-HEALTH CONNECTION

Extreme heat events can be deadly. These events result in increased related illness, as well as cardiovascular disease.

- Extreme heat events can trigger a variety of heat stress conditions, such as heat stroke. Heat stroke is the most serious heat-related disorder. It occurs when the body becomes unable to control its temperature. Body temperature rises rapidly, the sweating mechanism fails, and the body cannot cool down. This condition can cause death or permanent disability if emergency treatment is not given. Small children, the elderly, and certain other groups including people with chronic diseases, low-income populations, and outdoor workers have higher risk for heat-related illness.
- Higher temperatures and respiratory problems are also linked. One reason is because higher temperatures contribute to the build-up of harmful air pollutants.
- Many cities across the United States, including St. Louis, Philadelphia, Chicago, and Cincinnati, have seen large increases in death rates during heat waves.

CLIMATE CHANGE DECREASES THE QUALITY OF THE AIR WE BREATHE

Climate change poses many risks to human health. Some health impacts of climate change are already being felt in the United States. We need to safeguard our communities by protecting people's health, wellbeing, and quality of life from climate change impacts. Many communities are already taking steps to address these public health issues and reduce the risk of harm.

BACKGROUND

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Climate change might also affect human health by making our air less clean. Lead to an increase in allergens and harmful air pollutants. For instance, pollen seasons – which can increase allergic sensitizations and asthma and school days. Higher temperatures associated with climate change also lead to an increase in ozone, a harmful air pollutant.

THE CLIMATE-HEALTH CONNECTION

Decreased air quality introduces a number of health risks and concerns.

- According to the National Climate Assessment, climate change will affect human health by increasing ground-level ozone and/or particulate matter air pollution in some locations. Ground-level ozone is a key air pollutant that causes many health problems, including diminished lung function, increased emergency department visits for asthma, and increases in preterm births.
- More and larger wildfires linked to climate change could also significantly affect human health in a number of ways. Smoke exposure increases asthma, illness, respiratory and cardiovascular hospitalizations, and medical emergency department visits for asthma, and increases in preterm births.
- Exposure to allergens causes health problems for many people. When exposed to allergens and air pollutants, allergic reactions often become more severe. Pollutants makes the effects of increased allergens associated with existing pollen allergies may have increased risk for acute reactions.

WARMER WATER AND FLOODING INCREASE THE RISK OF ILLNESS

Climate change poses many risks to human health. Some health impacts of climate change are already being felt in the United States. We need to safeguard our communities by protecting people's health, wellbeing, and quality of life from climate change impacts. Many communities are already taking steps to address these public health issues and reduce the risk of harm.

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Climate change also affects human health by impacting the quality and safety of both our water supply and our recreational water. As the earth's temperature rises, surface water temperatures in lakes and oceans also rise. Warmer waters create a more hospitable environment for some harmful algae and other microbes to grow. Climate change can also lead to heavier downpours and floods. Flood waters often contain a variety of contaminants. In some cases, floods can overwhelm a region's drainage or wastewater treatment systems, increasing the risk of exposure to bacteria, parasites, and other unhealthy pollutants.

THE CLIMATE-HEALTH CONNECTION

Warmer waters and flood conditions introduce a number of public health concerns.

- Certain marine bacteria that make humans sick are more likely to survive and grow as oceans get warmer. *Vibrio parahaemolyticus* is responsible for diarrheal illnesses linked with consuming raw or undercooked oysters from the Gulf of Mexico. *Vibrio vulnificus* causes vomiting, diarrhea, and abdominal pain in healthy adults. *Vibrio vulnificus* is more severe than *Vibrio parahaemolyticus* and is responsible for most of the seafood-related deaths in the United States. Both can also cause serious infections through contact with contaminated water while swimming.

CLIMATE CHANGE INCREASES THE NUMBER AND GEOGRAPHIC RANGE OF DISEASE-CARRYING INSECTS AND TICKS

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One way climate change might affect human health is by increasing the risk of vector-borne diseases. A vector is any organism – such as fleas, ticks, or mosquitoes – that can transmit a pathogen, or infectious agent, from one host to another. Because warmer average temperatures can mean longer warm seasons, earlier spring seasons, shorter and milder winters, and hotter summers, conditions might become more hospitable for many carriers of vector-borne diseases.

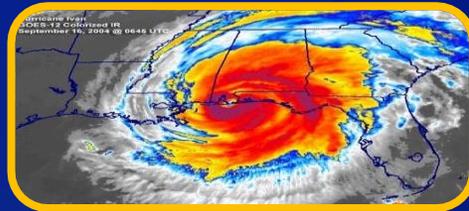


THE CLIMATE-HEALTH CONNECTION

The potential increase of harmful vectors is related to a number of health risks:

- The development and survival of ticks, their animal hosts (such as deer), and the bacterium that causes Lyme disease are all strongly influenced by climatic factors, especially temperature, precipitation, and humidity. Most occurrences of Lyme disease in the U.S. are in the Northeast, particularly Connecticut. An expansion of the geographic area in which ticks can survive may lead to more people having contact with infected ticks. In regions where Lyme disease already exists, milder winters result in fewer disease-carrying ticks dying during winter. This can increase the overall tick population, which increases the risk of contracting Lyme disease in those areas.
- West Nile virus is another example of a vector-borne disease that may be influenced by climate change. Preventing people from contracting West Nile virus is important, because there are no medications to treat or vaccines to prevent this virus in humans, and recovery from severe disease may take several weeks or months.





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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

National Center for Environmental Health
Division of Environmental Hazards and Health Effects

