



# THE IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH

IN THE UNITED STATES:  
A SCIENTIFIC ASSESSMENT

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U.S. Global Change  
Research Program

[Health2016.globalchange.gov](http://Health2016.globalchange.gov)

# USGCRP Climate and Health Assessment

## What is the USGCRP Climate and Health Assessment?

- An Interagency product of the US Global Change Research Program (USGCRP)
- Part of the National Climate Assessment (NCA) sustained assessment process and called for under the President's Climate Action Plan



## What is the purpose of the Climate and Health Assessment?

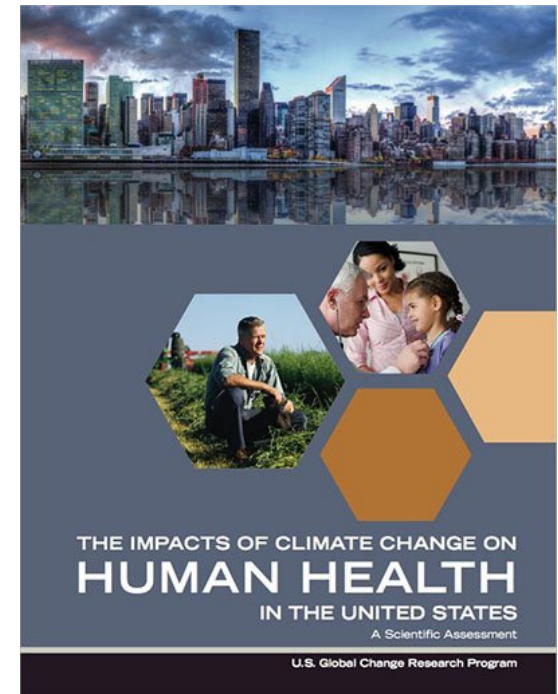
- Enhance understanding about the growing threat climate change poses to the health and well-being of Americans
- Inform decisions made by public health officials, planners, decision makers, and stakeholders



# Process and People

## What was the process for development?

- Driven by the USGCRP Interagency Crosscutting Group on Climate Change and Human Health (CCHHG)
- Coordinated by the EPA
- Written by a team of ~100 Federal employees, contractors, and grantees from eight U.S. Federal agencies: HHS (NIH, CDC, NIOSH, ASPR, FDA, SAMHSA), NOAA, EPA, USDA, NASA, USGS, DOD (USUHS), VA
- Extensively reviewed by the public and experts, including a committee of the National Academies of Sciences and the 13 Federal agencies of the USGCRP; draws from a large body of scientific peer-reviewed research



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# Scope

## **The Climate and Health Assessment is a Highly Influential Scientific Assessment (HISA):**

- Synthesizes literature, assesses peer-reviewed science, weighs evidence, and provides confidence levels for key findings
- Advances the science: four chapters highlight new peer-reviewed quantitative analyses of projected health impacts
- Focuses on quantifying, where possible, observed and projected impacts.

## **The Climate and Health Assessment does not address:**


- Mitigation, adaptation, economic valuation, or any policy recommendations.
- Indirect non-climate factors or other compounding, secondary, or cumulative effects of climate change.
- Research needs: though briefly summarized research needs are not described comprehensively.

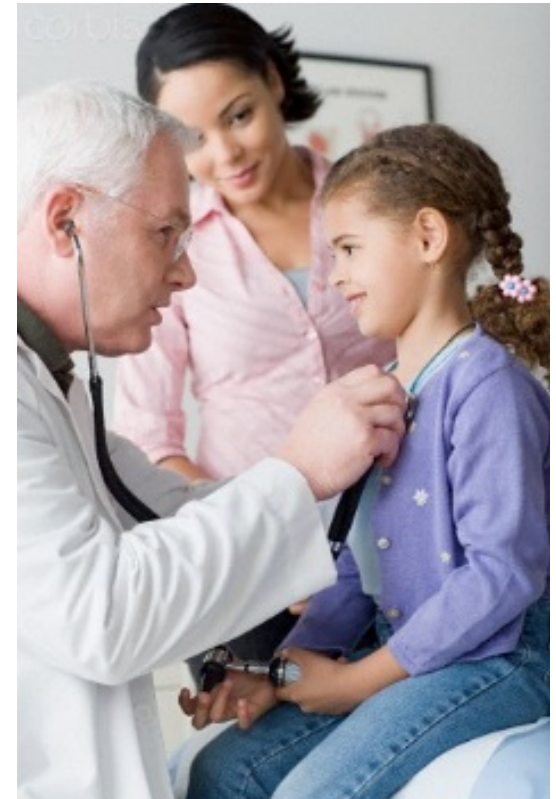
### **Table of Contents**

- 1. Climate Change and Human Health (Introduction)**
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- 7. Food Safety, Nutrition, and Distribution**
- 8. Mental Health and Well-Being**
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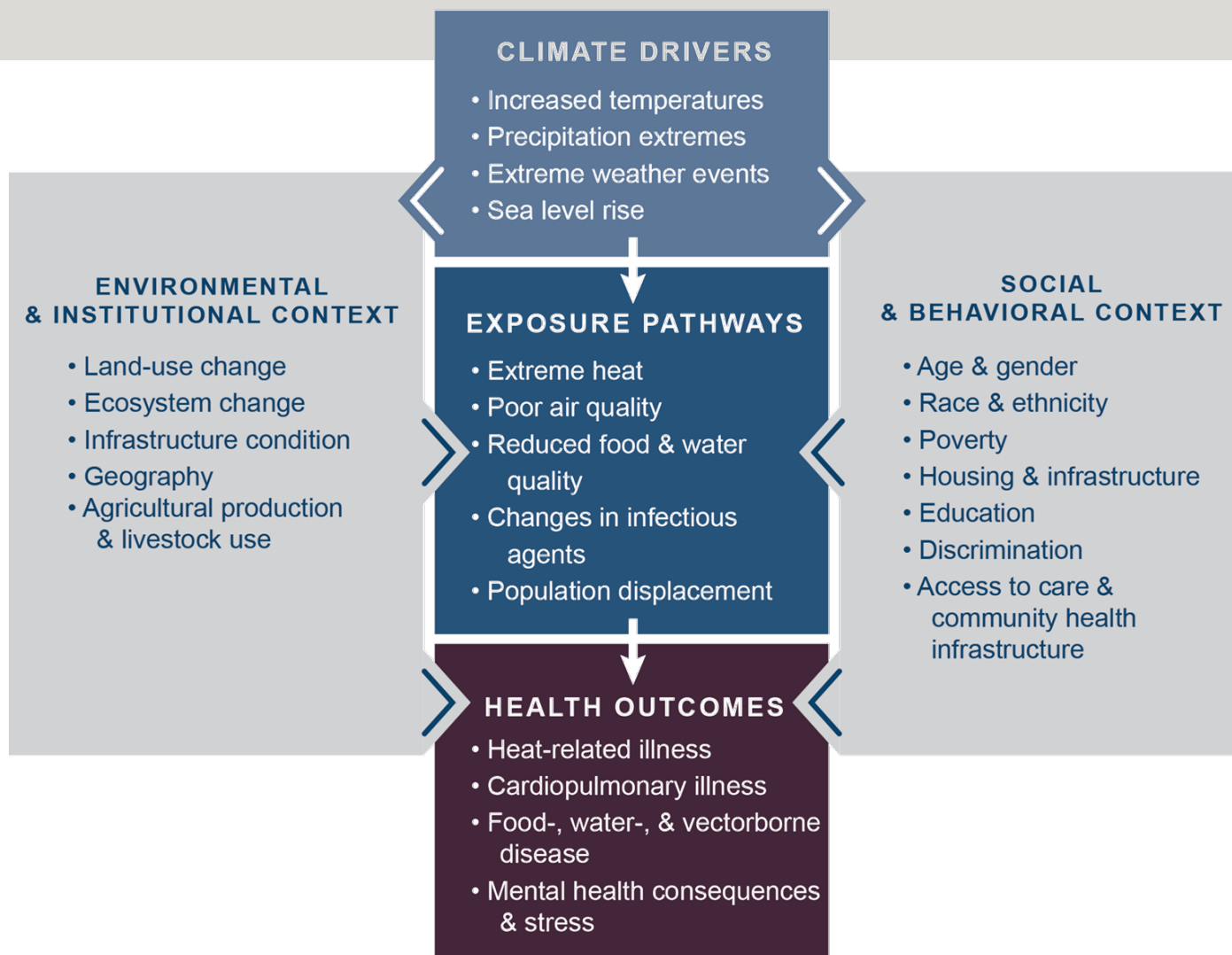


# Top Line Messages of the Report

- 
- Climate change is a significant threat to the health of the American people.
  - Climate change exacerbates some existing health threats and creates new public health challenges.
  - This assessment significantly advances what we know about the impacts of climate change on public health, and the confidence with which we know it.
  - Every American is vulnerable to the health impacts associated with climate change.



# Chapter 1: Introduction: Climate Change and Health



# Chapter 2: Temperature- Related Death and Illness

## Key Finding 1: Future Increases in Temperature-Related Deaths

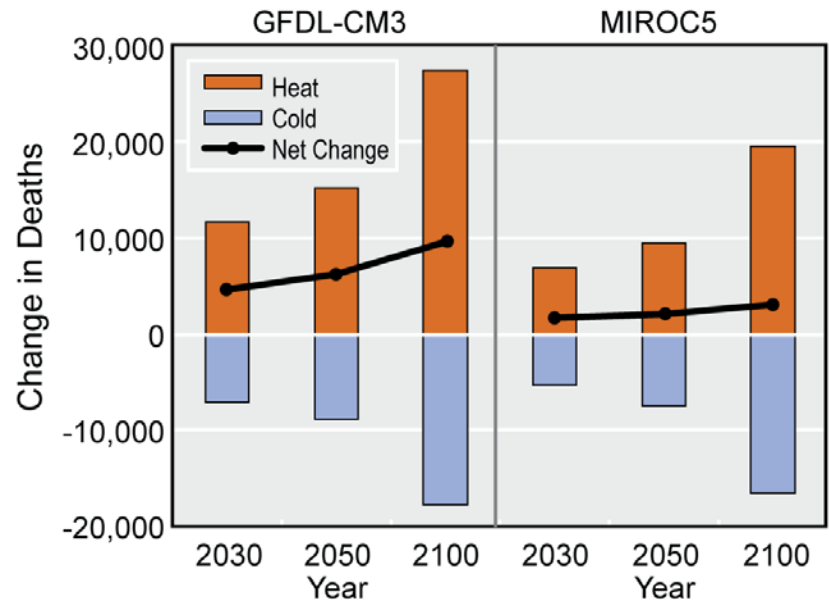
*Based on present-day sensitivity to heat, an increase of thousands to tens of thousands of premature heat-related deaths in the summer are projected each year as a result of climate change by the end of the century.*

**KF2:** Even Small Differences from Seasonal Average Temperatures Result in Illness and Death

**KF3:** Changing Tolerance to Extreme Heat

**KF4:** Some Populations at Greater Risk

Projected Changes in Deaths in U.S. Cities by Season



# Chapter 3: Air Quality Impacts

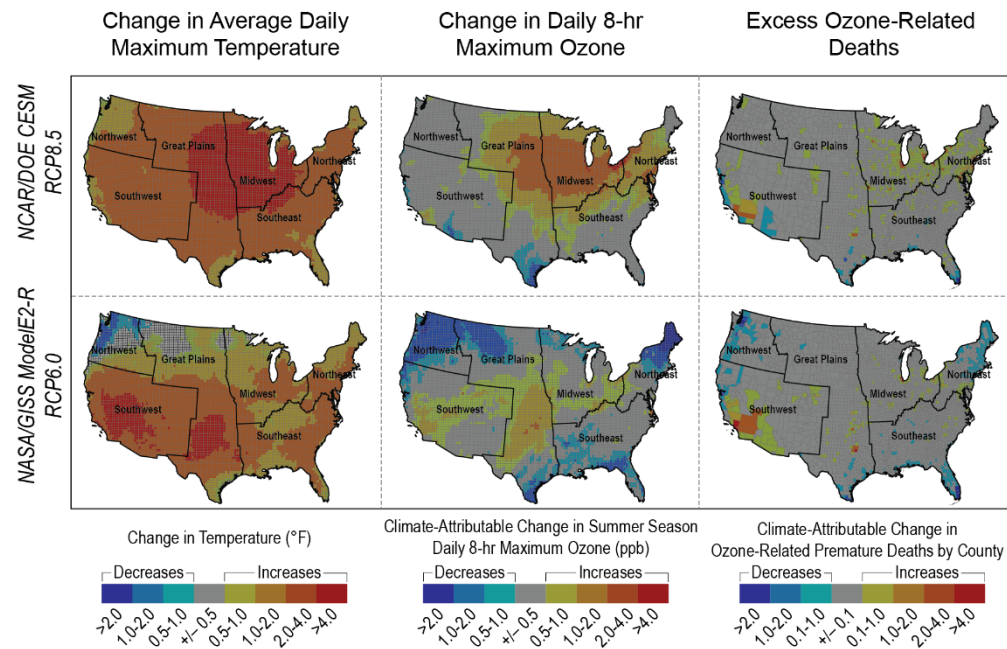
## Key Finding 1: Exacerbated Ozone Health Impacts

*Climate change will make it harder to reduce ground-level ozone pollution in the future as air and weather conditions support more ozone formation across most of the US. Unless offset by additional emissions reductions of ozone-producing chemicals, these climate-driven increases in ozone will cause premature deaths, hospital visits, lost school days, and acute respiratory symptoms.*

**KF2:** Increased Health Impacts from Wildfires

**KF3:** Worsened Allergy and Asthma Conditions

Projected Changes in Temperature, Ozone, and Ozone-Related Premature Deaths in 2030

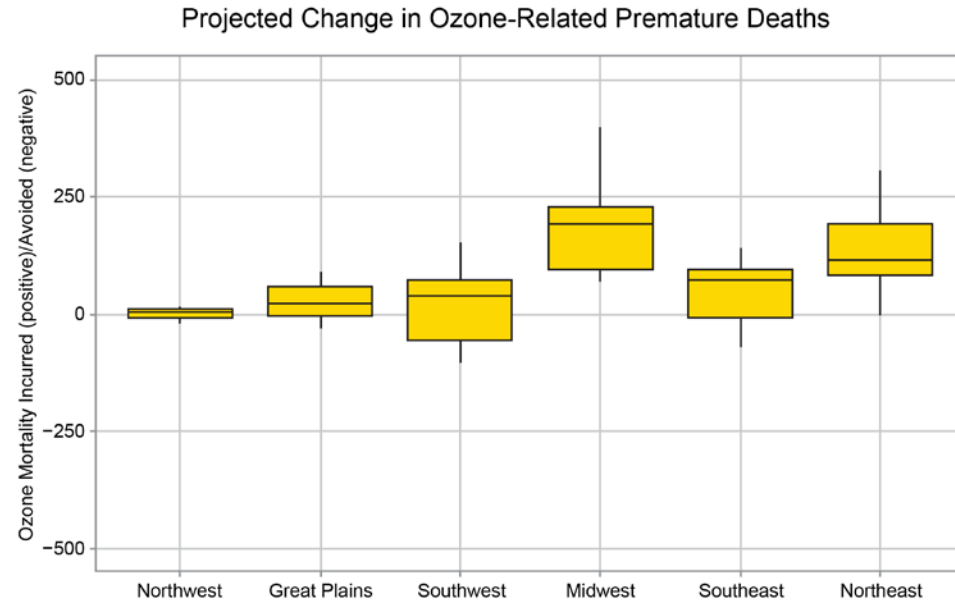




# Chapter 3: Air Quality Impacts

## Research Highlight: Ozone-Related Health Effects (Fann et al., 2015)

- **Objective:** Project number and distribution of additional ozone-related illnesses and premature deaths in the U.S. due to climate change between 2000 and 2030 under projected air quality policies.
- **Methods:**
  - RCP6.0 and 8.5; GISS-E2, CESM, dynamic downscale
  - ICLUS population data, BenMAP, SES, air condition prevalence, baseline health status data
  - Emissions projections for 2030 and regional chemical transport model simulate changes in ozone used to compute regional health effects
- **Results:** 1°C to 4°C (1.8°F to 7.2°F) increases in average daily maximum temperatures and 1 to 5 parts per billion increases in daily 8-hour maximum ozone in 2030 resulting in tens to thousands of additional ozone-related illnesses and premature deaths per year.



## Research Highlight II: Residential Infiltration and Indoor Air (Ilacqua et al., 2015)

Infiltration projected to decrease by ~5%, averaged across cities, seasons, and climate models in 2040-2070. Exposure to indoor pollutants would correspondingly increase, while exposure to outdoor air pollutants would decrease to some extent.



# Chapter 4: Extreme Events

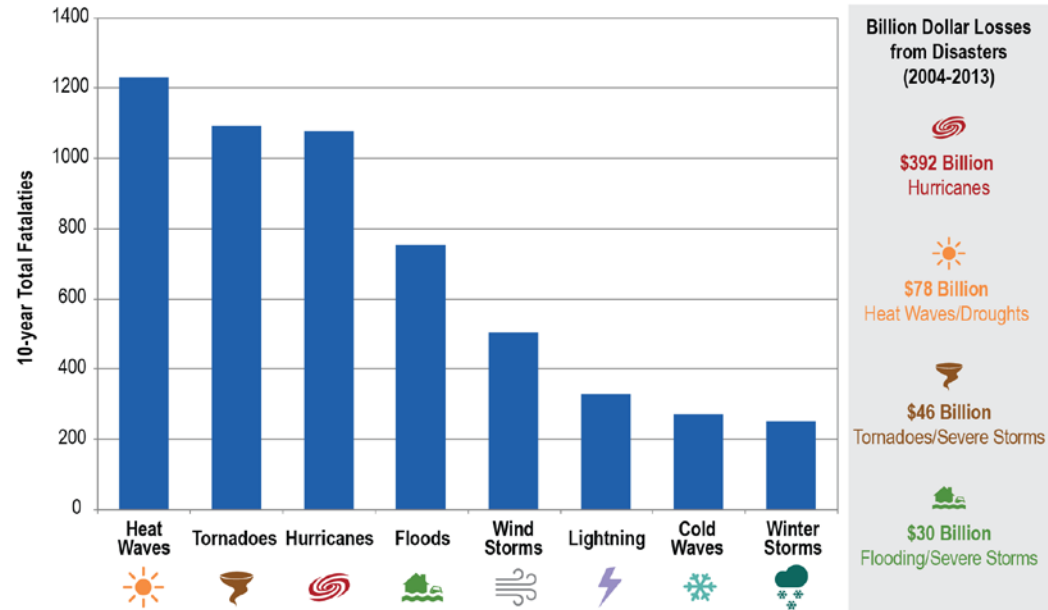
## KF1: Increased Exposure to Extreme Events

### Key Finding 2: Disruption of Essential Infrastructure

*Many types of extreme events related to climate change cause disruption of infrastructure, including power, water, transportation, and communication systems, that are essential to maintaining access to health care and emergency response services and safeguarding human health.*

## KF3: Vulnerability to Coastal Flooding

Estimated Deaths and Billion Dollar Losses from Extreme Events in the U.S., 2004–2013



# Chapter 5: Vector-borne Diseases

**KF1:** Changing Distributions of Vectors and Vector-borne Diseases

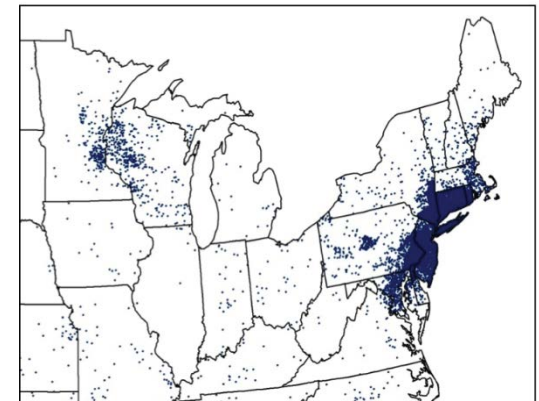
**Key Finding 2: Earlier Tick Activity and Northward Range Expansion**

*Ticks capable of carrying the bacteria that cause Lyme disease and other pathogens will show earlier seasonal activity and a generally northward expansion in response to increasing temperatures associated with climate change. Longer seasonal activity and expanding geographic range of these ticks will increase the risk of human exposure to ticks.*

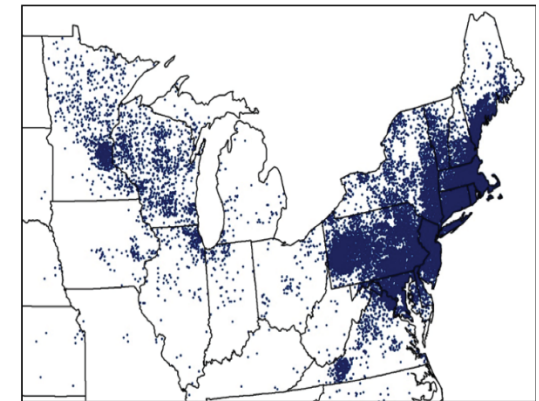
**KF3:** Changing Mosquito-borne Disease Dynamics

**KF4:** Emergence of New Vectorborne Pathogens

Changes in Lyme Disease Case Report Distribution



2001



2014



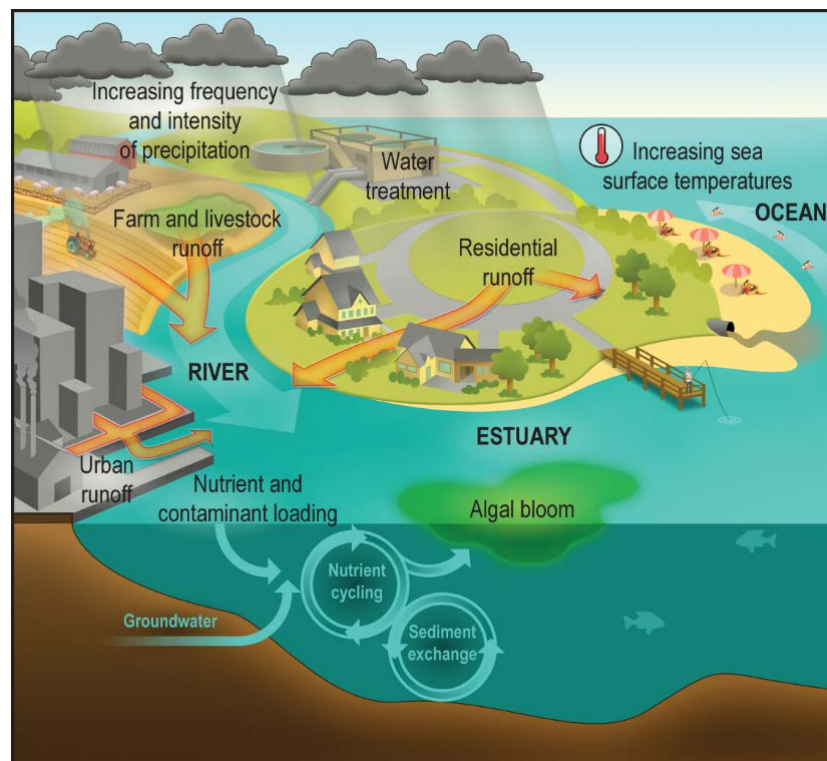
# Chapter 6: Water-Related Illnesses

## Key Finding 1: Seasonal and Geographic Changes in Waterborne Illness Risk

*Increases in water temperatures associated with climate change will change the seasonal windows of growth and the habitat range for freshwater and marine toxin-producing algae as well as certain naturally occurring Vibrio bacteria. These changes will increase the risk of exposure to waterborne pathogens and toxins that can cause a variety of illnesses.*

**KF2:** Runoff from Extreme Precipitation Increases Exposure Risk

**KF3:** Water Infrastructure Failure



# Chapter 7: Food Safety, Nutrition, and Distribution

**KF1:** Increased Risk of Foodborne Illness

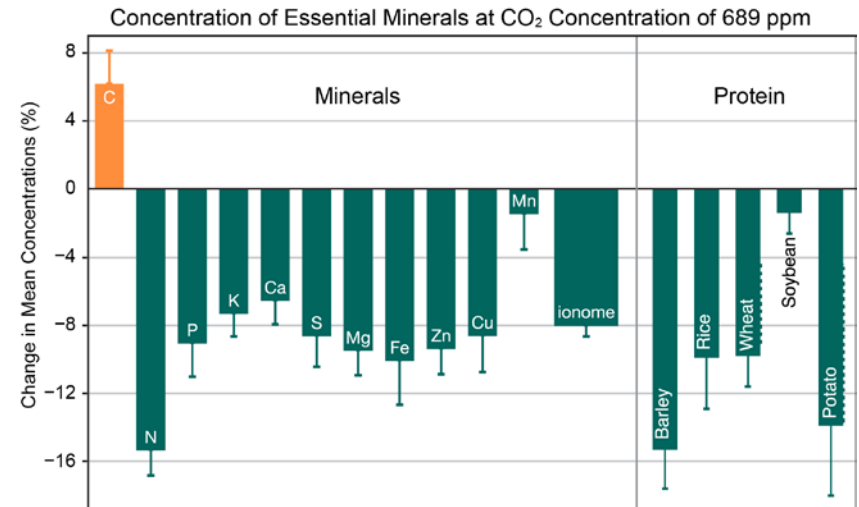
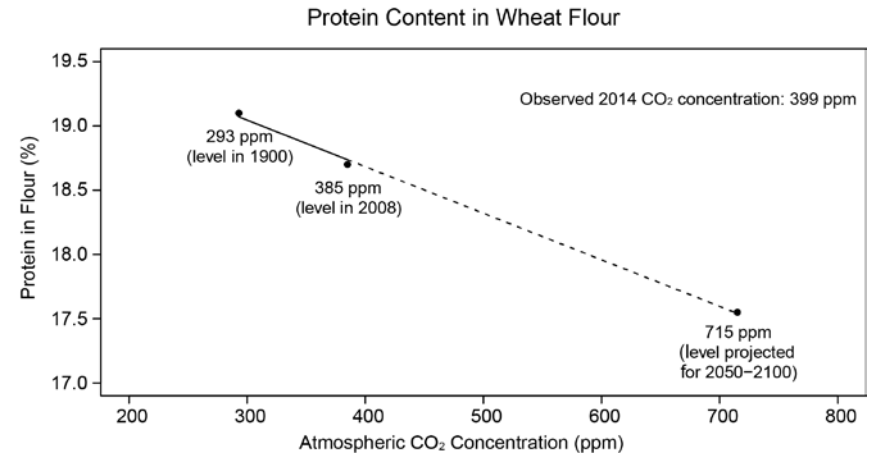
**KF2:** Chemical Contaminants in the Food Chain

## Key Finding 3: Rising Carbon Dioxide Lowers Nutritional Value of Food

*The nutritional value of agriculturally important food crops, such as wheat and rice, will decrease as rising levels of atmospheric carbon dioxide continue to reduce the concentrations of protein and essential minerals in most plant species.*

**KF4:** Extreme Weather Limits Access to Safe Foods

Effects of Carbon Dioxide on Protein and Minerals



# Chapter 8: Mental Health and Well-Being

**KF1:** Exposure to Disasters Results in Mental Health Consequences

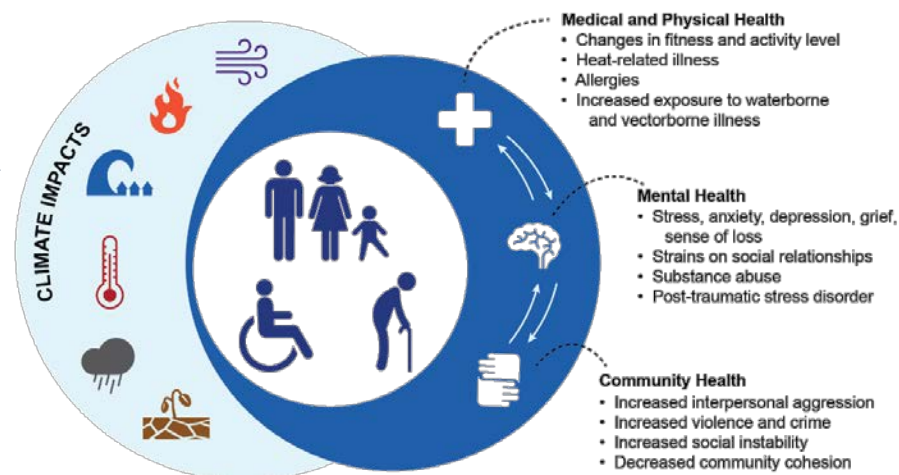
**KF2:** Specific Groups of People Are at Higher Risk

**KF3:** Climate Change Threats Result in Mental Health Consequences and Social Impacts

## Key Finding 4: Extreme Heat Increases Risks for People with Mental Illness

*People with mental illness are at higher risk for poor physical and mental health due to extreme heat. Increases in extreme heat will increase the risk of disease and death for people with mental illness, including elderly populations and those taking prescription medications that impair the body's ability to regulate temperature.*

Impact of Climate Change on Physical, Mental, and Community Health



# Chapter 9: Populations of Concern

**KF1:** Vulnerability Varies Over Time and is Place-Specific

**KF2:** Health Impacts Vary with Age and Life Stage

**Key Finding 3: Social Determinants of Health Interact with Climate Factors to Affect Health Risk**

*Climate change threatens the health of people and communities by affecting exposure, sensitivity, and adaptive capacity. Social determinants of health, such as those related to socioeconomic factors and health disparities, may amplify, or otherwise influence climate-related health effects, particularly when these factors occur simultaneously or close in time or space.*

**KF4:** Mapping Tools and Vulnerability Indices Identify Climate Health Risks



# Resources: health2016.globalchange.gov

Quick links to downloads and chapters



The screenshot shows the top navigation bar of the GlobalChange.gov website. On the left is the logo for GlobalChange.gov, U.S. Global Change Research Program. In the center is the text "Climate and Health Assessment". On the right is a search bar, a home icon, a "DOWNLOADS" icon (a downward arrow with a document), and a "MENU" icon (three horizontal lines). A red circle highlights the "DOWNLOADS" and "MENU" icons, with a red arrow pointing to them from the text above. Below the navigation bar is a large banner image of a city skyline at sunset. The main text on the banner reads: "The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment". Below this is a paragraph: "Climate change is a significant threat to the health of the American people. This scientific assessment examines how climate change is already affecting human health and the changes that may occur in the future." There are two hexagonal icons on the right side of the banner: one with a downward arrow and one with a share symbol. At the bottom center of the banner is a "VIEW SUMMARY" button with a downward arrow. On the far right edge of the banner is a vertical list of circular icons, with the top one filled.





# Resources: health2016.globalchange.gov

Download page has report, chapters, citations, figures, PowerPoint presentations, and 2-pg summaries

The PDF is the official version of the Climate and Health Assessment.

	10MB	25MB				
	Screen	Print	Citation	Figures	Presentation	Brochure
Climate and Health Assessment	39MB	98MB	738B	-	-	-
Front Matter	3MB	7MB	-	-	-	-
Executive Summary	9MB	9MB	682B	2MB	4MB	-
Ch. 1. Climate Change and Human Health	3MB	7MB	546B	1MB	3MB	600KB
Ch. 2. Temperature-Related Death and Illness	2MB	4MB	572B	614KB	2MB	2MB

Spanish translated Executive Summary also available



# Resources: [health2016.globalchange.gov](http://health2016.globalchange.gov)

Figure 7.1: Farm to Table: The Potential Interactions of Rising CO<sub>2</sub> and Climate Change on Food Safety and Nutrition



Icons let you download figures, view metadata, and share through social media



# EPA Resources

[www.epa.gov/climatechange/impacts/](http://www.epa.gov/climatechange/impacts/)

**Climate Change** En Español Contact Us Share

You are here: EPA Home » Climate Change » Impacts

## Climate Change Impacts

The changing climate impacts society and ecosystems in a broad variety of ways. For example climate change can increase or decrease rainfall, influence agricultural crop yields, affect human health, cause changes to forests and other ecosystems, or even impact our energy supply. Climate-related impacts are occurring across regions of the country and across many sectors of our economy.

Explore the impacts of climate change by region or by sector.

### Impacts by Region

Northwest | Midwest | Northeast | Southwest | Great Plains | Southeast | Alaska | U.S. Tropical Islands

Alaska | Islands | Northwest | Northwest | Southeast | Southwest | Midwest | Great Plains | International

### Impacts by Sector

Agriculture | Coasts | Ecosystems | Energy | Forests | Society | Transportation | Water Resources

### Human Health Impacts

Learn about the health impacts of climate change

Quiz: How much do you know about the Health Impacts of Climate Change?

Factsheets: Climate Change, Health, and Populations of Concern

How Will Climate Change Affect My Health? (PDF, 1 pp, 1 MB) (Text version (PDF, 2 pp, 551 KB))

or search for: “EPA climate impacts health”

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# EPA Resources

## 10- question online quiz with social media sharing options

### Quiz: How Much Do You Know About the Health Impacts of Climate Change?

Understanding the threats that climate change pose to human health can help us work together to lower risks and be prepared. Take this quiz to see how much you know about the health impacts of climate change.

**4** Which illness does NOT increase in frequency along with higher temperatures?


A. Dehydration

B. Arthritis

C. Kidney stones

D. Legionnaires' disease

**SUBMIT**



Source: Impacts of Climate Change on Human Health in the United States: A Scientific Assessment

4/10

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[How Will Climate Change Affect My Health? \(PDF, 1 pp, 1 MB\) \(Text version \(PDF, 2 pp, 551 KB\)\)](#)

<https://www.epa.gov/climatechange/impacts/health-assessment-quiz.html>

# EPA Resources

## Eight factsheets covering issues related to populations especially vulnerable to the health impacts of climate change



1. Indigenous/tribal
2. Environmental justice (e.g., low income, minority, immigrants)
3. Occupational groups
4. Older adults/elderly
5. Children
6. Pregnant women
7. People with disabilities
8. People with pre-existing medical conditions

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<https://www.epa.gov/climatechange/impacts/health/factsheets/>

# EPA Resources

## Graphic on how climate change can affect your health at different stages of your life

**HOW WILL CLIMATE CHANGE AFFECT MY HEALTH?**

Below are examples of how climate change can affect your health at different stages of your life.

**PREGNANT WOMEN** who experience extreme weather, like floods and heat waves, can experience mental health effects, injuries, and other health risks that affect their pregnancies and newborn infants.

**RISING TEMPERATURES**  
Increasing temperatures mean heat waves are more frequent, more intense, and last longer. **Health risks: dehydration, heat stroke, worsened heart and lung disease, death.**

**REDUCED AIR QUALITY**  
Rising temperatures, changes in rain patterns, and increasing wildfires lead to more smog, plant allergens, and other air pollutants. **Health risks: increased episodes of asthma and chronic lung disease, heart disease, death.**

**INFANTS AND TODDLERS** have developing immune systems that make them sensitive to heat, allergens, diseases carried by ticks and mosquitoes, and food and water-related illness.

**INCREASING EXTREME WEATHER**  
Hurricanes, severe storms, flooding, droughts, and wildfires are already increasing in frequency, intensity, or length. **Health risks: water and food-related illnesses, respiratory illness, injuries, mental health problems.**

**SPREADING DISEASES FROM MOSQUITOES AND TICKS**  
Changes in temperatures and precipitation patterns affect when and where diseases carried by mosquitoes and ticks occur. **Health risks: Lyme disease, West Nile virus.**

**CHILDREN** are sensitive to heat, poor air quality, water and food-related illnesses. They are often exposed to mosquitoes and ticks during outdoor play.

**ADOLESCENTS** can suffer heat-related illness, asthma or allergies while playing outdoors or competing in sports.

**EXPANDING WATER-RELATED ILLNESS**  
Increasing water and air temperatures, heavy rainfall, flooding, and sea level rise can expose people to contaminated waters. **Health risks: diarrhea, skin and eye infections.**

**DECREASED FOOD SAFETY**  
Increasing air and water temperatures and extreme weather lead to food contamination, spoilage, and disrupted food distribution. **Health risks: food poisoning, diarrhea, reduced access to food.**

**OLDER ADULTS** are sensitive to heat because they are less able to regulate body temperatures. They are less able to respond to extreme weather due to normal aging processes that affect physical or mental ability.

Read more in the *Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* at <https://health2016.globalchange.gov>.

**Human Health Impacts**

Learn about the health impacts of climate change

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<https://www.epa.gov/climatechange/impacts/health/factsheets/climate-health-life-stages.pdf>

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**USGCRP resources:** [health2016.globalchange.gov](http://health2016.globalchange.gov)

**EPA resources:** [www.epa.gov/climatechange/impacts/health.html](http://www.epa.gov/climatechange/impacts/health.html)

