



## Climate Change Human Health Impacts & Adaptation

[climatechange/impacts-adaptation/health.html#adapt](http://climatechange/impacts-adaptation/health.html#adapt)



### [Climate Impacts on Human Health](#)

### [Adaptation Examples in Human Health](#)

Weather and climate play a significant role in people's health. Changes in climate affect the average weather conditions that we are

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accustomed to. Warmer average temperatures will likely lead to hotter days and more frequent and longer [heat waves](#). This could increase the number of heat-related illnesses and deaths. Increases in the frequency or severity of [extreme weather](#) events such as storms could increase the risk of dangerous flooding, high winds, and other direct threats to people and property. Warmer temperatures could increase the concentrations of unhealthy [air and water pollutants](#). Changes in temperature, precipitation patterns, and extreme events could enhance the spread of some [diseases](#).



Sun setting over a city on a hot day.  
Source: [EPA \(2010\)](#)

The impacts of climate change on health will depend on many factors. These factors include the effectiveness of a community's public health and safety systems to address or prepare for the risk and the behavior, age, gender, and economic status of individuals affected. Impacts will likely vary by region, the sensitivity of populations, the extent and length of exposure to climate change impacts, and [society's ability to adapt](#) to change.

Although the United States has well-developed public health systems (compared with those of many developing countries), climate change will still likely affect many Americans. In addition, the impacts of climate change on public health around the globe could have important consequences for the United States. For example, more frequent and intense storms may

require more disaster relief and declines in agriculture may increase food shortages.

### Impacts from Heat Waves

Heat waves can lead to heat stroke and dehydration, and are the most common cause of weather-related deaths.<sup>[1][2]</sup> Excessive heat is more likely to impact populations in northern latitudes where people are less prepared to cope with excessive temperatures. Young children, older adults, people with medical conditions, and the poor are more vulnerable than others to heat-related illness. The share of the U.S. population composed of adults over age 65 is currently 12%, but is projected to grow to 21% by 2050, leading to a larger vulnerable population.<sup>[1]</sup>

Climate change will likely lead to more frequent, more severe, and longer heat waves in the summer (see [100-degree-days figure](#)), as well as less severe cold spells in the winter. A recent assessment of the science suggests that increases in heat-related deaths due to climate change would outweigh decreases in deaths from cold-snaps.<sup>[1]</sup>

[Urban areas](#) are typically warmer than their rural surroundings. Climate change could lead to even warmer temperatures in cities. This would increase the demand for electricity in the summer to run air conditioning, which in turn would increase [air pollution](#) and greenhouse gas emissions from power plants. The impacts of future heat waves could be especially severe in

#### Key Points

- A warmer climate is expected to both increase the risk of heat-related illnesses and death and worsen conditions for air quality.
- Climate change will likely increase the frequency and strength of extreme events (such as floods, droughts, and storms) that threaten human safety and health.
- Climate changes may allow some diseases to spread more easily.

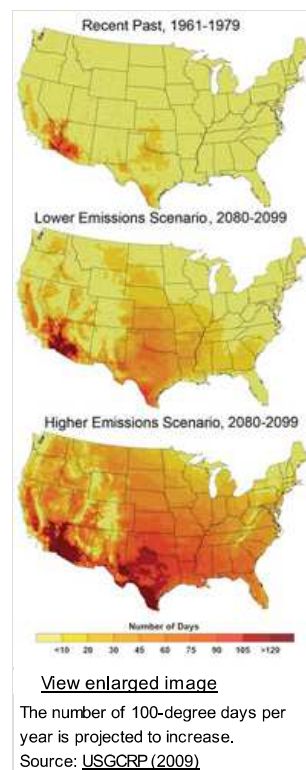
#### Related Links

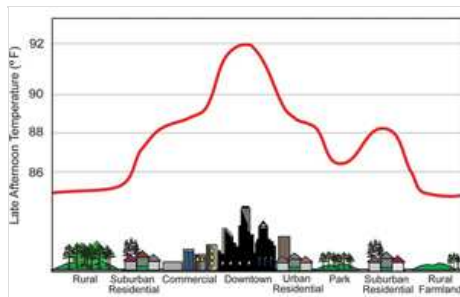
EPA:

- [Climate Change Indicators in the United States](#)
- [Heat Island Effect](#)
- [Excessive Heat Events Guidebook](#)
- [Global Change Research Program](#)
- [Climate Change and Children's Health](#)
- [Climate Change and Health Effects on Older Adults](#)
- [Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A Synthesis of Climate Change Impacts on Ground-Level Ozone](#)
- [Our Nation's Air: Status and Trends Through 2008](#)

Other:

- [CDC Climate Change and Public Health](#)
- [USGCRP Synthesis Assessment Product 4.6: Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems](#)
- [IPCC Fourth Assessment Report, Working Group II](#) [\[EXIT Disclaimer\]](#)
- [USGCRP Global Climate Change Impacts in the United States: Human Health](#)
- [NRC America's Climate Choices: Adapting to the Impacts of Climate Change](#) [\[EXIT Disclaimer\]](#)
- [National Institute of Environmental Health Sciences: A Human Health Perspective on Climate Change \(PDF\)](#)
- [World Health Organization. Climate Change and Human Health: Risks and Responses](#) [\[EXIT Disclaimer\]](#)





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The "urban heat island" refers to the fact that the local temperature in urban areas is a few degrees higher than the surrounding area. Source: [USGCRP \(2009\)](#)

- Reduce the availability of fresh food and water. <sup>[2]</sup>
- Interrupt communication, utility, and health care services. <sup>[2]</sup>
- Contribute to carbon monoxide poisoning from portable electric generators used during and after storms. <sup>[2]</sup>
- Increase stomach and intestinal illness among evacuees. <sup>[1]</sup>
- Contribute to mental health impacts such as depression and post-traumatic stress disorder (PTSD). <sup>[1]</sup>

### Impacts from Reduced Air Quality

Despite significant improvements in U.S. air quality since the 1970s, as of 2008 more than 126 million Americans lived in counties that did not meet national air quality standards. <sup>[3]</sup>

#### Increases in Ozone

Scientists project that warmer temperatures from climate change will increase the frequency of days with unhealthy levels of ground-level ozone, a harmful air pollutant, and a component in smog. <sup>[2] [3]</sup>

- Ground-level ozone can damage lung tissue and can reduce lung function and inflame airways. This can increase respiratory symptoms and aggravate asthma or other lung diseases. It is especially harmful to children, older adults, outdoor workers, and those with asthma and other chronic lung diseases. <sup>[4]</sup>
- Ozone exposure also has been associated with increased susceptibility to respiratory infections, medication use, doctor visits, and emergency department visits and hospital admissions for individuals with lung disease. Some studies suggest that ozone may increase the risk of premature mortality, and possibly even the development of asthma. <sup>[1] [2] [3] [5]</sup>
- Ground-level ozone is formed when certain air pollutants, such as carbon monoxide, oxides of nitrogen (also called  $\text{NO}_x$ ), and volatile organic compounds, are exposed to each other in sunlight. Ground-level ozone is one of the pollutants in smog. <sup>[2] [3]</sup>
- Because warm, stagnant air tends to increase the formation of ozone, climate change is likely to increase levels of ground-level ozone in already-polluted areas of the United States and increase the number of days with poor air quality. <sup>[1]</sup> If emissions of air pollutants remain fixed at today's levels until 2050, warming from climate change alone could increase the number of Red Ozone Alert Days (when the air is unhealthy for everyone) by 68% in the 50 largest eastern U.S. cities. <sup>[1]</sup> (See Box below "EPA Report on Air Quality and Climate Change.")

#### Changes in Fine Particulate Matter

Particulate matter is the term for a category of extremely small particles and liquid droplets suspended in the atmosphere. Fine particles include particles smaller than 2.5 micrometers (about one ten-thousandth of an inch). These particles may be emitted directly or may be formed in the atmosphere from chemical reactions of gases such as sulfur dioxide, nitrogen dioxide, and volatile organic compounds.

- Inhaling fine particles can lead to a broad range of adverse health effects, including premature mortality, aggravation of cardiovascular and respiratory disease, development of chronic lung disease, exacerbation of asthma, and decreased lung function growth in children. <sup>[6]</sup>
- Sources of fine particle pollution include power plants, gasoline and diesel engines, wood combustion, high-temperature industrial processes such as smelters and steel mills, and forest fires. <sup>[6]</sup>

Due to the variety of sources and components of fine particulate matter, scientists do not yet know whether climate change will increase or decrease particulate matter concentrations across the United States. <sup>[7] [8]</sup> A lot of particulate matter is cleaned from the air by rainfall, so increases in precipitation could have a beneficial effect. At the same time, other climate-related changes in stagnant air episodes, wind patterns, emissions from vegetation and the chemistry of atmospheric pollutants will likely affect particulate matter levels. <sup>[2]</sup> Climate change will also affect particulates through changes in wildfires, which are expected to become more frequent and intense in a warmer climate. <sup>[7]</sup>

large metropolitan areas. For example, in Los Angeles, annual heat-related deaths are projected to increase two- to seven-fold by the end of the 21st century, depending on the future growth of greenhouse gas emissions. <sup>[11]</sup> Heat waves are also often accompanied by periods of stagnant air, leading to increases in air pollution and the associated health effects

### Impacts from Extreme Weather Events

The frequency and intensity of extreme precipitation events is projected to increase in some locations, as is the severity (wind speeds and rain) of tropical storms. <sup>[11]</sup> These extreme weather events could cause injuries and, in some cases, death. As with [heat waves](#), the people most at risk include young children, older adults, people with medical conditions, and the poor. Extreme events can also indirectly threaten human health in a number of ways. For example, extreme events can:



Flooded streets in New Orleans after Hurricane Katrina in 2005. Source: [FEMA \(2005\)](#)

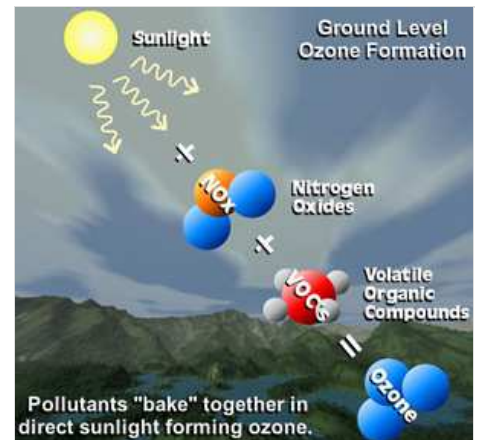
### Climate Change Affects Human Health and Welfare

In 2008, the U.S. Global Change Research Program produced a [report](#) that analyzed the impacts of global climate change on human health and welfare. The report finds that:

- Many of the expected health effects are likely to fall mostly on the poor, the very old, the very young, the disabled, and the uninsured.
- Climate change will likely result in regional differences in U.S. impacts, due not only to a regional pattern of changes in climate but also to regional variations in the distribution of sensitive populations and the ability of communities to adapt to climate changes.
- Adaptation should begin now, starting with public health infrastructure. Individuals, communities, and government agencies can take steps to moderate the impacts of climate change on human health. (To learn more, see the [Health Adaptation](#) section)



Smog in Los Angeles decreases visibility and can be harmful to human health. Source: [California Air Resources Board \(2011\)](#)



Ozone chemistry. Source: [NASA \(2012\)](#)

## Changes in Allergens

Climate change may affect allergies and respiratory health.<sup>[4]</sup> The spring pollen season is already occurring earlier in the United States due to climate change. The length of the season may also have increased. In addition, climate change may facilitate the spread of ragweed, an invasive plant with very allergenic pollen. Tests on ragweed show that increasing carbon dioxide concentrations and temperatures would increase the amount and timing of ragweed pollen production.<sup>[1] [2] [9]</sup>

## Impacts from Climate-Sensitive Diseases

Changes in climate may enhance the spread of some diseases.<sup>[1]</sup> Disease-causing agents, called pathogens, can be transmitted through food, water, and animals such as deer, birds, mice, and insects. Climate change could affect all of these transmitters.

### Food-borne Diseases

- Higher air temperatures can increase cases of salmonella and other bacteria-related food poisoning because bacteria grow more rapidly in warm environments. These diseases can cause gastrointestinal distress and, in severe cases, death.<sup>[1]</sup>
- Flooding and heavy rainfall can cause overflows from sewage treatment plants into fresh water sources. Overflows could contaminate certain food crops with pathogen-containing feces.<sup>[1]</sup>

### Water-borne Diseases

- Heavy rainfall or flooding can increase water-borne parasites such as *Cryptosporidium* and *Giardia* that are sometimes found in drinking water.<sup>[1]</sup> These parasites can cause gastrointestinal distress and in severe cases, death.
- Heavy rainfall events cause stormwater runoff that may contaminate water bodies used for recreation (such as lakes and beaches) with other bacteria.<sup>[9]</sup> The most common illness contracted from contamination at beaches is gastroenteritis, an inflammation of the stomach and the intestines that can cause symptoms such as vomiting, headaches, and fever. Other minor illnesses include ear, eye, nose, and throat infections.<sup>[2]</sup>

### Animal-borne Diseases

- The geographic range of ticks that carry Lyme disease is limited by temperature. As air temperatures rise, the range of these ticks is likely to continue to expand northward.<sup>[9]</sup> Typical symptoms of Lyme disease include fever, headache, fatigue, and a characteristic skin rash.
- In 2002, a new strain of West Nile virus, which can cause serious, life-altering disease, emerged in the United States. Higher temperatures are favorable to the survival of this new strain.<sup>[1]</sup>

The spread of climate-sensitive diseases will depend on both climate and non-climate factors. The United States has public health infrastructure and programs to monitor, manage, and prevent the spread of many diseases. The risks for climate-sensitive diseases can be much higher in poorer countries that have less capacity to prevent and treat illness.<sup>[9]</sup> For more information, please visit the International Impacts & Adaptation page.

## Other Health Linkages

Other linkages exist between climate change and human health. For example, changes in temperature and precipitation, as well as droughts and floods, will likely affect agricultural yields and production. In some regions of the world, these impacts may compromise food security and threaten human health through malnutrition, the spread of infectious diseases, and food poisoning. The worst of these effects are projected to occur in developing countries, among vulnerable populations.<sup>[9]</sup> Declines in human health in other countries might affect the United States through trade, migration and immigration and have implications for national security.<sup>[1] [2]</sup>

Although the impacts of climate change have the potential to affect human health in the United States and around the world, there is a lot we can do to prepare for and adapt to these changes. Learn about how we can adapt to climate impacts on health.

## References

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6. EPA (2009). Integrated Science Assessment for Particulate Matter: Final Report. U.S. Environmental Protection Agency, Washington, DC, USA.
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### EPA Report on Air Quality and Climate Change

Improving America's air quality is one of EPA's top priorities. EPA's Global Change Research Program is investigating the potential consequences of climate change on U.S. air quality. A recent interim assessment finds that:

- Climate change could increase surface-level ozone concentrations in areas where pollution levels are already high.
- Climate change could make U.S. air quality management more difficult.
- Policy makers should consider the potential impacts of climate change on air quality when making air quality management decisions.



Mosquitoes favor warm, wet climates and can spread diseases such as West Nile virus.

8. [EPA \(2009\). \*Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A Synthesis of Climate Change Impacts on Ground-Level Ozone \(An Interim Report of the U.S. EPA Global Change Research Program\)\*](#). U.S. Environmental Protection Agency, Washington, DC, USA.

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