



# Climate Change - Health and Environmental Effects

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## Health

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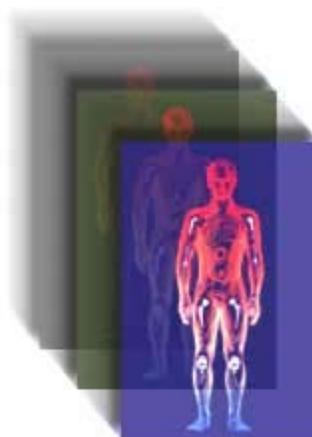
Throughout the world, the prevalence of some diseases and other threats to human health depend largely on local climate. Extreme temperatures can lead directly to loss of life, while climate-related disturbances in ecological systems, such as changes in the range of infective parasites, can indirectly impact the incidence of serious infectious diseases. In addition, warm temperatures can increase air and water pollution, which in turn harm human health.

Human health is strongly affected by social, political, economic, environmental and technological factors, including urbanization, affluence, scientific developments, individual behavior and individual vulnerability (e.g., genetic makeup, nutritional status, emotional well-being, age, gender and economic status). The extent and nature of climate change impacts on human health vary by region, by relative vulnerability of population groups, by the extent and duration of exposure to climate change itself and by society's ability to adapt to or cope with the change.

The Intergovernmental Panel on Climate Change ([IPCC, 2007](#)) concluded:

Human beings are exposed to climate change through changing weather patterns (for example, more intense and frequent extreme events) and indirectly through changes in water, air, food quality and quantity, ecosystems, agriculture, and economy. At this early stage the effects are small but are projected to progressively increase in all countries and regions.

Given the complexity of factors that influence human health, assessing health impacts related to climate change poses a difficult challenge. Furthermore, climate change is expected to bring a few benefits to health, including fewer deaths due to exposure to cold. Nonetheless, the IPCC has concluded that, overall (globally), negative climate-related health impacts are expected to outweigh positive health impacts during this century ([IPCC, 2007](#)). At the same time, the quality of medical care and public health systems in the United States may lessen climate impacts on human health within the U.S.



### Related Links

#### EPA

- Excessive Heat Events Guidebook
- Global Change Research Program
- Global Change Environmental Assessment
- Global Change Environmental Research and Grants
- Climate Change and Children's Health
- Health Effects on Older Adults
- Climate Change and Health Effects (PDF) (2 pp, 331K, About PDF)

#### U.S. Global Change Research Program Synthesis and Assessment Reports

- 4.6 Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems

#### Interagency Working Group on Climate Change and Health

- A Human Health Perspective on Climate Change (PDF) (80 pp, 5.0MB, About PDF)

#### Other [EXIT Disclaimer](#)

- IPCC Working Group II, Fourth Assessment Report, Health Chapter (PDF) (42 pp, 796K, About PDF)
- IPCC Working Group II, Fourth Assessment Report, North America Chapter (PDF) (36 pp, 872K, About PDF)
- National Research Council, Global Air Quality: An Imperative for Long-Term Observational Strategies
- Special Issue of *Environmental Health Perspectives*: Human Health Consequences of Climate Variability and Change for the United States
- World Health Organization, Climate Change and Human Health: Risks and Responses

## Direct Temperature Effects

Climate change may directly affect human health through increases in average temperature. Such increases may lead to more extreme heat waves during the summer while producing less extreme cold spells during the winter. Rising average temperatures are predicted to increase the incidence of heat waves and hot extremes. In the United States, Chicago is projected to experience 25 percent more frequent heat waves and Los Angeles a four-to-eight-fold increase in heat wave days by the end of the century (IPCC, 2007). Particular segments of the population such as those with heart problems, asthma, the elderly, the very young and the homeless can be especially vulnerable to extreme heat.

## Extreme Events

Extreme weather events can be destructive to human health and well-being. The extent to which climate change may affect the frequency and severity of these events, such as hurricanes and extreme heat and floods, is being investigated by the U.S. Global Change Research Program. An increase in the frequency of extreme events may result in more event-related deaths, injuries, infectious diseases, and stress-related disorders.

## Climate-Sensitive Diseases

Climate change may increase the risk of some infectious diseases, particularly those diseases that appear in warm areas and are spread by mosquitoes and other insects. These "vector-borne" diseases include malaria, dengue fever, yellow fever, and encephalitis. Also, algal blooms could occur more frequently as temperatures warm — particularly in areas with polluted waters — in which case diseases (such as cholera) that tend to accompany algal blooms could become more frequent.

Higher temperatures, in combination with favorable rainfall patterns, could prolong disease transmission seasons in some locations where certain diseases already exist. In other locations, climate change will decrease transmission via reductions in rainfall or temperatures that are too high for transmission. For example, temperature and humidity levels must be sufficient for certain disease-carrying vectors, such as ticks that carry Lyme disease, to thrive. And climate change could push temperature and humidity levels either towards or away from optimum conditions for the survival rate of ticks.

Though average U.S. and global temperatures are expected to continue to rise, the potential for an increase in the spread of diseases [EXIT Disclaimer](#) will depend not only on climatic but also on non-climatic factors, primarily the effectiveness of the public health system (WHO, 2003).

The IPCC has noted that the global population at risk from vector-borne malaria will increase by between 220 million and 400 million in the next century. While most of the increase is predicted to occur in Africa, some increased risk is projected in Britain, Australia, India and Portugal (IPCC, 2007).

Tick-borne Lyme disease also may also expand its range in Canada. However, socioeconomic factors such as public health measures will play a large role in determining the existence or extent of such infections. Water-borne diseases may increase where warmer air and water temperatures combine with heavy runoff from agricultural and urban surfaces, but may be largely contained by standard water-treatment practices.

The U.S. Environmental Protection Agency has produced the Excessive Heat Events Guidebook with the National Oceanic and Atmospheric Administration (NOAA), the Centers for Disease Control and Prevention (CDC), and the Department of Homeland Security (DHS). Municipal officials in both the U.S. and Canada provided useful information that can be used to help the public cope with excessive heat.

Designed to help community officials, emergency managers, meteorologists, and others plan for and respond to excessive heat events, the guidebook highlights best practices that have been employed to save lives during excessive heat events in different urban areas and provides a menu of options that officials can use to respond to these events in their communities.

## Air Quality

Climate change is expected to contribute to some air quality problems ([IPCC, 2007](#)). Respiratory disorders may be exacerbated by warming-induced increases in the frequency of smog ([ground-level ozone](#)) events and [particulate air pollution](#).

Ground-level ozone can damage lung tissue, and is especially harmful for those with asthma and other chronic lung diseases. Sunlight and high temperatures, combined with other pollutants such as nitrogen oxides and volatile organic compounds, can cause ground-level ozone to increase. Climate change may increase the concentration of ground-level ozone, but the magnitude of the effect is uncertain. For other pollutants, the effects of climate change and/or weather are less well studied and results vary by region ([IPCC, 2007](#)).

The EPA Office of Research and Development's Global Change Research Program has been investigating and supporting research on the effects of climate change on U.S. air quality.

Many individual research projects examining the effects of global change on U.S. air quality have been funded through Office of Research and Development's STAR grant program. Summary information and progress reports from these and other STAR grants can be found at EPA's National Center for Environmental Research .

Another pollutant of concern is "[particulate matter](#)," also known as particle pollution or PM. Particulate matter is a complex mixture of extremely small particles and liquid droplets. When breathed in, these particles can reach the deepest regions of the lungs. Exposure to particle pollution is linked to a variety of significant health problems. Particle pollution also is the main cause of visibility impairment (haze) in the nation's cities and national parks. Climate change may indirectly affect the concentration of PM pollution in the air by affecting natural or "biogenic" sources of PM such as wildfires and dust from dry soils.

## Other Health Linkages

Other, less direct linkages exist between climate change and human health. For example, regional climate change impacts on [agricultural yields and production](#) are likely to grow over time, with the most negative effects expected in developing countries. This is expected to increase the number of undernourished people globally and consequently lead to complications in child development ([IPCC, 2007](#)).

Climate change may also [contribute to social disruption, economic decline, and displacement of populations in certain regions](#) ([PDF](#)) (22 pp, 915K, [About PDF](#)) [EXIT Disclaimer](#), due to effects on agricultural production, already-scarce water resources, and extreme weather events (e.g., [Schwartz and Randall, 2003](#)). These issues are likely to be more severe in developing countries, and may worsen human health and well-being in affected regions ([IPCC, 2007](#)).

## References

- [IPCC, 2007: Climate Change 2007: Impacts, Adaptation, and Vulnerability](#). [EXIT Disclaimer](#) Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Parry, Martin L., Canziani, Osvaldo F., Palutikof, Jean P., van der Linden, Paul J., and Hanson, Clair E. (eds.)]. Cambridge University Press, Cambridge, United Kingdom, 1000 pp.
- [National Research Council \(NRC\), 2001. Climate Change Science: An Analysis of Some Key Questions](#). [EXIT Disclaimer](#) National Academy Press, Washington, DC
- [Schwartz and Randall, 2003. An Abrupt Climate Change Scenario and Its Implications for United States National Security](#) ([PDF](#)) (22 pp, 915K, [About PDF](#)) [EXIT Disclaimer](#). October 2003.
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