



## TEMPERATURE-RELATED DEATH AND ILLNESS

Increasing concentrations of greenhouse gases lead to an increase of both average and extreme temperatures. This is expected to lead to an increase in deaths and illness from heat and a potential decrease in deaths from cold, particularly for a number of communities especially vulnerable to these changes, such as children, the elderly, and economically disadvantaged groups.

Days that are hotter than the average seasonal temperature in the summer or colder than the average seasonal temperature in the winter cause increased levels of illness and death by compromising the body's ability to regulate its temperature or by

inducing direct or indirect health complications. Loss of internal temperature control can result in a cascade of illnesses, including heat cramps, heat exhaustion, heatstroke, and hyperthermia in the presence of extreme heat, and hypothermia and frostbite in the presence of extreme cold.

Temperature extremes can also worsen chronic conditions such as cardiovascular disease, respiratory disease, cerebrovascular disease, and diabetes-related conditions. Prolonged exposure to high temperatures is associated with increased hospital admissions for cardiovascular, kidney, and respiratory disorders.



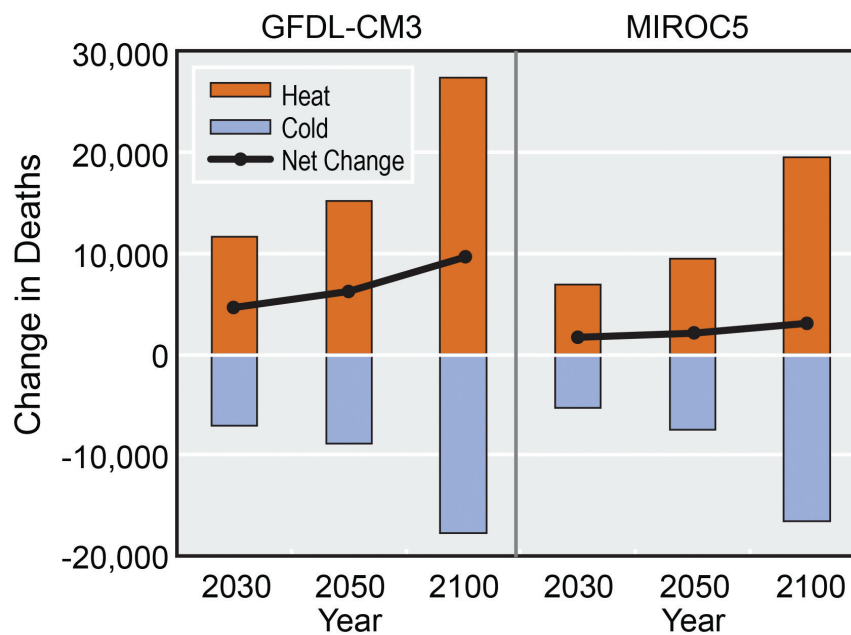
Climate change will increase the frequency and severity of future extreme heat events while also resulting in generally warmer summers and milder winters, with implications for human health.

### Future Increases in Temperature-Related Deaths

**Key Finding 1:** Based on present-day sensitivity to heat, an increase of thousands to tens of thousands of premature heat-related deaths in the summer [*Very Likely, High Confidence*] and a decrease of premature cold-related deaths in the winter [*Very Likely, Medium Confidence*] are projected each year as a result of climate change by the end of the century. Future adaptation will very likely reduce these impacts (see the Changing Tolerance to Extreme Heat Finding). The reduction in cold-related deaths is projected to be smaller than the increase in heat-related deaths in most regions [*Likely, Medium Confidence*].

### Even Small Differences from Seasonal Average Temperatures Result in Illness and Death

**Key Finding 2:** Days that are hotter than usual in the summer or colder than usual in the winter are both associated with increased illness and death [*Very High Confidence*]. Mortality effects are observed even for small differences from seasonal average temperatures [*High Confidence*]. Because small temperature differences occur much more frequently than large temperature differences, not accounting for the effect of these small differences would lead to underestimating the future impact of climate change [*Likely, High Confidence*].



This figure shows the projected increase in deaths due to warming in the summer months (hot season, April–September), the projected decrease in deaths due to warming in the winter months (cold season, October–March), and the projected net change in deaths compared to a 1990 baseline period for the 209 U.S. cities examined, using the GFDL–CM3 and MIROC5 climate models (see Ch. 2: Temperature-Related Deaths and Illness). (Figure source: adapted from Schwartz et al. 2015)<sup>2</sup>

### Changing Tolerance to Extreme Heat

**Key Finding 3:** An increase in population tolerance to extreme heat has been observed over time [*Very High Confidence*]. Changes in this tolerance have been associated with increased use of air conditioning, improved social responses, and/or physiological acclimatization, among other factors [*Medium Confidence*]. Expected future increases in this tolerance will reduce the projected increase in deaths from heat [*Very Likely, Very High Confidence*].

### Some Populations at Greater Risk

**Key Finding 4:** Older adults and children have a higher risk of dying or becoming ill due to extreme heat [*Very High Confidence*]. People working outdoors, the socially isolated and economically disadvantaged, those with chronic illnesses, as well as some communities of color, are also especially vulnerable to death or illness [*Very High Confidence*].



Outdoor workers spend a great deal of time exposed to temperature extremes, often while performing vigorous activities.