GLOBAL CLIMATE CHANGE: IMPACTS IN THE MIDWEST

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The climate of the Midwestern states is already changing. Annual average temperatures have risen in recent decades, with the largest increases in the winter months. Extreme heat events are occurring more frequently, and heavy downpours are becoming much more common as well. The duration of lake ice, including on the Great Lakes, is decreasing, and the growing season is starting earlier and lasting longer.

These trends are expected to continue, although the extent of the changes that do occur will depend on whether emissions of heat-trapping gases are cut substantially or continue to rise at close to their current pace. By the end of the century, under a business-as-usual emissions scenario, an Illinois summer could feel like one in east Texas today. And a Michigan summer may feel like an Arkansas summer does now.

The following specific impacts of climate change are among those projected for the eight states in the Midwest—Illinois, Indiana, Iowa, Missouri, Michigan, Minnesota, Ohio, and Wisconsin:

- Increasingly frequent and more intense heat waves will adversely affect human health.
- More frequent heavy rainstorms will cause flooding and trigger sewage overflows.
- Increases in heat, insect pests, and weather extremes will pose challenges for agriculture.
- Great Lakes water levels will decline, increasing shipping costs and dredging requirements.
- Changing climate conditions will threaten many native species.

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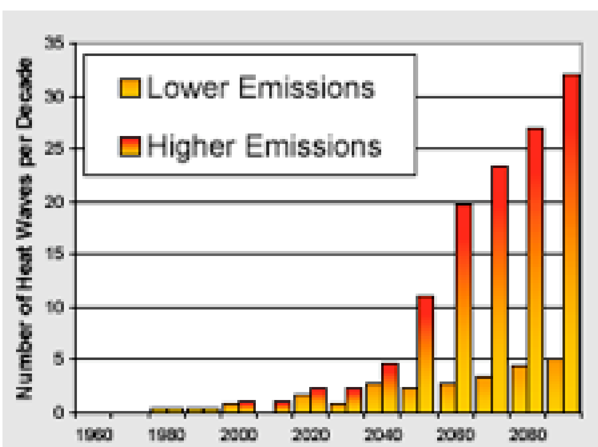


Total number of 1995-like heat wave events projected to occur each decade in Chicago.

Midwestern cities are expected to experience more frequent, longer, and hotter heat waves than in the past. Extreme heat events—such as the seven-day 1995 Chicago heat wave that claimed almost 700 lives—will become much more common. By the end of the century, there is likely to be one such severe heat wave every other year under a lower-emissions scenario—and more than three such heat waves *each year* under a higher emissions scenario.†

The projected increase in the frequency of extremely hot summers poses a significant risk to human health. More cases of heat-related illness and mortality can be expected—particularly among the elderly, children, and those with pre-existing health conditions.

† *Lower emissions scenario*: Shift to less fossil fuel-intensive industries and introduction of clean-energy technologies; carbon dioxide (CO_2) levels—currently 385 parts per million (ppm) —reach 550 ppm by 2100. *Higher emissions scenario*: Continued global dependence on fossil fuels as the primary energy source; CO_2 levels reach 940 ppm by 2100. (Many climate scientists believe that concentrations of CO_2 must stabilize well below 450 ppm to avoid dangerous interference with the climate system.)

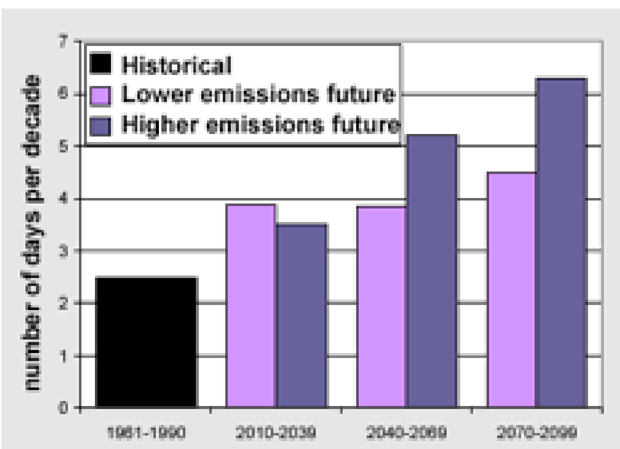
Urban populations will be especially vulnerable since buildings and other man-made surfaces absorb and retain more heat than does the surrounding countryside. This heat island effect keeps temperatures high around the clock, allowing little relief from heat at night and increasing the toll on city residents.

Air quality is likely to worsen. Higher temperatures tend to increase the formation of dangerous levels of ground-level ozone, exacerbating asthma and other respiratory diseases. The stagnant air masses that often accompany heat waves allow pollution to accumulate, further contributing to poor air quality that threatens public health.

Disease-carrying insects, such as mosquitoes, will proliferate in the warmer conditions, increasing the risk of vector-borne diseases such as West Nile virus.

More frequent heavy rainstorms will cause flooding and trigger sewage overflows. Annual precipitation is expected to increase, with most of that increase projected to occur in winter and spring. The frequency and intensity of heavy rain events are expected to increase as well. Heavy downpours can overwhelm drainage systems and water treatment facilities, leading to the discharge of contaminants and untreated sewage into nearby lakes and rivers.

Heavy rains are a particularly serious problem for older cities with combined sewer systems. Extended rain and runoff in Milwaukee in 1993, for example, swamped the municipal water purification system, leading to a cryptosporidium outbreak and causing over 400,000 cases of intestinal illness and 54 deaths.



Projected changes in the frequency of heavy precipitation events (more than 2.5 inches of rain per day) in the Chicago region.

In Chicago, rainfall of 2.5 inches in one day is the threshold for a combined sewer overflow into Lake Michigan. The frequency of such heavy rain events is projected to increase—under the higher emissions scenario—from about once every four years to once every other year by the end of the century.

The projected increase in precipitation in spring—when most rivers reach their peak levels due to melting snow—could add to the risk of flooding in many areas. Similarly, the expected increase in heavy downpours is likely to result in more events like the flash flooding that caused extensive damage in the Chicago area in 2006 and the disastrous Iowa flood in 2008.

Increases in heat, insect pests, and weather extremes will pose challenges for agriculture. A longer growing season and higher levels of carbon dioxide will stimulate plant growth and increase some crop yields. But other aspects of a warmer climate are likely to have adverse impacts on the agricultural sector.

Warmer and shorter winters will allow insect pests to expand their range northward, and a longer growing season will allow some pests to produce more generations per year. Warmer temperatures will also stimulate weed growth and will allow the northward spread of invasive plants that now cause major damage in southern states (e.g., kudzu). Pesticide and herbicide use is likely to increase as a result, bringing additional economic and environmental costs.

Increased spring rainfall will raise the risk of floods and could delay planting. Summer rainfall, on the other hand, is projected to decrease, especially in the southern and western portions of the Midwest. Long dry spells during the growing season could reduce crop production, while intense downpours in summer and fall could delay harvesting.

Higher summer temperatures and humidity levels will negatively affect livestock and dairy animals, reducing animals' ability to gain weight, give milk, and reproduce.

Great Lakes water levels will decline, increasing shipping costs and dredging requirements.
Warming temperatures are projected to further reduce ice cover on the Great Lakes. This in turn will mean increased lake evaporation and a likely decline in lake water levels. Under the higher emissions scenario, the average level of Lake Michigan, for example, could drop as much as 1.5 feet by the end of the century.

Although reduced ice coverage would open up more of the Great Lakes to commercial shipping and recreational boating, lower lake levels could bring adverse economic impacts. Ships would not be able to carry as much cargo, and extensive dredging would be needed to keep shipping channels open and harbors functioning.

Changing climate conditions will threaten many native species.
Plant hardiness zones are projected to shift northward as temperature warms—by one zone by the end of the century under the lower emissions scenario and by one and a half zones under the higher emissions scenario. Habitats of many tree species will shift northward, and more heat- and drought-tolerant species will become more abundant. Corresponding changes in animal and insect communities can also be expected as the timing and quality of their food resources change.

Currently important tree species will be affected by the larger populations of insect pests that thrive in warmer climates. Devastating forest pests such as the gypsy moth will almost certainly become more widely established throughout the region. Drier summer conditions will increase the risk of forest fires.

Rising temperatures will lead to warmer lake water temperatures. As surface waters warm earlier in spring, the duration of stratification will increase—the summer separation of a warm surface layer of water over cooler, deeper water. The warm water layer gradually cuts off oxygen to the bottom layers, increasing the risk of dead zones that cannot support fish and other organisms.

Warmer water, together with lower oxygen levels, also accelerates the release of mercury and other contaminants that can accumulate in the aquatic food chain and ultimately in fish. Species of coldwater fish are likely to decline in southern parts of the region while warm-water species expand northward.

Sources

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• *Climate Change and Chicago: Projections and Potential Impacts*, City of Chicago (November 2007).