Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

backgrounder

All information in this summary is entirely based on "Global Climate Change Impacts in the United States" (USGCRP, 2009). To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

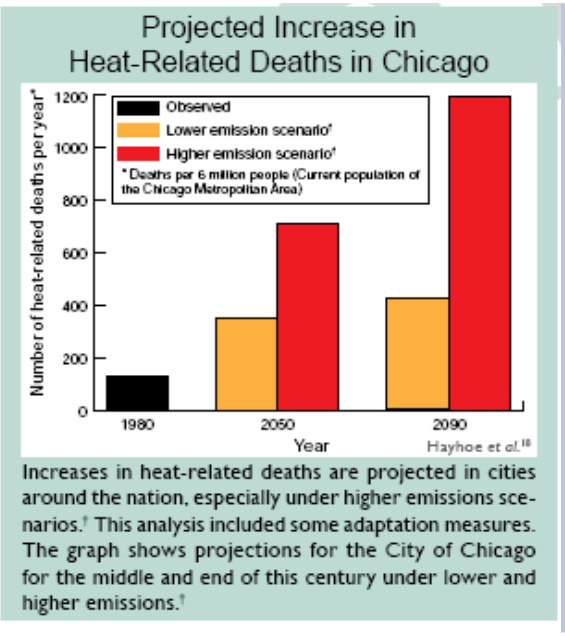
Midwest

Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin

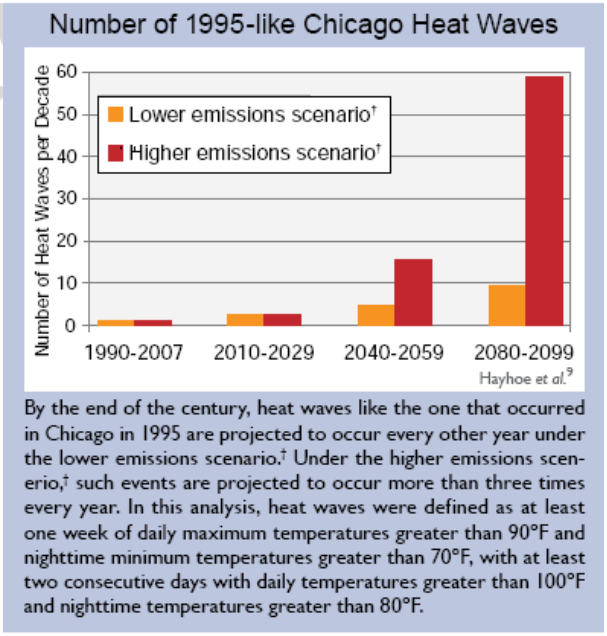
HUMAN HEALTH IMPACTS

During the summer, public health and quality of life, especially in cities, will be negatively affected by increasing heat waves, reduced air quality, and insect and water-borne diseases.

- **Heat waves** that are more frequent, more severe, and longer-lasting are projected.
- The **frequency of hot days** and the length of the heat-wave season both will be more than twice as great under the higher emissions scenario compared to the lower emissions scenario.
- Events such as the **Chicago heat wave** of 1995, which resulted in over 700 deaths, will become more common. Under the lower emissions scenario, such a heat wave is projected to occur every other year in Chicago by the end of the century, while under the higher emissions scenario, there would be about three such heat waves per year.
- Even **more severe heat waves**, such as the one that claimed tens of thousands of lives in Europe in 2003, are projected to become more frequent in a warmer world, occurring as often as every other year in the Midwest by the end of this century under the higher emissions scenario. Some health impacts can be reduced by better preparation for such events.
- **Insects** such as ticks and mosquitoes that carry **diseases** will survive winters more easily and produce larger populations in a warmer Midwest. One potential risk is an increasing incidence of diseases such as West Nile virus. Water-borne diseases will present an increasing risk to public health because so many pathogens thrive in warmer conditions.



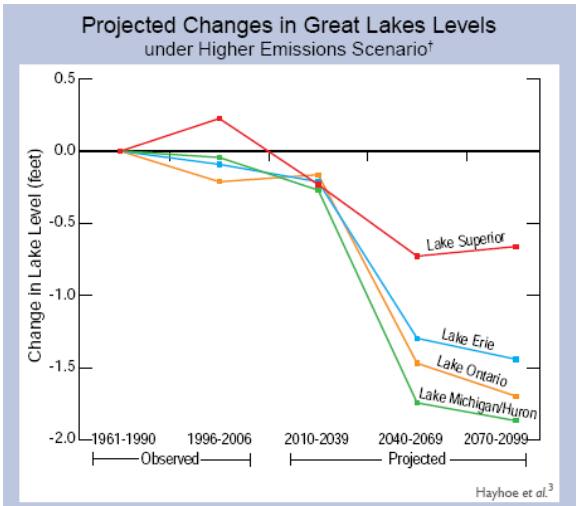
Increases in heat-related deaths are projected in cities around the nation, especially under higher emissions scenarios.† This analysis included some adaptation measures. The graph shows projections for the City of Chicago for the middle and end of this century under lower and higher emissions.†



By the end of the century, heat waves like the one that occurred in Chicago in 1995 are projected to occur every other year under the lower emissions scenario.† Under the higher emissions scenario,† such events are projected to occur more than three times every year. In this analysis, heat waves were defined as at least one week of daily maximum temperatures greater than 90°F and nighttime minimum temperatures greater than 70°F, with at least two consecutive days with daily temperatures greater than 100°F and nighttime temperatures greater than 80°F.

SHIPPING ON THE THE GREAT LAKES

As the climate has warmed, ice coverage on the Great Lakes has fallen, and is projected to continue to rise this century.



Average Great Lakes levels depend on the balance between precipitation (and corresponding runoff) in the Great Lakes Basin on one hand and evaporation and outflow on the other. As a result, lower emissions scenarios† with less warming show less reduction in lake levels than higher emissions scenarios.† Projected changes in lake levels are based on simulations by the NOAA Great Lakes model for projected climate changes under a higher emissions scenario.†

- The maximum seasonal coverage of Great Lakes **ice decreased at a rate of –8.4 percent per decade** from 1973 through 2008, amounting to a roughly 30 percent decrease in ice coverage.
- Under a lower emissions scenario, water levels in the Great Lakes are projected to fall no more than 1 foot by the end of the century, but under a higher emissions scenario, they are projected to fall between 1 and 2 feet.
- The greater the temperature rise, the higher the likelihood of a larger decrease in lake levels.

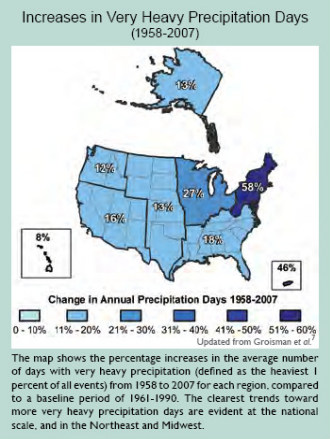
There are potential impacts on beaches, coastal ecosystems, dredging requirements, infrastructure, and shipping.

- Even a decrease of 1 foot, combined with normal fluctuations, can result in significant lengthening of the distance to the lakeshore in many places.
- Lower lake levels reduce "draft," or the distance between the waterline and the bottom of a ship, which lessens a ship's ability to carry freight. Large vessels, sized for passage through the St. Lawrence Seaway, lose up to 240 tons of capacity for each inch of draft lost.
- With lower lake levels, ships will be unable to carry as much cargo and hence shipping costs will increase.
- These impacts will have costs, including increased shipping, repair and maintenance costs, and lost recreation and tourism dollars.
- A recent study, for example, found that the projected reduction in Great Lakes water levels would result in an estimated 13 to 29 percent increase in shipping costs for Canadian commercial navigation by 2050, all else remaining equal.

WATER RESOURCES – INCREASED RAINFALL AND FLOODING

Precipitation is projected to increase in winter and spring, and to become more intense throughout the year. This pattern is expected to lead to more frequent flooding, increasing infrastructure damage, and impacts on human health.

- Heavy downpours are now twice as frequent as they were a century ago.
- Both summer and winter precipitation have been above average for the last three decades, the wettest period in a century.
- The Midwest has experienced two record-breaking floods in the past 15 years. Heavy downpours have increased in recent decades and are projected to increase further as the world continues to warm.
- In the United States, the amount of precipitation falling in the heaviest 1 percent of rain events increased by 20 percent in the past century, while total precipitation increased by 7 percent.
- Over the last century, there was a 50 percent increase in the frequency of days with precipitation over 4 inches in the upper Midwest.



For the future, precipitation intensity is projected to increase everywhere, with the largest increases occurring in areas in which average precipitation increases the most.

- For example, the Midwest and Northeast, where total precipitation is expected to increase the most, will also experience the largest increases in heavy precipitation events.

Such intense precipitation is likely to increase the frequency and severity of events such as the **Great Flood of 1993**, which caused catastrophic flooding along 500 miles of the Mississippi and Missouri river system, paralyzing surface transportation systems, including rail, truck, and marine traffic. Major east-west traffic was halted for roughly six weeks in an area stretching from St. Louis, Missouri, west to Kansas City, Missouri and north to Chicago, Illinois, affecting one-quarter of all U.S. freight that either originated or terminated in the flood-affected region.

The **June 2008 Midwest flood** was the second record-breaking flood in the past 15 years. Dozens of levees were breached or overtopped in Iowa, Illinois, and Missouri, flooding huge areas, including nine square miles in and around Cedar Rapids, Iowa. Numerous highway and rail bridges were impassable due to flooding of approaches and transport was shut down along many stretches of highway, rail lines, and normally navigable waterways.

Such heavy downpours can overload drainage systems and water treatment facilities, increasing the risk of water-borne diseases.

- Such an incident occurred in Milwaukee in 1993 when the water supply was contaminated with the parasite *Cryptosporidium*, causing 403,000 reported cases of gastrointestinal illness and 54 deaths.
- The consequences will be particularly severe in the 950 U.S. cities and towns, including New York, Chicago, Washington DC, Milwaukee, and Philadelphia, that have “combined sewer systems;” an older design that carries storm water and sewage in the same pipes.
- During heavy rains, these systems often cannot handle the volume, and raw sewage spills into lakes or waterways, including drinking water supplies and places where people swim.
- In 1994, the EPA established a policy that mandates that communities substantially reduce or eliminate their combined sewer overflow, but this mandate remains unfulfilled.35 In 2004, the EPA estimated it would cost $203 billion to address these and other needs of publicly-owned wastewater treatment systems.
- In Chicago, rainfall of more than 2.5 inches per day is an approximate threshold beyond which combined water and sewer systems overflow into Lake Michigan (such events occurred 2.5 times per decade from 1961 to 1990). This generally results in beach closures to reduce the risk of disease transmission. Rainfall above this threshold is projected to occur twice as often by the end of this century under the lower emissions scenario† and three times as often under the higher emissions scenario. Similar increases are expected across the Midwest.

More intense rainfall can lead to floods that cause significant impacts regionally and even nationally.

- For example, the Great Flood of 1993 caused catastrophic flooding along 500 miles of the Mississippi and Missouri river systems, affecting one-quarter of all U.S. freight (see *Transportation* sector).

- Another example was a record-breaking 24-hour rainstorm in July 1996, which resulted in flash flooding in Chicago and its suburbs, causing extensive damage and disruptions, with some commuters not being able to reach Chicago for three days (see *Transportation* sector).
- Another record-breaking storm took place in August 2007. Increases in such events are likely to cause greater property damage, higher insurance rates, a heavier burden on emergency management, increased clean-up and rebuilding costs, and a growing financial toll on businesses, homeowners, and insurers.

The June 2008 Midwest floods caused I-80 in eastern Iowa to be closed for more than five days, disrupting major east-west shipping routes for trucks and the east-west rail lines through Iowa. These floods exemplify the kind of extreme precipitation events and their direct impacts on transportation that are likely to become more frequent in a warming world. These extremes create new and more difficult problems that must be addressed in the design, construction, rehabilitation, and operation of the nation's transportation infrastructure.

The past century is no longer a reasonable guide to the future for water management.

- Because climate change will significantly modify many aspects of the water cycle, the assumption of an unchanging climate is no longer appropriate for many aspects of water planning.
-

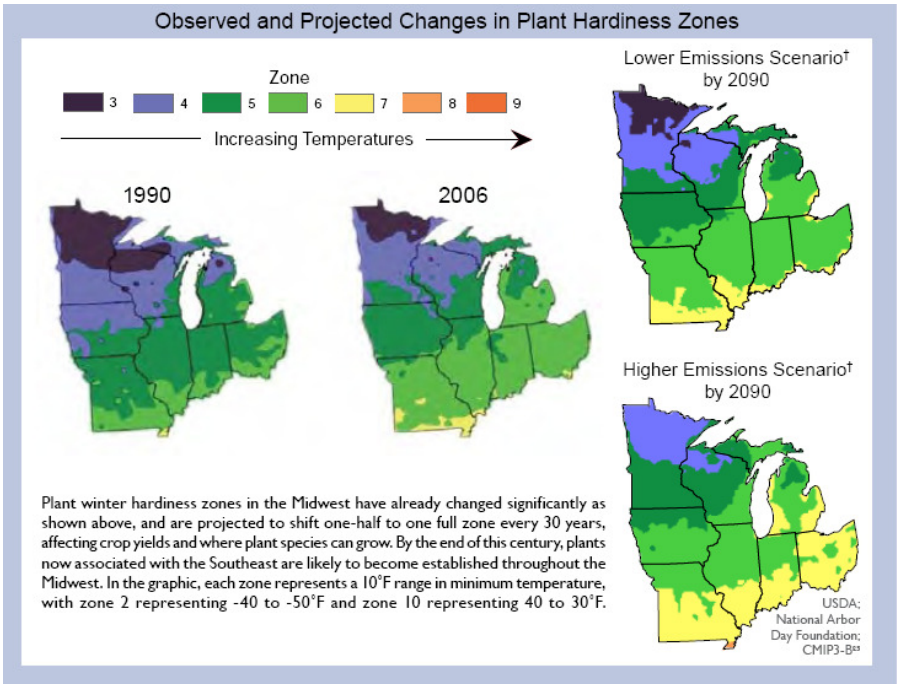
AGRICULTURE

The projected increase in winter and spring precipitation and flooding is likely to delay planting and crop establishment.

Longer growing seasons and increased carbon dioxide have positive effects on some crop yields, but this is likely to be counterbalanced by the negative effects of additional disease-causing pathogens, insect pests, and weeds (including invasive weeds).

Livestock production is expected to become more costly as higher temperatures stress livestock, decreasing productivity and increasing costs associated with the needed ventilation and cooling equipment.

By the end of the century, plants now associated with the Southeast are likely to become established throughout the Midwest. Impacts on forests are likely to be mixed, with the positive effects of higher carbon dioxide and nitrogen levels acting as fertilizers potentially negated by the negative effects of decreasing air quality. In addition, **more frequent droughts**, and hence **fire hazards**, and an increase in **destructive insect pests**, such as gypsy moths, hinder plant growth. Insects, historically controlled by cold winters, more easily survive milder winters and produce larger populations in a warmer climate



One consequence of excessive rainfall is **delayed spring planting**, which jeopardizes profits for farmers paid a premium for early season production of high-value crops such as melon, sweet corn, and tomatoes.
Field flooding during the growing season causes crop losses due to low oxygen levels in the soil, increased susceptibility to root diseases, and increased soil compaction due to the use of heavy farm equipment on wet soils. In spring 2008, heavy rains caused the Mississippi River to rise to about 7 feet above flood stage, inundating hundreds of thousands of acres of cropland. The flood hit just as farmers were preparing to harvest wheat and plant corn, soybeans, and cotton. Preliminary estimates of agricultural losses are around $8 billion; recovery is expected to take years. The flooding severely eroded upland soils where erosion put some farmers out of business. The flooding also caused an increase in runoff and leaching of agricultural chemicals into surface water and groundwater.

More rainfall concentrated into **heavy downpours** also increases the likelihood of water deficiencies at other times because of reductions in rainfall frequency. Another impact of heavy downpours is that wet conditions at harvest time result in reduced quality of many crops. **Storms with heavy rainfall** often are accompanied by wind gusts, and both strong winds and rain can flatten crops, causing significant damage. **Vegetable and fruit crops** are sensitive to even short-term, minor stresses, and as such are particularly **vulnerable to weather extremes**.

Temperature extremes also will pose problems. Even crop species that are well-adapted to warmth, such as tomatoes, can have reduced yield and/or quality when daytime maximum temperatures exceed 90°F for even short periods during critical reproductive stages. For many high-value crops, just hours or days of moderate heat stress at critical growth stages can reduce grower profits by negatively affecting visual or flavor quality, even when total yield is not reduced. **Drought frequency** and severity are projected to increase in the future over much of the United States, particularly under higher emissions scenarios.
Increased drought will be occurring at a time when crop water requirements also are increasing due to rising temperatures. Water deficits are detrimental for all crops.