

Iowa

Climate Change in the Hawkeye State

Impacts on Iowa Communities and Ecosystems



Photos: Lynn Betts, USDA Natural Resources Conservation Service

Iowa, located in the very heart of North America, is bound by the Mississippi River to the east and the Missouri to the west. Iowa lies in a transition zone where ecosystems of the Great Plains abut more easterly forests. With its more than 97,000 farms, Iowa's landscape is still largely rural, and the state is an essential part of America's, and thus the world's, breadbasket. More than half of Iowa's three million residents, however, now live in urban and suburban areas.

This summary highlights the potential impacts of climate change on Iowa's economy, people, and the places where they live, work, and enjoy the outdoors. A fully referenced version of this document can be obtained at www.ucsusa.org/iowa.

The overwhelming majority of scientists is now convinced that human activities—primarily the burning of fossil fuels to produce electricity and drive our cars, as well as land use changes—are changing our climate. These activities emit gases, principally carbon dioxide (CO₂), that blanket the planet and trap heat. Already, we are seeing signs of climate change throughout the Midwest: average annual temperatures are increasing; severe rainstorms have become more frequent and overall precipitation has increased; and growing seasons have become longer while winters are getting shorter.

Climate Projections

The latest, most reliable projections of future climate change combine 100 years of historical data for Iowa with the most up-to-date general circulation models of the Earth's climate system. While uncertainties in these climate models remain, there is general agreement among climate scientists that Iowa's climate will grow considerably warmer and probably drier over this century, especially in summer.

- **Temperature.** By the end of the 21st century, maximum daily temperatures are projected to rise 5–14°F in winter and 9–22°F in summer. This warming is more dramatic than the warming seen since the last ice age. Extreme heat will also become more common, and the growing season could be three to seven weeks longer by the end of the century.

- **Precipitation.** While annual average precipitation may not change much, seasonal precipitation in the state is likely to change, increasing in winter and spring by up to 30 percent and decreasing in summer by 10 to 35 percent. When summer rain does fall, it will likely come in intense downpours. For example, the frequency of heavy 24-hour rainstorms, which already nearly doubled over the past century, may double again by 2100.

- **Soil moisture.** By the end of the century, the combination of significant increases in summer temperature, more evaporation, more runoff from intense rainfall events, and the decline in summer precipitation could lead to drier soils and more droughts. Saturated soils and floods in spring, however, could delay planting.

What the Climate Will Be Like

These changes will dramatically affect what the climate will be like. By 2030, Iowa summers may resemble those of Kansas in terms of average temperature and rainfall. By the end of the century, Iowa's summer climate will generally be more like that of current northwest Mississippi. Winters will also change, albeit less drastically. By century's end, they may be similar to current-day northern Kansas.

Potential Impacts from Climate Change

Agriculture

Iowa devotes the most land area of all U.S. states to agriculture, and agricultural exports exceed \$3 billion. In 2002, Iowa ranked first nationwide in soybean, corn, and egg production; and in livestock, the state is first in hogs, ninth in cattle, and twelfth in milk production.

Climate exerts a significant influence on agricultural yields and profitability, yet scientists point out that population growth, market fluctuations, and access to emerging technologies also influence farmers' options. Previous studies have suggested that climate change is not likely to seriously disrupt

Iowa's agricultural capacity during the next 100 years, but more recent studies are less optimistic and highlight significant challenges to agriculture. Iowa's farmers may see the following impacts in the future:

- Increased atmospheric CO₂ and active forms of nitrogen, a longer growing season, greater water use efficiency, and improvements in soil organic matter could boost yields of some crops, such as soybeans and wheat, and less so for corn.

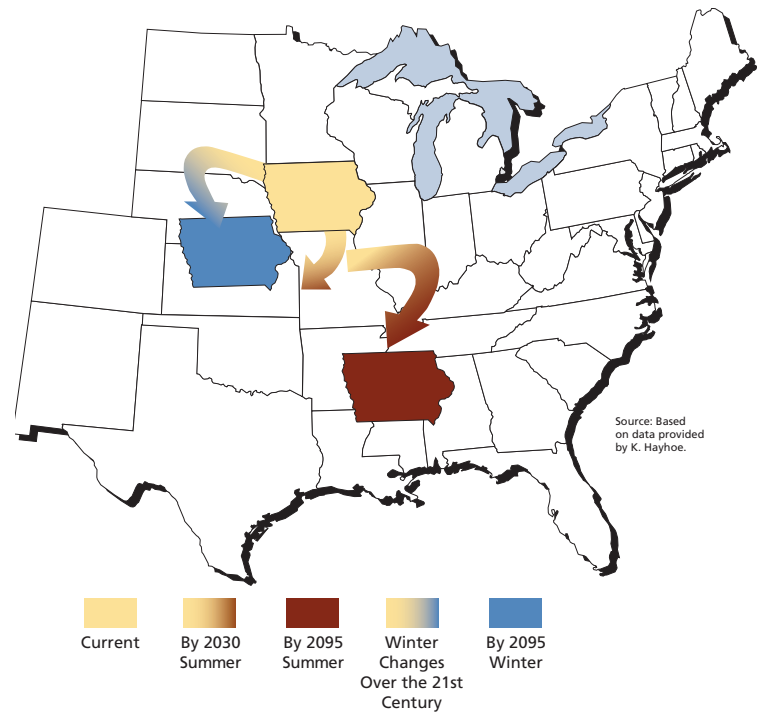
• Extreme events, such as severe storms and floods during the planting season, are likely to depress productivity. The combination of flooding and high heat is particularly lethal to row crops.

• Hotter and drier conditions and potentially more frequent droughts during the early and main growing season can disrupt production. For example, four days of soil moisture stress can reduce corn yield by 50 percent. Thus, currently rain-fed crops may require irrigation, an additional economic challenge to farmers.

• Higher ozone concentrations may counter positive impacts of a warmer climate. In particular, ozone damage is expected to cause losses in soybean yields and horticultural crops.

• Soil erosion and chemical and agricultural waste runoff are likely to increase with more frequent flooding, intensifying the air and water quality problems associated with confined animal feeding operations and the widespread use of agrochemicals. Farmers' costs to maintain soil fertility and the downstream costs to preserve or restore safe drinking water are likely to increase.

Increased flooding will worsen soil erosion and runoff of agricultural chemicals and animal wastes into the water supply.



- Warmer winters, longer freeze-free periods, and shifts in temperature and rainfall combine to create more favorable conditions for a number of pests. Milder winters, for example, lead to bigger corn and soybean pest populations—respectively, corn borer and western corn rootworm, and aphids (which carry soybean mosaic virus), leaf hoppers, and bean beetles—and also result in northward shifts of pests currently uncommon in Iowa.

- Warmer summer temperatures suppress appetite and decrease weight gain in livestock; warmer winters and less snow cover likely will reduce the quantity and quality of spring forage and, thus, milk quality. Extreme heat also decreases milk production. Livestock production (e.g., hogs, chickens) will likely become more expensive as the need for cooling grows.

Water Supply and Pollution

Iowa depends heavily on groundwater, surface waters, and rainfall for agriculture, drinking, and industrial uses. Projected changes in rainfall, evaporation, and groundwater recharge rates will affect all freshwater users.



- Stream flow in both the Upper Mississippi River Basin and the Upper Missouri River Basin is likely to shift to a more pronounced seasonal pattern: more stream flow in winter and spring, less in summer and fall.

- Reduced summer water levels are likely to diminish the recharge of groundwater, cause small streams to dry up, and reduce the area of wetlands, resulting in poorer water quality.

- Impacts from development and climate change combine to degrade the natural flood-absorbing capacities of wetlands and floodplains.

- Increased flooding will worsen soil erosion and runoff of agricultural chemicals and animal wastes into the water supply. This could exacerbate existing water quality problems from nitrate pollution, pesticide residues, bacterial contamination, and other toxins entering ground- and surface-water reservoirs.

Human Health

Climate projections suggest that extreme heat periods are likely to become more common, as will severe rainfall and flooding events. Iowa has experienced a stark preview of this future scenario during the past decade with the Mississippi

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River flood of 1993 (with over \$1.56 billion dollars in direct damages and costs, the state's costliest disaster ever); more record-breaking floods in 1998, 1999, and 2002; intense heat waves in 1995, 1999, 2000, and 2003; and drought conditions in

late summer 2003. Events such as these are likely to become more common in a warmer climate.

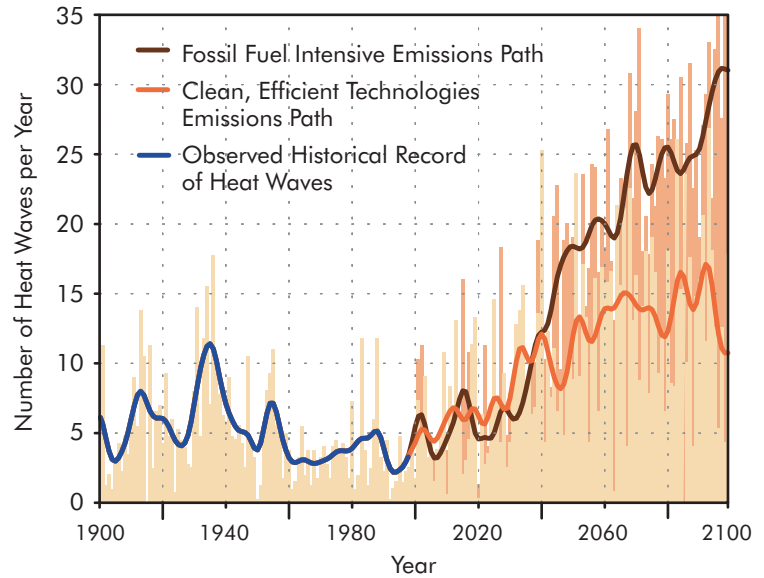
- Health risks from winter cold-related morbidity or mortality will decrease, while summer heat-related morbidity or mortality is likely to increase. The number of days above 90°F in Iowa is projected to increase two- to five-fold, with years later in the century experiencing 50 to 85 such days. Of even greater concern is the projected increase in extreme heat days (exceeding 97°F). By 2080–2100, Iowa could see 30 to 60 such days annually, which will require improved warning systems, more secure power supplies for cooling, and other medical preparation to avoid severe health impacts. Also, by 2030, three-day heat waves could occur two to three times as frequently as today, and by century's end, Iowans could experience 15 to 25 heat waves per year.

- Higher temperatures and more electricity generation for air conditioning could increase the formation of ground-level ozone, likely exacerbating asthma and other respiratory diseases.

- Threats to public health during flood events, such as flood-related injuries, temporary loss or contamination of drinking water supplies, or closure of public sewer systems could become more common.

- The occurrence of many infectious diseases is strongly seasonal, suggesting that climate plays a role in influencing transmission. Some diseases carried by ticks, such as monocytic ehrlichiosis (transmitted via infected white-tailed deer), or by mosquitoes, such as West Nile fever and western equine encephalitis, are rapidly expanding across the state. While this spread is attributed largely to land-use changes, future changes in rainfall

Annual Number of Three-Day Heat Waves Over 90°F



Without a shift to clean, efficient technologies in all sectors that will reduce heat-trapping gas emissions (orange line), Iowans may experience unrelenting heat waves by the end of the century (brown line).

or temperatures could encourage greater reproduction or survival of the disease-carrying vectors.

Property and Infrastructure

Cities such as Des Moines, Cedar Rapids, Davenport, Sioux City, and smaller cities, especially along rivers, are particularly vulnerable to the risks of climate extremes. Iowa's burgeoning insurance sector could become more vulnerable economically as weather-related hazardous events affect rural areas (farms and crops), cities (property and infrastructure), industry, and businesses.

- More frequent extreme weather events such as storms and floods, exacerbated by stream channeling, levee construction, and more paved surfaces, will likely increase property damage and the risk of landslides, place heavier burdens on emergency management, increase cleanup and rebuilding costs, and exact a financial toll on farms, businesses, and homeowners.

- Storms, and flooding in particular, will require changes in infrastructure. Municipalities in Iowa will have to upgrade levees, sewer pipes, and wastewater treatment plants in anticipation of more frequent extreme downpours.

Forests, Prairies, and Terrestrial Wildlife

The 2.1 million acres of hardwood forests remaining in southern and eastern Iowa are crucial for wildlife, water supply protection, erosion control, and recreation. Woodlands along streams and rivers provide shade and cooling for fish and aquatic life; they also provide habitat for the declining redheaded woodpecker and the federally protected Indiana bat.

- The state's natural woodlands are home to Iowa's state tree, the oak. Wild turkeys, pheasants, quail, wood ducks, nuthatches, grackles, and some woodpeckers depend on

acorns in their diets. As Iowa grows hotter and probably drier overall, many oak species may be gradually replaced by more drought-tolerant species, such as southern pine or bur oak. Other tree species, such as white pine, balsam fir, and yellow birch, are extremely vulnerable to climate change and may be lost from the state.

- Increasing atmospheric CO₂ will likely spur forest growth in the short term. However, higher concentrations of ground-level ozone, more frequent droughts, and a greater risk from insect pests, combined with the already existing pressures from invasive species, could damage long-term forest health.

- Increasing climate extremes or variability (e.g., droughts, floods) can have particularly devastating impacts on isolated patches of native plant habitat, such as tallgrass prairies and oak savannas, potentially leading to local loss of species.

- Many bird species have already reacted to the moderate warming that has occurred in the Midwest over the past century, as evidenced in earlier arrival and breeding dates as well as range shifts. Iowa could experience a net loss of 26 songbird species by the end of the century as a result of climate shifts. Iowa's state bird, the American goldfinch, may contract its range to the northern part of the state.

Recreation along Rivers, Streams, and Wetlands

Iowa has more than 19,000 miles of fishable rivers and streams and more than 230 lakes that draw countless local anglers, birders, and hunters each year. Wetland areas have been dramatically reduced since settlement, including north-central Iowa's Prairie Pothole region. The state's wetlands, however, still provide crucial stopover habitat for many waterfowl and migratory shorebirds of the western hemisphere, as well as important recreational opportunities.

- Anglers will be affected by range shifts, loss of habitat, and increases or declines of their preferred catch. Iowa's only cold-water fish, the trout, may not survive in the state's warming waters. The Western mosquitofish—in the past limited in its range by cold Iowa winters—is already moving northward; other, more southerly fish species, such as the spotted gar, might migrate north in the Mississippi River.

- Earlier spring runoff, more intense flooding, lower summer water levels, and extended droughts in a warmer climate will generally spell trouble for Iowa's wetlands and the species that depend on them. Wetland restoration efforts will also be hampered. Development and agriculture have already significantly reduced wetland habitat and resulted in amphibian and reptile declines throughout the state. Loss of habitat or food for migratory birds and waterfowl will affect Iowans' birdwatching and hunting activities.

- In 1999, Iowa ranked 17th in the nation in terms of mercury pollution from power plants. Lower water levels in rivers coupled with warmer water temperatures may accelerate



Climate change threatens Iowa's remaining wetlands, reducing food and habitat for migratory birds and waterfowl and affecting birdwatching and hunting activities.

Lynn Betts, USDA Natural Resources Conservation Service

the accumulation of mercury and other contaminants in the aquatic food chain and ultimately in fish.

- Common invasive plants in lakes and wetland areas, such as Eurasian watermilfoil and purple loosestrife, already create pressures on native plant and animal communities. Climate change generally tends to favor such invasives, as their habitat requirements are less specialized than those of native plants.

- Future summer recreation may involve some restrictions and require behavior change given projections of more extreme heat, downpours, and wider spread of disease vectors.

Climate Change Solutions

Climate change requires a comprehensive response. Iowans can help reduce the potential impacts from climate change by pursuing three necessary and complementary strategies:

- *Reducing heat-trapping gas emissions* to help curb the threat from a changing climate;

- *Minimizing pressures on the environment* by improving air quality, protecting the quality and supply of water resources, protecting habitat, and limiting sprawl through more effective urban and rural planning; and

- *Preparing for the unavoidable impacts* from global warming through adaptations in agriculture, better planning and emergency preparedness, strengthened public health response and warning systems, improved insurance coverage, and adjustments to flood control measures based on projected precipitation trends.

This three-pronged approach will require an ongoing, active dialogue between scientists and decisionmakers in the private and public sector. For additional information on climate change solutions see the UCS factsheet, *Global Warming Solutions: Reducing Heat-Trapping Emissions in Iowa* at www.ucsusa.org/iowa.



Two Brattle Square
Cambridge, MA 02238-9105
617-547-5552
ucs@ucsusa.org
www.ucsusa.org

This state summary is based on a fully referenced document, *Climate Change in the Hawkeye State: Potential Impacts on Iowa*, published in January 2004 by the Union of Concerned Scientists. The summary was written by climate science and impacts experts Dr. Susanne Moser (NCAR), in collaboration with Katharine Hayhoe (ATMOS Research) and Dr. Michelle Wander (University of Illinois at Urbana-Champaign). The Iowa Solutions fact sheet was written by Steve Clemmer (UCS).

Steve Clemmer (617) 547-5552 • Dr. Susanne Moser (303) 497-8132

The referenced version is available from UCS at www.ucsusa.org/iowa or call (617) 547-5552.