The summer of 2011 was a scorcher. All but eight states reported above-average summer temperatures, and four states broke records for extreme heat. Such sticky, steamy, uncomfortable weather is poised to become even more common as our climate warms. But hot, humid days are not just uncomfortable. Extreme heat kills. Heat is actually the biggest weather-related killer in the United States, claiming, on average, more lives each year than floods, lightning, tornadoes, and hurricanes combined. From 1999 to 2003, exposure to excessive heat killed an estimated 3,442 U.S. residents.

High temperatures can lead to dehydration, heat exhaustion, and deadly heatstroke. Very hot weather can also aggravate existing medical conditions, such as diabetes, respiratory disease, kidney disease, and heart disease. Urban residents, the elderly, children, agricultural workers, and people with impaired health and limited mobility are particularly susceptible to heat-related illness and death. Air pollutants such as ozone and particulate matter may also work in concert with heat, exacerbating its health effects.

Dangerous heat is not just a future concern. Through original research, we found that hot summer weather and heat waves have indeed become more common, on average, in the nation’s heartland over the last six decades. In other words, many baby boomers living in the Midwest have already faced these changes during their lifetimes.

Some 65 million Americans call the Midwest home, and some of our nation’s most populous and vibrant cities thrive in the eight states in the region. The Midwest also boasts one of the largest bodies of freshwater in the world, and is intersected by two major rivers. To represent this vast and varied region, we selected five major metropolitan areas and five nearby smaller cities. Some of these cities are landlocked, while some sit on the Great Lakes; some are in the northern tier of states while others are more southerly; some are on the region’s easterly edge, while one was once considered a gateway to the West.

Our research focuses on weather systems called air masses: vast bodies of air that define the weather around us. We explored whether the number of days with dangerously hot summer air masses, which are linked to human health risks, as well as cool, dry summer air masses has changed over the last 63 years. We also examined how average daytime and nighttime temperatures and humidity levels within these weather systems have changed over time. We did so because high temperature, lack of cooling relief at night, and high humidity all contribute to heat-related illness.

Our Results
Our results show that the two types of summer air masses that can harm people’s health have become more common in Chicago over the past 63 years. The city now has four more days of the hottest and most humid weather and hot, dry weather than in the 1940s each summer, on average. Meanwhile Chicago now gets significantly less relief from the heat, as it sees more than seven fewer cool, dry days per summer, on average—a 40 percent drop since 1948. Peoria, too, has experienced a significant increase in very hot, humid days and a decrease in cool, dry days.

Nighttime cooling is critical for reducing heat stress from higher daytime temperatures. However, nighttime temperatures for the two most dangerous types of summer air masses have risen over the past six decades. Temperatures on hot, humid nights have increased by 1.7°F each summer, on average, while temperatures on hot, dry nights have risen by 2.6°F. In Peoria, overnight temperatures have increased on very hot and humid, hot and dry, and cool and dry nights.

Chicago now also has one extra heat wave—three or more consecutive days with dangerously hot air masses—each summer, on average. A 2009 study projected that the city could face an average of 30 days with temperatures of 100°F or above each year by the end of this century under a scenario with higher global warming emissions. The number of such days would rise by only eight each year under a lower-emissions scenario.
Building a More Resilient Illinois

How Communities Can Protect Health during Extreme Heat
The Environmental Protection Agency’s Excessive Heat Events Guidebook outlines several steps that officials can take to protect public health and save lives during extreme heat events:

- Communicating the danger of extreme heat by ensuring real-time public access to information on the risks and appropriate responses,
- Establishing and facilitating access to air-conditioned public shelters,
- Directly assessing and, if needed, intervening on behalf of those at greatest risk, including homeless individuals, older people, those in public housing, and those with known medical conditions,
- Establishing systems to alert public health officials about high-risk individuals or those in distress during an extreme heat event, such as lists of these residents and telephone hotlines they can call.

While all communities can benefit from these tools and planning initiatives, urban neighborhoods are uniquely susceptible to extreme heat. Officials, urban planners, and architects should make special efforts to mitigate rising temperatures in these neighborhoods, such as by expanding the amount of vegetation in public spaces, adopting standards for reflective roofing and paving materials, and lowering global warming emissions.

63 Years of Weather Trends: Chicago, IL (1948–2011)

**Daily Summer Weather Trends**
Very hot, humid days and hot, dry days are both dangerous to human health, while cool, dry days bring relief from the summer heat and humidity.

**Nighttime Summer Weather Trends**
High nighttime temperatures and high relative humidity bring no relief from the heat, putting people at risk for heat-related illness and death.

**Temperature and Humidity Changes in Very Hot, Humid Nights**

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<thead>
<tr>
<th>Temperature and Humidity Changes</th>
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<tr>
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<tr>
<td>Increased</td>
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**Three-Day Heat Wave Trends**
Three consecutive days of high heat and humidity can increase heat-related illness and death.

Average Increase in Heat Waves Harmful to Human Health

**What the Future Might Look Like**
Assuming current carbon emissions trends continue (equivalent to the higher-emissions scenario), the Midwest will likely face scorching summer days with temperatures that soar above 90°F—and even 100°F—late in this century. If carbon emissions are significantly curtailed (lower-emissions scenario), far fewer summer days will be extremely hot. The data for this section were compiled from other sources. This report’s original research does not include projections of potential future climate changes.
Climate change affects each city and state in unique ways, and policy makers must be aware of local patterns. Successful heat-response plans require collaboration among many agencies and organizations, city-specific criteria on the risks of extreme heat and methods to reach residents most at risk, and a communication plan. Developing such comprehensive plans will require effort and funding, but they are vital to preparing for the extreme temperatures to come.

**Action Plans and Resources**

In 2008 Chicago launched its Chicago Climate Action Plan to mitigate and prepare for climate change, including action dedicated to managing heat. As part of that plan, the city formed an Extreme Heat Working Group to contribute to updating the Extreme Weather Operations Plan, assess the effectiveness of cooling centers, and complete thermal mapping of the city to improve site-specific decision making. To assist its most vulnerable populations, for example, the city uses maps of urban heat islands to target development of green infrastructure, such as parks and rooftop gardens.

Chicago's Office of Emergency Management and Communications maintains the city's Extreme Weather Operations Plan and updates it annually, as needed, in coordination with other agencies. The plan calls for a range of actions during extreme heat events, including:

- Using government facilities as cooling centers, including police stations, libraries, schools, park district buildings, community centers, and senior centers
- Opening 24-hour cooling centers

**How Heat Affects Health**

- **Head**
  - Symptoms of heat exhaustion can include headache, dizziness, irritability, fatigue, and loss of coordination. Hallmarks of heatstroke—a medical emergency—include marked changes in mental status, such as confusion, delirium, irritability, loss of consciousness, and seizures.

- **Mouth**
  - Increased thirst, dry mouth, and other symptoms such as weakness and nausea often signal dehydration—a loss of water or salts because of heavy sweating or inadequate fluid intake. If left untreated, dehydration can lead to serious health effects.

- **Lungs**
  - Asthma, chronic obstructive pulmonary disease, and other respiratory diseases can worsen when temperatures spike. People with pneumonia and influenza are also at greater risk of hospitalization during a heat wave.

- **Liver**
  - Heatstroke can injure the liver.

- **Kidneys**
  - Heatstroke can lead to kidney failure.

- **Arms and Legs**
  - Heat cramps can cause painful muscle spasms and cramping in the arms, shoulders, and legs.

- **Skin**
  - Heat rash—also called prickly heat, or miliaria—occurs when sweat ducts become blocked. It is most common in babies, and in hot, humid environments. Flushed, pale, or clammy skin and profuse sweating can be signs of heat exhaustion.

- **Heart**
  - Your heart has to work harder to keep your body from overheating when outside temperatures rise. Tachycardia (rapid heartbeat) can occur with heat exhaustion, and cardiac arrhythmias (abnormal or irregular heart rhythms) can occur with heatstroke. Patients with a history of cardiovascular disease and high blood pressure are at greater risk of hospitalization during heat waves.

- **Source:** Becker and Steward 2011; Glazer 2005; Lugo-Amador, Rothenhaus, and Mouyer 2004; Semenza et al. 1999.

The weather types that have become more common in the Illinois cities of Chicago and Peoria—very hot, humid air masses, and hot, dry air masses—are associated with heat-related illness and death. Very hot, humid air masses increase the risk of hyperthermia—elevated body temperature—while hot, dry air masses raise the risk of dehydration. Heat waves, which are also becoming more common, further negatively affect human health. Rising overnight temperatures are also problematic, because a lack of nighttime relief increases the risk of heat-related complications.
• Deploying public safety and human service personnel to conduct well-being checks of seniors and at-risk individuals
• Inspecting high-risk buildings (such as those with no air conditioning) to ensure that windows and ventilation systems are operating properly
• Distributing heat preparedness information to the public, city workers, clients, and visitors through press releases, news conferences, mass media, the Internet, social media, and flyers
• Monitoring the electricity system’s load to help officials respond to residents affected by power outages

The Department of Family and Support Services operates 12 cooling centers. However, when the National Weather Service issues an extreme heat warning, the city may open up to 990 municipal buildings throughout Chicago to serve as cooling centers. The city also extends the hours of parks with beaches, outdoor pools, and other water features during heat emergencies. Likely due to these sustained efforts to reduce the health risks of extreme heat, only 14 Chicago residents died of heat-related causes during a 2011 heat wave, compared with more than 700 during the deadly heat wave of 1995.

Other State Initiatives
As part of the Keep Cool Illinois campaign, the state has also designated more than 120 facilities—including state-affiliated sites in Chicago—for use as cooling centers. Open from 8:30 a.m. to 5:00 p.m. Monday through Friday, these facilities offer residents a cool, comfortable place to escape the summer heat for a few hours.

Conclusion
In addition to investing in preventive measures to protect public health and save lives during extreme heat events, we must also take aggressive action to reduce heat-trapping emissions from the burning of fossil fuels. If we do not, temperatures will likely continue to rise, and we will have to cope with the effects of extreme heat on our daily lives, our health, and our economy for decades to come. We need strategies to both build climate-resilient communities and reduce the global warming emissions that are driving climate change. Our health and well-being—and those of our children—depend on it.

Chicago has an aggressive heat-response plan—educating and checking on residents, setting up cooling centers, and extending hours for parks with water features during heat emergencies. Officials at Chicago’s Emergency Operations Center monitor the city’s actions and ensure the heat-response plan is implemented effectively.