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 52 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
The two types of summer air masses that can harm people’s health have become more common in Detroit over the past 52 years. The city now has 3.5 more days of the hottest and most humid weather each summer than in the late 1950s, on average. Detroit also faces three additional hot, dry days each summer, for a total of more than six extra days of dangerous hot weather compared with 50 years ago. Meanwhile the city now gets significantly less relief from the heat, as it sees more than 10 fewer cool, dry days per summer, on average.

Nighttime cooling is critical for reducing heat stress from higher daytime temperatures. However, temperatures on hot, dry nights have increased by 4.3°F per summer, on average. Hot, humid nights have not only become hotter but also more humid, with dew point temperatures rising by 2.5°F.

Detroit now has two more heat waves—three or more consecutive days with dangerously hot air masses—each year, on average. A 2009 study projected that the city could face 23 days with temperatures of 100°F or above each summer by the end of this century, on average, given a scenario with higher global warming emissions. The number of such days would rise by only five each year under a lower-emissions scenario.
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

Temperature and Humidity Changes in Hot, Dry Nights

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

Increased 2 per year

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.

Building a More Resilient Michigan

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, through broadcast media, websites, and toll-free phone lines
- 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.
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**

Detroit’s extreme heat plan is a coordinated effort involving three agencies—the Department of Health and Wellness Promotion, the Office of Homeland Security and Emergency Management, and the Recreation Department. Detroit’s community partners—the American Red Cross, the Salvation Army, and a volunteer registry composed of community members—help implement the plan. Heat-related activities are usually well under way before the summer season.

- When the National Weather Service notifies the Health Department of an extreme heat event, it sends out advisories and coordinates the opening of recreation and other cooling centers.
- The Health Department’s All Hazard Plan, Emergency Management’s Emergency Operations Plan, and the Recreation Department’s protocol for opening cooling centers take effect during heat emergencies.
- Local media have helped publicize the locations and operating times of cooling centers and other shared resources for coping with heat events.

### 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.

**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.

**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.

The weather types that have become more common in Detroit—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.
Other Initiatives

The Metro-Detroit Climate Justice Task Force, composed of volunteers from the academic, social service, and government sectors, came together in early 2011 to raise awareness of the risks of heat-related illness, and to provide resources to at-risk populations. Shortly after forming, for example, the task force joined forces with the University of Michigan to host a workshop to prepare social service providers to assist vulnerable populations. Participants included staff from senior centers and senior nutrition programs, recreation centers, and church programs; emergency outreach workers; and housing coordinators.

In partnership with a concerned member of the city council, the task force also created a public service announcement on the dangers of extreme heat. And the task force has worked with the American Red Cross to provide outreach and education to the elderly and other high-risk individuals during heat emergencies.

Detroiter's Working for Environmental Justice has recently formed the Detroit Climate Action Collaborative and, partnering with the Homeland Security office and other entities, is building public awareness of climate change and its impact on residents.

ICLEI–Local Governments for Sustainability and the University of Michigan also hosted a workshop on preparing for heat events for government officials, community leaders, and researchers in December 2011.

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.

Building resilience in the face of extreme heat requires commitment and collaboration. Detroit officials, for example, implement heat-response plans during emergencies, such as opening cooling centers like this one at the Farwell Recreation Center during a 2010 heat wave. A public-private partnership, Detroiter's Working for Environmental Justice, has recently formed the Detroit Climate Action Collaborative to build public awareness of climate change and its impact on city residents.