Planning for Climate & Health Impacts in Metro Minnesota

Emergency Management Considerations for HSEM Region 6

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DEPARTMENT OF HEALTH

ABOUT THE REGIONAL PROFILE

EXTREME WEATHER IS A FAMILIAR CONCERN FOR MINNESOTANS

While experience has helped Minnesotans adapt to historical weather patterns, climate change trends are pushing us to adapt even further to weather patterns and extreme events that pose major threats to our health, homes, environment, and livelihood. Over 50 years of storm data on record document that Minnesota has experienced an increase in the number and strength of weather-related natural disasters, particularly those related to rising temperatures and heavy downpours. These events cost our state millions in property loss, damaged infrastructure, disrupted business, medical care and support services, and put residents and responders at risk. Understanding how our weather is changing now and into the future will help planners and decision-makers in emergency management and supporting fields extend our progress in climate adaptation and lead to more resilient communities.

CLIMATE PROJECTION DATA AS A TOOL

Climate projections can help us prepare for the future. These data result from highly sophisticated global climate models and provide a general idea of trends in temperature and precipitation many decades into the future at ever-increasing time and spatial scales. Like every dataset, there are limitations to our understanding and application of the information to real-life decision-making. Yet despite limitations, climate projection data offer a crucial glimpse into our potential futures, and allow us to start considering the best way to allocate our preparedness dollars and management resources to reduce the severe impacts of extreme weather.

Golfer drinking water (Pexels, 2018)

PUTTING CLIMATE CHANGE INTO CONTEXT

Sometimes, climate change and extreme weather events and the impact on our communities appear distant and abstract. That is why the Minnesota Department of Health's Minnesota Climate & Health Program teamed up with state and local emergency management and preparedness professionals as well as state climatologists to develop a custom climate profile for each of the six Homeland Security and Emergency Management (HSEM) regions across the state. Each regional profile includes a description of climate change trends along with a summary of climate projection data to illustrate these trends. Regional climate data are presented alongside population projection data, as it's important to consider both our climate future and population future as we plan to minimize risk and build resilience against climate impacts.

Additionally, each regional profile provides a local case study, a "focusing event," to illustrate the links between extreme weather and natural disasters and what climate projection data can (and cannot) signify for similar events in the future. Each case study features a recent natural disaster that impacted the HSEM region and provides a comparison between temperature and precipitation measures related to that event alongside historical baseline trends and future projection estimates. Taken together, the six HSEM regional profiles provide an extensive overview of climate change trends for Minnesota and describe the potential impact of these trends for emergency management and preparedness professionals and their partners.

FOR MORE INFORMATION

A long form report, including all six profiles, individual county data, and a more comprehensive description of climate change trends and supporting research will be available at:
[Minnesota Climate & Health Planning Tools & Data](www.health.state.mn.us/divs/climatechange/data.html)
(www.health.state.mn.us/divs/climatechange/data.html)

REGION 6 OVERVIEW

REGION 6: Metro

COUNTIES

- Anoka
- Carver
- Chisago
- Dakota
- Hennepin
- Isanti
- Ramsey
- Scott
- Sherburne
- Washington

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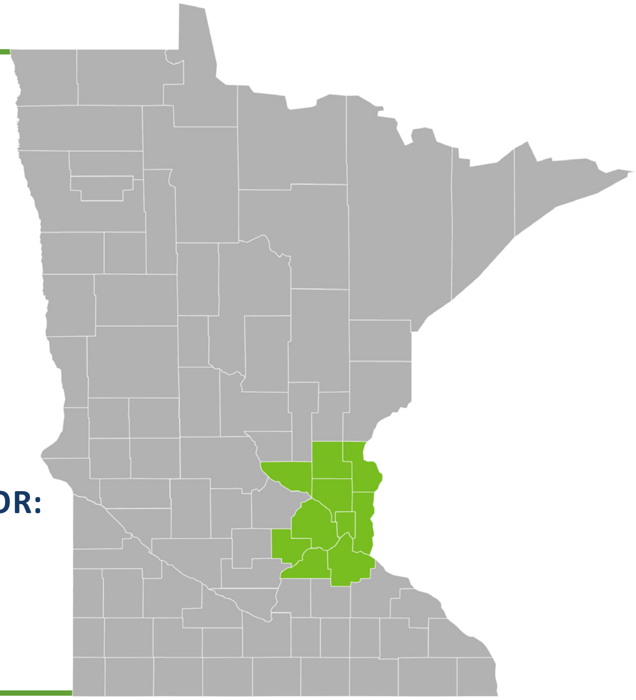


MINNESOTA CLIMATE & POPULATION TRENDS

OUR KNOWLEDGE OF CLIMATE CHANGE IS EXPANDING RAPIDLY

Climate records show that across the Midwest and here in Minnesota we are experiencing an increase in warmer, wetter conditions as well as an increase in extreme weather events and related natural disasters. Experts expect these conditions to continue well into the future. By mid-century, Minnesotans can expect much warmer winters, more severe summer heat waves, a higher frequency of very heavy rain events, and a higher frequency of late growing season drought conditions.

Many communities in Minnesota rely on economies rooted in agriculture and outdoor recreation, such as wintertime tourism, including snowmobiling, ice fishing, and skiing. Future climate conditions may stress agricultural economies by delaying planting and fieldwork, increasing disease and pest pressure, and reducing crop yields due to cycles of flooding and dry spells. Rapidly warming winter temperatures will turn snowfall into rain and reduce the depth and timing of lake ice cover, affecting winter recreation.

Extreme rainfall events will increase flood risk, particularly in floodplain areas, disrupting transportation and utility service, and damaging property and infrastructure. In addition, surface runoff may lead to soil erosion, lake pollution, and reduced drinking water quality. Nutrient runoff in particular, along with warmer temperatures, are likely to contribute to a larger occurrence of harmful algal blooms on waters, many valued for recreation. Changing climate conditions are likely to strain the viability of native species, including popular recreational fish, invite encroachment by invasive species, and increase the geographic range and types of ticks and mosquitoes.

Some of these trends are evident in the current climate projection data that are available. However, because these data are often averaged or summarized for large areas over large time periods, they can mask the local peaks in temperature and precipitation that can trigger disasters. Until more finely-scaled climate projection data become available to Minnesota planners and decision-makers, the current data still remain useful for exploring the future ahead and establishing a baseline understanding of what our weather challenges may be moving forward.

REGION 6 CLIMATE PROFILE

Use the following information on temperature, precipitation, and vulnerable populations to help plan for future weather-related incidents.

TEMPERATURE

There has been an increase in winter and summer temperatures. Our average winter lows are rising rapidly, and our coldest days of winter are now warmer than we have ever recorded. In fact, Minnesota winters are warming nearly 13 times faster than our summers. The continued rise in winter temperatures will result in less snow pack, which will increase chances for grassland/wildfires as well as drought. The warmer winter temperatures will also have major consequences for our ecosystems, including native and invasive species, whose growth, migration, and reproduction are tied to climate cues. The increase in Lyme disease across Minnesota is also likely influenced in part by the loss of our historical winters, due to a longer life-cycle period for ticks. Freeze-thaw cycles are likely to increase as well, damaging roads, power lines and infrastructure, and causing hazardous travel conditions. By mid-century our average summer highs will also see a substantial rise, coupled with an increase in more severe, prolonged heat waves that can contribute to drought and wildfires and pose a serious health threat, particularly to children and seniors. Here are temperature trends for HSEM Region 6:

Average Summer Maximum Temperature for HSEM Region 6		
1981-2010	2050-2075	Change
81.1 °F	88.7 °F	+7.7 °F

Average Winter Minimum Temperature for HSEM Region 6		
1981-2010	2050-2075	Change
7.6 °F	17.2 °F	+9.6 °F

PRECIPITATION

There has been an increase in total average as well as heavy precipitation events, with longer periods of intervening dry spells. Our historical rainfall patterns have changed substantially, giving rise to larger, more frequent heavy downpours. Minnesota's high-density rain gauge network has captured a nearly four-fold increase in "mega-rain" events just since the year 2000, compared to the previous three decades. Extreme rainfall events increase the probability of disaster-level flooding and new research suggests a recent increase in precipitation-triggered landslide activity in the metro region. However, there is also an increased probability that by mid-century heavy downpours will be separated in time by longer dry spells, particularly during the late growing season. Over the past century, the Midwest hasn't experienced a significant change in drought duration. However, the average number of days without precipitation is projected to increase in the future, leading Minnesota climate experts to state with moderate-to-high confidence that drought severity, coverage, and duration are likely to increase in the state. Modeling future precipitation amounts and patterns is less straight-forward compared to temperature. Some climate models do a better job than others representing rainfall for the Midwest, and available data sources only provide average estimates on a monthly scale, masking the spikes in extremes that trigger flood and drought disasters. Trend data provided here for HSEM Region 6 are summarized for early summer, when historically Minnesota receives most of its rainfall, and for early fall when rainfall scarcity may threaten crop harvests and local agricultural economies:

Average Early Summer Precipitation for HSEM Region 6		
1981-2010	2050-2075	Change
4.4"	5.0"	+0.6"

Average Early Fall Precipitation for HSEM Region 6		
1981-2010	2050-2075	Change
2.9"	2.9"	0.0"

VULNERABLE POPULATIONS

There has been an increase in the older adult population. Extreme weather events cause a range of health impacts and disruptions that vary across population groups. The vulnerability of a group is a function of its sensitivity to a hazard, exposure to risks, and capacity for responding or coping with the impacts. Children and older adults are often identified as groups vulnerable to climate change threats, including extreme weather and natural disasters. For example, physiologically these groups have a lower capacity to tolerate extreme heat and are often dependent on others for transportation to cooling centers. These groups are also often critically dependent on others during a disaster, such as needing help to evacuate during a flood or wildfire, or to find alternative housing if displaced. Planning for the specific needs of vulnerable populations strengthens local efforts to reduce the impact of extreme weather-related events. Population trend data provided here for HSEM Region 6 are intended to highlight the changes in two key demographic groups for the region, but planners and managers should also consider future changes in other populations of concern, such as those with low incomes, immigrant groups, indigenous peoples, persons with disabilities, or vulnerable occupational groups (such as outdoor workers):

Childhood Population (0-14) Projection Estimates for HSEM Region 6		
2015	2050	Change
1,274,638	1,616,484	+27%

Elder Population (65+) Projection Estimates for HSEM Region 6		
2015	2050	Change
585,000	1,039,608	+78%

REGION 6 CASE STUDY

The following case study is intended to illustrate the links between climate and weather and natural disasters. Acting as a “focusing event,” the case study demonstrates how a previous weather-related event (i.e., drought and extreme heat) impacted important economic drivers, environmental resources, and population health. Then, the Climate Projection Data section compares weather data from the case study with baseline and projected weather data to show the possibilities of future disaster events. This case study highlights the relevancy of climate projection data for understanding future climate and weather risks in Minnesota.

EVENT: EXTREME HEAT **DATE: JULY 2011**

The Extreme Heat Wave of 2011 impacted all Region 6 counties in addition to the rest of Minnesota and much of the Midwest, putting nearly 141 million Americans under some level of heat advisory or warning. By far, the most intense heat and humidity records were recorded in Minnesota, where Minneapolis experienced its most humid day on record and tied the all-time record for a heat index (119 degrees). The magnitude and persistence of high dew point temperatures and heat index values led meteorologists to label the event a “humidity storm”. In the metro area, temperatures soared both day and night – two days hit a maximum 100 degrees and 12 more reached 90 degrees, while a record of 80 degrees was set for nighttime lows. Due to the urban heat island effect, temperatures in the metro region are often higher compared to less urban surrounding areas, usually an average of 2 degrees higher. However, during heat waves this temperature difference can spike to as much as 9 degrees. Ultraviolet (UV) monitoring showed dangerously elevated levels of radiation during the heat wave, which can lead to acute and chronic effects on the skin, eyes, and immune system, including skin cancer and cataracts. The average UV index for July 2011 (9.7) was the highest for any July since 1994. The UV index for days during peak heat intensity were above 10, a level associated with a very high risk of serious health effects.

REGION 6 CASE STUDY: KEY IMPACTS

It is nearly impossible to capture all the various impacts from a natural disaster. These impacts broadly include costly infrastructure damage, disrupted utility service, prolonged work and school absences, acute physical injury, and persistent strains on mental health, on scales ranging from the community to the household to the individual.

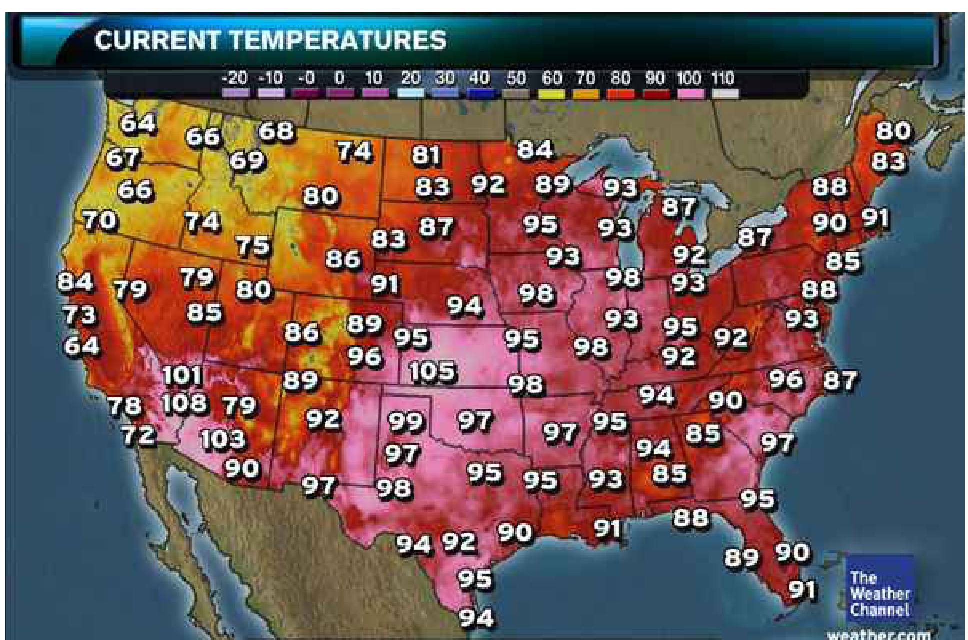
The extensive costs associated with the 2011 Extreme Heat Wave are difficult to capture in a single estimate, in part due to challenges with capturing representative data. For example, extreme heat exposure can aggravate many common medical conditions, like heart and lung disease, diabetes, or mental illness. When patients seek medical assistance, heat exposure is not often included in hospital records as a contributing cause. It is likely that there are many more heat-related illness cases, and thus medical expenditures, than are actually captured by current health monitoring efforts. In addition, when temperatures soar, the reliance on air-conditioning also escalates and can lead to substantial strains on the energy grid as well as high utility bills for customers. Some residents on restricted incomes may jeopardize their comfort, and well-being, by not utilizing their air-conditioning, even when a unit is present.

Following are a few examples of the adverse impacts on HSEM Region 6 communities from the 2011 Extreme Heat Wave:

PUBLIC SAFETY: Large numbers of residents sought medical attention for conditions brought on or aggravated by the heat. Nearly 800 people in the metro region were taken to the emergency department or hospitalized for specifically coded heat-related illness, and at least a few fatalities were recorded.

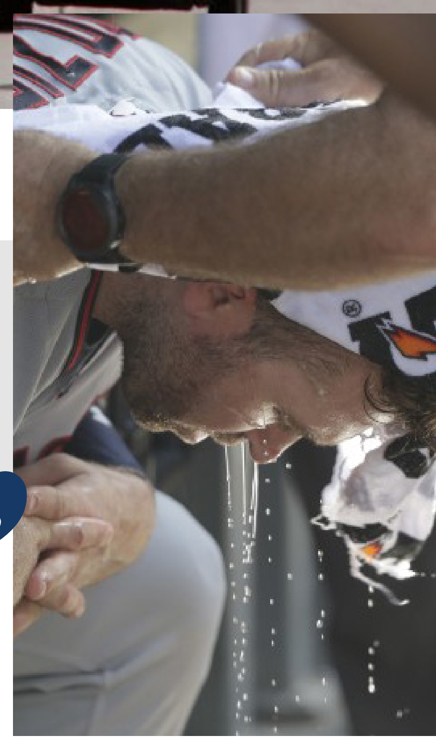
INFRASTRUCTURE DAMAGE: The Minnesota Department of Transportation (MnDOT) reported numerous points of road buckling, including areas of I-94, which can be extremely dangerous for motorists.

STRAIN ON ESSENTIAL SERVICES: Utilities were strained to meet cooling demands. Although not located in Region 6, one utility in northeastern Minnesota reported using more power during a single day of the heat wave than on any other day in the company's records. Besides the upsurge in activity for paramedics and emergency services personnel, police officers were asked to take on wellness checks for people in their patrol areas who might be susceptible to problems with the heat, like elderly and people experiencing homelessness.



Temperatures on July 20, 2011 (The Weather Channel, 2011)

“Minneapolis experienced its most humid day on record and tied the all-time record for a heat index (119 °F).”



Top: Pavement buckled on I-94 N creating a logjam heading out of Minneapolis (Brian Peterson, 2011)
Bottom left: Hazy sunrise (Pexels, 2018)
Bottom right: Brian Dozier from the Minnesota Twins cooling down during a hot game (Carles Rex Arbogast, 2018)

CLIMATE PROJECTION DATA

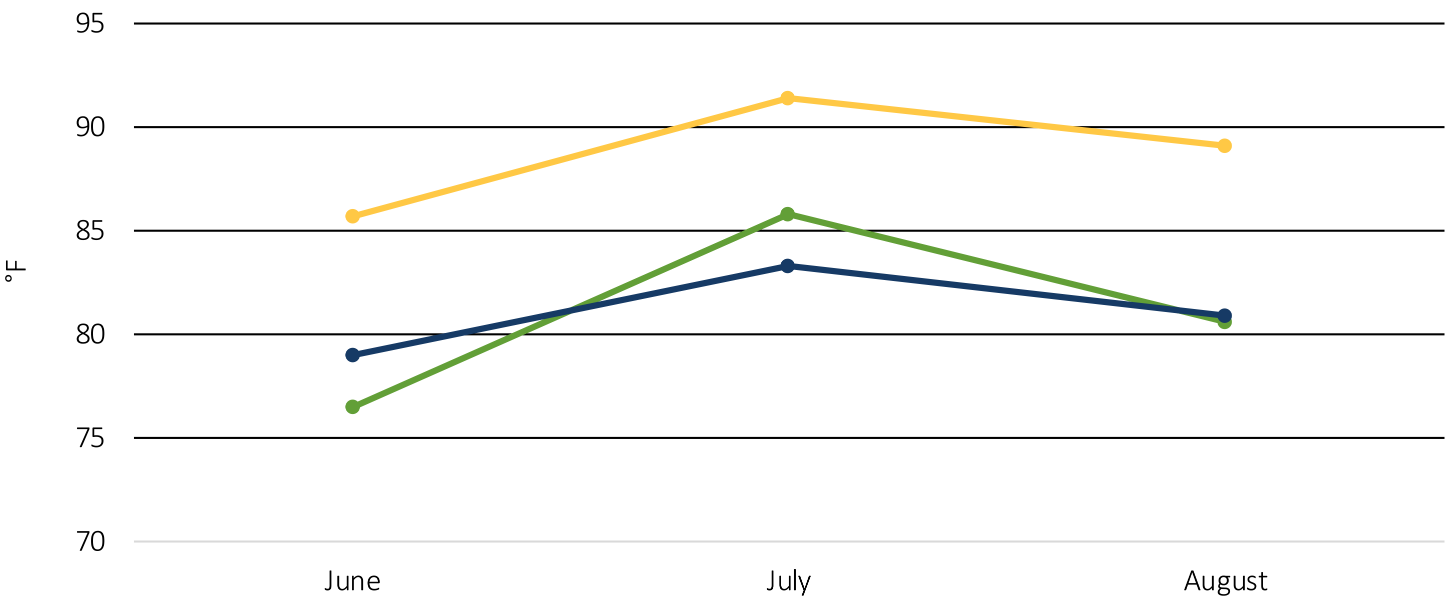
Following are visual representations of climate projection data for Region 6. Data for all counties included in Region 6 were averaged to derive regional estimates. (Data for individual counties are available in the long-form report.) The graphs below compare future temperature and precipitation projection data (in yellow) with a historical climate baseline (in blue) and climate measures from the regional case study event (in green). Although peak heat intensity occurred in July, measures for June and August are also included.

LEGEND

- **Historical:** 1981- 2010
- **Case Study:** 2011 extreme heat event
- **Projected:** 2050- 2074

Maximum Temperature

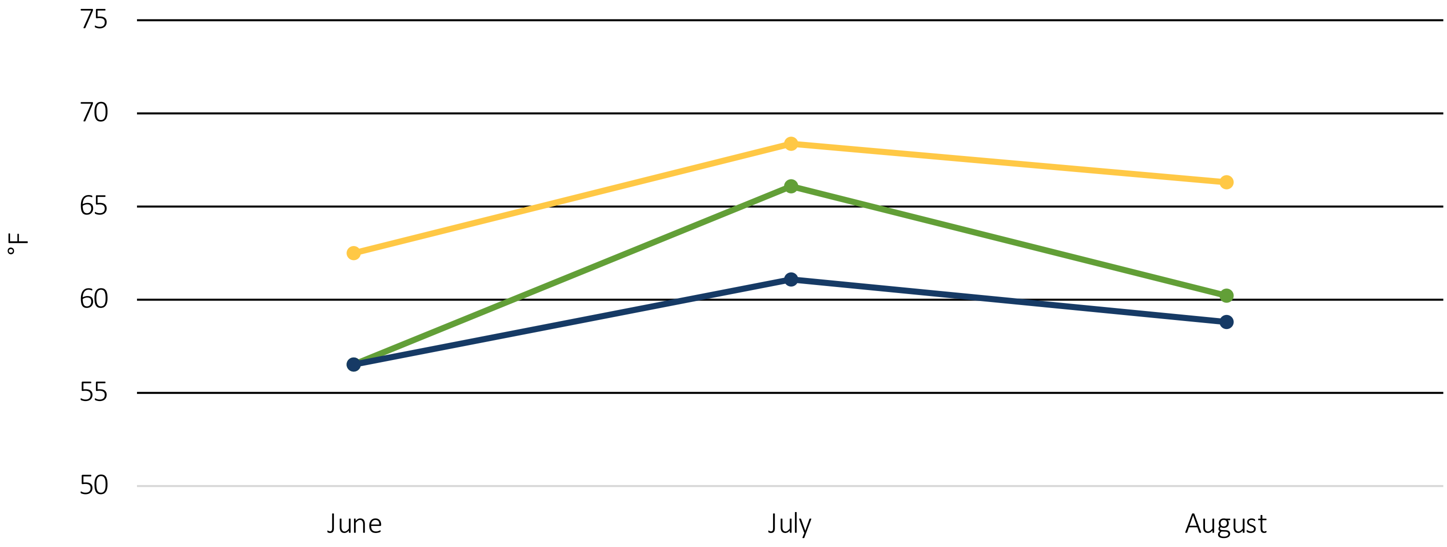
Trend comparison to 2011 extreme heat event data



	June	July	August
Historical	79.0	83.3	80.9
Case Study	76.5	85.8	80.6
Projected	85.7	91.4	89.1

Minimum Temperature

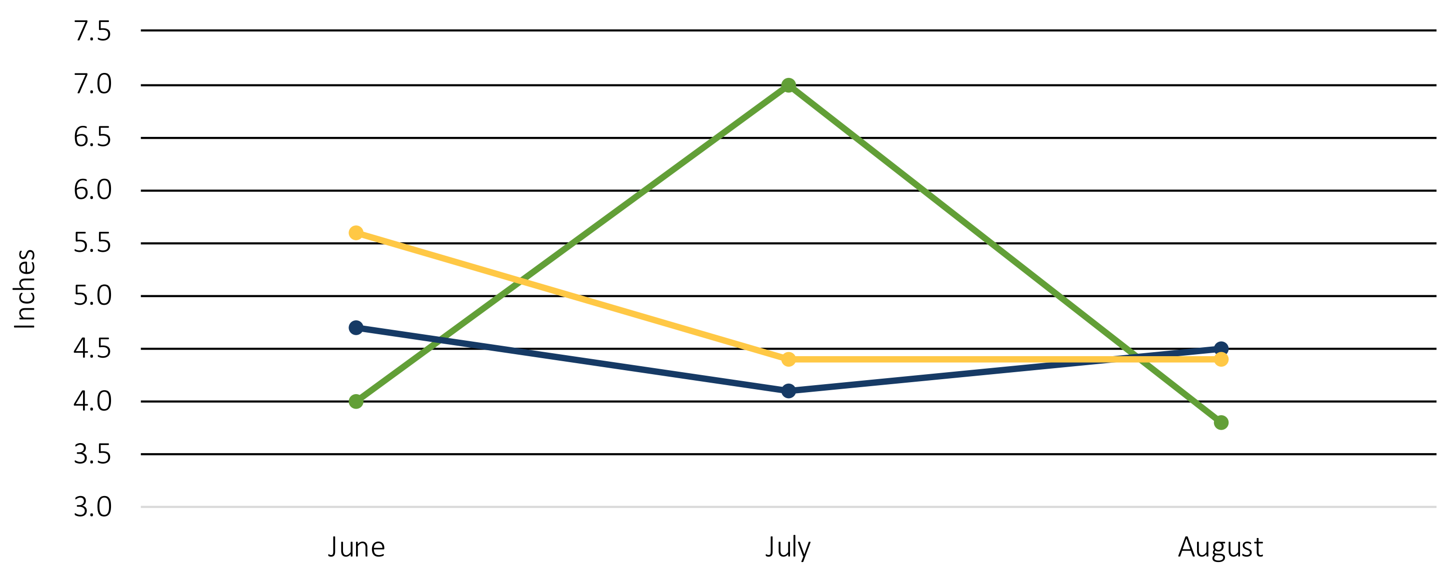
Trend comparison to 2011 extreme heat event data



	June	July	August
Historical	56.5	61.1	58.8
Case Study	56.5	66.0	60.2
Projected	62.5	68.3	66.3

Total Precipitation

Trend comparison to 2011 extreme heat event data



	June	July	August
Historical	4.7	4.1	4.5
Case Study	4.0	7.0	3.8
Projected	5.6	4.4	4.4

SUMMARY

CLIMATE DATA EXPERTS expect that future climate conditions across the Midwest will continue to change and affect our environment, economy, and public health. Such conditions are projected to lead to a higher frequency of late growing season drought conditions, elevated winter temperatures with reduced snowpack, prolonged high heat days, and extended periods of low rainfall. For the 2011 Extreme Heat Wave, maximum and minimum temperatures for July, when the heat wave peaked, were well above baseline values. Mid-century climate estimates indicate that average summer maximum and minimum temperatures for Region 6 counties will be approximately 6-9°F warmer than historical trends. As average temperatures increase, the likelihood of more frequent extremes also increases. Currently, the primary response to protecting ourselves from the stress of high outdoor heat is to remain in air-conditioned indoor spaces.

However, this reliance comes at a cost, particularly to Region 6 communities where much of the state's population is concentrated. Over 98% of housing units in the Twin Cities metro region have some form of air-conditioning. The addition of schools, businesses, entertainment venues, and other cooled buildings puts a hefty strain on the region's energy grid during prolonged periods of extreme heat, and this strain is projected to increase more in Region 6 counties than any other region of the state. The consequences go beyond rising utility costs to residents, which may lead some to risk getting a heat-illness to avoid unmanageable bills. Rising electricity usage may also lead to power disruption or even prolonged outages, which can have further negative health effects.

Another concern is when multiple disaster events happen together. In addition to the 2011 Extreme Heat Wave, a large cluster of July thunderstorms swept through the metro region bringing 1-2 inch diameter hail, wind gusts over 80 mph, and a number of tornado sightings. Damage was widespread, including electricity outages and downed power lines. The most intense rain was focused on the metro area and dropped 1 inch of rain in just over 20 minutes. Region 6 counties received an average July rainfall far above historical norms posing a potential flood risk. When extreme events co-occur the demands can overwhelm utilities, derail the power grid, and tax emergency management and response resources beyond capacity.

> *"Climate data is a critical tool in planning for resilient communities into the future."*

CLIMATE DATA IS A CRITICAL TOOL in planning for resilient communities into the future. Assessing threats from climate change and planning effective mitigation and response strategies is a key element for emergency managers and other planners to reduce future risk. It is crucial to understand the potential impacts of climate change and the associated priorities and vulnerabilities of communities, including population, the environment, critical infrastructure, and more. However, vulnerability is a nuanced concept and most effective as an indicator of risk when planners seek to understand and address vulnerability as close to the individual level as possible and in association with a specific hazard.

For example, in HSEM Region 6, population projections show a sizable increase in children alongside a substantial increase in seniors. Children and seniors have a reduced physical capacity to adjust to and cope with high heat, and are often partially dependent on others to ensure their personal safety and well-being, characteristics that contribute to increased vulnerability. In addition, children often spend more time engaged in physical activity outdoors, while seniors on limited incomes may struggle to pay for air-conditioning. Considering the impacts of climate change to vulnerable populations is just one example of how to prioritize mitigation and response planning.

CLIMATE PROJECTION DATA continues to improve and should be considered as a priority to advance. Minnesota would benefit from a statewide high-quality climate projection dataset that is derived using the climate and environment features unique to our state, similar to datasets developed for other states. Meanwhile, data from national resources, like the U.S. Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA), can still provide a powerful input to regional scenario-planning efforts by allowing planners, managers, and analysts a means of "unpacking" general climate change predictions for the Midwest by looking at potential monthly fluctuations in coarse precipitation and temperature measures for Minnesota and its counties.

NEXT STEPS: MINIMIZE RISK & BUILD RESILIENCE

Prepare today for tomorrow's climate hazards. Emergency managers, planners, elected officials, and the public play a critical role in creating safe and healthy communities, especially in the face of extreme weather events. There are steps you can take to minimize local risk and build more resilient communities:

BRING EVERYONE TO THE TABLE: Build an inclusive yet nimble team to collectively identify climate hazards and potential impacts. Be sure to include members of the community; local department professionals responsible for built, natural, and health resources; planning commissioners; faith-based and cultural organizations; research centers; and commercial organizations. Including diverse perspectives throughout your process will help support more equitable planning efforts that best leverage cross-functional resources.

INCORPORATE CLIMATE INTO PLANNING: Incorporate climate projection data into planning efforts, such as exercise scenarios and long-range planning, to comprehensively identify future climate hazards and potential cascading effects. Explore how these interact with non-climate hazards in the community, such as aging infrastructure, to understand potential exposure to multiple threats and prioritize actions that build the community's capacity to respond.

CHAMPION CLIMATE & HEALTH: Be a champion for climate and health data. Seek opportunities to learn about these data and incorporate it in your work on an iterative basis. Support its application in professional networks and articulate the need to fund dynamically downscaled climate projection datasets for Minnesota. Climate data is a critical multi-discipline tool in proactively planning for resilient communities.

RESOURCES & REFERENCES

TOOLS & DATA

- Climate at a Glance: National Climatic Data Center, National Oceanic and Atmospheric Administration
  Source for all historical and much of the case study data presented in this profile.
  www.ncdc.noaa.gov/cag/
- Minnesota Climate and Health Profile Report (PDF), Minnesota Department of Health
  Profiles historic climate trends, future projections, and likely climate change impacts on the health of Minnesotans.
  http://www.health.state.mn.us/divs/climatechange/docs/mnprofile2015.pdf
- Minnesota Climate Change Vulnerability Assessment (PDF), Minnesota Department of Health
  Assesses five climate hazards and the populations that are most vulnerable to the hazards in Minnesota.
  http://www.health.state.mn.us/divs/climatechange/docs/mnclimvulnreport.pdf
- Minnesota Population Projection Data, Minnesota State Demographic Center
  Source for all population projection data presented in this profile.
  https://mn.gov/admin/demography/data-by-topic/population-data/our-projections/
- National Climate Change Viewer, United States Geological Survey
  Source for all climate projection data presented in this profile.
  www2.usgs.gov/climate_landuse/clu_rd/nccv/viewer.asp

RESOURCES & REFERENCES

KNOWLEDGE & CAPACITY

- Climate Change and Minnesota, Minnesota Department of Natural Resources
  Source of information on climate change trends and impacts for Minnesota, with an emphasis on natural resources.
  www.dnr.state.mn.us/climate/climate_change_info/index.html
- Extreme Heat, Center for Disease Control and Prevention
  General information on health protective actions for the general public and vulnerable populations.
  www.cdc.gov/disasters/extremeheat/index.html
- Extreme Heat Events, Minnesota Department of Health
  Information of health protective actions for Minnesotans, including an Extreme Heat Toolkit.
  www.health.state.mn.us/divs/climatechange/extremeheat.html
- Five Steps Toward Enhancing Climate Resilience, Emily Wasley, DomesticPreparedness.com
  Practical action steps to help emergency managers build a path to enhance their climate resilience.
  https://www.domesticpreparedness.com/resilience/five-steps-toward-enhancing-climate-resilience/
- U.S. Climate Resilience Toolkit, United States Global Change Research Program
  Information and tools to help communities adapt to climate change, featuring real-world case studies.
  https://toolkit.climate.gov/

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- Auffhammer et al., 2017. Climate Change is Projected to have Severe Impacts on the Frequency and Intensity of Peak Electricity Demand Across the United State (PDF).
  http://www.pnas.org/content/pnas/114/8/1886.full.pdf

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Front cover photo: Sunrise (Pexels, 2018)

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