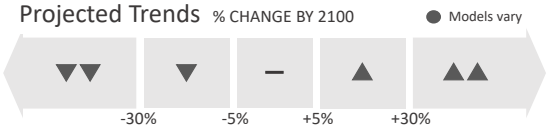
OBSERVED/PROJECTED CLIMATE CHANGES AND ASSOCIATED IMPACTS FOR KALAMAZOO, MICHIGAN



CLIMATE CHANGES	METRIC	TREND	OBSERVED/PROJECTED CHANGES
Air temperature	Minimum temperature AVG DAILY MIN TEMP (°F)	▲	43.9°F (+4.8°F) by 2050 and 50.2°F (+11.1°F) by 2100[1] COMPARED TO HISTORICAL AVERAGE OF 39.1°F FROM 1961–1990
	Maximum temperature AVG DAILY MAX TEMP (°F)	▲	64.4°F (+5.2°F) by 2050 and 70.8°F (+11.6°F) by 2100[1] COMPARED TO HISTORICAL AVERAGE OF 59.2°F FROM 1961–1990
Extreme heat	Days over 90°F # OF DAYS WITH MAX TEMPS >90°F	▲▲	44.9 days (+340%) by 2050 and 90.9 days (+791%) by 2100[1] COMPARED TO HISTORICAL AVERAGE OF 10.2 DAYS PER YEAR FROM 1961–1990
Precipitation	Annual precipitation AVG INCHES PER YEAR	–	38.2 in (+3.5%) by 2050 and 40.8 in (+10.6%) by 2100[1] COMPARED TO HISTORICAL AVERAGE OF 36.9 INCHES PER YEAR FROM 1961–1990
	Seasonality	▲▼	Significant increase in winter and spring precipitation (up to 20–30%); very slight increases are possible in fall and slight decreases in summer[2]
Snow	Lake-effect snow	▲	Significant upward trend in lake-effect snow for the Lake Michigan snowbelt since ~1900, likely due to warmer surface waters and reduced lake ice cover[3] Increases in temperature past the freezing threshold would likely result in more precipitation falling as rain or freezing rain[4]
Extreme precipitation	Intensity 99th PERCENTILE DAILY PRECIP TOTAL	▲▲	+42% in extreme precipitation total from the heaviest rain events in the Midwest from 1958–2016[2] +40% or more additional increase by 2100 (compared to 1986–2015)[5]
	Frequency # OF 2-DAY EVENTS THAT EXCEED THE 5-YEAR RETURN INTERVAL	▲▲	+150% or more in the number of extreme precipitation events between 2006 and 2100[2]
Severe storms	Frequency	▲	Increased likelihood of severe thunderstorms, particularly in the spring (up to +2.4 days per season by 2100)[6] Possible increase in days with conditions supportive of tornadic storms[6]
Drought	Frequency & intensity	▲	Likely increase in prolonged dry periods, particularly by late century[7]

[1] U.S. Climate Resilience Toolkit Climate Explorer (https://crt-climate-explorer.nemac.org), generated using the high-emissions (RCP 8.5) scenario for the average of 2041–2049 and 2091–2099 time periods compared to historical conditions (average of 1961–1990).
[2] D. R. Easterling et al., in Climate Science Special Report: Fourth National Climate Assessment, Volume I, D. J. Wuebbles et al., Eds. (U.S. Global Change Research Program, Washington, DC, 2017), pp. 207–230.
[3] K. E. Kunkel *et al.*, *Journal of Great Lakes Research*. **35**, 23–29 (2009).
[4] GLISA, Snow in the Great Lakes: Past, Present, and Future (https://glisa.umich.edu/resources-tools/climate-impacts/snow-in-the-great-lakes-past-present-and-the-future/).
[5] Z. Feng et al., Nature Communications. 7, 13429 (2016).
[6] N. S. Diffenbaugh, M. Scherer, R. J. Trapp, *PNAS*. **110**, 16361–16366 (2013).
[7] GLISA, Extreme Precipitation (https://glisa.umich.edu/resources-tools/climate-impacts/extreme-precipitation/).

LIKELY IMPACTS ASSOCIATED WITH PROJECTED CLIMATE CHANGES*

 **Connected Communities**	• Increased risk of damage to housing, roads, and other critical infrastructure (e.g., utilities) following storms, floods, and extreme heat • Road blockages and loss of access following extreme events, impacting evacuation routes, emergency access, and other critical travel • Increased heat stress in developed areas, exacerbated by large areas of impervious surfaces and lack of vegetation • Slower travel or road closures due to melting asphalt, overheating engines, and other impacts associated with extreme heat • Increased energy demand during heat waves, straining electrical grids and potentially resulting in power outages • Extreme heat and flooding exacerbate existing patterns of inequity for low-income neighborhoods and other vulnerable communities more likely to experience heat island effect and poor drainage
 **Food Security & Agriculture**	• Increased length of the growing season and potential increases in heat stress, disease, and insect pests, impacting growth and productivity of agricultural crops • Increased presence of weeds and fungi that compete with crops for light, water, and nutrients • Current crops may not be suited for new conditions, requiring changes in crops and equipment needed for new crop cultivation and processing • Economic impacts of crop failures and damage to agricultural operations following extreme events (e.g., floods), which may increase the cost of food • Increased health risks for agricultural workers exposed to extreme temperatures, vector-borne diseases, and other outdoor hazards exacerbated by climate change
 **Habitat Conservation & Biodiversity**	• Reduced growth and productivity of native vegetation due to heat stress and increases in evapotranspiration • Expansion of non-native invasive plants and insect pests as temperatures increase (particularly winter temperatures) • Increased flooding and erosion, impacting native plant communities as well as access to greenspace • Increased soil erosion and nutrient runoff into rivers and streams during heavy rainfall, reducing water quality • Increased concentration of contaminants and increased risk of algal blooms in water sources during hot/dry periods, impacting aquatic organisms as well as recreational use • Potential increase in insect pests and diseases, with associated impacts to native plants and wildlife • Increased risk of wildfire during severe droughts, impacting native plants and animals

* All icons from the Noun Project: (1) Housing icon created by Carlos Dias; (2) Road icon created by Jorge Namos; (3) Agriculture icon created by Vectors Point; (4) Biodiversity icon created by Nithinan Tatah

Resources:

- U.S. Climate Resilience Toolkit Climate Explorer (https://crt-climate-explorer.nemac.org)
- Midwest Chapter of the Fourth National Climate Change Assessment (https://nca2018.globalchange.gov/chapter/21/)
- Great Lakes Integrated Sciences and Assessments (https://glisa.umich.edu/resources-tools/)
- Flood Factor – Flood risk overview for Kalamazoo (https://floodfactor.com/city/kalamazoo-michigan/2642160_fsid)

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