

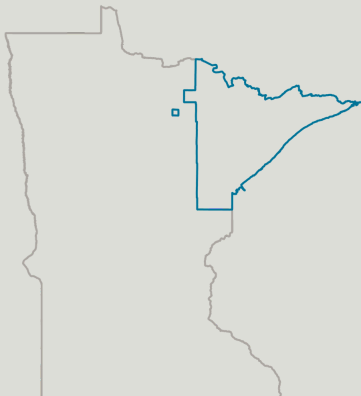
CLIMATE CHANGE IN MINNESOTA'S LAKE SUPERIOR COASTAL REGION

Carlton, Cook, Lake, and St. Louis Counties, the Bois Forte, Fond du Lac, and Grand Portage Tribal Nations, and the 1854 Ceded Territory



Climate Adaptation Partnership

UNIVERSITY OF MINNESOTA



Key Points

In the Lake Superior Coastal Region, **average annual temperature is projected to increase by 3.7-4.4 degrees Fahrenheit (°F) and average annual precipitation is projected to increase by up to 1.3 inches** by mid-century (2040-2059), depending on the emissions scenario.

The timing and intensity of precipitation is also expected to shift, with **wetter springs, drier summers, shorter snow seasons, heavier rain events, and longer dry spells** without measurable rainfall.

Changes We've Already Observed

Between 1895 and 2024, **the average annual temperature in the Lake Superior Coastal Region has increased by 3.5°F**. The statewide average increase over the same period was 3.3°F.

Most of this warming is concentrated during the coldest months of the year, with average winter temperatures increasing by 5.9°F and average winter low temperatures increasing by 7.1°F.

The region also experienced, on average, an increase of 2.9 inches of precipitation per year between 1895 and 2024. Meanwhile, the statewide increase was 3.5 inches of precipitation per year.

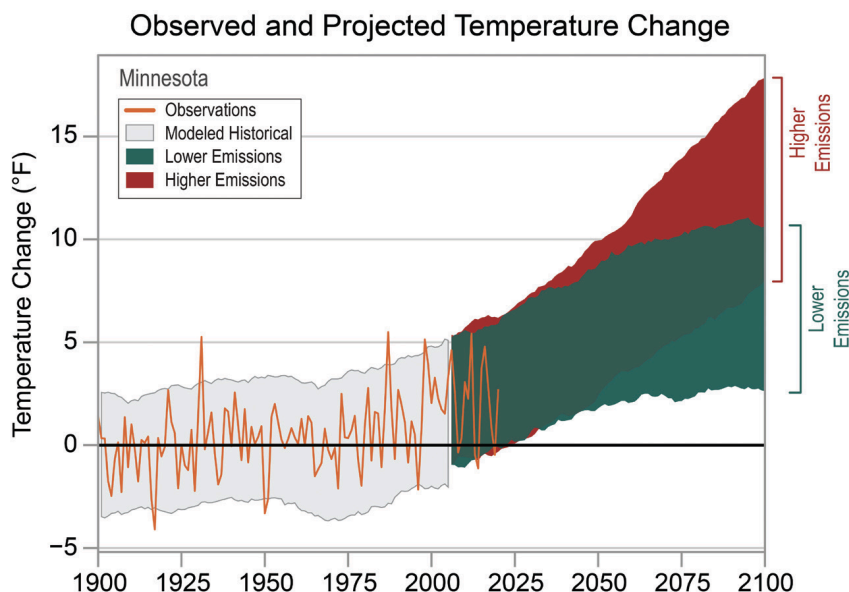


Figure 1: Observed and projected temperature changes in Minnesota under “lower” (teal) and “higher” (red) emissions scenarios out to 2100 compared to historical temperature observations (orange). Figure from: Runkle, J., K.E. Kunkel, R. Frankson, D.R. Easterling, S.M. Champion, 2022: Minnesota State Climate Summary 2022. NOAA Technical Report NESDIS 150-MN. NOAA/NESDIS, Silver Spring, MD, 4 pp.

Key Terms

Time Periods

- Historical Simulations: 1995-2014
- Mid-century: 2040-2059
- Late-century: 2060-2079
- End-of-century: 2080-2099

Emissions Scenarios*

- Intermediate emissions: “business as usual” economic, social and technology trends (SSP245)
- Very high emissions: driven by increased fossil fuel consumption (SSP585)

*More info on climate modeling and emissions scenarios: <https://z.umn.edu/climateprimer>

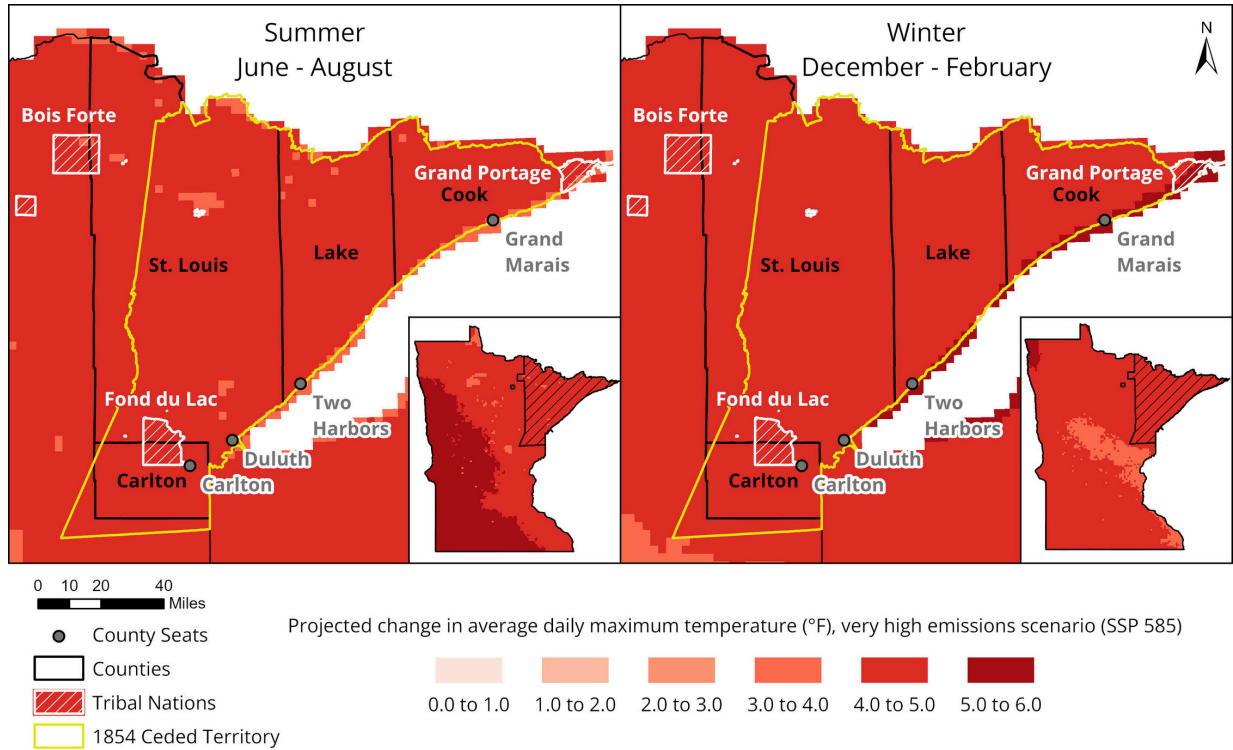


Figure 2. Projected change in average daily maximum temperature (°F) in summer and winter by mid-century (2040-2059) relative to historical simulations (1995-2014) under a very high emissions scenario (SSP 585) using an ensemble of six climate models. Data from: Liess, S. Roop, H.A., Twine, T.E., Noe, R., Meyer, N., Fernandez, A., Dolma, D., Gorman, J., Clark, S., Mosel, J., Farris, A., Hoppe, B., Neff, P. 2023. Fine-scale Climate Projections over Minnesota for the 21st Century. Prepared for the University of Minnesota Climate Adaptation Partnership. V1 released October 2023.

By mid-century, the **annually averaged daily maximum temperature in the Lake Superior Coastal Region is projected to increase between 3.5°F under an intermediate emissions scenario and 4.2°F under a very high emissions scenario.** This is similar to the statewide average, which is projected to increase between 3.6°F under an intermediate emissions scenario and 4.2°F under a very high emissions scenario.

Similar to observed trends, projected increases in wintertime lows are greater than projected increases in summertime highs. **On average, daily minimum temperatures in the winter are projected to increase by 5.9°F, and daily maximum temperatures in the summer are projected to increase by 4.5°F** by mid-century under a very high emissions scenario.

By mid-century, warming temperatures could result in **20 - 24 fewer days with a low below freezing (32°F)** in the Lake Superior Coastal Region in a given year.

| Emissions Scenario | Intermediate | Very High |
|--|--------------|-----------|
| Change in number of days with a minimum temperature below 32°F | -20 | -24 |
| Change in number of days that exceed 90°F | +4 | +6 |

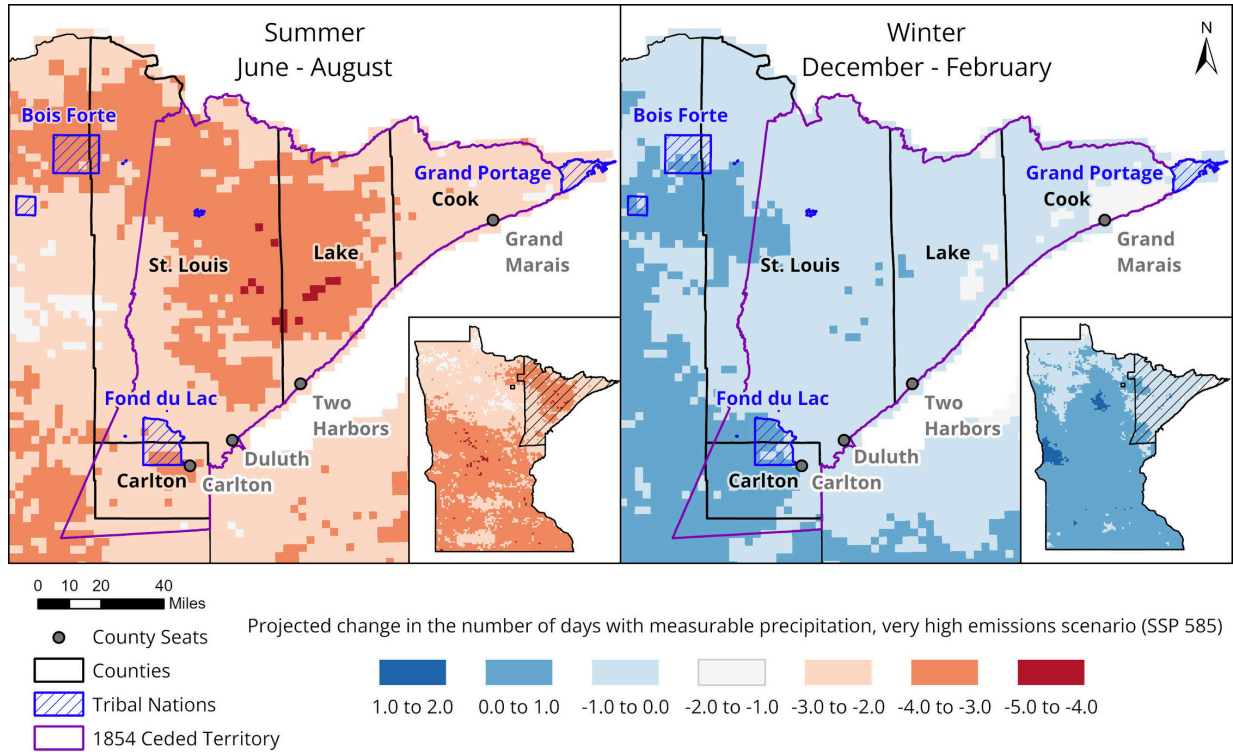


Figure 3. Projected change in the average number of days with measurable precipitation (over 0.01 inches) in summer and winter by mid-century (2040-2059) relative to historical simulations (1995-2014) under a very high emissions scenario (SSP 585) using an ensemble of six climate models. Data from: Liess, S. Roop, H.A., Twine, T.E., Noe, R., Meyer, N., Fernandez, A., Dolma, D., Gorman, J., Clark, S., Mosel, J., Farris, A., Hoppe, B., Neff, P. 2023. Fine-scale Climate Projections over Minnesota for the 21st Century. Prepared for the University of Minnesota Climate Adaptation Partnership. V1 released October 2023.

Average annual precipitation in the Lake Superior Coastal Region is projected to increase between 0 inches (0%) under a very high emissions scenario and 1.3 inches (4.5%) in an intermediate emissions scenario by mid-century. This is similar to the statewide average, which is projected to increase by 0.1 inches (0.3%) under a very high emissions scenario and by 1.2 inches (4.1%) under an intermediate emissions scenario.

Precipitation is not expected to change uniformly throughout the year, often with wintertime and springtime averages projected to *increase*, and summertime averages projected to *decrease*. In the higher emissions scenarios, summertime averages are expected to decrease so much that they can lower annual average values overall.

Average changes lead to big impacts

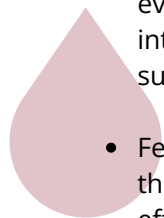
On average, rain events are projected to intensify, meaning more rain will likely fall in a single storm, with longer dry periods in between [1]. **By mid-century, the amount of rain that falls in a 2-day rain event in the Lake Superior Coastal Region is expected to increase by 0.2 inches on average for both intermediate and very high emissions scenarios.**

Additionally, due to warming temperatures, by mid-century, the **number of days per year with at least 1 inch of snow cover is expected to decline by 14 (intermediate emissions) to 17 (very high emissions) days.**

| Emissions scenario | Change in number of days with snow cover depth greater than 1 inch | Change in number of days with snow cover depth greater than 6 inches |
|--------------------|--|--|
| Intermediate | -14 | -14 |
| Very High | -17 | -18 |

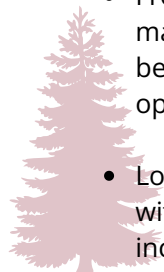
Water Resources

- More intense rainfall events can overwhelm existing stormwater infrastructure. Flooding events can also lead to injury and death, and introduce waterborne diseases to humans in surrounding areas [2].
- Fewer days below freezing will likely shorten the ice season for area lakes [3]. Cascading effects include an earlier warming of lake surface waters and earlier summertime plankton blooms, which can deplete oxygen and degrade fish habitat [4].



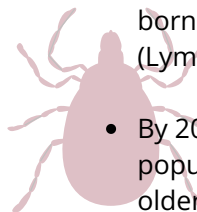
Forestry

- Frozen ground conditions are important for many winter timber harvests. Fewer days below freezing may reduce or shift forestry operations [5].
- Longer dry spells, especially in combination with heat, cause stress for local tree species including paper birch, balsam fir, and cedar [6].



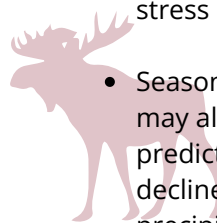
Human Health

- Warming temperatures will expand the habitat and lifecycle for carriers of vector-borne diseases, such as the black-legged tick (Lyme Disease) [7, 8].
- By 2040, nearly one-third of this region's population is projected to be 65 years old or older [9]. This population is especially sensitive to the impacts of heat, flooding, and poor air quality [10].



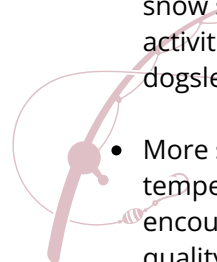
Tribal Lifeways

- Important relatives like moose face increased stress as temperatures warm [11].
- Seasonal harvesting activities like sugarbush may also shift as temperatures fluctuate less predictably [12]. Wild rice harvests may also decline because of increasing spring precipitation and little snowfall in the winter [13].



Tourism and Recreation

- More wintertime precipitation could fall as rain, leading to less snowpack and a shorter snow season [2]. Popular winter recreation activities like skiing, snowmobiling and dogsledding will likely be constrained.
- More sporadic precipitation, warmer average temperatures, and longer periods of drought encourage the likelihood of wildfires. Poor air quality due to wildfire smoke can exacerbate and lead to diseases such as asthma, bronchitis, heart attack, and cancer [14].



Citations

1. Akinsanola et al., 2020. Environ. Res. Lett.
2. Payton et al., 2023. USGCRP
3. Wilson et al., 2023. USGCRP
4. Sharma et al., 2001. JGR Biogeosci.
5. Stockstad, 2024. Frozen Forest. UMN Extension.
6. Reich et al., 2018. Nature.
7. Hayden et al., 2023. NCA5
8. Johnson et al., 2018. Am. J. Trop. Med. Hyg
9. Gorecki, 2023. MNDEED
10. Hosseini et al., 2024. Health Promot. Int.
11. Weiskopf et al., 2019. J. Wildlife Mgmt.
12. Houle et al., 2015. PLOS ONE.
13. GLIFWC Climate Change Team, 2023. Grt Lks Indian Fish and Wildlife Cmsn
14. Gao et al., 2023. Env. Pol.
15. Liess et. al., 2023 Fine-scale Climate Projections over MN

The historical data in this summary are from the National Oceanic and Atmospheric Administration (NOAA) and the Minnesota Department of Natural Resources (DNR). Climate projection data are provided by the University of Minnesota Climate Adaptation Partnerships MN-CLIMAT tool, which provides highly localized climate projections for Minnesota out to 2100 [15]. This is not a comprehensive summary; for other time horizons, variables, regions, and climate scenarios, please go to app.climate.umn.edu. Email mnclimate@umn.edu with any questions. © 2024 Regents of the University of Minnesota. University of Minnesota Extension is an equal opportunity educator and employer. In accordance with the Americans with Disabilities Act, this publication/material is available in alternative formats upon request. Direct requests to 612-624-9282.

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