

Preparing for NH’s New Climate Normal: *2022 NH State Climate Assessment*

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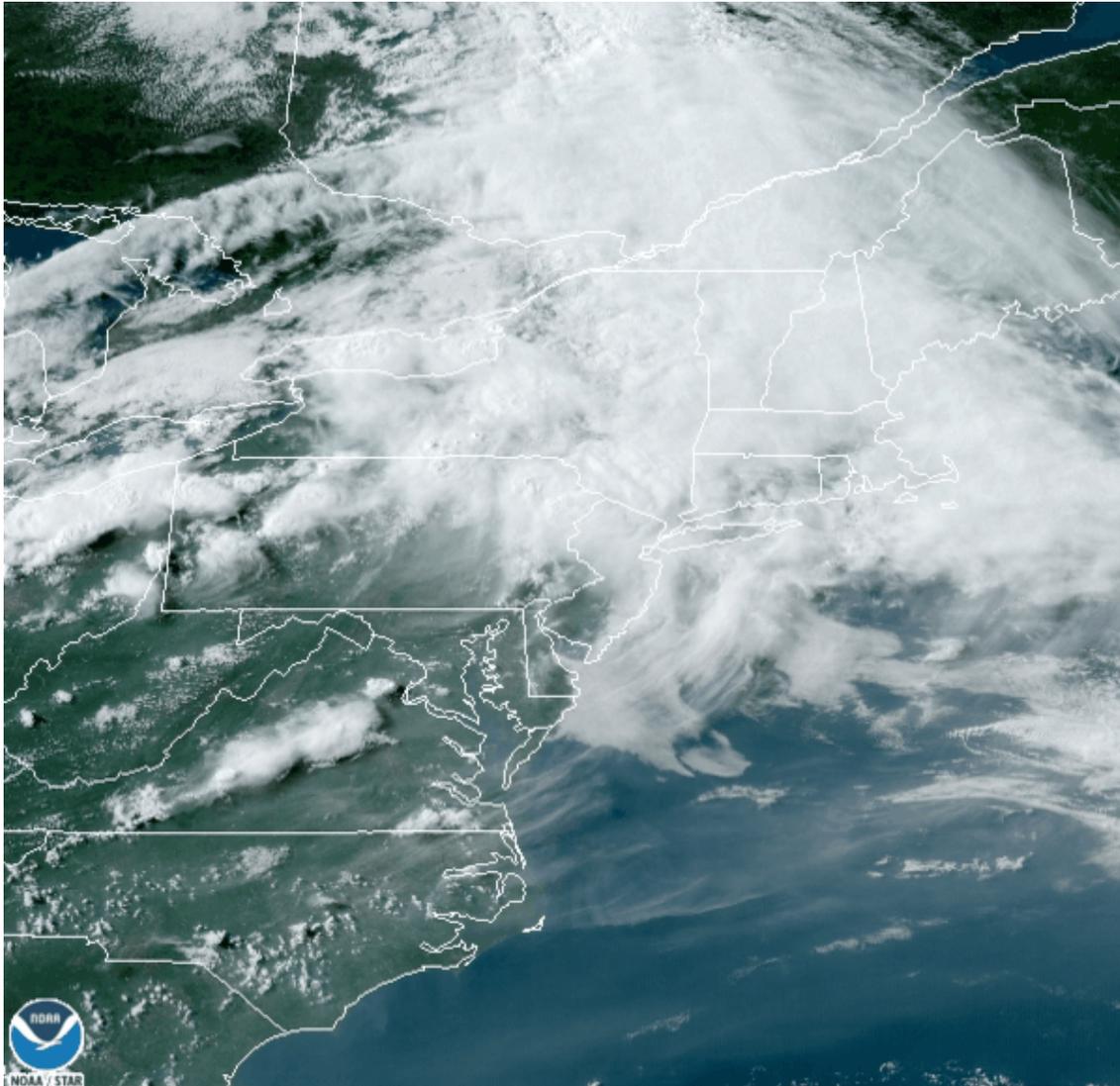
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Lemcke-Stampone, Mary D. Wake, Cameron P.; and Burakowski, Elizabeth, "New Hampshire Climate Assessment 2021" (2022). *The Sustainability Institute*. 71. <https://scholars.unh.edu/sustainability/71>

New Hampshire's Climate



New Hampshire's climate is characterized by distinct seasonality and variable weather.

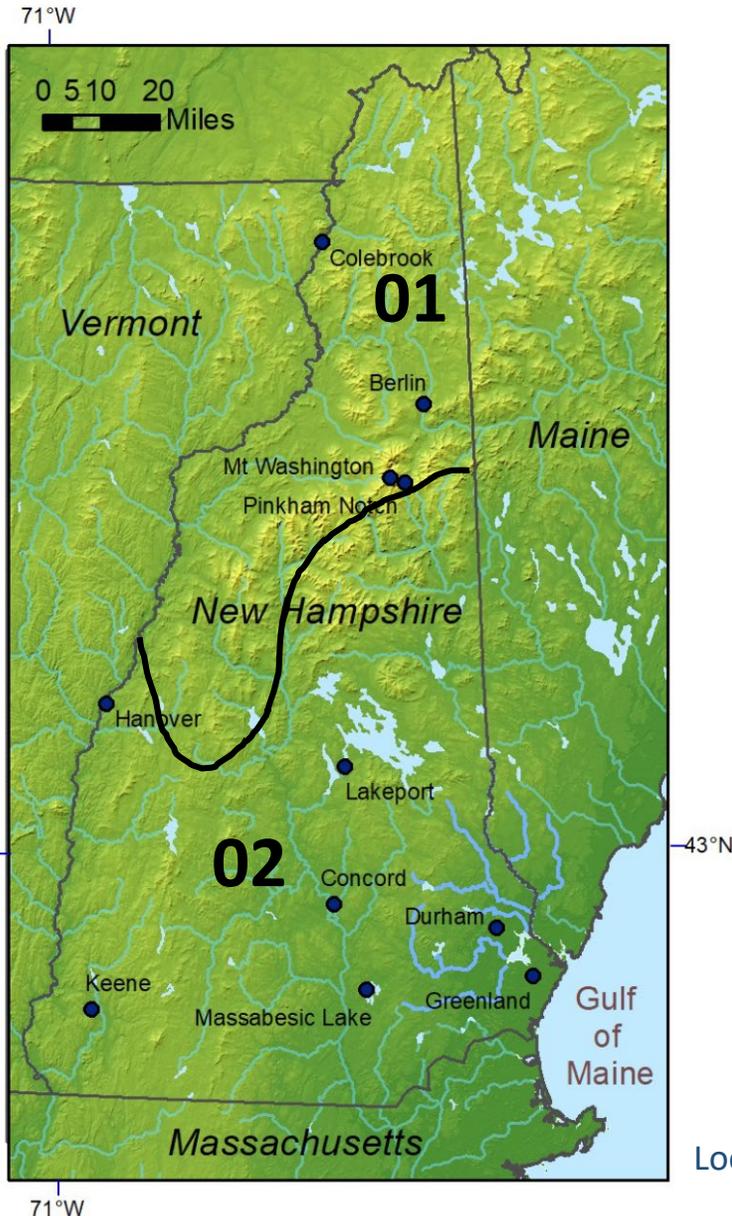
Located below the confluence of several major storm tracks, temperature and precipitation patterns are strongly influenced by passing midlatitude weather systems.

Historical Climate Change

Past climate change is evaluated statewide and at select locations across the New Hampshire

- State-averaged change in temperature and precipitation since 1901 are quantified using data from NOAA's U.S. Climate Divisional Dataset (nClimDiv).
- Daily weather data (GHCNd) was used to quantify local-scale variability and trends in 32 climate indicators since 1971 at 10 cities across NH.
- Long-term trends in daily data from 1901-2020 available at Durham, Hanover, and Keene, NH (Berlin, NH 1917-2020)

Locations of meteorological stations referred to in this report. (Figure source: Lemcke-Stampone et al., 2022).



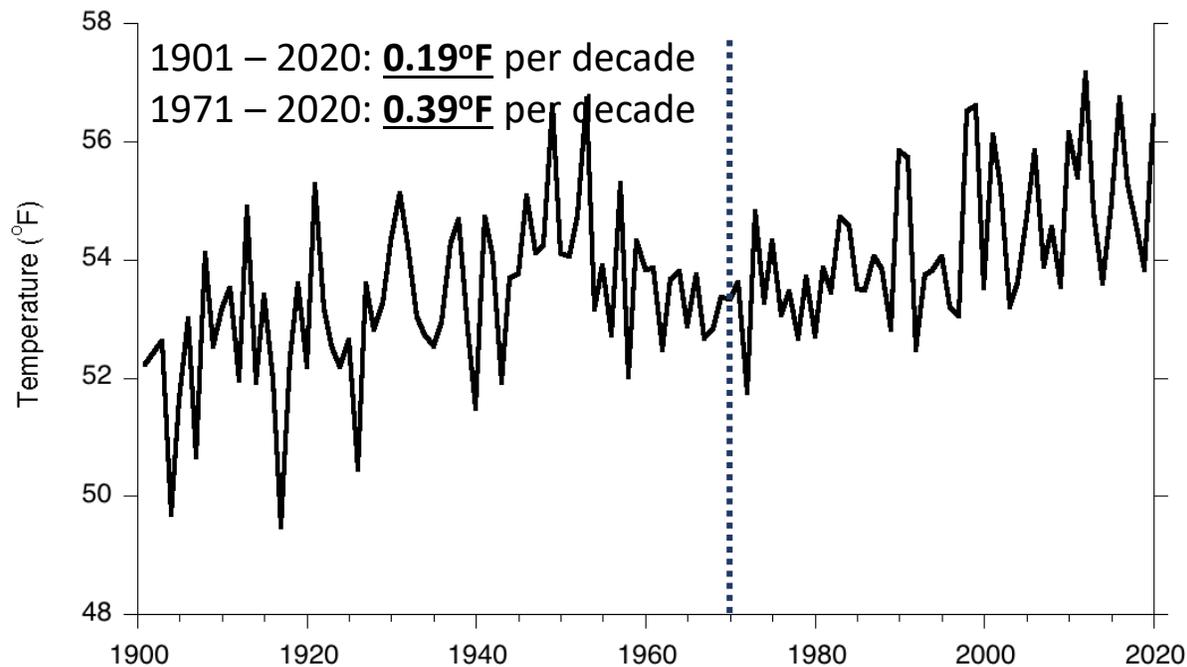
Key Findings:

- Temperatures across New Hampshire increased by an average of 3°F since 1901. Warming was highest during the fall and winter seasons and was associated with a decrease in frequency and severity of cold extremes.
- Since 1971, snowpack decreased from 59-91% across central New Hampshire while spring ice-out dates on Lake Winnepesaukee and Lake Sunapee shifted 8 and 11 days earlier, respectively.
- There was a 12% increase in annual precipitation over the past 120 years largely due to an increase in heavy precipitation since 1971. The Seacoast saw an increase in extreme precipitation events exceeding 4 inches while areas inland and north saw an increase in the number of daily 1-inch events.

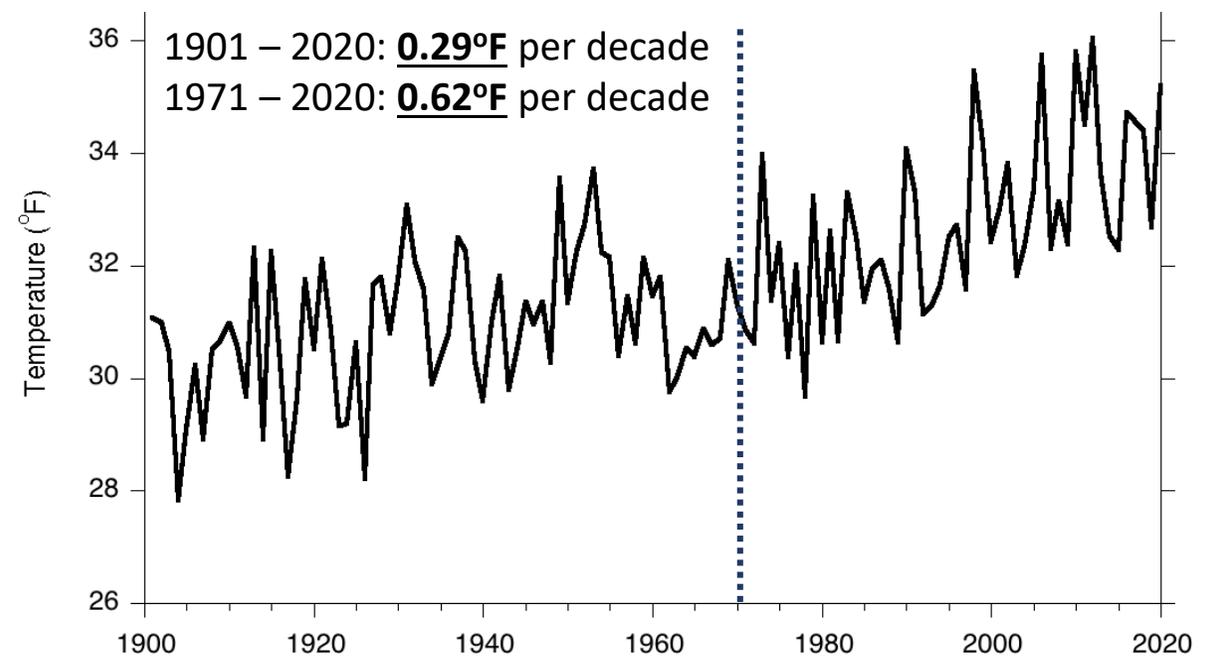
Historical Climate Change - *Temperature*

Average annual temperature for NH increased $\sim 3^{\circ}\text{F}$ since 1901.

(A) NH Average Annual Maximum Temperatures – 1901-2020



(B) NH Average Annual Minimum Temperatures – 1901-2020

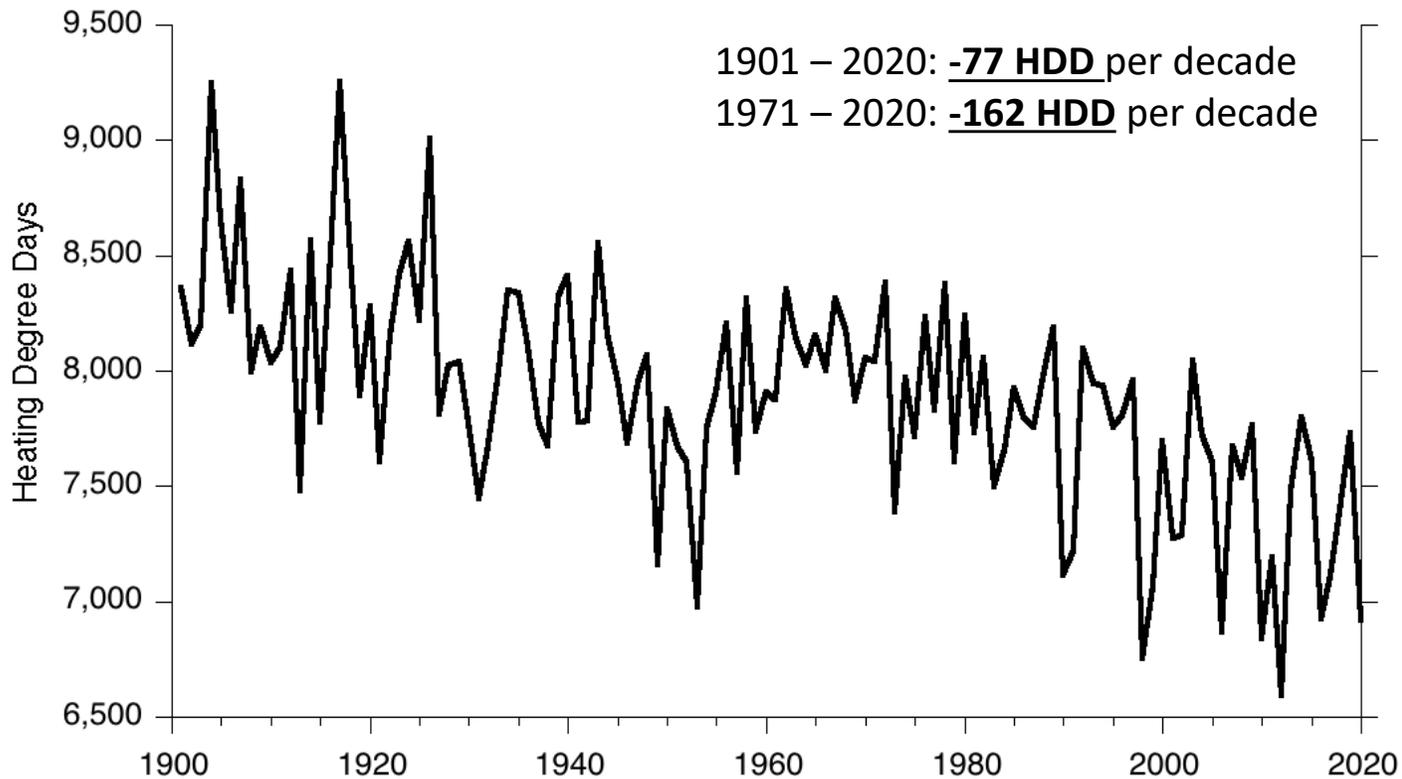


Observed (1901-2020) New Hampshire annual maximum and minimum temperature (Figure source: Lemcke-Stampone et al., 2022).

Historical Climate Change - *Temperature*

Historically, the winter season warmed three times faster than summer

Observed change in annual heating degree days – 1980 - 2099



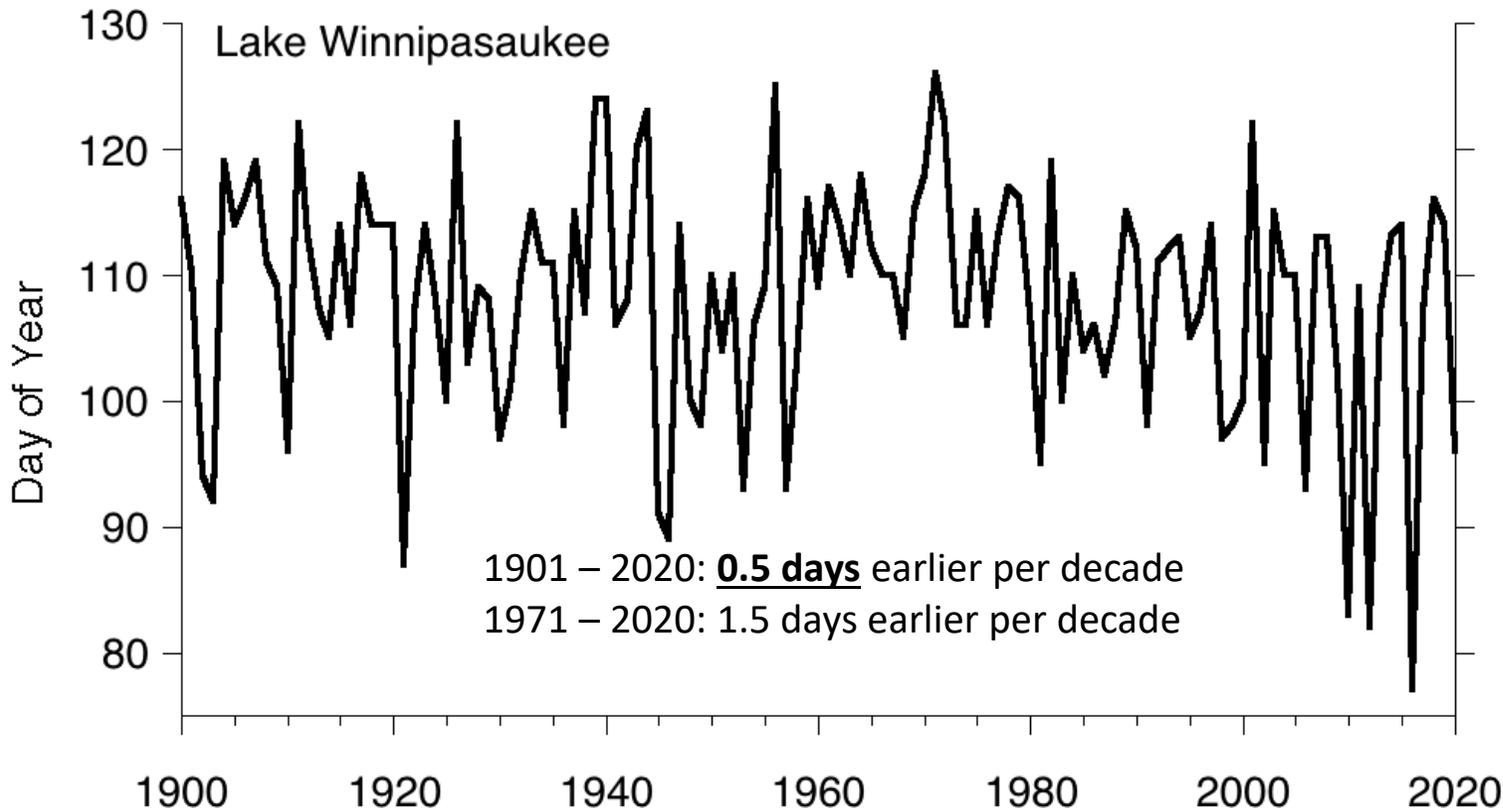
- Decrease in frequency and severity of cold extremes.
- Increase in the number of thaw events.
- Decreases in length and severity of the cold season.
- 10% decrease in heating degree days.

Observed change in annual heating degree days (1901-2020). (Figure source: Lemcke-Stampone et al., 2022).

Historical Climate Change - *Temperature*

NH winters have become warmer and shorter with fewer cold extremes

Ice-out date, Lake Winnepesaukee (1900-2020)

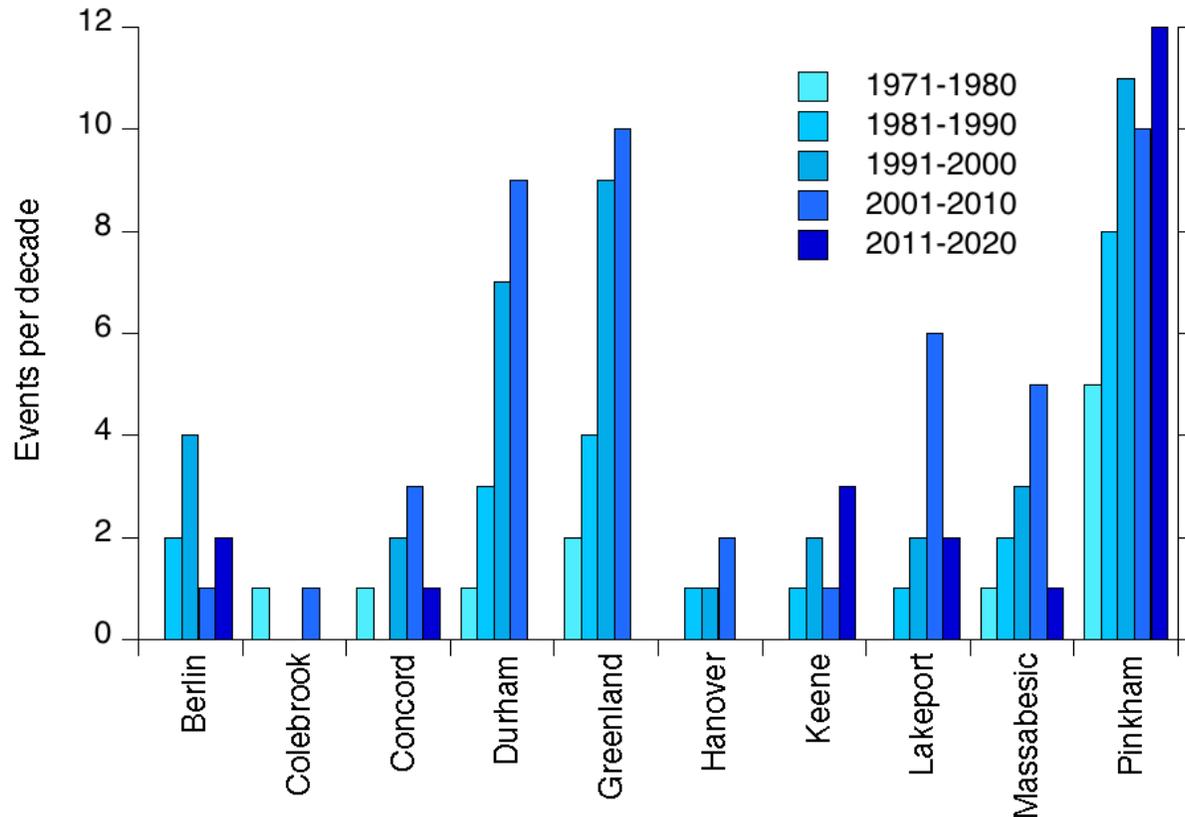


- 59-91% decrease in snow-water content across central NH.
- Spring ice-out dates 8 days earlier on Lake Winnepesaukee (11 days earlier on Lake Sunapee).

Historical Climate Change - *Precipitation*

Total annual precipitation for NH is projected to increase by **8.1 inches (19%) since 1901.**

Number of multi-day precipitation events >4 inches per decade – 1971-2020



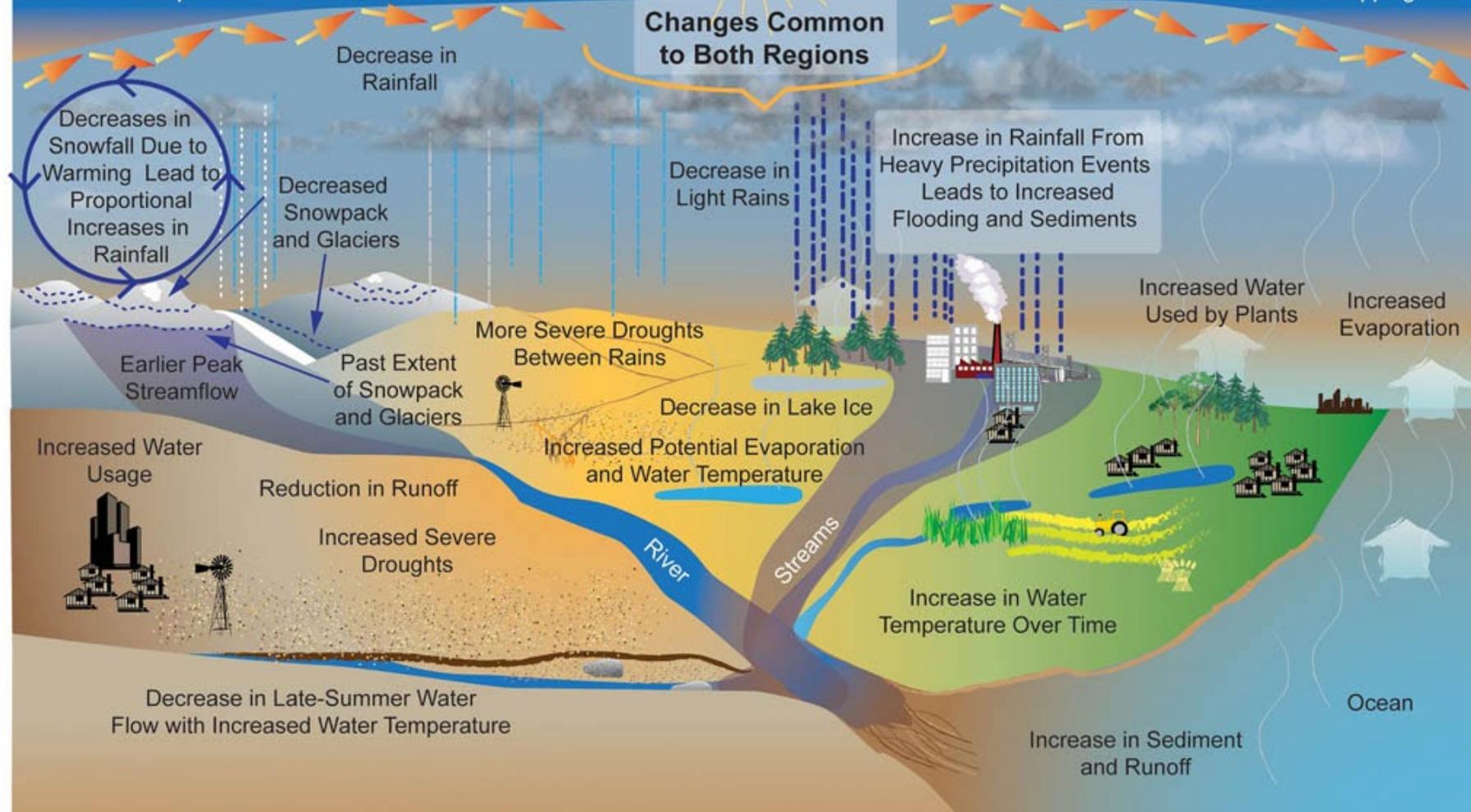
- Largely due to an increase in heavy precipitation since 1971.
- Inland and northern parts of the state saw an increase in the number of daily 1-inch events.
- The number of multi-day precipitation events exceeding 4 inches increased near the coast.

Hotter/Drier Conditions (Interior West)

Heat Trapped by the Atmosphere Causes more Evaporation and More Precipitation

Hotter/Wetter Conditions (NE and Coasts)

A Warmer Atmosphere Holds More Water Vapor, Which is Also a Heat Trapping Gas

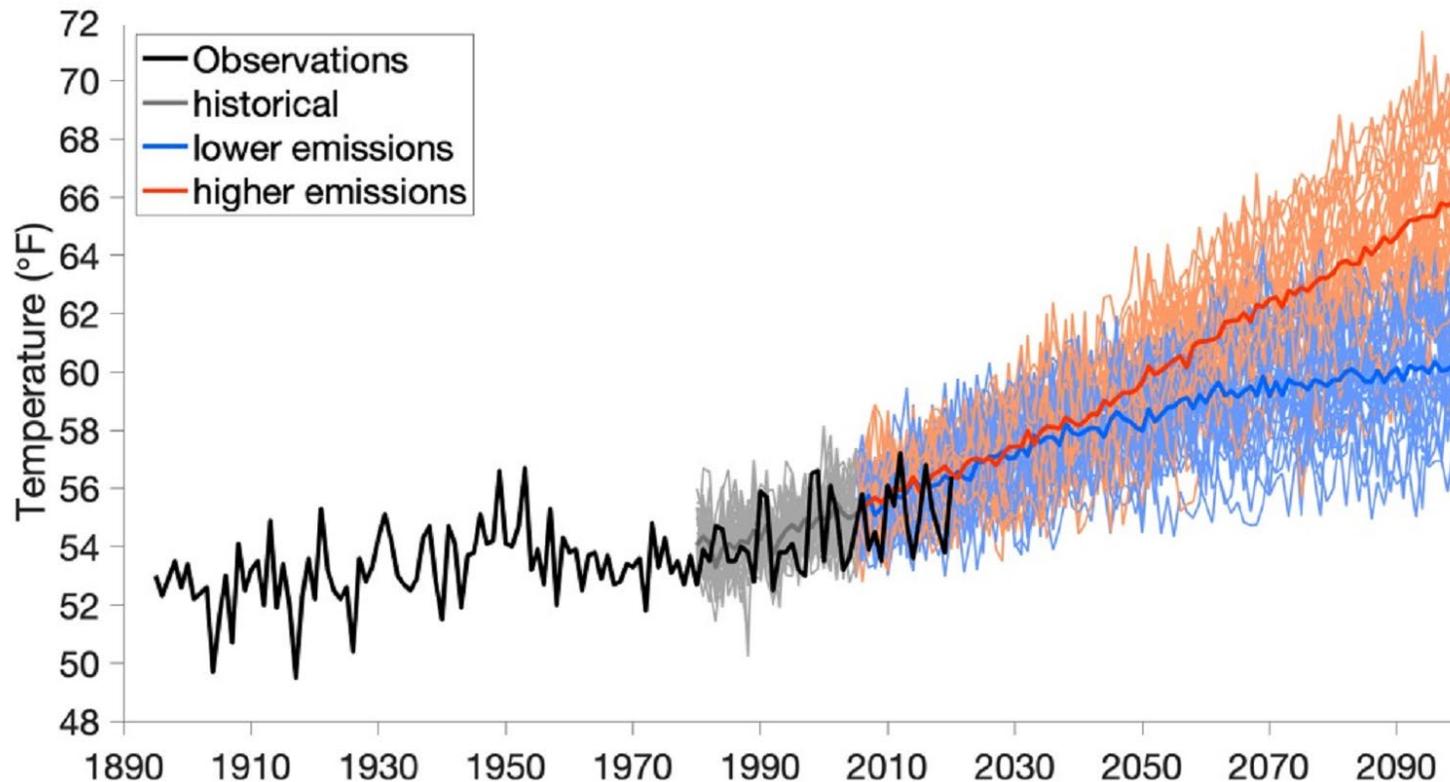


“The changing climate of the Northeast threatens the health and well-being of residents through environmental changes ...”

- 4th National Climate Assessment

Model Projections

Future climate change is evaluated using the ensemble mean of 29 different models



- **Observations** represent measured climate variables derived from NOAA's U.S. Climate Divisional Dataset (nClimDiv).
- Model output includes **historical** simulations (1980-2005) and future projections (2006-2099) for **lower** and **higher** atmospheric GHG concentrations.

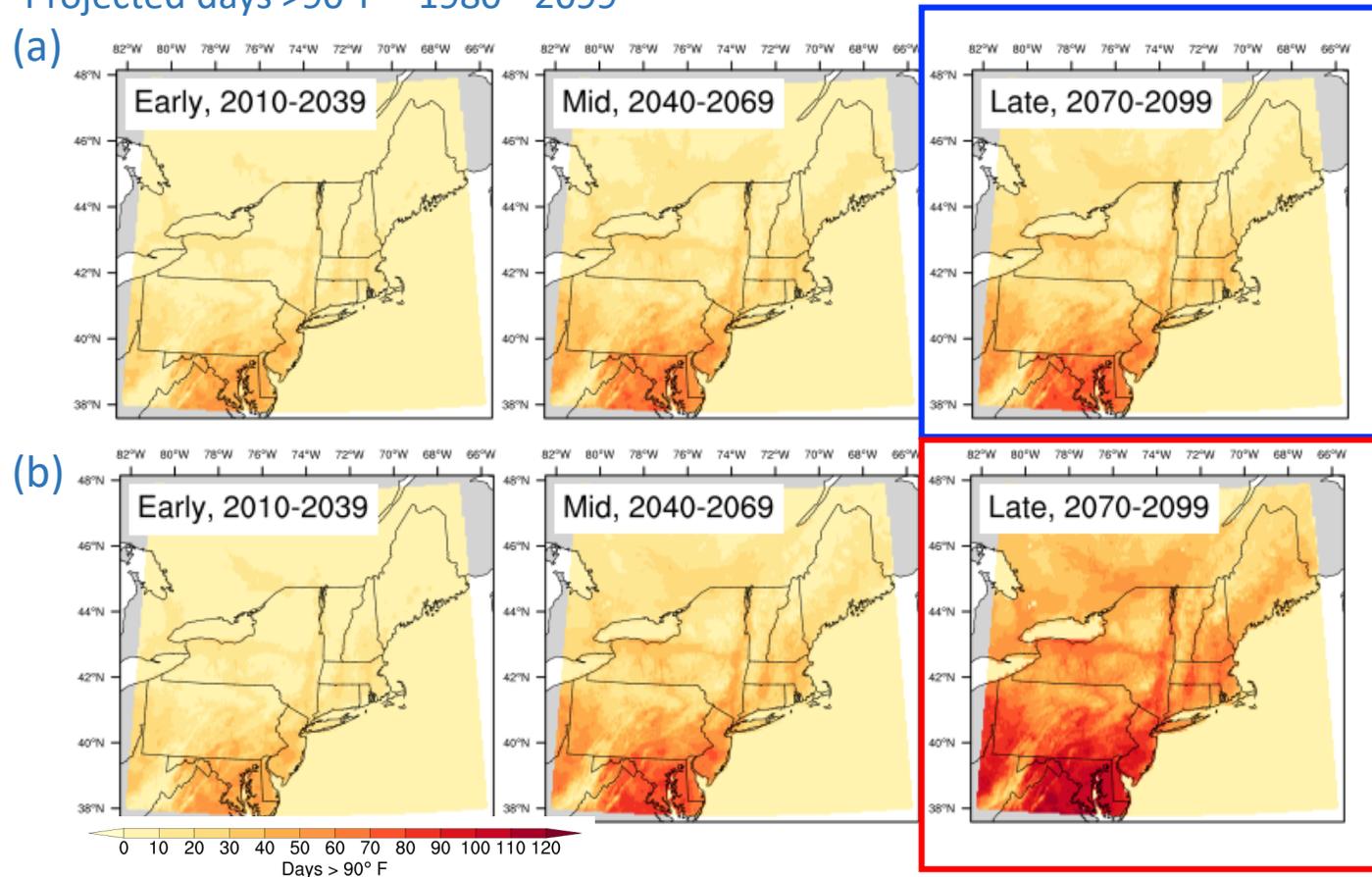
Key Findings:

- Temperatures across New Hampshire are likely to continue rising through the 21st Century with projected warming for higher atmospheric GHG concentrations nearly double that expected for reduced GHG emission by mid-century.
- The warmest daily temperatures and frequency of hot temperature extremes, like days above 90°F, are likely to increase throughout this century. Continued warming during winter will likely result in a decrease in the severity of cold extremes, snowfall and snow cover while the number of thaw events are expected to increase.
- Total annual precipitation is projected to continue increasing with the greatest season increases expected during the winter and spring seasons. The frequency of and intensity of extreme precipitation events will also continue to increase with significant increases in the most extreme precipitation events (i.e. 2 inches in 24 hours and 4 inches in 48 hours).

Model Projections - *Temperature*

Mean maximum and minimum temperature for NH are projected to increase **2.2-2.4°F by 2040**.

Projected days >90°F – 1980 - 2099

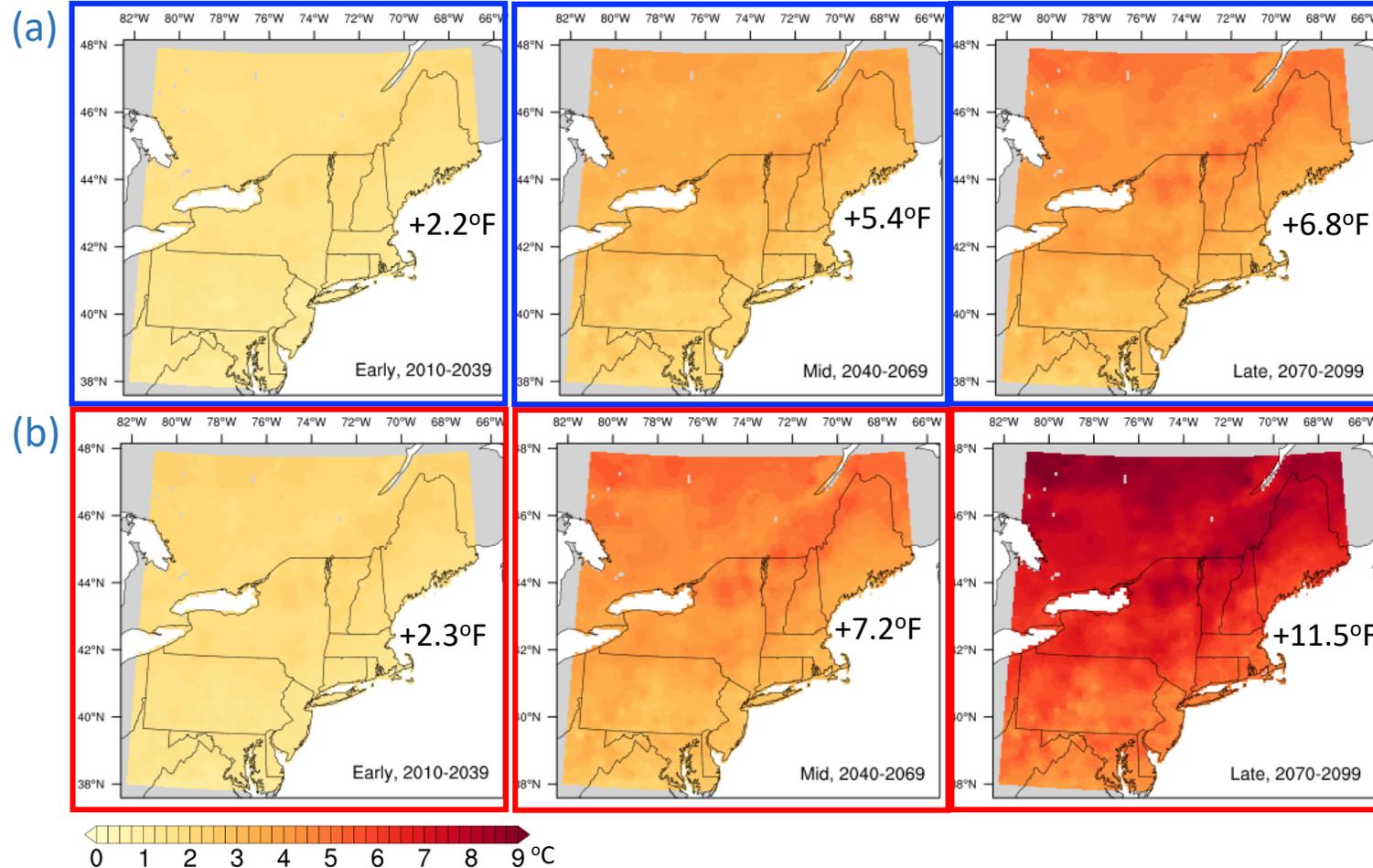


- Increases in the warmest daily temperatures and the frequency of hot extremes.
- The hottest day and night projected to increase 5 – 12°F.
- Twice as many days above 90°F are expected under the higher concentration pathway (50 – 60 days).

Projected number of days above 90°F (1980-2099) under (a) low and (b) high emissions. (Figure source: Lemcke-Stampone et al., 2022).

Model Projections - *Temperature*

Projected change in winter (DJF) minimum temperatures – 1980 - 2099



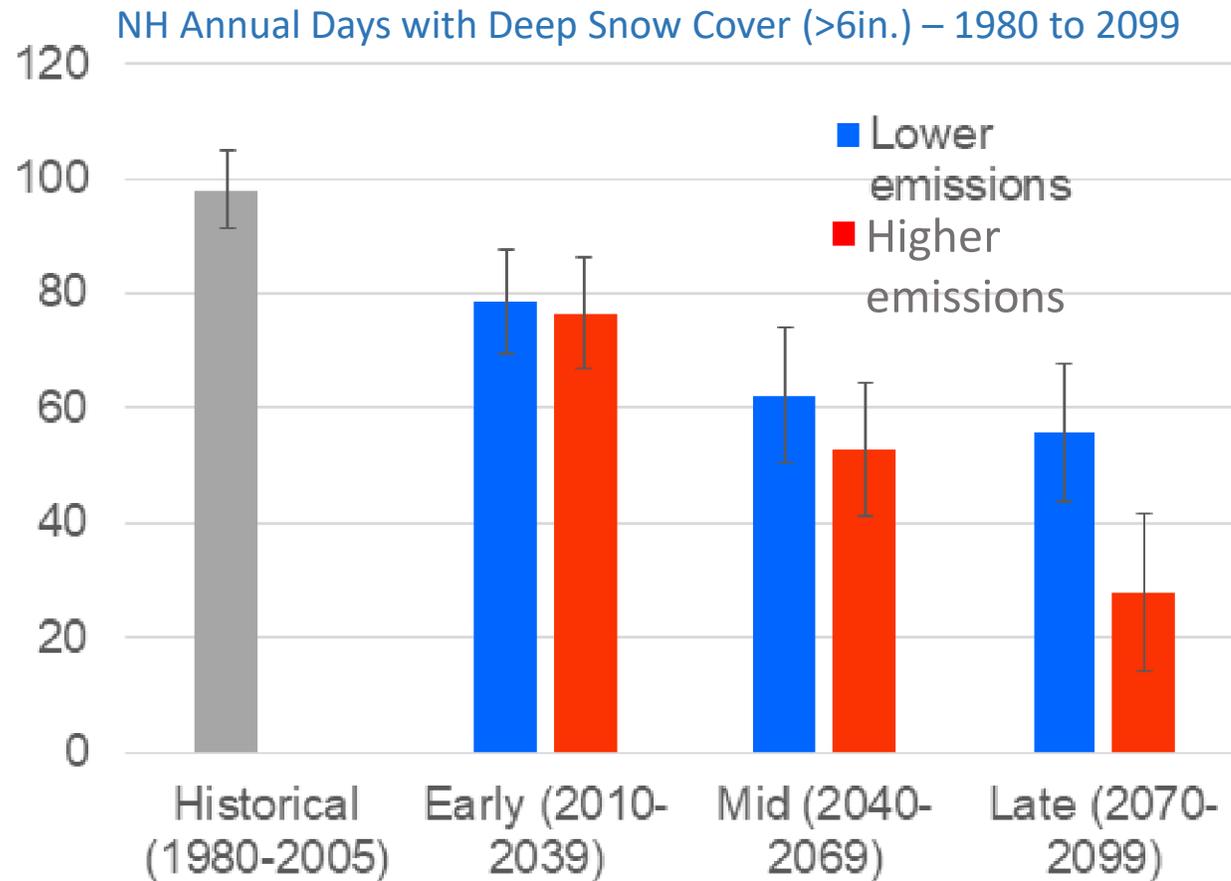
Historically, the winter season warmed three times faster than summer

- Coldest day and night are projected to warm as much as 12°F (lower) to 22°F (higher) across northern NH.
- 20 – 35 fewer nights below 28°F (i.e., hard freeze).
- 19 to 35% decrease in indoor heating needs.

Projected change in winter minimum temperature (1980-2099) under (a) low and (b) high emissions. (Figure source: Lemcke-Stampone et al., 2022).

Model Projections - *Precipitation*

Total annual precipitation for NH is projected to increase **by 7-9% by 2040.**



- Frequency and intensity of extreme precipitation will continue to increase for 2-inch and 4-inch events.
- Largely due to increases in the winter and spring seasons.
- Snowfall projected to decrease 20-50% by 2099.
- Decrease in snow cover season length by about one month.

1 under low and high emissions



Our New Normal

Climate change is already impacting New Hampshire and these changes are likely to continue through the end of century.

- Climate change **threatens the health and well-being** of New Hampshire residents through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise.
- **Rural industries and livelihoods are at risk** from changes to forests, wildlife, snowpack, and streamflow.
- **Infrastructure is not designed** for current & projected future climate conditions.
- **Services and resources at risk** for disruption during severe weather.

- Dupigny-Giroux, L.A., E.L. Mccray, M.D. Lemcke-Stampone, G.A. Hodgkins, E.E. Lentz, K.E. Mills, E.D. Lane, R. Miller, D.Y. Hollinger, W.D. Solecki, G.A. Wellenius, P.E. Sheffield, A.B. MacDonald, and C. Caldwell, 2018: Northeast. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 669–742. doi: 10.7930/NCA4.2018.CH18 [<https://nca2018.globalchange.gov/chapter/18/>]
- Easterling, D.R., Kunkel, K.E., Arnold, J.R., Knutson, T., LeGrande, A.N., Leung, L.R., Vose, R.S., Waliser, D.E. & Wehner, M.F. (2017). Precipitation Change in the United States. Climate Science Special Report: Fourth National Climate Assessment, Volume I. Wuebbles, D.J., Fahey, D.W., Hibbard, K.A., Dokken, D.J., Stewart, B.C. & Maycock, T.K. Eds. U.S. Global Change Research Program, Washington, DC, USA, 207-230. doi: <http://dx.doi.org/10.7930/J0H993CC>. [<https://science2017.globalchange.gov>]
- Eggleston, K.L., 2021: xmACIS Version 1.0.65. NOAA Northeast Regional Climate Center, accessed 11 January 2021, <https://xmacis.rcc-acis.org>.
- IPCC, 2021: AR6 Climate Change 2021: The Physical Science Basis [<https://www.ipcc.ch/report/ar6/wg1/#SPM>]
- NOAA-NCEI Climate at a Glance: Time Series - Statewide [<https://www.ncdc.noaa.gov/cag/statewide/time-series>]
- Runkle, J., K.E. Kunkle, 2017: New Hampshire. In *State Summaries*. NOAA National Centers for Environmental Information, 149-NH, [HTTPS://STATESUMMARIES.NCICS.ORG/NH](https://statesummaries.ncics.org/NH) [<https://statesummaries.ncics.org/downloads/NH-print-2016.pdf>]
- Wake, C., Knott, J., Lippmann, T., Stampone, M., Ballestero, T., Bjerklie, D., Burakowski, E., Glidden, S., Hosseini-Shakib, I., Jacobs, J. (2019). New Hampshire Coastal Flood Risk Summary – Part I: Science. Prepared for the New Hampshire Coastal Flood Risk Science and Technical Advisory Panel. Report published by the University of New Hampshire, Durham, NH. [<https://scholars.unh.edu/cgi/viewcontent.cgi?article=1209&context=ersc>]