

# 2021 NH State Climate Assessment\*: *Coastal Impacts*

DR. MARY STAMPONE

ASSOCIATE PROFESSOR

NH STATE CLIMATOLOGIST

DEPARTMENT OF GEOGRAPHY

COLLEGE OF LIBERAL ARTS

UNIVERSITY OF NEW HAMPSHIRE

DR. CAMERON WAKE

RESEARCH PROFESSOR

INSTITUTE FOR THE STUDY OF EARTH, OCEANS & SPACE

JOSEPHINE LAMPREY PROFESSOR OF CLIMATE

SUSTAINABILITY INSTITUTE

UNIVERSITY OF NEW HAMPSHIRE

\*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 Changing Climate

New Hampshire will very likely continue get warmer & wetter through the 21st Century.

Magnitude of change depends on global atmospheric greenhouse concentrations and efforts to reduce emissions.

## Global Warming by 2100

A Renewable Energy  
Efficient Future  
LOW EMISSIONS

A Business as Usual  
Future  
HIGH EMISSIONS

4°F ▲

8°F ▲

## New Hampshire Climate Assessment Executive Summary

M.D. Lemcke-Stampone, C.P. Wake, and E.A. Burakowski  
University of New Hampshire

June 2022

<https://scholars.unh.edu/sustainability/71/>

*Global average temperature increases by 2100, lower emissions compared to high emissions, from the Intergovernmental Panel for Climate Change (IPCC) Sixth Assessment Report (2021).*

# New Hampshire's Changing Climate

## New Hampshire Climate Assessment Executive Summary

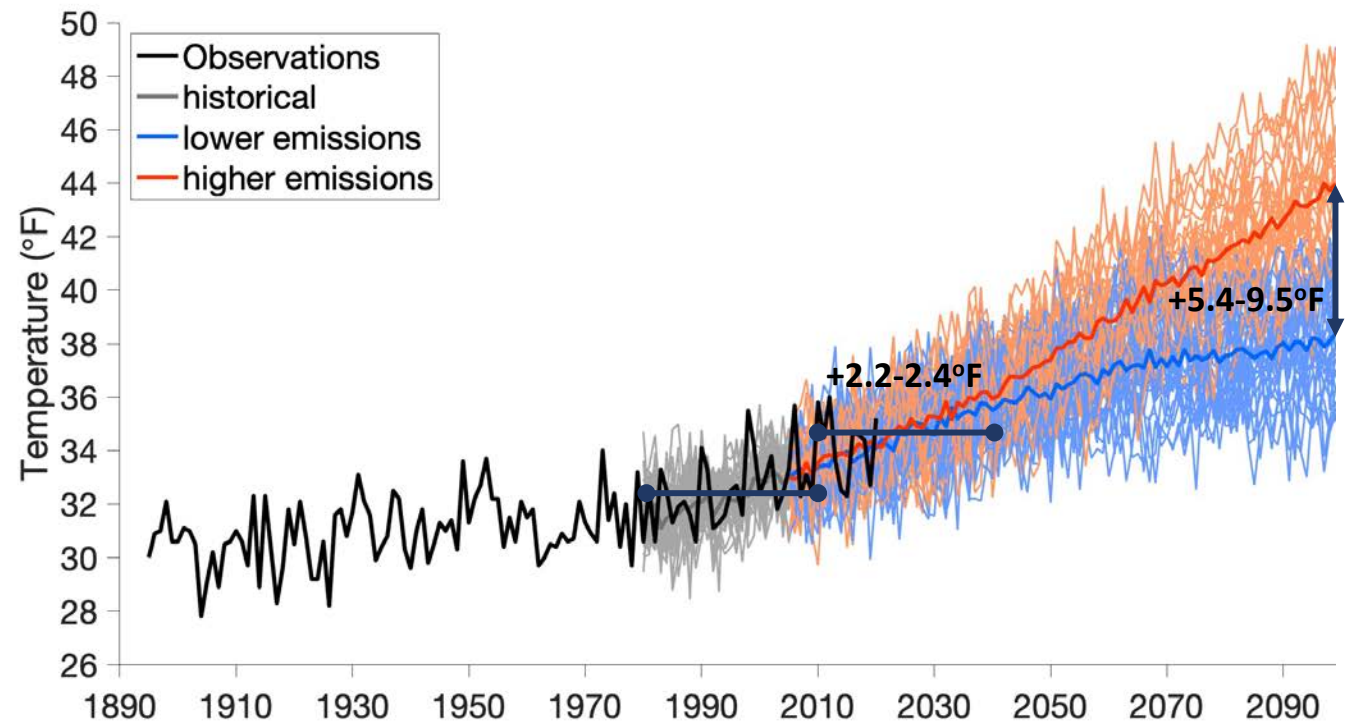
M.D. Lemcke-Stampone, C.P. Wake, and E.A. Burakowski  
University of New Hampshire

June 2022

<https://scholars.unh.edu/sustainability/71/>

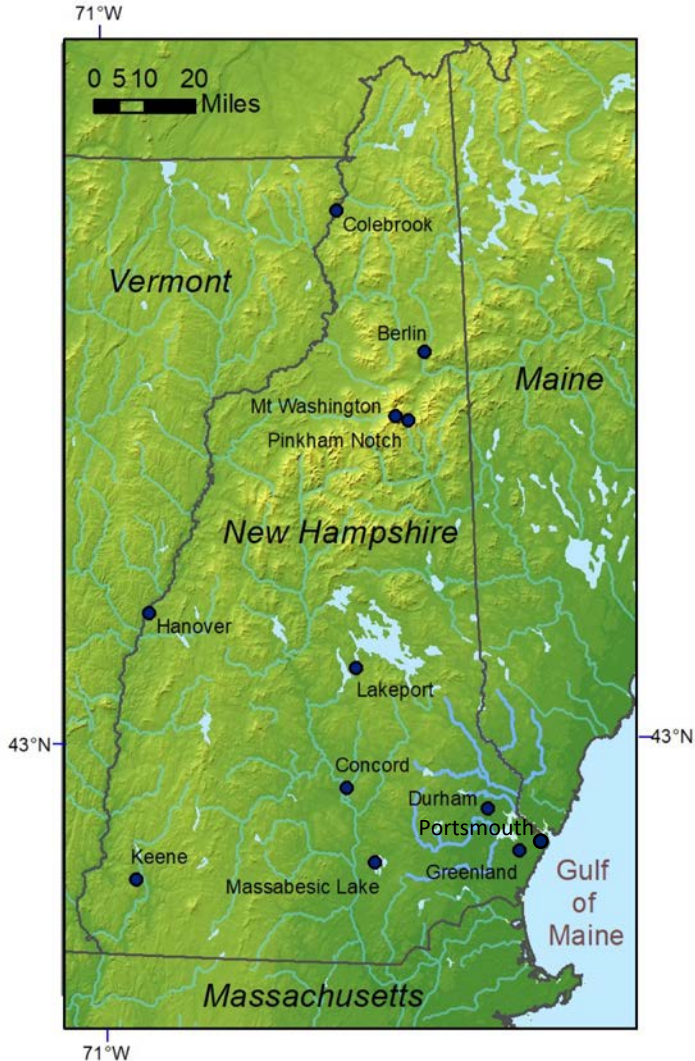
IMAGE CREDIT: JENNIFER DUBOIS

### NH Average Annual Maximum Temperatures – 1895 to 2099



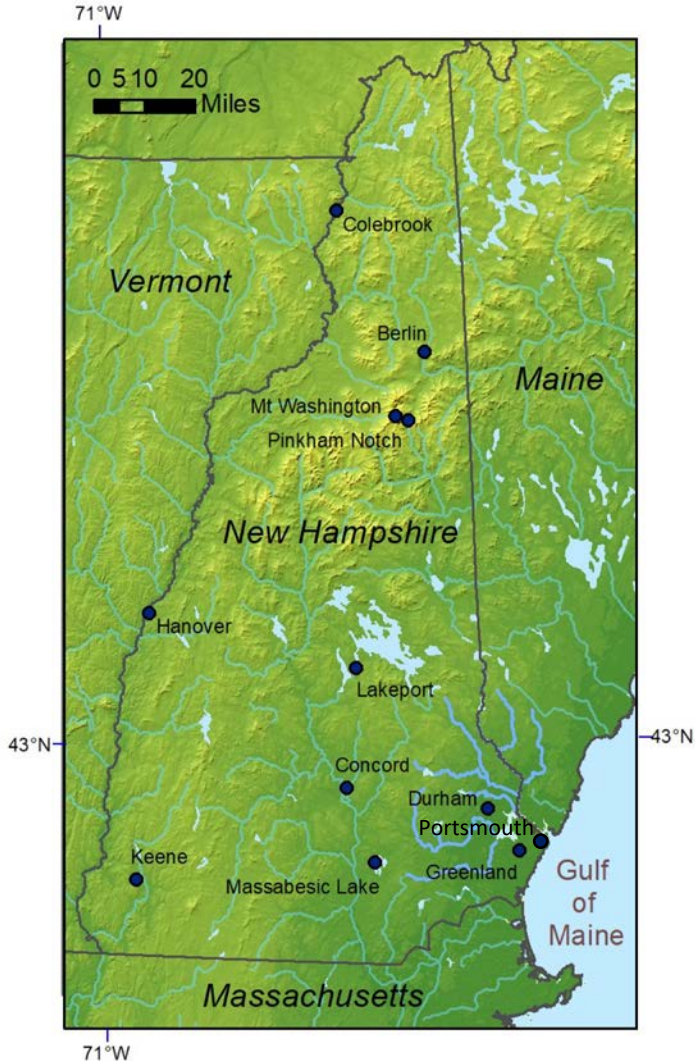
Observed (1895-2020) and projected (1980-2099) average annual maximum temperature for New Hampshire (Figure source: Lemcke-Stampone et al., 2022).

# Climate Projections (31 Indicators) – Portsmouth, NH



Climate Indicator	Historical 1980-2009	Change from historical (+ or -)					
		2010-2039		2040-2069		2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Maximum Temperature (deg F)</b>							
Annual TMAX	59.7	2.0	2.1	3.8	5.3	4.8	9.1
Winter TMAX	37.0	2.1	2.4	4.1	5.6	5.2	9.2
Spring TMAX	57.6	2.1	2.0	3.8	5.1	4.9	8.5
Summer TMAX	81.3	1.8	1.9	3.5	5.0	4.4	9.1
Fall TMAX	62.4	1.9	2.1	3.8	5.4	4.8	9.5
<b>Minimum Temperature (deg F)</b>							
Annual TMIN	59.7	2.0	2.1	3.8	5.3	4.8	9.1
Winter TMIN	17.2	2.5	2.9	4.9	6.6	6.2	10.8
Spring TMIN	34.4	2.0	2.0	3.7	5.0	4.8	8.5
Summer TMIN	56.3	1.7	1.8	3.4	4.8	4.2	8.7
Fall TMIN	39.7	1.8	2.0	3.7	5.3	4.8	9.4
<b>Precipitation (inches)</b>							
Annual PRECIP	45.3	1.5	1.6	2.3	3.0	3.0	4.5
Winter PRECIP	11.7	0.6	0.5	0.8	1.4	1.4	2.2
Spring PRECIP	11.4	0.4	0.7	0.6	0.9	0.8	1.6
Summer PRECIP	9.7	0.4	0.4	0.6	0.4	0.7	0.5
Fall PRECIP	12.5	0.2	0.1	0.4	0.4	0.2	0.4

# Climate Projections (31 Indicators) – Portsmouth, NH



Climate Indicator	Historical 1980-2009	Change from historical (+ or -)					
		2010-2039		2040-2069		2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Heating and Cooling Degree Days</b>							
Heating Degree Days	6631	-554	-1436	-1055	-1412	-1337	-2296
Cooling Degree Days	536	169	183	354	529	462	1066
<b>Extreme Temperature</b>							
TMAX on coldest day of year (F)	14.5	2.9	3.1	5.7	7.8	7.4	13.2
TMIN on coldest day of year (F)	-9.3	3.4	4.3	7.5	10.3	9.7	17.2
Days < 0F	6.2	-2.7	-3.2	-4.6	-5.3	-5.2	-6.1
Days < 32F	148.6	-13.0	-14.3	-25.2	-34.7	-32.8	-60.5
Days > 90F	10.9	7.0	7.6	15.6	24.1	20.6	50.9
Days > 95F	1.9	2.6	2.9	6.4	11.2	9.0	29.9
TMAX on hottest day of year (F)	96.1	2.2	2.6	4.1	5.9	5.3	10.2
TMIN on hottest day of year (F)	43.3	1.8	3.1	3.2	7.8	4.0	13.2
Days TMIN > 28F	244.5	13.2	13.6	23.1	34.6	31.0	68.3
<b>Extreme Precipitation</b>							
Days > 1 inch in 24 hours	6.3	0.6	0.7	1.2	1.6	1.5	2.5
Days > 2 inch in 24 hours	0.9	0.1	0.1	0.2	0.3	0.3	0.6
Events > 4 inches in 48 hours	0.3	0.1	0.1	0.2	0.2	0.2	0.3
Precip. on wettest day of year (in)	2.2	0.1	0.2	0.2	0.3	0.2	0.5
<b>Snow Cover Days</b>	113	-12	-13	-26	-43	-38	-97

# Key Message 1: Extreme Heat

Continued warming will likely result in an **increase in the warmest daily temperatures and the frequency of hot extremes.**

- Days above 90°F double each time period for unregulated emissions.
- Warmer summer with little change in precipitation increases drought risk.

## APPENDIX 3: PROJECTIONS BY STATION

Table A3-10A. Portsmouth Station – Change from Historical

Climate Indicator	Historical 1980-2009	Change from historical (+ or -)					
		2010-2039		2040-2069		2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Temperature (deg F)</b>							
Summer TMAX	81.3	1.8	1.9	3.5	5.0	4.4	9.1
Summer TMIN	56.3	1.7	1.8	3.4	4.8	4.2	8.7
<b>Precipitation (inches)</b>							
Summer PRECIP	9.7	0.4	0.4	0.6	0.4	0.7	0.5
<b>Extreme Temperature</b>							
Days > 90F	10.9	7.0	7.6	15.6	24.1	20.6	50.9
Days > 95F	1.9	2.6	2.9	6.4	11.2	9.0	29.9
TMAX on hottest day of year (F)	96.1	2.2	2.6	4.1	5.9	5.3	10.2
TMIN on hottest day of year (F)	43.3	1.8	3.1	3.2	7.8	4.0	13.2

*Projected change in summer climate indicators at Portsmouth, NH (Source: Lemcke-Stampone et al., 2022).*

# Key Message 2: Winter Warming

As winters continue to warm, the frequency of **cold extremes and snow cover is expected to decrease.**

- 10 fewer nights below freezing by mid-century without GHG mitigation.
- 3 to 5 week increase in length of the growing season by mid-century.

## APPENDIX 3: PROJECTIONS BY STATION

Table A3-10A. Portsmouth Station – Change from Historical

Climate Indicator	Historical 1980-2009	Change from historical (+ or -)					
		2010-2039		2040-2069		2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Temperature (deg F)</b>							
Winter TMAX	37.0	2.1	2.4	4.1	5.6	5.2	9.2
Winter TMIN	17.2	2.5	2.9	4.9	6.6	6.2	10.8
<b>Extreme Temperature</b>							
TMAX on coldest day of year (F)	14.5	2.9	3.1	5.7	7.8	7.4	13.2
TMIN on coldest day of year (F)	-9.3	3.4	4.3	7.5	10.3	9.7	17.2
Days < 0F	6.2	-2.7	-3.2	-4.6	-5.3	-5.2	-6.1
Days < 32F	148.6	-13.0	-14.3	-25.2	-34.7	-32.8	-60.5
Days TMIN > 28F	244.5	13.2	13.6	23.1	34.6	31.0	68.3
<b>Snow Cover Days</b>	113	-12	-13	-26	-43	-38	-97

*Projected change in winter climate indicators at Portsmouth, NH (Source: Lemcke-Stampone et al., 2022).*

# Key Message 3: Heavy Precipitation

Projected increases in total annual precipitation are largely due to **increases in the frequency of and intensity of extreme precipitation.**

- Daily events over 1” and 2” increase by at least 20% by mid-century.
- Potential for 50% or greater increase in large storms by mid-century.

## APPENDIX 3: PROJECTIONS BY STATION

Table A3-10B. Portsmouth Station – Percent Change from Historical

Climate Indicator	Historical 1980-2009	Change from historical (+ or -)					
		2010-2039		2040-2069		2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
<b>Precipitation (inches)</b>							
Annual PRECIP	45.3	3%	4%	5%	7%	7%	10%
Winter PRECIP	11.7	5%	4%	7%	12%	12%	18%
Spring PRECIP	11.4	3%	6%	5%	8%	7%	14%
Summer PRECIP	9.7	4%	4%	6%	4%	7%	5%
Fall PRECIP	12.5	1%	1%	3%	3%	2%	3%
<b>Extreme Precipitation</b>							
Days > 1 inch in 24 hours	6.3	9%	11%	19%	25%	24%	39%
Days > 2 inch in 24 hours	0.9	8%	17%	21%	36%	30%	69%
Events > 4 inches in 48 hours	0.3	36%	44%	56%	82%	64%	124%
Precip. on wettest day of year (in)	2.2	6%	7%	8%	13%	11%	21%

Projected change in precipitation indicators at Portsmouth, NH (Source: Lemcke-Stampone et al., 2022).





# Our New Normal

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

- 
- Longer, warmer growing season increases risk for short-term drought during summer.
  - Milder, wetter winters will likely result greater variability in precipitation type.
  - Stronger storms with heavy rain over impervious surface cover increases run off and flood risk.

# References

- Dupigny-Giroux, L.A., E.L. Mearns, 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, <https://xmacis.rcc-acis.org>.
- IPCC (2021). AR6 Climate Change 2021: The Physical Science Basis [<https://www.ipcc.ch/report/ar6/wg1/#SPM>]
- Lemcke-Stampone, Mary D.; Wake, Cameron P.; and Burakowski, Elizabeth (2022). "New Hampshire Climate Assessment 2021" *The Sustainability Institute*. 71. [<https://scholars.unh.edu/sustainability/71>]
- 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>]