

SUMMARY OF PROJECTED CLIMATE CHANGE IN THE U.S. NORTHEAST

Climate Variable	General Change Expected	Specific Change Expected and Reference Point	Size of Projected Changes Compared to Recent Changes	Seasonal Patterns of Change	Confidence	Source(s) and Context
Temperature	Increase	<p>Winter: +2.5° to 4° F [next several decades, 2010-2039] +4° to 7° F [mid-century, 2040-2069] +5° to 12° F [late century, 2070-2099]</p> <p>Summer: +1.5° to 3.5° F [next several decades] +2° to 8° F [mid- century] +3° to 14° F [late century]</p> <p>Compared to 1970-2000 averages</p> <p>Annual Minimum Temperature: +1.8°F by 2030 +5.6° [HadCM2] or 9.5° F [CGCM1] by 2100</p> <p>Annual Maximum Temperature: +2.7°F by 2030</p>	<p>-The New England region has warmed 0.7° F since 1895, which was slightly less than the national average of 1°F</p> <p>-Between 1895-1999, MA average summer temperature increased 0.9°F and winter 2.1° F</p> <p>-Regionally, average summer temperature increased 0.5°F and winter 1.8°F</p> <p>-Projected warming significantly larger than steady regional warming trend</p> <p>-Increased warming will lead to average annual temperatures resembling that of Southeast temps. from 20th century</p>	Warmer winter and summer months	<p>-High confidence that the Northeast region will continue to warm</p> <p>-Warming will be variable from state to state</p> <p>-The Canadian model CGCM1 [NERA 2001] projects warming temperatures more inland, rather than coastally. This is in disagreement with past findings.</p>	<p>Publication: New England Regional Assessment [NERA] 2001, Northeast Climate Impacts Assessment [NCIA] 2006, Frumhoff, P.C. et al 2007</p> <p>Temperature projections encompass low and high emission scenarios for century time frame*</p> <p>Projections are based on the following climate models: GFDL, HadCM3, PCM, HadCM2, CGCM1</p> <p>Geographical region of Northeast defined as CT, MA, ME, NH, NJ, NY, PA, RI, VT</p> <p>Geographical region of New England defined as CT, MA, ME, NH, RI, VT, upstate NY</p>

		+3.6° [HadCM2] or 9°F [CGCM1] by 2100 Compared to past 100 year recorded averages				
Precipitation	Increase	Total 10% increase of annual precipitation [end of century] Winter precipitation: +11 to 16% [mid-century] +20 to 30% [end of century] Compared to the 1961-1990 averages Precipitation by 2090 as projected by Canadian model CGCM1, 10% increase; Hadley model HadCM3, 30% increase	-New England saw an average increase of 3.7% in annual precipitation [1895-1999] -MA had the greatest increase of annual precipitation, 29.5%, in the region [1895-1999] -Projected annual precipitation coincides with regional long term trends of a modest 4% increase - Winter precipitation increase is projected to more than double the annual precipitation increase [starting mid-century] under either low or high emissions scenario	Increase of rain during the winter months with little change in summer months	-High variability in rainfall from year to year and month to month -Confident that as temperatures rise, precipitation in winter months will fall more as rain than snow -Little is known as to why precipitation increases are non uniform across the New England and Northeast regions -Hadley model HadCM2 suggests no drought, while Canadian model CGCM1 suggests large fluctuations in precipitation [i.e. heavy rainfall events] with some drought events	Publication: UCS 2006, NERA 2001 Projections are based on the following climate models: GFDL, HadCM3, PCM, HadCM2, CGCM1 Geographical region of Northeast defined as CT, MA, ME, NH, NJ, NY, PA, RI, VT Geographical region of New England defined as CT, MA, ME, NH, RI, VT, upstate NY

Sea Level	Increase	<p>Globally: +9.6 [low emissions] to 16.1 inches [high emissions] +18.9 inches by 2100 [USGS] +2 to 4 feet [end of century]</p> <p>Regionally: -Locations and subsidence play a significant role in the rate of sea level rise** [Boston, MA 3.5"/century; southern, MA 1'/century]</p> <p>Compared to 2005 levels</p>	<p>-Projected change in local sea level rise increasing faster than global average</p> <p>-Differentiating rates are due to subsidence</p> <p>-In the past century global sea level has risen about 7.1 inches</p> <p>-Projected changes are more than double the rate of sea level rise over the past century</p>	-n/a	<p>-Sea level predictions are considered conservative at best</p>	<p>Publication: NERA 2001, Frumhoff, P.C. et al 2007, Theiler, E.R. et al 2002</p> <p>Projections are based on the following climate models: GFDL, HadCM3, PCM, Rahmstorf</p> <p>Geographical region of Northeast is defined as CT, MA, ME, NH, NJ, NY, PA, RI, VT</p>
Flooding	Increase	<p>Frequency of flooding Next several decades Boston, MA: -Every 2 to 3 years on average Woods Hole, MA: -Every 46 to 50 years on average By 2100 high emissions</p>	<p>-Increase in maximum flood elevation to surpass 100 year flood averages. -Example: Boston's 100 year maximum flood height is 9.7 feet. Increase in frequency in flooding and sea level rise will set new</p>	-n/a	<p>-Increase of frequent flooding is correlated to sea level rise, predictions are also considered conservative -Predictions do not take into account storm intensity or frequency, which could</p>	<p>Publication: Frumhoff, P.C. et al 2007</p> <p>Projections are based on the following climate models: GFDL, HadCM3, PCM in combination with 100 year flood averages [maximum flood</p>

		Boston, MA: -Every 1 or 2 years Woods Hole, MA: -Every 9 years By 2100 low emissions Boston, MA: -Every 1 or 2 years Woods Hole, MA: -Every 21 years	standards for the maximum height. -By 2100 the expected increase in 100 year flood elevations is 1.5 feet under high emissions and 1 foot under low emissions		lead to more intense flooding	elevation likely to be equaled or surpassed on average once per century] Geographical region of Northeast defined as CT, MA, ME, NH, NJ, NY, PA, RI, VT Coastal sites examined: Atlantic City, NJ; Woods Hole, MA; Boston, MA; New London, CT; New York City, NY
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*Example: Winter temperature increase 2.5° to 4° F [next several decades, 2010-2039]

2.5° is the lowest temperature increase under a low emission scenario while 4° is the highest temperature increase under a high emission scenario

Most of the projected changes that are identified as a high or low emissions scenario were extracted from the report on *Climate Change in the U.S. Northeast*. The report defines these scenarios as the following:

High Emissions Scenario- “is a future where people---individuals, communities, businesses, states, and nations---allow emissions to continue growing rapidly”

Low Emissions Scenario- “second is one in which society transitions onto a pathway of economic development with substantially lower emissions.”

**Particularly on Cape Cod where some areas are more vulnerable to sea level rise. Information on coastal vulnerability can be found in the USGS reports: *Vulnerability of U.S. National Parks to Sea-level Rise and Coastal Change* and *National Assessment of Coastal Vulnerability to Future Sea-level Rise*.

This Resource Sheet was prepared for the PLAN TO PROTECT CLIMATE CHANGE WORKSHOP by the Waquoit Bay Reserve Coastal Training Program.