

New Hampshire's Climate: PAST AND FUTURE CHANGES

Climate has varied throughout the Earth's history, and will continue to change. However, a recent climate assessment from the University of New Hampshire shows that the rate of change in New Hampshire has increased significantly over the last four decades, with the state getting warmer and wetter.

TEMPERATURES

WHAT HAVE WE SEEN SINCE 1970?

- Average maximum temperatures have warmed by 2.0°F (annual) and 2.9°F (winter)
- Average minimum temperatures have warmed by 3.2°F (annual) and 6.1°F (winter)

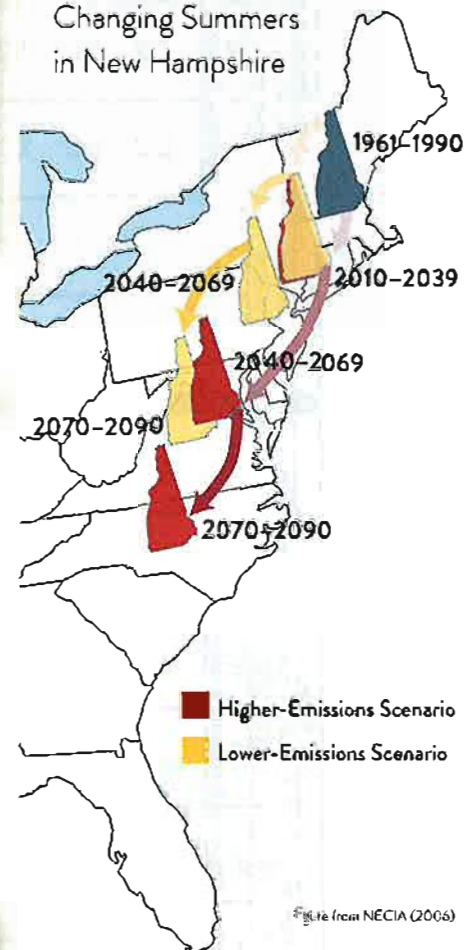
WHAT CAN WE EXPECT?

- Warmer winters: 20-45 fewer days below 32°F
- Hotter summers:
10-35 days above 90°F for northern NH (compared to 3 currently);
16-47 days above 90°F for southern NH (compared to 7 currently)



CLIMATE ON THE MOVE

Changing Summers
in New Hampshire



RAINFALL AND FLOODING

WHAT HAVE WE SEEN SINCE 1970?

- Annual precipitation has increased 8-22%
- Both the frequency and magnitude of extreme precipitation events has increased

WHAT CAN WE EXPECT?

- More precipitation (annual averages will increase by 15-20%)
- A two- to three-fold increase in extreme precipitation events
- More frequent and severe flooding

SNOW AND ICE

WHAT HAVE WE SEEN SINCE 1970?

- Fewer days with snow cover
- Lake ice-out dates are occurring earlier

WHAT CAN WE EXPECT?

- Less snow and more rain
- Significant decrease in number of snow covered days:
20-30% decrease in northern NH; 20-50% decrease in southern NH



Yellow arrows track what summers are projected to feel like under a lower emissions scenario, while red arrows track projections for a higher emissions scenario. For example, under the higher emission scenario, by late this century residents of New Hampshire would experience a summer climate more like what occurs today in North Carolina.

Hanover, NH

Indicators	Historical 1980-2009	Actual						Change from Historical (+ or -)											
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099							
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions						
Temperature Anomaly (°F)																			
Annual TMIN	35.2	37.0	37.2	38.1	40.3	39.1	44.0	1.8	2.0	2.9	5.1	3.9	8.8						
Winter TMIN	12.3	14.8	15.2	16.3	18.5	17.8	22.6	2.5	2.9	4.0	6.2	5.5	10.3						
Spring TMIN	32.9	35.9	34.5	37.6	37.3	38.8	40.6	3.0	1.6	4.7	4.4	5.9	7.7						
Summer TMIN	56.2	57.7	58.2	58.8	61.4	59.4	65.2	1.5	2.0	2.6	5.2	3.2	9.0						
Fall TMIN	38.9	39.1	40.5	39.4	43.8	39.9	47.0	0.2	1.6	0.5	4.9	1.0	8.1						
Annual TMAX	56.7	58.5	58.5	59.8	61.6	60.7	65.0	1.8	1.8	3.1	4.9	4.0	8.3						
Winter TMAX	31.5	33.3	33.2	34.2	35.1	35.4	37.8	1.8	1.7	2.7	3.6	3.9	6.3						
Spring TMAX	56.0	58.5	57.6	60.9	60.8	62.6	64.7	2.5	1.6	4.9	4.8	6.6	8.7						
Summer TMAX	80.3	82.1	82.4	83.6	86.1	84.5	89.9	1.8	2.1	3.3	5.8	4.2	9.6						
Fall TMAX	58.7	59.6	60.3	60.0	64.0	60.2	67.2	0.9	1.6	1.3	5.3	1.5	8.5						
Temperature Extreme (days per year)																			
<32°F	156	146	146	140	130	136	112	-10	-10	-16	-26	-20	-44						
<40°F	18	13	13	9	8	8	2	-5	-5	-9	-12	-10	-16						
>80°F	8	13	14	21	32	26	58	5	6	13	24	18	50						
>95°F	1	2	3	5	11	7	28	1	2	4	10	6	27						
TMAX on hottest day of the year	94.2	96.0	95.5	97.1	98.8	98.2	102.5	1.8	1.3	2.9	4.6	4.0	8.3						
TMIN on coldest day of the year	-18.0	-14.0	-13.6	-11.9	-7.3	-9.9	0.6	4.0	4.4	6.1	10.7	8.1	18.6						
Precipitation (in.)																			
Annual mean	38.5	42.2	41.4	43.0	44.7	44.9	47.6	3.7	2.9	4.5	6.2	6.4	9.1						
Winter mean	8.2	9.1	8.8	9.1	9.3	9.7	10.4	0.9	0.6	0.9	1.1	1.5	2.2						
Spring mean	8.3	10.1	10.3	10.9	11.0	11.0	12.3	0.8	1.0	1.5	1.7	1.7	3.0						
Summer mean	10.7	12.1	11.4	11.6	12.6	12.8	12.1	1.4	0.7	0.9	1.9	2.1	1.4						
Fall mean																			
Extreme Precipitation (events per year)																			
1" in 24 hrs	8.2	9.8	9.8	10.3	11.0	11.2	13.1	1.6	1.5	2.1	2.8	3.0	4.9						
2" in 48 hours	3.1	4.3	3.8	4.2	5.3	5.3	6.6	1.2	0.8	1.1	2.2	2.2	3.5						
Extreme Precipitation (events per decade)																			
4" in 48 hours	1.0	2.6	1.7	2.4	3.7	5.3	5.9	1.6	0.7	1.4	2.7	4.3	4.9						
Snow Covered Days	117	107	106	100	84	92	67	-10	-11	-17	-33	-25	-50						
Drought (months per 30 years)																			
Growing Season (days)	168	182	182	188	199	191	219	14	14	20	31	23	51						

*Daily meteorological data was not available for all sites, so the historical values in these tables were derived from the downscaled GCM model output.

TWENTY ONE THINGS YOU CAN DO...

TO DECREASE YOUR CONTRIBUTION TO CLIMATE CHANGE:

1. Use energy efficiently – buy energy star products (light bulbs & appliances), turn off and unplug electronics when not in use
2. Weatherize your home and use drapes for the windows (keeps heat in winter, keeps sun/heat out in summer)
3. Purchase clean/renewable energy sources from your electricity provider, or install a renewable energy system
4. Drive a fuel-efficient vehicle, carpool, and avoid unnecessary trips - walk or bike if possible to stay healthy!
5. Waste less – use cloth napkins, bags, and reusable food/beverage containers at work and school
6. Get a rain barrel to collect water from your roof to use for plants and outdoor clean up
7. Eat locally produced food to reduce transportation and support your local economy
8. Wash full loads in your clothes and dish washer
9. Recycle – recycling 1 aluminum can saves enough energy to power a TV or computer for 3 hours!
10. Know Your Footprint – calculate your carbon footprint on-line (many free on-line calculators) and strategize with your family on how to reduce your footprint
11. Use your Voice - Tell your friends, family, network and elected officials that climate change matters to you and encourage action.

TO PREPARE FOR CLIMATE CHANGE IMPACTS:

1. Pay attention to warnings for strong storms
2. Have a personal/family preparedness plan for emergencies or storm events (include your pets!)
3. Be prepared to be without electricity (keep jugs for water, non perishable food and batteries on hand)
4. Be aware of neighbors or family members who are dependent on electricity for health reasons (i.e. oxygen)
5. Check your home and driveway for adequate drainage to prevent washouts
6. Evaluate whether you need to purchase a generator for periods of no electricity
7. Do regular tick checks after being outside and be aware of early warning signs of Lyme Disease
8. Have large trees around your house removed to prevent them from hitting your house during storms
9. Participate in community conversations to support preparedness in your town
10. Vote for local initiatives including increased efficiency in municipal buildings, culvert maintenance, tree removal etc...

UPPER VALLEY ADAPTATION WORKGROUP CLIMATE CHANGE RESOURCES

UPPER VALLEY

Upper Valley Adaptation Workgroup – UVAW is a bi-state, multi-stakeholder working group of leaders and partner organizations. UVAW's aim is to support the building of climate resilient communities in the Upper Valley region of Vermont and New Hampshire. <http://www.uvlsrc.org/resources/uvaw/>

Upper Valley Strong – A group of Upper Valley Organizations that are working together to help communities and families rebuild and recover from weather disasters. <http://www.uvstrong.org/>

Upper Valley Sustainable Living – A resource for living sustainably in the Upper Valley. (The site is in early stages of development – bookmark and check back often). <http://www.uppervalleysustainableliving.net/>

VERMONT

Vermont Agency of Natural Resources Climate Change Team – Web site for information on climate change and what it means for Vermont and Vermonters. Includes a catalog of ongoing climate-change initiatives, reports on the state's greenhouse gas emissions, some background on the climate change issue, a discussion of the adaptation issues including a series of white papers addressing adaptation in eight sectors; a library of state plans and reports, a list of actions individuals can take to make a difference, and a link to a quarterly newsletter. www.vtclimatechange.us

Vermont Comprehensive Energy Plan 2011 - The Comprehensive Energy Plan (CEP) addresses Vermont's energy future for electricity, thermal energy, transportation, and land use, and sets the goal of 90% of the state's energy from renewable sources by 2050. http://publicservice.vermont.gov/publications/energy_plan

VTrans Climate Change Adaptation White Paper 2012 – This report is an overview of climate related adaptation and resilience oriented efforts both underway and under consideration by the Vermont Agency of Transportation. http://vtransplanning.vermont.gov/sites/aot_policy/files/documents/planning/Climate%20Change%20Adaptation%20White%20Paper.pdf

Vermont Department of Health Environmental Public Health Tracking: Climate Change – As part of its Environmental Health Tracking Program, the department has recently begun tracking the incidences of heat stress and heat-related fatalities. While Vermont has not yet experienced the number of prolonged extreme heat events that many other states have, heat stress is expected to become a more significant risk in the lives of Vermont residents. http://healthvermont.gov/tracking/enviro_climate.aspx

In addition, as pathogen-bearing ticks have become more prevalent in the state (and region), the department has also launched a crowd-sourced tick tracking database. <http://healthvermont.gov/ticktracker/>

The Resilient Vermont Project – A project led by the Institute for Sustainable Communities that is developing statewide recommendations to build climate resiliency into Vermont communities, state and environment. <http://resilientvt.org/>

The East Central Vermont: What We Want – A project intended to create a Sustainable Community Regional Plan that is focused on economic competitiveness, housing, transportation, climate resilience, energy, habitat, health and society in the East Central Vermont 40-town region. <http://ecvermont.org/>

NEW HAMPSHIRE

New Hampshire Department of Environmental Services – Website for information on climate change. Includes the Climate Action Plan and the Greenhouse Gas Inventory.

<http://des.nh.gov/organization/divisions/air/tsb/tps/climate/index.htm>

New Hampshire Department of Environmental Services - Adaptation Tool-kit - New Hampshire has recently developed an Adaptation Tool-kit. The Tool-kit has information on state, regional, and local initiatives as well as suggestions for climate change messaging, starting community conversations, case studies, vulnerability assessments, planning, implementation, funding and other resources.

<http://des.nh.gov/organization/divisions/air/tsb/tps/climate/toolkit/index.htm>

New Hampshire Department of Environmental Services - Strategic Plan to Address the Health Impacts of Climate Change in New Hampshire The Environmental Health Program worked with the state public health system and conducted a needs assessment to better understand the capacity to address climate change. The results of the needs assessment were used to develop a strategic plan to assist the public health system in being better prepared for the impacts of climate change. <http://des.nh.gov/organization/divisions/air/pehb/ehs/ehp/documents/strategic-plan.pdf>

New Hampshire Coastal Adaptation Workgroup - Storm Smart Coast website – Website is coastal focused but also has resources and information applicable for inland communities <http://nh.stormsmart.org/>

Granite State Future - A project coordinated by the state's nine regional planning commissions promoting local and regional dialogue among businesses and non-profit organizations, governmental agencies and voters, newcomers and long-term residents. This initiative is asking residents to consider the critical question: how should we plan for the future? <http://granitestatefuture.org/>

NATIONAL

National Climatic Data Center – A comprehensive resource focusing on climate change and climate related impacts by NOAA. <http://www.ncdc.noaa.gov/>

CDC Climate and Health Project – A resource by Centers for Disease Prevention and Control that outline health risks and health strategies related to climate change. Also is information on the CDC's Climate – Ready Cities and States Initiative, in which NH and VT are participating. <http://www.cdc.gov/climateandhealth/>

FUNDING OPPORTUNITY

Title: [FEMA Pre-Disaster Mitigation Grant Program - \\$23.7 million](#) Application Due: October 18, 2013

Description:

Eligible Entities: States, territories, Indian tribal governments, communities, and universities

The Pre-Disaster Mitigation (PDM) program provides funds for hazard mitigation planning and the implementation hazard mitigation of projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. Eligible activities include: property acquisition and structure demolition or relocation; structure elevation; dry floodproofing; minor localized flood reduction activities; structural or non-structural retrofitting of existing buildings; infrastructure retrofits; soil stabilization; wildfire mitigation; and hazard mitigation planning.

For more information, visit the [grant opportunity synopsis](#).

Adaptation

The ability of a natural or human system to adjust or become suitable to a new or changing environment. The Intergovernmental Panel on Climate Change (IPCC) identified three types of strategies to address changes in climatic factors and the secondary impacts to natural system dynamics: Retreat, Accommodation, and Protection.

AR4 (Assessment Report 4) and AR5

AR4 is the 4th Assessment Report produced by the Intergovernmental Panel on Climate Change (IPCC) published in 2007. The 5th Assessment Report "Summary for Policy Makers" was released on September 27, 2013, and states, "It is extremely likely [$>95\%$ chance] that human influence has been the dominant cause of the observed warming since the mid-20th century".

Business as Usual

A scenario used for projections of future CO₂ emissions assuming that no action, or no new action, is taken to decrease carbon emissions.

Climate

Climate in a narrow sense is usually defined as the "average weather". The classical period over which to average weather observations is 30 years. These observations are most often surface variables such as temperature, precipitation, and wind.

Climate Commitment

This describes the fact that climate will have a delayed reaction (see *climate lag*) to some influencing factors, such as greenhouse gas emissions. Climate commitment studies attempt to assess the amount of future warming that is "committed" assuming the level of emissions remains constant.

Climate Lag

The delay that occurs in climate change as a result of factors that change slowly. For example, the effects of releasing more carbon dioxide into the atmosphere occur gradually because the ocean takes a long time to warm up in response to a change in radiation.

Climate Model

A numerical representation of the climate system based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. Climate models are applied, as a research tool, to study and simulate the climate, but also for operational purposes, including monthly, seasonal, and inter-annual climate predictions

Downscaling

General Circulation Models (GCMs) provide a "coarse-scale" resolution, with the geographical area that the models target can range up to 250 miles on a side. In general, this type of resolution is too coarse to capture the kinds of "fine-scale" changes we are already

experiencing. For that reason, scientists use statistical techniques to down-scale these global projections for changes into a climate to projections of tens rather than hundreds of miles.

Emissions Scenario

Emissions scenarios describe future releases into the atmosphere of greenhouse gases, aerosols, and other pollutants and, along with information on land use and land cover, provide inputs to climate models. They are based on assumptions about driving forces such as patterns of economic and population growth, technology development, and other factors.

General Circulation Model (GCM)

A global, three-dimensional computer model of the climate system which can be used to simulate natural and human-induced climate change. GCMs are highly complex and they represent the effects of such factors as reflective and absorptive properties of atmospheric water vapor, greenhouse gas concentrations, clouds, annual and daily solar heating, ocean temperatures and ice boundaries. The most recent GCMs include fully interactive global representations of the atmosphere, oceans, and land surface.

Heat Island

An urban area characterized by higher temperatures than surrounding non-urban areas because buildings, roads, and other infrastructure absorb more solar energy than open land.

Intergovernmental Panel on Climate Change (IPCC)

The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. The latest Assessment Report (5th) is being released in September 2013.

Mitigation

A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

Resilience

The capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.

Sensitivity

The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).