

WORKING TOWARD CLIMATE RESILIENCE

General climate information prepared for Westchester County

January 2024

Introduction

The Hudson River Estuary Program prepared this summary of climate planning and decision-making as a part of the Climate Adaptive Planning Institute (CAPI). It identifies historic climate trends and introduces future projections and strategies to address the climate hazards most likely to affect Westchester County.

This summary provides a starting point for recognizing important climate hazard and risks in the county but is limited to information available to the New York State Department of Environment Conservation (NYS DEC) and its partners at the time of this writing and is not a substitute for on-site survey and assessment. New York's changing climate presents new challenges and opportunities for communities in the state. It is vital for local decision-makers and community members to understand their community's vulnerability to a changing climate and take steps to increase their climate resilience.

Using the latest studies from New York State, this document presents the Dutchess County primary climate hazards and the risks and opportunities they present. A lot can change in a century, so it is never too early to start.

MAP OF WESTCHESTER COUNTY

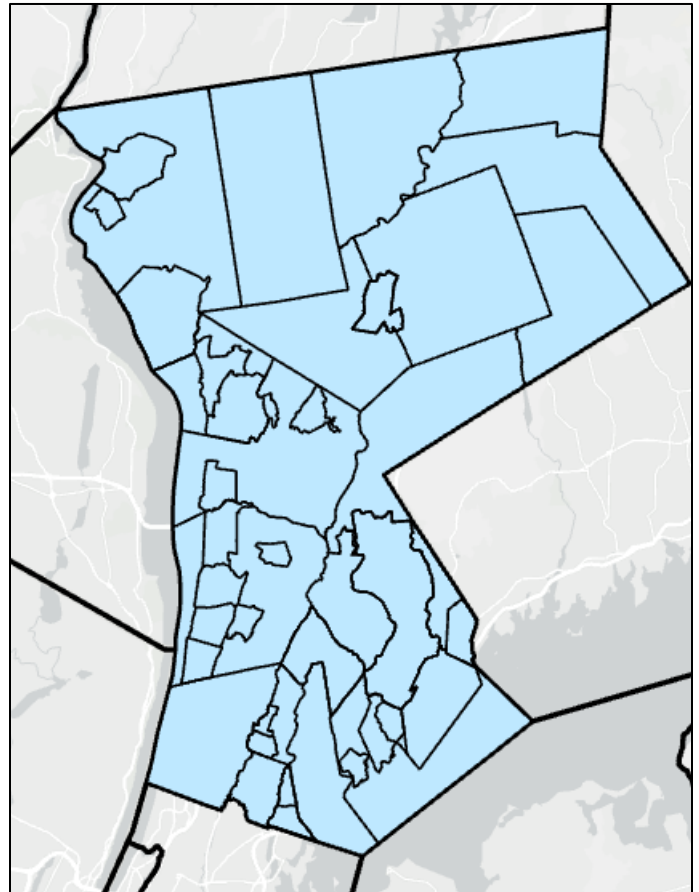


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Climate Hazards in New York State

Three significant climate hazards (trends) are expected to affect New York State residents during the 21st century: *increasing temperatures, rising sea level, and changing precipitation patterns*. These trends are leading to three primary climate risks (human impacts): *flooding, heat waves and drought*. Communities can plan and implement resilience strategies to reduce their vulnerability and thrive under changing conditions. Risks and resilience opportunities are discussed later in this document.



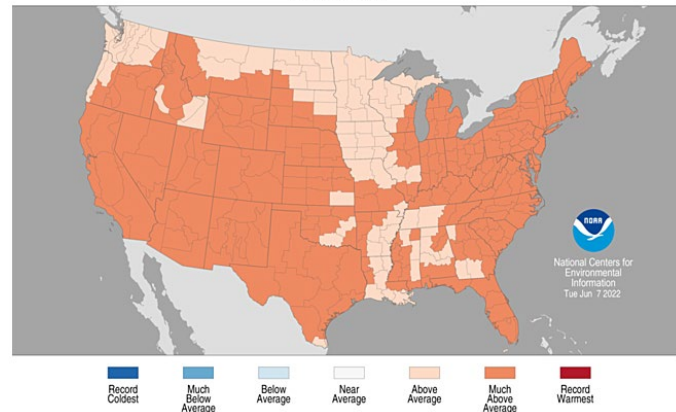
Increasing Temperatures

Annual average temperatures have been steadily increasing in New York State, posing new challenges to human health, electricity demand, and many of our industries, including tourism, recreation, and agriculture. Since 1970, temperature increases in New York have surpassed national and global averages:

- Global annual average temperature up **1.4°F**
- U.S. annual average temperature up **1.8°F**
- New York annual average temperature up **2.6°F** since 1901

The average annual temperature around Westchester county is expected to increase approximately four to six degrees by mid-century and as much as 11 degrees by 2100. Overall, Westchester County can expect warm temperatures by the end of the century to be similar to South Carolina today.

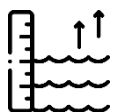
Divisional Average Temperature Ranks
June 2021–May 2022
Period: 1895–2022



Air Temperature Projections for the South Hudson River Valley

	Baseline 1981 -2010	2030s	2050s	2080s	2100
Annual average air temperature	50.8° F	52.8 – 55.7°F	54 – 58°F	55.6 – 62.7°F	56° – 64.7°F
Increase in annual average		2.0 – 4.9°F	3.2 – 7.2°F	4.8 – 11.9	5.2 – 13.9°F

Like all projections, these climate projections have uncertainty embedded within them. Sources of uncertainty include data and modeling constraints, the random nature of some parts of the climate system, and limited understanding of some physical processes. Levels of uncertainty are characterized using state-of-the-art climate models, multiple scenarios of future greenhouse gas concentrations, and recent peer-reviewed literature. Even so, the projections are not true probabilities, so the specific numbers should not be emphasized, and the potential for error should be acknowledged



Rising Sea Level

Global sea level is rising due to various factors, including thermal expansion from warmer water temperatures and melting of land-based ice. The Hudson River is connected to and influenced by the sea; therefore, it experiences tides and contains saltwater in its lower reaches. This is why the river south of the federal dam at Troy is considered an estuary. It is also the reason why the Hudson River’s water level is rising with global sea level.

Since 1900, sea level in the lower Hudson has risen over 13 inches. More concerning, the water is rising faster and faster (from 2000 to 2014 the average rate was 6.8 millimeters per year compared to 4.6 millimeters per year from 1990 to 2014). Projections for additional sea-level rise along the Hudson River range from 1-10 inches by 2020 and 5-30 inches by mid-century. It is possible that riverfront communities like Athens could experience as much as 71 inches of sea-level rise by the end of this century if rapid melting of the Greenland ice sheet continues.

The following sea-level rise on the Hudson River and elsewhere in New York State were provided by reports from the NYS Climate Impacts Assessments and the NYS 2100 Commission.

Sea Level Rise Projections

	Baseline 1981 -2010	2030s	2050s	2080s	2100
New York City (The Battery) Sea Level Rise - Inches	-	6" – 13"	12" – 23"	21" – 45"	25" – 65"

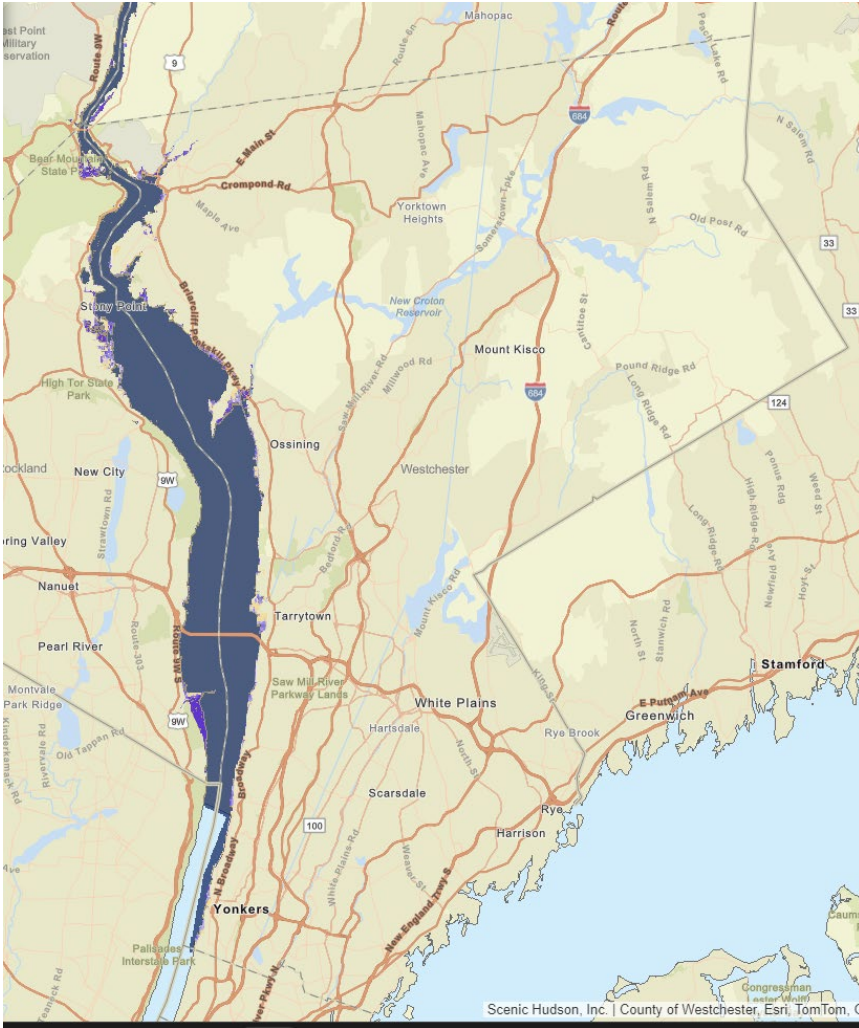
From *Climate Impacts Assessment, 2023*

Note: Scenarios are three used by the IPCC: SSP2-4.5-medium confidence, SSP5-8.5-medium confidence, and SSP5-8.5-low confidence New York City (The Battery) Sea Level Rise (inches) Like all projections, these climate projections have uncertainty embedded within them. Sources of uncertainty include data and modeling constraints, the random nature of some parts of the climate system, and limited understanding of some physical processes. Levels of uncertainty are characterized using state-of-the-art climate models, multiple scenarios of future greenhouse gas concentrations, and recent peer-reviewed literature. Even so, the projections are not true probabilities, so the specific numbers should not be emphasized, and the potential for error should be acknowledged

	2020s	2050s	2080s	2100
Sea- Level Rise with Rapid Ice Melt	4" -9"	17"-26"	37"-50"	52" – 68"

From *NYS 2100 Commission Report*

5. Values are the central range (middle 67%) of model-based probabilities; temperature ranges are rounded to the nearest half-degree and precipitation to the nearest 5%. 6. Values are the central range (middle 67%) of model-based probabilities rounded to the nearest inch. The rapid-ice melt scenario is based on acceleration of recent rates of ice melt in the Greenland and West Antarctic Ice sheets and paleoclimate studies.



Map of Sea level rise projections for Westchester county shown for six feet of Sea level rise.

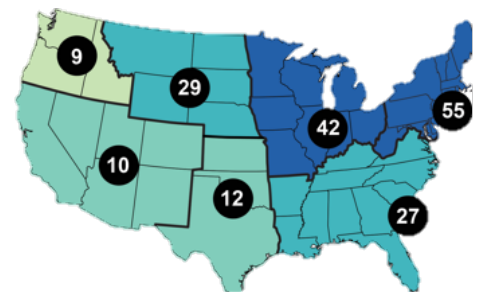
Screenshot taken from [Scenic Hudson's Sea Level rise Mapper](#).



Changing precipitation patterns

Precipitation has become more variable and extreme, whereas total rainfall has changed only marginally. **The amount of rain falling in heavy downpour events increased 55% from 1958 to 2016 in the Northeast.** Projections indicate total annual precipitation could increase as much as 18% by mid- century and 21% by 2100. Overall, New York State models project more dry periods intermixed with heavy rain and decreased snow cover in winter.

Observed Change in Total Annual Precipitation (1958-2016)



(Source: National Climate Assessment, 2016)

Precipitation Projections for the South Hudson River Valley

	Baseline 1981 -2010	2030s	2050s	2080s	2100
Mean Precipitation	45.8 in.	45.8" – 50.4"	46.3" – 51.8"	46.7" – 55.9"	44.9" – 58.6"
% Increase in precipitation		0 – 10%	1-13%	2 – 22%	-2 – 28%

Like all projections, these climate projections have uncertainty embedded within them. Sources of uncertainty include data and modeling constraints, the random nature of some parts of the climate system, and limited understanding of some physical processes. Levels of uncertainty are characterized using state-of-the-art climate models, multiple scenarios of future greenhouse gas concentrations, and recent peer-reviewed literature. Even so, the projections are not true probabilities, so the specific numbers should not be emphasized, and the potential for error should be acknowledged

Climate Risks and Opportunities for Westchester County

Weather Station Data: Dobbs Ferry, NY

Annual Average Temperature from 1901-2020 from observed weather stations

Temperature trend for Southern Hudson River Valley - Dobbs Ferry: 0.34 °F/decade

Trend is significant at the 99% significance level

Trends in Annual Precipitation from 1901–2020 for Observed Weather Stations in New York State

Precipitation Trend for Southern Hudson River Valley – Dobbs Ferry: 0.39 inches/decade

Projected Changes in Extreme Events for Dobbs Ferry, New York

Note: Projections are based on 16 GCMs (14 for heat index) and 2 SSPs and are relative to the 1981–2010 base period. Baseline data are for the 1981–2010 base period and are from the NOAA National Centers for Environmental Information (NCEI). Decimal places are shown for values less than 1, although this does not indicate higher precision or certainty. Heat index was computed using the formula from the National Weather Service.

Heat waves are defined as three or more consecutive days with maximum temperatures at or above 90°F.

Heat Index is what the temperature feels like to the human body when relative humidity is combined with the air temperature. This has important considerations for the human body's comfort. When the body gets too hot, it begins to perspire or sweat to cool itself off.

	Baseline 1981-2010	2030s	2050s	2080s
# Days per year above 90°F	18	29 – 57	34 – 73	48 – 108
# Days per year above 95°F	4	7 – 29	9 – 38	18 – 76
# Heat waves per year	2	4 – 8	5 – 9	6 – 10
Average # days of each heat wave	4	5 – 6	5 – 6	5 – 10
Maximum heat Index	100	106 - 114	108 - 120	112 - 136
# Days per year ≤ 32°F	106	67 – 90	37 – 82	8 – 74

	Baseline 1981-2010	2030s	2050s	2080s
# Days with precipitation > 1"	15	15 – 19	15 – 18	15 – 19
# Days with precipitation > 2"	3	4 – 5	4 – 5	4 – 6
# Days with precipitation > 4"	0.2	0.2	0.2	0.2 – 0.6

Municipality Accomplishments

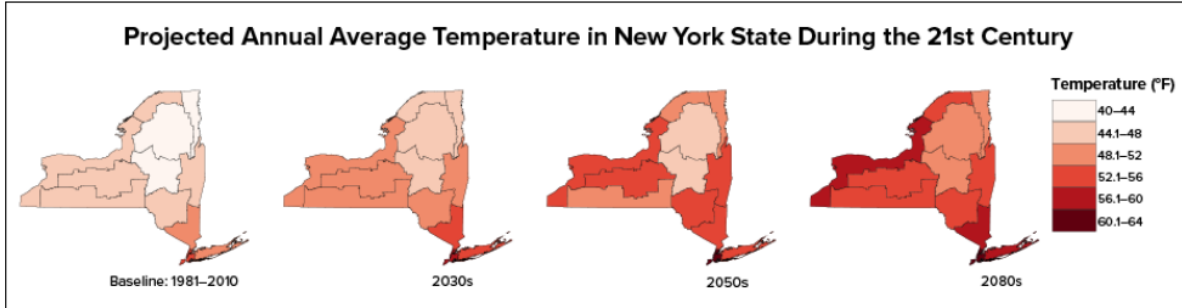
MUNICIPALITY	Hastings-On-Hudson	Irvington Village	Ossining Town	Ossining Village	Peekskill City	Pelham Village	Tarrytown Village	White Plains City	Westchester County
Registered Climate Smart Community	✓	✓	✓	✓	✓	✓	✓	✓	✓
Certified Climate Smart Community	✓	✓			✓	✓	✓	✓	✓
Completed Climate adaptive Design Studio Phase I			✓	✓			✓		
Completed Climate adaptive Design Studio Phase II			✓	✓					
Flood Resilience Network Member	✓		✓	✓			✓		✓
Climate Smart Community Actions Completed: Pledge Element 6: Implement Climate-smart land-use									
PE6: Comp Plan with Sustainability Elements	✓	✓						✓	
PE6: Natural Resources Inventory	✓				✓				
PE6: Zoning for Protection of Natural Areas (CLU)	✓							✓	
Climate Smart Community Actions Completed: Pledge Element 7: Enhance community resilience to climate change									
PE7: Source Water Protection									
PE7: Water Conservation & Reuse	✓								
PE7: Water-smart landscaping	✓								
PE7 Action: Climate Vulnerability Assessment	✓								

MUNICIPALITY	Hastings-On-Hudson	Irvington Village	Ossining Town	Ossining Village	Peekskill City	Pelham Village	Tarrytown Village	White Plains City	Westchester County
PE7: Evaluate Policies for Climate Resilience	✓								
PE7: Climate Adaptation Planning	✓								
PE7: Hazard Mitigation Plan	✓				✓				
PE7: Heat Emergency Plan	✓								
PE7: Shade Structures Policy	✓								
PE7: Cooling Centers	✓								
PE7: Conserve Natural Areas	✓								
PE7: Watershed-based Flood Mitigation Plan		✓							
PE7: Design Flood Elevation & Flood Maps									
PE7: Culverts and Dams									
PE7: Freeboard Policies									
PE7: Green Infrastructure	✓								
PE7: Riparian Buffers									
PE7: Strategic Relocation									
PE7: Nature-based Shorelines									
PE7: National Flood Insurance Program Community Rating System									

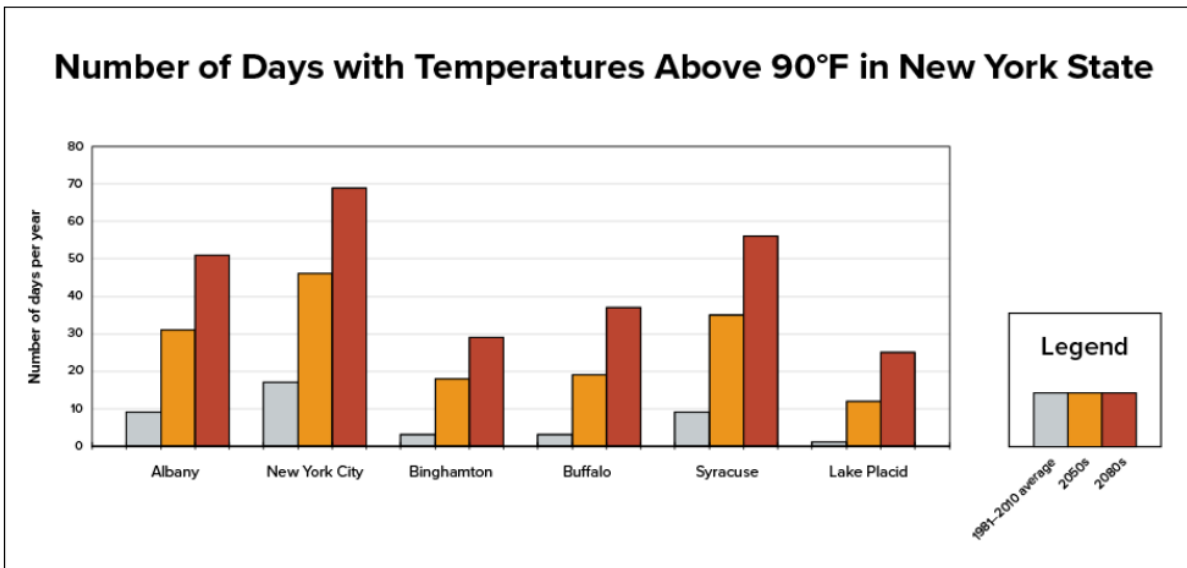
MUNICIPALITY	Hastings-On-Hudson	Irvington Village	Ossining Town	Ossining Village	Peekskill City	Pelham Village	Tarrytown Village	White Plains City	Westchester County
PE7: Watershed Plan for Water Quality									
Climate Smart Community Actions Completed: Pledge Element 9: Inform and inspire the public									
PE9: Climate Change Education & Engagement	✓					✓		✓	✓

Alternative Graphics for Climate Summaries

Graphics from [Climate Impacts Assessment](#), 2023

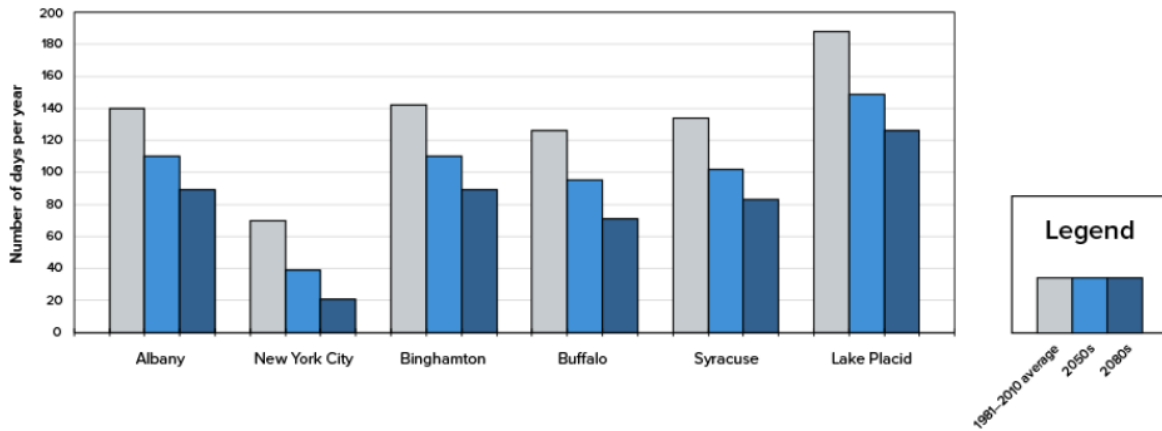


Projected changes to annual average temperatures over the course of the century. Refer to Chapter 2, New York State’s Changing Climate, to learn more about this figure. Source: Projections developed for this assessment.



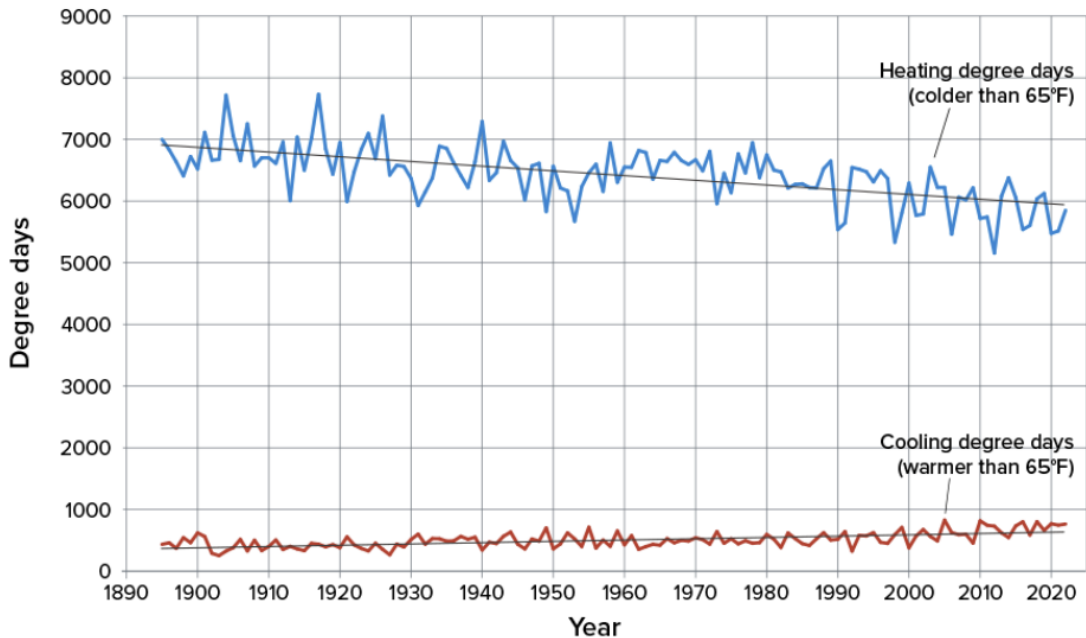
Projected changes to the number of days per year with temperatures above 90°F at six locations across the state. Source: Projections developed for this assessment.

Number of Days with Temperatures Below 32°F in New York State



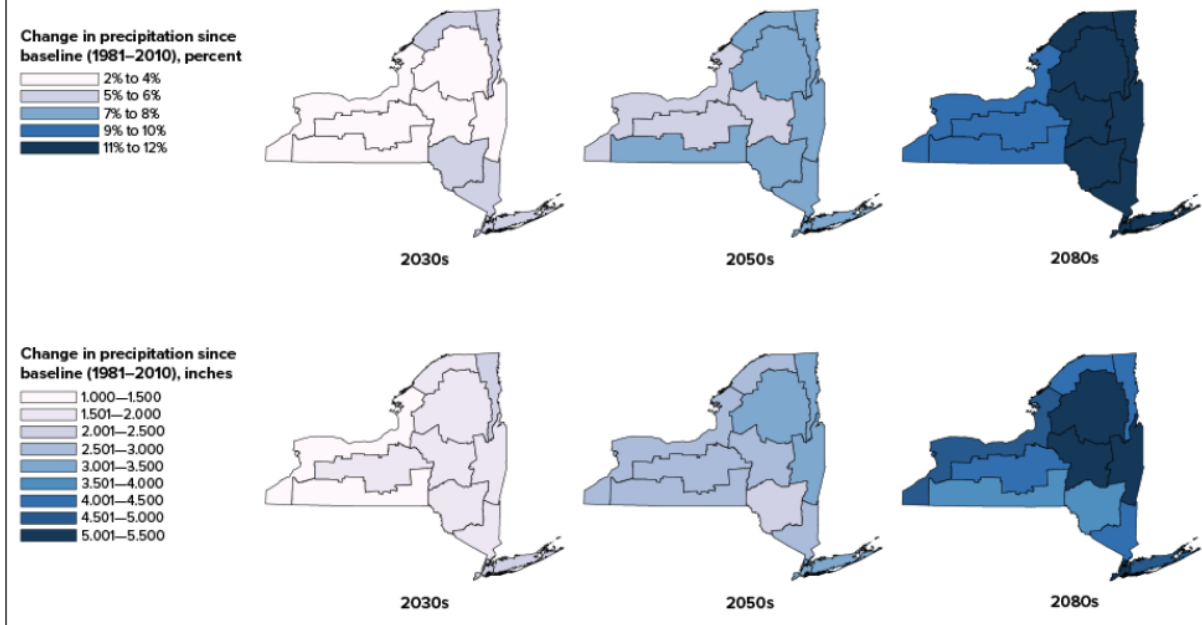
Projected changes to the number of days per year with temperatures below freezing for six locations across the state. Source: Projections developed for this assessment.

Heating and Cooling Degree Days in New York State, 1895–2022



Historical changes to heating and cooling degree days. These trends are projected to continue in the future. Refer to Chapter 2, New York State's Changing Climate, to learn more about this figure. Source: Projections developed for this assessment.

Projected Annual Precipitation in New York State During the 21st Century



Projected changes to precipitation in New York State over the course of the century. Refer to Chapter 2, New York State’s Changing Climate, to learn more about this figure. Source: Projections developed for this assessment.

Extreme Events in New York State



Hurricanes and tropical storms are projected to increase in intensity, producing stronger winds, more rain, and more coastal and inland flooding.



As sea levels rise, storm surges will reach farther inland, resulting in more destruction.

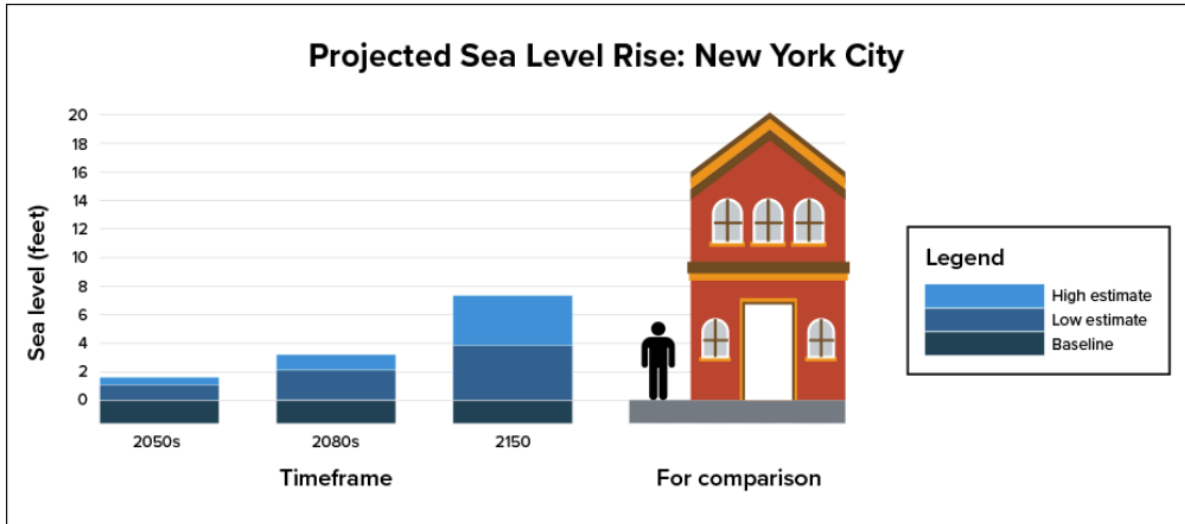


Based on projected precipitation and temperature patterns, New York State is not at an increased risk of extended, multi-year droughts. However, the risk of short-term droughts, lasting from weeks to months, could increase, especially in summer.



Climate change is not expected to significantly increase the risk of wildfires in New York State. A bigger concern will likely be poor air quality caused by smoke from large wildfires in other parts of the United States and Canada.

Projected changes to extreme events in New York State. Source: Projections developed for this assessment.



Projected sea level rise for New York City. The figure includes three timeframes (2050s, 2080s, and 2150) and a high and low sea level rise estimate for each. A person (5 feet, 6 inches) and two-story house (20 feet) are provided for comparison. This graphic shows a visual representation of the average projected sea level rise; observable changes in water level will vary throughout the city depending on distance from the shoreline, elevation above sea level, and many other factors. Source: Projections developed for this assessment.

Alternative Hazard to potentially include

Invasive Species Data

Specific Invasive Species to Westchester County (taken from Westchester county gov [Website](#))

- Barberry (*Berberis thunbergii*)
- Black Swallowwort (*Cynanchum louiseae*)
- Burning Bush (*Euonymus alatus*) - nn image
- Common Reed Grass (*Phragmites australis*) - nn image
- English Ivy (*Hedera helix*)
- Garlic Mustard (*Alliaria petiolate*)
- Giant Hogweed (*Heracleum mantegazzianum*)
- Glossy Buckthorn (*Frangula alnus*)
- Japanese Angelica Tree (*Aralia elata*)
- Japanese Knotweed (*Reynoutria japonica*; also, *Fallopia japonica*, *Polygonum cuspidatum*) - nn image
- Japanese Stiltgrass (*Microstegium vimineum*)
- Jetbead (*Rhodotypos scandens*)
- Lesser Celandine (*Ficaria verna*)
- Mile a Minute (*Persicaria perfoliata*)

Mugwort (*Artemisia vulgaris*), with common names, mugwort, wormwood, cronewort - nn image

Multiflora Rose (*Rosa multiflora*)

Norway Maple (*Acer platanoides*)

Oriental Bittersweet (*Celastrus orbiculatus*)

Oriental Lady's Thumb (*Persicaria longisetata*, *Polygonum cespitosum*)

Porcelain Berry (*Ampelopsis brevipedunculata*; also known as Amur peppervine) - nn image

Purple Loosestrife (*Lythrum salicaria*)

Spotted Lanternfly

Tree of Heaven (*Ailanthus altissima*)

Wineberry (*Rubus phoenicolasius*)

Yellow Flag Iris (*Iris pseudacorus*)