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 Action 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.

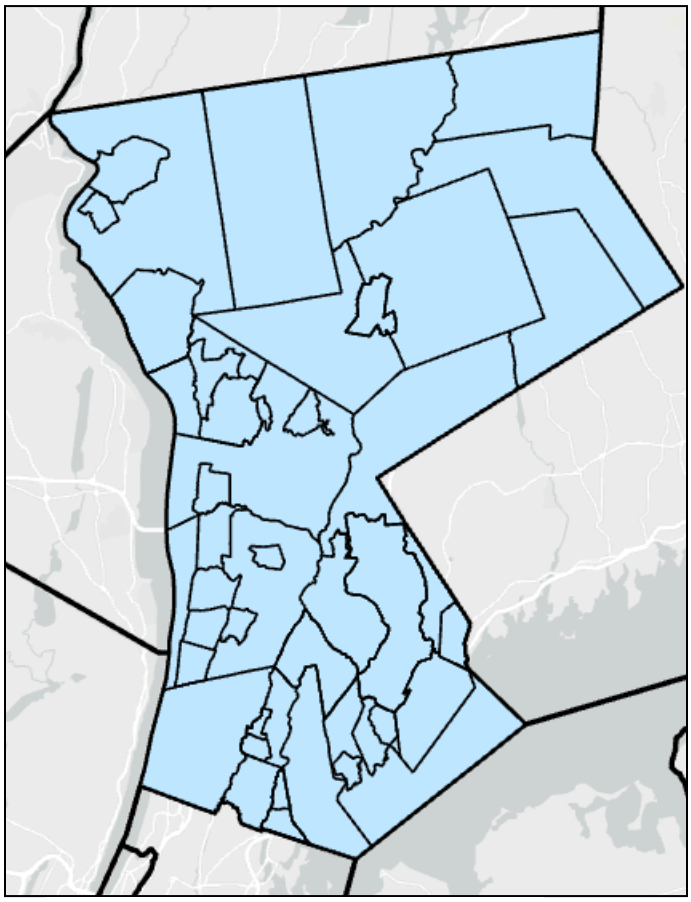


Figure 1. Map of Westchester County

This summary provides a starting point for recognizing important climate hazards 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 Governors' 2100 Commission report and the NYS Climate Impacts assessments, this document presents the Westchester 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.

Table of Contents

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

I

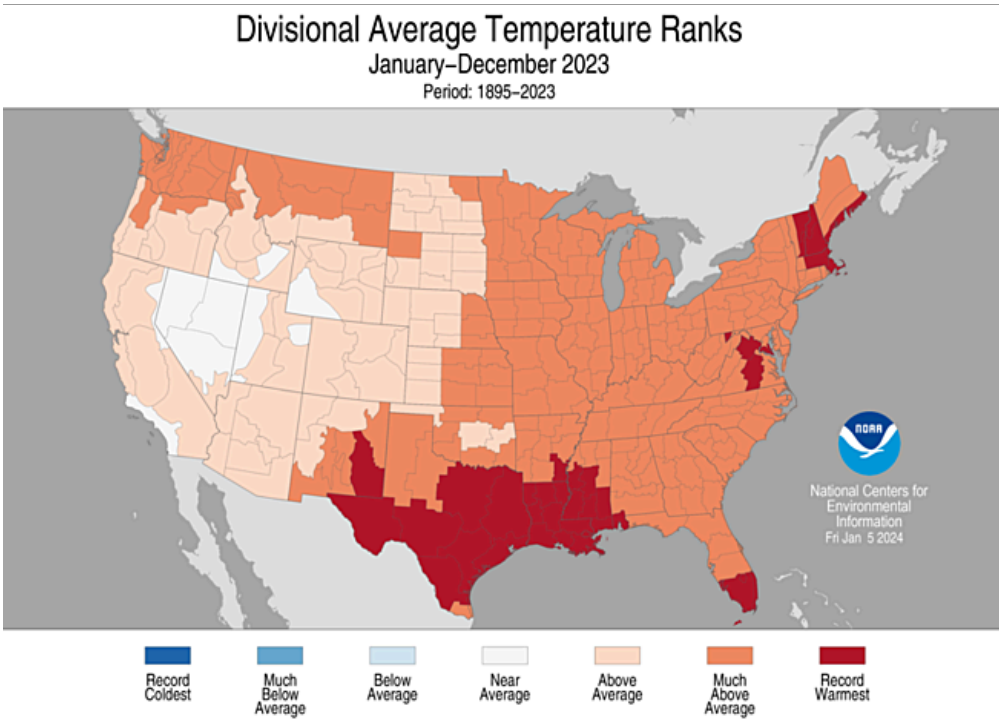


Figure 2. *Average annual temperature as it compares to the average annual temperature for 1895-2023. Source: National Centers for Environmental Information.*

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:

- 2023 Global annual average temperature up **2.12°F** above 20th century average[1]

- 2023 U.S. annual average temperature up **2.4°F** above 20th century average[2]
- 2023 New York annual average temperature up **2.2°F** above the average from 1991-2020[2]

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.[2] As a reference point, by the 2080s, New York City's average temperature is projected to be on par with the 20th century average for Birmingham, Alabama.[3]

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

Table 1. 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. Source: Climate Impacts Assessment[3]

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.[4] Below are Albany sea level rise projections taken from the 2023 Climate Impacts Assessment for New York State which are based on the results from the IPCC 6th Assessment report and show the range from the low-estimate (10th percentiles) to the high-estimate(90th percentile). The table showing the projections of the Sea-level rise with rapid ice melt were taken from NYS 2100 Commission Report. 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. These projections are consistent with the most recent projections released by New York State in the Governor's 2100 Commission report (http://goo.gl/K9ohoi).[5]

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”

Table 2. 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. Source: NYS Climate Impacts Assessments.[3]

		2020s	2050s	2080s	2100
Sea- Level Rise with Rapid Ice Melt	No baseline	4”-9”	17”-26”	37”-50”	52” – 68”

Table 3. Values are the central range (middle 67%) of model-based probabilities. 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. These projections are consistent with the most recent projections released by New York State in the Governor's 2100 Commission report. Source: NYS 2100 Commission Report.[5]

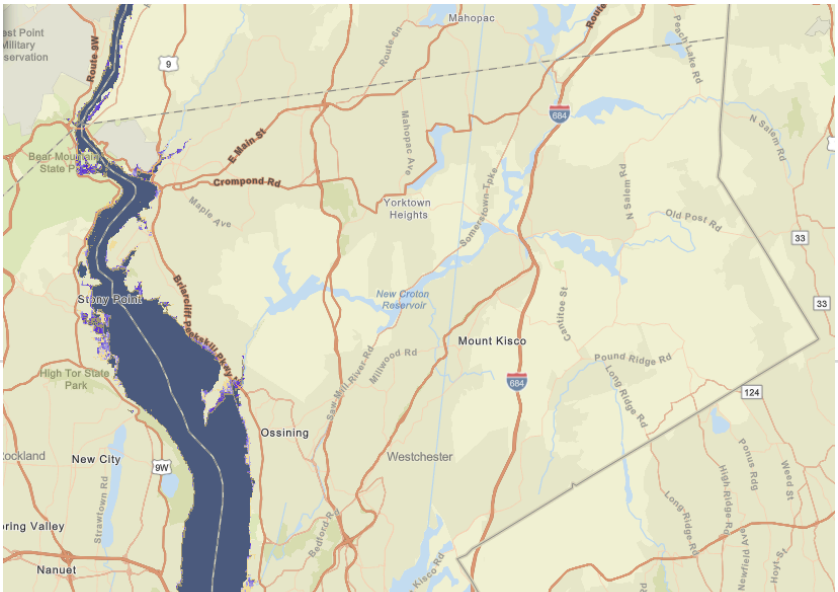


Figure 3. Map of Sea level rise projections for Westchester County shown for six feet of sea level rise. Source: Scenic Hudson's Sea Level Rise Mapper. [6]

Changing precipitation patterns

Precipitation has become more variable and extreme, whereas total rainfall has changed only marginally. **The total annual precipitation in New York State from 1901 – 2022 has increased by 10% to 20%.** Overall, while New York is projected to remain a "water-rich" state, water quality can be affected by increased in total precipitation.[3]

Below you will find a table depicting the projections for the average precipitation (mean precipitation) for the South Hudson River Valley, of which Westchester County is located in. These projections were taken from the NYS Climate Impacts Assessment and are based on the global climate model(GCM) simulations from the latest version of the world climate research programme's Coupled Model Intercomparison project [3]

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%

Table 4. 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. Source: NYS Climate Impacts Assessments.[3]

Climate Risks and Opportunities for Westchester County

An analysis of historical trends in annual average temperature and precipitation were conducted for 27 weather stations across New York State. Below are the results from the Southern Hudson River Valley's Dobbs Ferry weather station in New York State taken from the latest New York State Climate Change Projections.[3]

Annual Average Temperature form 1901-2020 from observed weather stations
❖ Temperature increase for Southern Hudson River Valley - Dobbs Ferry: **0.34 °F/decade**
Trends in Annual Precipitation from 1901–2020 for Observed Weather Stations in New York State
❖ Precipitation increase for Southern Hudson River Valley – Dobbs Ferry: **0.39 inches/decade**

Table 5. Trend is significant at the 99% significance level. Source: Weather Station Data: Dobbs Ferry, NY

Projected Changes in Extreme Events for Dobbs Ferry, New York

	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

Table 6. 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. Source: Stevens, A., & Lamie, C., Eds. (2024). New York State Climate Impacts Assessment: Understanding and preparing for our changing climate. *https://nysclimateimpacts.org*

References

1 NOAA National Centers for Environmental Information, Monthly Global Climate Report for Annual 2023, published online January 2024, retrieved on February 7, 2024 from https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202313.

2 NOAA National Centers for Environmental Information, Monthly National Climate Report for Annual 2023, published online January 2024, retrieved on Jan 31, 2024 from https://www.ncei.noaa.gov/access/monitoring/monthly-report/national/202313.

3 Stevens, A., & Lamie, C., Eds. (2024). New York State Climate Impacts Assessment: Understanding and preparing for our changing climate. https://nysclimateimpacts.org

4 Horton, R., D. Bader, C. Rosenzweig, A. DeGaetano, and W.Solecki. 2014. Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information. New York State Energy Research and Development Authority (NYSERDA), Albany, New York. https://www.nyserda.ny.gov/climaid

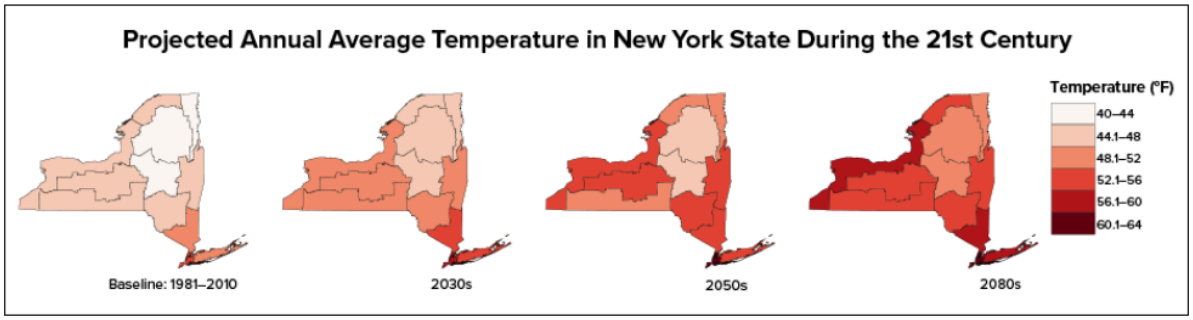
5 Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure NYS 2100 COMMISSION https://www.cakex.org/sites/default/files/documents/NYS2100.pdf.

6 Hudson, Scenic. "Sea Level Rise Mapper ." Scenichudson.Maps.Arcgis.Com*, Scenic Hudson, scenichudson.maps.arcgis.com/apps/MapJournal/index.html?appid=3a3d0dc3884c4637ad0a51f4aa912189. Accessed 31 Jan. 2024.*

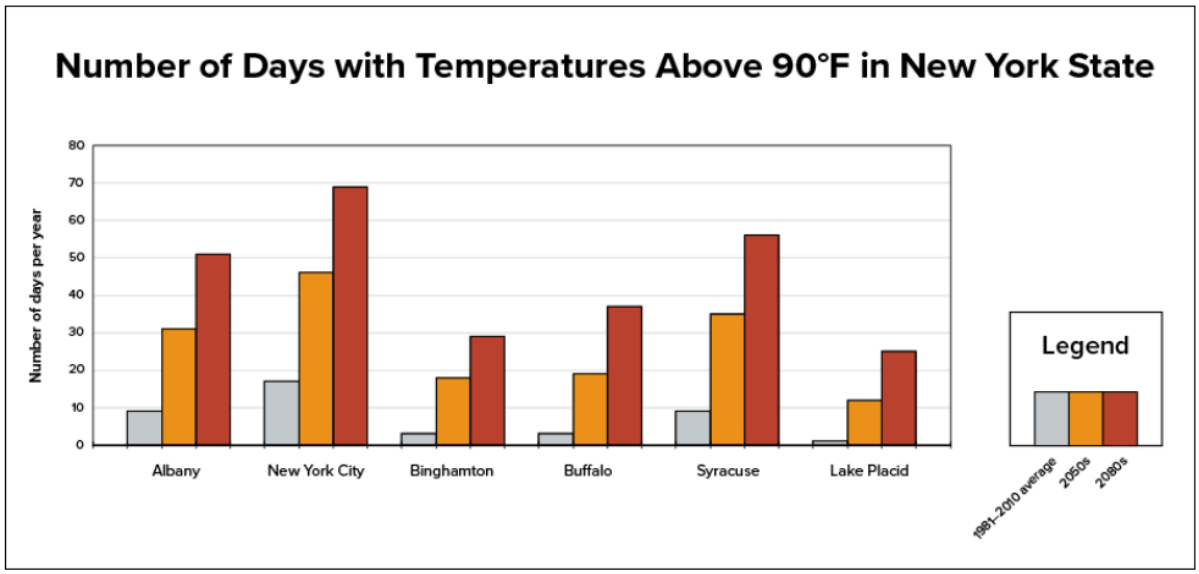
Appendix 1: Alternative Graphics for Climate Summaries

Graphics from Climate Impacts Assessment, 2023.

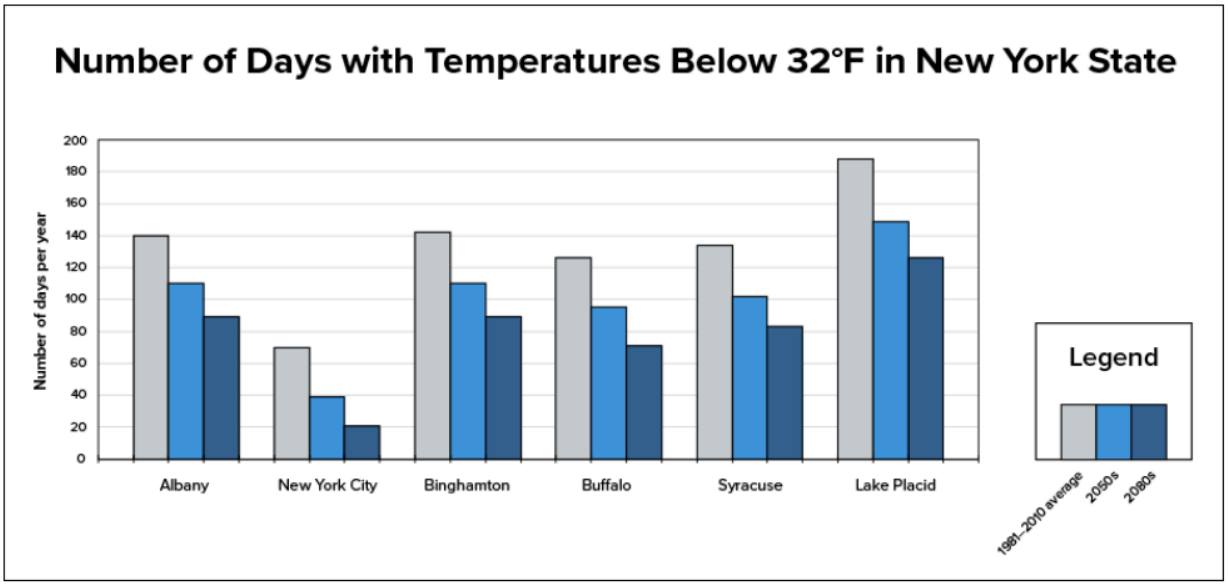
Stevens, A., & Lamie, C., Eds. (2024). New York State Climate Impacts Assessment: Understanding and preparing for our changing climate. https://nysclimateimpacts.org This work is licensed under CC BY 4.0



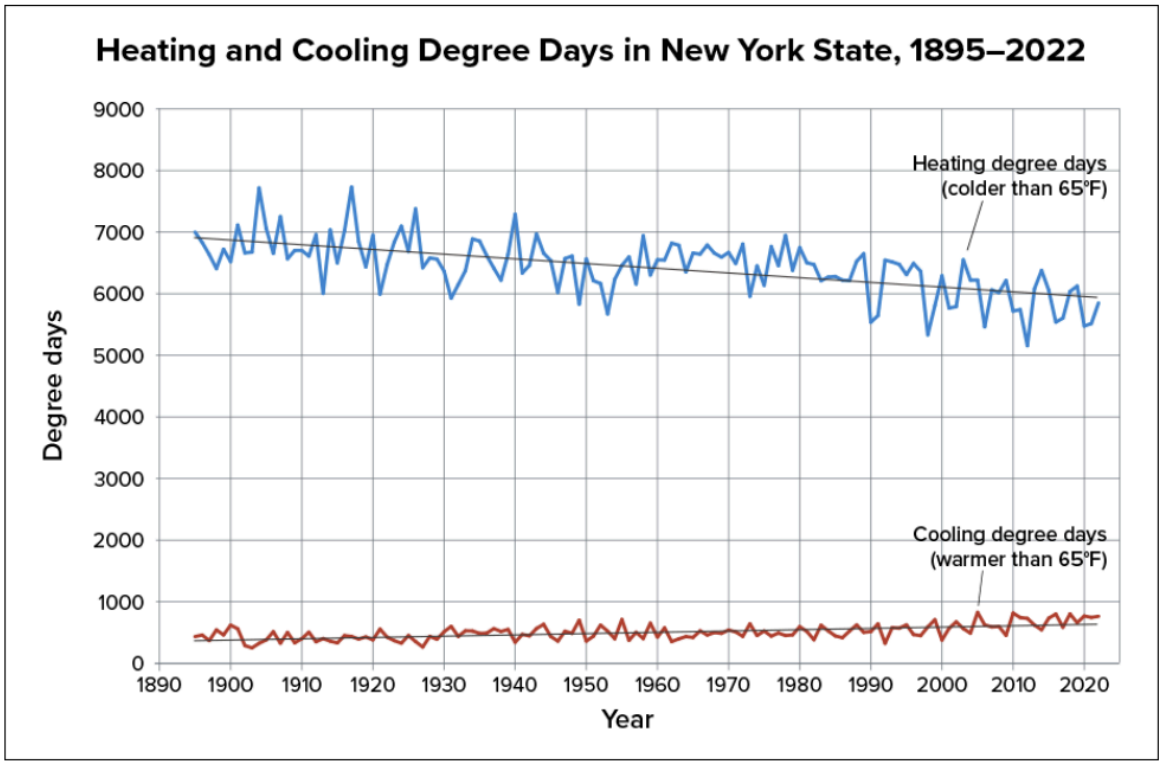
Projected changes to annual average temperatures over the course of the century. Refer to Chapter 2, New York State's Changing Climate, to learn more about this figure. Source: Projections developed for this assessment..



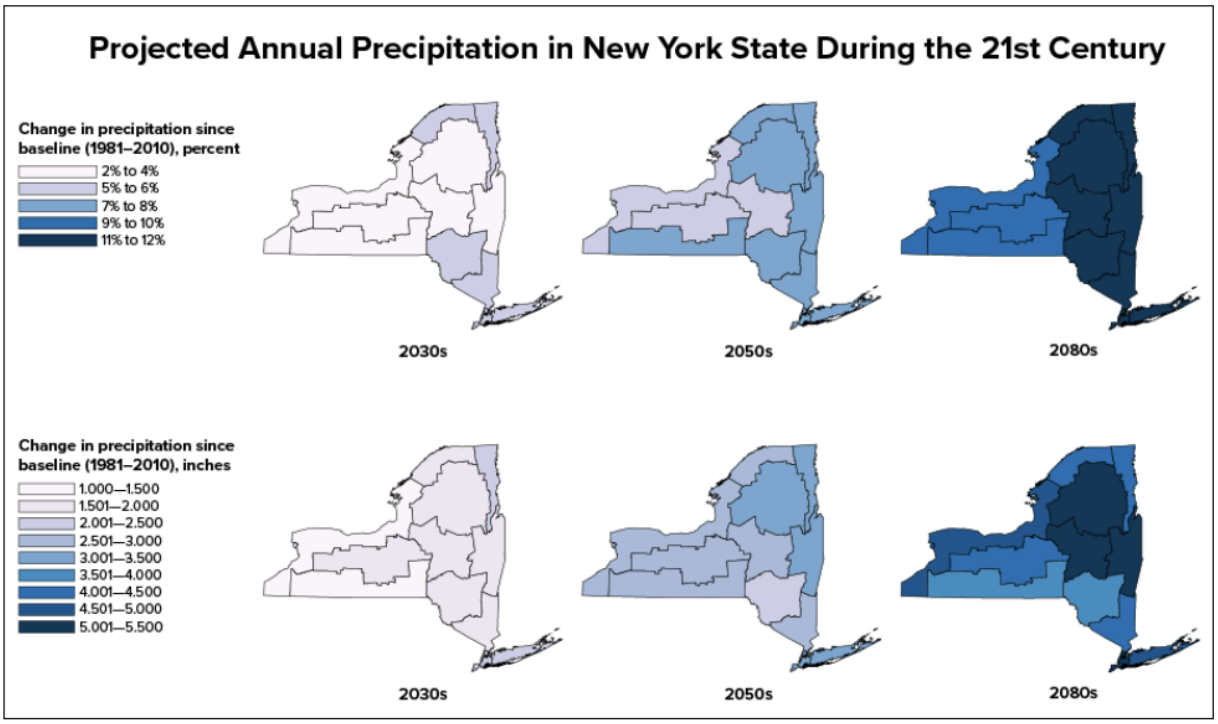
Projected changes to the number of days per year with temperatures above 90°F at six locations across the state. Source: Projections developed for this assessment.



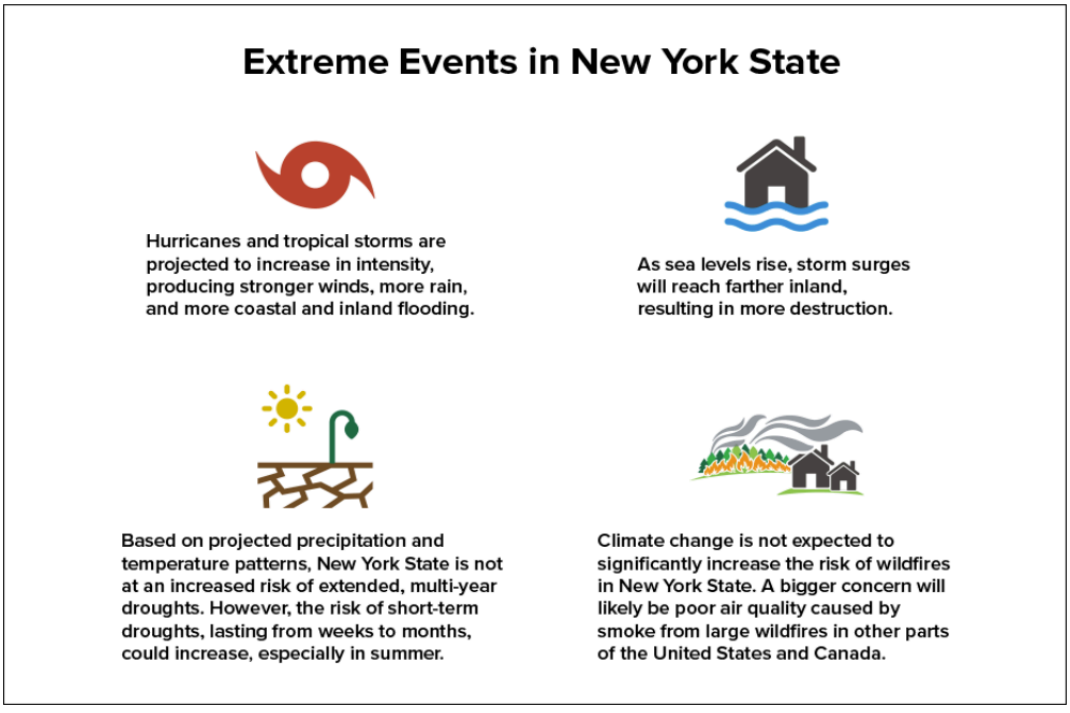
Projected changes to the number of days per year with temperatures below freezing for six locations across the state. Source: Projections developed for this assessment.



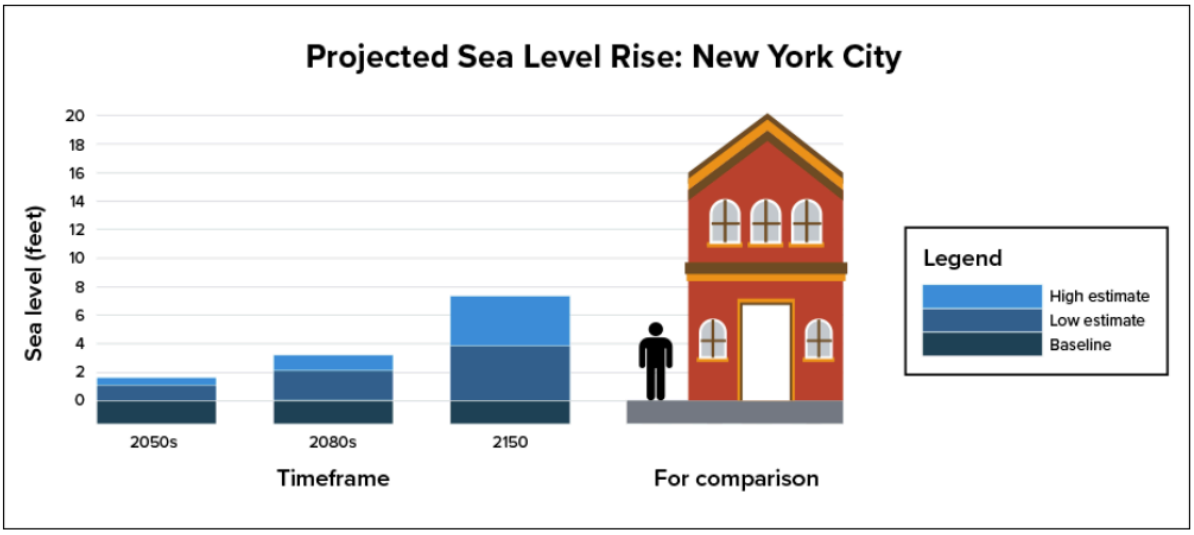
Historical changes to heating and cooling degree days. These trends are projected to continue in the future. Refer to Chapter 2, New York State's Changing Climate, to learn more about this figure. Source: Projections developed for this assessment.



Projected 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.



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.

Appendix 2: Alternative Hazard (for potential inclusion)

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 platinoides)
Oriental Bittersweet (Celastrus orbiculatus)
Oriental Lady's Thumb (Persicaria longiseta, 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)

Appendix 3: Partial List of CAPI Cohort Accomplishments

The below table is a partial accounting of related work and accomplishments from the Westchester CAPI Adapt cohort. Some information may be outdated. It is included to encourage ideas and networking on potential recommended actions and strategies. For feedback or questions, please contact: Jesenia.laureano@dec.ny.gov.

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	✔					✔		✔	✔