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DFS Webinar Series-

Physical Climate Risks in New York: Part 1

Mark Lowery

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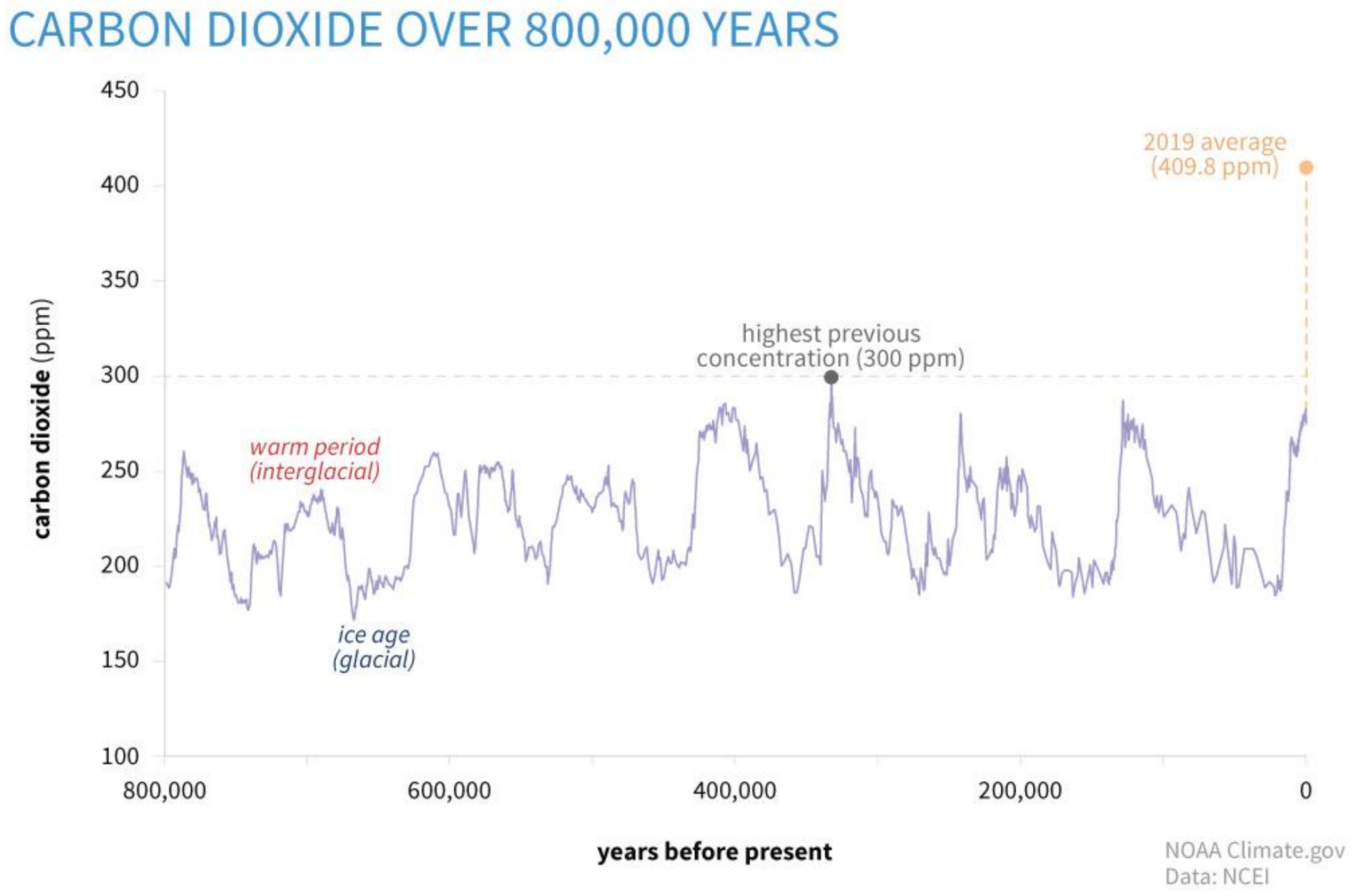
New York State Department of Environmental Conservation

Carbon dioxide over 800,000 years



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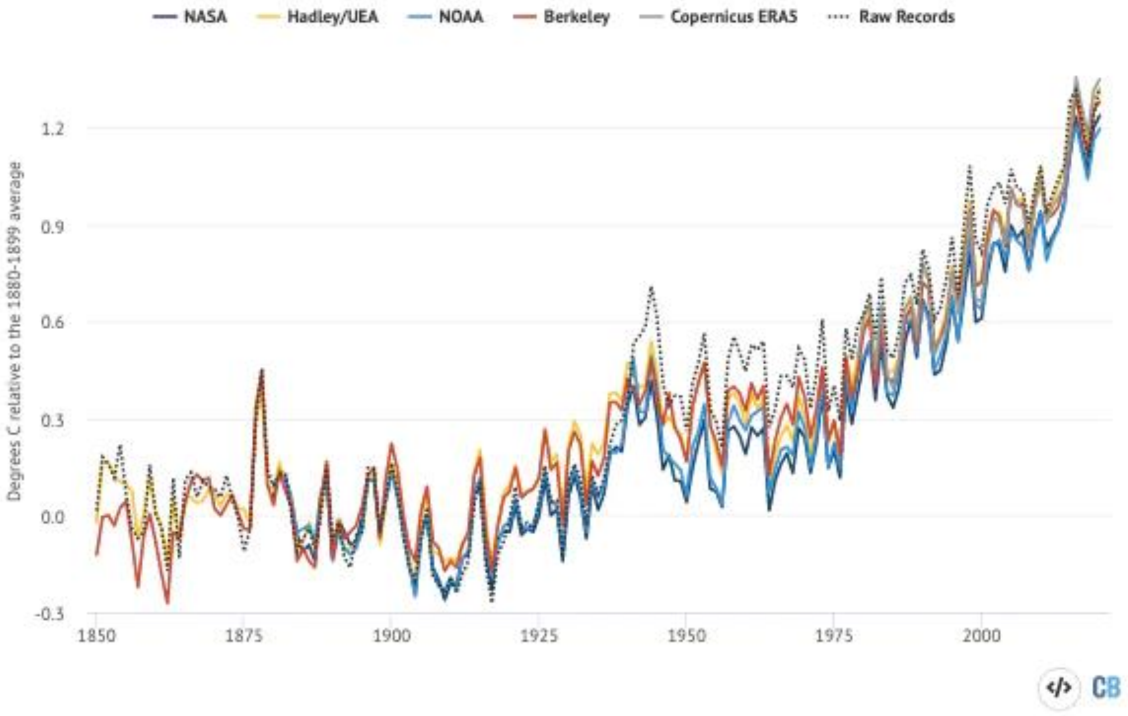
2020: Warmest (or 2nd warmest) on record

Global surface temperature records, 1850-2020



Annual global average surface temperatures from 1850-2020. Data from NASA GISTEMP, NOAA GlobalTemp, Hadley/UEA HadCRUT5, Berkeley Earth and Carbon Brief's raw temperature record. 1979-2000 temperatures from Copernicus ERA5 (as the reanalysis record starts in 1979). Anomalies plotted with respect to a 1880-1899 baseline to show warming since the preindustrial period. Chart by Carbon Brief using Highcharts.

- 2020 and 2016 in a statistical tie
  - 2016 El Niño
  - 2020 La Niña
- 2020 1.2-1.3°C warmer than late 19th century

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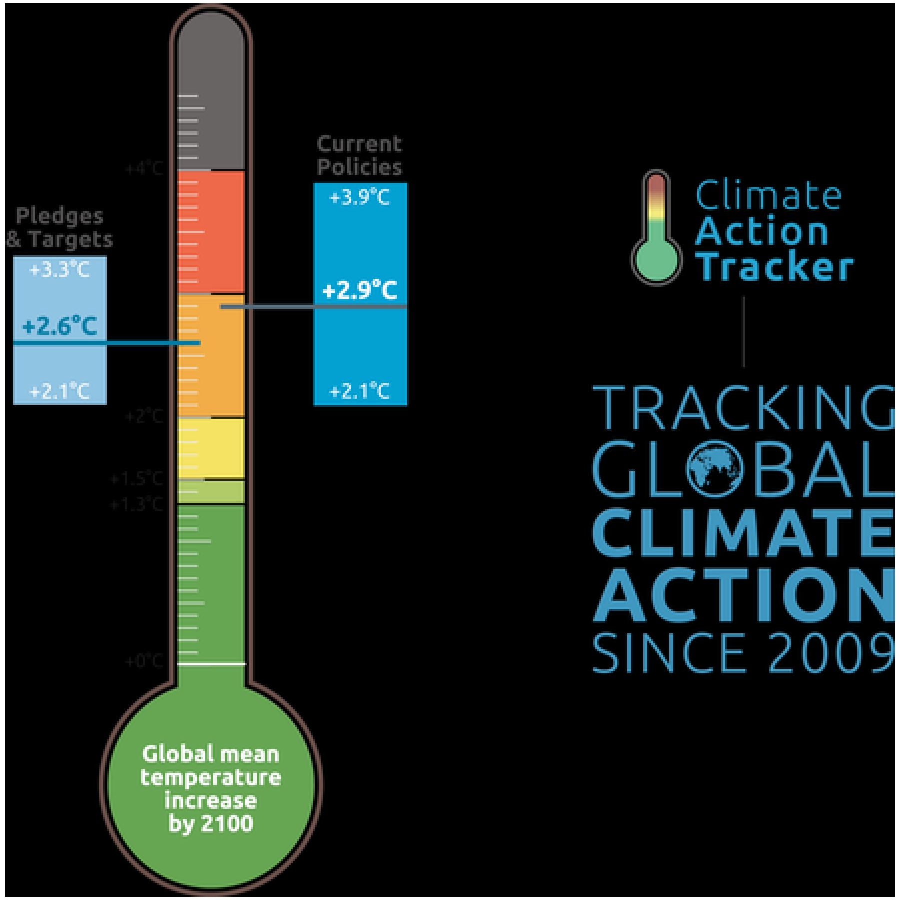
Significant Risk in Continuing GHG Emissions

- Economic damage attributable to climate change in the US will be in the 100s of billions of dollars per year by 2090 under a high emissions scenario – close to our current emissions track (NCA4).
- Even 1.5^{o}C will carry significant risks, and risks are substantially higher at 2^{o}C warming. Allowing warming of 1.5C could trigger feedback loops with the potential to cause runaway warming.(IPCC)
- Current national commitments would lead to a 2.1-3.3^{o}C rise. (Climate Action Tracker)
- On current track we will emit enough greenhouse gases by 2030 to make holding warming to 1.5^{o}C impossible. (IPCC)



Effects in New York

- Higher temperatures
- More precipitation
- More frequent drought
- Sea-level rise
- More extreme events:
  - Floods
  - Heat
  - Ice/snow
  - Winds
  - Coastal storms
- Disease and pests

- Risks to people
- Stressed infrastructure
- Agricultural and ecosystem effects

Conservation Value Notes

Greenpeace International

NYSDEC

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PhillipC/flickr

T.B. Ryder

NYSDEC

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Integrated Climate Assessments

NYS ClimAID

- ClimAID
  - Published in 2011, updated in 2014
  - 24 global climate models
  - 2 Representative Concentration Pathways: 4.5, 8.5
  - 2020s, 2050s, 2080s, 2100
- Quantitative Projections
  - Temperature (mean and extreme events)
  - Precipitation (mean and extreme events
  - Sea-level rise
- Qualitative Projections
  - Heat indices (heat and humidity)
  - Snow and ice storms
  - Lightning
  - Storms and tornadoes

- Sectors

Agriculture	Public Health
Coastal Zones	Telecommunications
Ecosystems	Transportation
Energy	Water Resources

- Climate Assessment Update
  - Economic impacts
  - Projections updates
  - Sector-based impacts and adaptation

www.nyserda.ny.gov/climaid

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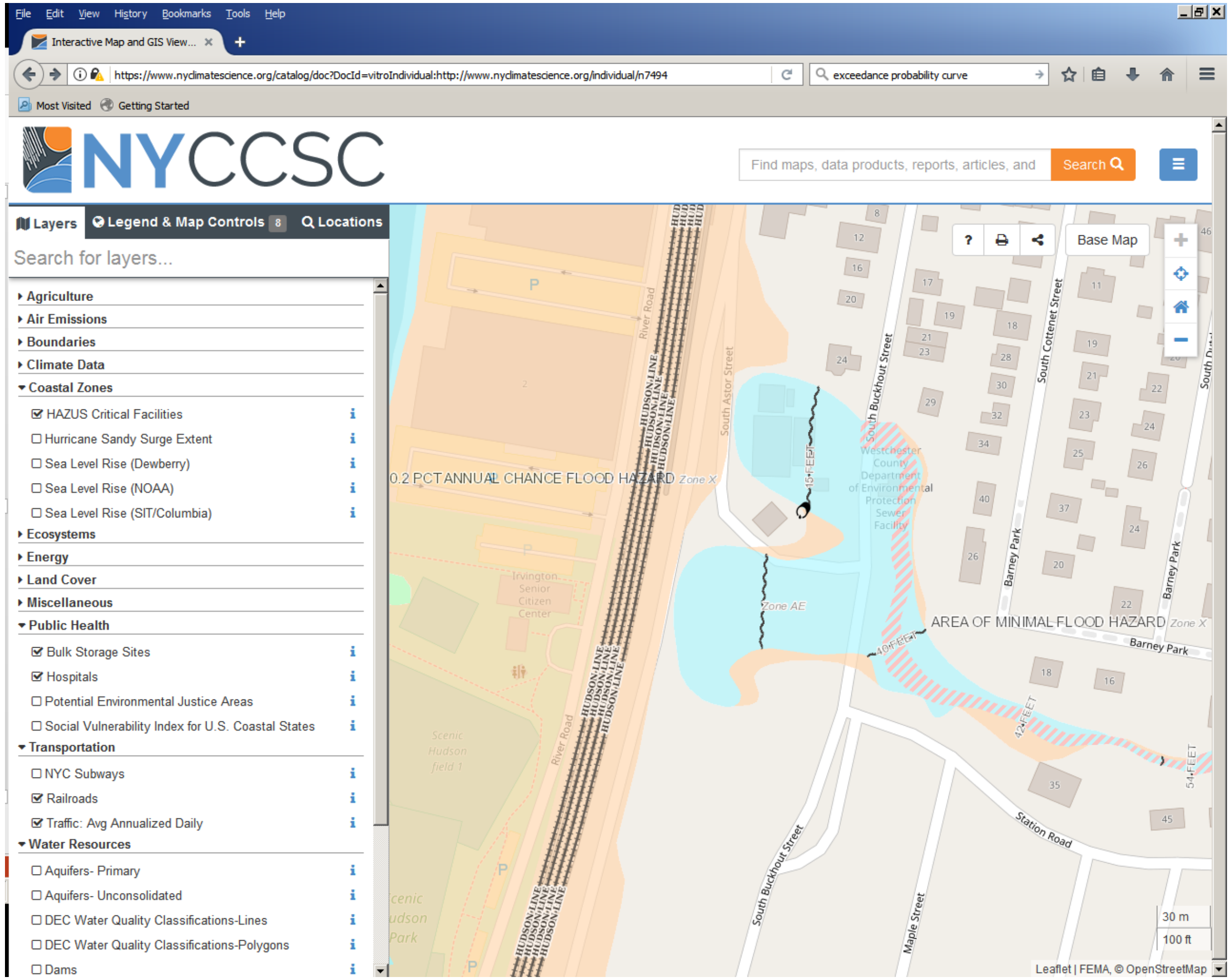
NY Climate Change Science Clearinghouse



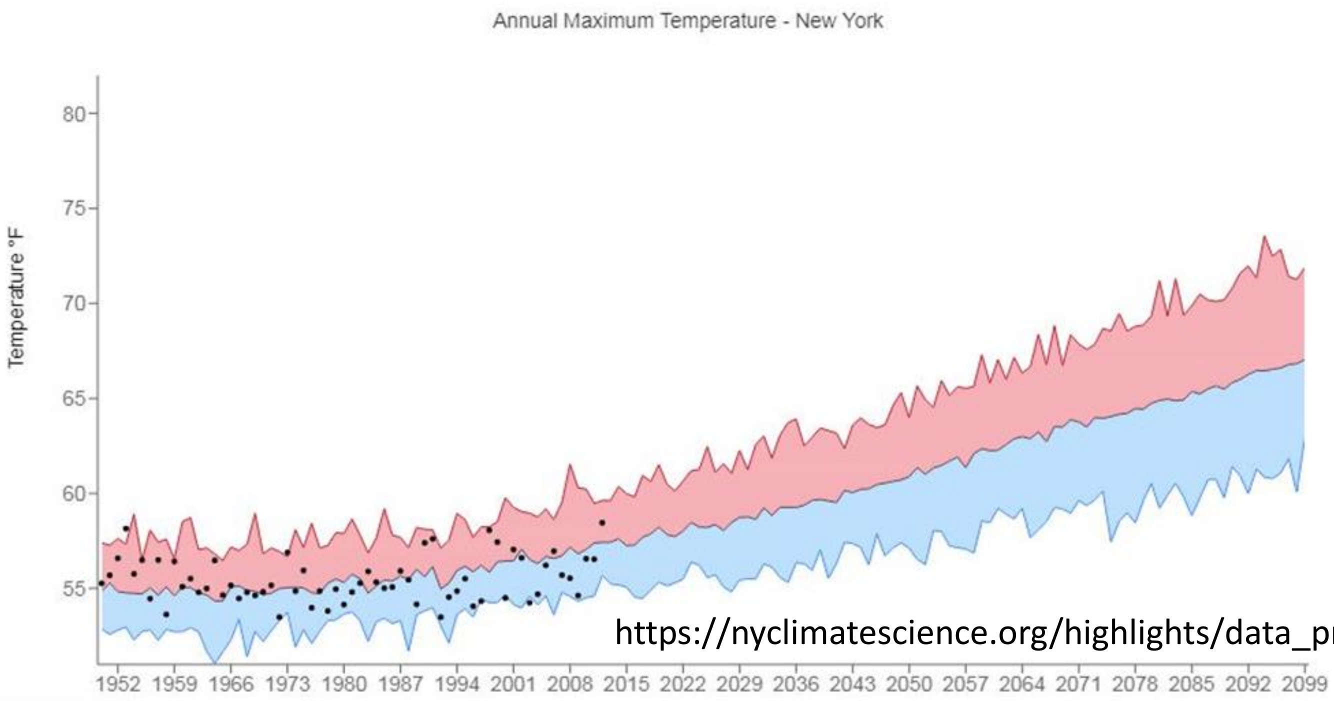
https://www.nyclimatescience.org/

Clearinghouse: Maps, data and documents to support decision making

Climate Data Grapher

Monthly, seasonal, and annual records:

- •Daily maximum temperature (F)
- •Daily minimum temperature (F)
- •Daily average temperature (F)
- •Growing degree day accumulation, base 50 F
- •Heating degree day accumulation, base 65 F
- •Cooling degree day accumulation, base 65 F
- •Counts of days with maximum temperature above 90 F
- •Counts of days with maximum temperature above 95 F
- •Counts of days with maximum temperature above 100 F
- •Counts of days with minimum temperature below 0 F
- •Counts of days with minimum temperature below 32 F
- •Total precipitation (inches)
- •Total snowfall (inches; station data only)
- •Maximum daily snow depth (inches; station data only)
- •Counts of days with precipitation greater than 1 inch
- •Counts of days with precipitation greater than 2 inches
- •Counts of days with precipitation greater than 4 inches
- •Counts of days with snow depth greater than 1 inch (station data only)
- •Growing season length (station data only)



https://nyclimatescience.org/highlights/data_products

Observed and CMIP5 projected climate data at county and river-basin levels

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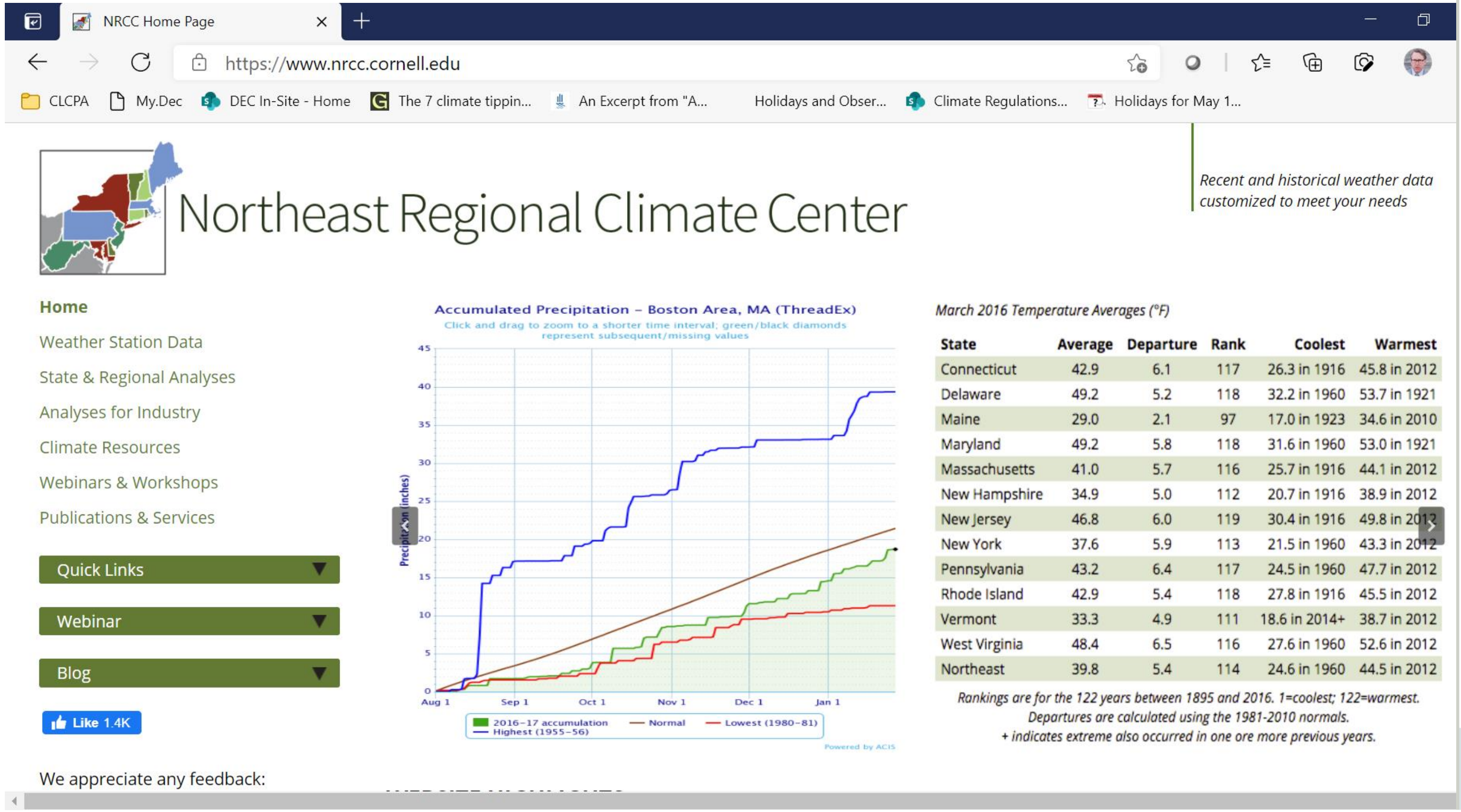
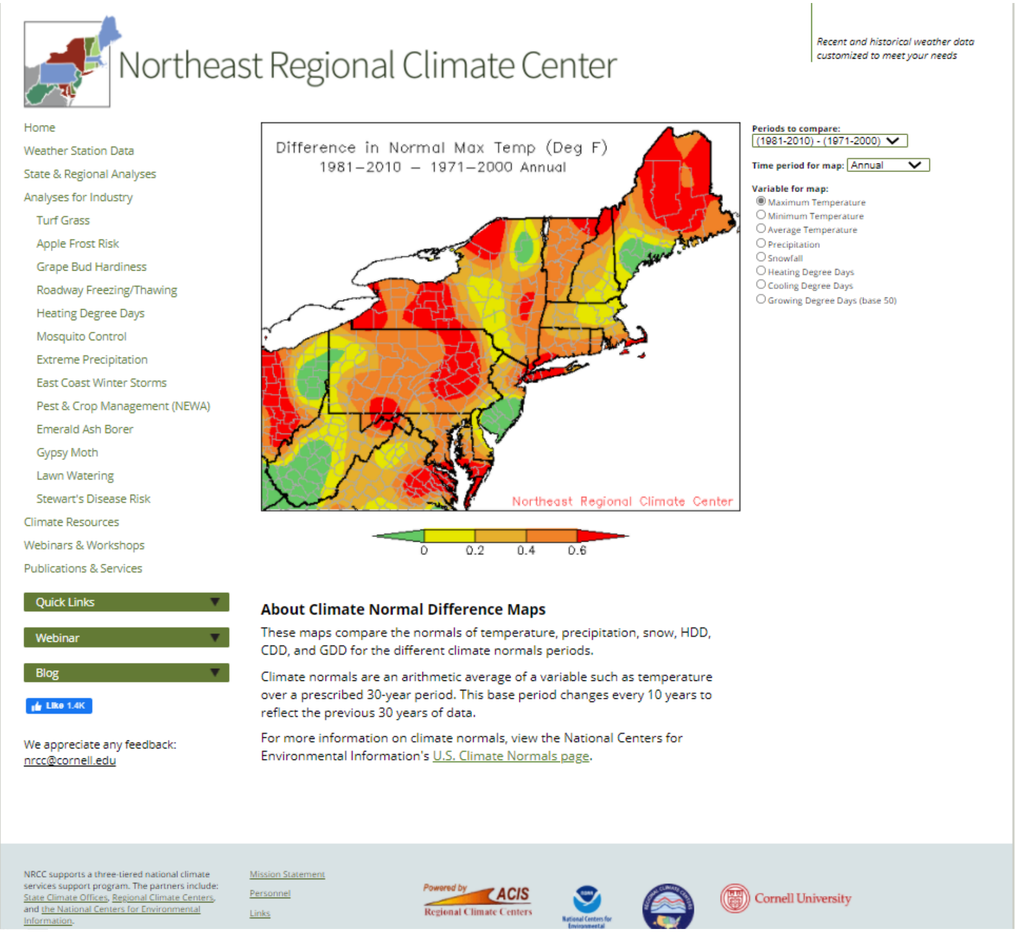
Northeast Regional Climate Center



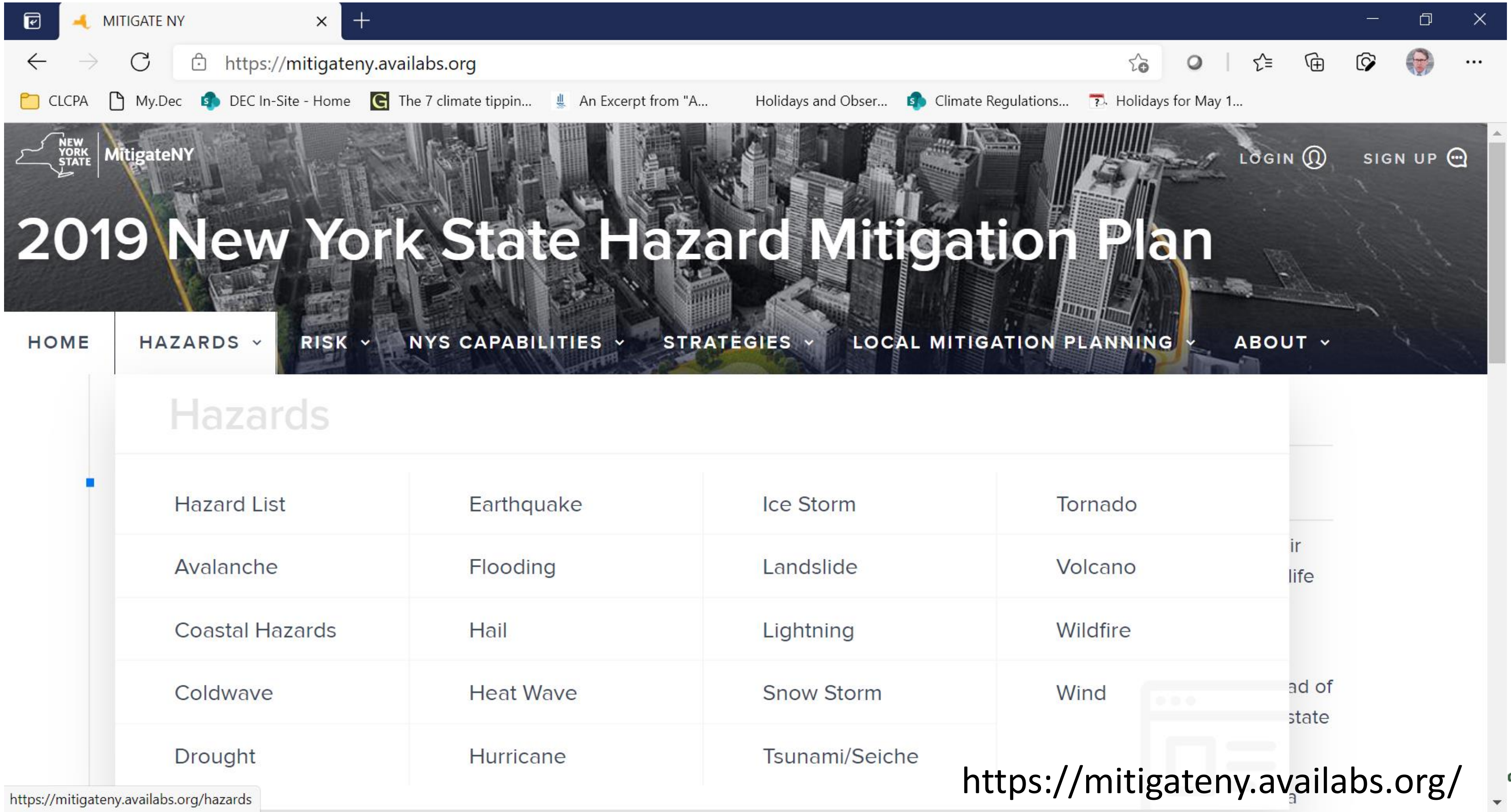
State	Average	Departure	Rank	Coolest	Warmest
Connecticut	42.9	6.1	117	26.3 in 1916	45.8 in 2012
Delaware	49.2	5.2	118	32.2 in 1960	53.7 in 1921
Maine	29.0	2.1	97	17.0 in 1923	34.6 in 2010
Maryland	49.2	5.8	118	31.6 in 1960	53.0 in 1921
Massachusetts	41.0	5.7	116	25.7 in 1916	44.1 in 2012
New Hampshire	34.9	5.0	112	20.7 in 1916	38.9 in 2012
New Jersey	46.8	6.0	119	30.4 in 1916	49.8 in 2012
New York	37.6	5.9	113	21.5 in 1960	43.3 in 2012
Pennsylvania	43.2	6.4	117	24.5 in 1960	47.7 in 2012
Rhode Island	42.9	5.4	118	27.8 in 1916	45.5 in 2012
Vermont	33.3	4.9	111	18.6 in 2014+	38.7 in 2012
West Virginia	48.4	6.5	116	27.6 in 1960	52.6 in 2012
Northeast	39.8	5.4	114	24.6 in 1960	44.5 in 2012

Rankings are for the 122 years between 1895 and 2016. 1=coolest; 122=warmest.
Departures are calculated using the 1981-2010 normals.
+ indicates extreme also occurred in one ore more previous years.



https://www.nrcc.cornell.edu/

New York State Hazard Mitigation Plan



https://mitigateny.availabs.org/

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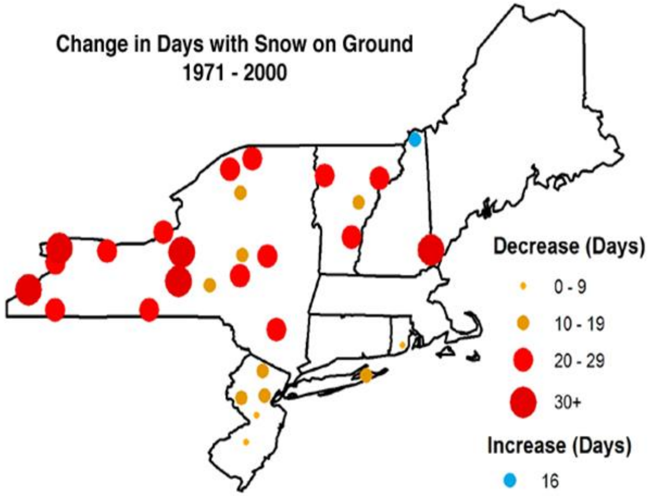
Increased Mean Annual Temperature (very likely)

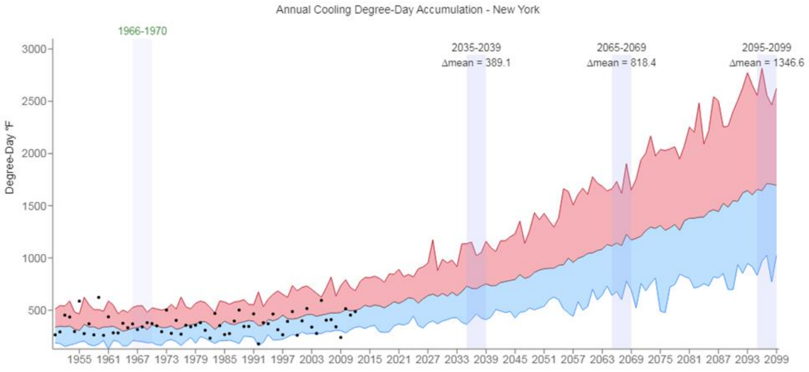
NYS since 1970

- Annual mean +1.3°C (2.3°F)
- Winter mean +2.4°C (4.3°F)
- Less snow cover



Projections (Capital Region)

- Warmer!
  - up to 3.9°C by 2050s
  - up to 6.3°C by 2080s
  - up to 7.6°C (13.6°F) by 2100

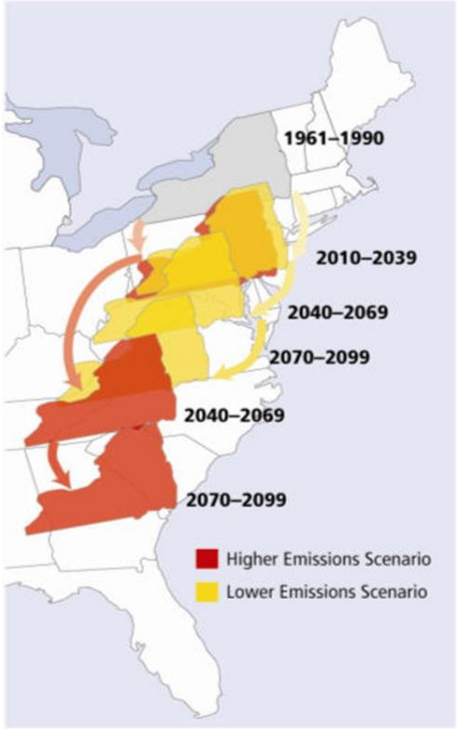


Observed

YEAR	VALUE	MEAN
1970	372.5	-
1966-1970	-	362.5

Modeled

YEAR	MIN	MEAN	MAX	Δ min	Δ mean	Δ max
1966-1970	198.8	337.1	523	0.0	0.0	0.0
2034-2039	415.5	726.2	1104.7	216.7	389.1	581.7
2064-2069	679.3	1155.5	1713.5	480.5	818.4	1190.5
2094-2099	925.3	1683.7	2603.7	726.5	1346.6	2080.7



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Vulnerabilities to Increasing Temperature

- Increased strain on A/C capacity
- Increased demand on water supplies
- Increased algal growth in water bodies
- Insects see more generations per season
- Increased weed, disease, and insect pressure
- Reduced water cooling capacity
- Sagging power lines
- Wear on transformers
- Increased energy demand
- Increased strain on runway material
- Rail buckling
- Increased strain on bridge materials

More Extreme-heat Events (very likely)

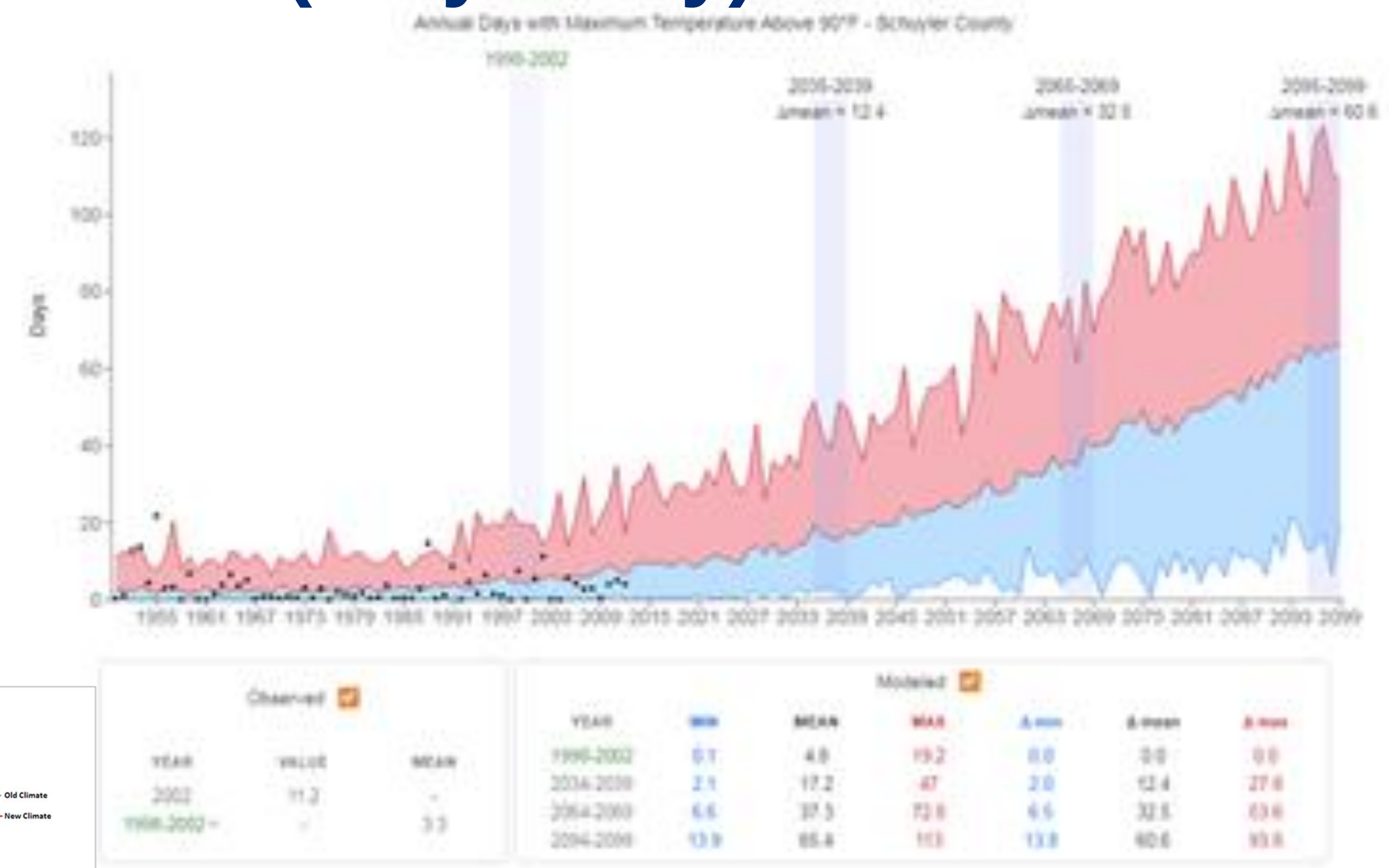
<u>Capital Region</u>

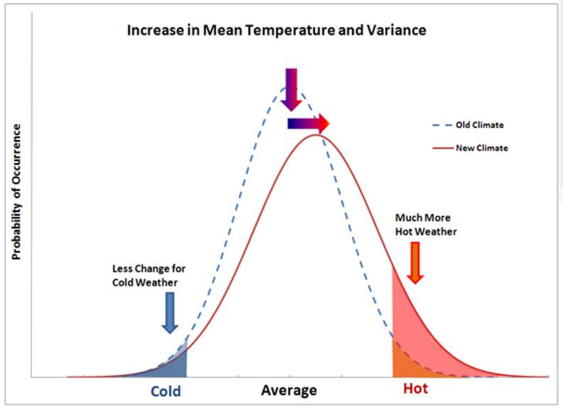
More extreme heat days (> 90°F)

- 14 to 23 days by 2020s (instead of 10!)
- 27 to 82 days by 2080s

More heat waves

- 2 to 4 by 2020s (instead of 1!)
- 4 to 9 by 2080s





Adapted from IPCC (2001)

Vulnerabilities to Extreme Heat Events

- Increased strain on A/C capacity
- Crop and livestock stress
- Increased energy demand/power failures
- Increased strain on runway material
- Rail buckling
- Increased strain on bridge materials

AP Photo/Peter Morgan

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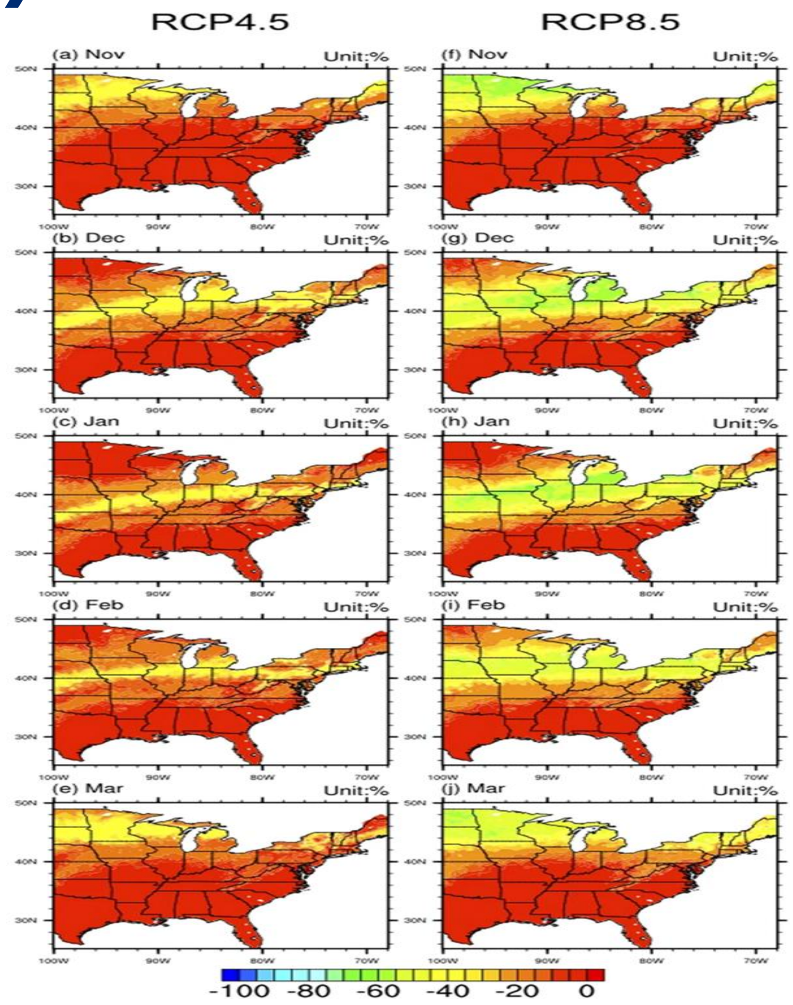
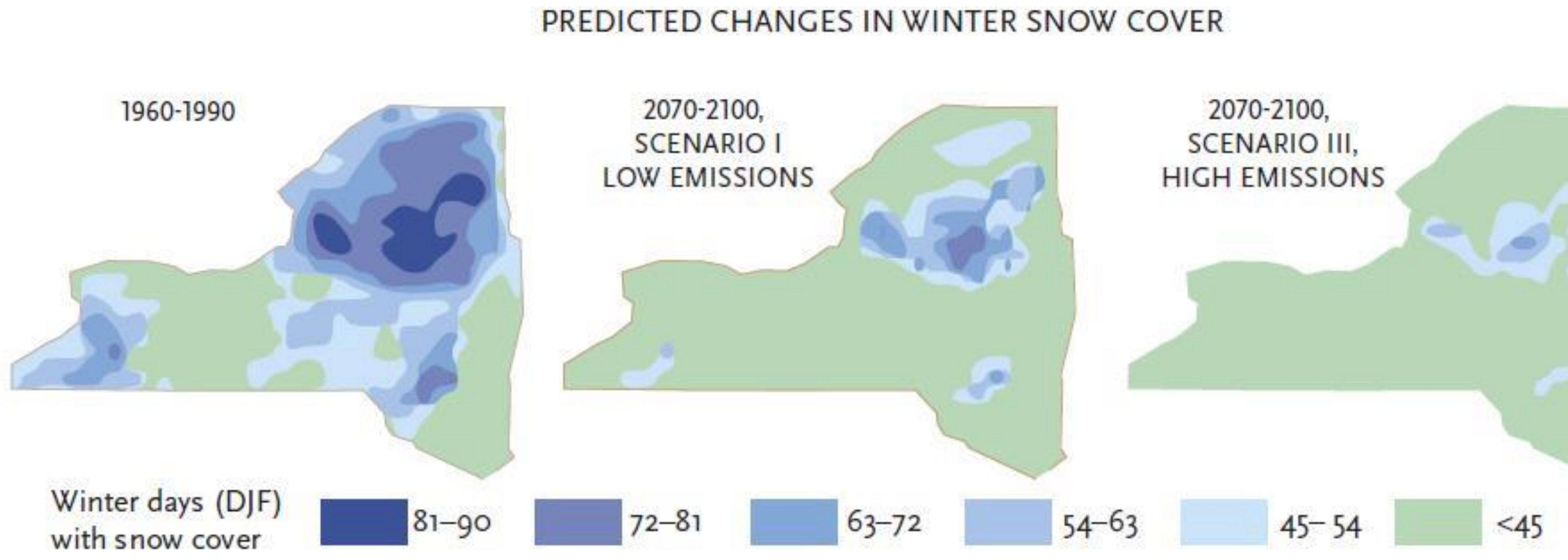
Warmer winters (very likely)

- Longer growing season
- Earlier blooming of perennials
- Not enough freeze days for certain crops
- Increased freeze or frost damage of woody perennials
- Potential changes in sap flow
- Increased winter survival of deer populations
- Increased survival of insect pests
- Earlier arrival of migratory birds
- Northward expansion of invasive weeds



Changes in ensemble averaged snow frequency relative to historical simulation (Unit: %). Ning et al., 2015.

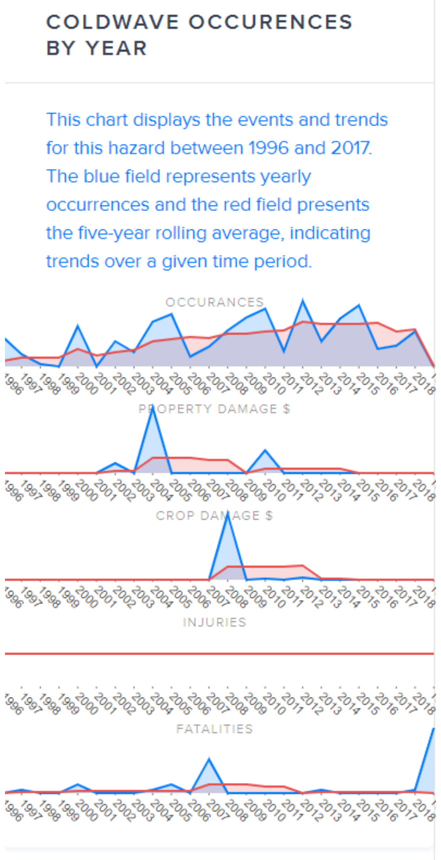
Recreation and Tourism Effects



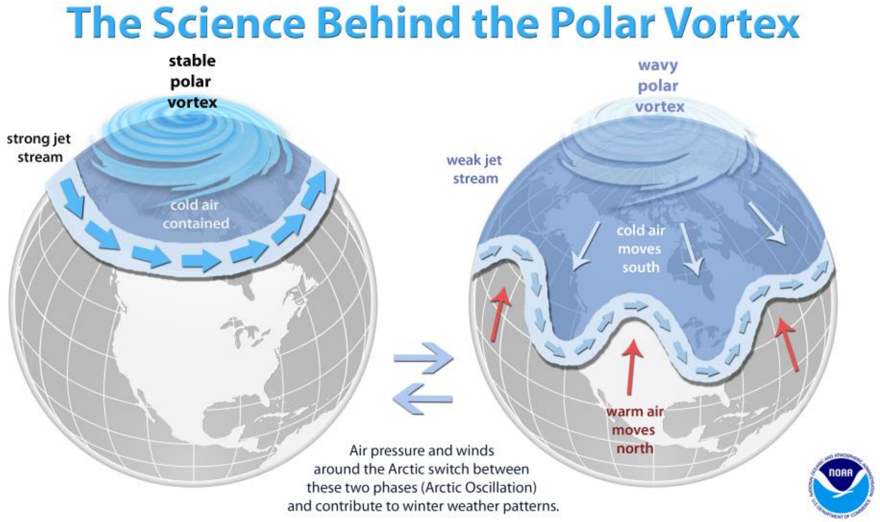
From: Climate Change in the Adirondacks, J. Jenkins

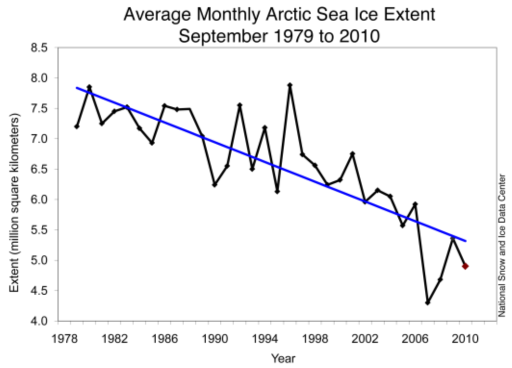
Fewer Extreme Cold Events (likely overall, but potential for extreme cold)

- Extreme Cold
  - Damage to property, public infrastructure
  - Crop damage
  - Demand for electricity (heating)
  - Fatalities



Source: NOAA NCEI Storm Events Dataset





https://mitigateny.availabs.org/hazards/coldwave

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Increased mean annual precipitation (more likely than not)

Region 1 (Rochester) – Precipitation

Baseline (1971-2000) 34.0 inches	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	0 percent	+ 2 to + 7 percent	+ 8 percent
2050s	+ 2 percent	+ 4 to + 10 percent	+ 12 percent
2080s	+ 1 percent	+ 4 to + 13 percent	+ 17 percent
2100	- 3 percent	+ 4 to + 19 percent	+ 24 percent

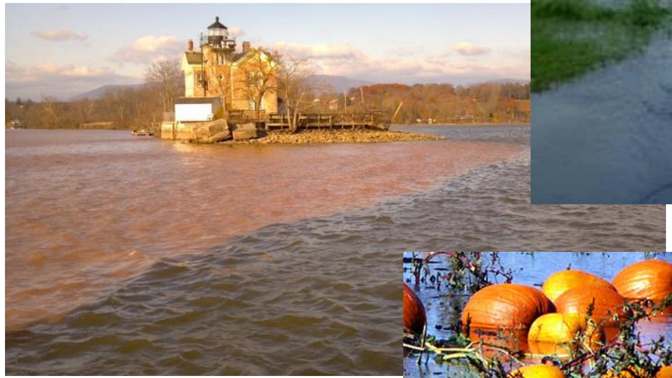
Region 4 (New York City) – Precipitation

Baseline (1971-2000) 49.7 inches	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
2020s	- 1 percent	+ 1 to + 8 percent	+ 10 percent
2050s	+ 1 percent	+ 4 to + 11 percent	+ 13 percent
2080s	+ 2 percent	+ 5 to + 13 percent	+ 19 percent
2100	- 6 percent	- 1 to + 19 percent	+ 25 percent

- Increased across state since 1900
- More variable
- Shift to winter
- Projections less certain than for temperature

Vulnerabilities to Increased Mean Annual Precipitation/Flooding

- Urbanized watersheds rapidly aggregate water and have a limited capacity to attenuate rainfall inputs flow/flooding in large basins
- Increased turbidity of water supply reservoirs
- Increased flooding of wastewater treatment plants
- Increased flooding resulting in inability to access agricultural fields during critical times
- Increased flooding risk could delay spring planting and harvest
- Increased soil compaction because of tractor use on wet soils



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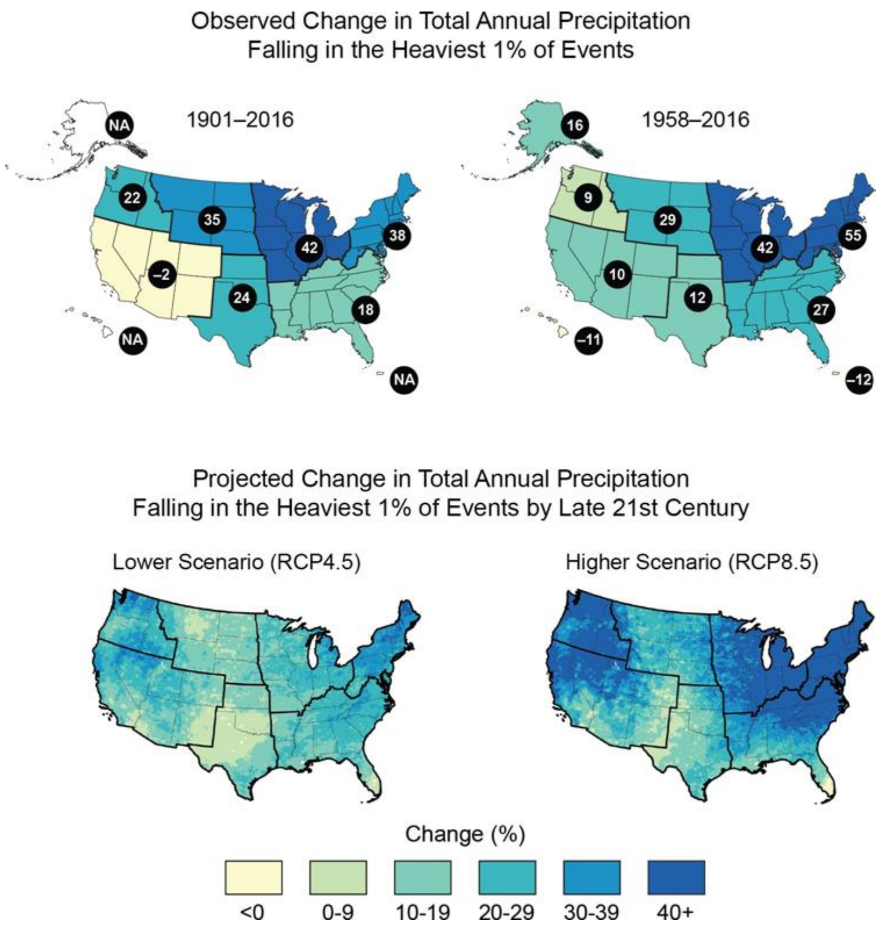
Extreme Precipitation/Flooding (more likely than not)

- Primary weather hazard in NYS
- "Where it rains, it can flood"
- Significant shift to extreme precipitation events, more to come
- 1996-2018 (not including hurricanes)
  - Avg. annual loss: $130 million
  - Avg. annual flooding episodes: 80
  - Avg. annual severe flooding episodes: 7
  - Total flooding fatalities: 84



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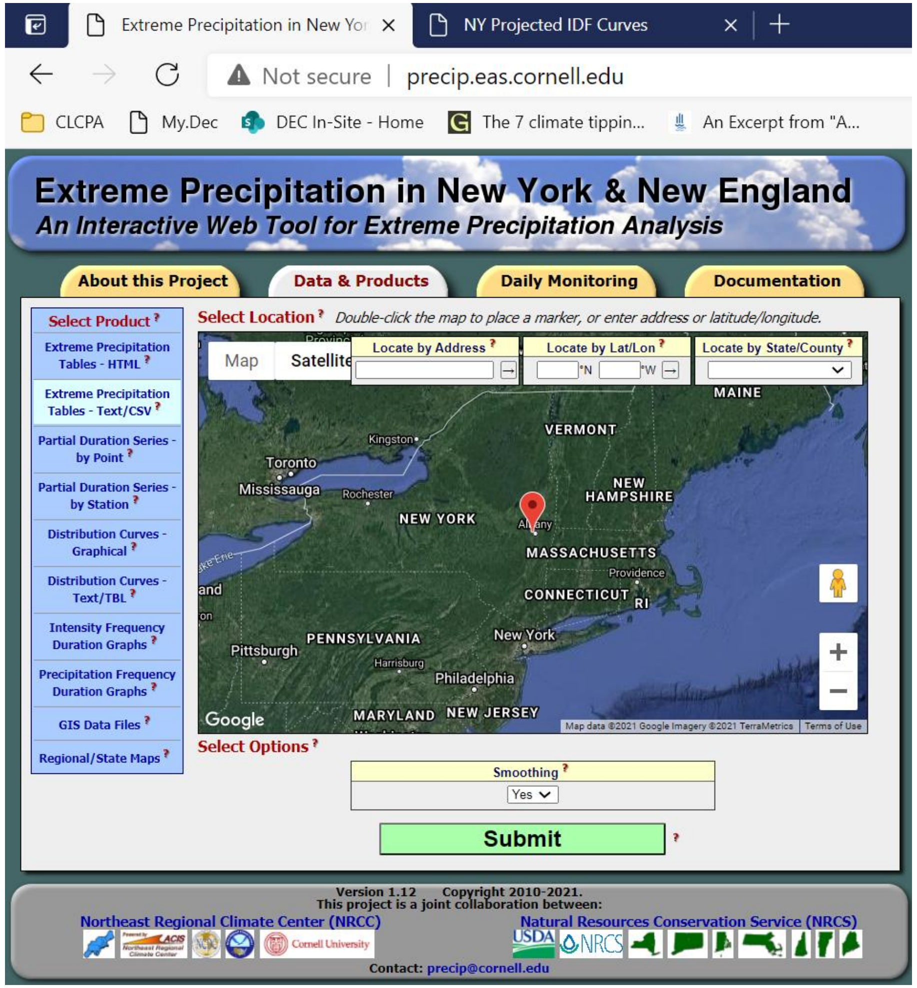
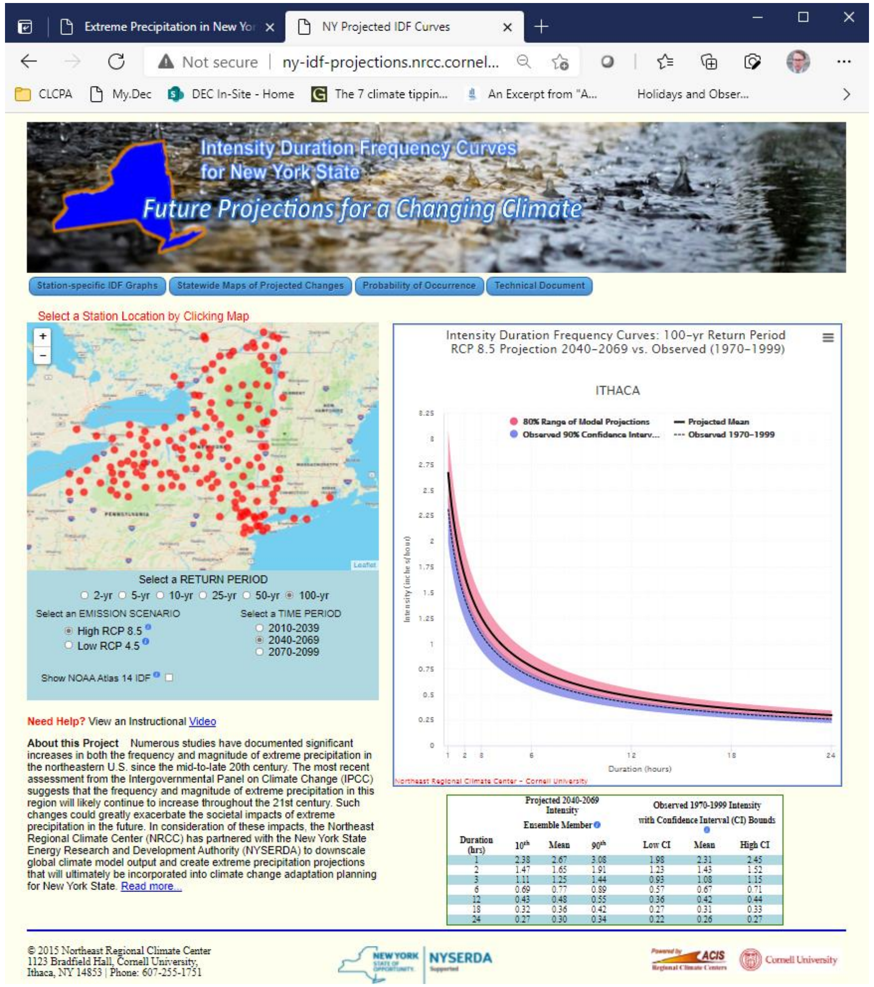
Resources: Future Extreme Precipitation





http://precip.eas.cornell.edu/

http://ny-idf-projections.nrcc.cornell.edu/

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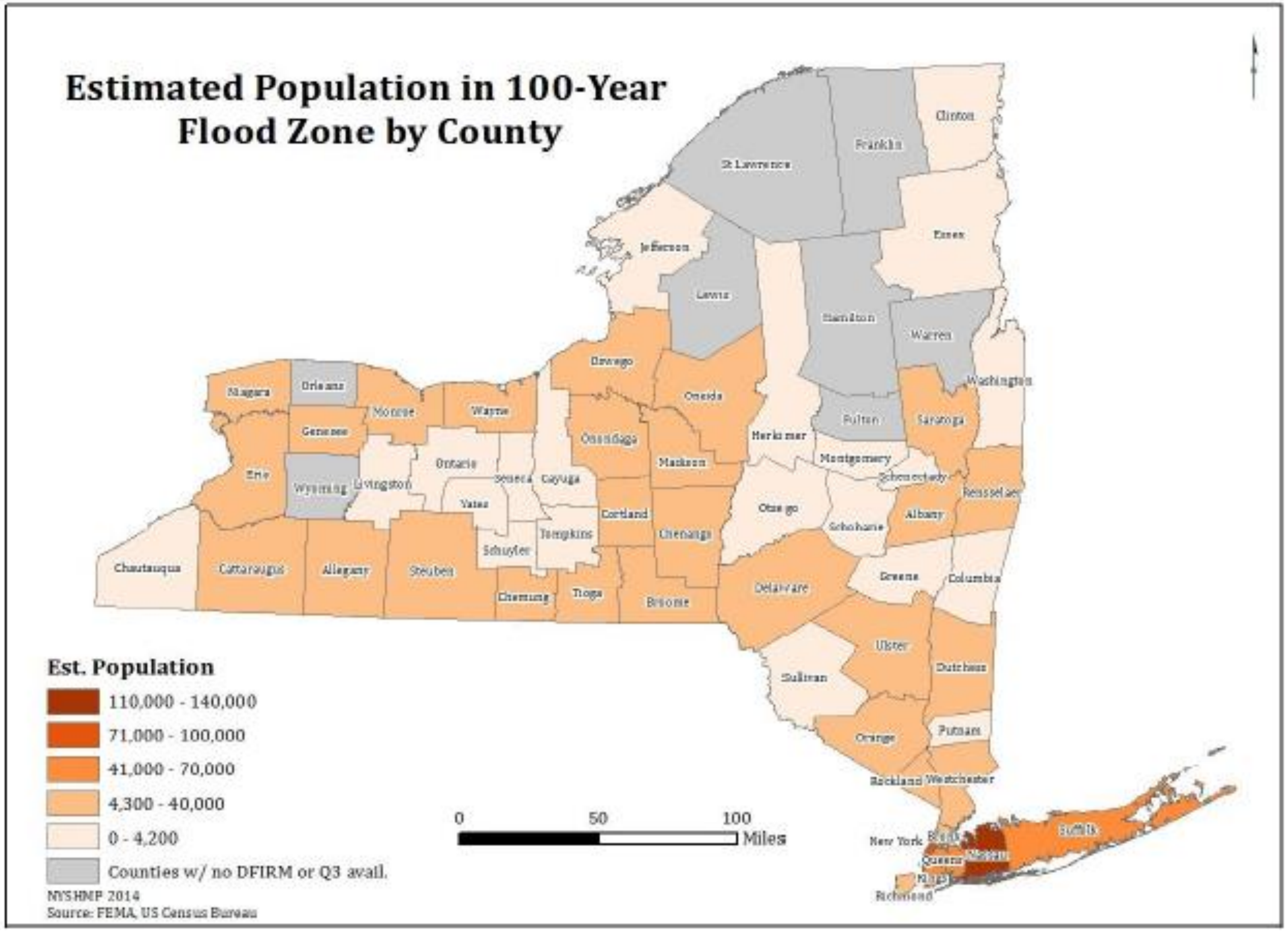
Flood Risk in New York



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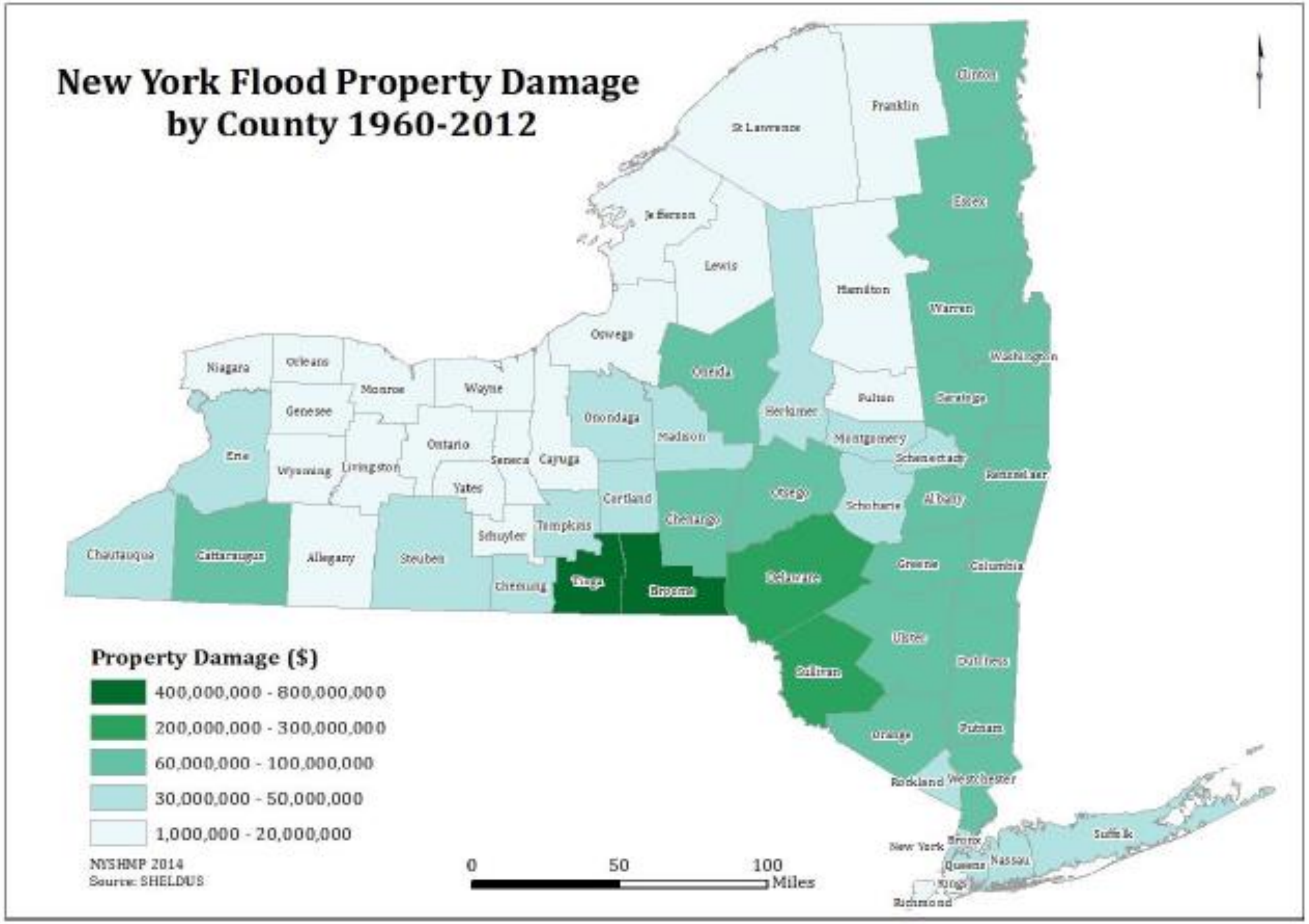
Flood Risk in New York



NYS Insured Losses

Decade	Losses (millions)
1950s	$44
1960s	$37
1970s	$866
1980s	$152
1990s	$757
2000s	$762
2010s	$11,547

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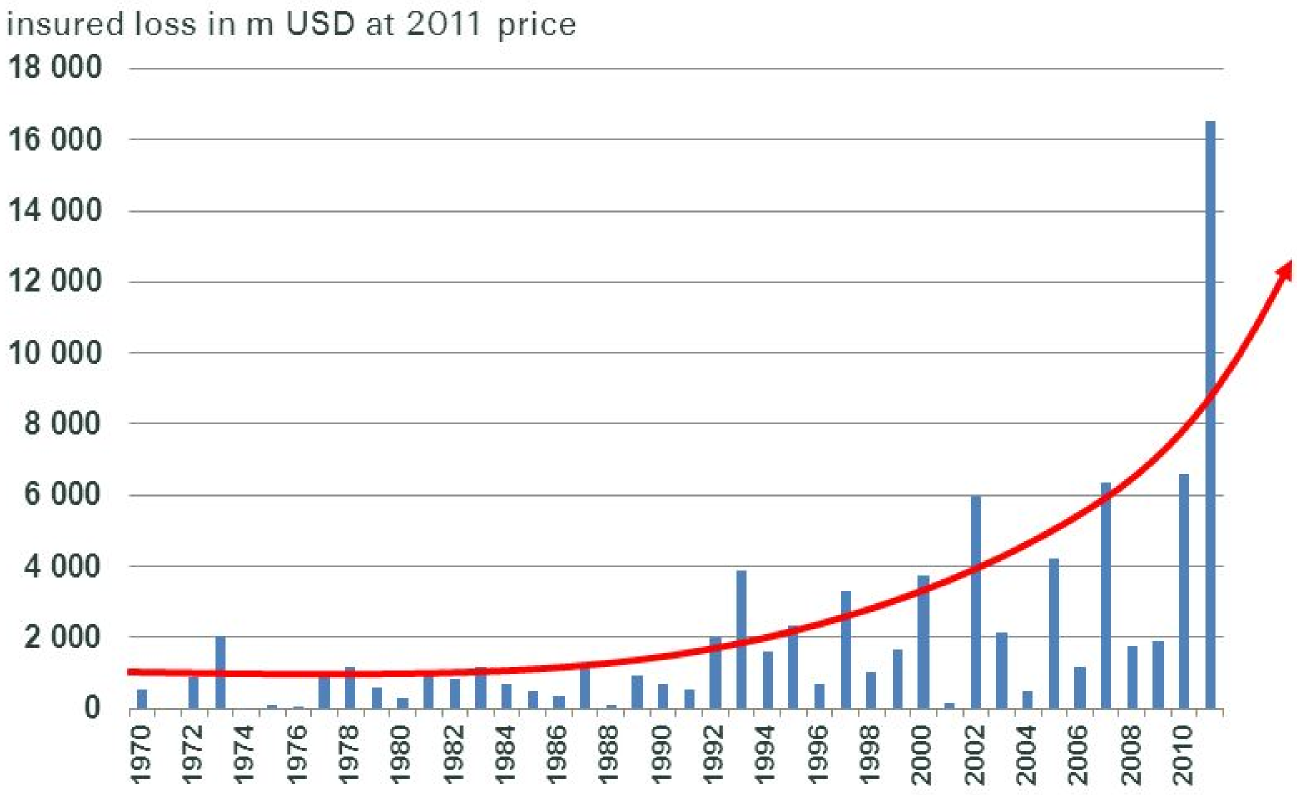
Increasing Flood Damage Nationally



- National flood damage costs are increasing
  - Function of changing precipitation, floodplain development, real estate values
  - Ca. 33% losses in X zone
  - Riverine SFHAs 45% broader and deeper by 2100, 55% for coastal SFHAs
- NFIP premiums 10 to 70% higher

Vulnerabilities to Extreme Precipitation/Flooding

- Increased runoff and reduced infiltration of rain into natural ground cover and soils
- Stress on crops, especially if extreme events occur in clusters
- Low lying areas susceptible to more frequent flooding
- Increased scour potential for bridge foundations
- Damage to road and rail embankments
- Spread of contamination
- Mudslides and landslides

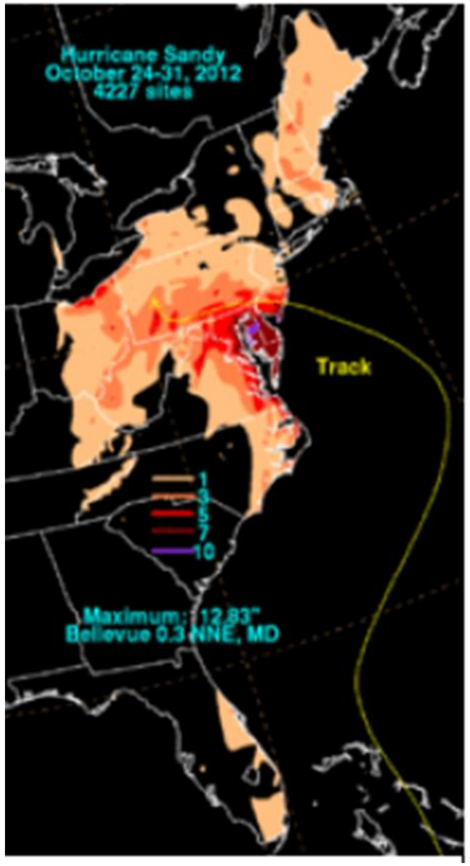
Community Risk and Resiliency Act Guidance Documents

- Using Natural Measures to Reduce the Risk of Flooding and Erosion
- New York State Flood Risk Management Guidance
- Guidance for Smart Growth Public Infrastructure Assessment
- Estimating Guideline Elevations

https://www.dec.ny.gov/energy/102559.html

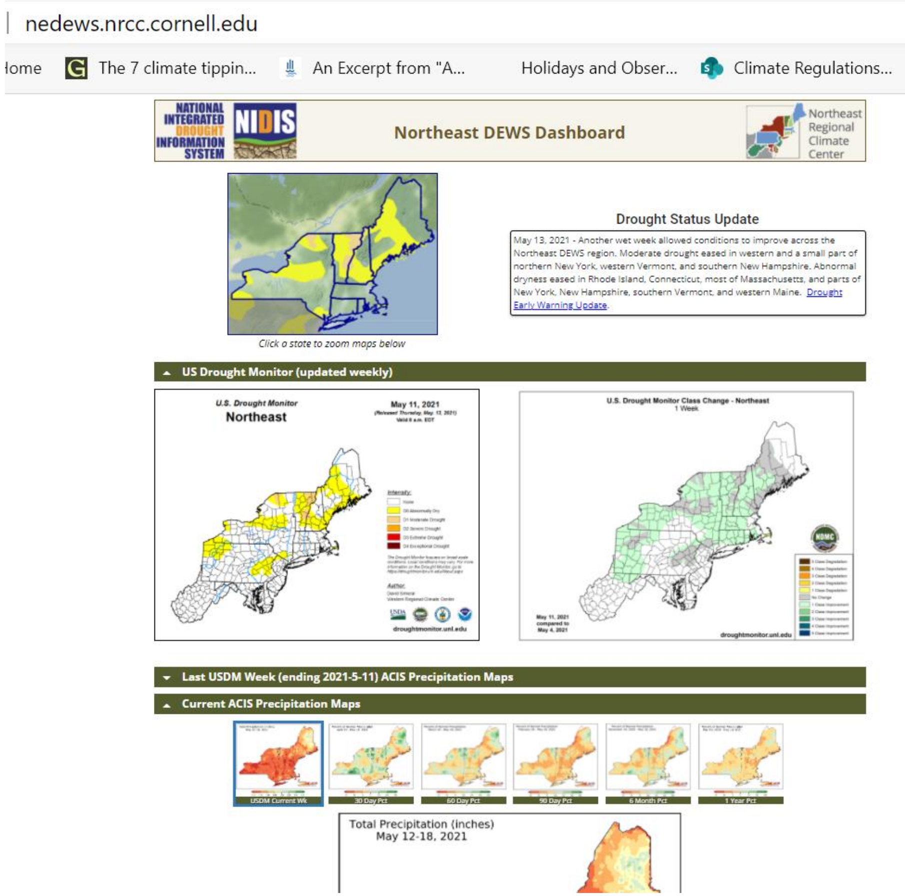
Coastal Storms (uncertain)

- Tropical cyclones:
  - Hurricanes, tropical storms
  - July –October
  - Storm surge, high winds, heavy rain
- Nor'easters
  - September – April
  - High winds, wave action, several tide cycles



More Frequent Drought (uncertain)

- Summer droughts likely more frequent
- Trend in multi-year droughts
- Exacerbated by high temperatures
- Long-range projections not available



http://nedews.nrcc.cornell.edu/

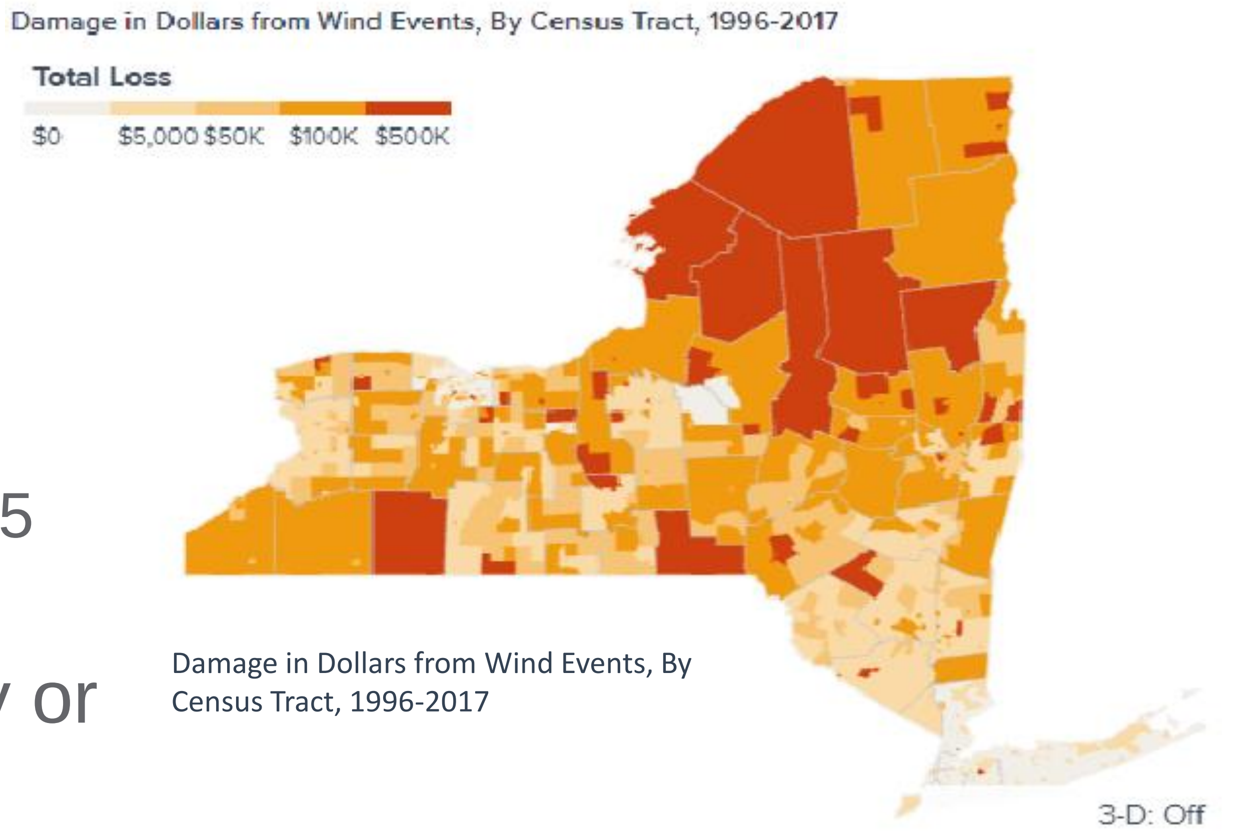
Vulnerabilities to Drought

- Changes in groundwater depths
- Dry streams or wells
- Seasonal variation in reservoir inflow and aquifer recharge
- Reduced supply in shallow wells, wells in moderately productive aquifers and small reservoirs
- Greater competition for water between potable, commercial uses, and ecological needs
- Decrease in availability for equipment cooling industrial and power-generation equipment
- Increased crop root disease and anoxia
- Increased stress on agricultural and native plants
- Inadequate irrigation capacity for some high value crop growers
- Lower water level of lakes and canals due to higher rates of evaporation

Tornadoes/thunderstorms (uncertain)

Source: NOAA NCEI Storm Events

- 1996-2018 (not including hurricanes)
  - Avg. annual tornado loss: $3.4 million
  - Avg. annual tornadoes: 7
  - Avg. annual wind damage: $13.5 million
- No strong trends in frequency or severity
- Future trends uncertain



Damage in Dollars from Wind Events, By Census Tract, 1996-2017

Interacting Hazards and Cascading Effects

Kingston, NY

Breezy Point, NY

Thank You

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- Community Risk and Resiliency Act: www.dec.ny.gov/energy/102559.html
- Climate Smart Communities: www.dec.ny.gov/energy/76483.html
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