DFS Webinar Series-

*Physical Climate Risks in New York: Part 1*

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New York State Department of Environmental Conservation
Carbon dioxide over 800,000 years
2020: Warmest (or 2\textsuperscript{nd} warmest) on record

- 2020 and 2016 in a statistical tie
  - 2016 El Niño
  - 2020 La Niña
- 2020 1.2-1.3°C warmer than late 19\textsuperscript{th} century
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°C will carry significant risks, and risks are substantially higher at 2°C warming. Allowing warming of 1.5°C could trigger feedback loops with the potential to cause runaway warming. (IPCC)
- Current national commitments would lead to a 2.1-3.3°C rise. (Climate Action Tracker)
- On current track we will emit enough greenhouse gases by 2030 to make holding warming to 1.5°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
Integrated Climate Assessments

- **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](http://www.nyserda.ny.gov/climaid)
NY Climate Change Science Clearinghouse

Clearinghouse: Maps, data and documents to support decision making

https://www.nyclimatescience.org/
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
Northeast Regional Climate Center

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We appreciate any feedback:
https://www.nrcc.cornell.edu/

Recent and historical weather data customized to meet your needs

March 2016 Temperature Averages (°F)

State | Average | Departure | Rank | Coldest | Warmest
--- | --- | --- | --- | --- | ---
Connecticut | 42.9 | 6.1 | 117 | 26.3 in 1916 | 45.8 in 2012
Delaware | 49.2 | 5.2 | 118 | 32.2 in 1900 | 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 1900 | 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 1900 | 38.9 in 1921
New Jersey | 46.8 | 6.0 | 119 | 20.4 in 1916 | 49.8 in 2012
New York | 37.6 | 5.9 | 113 | 21.3 in 1900 | 43.3 in 2010
Pennsylvania | 43.2 | 6.4 | 117 | 24.5 in 1900 | 47.7 in 2012
Rhode Island | 42.9 | 5.4 | 118 | 27.8 in 1916 | 45.5 in 2012
Vermont | 35.3 | 4.9 | 111 | 18.6 in 1904 | 36.7 in 1921
West Virginia | 48.4 | 6.5 | 116 | 27.6 in 1900 | 52.6 in 2012
Northeast | 39.8 | 5.6 | 114 | 24.6 in 1900 | 44.5 in 2012

Rankings are for the 122 years between 1895 and 2016. + indicates extreme also occurred in one or more previous years.
New York State Hazard Mitigation Plan

https://mitigateny.availabs.org/
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
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)

Capital Region
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
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

PREDICTED CHANGES IN WINTER SNOW COVER

1960-1990

2070-2100, SCENARIO I, LOW EMISSIONS

2070-2100, SCENARIO III, HIGH EMISSIONS

Winter days (DJF) with snow cover

81–90 72–81 63–72 54–63 45–54 <45

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

[Chart showing coldwave occurrences by year]

[Diagram explaining the science behind the polar vortex]

https://mitigateny.availabs.org/hazards/coldwave
Increased mean annual precipitation (more likely than not)

Region 1 (Rochester) – Precipitation

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>2020s</td>
<td>34.0 inches</td>
<td>0 percent</td>
<td>+ 2 to + 7 percent</td>
<td>+ 8 percent</td>
</tr>
<tr>
<td>2050s</td>
<td></td>
<td>+ 2 percent</td>
<td>+ 4 to + 10 percent</td>
<td>+ 12 percent</td>
</tr>
<tr>
<td>2080s</td>
<td></td>
<td>+ 1 percent</td>
<td>+ 4 to + 13 percent</td>
<td>+ 17 percent</td>
</tr>
<tr>
<td>2100</td>
<td></td>
<td>- 3 percent</td>
<td>+ 4 to + 19 percent</td>
<td>+ 24 percent</td>
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</table>

Region 4 (New York City) – Precipitation

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</thead>
<tbody>
<tr>
<td>2020s</td>
<td>49.7 inches</td>
<td>- 1 percent</td>
<td>+ 1 to + 8 percent</td>
<td>+ 10 percent</td>
</tr>
<tr>
<td>2050s</td>
<td></td>
<td>+ 1 percent</td>
<td>+ 4 to + 11 percent</td>
<td>+ 13 percent</td>
</tr>
<tr>
<td>2080s</td>
<td></td>
<td>+ 2 percent</td>
<td>+ 5 to + 13 percent</td>
<td>+ 19 percent</td>
</tr>
<tr>
<td>2100</td>
<td></td>
<td>- 6 percent</td>
<td>- 1 to + 19 percent</td>
<td>+ 25 percent</td>
</tr>
</tbody>
</table>

- 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
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
Resources: Future Extreme Precipitation

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

http://ny-idf-projections.nrcc.cornell.edu/
Flood Risk in New York

Estimated Population in 100-Year Flood Zone by County

- **Est. Population**
  - 110,000 - 140,000
  - 71,000 - 100,000
  - 41,000 - 70,000
  - 4,300 - 40,000
  - 0 - 4,200

Note: Counties w/ no NFIRM or Q3 avail.

Source: FEMA, US Census Bureau
Flood Risk in New York

New York Flood Property Damage by County 1960-2012

NYS Insured Losses

<table>
<thead>
<tr>
<th>Decade</th>
<th>Losses (millions)</th>
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<tbody>
<tr>
<td>1950s</td>
<td>$44</td>
</tr>
<tr>
<td>1960s</td>
<td>$37</td>
</tr>
<tr>
<td>1970s</td>
<td>$866</td>
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<tr>
<td>1980s</td>
<td>$152</td>
</tr>
<tr>
<td>1990s</td>
<td>$757</td>
</tr>
<tr>
<td>2000s</td>
<td>$762</td>
</tr>
<tr>
<td>2010s</td>
<td>$11,547</td>
</tr>
</tbody>
</table>

NYSHMP 2014
Source: SHLEDS1
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)

- 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
Interacting Hazards and Cascading Effects

Kingston, NY

Breezy Point, NY
Thank You

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Connect with us:

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