Climate Trends & Impacts on Northeast Agriculture

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New England Vegetable & Fruit Conference

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Presentation Outline

- Climate Change Key Points
  - Summary of agricultural impacts
- Temperature & Precipitation Trends
- Extreme Weather
- Resources

Climate Change in the Northeast

- **Warming across all seasons**
  - Most in winter (and fall)
- **Overall increase in annual precipitation**
  - Largest increase in summer
- **Changes in weather patterns have produced more extremes**
  - Heavy precipitation events
  - Increased likelihood of heat waves with very high dew points
  - Monthly & seasonal extremes, e.g., severe drought in 2020, record wetness in 2023

Winter Warming Impacts on Agriculture

- Chill hour deficiencies
- Winter injury from large temperature swings
- Frost/freeze damage from “false spring”
- Mid-winter rain producing prolonged periods of runoff and erosion
- Warming facilitates influx of new pests and invasive species

Slide (adapted) courtesy of R. Schattman and S. Keleman and from the USDA Northeast Climate Hub

Summer Warming Impacts on Agriculture

- Human health & overall farm productivity concerns
- Exacerbates pressures from pests, disease, and invasive species
- Crop yield loss or quality changes due to heat stress
- Greater irrigation pressure due to increased evaporation – though the effects of warming could be balanced by precipitation surpluses in some years

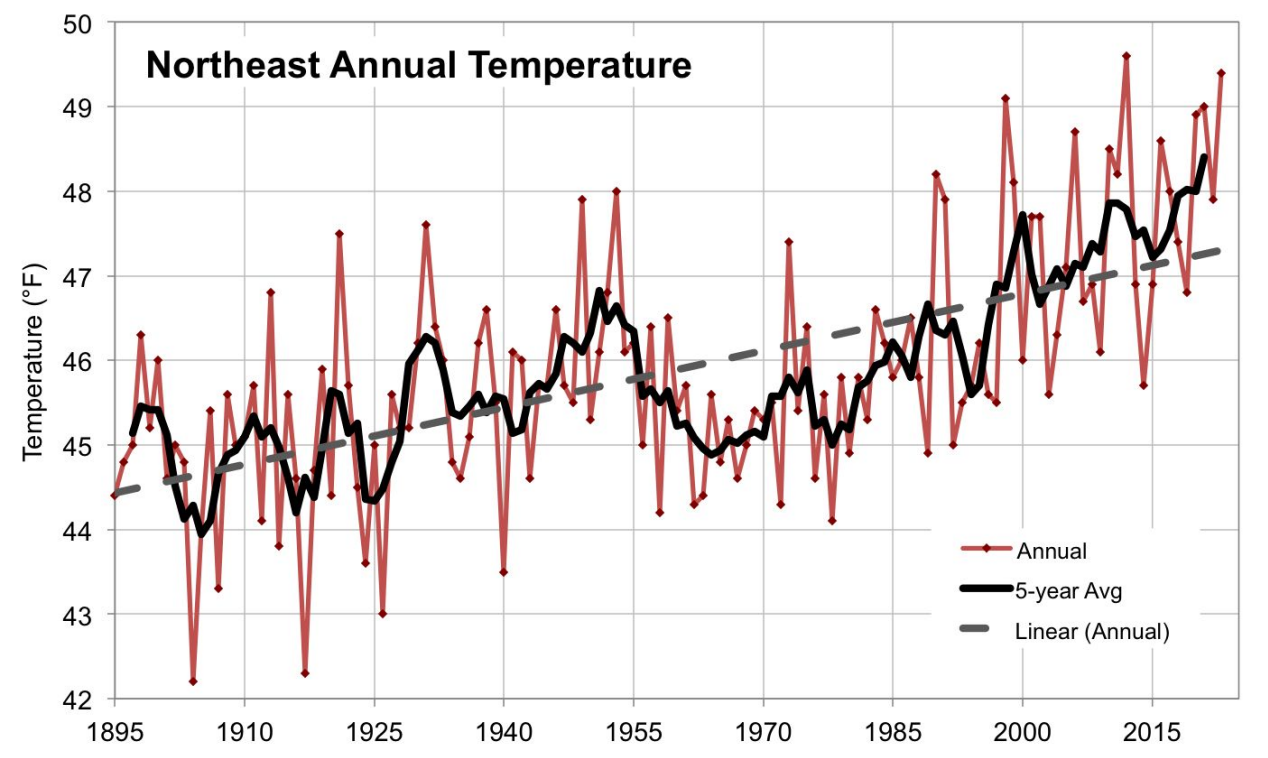
Slide (adapted) courtesy of R. Schattman and S. Keleman and from the USDA Northeast Climate Hub

In addition to challenges, climate change also presents agricultural & agroforestry opportunities

- Longer growing season
- More growing degree days
- Double cropping
- New crops

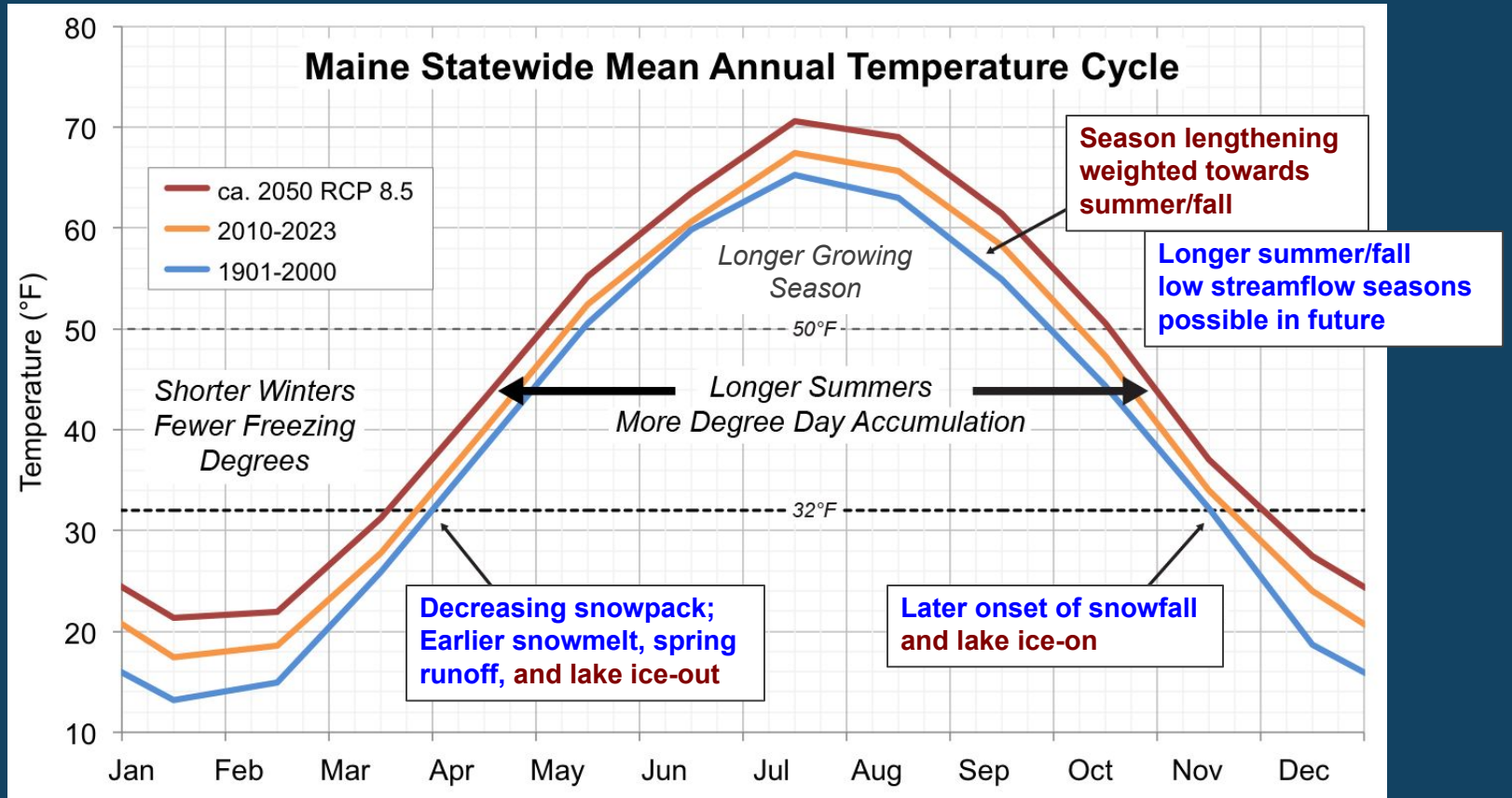
Slide (adapted) courtesy of R. Schattman and S. Keleman and from the USDA Northeast Climate Hub

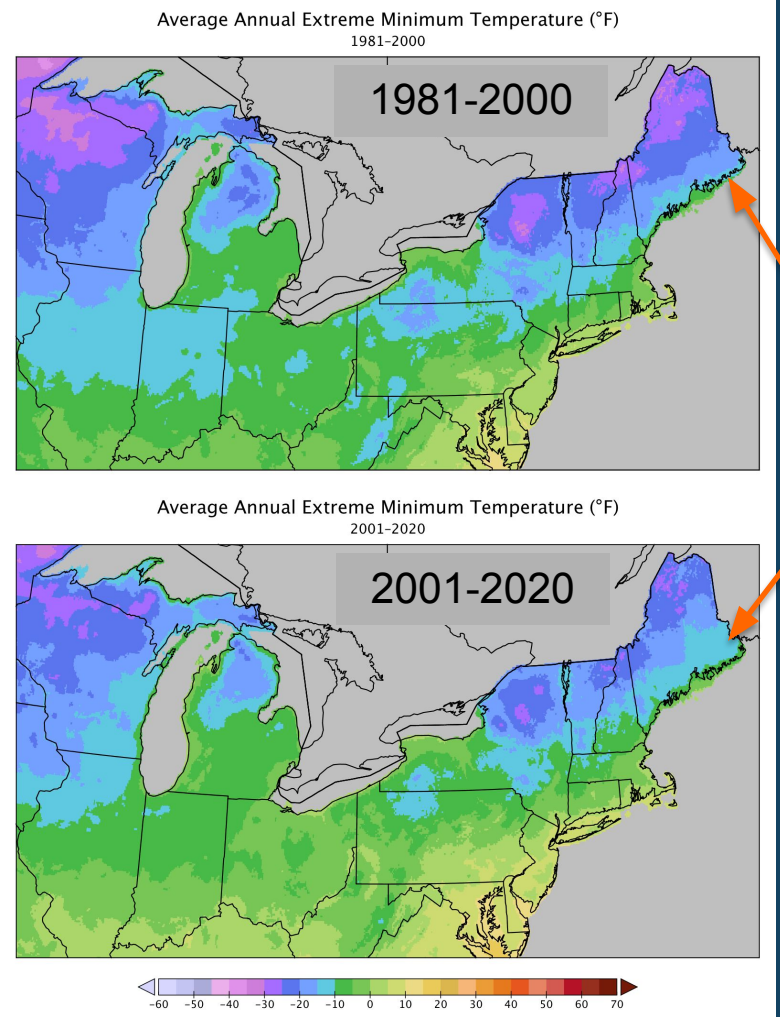
Northeast Region mean annual temperature has increased 3°F since 1895



- The 9 warmest years have occurred since 1998
- Warming across all seasons, especially winter and fall
- Overnight lows increasing more than daytime highs due to increasing humidity
- Projected warming by 2100 ranges 2–10°F depending on emissions scenario

Changes in the Temperature Annual Cycle

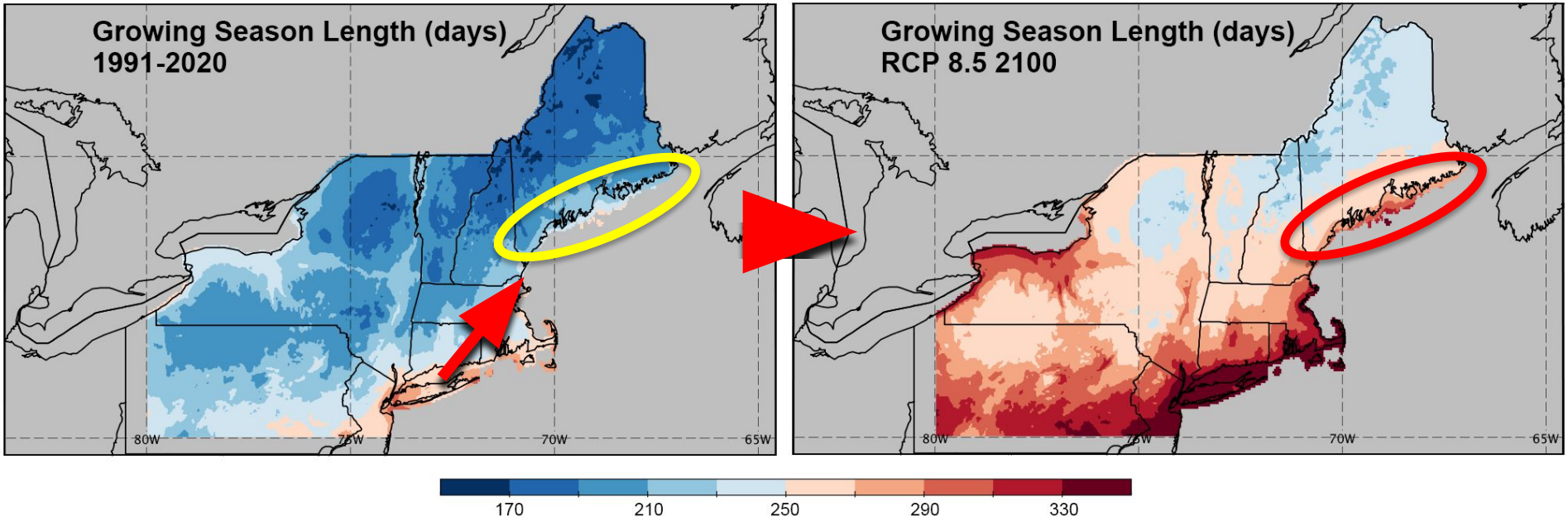




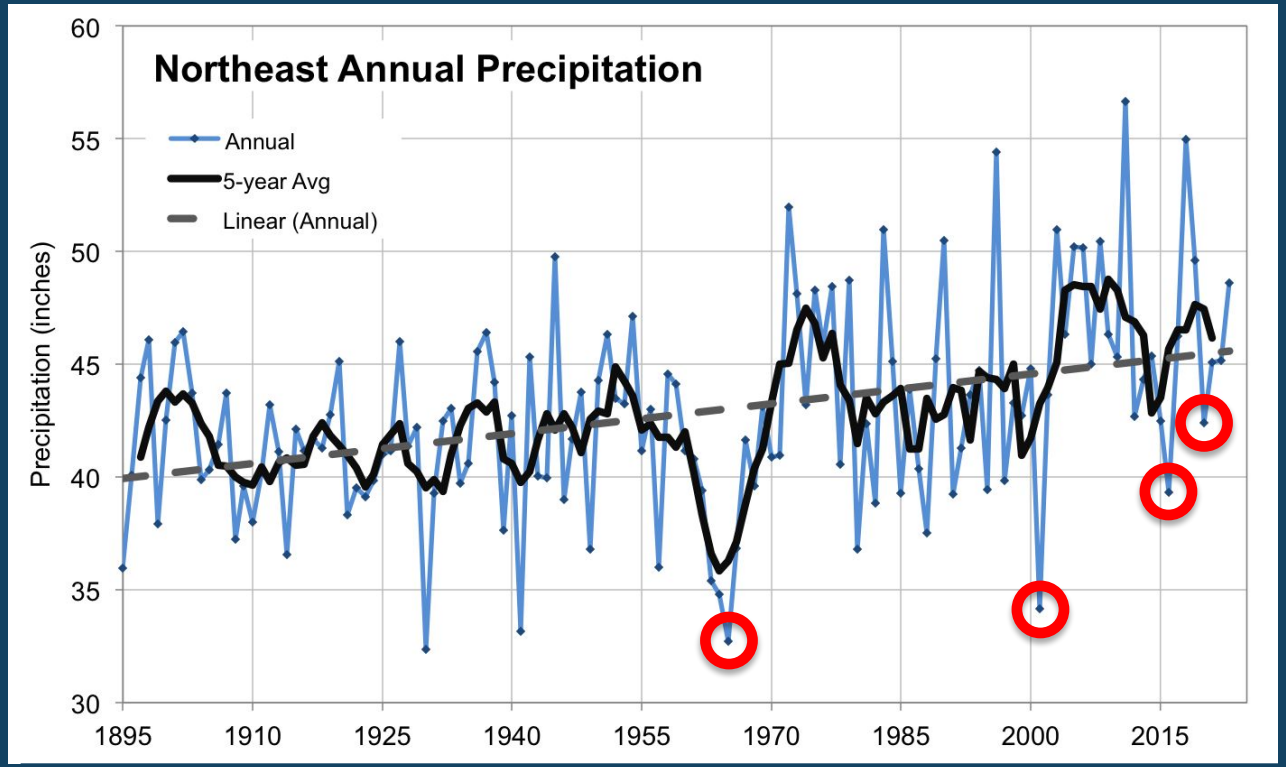
Northward Shift of Plant Hardiness Zones

Based on PRISM annual extreme minimum temperatures and USDA key

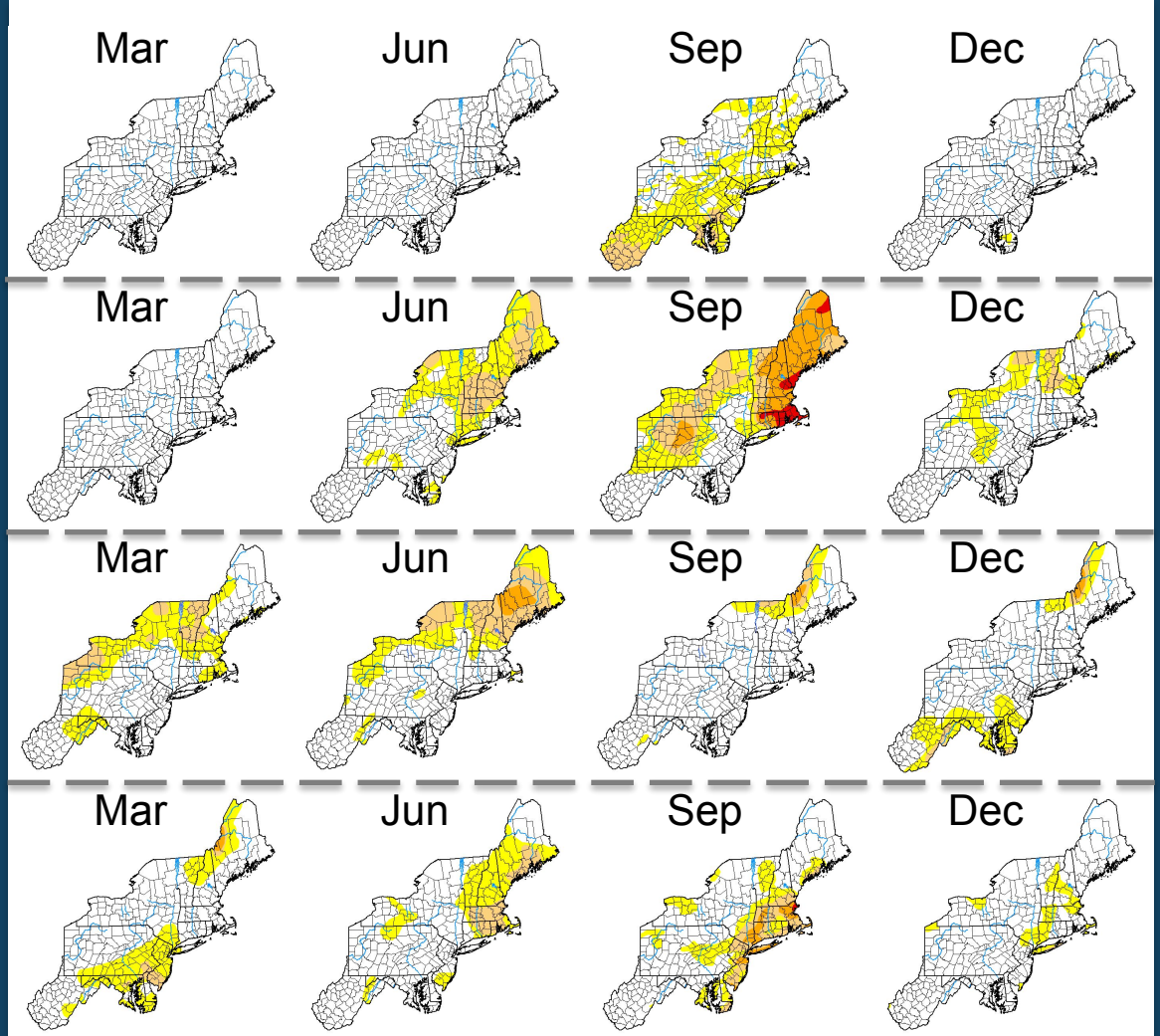
By 2100, Maine's coast could have a climate similar to that of today's Long Island, NY



Northeast Region total annual precipitation has increased 6 inches since 1895



- Largest increases have occurred in summer
- Heavy precipitation > 2” per day becoming more common
- Projected 5-14% annual rainfall increase by 2100 with more frequent extremes



What about drought?

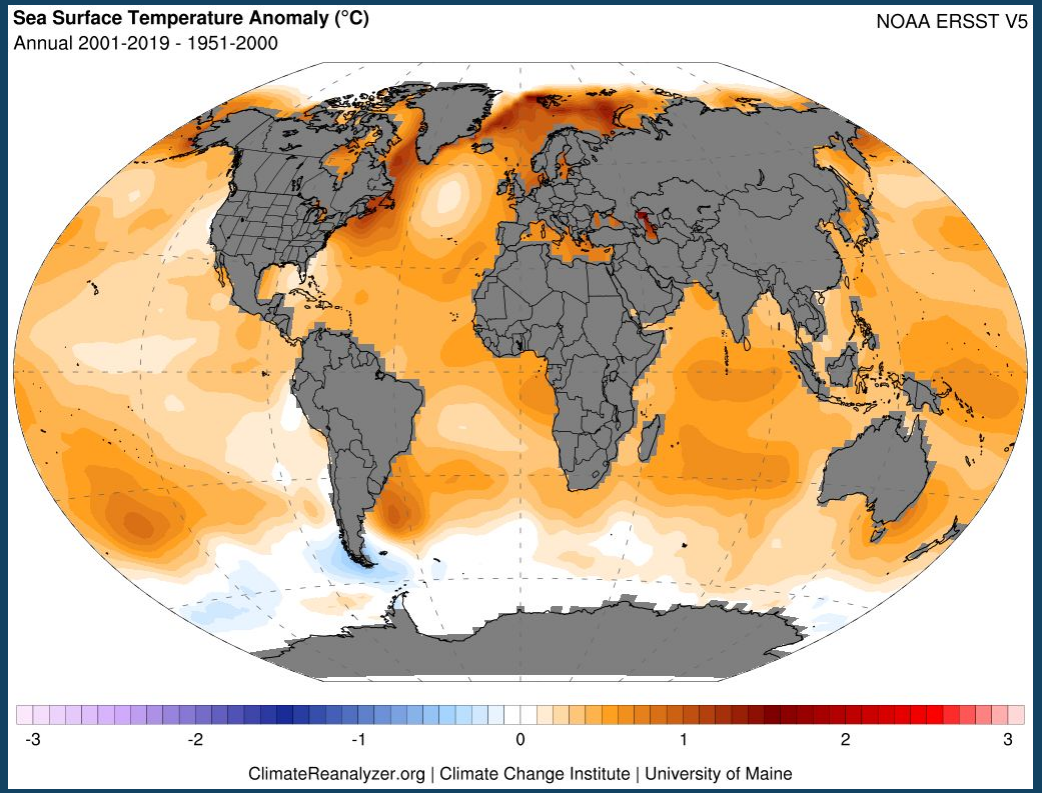
- Short-term drought is common in the Northeast
- Intensified hydrologic cycle produces more wet and dry extremes
- Uncertain whether drought will become more or less common, but warmer temps will exacerbate dryness when drought emerges

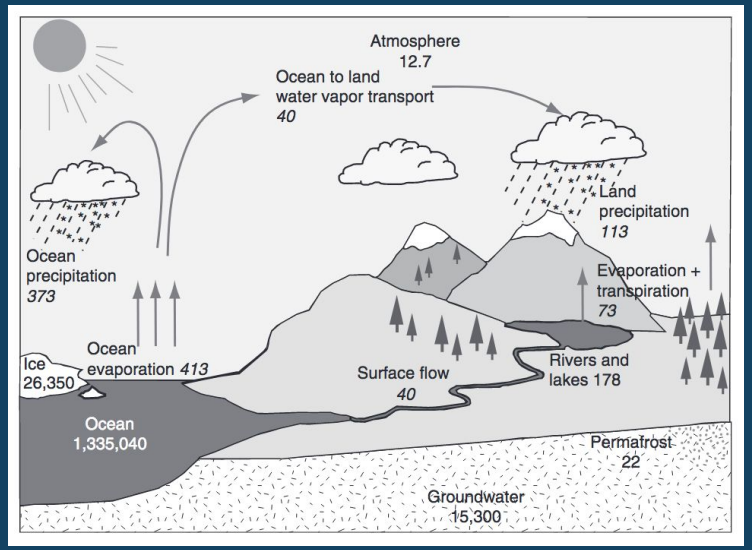
U.S. Drought Monitor

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Warming Oceans and an Intensifying Hydrologic Cycle



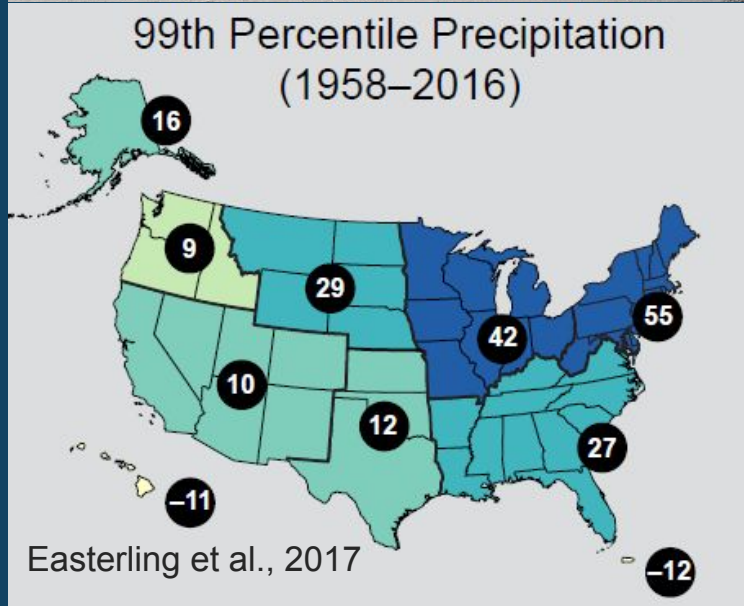


Trenberth et al. (2007), Huntington (2010)

- Warming drives increased ocean evaporation, atmospheric water vapor content, and changes in circulation leading to greater potential for weather extremes
- The water holding capacity of air increases 7% for 1.8°F (1°C) warming

Extreme Weather

- Extreme weather is becoming more common around the N. Hemisphere due to changes in atmospheric circulation.
- Increased likelihood of heat/cold waves, intense storms.
- Large increases (55%) in annual heavy daily precipitation across the USNE.
- In Maine, the last 20 years have seen the highest occurrence of 2” and 3” precipitation events (Fernandez et al., 2020).

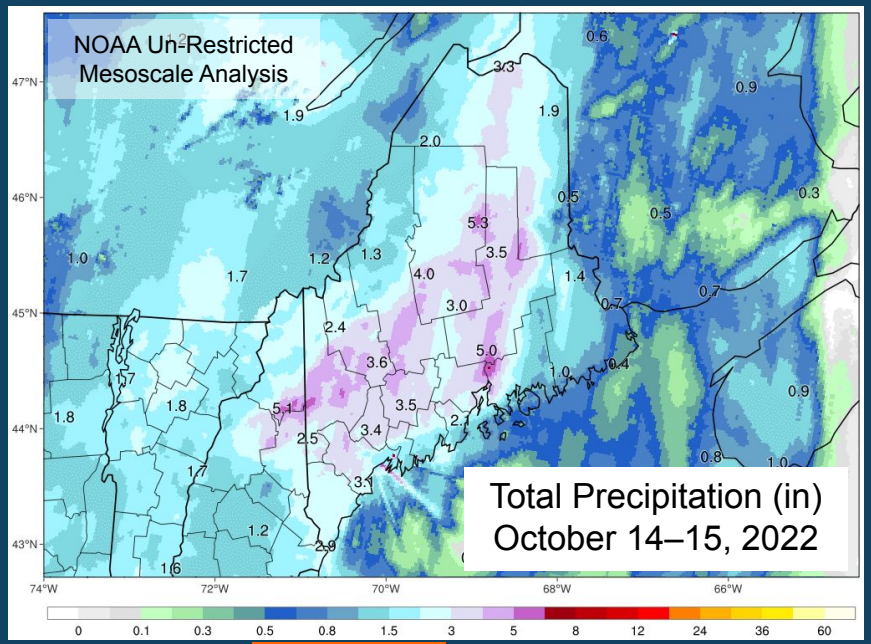


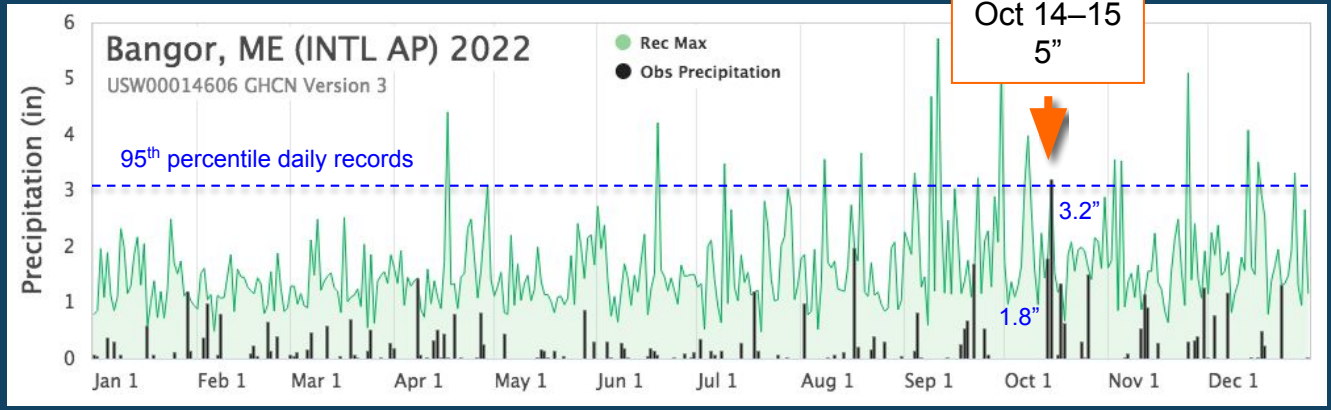
Posted October 15, 2022 | Updated October 17, 2022

Beyond the power outages, Friday's storm dumped record rainfall

Portland Press Herald

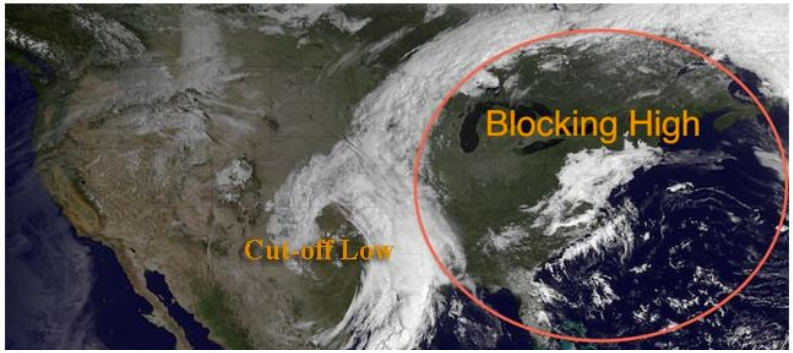
Rainfall in Portland and August broke longtime records for the day, according to the National Weather Service in Gray. Most outages were likely to be repaired by Saturday night, according to Central Maine Power.





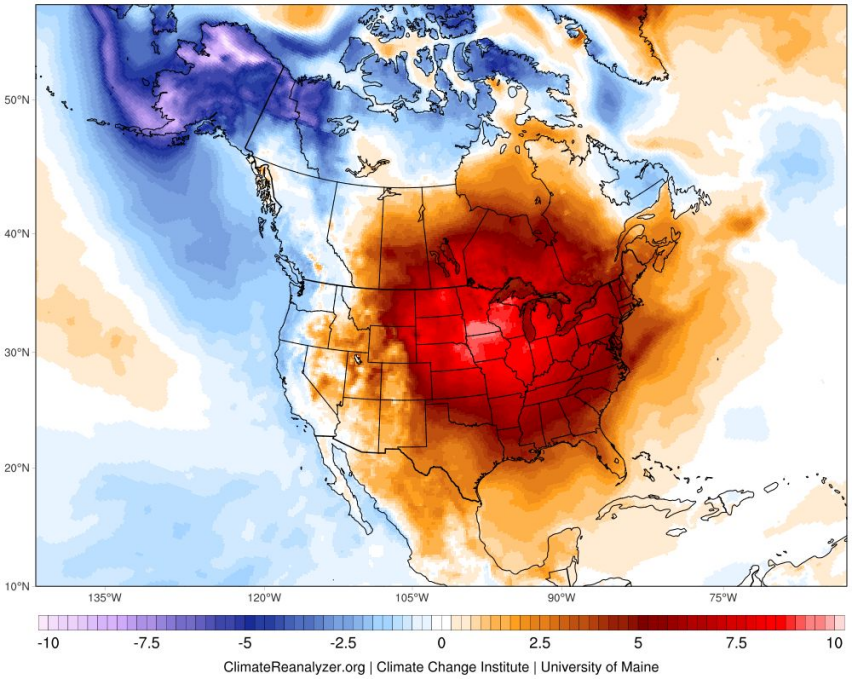
Summer in March, 2012

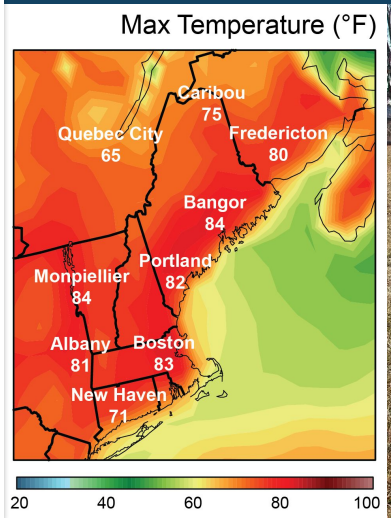
- Temperatures into the 80s across southern half of Maine 22-23 March without historical equivalent.
- Farmington 83°F March 23rd – a daily high temperature record set by 17°F!

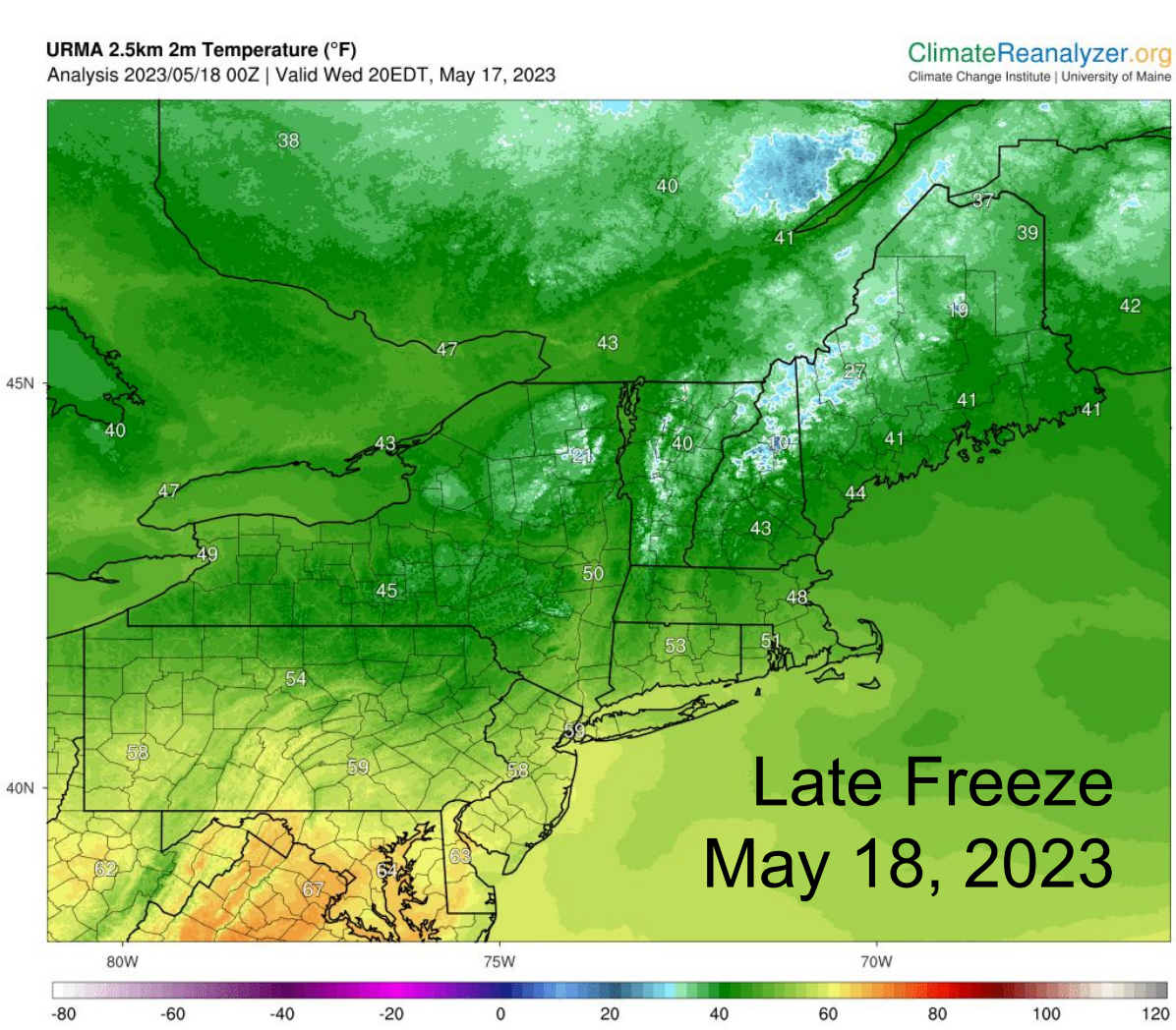


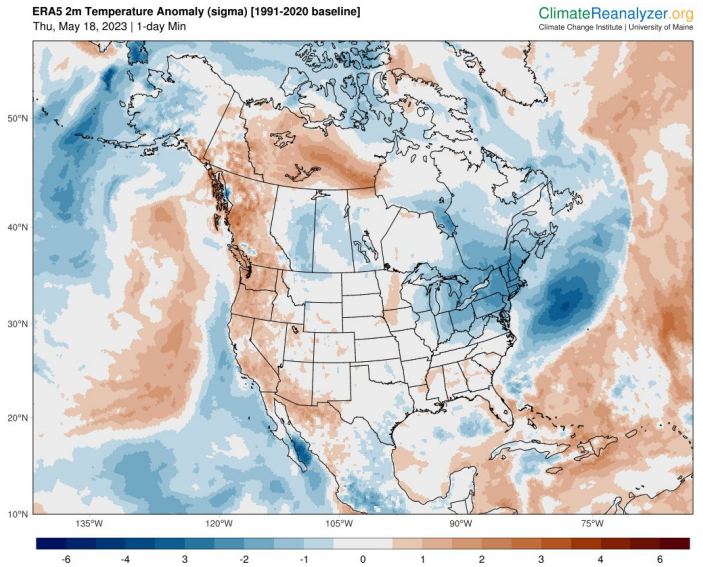
2m Temperature Anomaly (°C)
March 2012 - 1979-2000

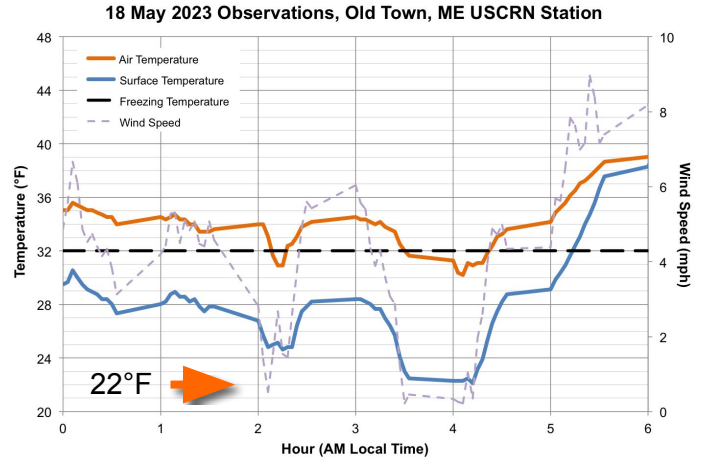
ECMWF ERA5





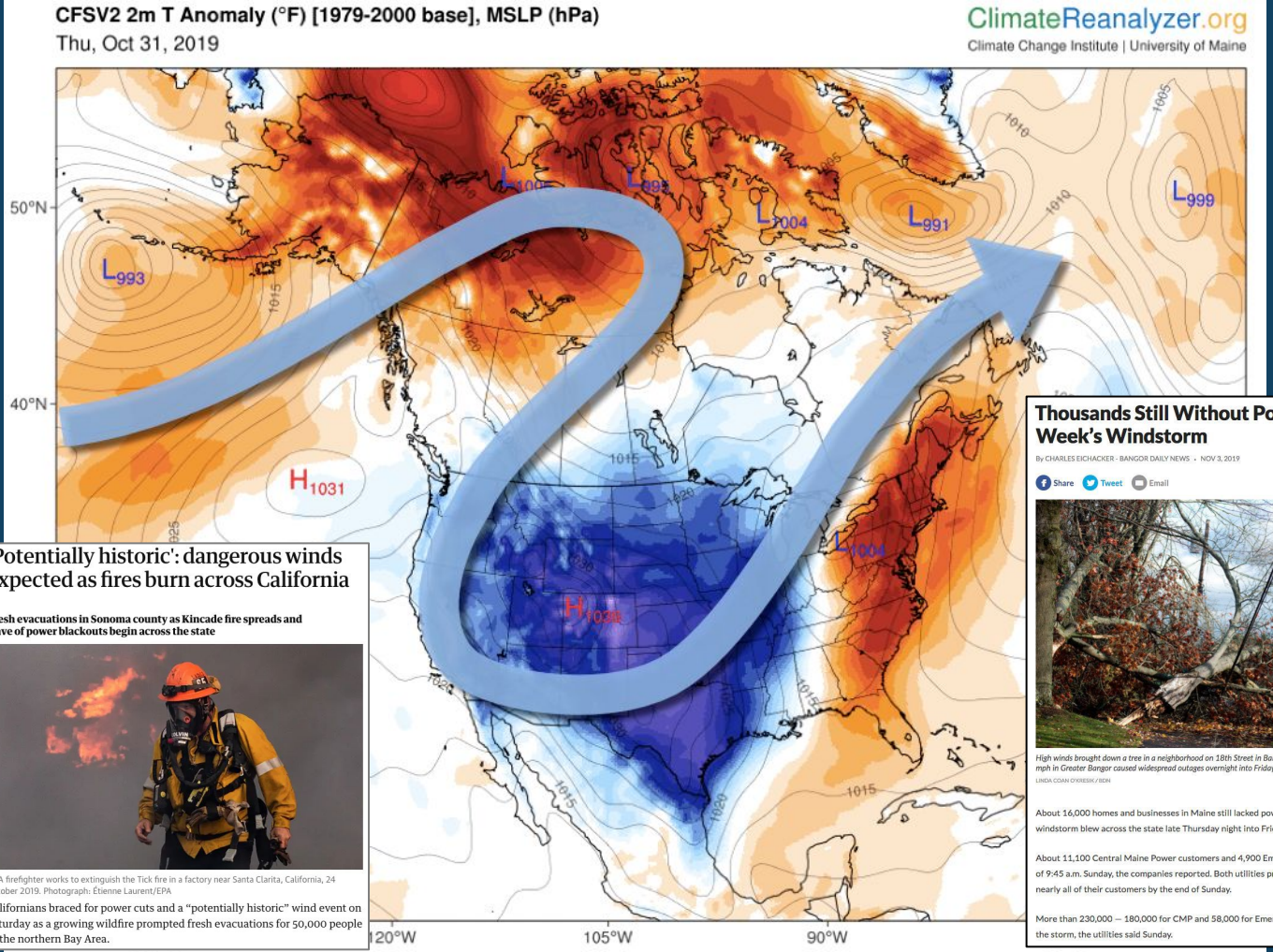

URMA 2.5km 2m Temperature (°F)
Analysis 2023/05/18 00Z | Valid Wed 20EDT, May 17, 2023
ClimateReanalyzer.org
Climate Change Institute | University of Maine
Late Freeze
May 18, 2023
45N
40N
80W
75W
70W
-80 -60 -40 -20 0 20 40 60 80 100 120


ERA5 2m Temperature Anomaly (sigma) [1991-2020 baseline]
Thu, May 18, 2023 | 1-day Min
ClimateReanalyzer.org
Climate Change Institute | University of Maine
50°N
40°N
30°N
20°N
10°N
135°W
120°W
105°W
90°W
75°W
-6 -4 -3 -2 -1 0 1 2 3 4 6


18 May 2023 Observations, Old Town, ME USCRN Station
Air Temperature
Surface Temperature
Freezing Temperature
Wind Speed
Temperature (°F)
Wind Speed (mph)
Hour (AM Local Time)
22°F

Connecting Extremes via the Jetstream

Late October / Early November 2019



'Potentially historic': dangerous winds expected as fires burn across California

Fresh evacuations in Sonoma county as Kincade fire spreads and wave of power blackouts begin across the state

A firefighter works to extinguish the Tick fire in a factory near Santa Clarita, California, 24 October 2019. Photograph: Étienne Laurent/EPA

Californians braced for power cuts and a "potentially historic" wind event on Saturday as a growing wildfire prompted fresh evacuations for 50,000 people in the northern Bay Area.

Thousands Still Without Power After Last Week's Windstorm

By CHARLES EICHACKER - BANGOR DAILY NEWS • NOV 3, 2019

Share Tweet Email

High winds brought down a tree in a neighborhood on 18th Street in Bangor on Friday morning. Winds gusting up to 52 mph in Greater Bangor caused widespread outages overnight into Friday morning

LINDA COAN O'KRESIK / BDN

About 16,000 homes and businesses in Maine still lacked power on Sunday morning after a heavy windstorm blew across the state late Thursday night into Friday.

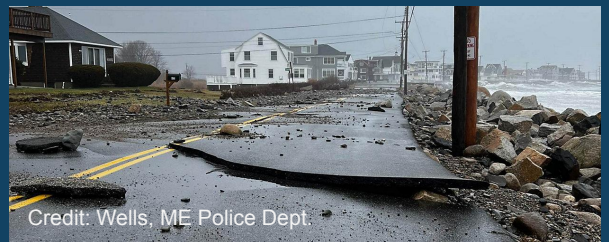
About 11,100 Central Maine Power customers and 4,900 Emera Maine customers still had outages as of 9:45 a.m. Sunday, the companies reported. Both utilities projected that they would restore power to nearly all of their customers by the end of Sunday.

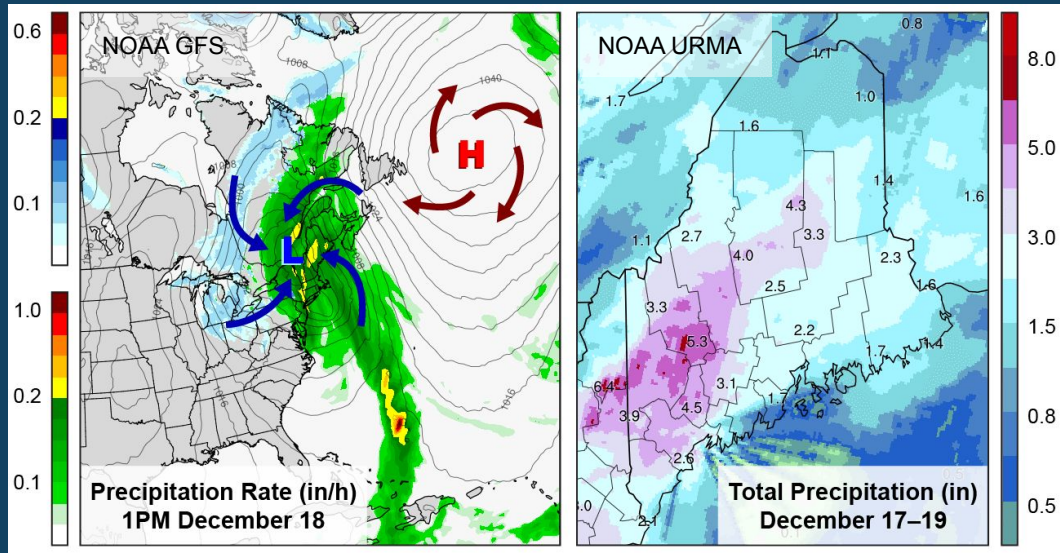
More than 230,000 — 180,000 for CMP and 58,000 for Emera Maine — lost power at the height of the storm, the utilities said Sunday.

Southeaster Storms
Dec 18, Jan 10 & 13

- Similar tracks north into Quebec produced strong SE winds across Maine
- Dec 18 gusts > 70 mph; 5–7” rain in parts of western Maine; worst flooding along Kennebec & Androscoggin in almost 40 years
- Power outages comparable to Ice Storm ’98
- Impact increased along the coast with each storm from previously weakened infrastructure
- Peak winds on 13th coincided with astronomical high tide, breaking storm level marks from 1978
- Developed against the backdrop of a strong El Niño & record warmth across the North Atlantic

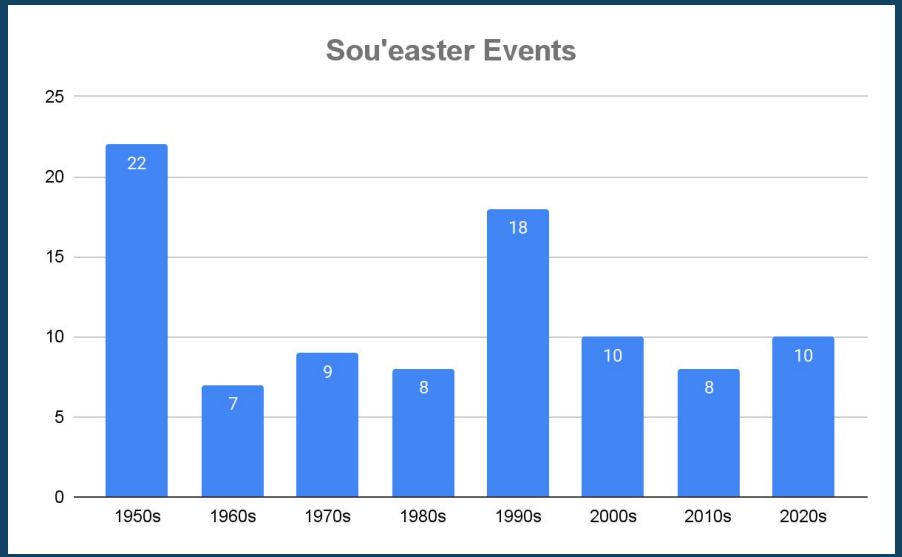

Sunday River Access Road, Newry, ME, Dec. 2023.
Photo: MaineDOT

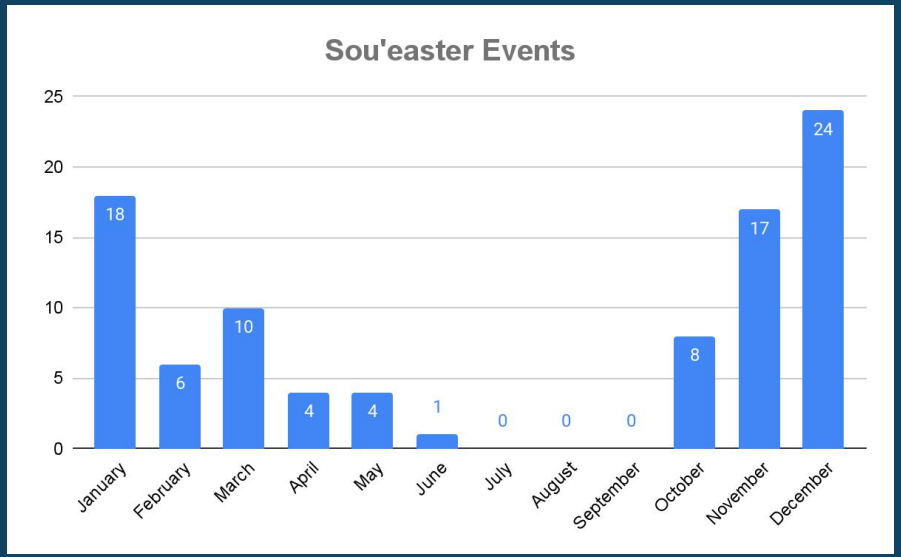

Credit: Wells, ME Police Dept.



Portland “Sou’easter” Climatology 1950–2024

Preliminary analysis by Derek Schroeter and Justin Arnott, National Weather Service

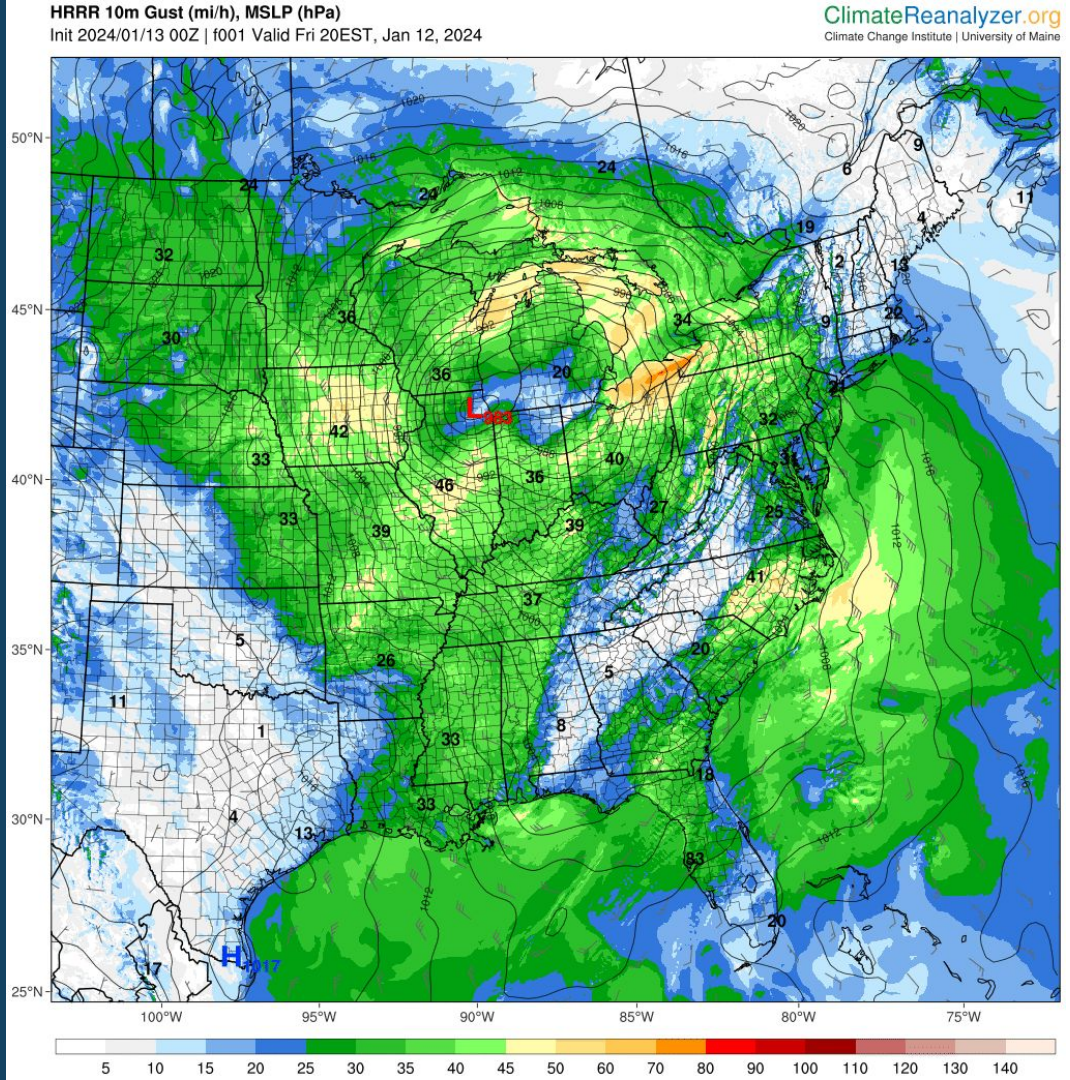




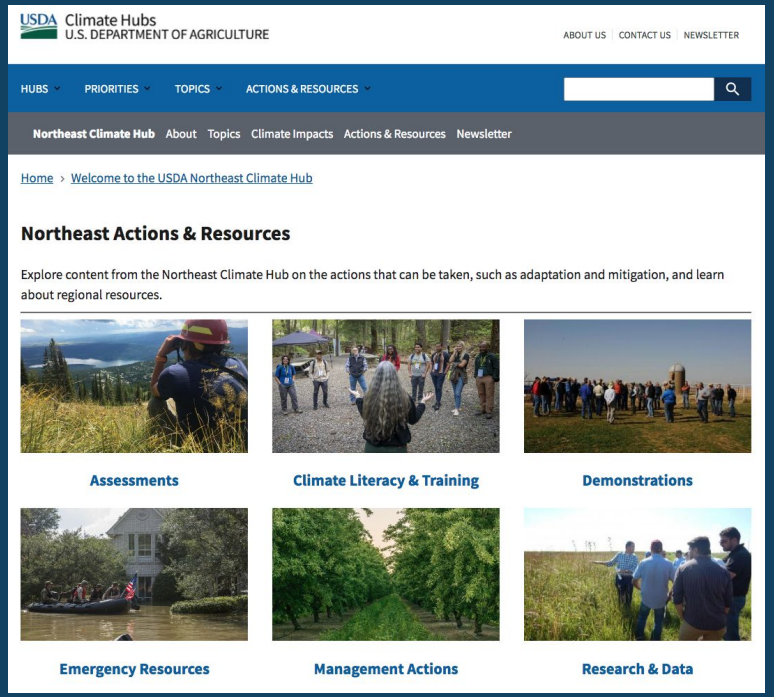
- No clear trend in frequency 1950 to early 2024
- Sou’easters occur primarily during cold season Oct–Mar, especially Nov–Jan

Storm Projections

- Heavy precipitation events becoming more common due to strengthening hydrologic cycle.
- Extratropical cyclones are projected to become more intense, and with more rainfall.
- Future storm frequencies remain uncertain because of complexity with storm track in relation to possible changes in poleward gradients.



Resources



Cornell Climate Smart Farming Decision Tools

The Cornell Climate Smart Farming online toolkit is designed to help farmers from the Northeast US improve their…

NEWA Integrated Pest Management Tools for Crop Production

NEWA can help producers evaluates crop risk for apples, berries, field crops, grapes, ornamentals, and vegetables…

Cover Crop Nitrogen Calculator (CC-NCALC)

To provide farmers and land managers with a science-based decision support tool to estimate cover crop nitrogen release…

Cover Crop Species Selector

To provide farmers and land managers with a science-based decision support tool to assist with cover crop species…

Coastal Forest Dieback Geospatial Layers (Ghost Forests)

This tool includes two Coastal Forest Dieback Layers: Upland Forest and Palustrine Woody Wetlands, as based on the 2016…

Climate Resilience Toolkit

With hundreds of tools in its library, the Toolkit offers a wide range of climate related tools ranging from climate…

Thank You

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