Quarterly Climate Impacts and Outlook

Gulf of Maine Region

December 2022

Gulf of Maine Significant Events – *September–November 2022*

Drought conditions eased in parts of New England during **autumn**. Several **notable storms** affected the region, including **Post-Tropical Cyclone Fiona**. See Regional Impacts for details.

Post-Tropical Cyclone Fiona was historic in the Maritimes, with high winds, heavy rain, and storm surge causing extensive damage in late September.

A wet September reduced drought conditions in New England.

September

September featured multiple storms, with **Post-Tropical Cyclone Fiona** being a **historic extreme event** for the Maritimes from **September 23 to 25**. The storm made landfall in eastern Nova Scotia with hurricane force winds and caused **hundreds of millions of dollars in damage** in all three provinces from high winds, heavy rainfall, and destructive storm surge.

October

A **cool spell** in the Maritimes in **early October** ended the frost advisory program early for the fourth straight year. From **October 1 to 5**, **Hurricane Ian's remnants** stalled off the U.S. coast, bringing wind gusts of up to 89 km/h (55 mph), up to 127 mm (5 in.) of rain, and rough surf to Massachusetts. The storm moved south of Nova Scotia on **October 6**, with up to 97 mm (4 in.) of rain leading to poor road conditions. From **October 13 to 15**, a storm fueled by Atlantic moisture brought up to 152 mm (6 in.) of rain to Maine where **flash flooding** led to road closures, caused two roads to collapse, and stranded vehicles. **Gusty winds** of up to 93 km/h (58 mph) downed trees and wires, blocking roads and causing over 100,000 customers to lose power. Many Maritimes sites had one of their five-warmest Octobers.

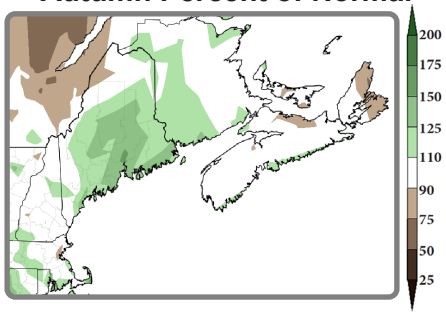
November

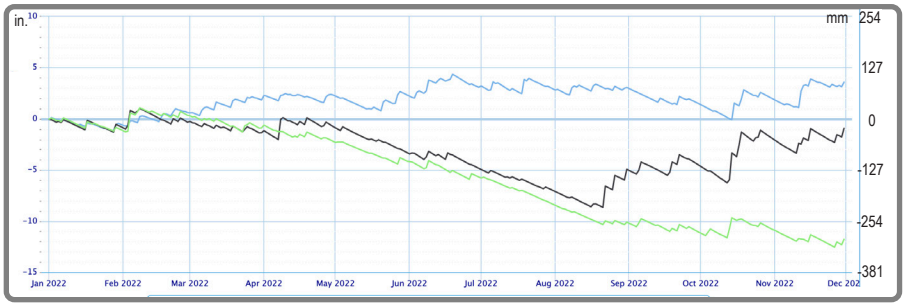
November 4 to 7 was **exceptionally warm**, with some sites seeing multiple days that were among their 10 warmest for November. Eight sites including Halifax, N.S., and Portland, ME, had their **warmest high temperature for November** with highs up to 26°C (78°F). Several U.S. sites including Boston, MA, and Caribou, ME, saw their **warmest low temperature for November** with lows of 15°C (59°F) or higher. Some sites had their **greatest number of November days** with a high of at least 21°C (70°F) and/or one of their 10 warmest Novembers. From **November 11 to 13**, the **remnants of Hurricane Nicole**, packed with unusually humid air for mid-November, dropped up to 103 mm (4 in.) of rain on the region, with Caribou having its 10th-wettest November day. Wind gusts of up to 87 km/h (54 mph) brought down trees already weakened by Fiona, causing over 13,000 customers to lose power in Nova Scotia, and contributed to the collapse of a coastal landmark on P.E.I. The **season's first accumulating snowfall** for northern New Brunswick and northern Maine was on **November 13**, the eighth latest date for measurable snowfall at Caribou. These areas saw **above-normal November snowfall**, while the rest of the region saw **below- or near-normal snowfall**. Bas-Caraquet and Woodstock, N.B., and Caribou had one of their 10 wettest Novembers. **Autumn** was **record warm** for Halifax, N.S., and Charlottetown, P.E.I., and among the 10 warmest for multiple sites.

Sea surface temperatures in the Gulf of Maine set **record daily highs** from **late October to mid-November**, continuing a trend of autumn water temperatures getting warmer and the warm season lengthening. Monthly mean sea surface temperatures in the Gulf's deep basins ranked as the fourth-warmest September, ninth-warmest October, and **record-warmest November.**

Regional Climate Overview – *September–November 2022*

Precipitation
Autumn Percent of Normal





Accumulated daily precipitation departures from normal for September 1 to November 30 at Caribou, ME (blue line); Portland, ME (black line); and Boston, MA (green line).

Autumn precipitation (accumulated from September to November) ranged from 75% of normal to 150% of normal. **September precipitation** ranged near normal to more than 200% of normal for most areas except northern Maine and northern New Brunswick which were drier. **October precipitation** ranged from 25% of normal in southeastern New Brunswick, P.E.I., and parts of Nova Scotia to more than 200% of normal in southeastern Massachusetts and parts of Maine. Portland, ME, had its eighth-wettest October. **November precipitation** ranged from 25% of normal in southeastern Massachusetts to 175% of normal in parts of New Brunswick. This November was among the 10 wettest for Caribou, ME, and Bas-Caraquet and Woodstock, N.B. *Precipitation normals based on 1991–2020 data.

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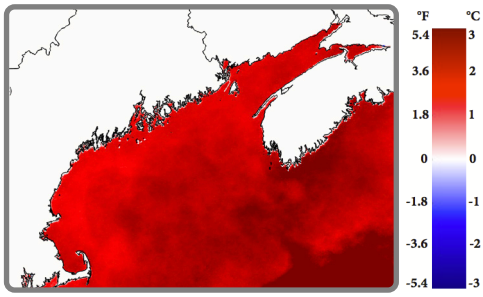
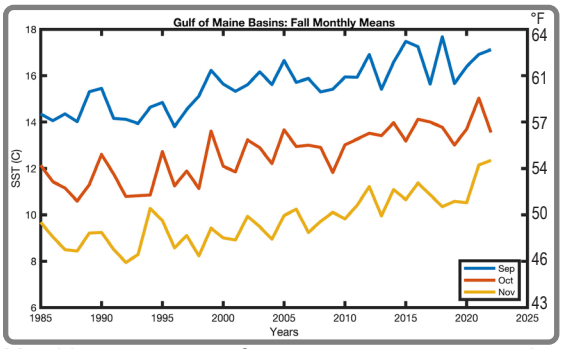
Regional Climate Overview – *September–November 2022*

Sea Surface Temperature

Autumn Departure from Normal



Autumn sea surface temperature anomalies over the Gulf of Maine were **above normal** in all regions. Anomalies were around 1.8°C (3.2°F) along the Gulf of Maine coast and in the Bay of Fundy, greater than 2.4°C (4.3°F) over deeper basins, and greater than 3.0°C (5.4°F) over the Scotian Shelf.



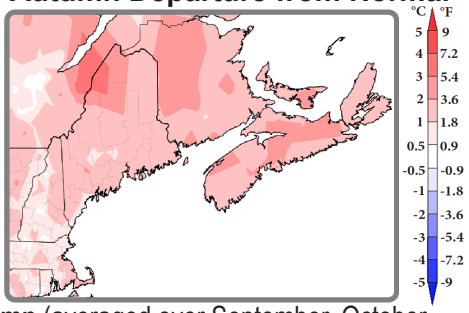
Monthly mean sea surface temperature, averaged over the Gulf of Maine deep basins, for September, October, and November (1985 to 2022). Credit: University of Maine School of Marine Sciences

*SST normals based on 1985–2014 data

Autumn **monthly mean sea surface temperatures**, averaged over the Gulf of Maine deep basins, showed **September** to be the **fourth warmest**, **October** to be the **ninth warmest**, and **November** to be the **warmest** on record. All were over 1°C (1.8°F) warmer than the 30-year climatology, and November was 2.9°C (5.2°F) above the climatology (over 3 standard deviations above the mean).

Temperature

Autumn Departure from Normal



Autumn (averaged over September, October, and November) was up to 3°C (5°F) **warmer than normal**. Autumn was **record warm** for two sites and among the 10 warmest for other sites. **September** temperatures ranged from 1°C (2°F) below normal in New England to 2°C (4°F) above normal in the Maritimes, with Charlo, N.B., having its seventh-warmest September. **October** was up to 4°C (7°F) **warmer than normal**, particularly in the Maritimes where many sites had one of their five warmest Octobers. Caribou, ME, had its eighth-warmest October. **November** was up to 3°C (5°F) **warmer than normal**, with several sites having one of their 10 warmest Novembers.

*U.S. normals based on 1991–2020 data; Canadian normals based on 1981–2010 data

Regional Impacts – *September–November 2022*

Post-Tropical Cyclone Fiona

Fiona formed in the Atlantic Ocean on September 14, became the hurricane season's third hurricane on the 18th, and strengthened to the **season's first major hurricane** on the 20th. Fiona maintained its strength as it traveled north in the Atlantic, making **landfall in eastern Nova Scotia** near Whitehead on **September 24** as a powerful post-tropical cyclone with hurricane force winds. Fiona then traveled across Cape Breton and into the eastern Gulf of St. Lawrence. Fiona was a **historic extreme event** for Atlantic Canada, likely the **strongest and most destructive tropical system** to have ever affected Canada. Preliminary data indicated Fiona produced **Canada's all-time lowest mean sea level pressures** of 931.7 mb at St. Peters, N.S., and 932.7 mb at Hart Island, N.S.

The **greatest rainfall totals** of 100 to 175 mm (4 to 7 in.) were in eastern P.E.I. and eastern Nova Scotia/Cape Breton. The **strongest wind gusts** of 100 to 170 km/h (62 to 106 mph) affected eastern New Brunswick, P.E.I., and central/eastern Nova Scotia, with an unofficial gust of 179 km/h (111 mph) in Arisaig, N.S. **Peak storm surge values** of 1.5 to 2 m (5 to 6.5 ft.) were reported along the coast of eastern New Brunswick, Nova Scotia, and P.E.I., where significant shoreline erosion occurred. Fiona's heavy rainfall, extreme winds, and destructive storm surge caused an estimated **$660 million in insured damages** including over $385 million in Nova Scotia, over $220 million in P.E.I., and over $30 million in New Brunswick. The hardest hit areas suffered widespread and extensive damage with thousands of uprooted/snapped trees, toppled power and telecommunication lines **affecting around 600,000 customers**, and damage to homes, businesses, ports, crops, farm outbuildings, and other infrastructure. Transportation was severely impacted with road/bridge closures and ferry and flight cancellations. Some schools were closed for a week. Clean-up and **repairs took weeks**, with around 4,500 customers without power two weeks after Fiona and over 100 customers without power three weeks after Fiona. A month after the storm, nearly 100 Cape Breton, N.S., residents were still displaced from their homes. Storm impacts in New England were limited to rough surf and gusty winds.

The Atlantic hurricane season was **near average** with 14 named storms of which eight became hurricanes and two became major hurricanes. November had three hurricanes, tying November 2001 for the **most November hurricanes**. The Canadian Hurricane Centre messaged on three storms that entered the response zone this season. A recent paper indicates hurricane intensification rates have increased along the U.S. East Coast over the past few decades, likely tied to warming sea surface temperatures.

Poles downed by Fiona in Dartmouth, N.S. Credit: Dr. Chris Fogarty

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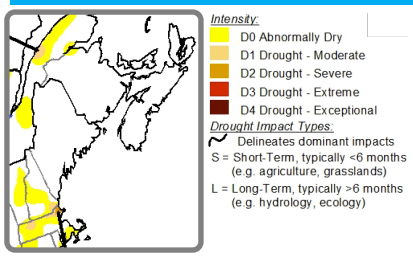
Regional Impacts – *September–November 2022*



North American Drought Monitor as of November 30, 2022.

Drought Conditions

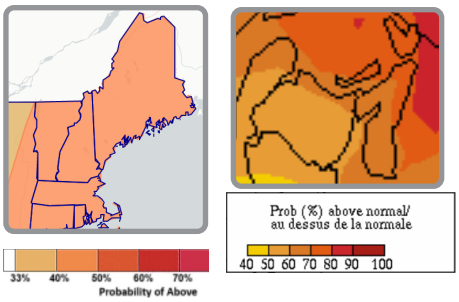
Multiple rounds of heavy rain in **September** allowed **drought and dryness to contract**; however, a mix of precipitation conditions in **October** and a **drier-than-normal November** allowed **drought and dryness to persist**. New England continued to experience impacts from drought, particularly in September.

Water Resources: **Record or near-record low flows** were observed on a few waterways in northeastern Massachusetts. **Below-normal groundwater levels** in Boston, MA, raised concerns of rotting wood pilings that hold up some buildings. A few Massachusetts towns had temporary boil water advisories in effect due to E. coli in the drinking water, with drought conditions followed by heavy rain being a possible cause. As of September 17, 96 **wells had run dry** in Maine. Summer water rates remained in effect for a **month longer than usual** in Ipswich, MA. Rainfall during September and October generally allowed **streamflow to improve**; however, **groundwater and reservoir levels did not fully recover** in some areas, causing **water restrictions** to continue through autumn. For example, as of November 3, 98 New Hampshire water systems and three municipalities had water restrictions in place, with most being mandatory. Some New Hampshire communities began exploring ways to **bolster their groundwater supplies** in preparation for future droughts.

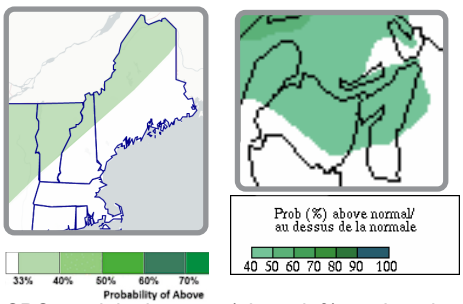
Agriculture: More Maine farmers sought assistance for replacing or installing irrigation systems, driven by the state's **third consecutive summer with drought conditions**. Some Massachusetts growers noted that the September rainfall came too late to benefit some crops, with one farmer reporting his irrigation costs were **more than 10 times normal** and another farmer paying $3,000 a day to water his apple crop. In Massachusetts, **Christmas tree saplings died** and some mature trees had brown needles and bare spots, causing some farms to not fully open and growers to raise prices.

Regional Outlook – *Winter 2022–23*

Temperature and Precipitation



CPC temperature map (above left) produced November 17. ECCC temperature map (above right) produced November 30.



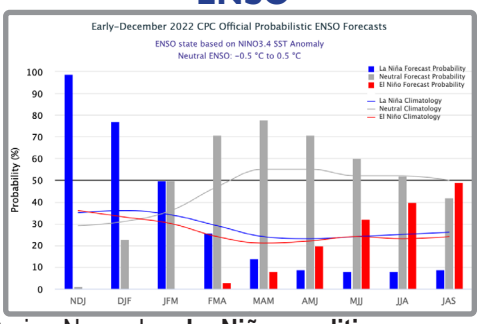
CPC precipitation map (above left) produced November 17. ECCC precipitation map (above right) produced November 30.

For **December–February**, NOAA's Climate Prediction Center (CPC) and Environment and Climate Change Canada (ECCC) favor **above-normal temperatures** for the Gulf of Maine region.

ECCC favors **above-normal precipitation** for most of P.E.I., portions of Nova Scotia and Cape Breton, and all but western New Brunswick for **December–February**, with **equal chances** of below-, near-, or above-normal precipitation forecast for the remainder of the Maritimes. CPC favors **above-normal precipitation** for northern and western Maine and northern New Hampshire, with **equal chances** for the rest of New England.

The increased likelihood of above-normal temperatures and above-normal precipitation in portions of New England is due in part to **La Niña conditions** and **decadal trends**.

ENSO



During November, **La Niña conditions persisted** in the equatorial Pacific Ocean. NOAA's Climate Prediction Center indicates La Niña will continue through winter, with a quick transition to ENSO-neutral conditions thereafter. There are equal chances of La Niña and ENSO-neutral for January–March, with a 71% chance of ENSO-neutral in February–April.

Contacts

National Oceanic and Atmospheric Administration

Environment and Climate Change Canada

Northeast Regional Climate Center

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