NL WATER RESOURCES MANAGEMENT DIVISION

NEWFOUNDLAND AND LABRADOR HURRICANE SEASON OUTLOOK 2024

WEATHER & CLIMATE

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1 ATLANTIC HURRICANE SEASON OUTLOOK 2024

The Atlantic Hurricane Season runs from June 1st to November 30th although storms can and do form outside of the designated season. The peak of the hurricane season for the basin and for Newfoundland and Labrador is early to mid-September. The hurricane season can be a trying time for many peoples in the Caribbean, central America, the US, and Atlantic Canada, with major costs to life and property at stake. While the greatest impacts of the hurricane season tend to be felt in the tropical and subtropics, Atlantic Canada is no stranger to significant impacts. We've seen the difficulties with Fiona (2022), Dorian (2019), Larry (2021), and Igor (2010).

There are numerous sources of weather data used in this hurricane outlook. The major sources are based on the prediction of the El Niño-Southern Oscillation (ENSO) condition, Sea Surface Temperatures (SSTs), model prediction, and weather patterns. Models have limited long-range skill in predicting SSTs, vertical wind shear, moisture availability, stability, and predicting weather patterns in the coming months. The seasonal weather pattern prediction is an outlook of an overall season, but we cannot fully convey the daily and weekly changes in the pattern. The short-term variability in the weather pattern plays a major role in the development, intensification, and tracking of tropical storms and hurricanes. Furthermore, the intensity and duration of the predicted tropical storms and hurricanes can occur under different combinations of climatic signals, which amplifies the uncertainty of such predictions.

Several agencies issue an Atlantic hurricane season outlook, including the National Oceanic and Atmospheric Administration (NOAA) [1] Colorado State University (CSU) [2], and Tropical Storm Risk (TSR) [3]. NOAA's 2024 Atlantic Hurricane Seasonal Outlook predicts an 85% chance of an above-normal season, followed by a 10% chance of a near-normal season and a 5% chance of a below-normal season. Both Colorado State and Tropical Storm Risk forecast Accumulated Cyclone Energy (ACE) which is aggregate measure of storm intensity, duration, and number. ACE biases toward long-lasting intense hurricanes rather than weak tropical storms because long-lasting intense hurricanes are more likely to cause destruction. Colorado State is predicting a seasonal ACE of 210, which is well above the 1991-2020 average of 123. Meanwhile, Tropical Storm Risk (TSR) is predicting a seasonal ACE of 217, also well above the 30-year climate normal. Table 1 below summarizes the predictions from each source. The CSU forecast team also forecasts the probability of a named storm impact for Newfoundland and Labrador at 41% with a 25% probability of a hurricane impact. These are both well above normal. An impact is defined as a storm centre passing within 80 km of the province.

Table 1. Atlantic Basin 2024 hurricane forecast by NOAA, CSU, and TSR

	NOAA	CSU	TSR
Named Storms	17-25[1]	23[2]	23[3]
Hurricanes	8-13	11	11
Major Hurricanes	4-7	5	5

[1] NOAA's Outlook was issued May 23rd

[2] CSU's forecast was issued April 4th

[3] Tropical Storm Risk's forecast was issued April 8th

The El Niño-Southern Oscillation (ENSO) is an irregular periodic variation in winds and sea surface temperatures of the tropical eastern Pacific Ocean. It is the leading predictor for seasonal forecasts as it is reasonably forecastable on time scale of months and has a large effect on the global atmospheric circulation. The El Niño phase of the ENSO is typically defined by the persistence of warm SST anomalies (>0.5 °C) for 5 consecutive 3-month periods in the Niño 3.4 region (Fig. 1), while the opposite is true for La Niña. The neutral phase is defined when the Niño 3.4 region is within ±0.5 °C for 5 consecutive 3-month periods.

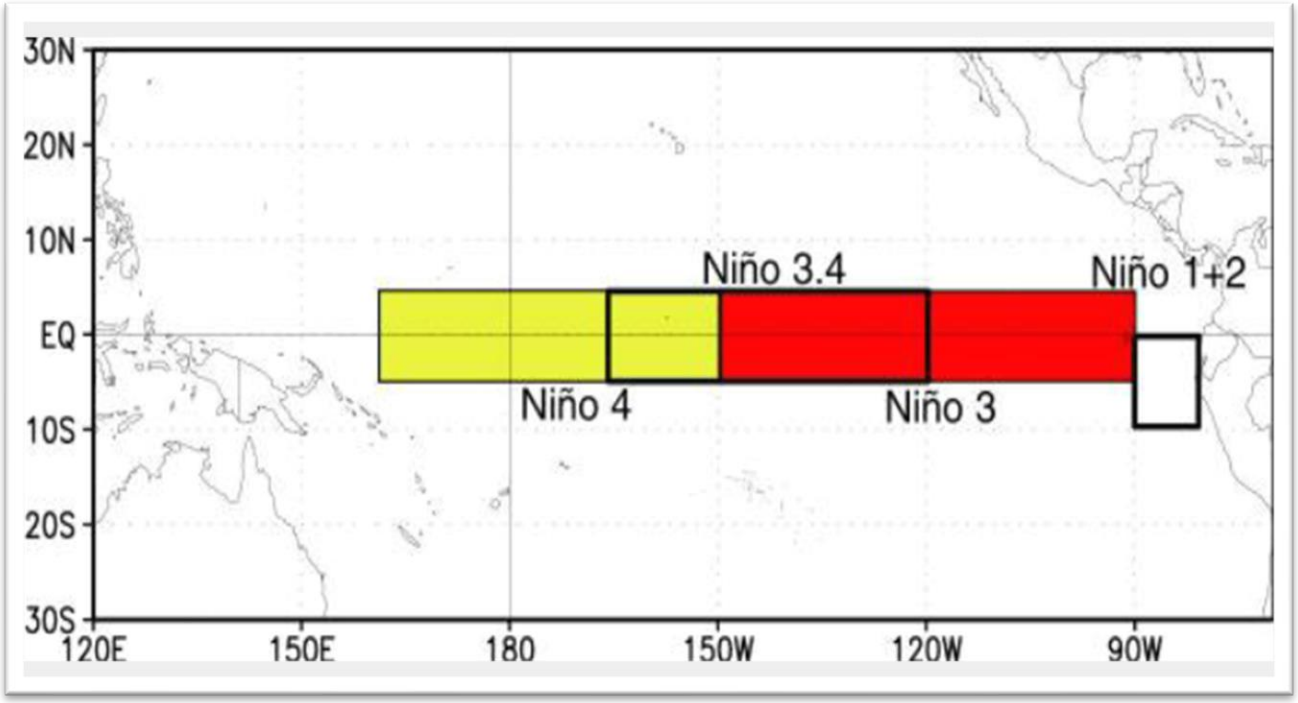


Figure 1 Niño Regions.

The La Niña phase is climatologically associated with weaker vertical wind shear, weaker trade winds, and increased atmospheric instability across the Atlantic basin, which in turn helps the overall organizational structure of any tropical storm. Meanwhile, the El Niño phase suppresses storm organization due to stronger wind shear, stronger trade winds, and greater atmospheric stability across the Atlantic basin. It is also worth noting that both ENSO phases have opposite effects on the east Pacific and Atlantic basins.

Figure 2 shows the NOAA probabilistic ENSO forecast based on the Niño 3.4 SST anomaly. The figure shows that La Nina conditions are likely to develop this summer and persist into the coming winter, with an 77% risk at the peak of hurricane season (ASO). There is a 1% risk of El Nino and a 22% chance of a neutral ENSO conditions.

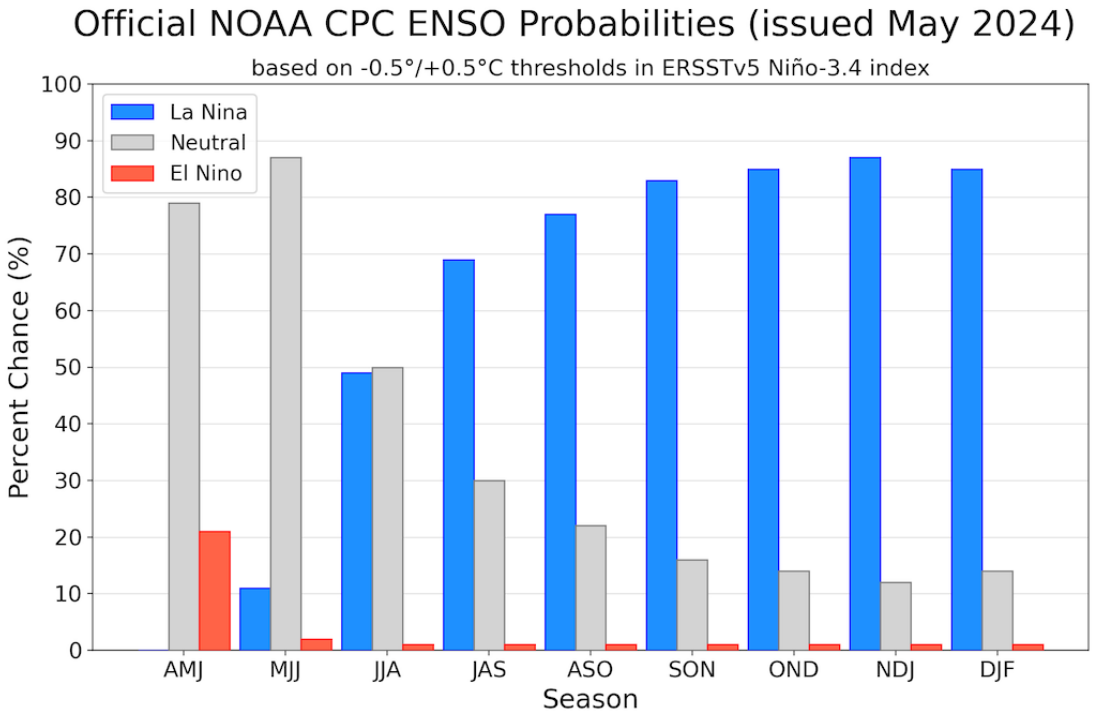


Figure 2 ENSO Probability Forecast (IRI/NOAA) [4]

Hurricane season predictions consider the various and complex interactions of variables such as the ENSO, Atlantic Multidecadal Oscillation (AMO), mid-level moisture, northwest Atlantic sea level pressure, and upper air patterns. The AMO is an index that measures the decadal SST variability in the Atlantic basin. Positive AMO years generally have warmer than normal SSTs in the tropical Atlantic and below normal SSTs in the subtropical Atlantic. The opposite is true for negative AMO years. The current positive phase of the AMO (Fig. 3) which we've been in since about 1995 is conducive to lower surface pressure, moist atmospheric mid-levels over the tropical Atlantic, and likewise, more hurricane activity.

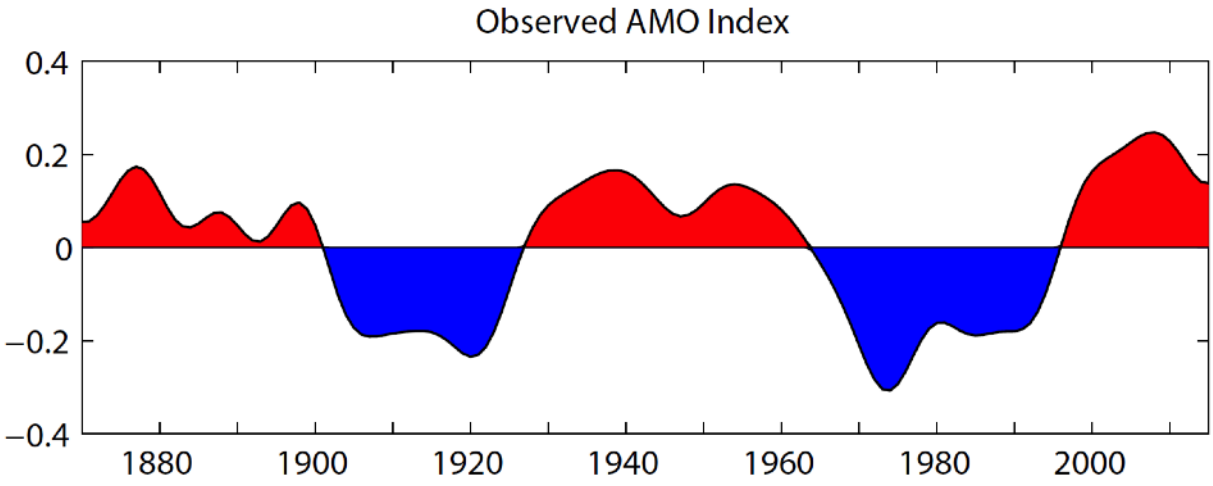


Figure 3 Smoothed AMO Index [1870-2021 (NCAR) [5]

The latest SST observation (Figure 4) shows record warm SSTs for May in the tropical Atlantic, in the Main Development Region (MDR), 10-20 °N, and 20-60 °W (right red box). While there is still warmer than normal SSTs in the Nino 3.4 region (left red box), this is leftover from the past year's El Nino. The cooler than normal SSTs near western South America and Peru is indicative of a developing La Nina. The synergy in the record warm MDR SSTs and the developing La Nina brings the risk of an active hurricane season and potentially very active hurricane season.

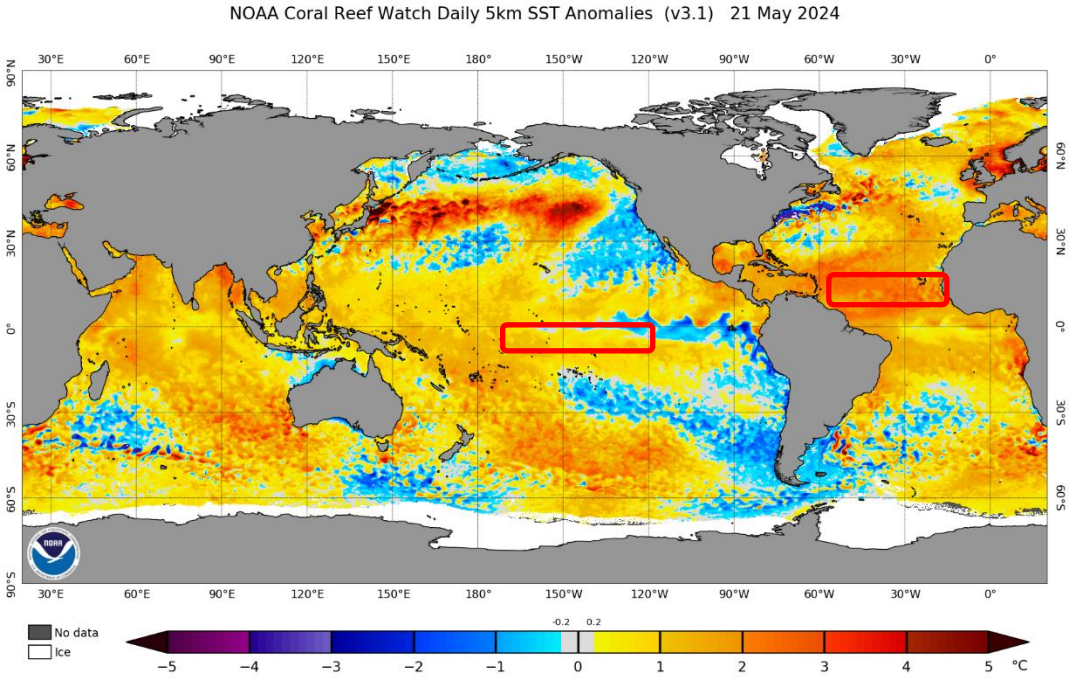


Figure 4 Global SST Anomaly on May 13th The right red box shows the extremely warm MDR region in the Atlantic Ocean and the left red box the warmer than normal, but cooling Niño 3.4 region in the Pacific (NOAA) [6]

The WSP Seasonal Outlook Team is anticipating a much above normal Atlantic Hurricane Season. The strong signal for developing La Nina, with many models showing moderate strength, should impart weaker than typical wind shear across the Caribbean, especially in the later portion of the season. Given the record warm tropical Atlantic Ocean, it is likely that tropical waves will find favorable areas for development. The seasonal models indicate an excess of precipitation and lower than normal sea level pressures across the MDR and the Caribbean and the Gulf of Mexico, both of which are associated with elevated hurricane activity. WSP's analogs are rather split in where the greatest threat is in the Atlantic Basin, with 2010 generally indicating an active central Atlantic, with lots of storm recurves and a relatively quiet Caribbean and Gulf of Mexico. 2007 is the opposite extreme, with intense Caribbean storms and less than typical activity in the main part of the Atlantic Ocean. The other three analogs generally show a mixture of these two opposing ideas.

2 HISTORICAL NEWFOUNDLAND AND LABRADOR HURRICANE SEASONS

The archive records from the National Hurricane Center HURDAT2 and NOAA's IBTrACS data sets show Newfoundland being impacted by more than double the tropical storms, hurricanes, and extratropical remnants than Labrador, as seen in Figure 5. This year's report continues to use a further expanded historical data set that better accounts for extratropical remnants and storms which didn't make landfall but tracked close enough to the province to make an impact. These storms do not have to retain much of their prior strength to bring high levels of atmospheric moisture, rainfall, and likewise flooding to our region.

Even so, this larger database does not cover all floods directly or indirectly related to tropical systems. Two floods of record, one from Post-Tropical Earl (2022) in eastern Newfoundland (Fig. 7) and another from the moisture from Hurricane Matthew (2016) in western and central Newfoundland are not included in this database. Earl tracked too far from Newfoundland (270 km SSE of Cape Race). The surface low of once Hurricane Matthew dissipated east of the North Carolina and is discussed in greater detail in Section 3.

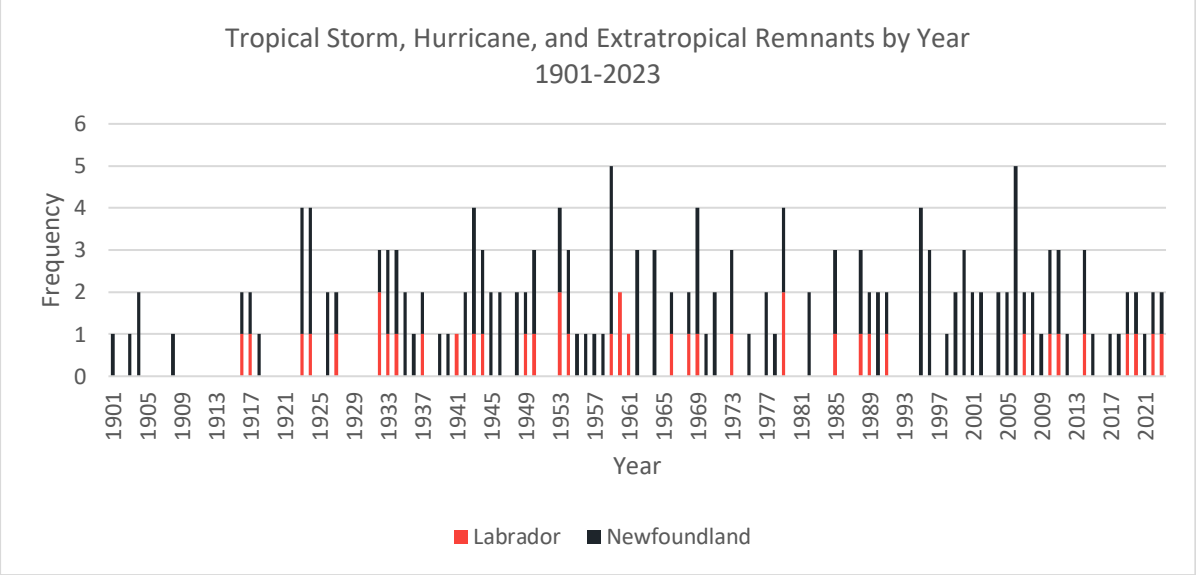
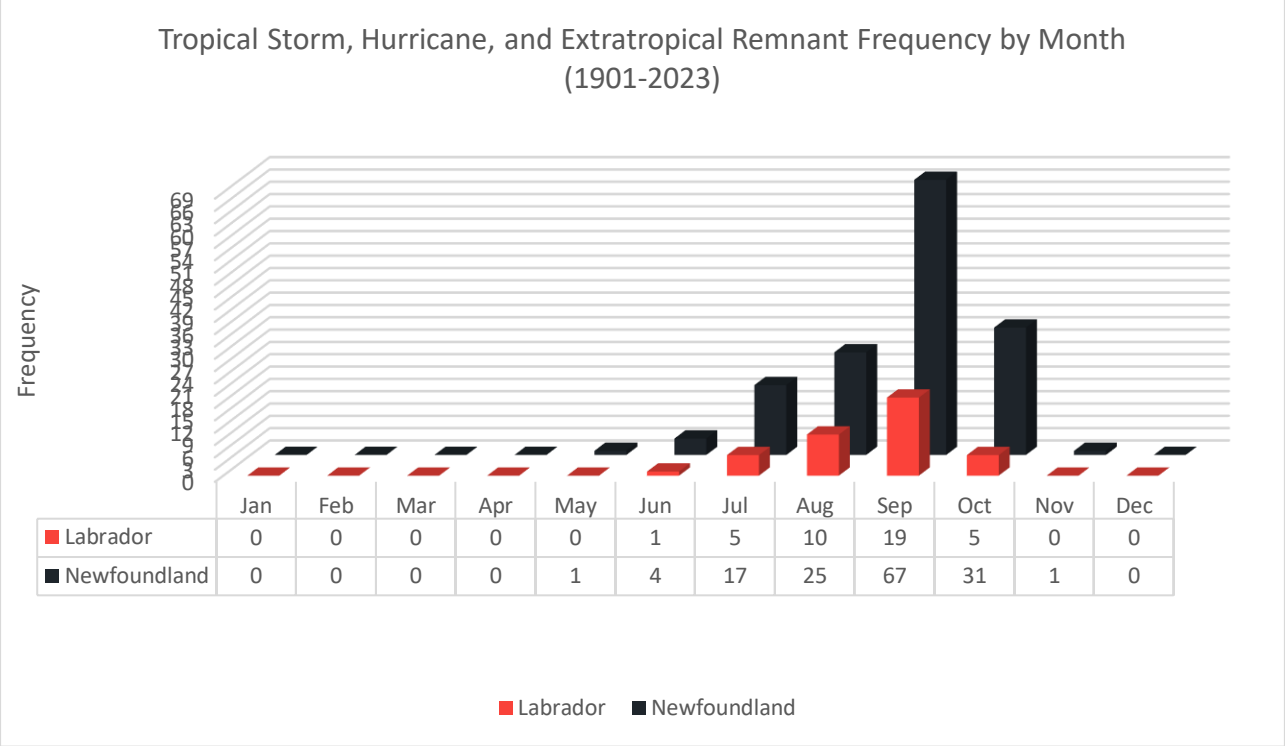


Figure 5 Tropical Cyclone and Extratropical Remnants by year for NL between 1901 and 2023 (NOAA) [7]

The same records reveal the month of September as the peak month for activity in the province, followed by October, and then August (Fig. 6).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Labrador	0	0	0	0	0	1	5	10	19	5	0	0
Newfoundland	0	0	0	0	1	4	17	25	67	31	1	0

Figure 6 Tropical Cyclone and Extratropical Remnant Frequency by month for NL between 1901 and 2023 (NOAA) [7]

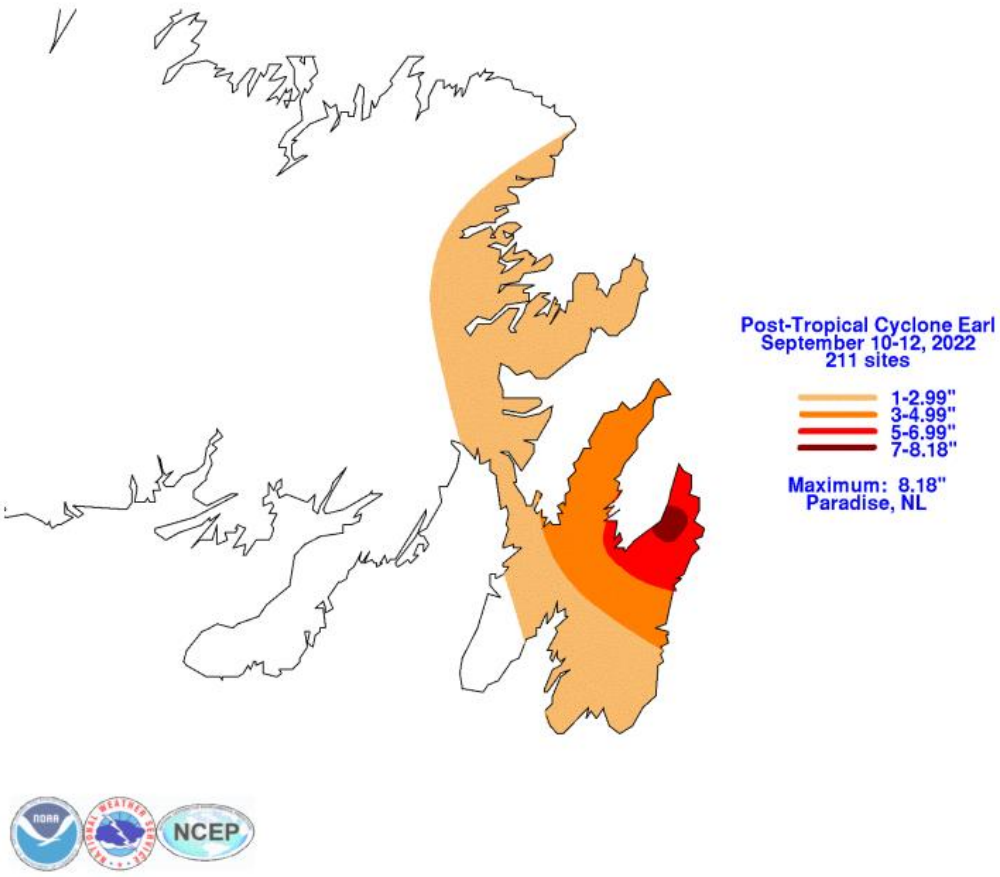


Figure 7 Rainfall Totals in Eastern Newfoundland from Earl (2022), 1 inch = 25.4 mm (NHC) [8]

Figure 8 shows the Florida State University (FSU) probabilistic tropical cyclones tracking over Newfoundland using 1886-2020 historical data. Storms that affect Newfoundland most regularly approach from the south-southwest and generally pass near or west of Bermuda before arriving on the Newfoundland Coast. Any storm this year that tracks through the blue and green colours on this chart will be further scrutinized by WSP forecasters to gauge potential future impacts to the province.

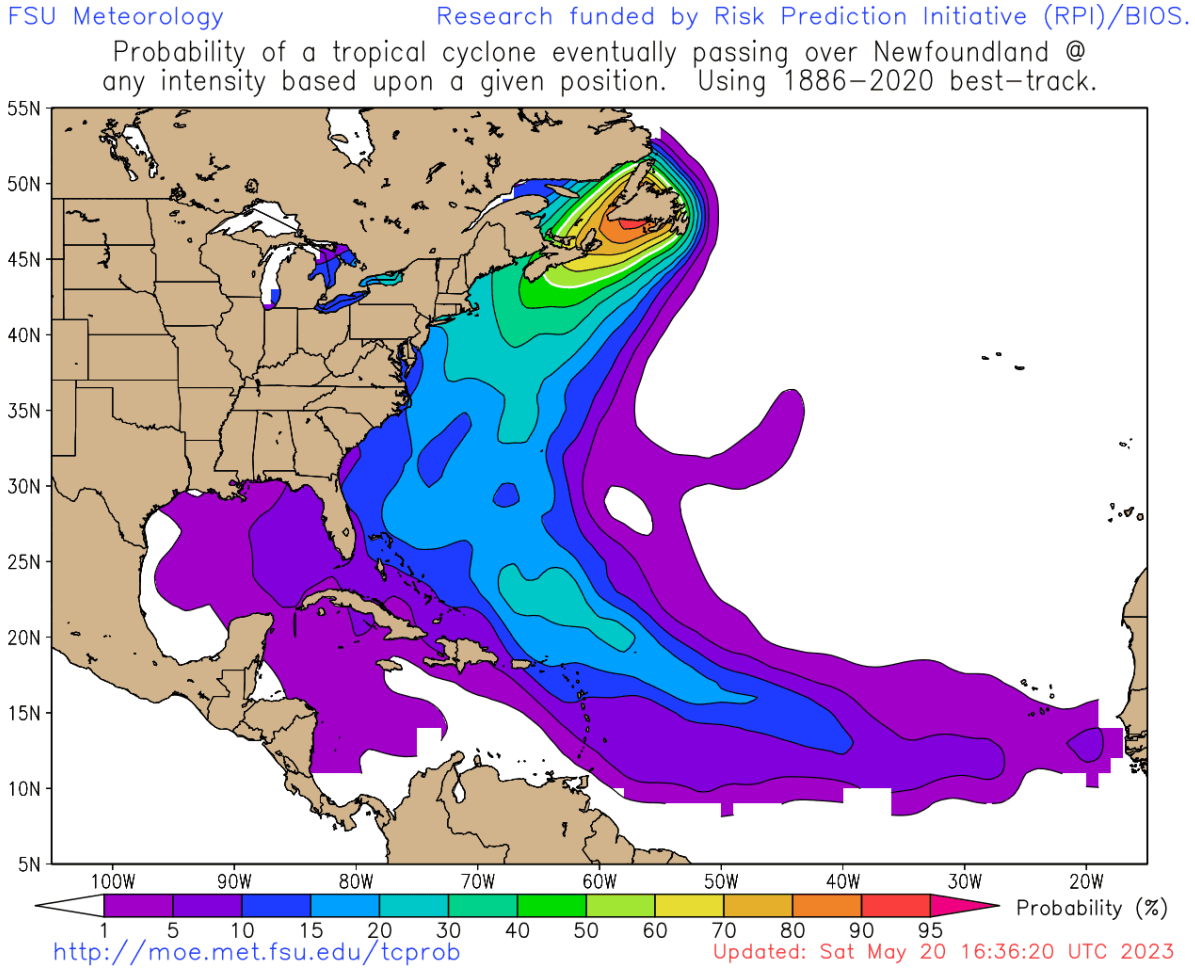


Figure 8 Newfoundland tropical cyclone probability using 1886-2020 best-track [9]

3 ANALOG YEARS AND HISTORICAL TRACKS

Given the projected ENSO conditions, the best analog years are 2010, 2020, 1998, 2016, and 2007. Figure 9 shows the upper air (500 hPa) geopotential height (m) composite anomaly based on 1991-2020 climatology for the period from June and through November for the combined analog years. There are a few interesting pattern findings here, with the ridge over the east and central US being favorable for Caribbean, Mexico, Florida, and Texas impacts. The ridging over the eastern Canadian Arctic, combined with the ridge over the central North Atlantic Ocean and the trough over the Maritimes brings the risk of a favorable impact pattern for eastern Newfoundland.

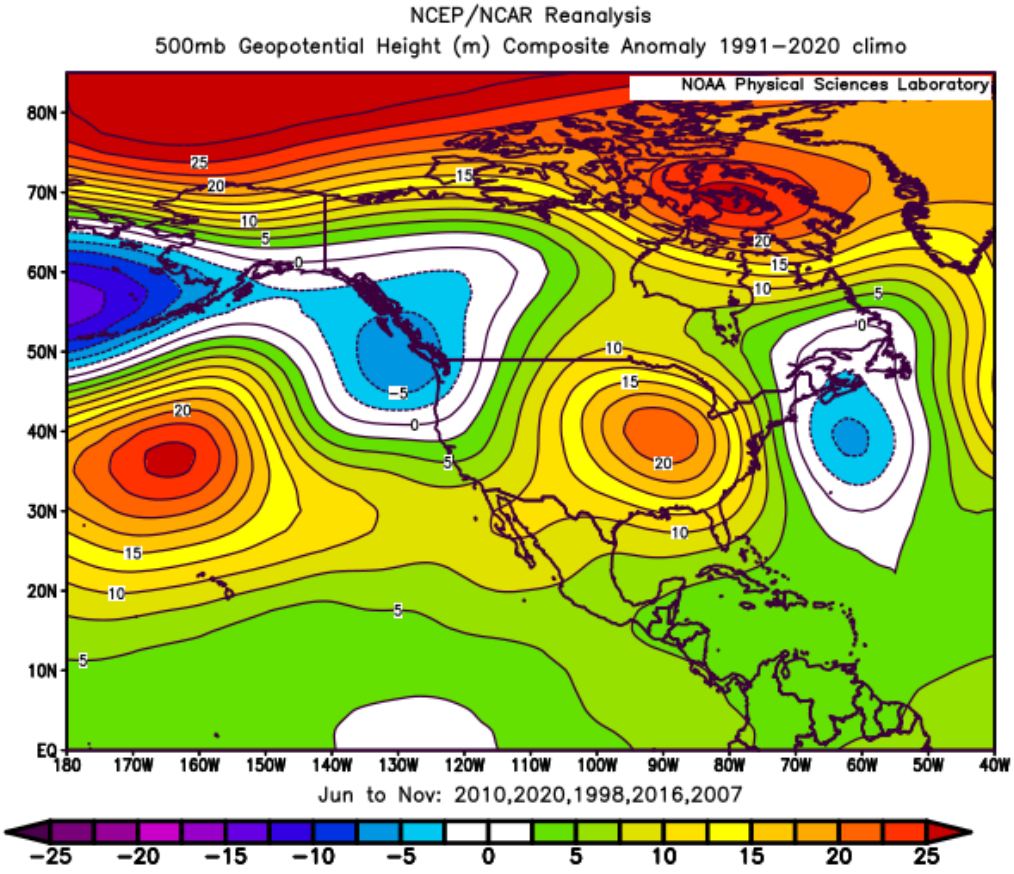


Figure 9 Upper air (500 hPa) Geopotential Heights (m) composite anomaly for June through November of the analog years (NOAA PSL) [10]

The hurricane track charts for the analog years are given in Figures 10 to 14. Generally, the analog years depict an above to much above normal hurricane season, with a range of 14 to 30 named storms, of which 6 to 14 became hurricanes, and of which 2 to 7 became major hurricanes.

Igor (2010) is generally the benchmark hurricane impact for eastern Newfoundland due to the combination of very strong winds and heavy rain. Hurricane Earl's (2010) remnants produced an estimated gust of 115 km/h in Stephenville, but no heavy rainfall nor flooding were observed. Hurricane Teddy's (2020) remnants brought a gust of 85 km/h in Port-aux-Basques, a gust of 76 km/h in Stephenville, and a gust to 78 km/h in St. Anthony. Rainfall totals reached about 30 mm in Port-aux-Basques. Greater effects from Teddy were observed in Nova Scotia where it was still a hurricane. Hurricane Earl's (1998) remnants re-intensified before making landfall in eastern Newfoundland. Earl produced a gust of 102 km/h in St. John's and approximately 40 mm of rainfall. The 2016 season featured heavy rain and flooding in October as the result of moisture from the remnants of Hurricane

Matthew being transported northward into a non-tropical low. Rainfall totals of greater than 200 mm were observed in western and central Newfoundland with numerous road washouts and states of emergency declared. The tropical low itself dissipated east of North Carolina so it doesn't show up on the hurricane tracking chart in Figure 13. The remnants of Tropical Storm Chantel (2007) re-intensified and brought heavy rain on July 31st and August 1st as an extratropical low to eastern Newfoundland. Road washouts were observed in Ship Harbour, Fox Harbour, and Dunville. St. John's reported approximately 100 mm of rain and Argentia nearly 200 mm.

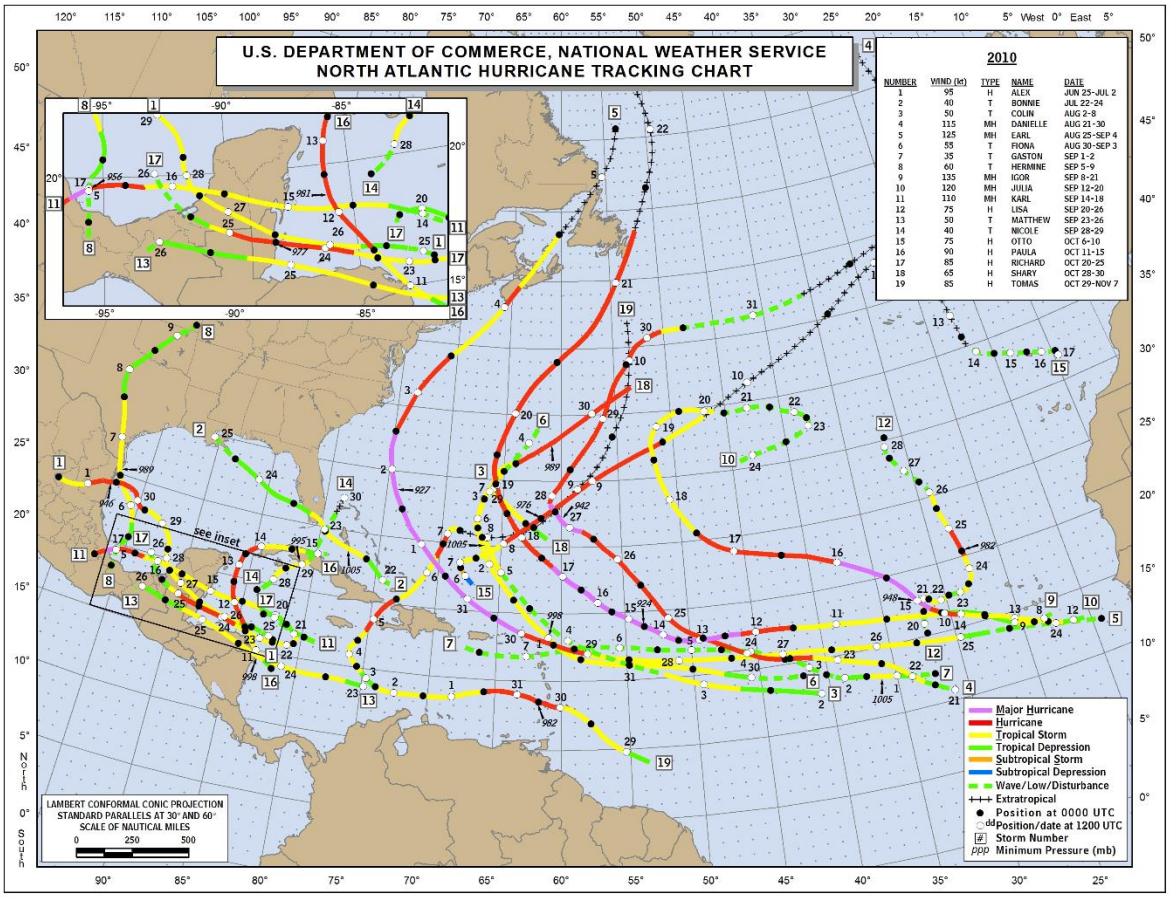


Figure 10 North Atlantic Hurricane Tracking Chart (2010) (NHC) [11]

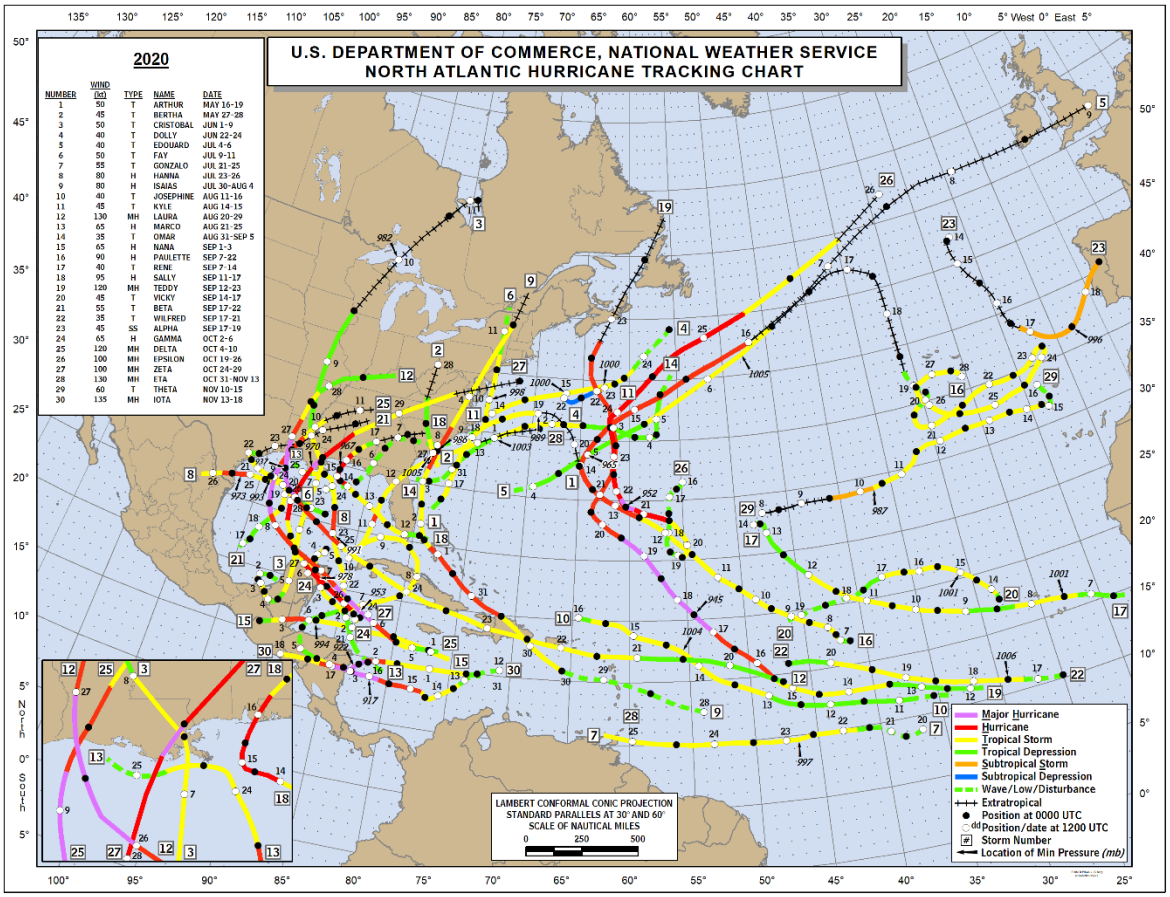


Figure 11 North Atlantic Hurricane Tracking Chart (2020) (NHC) [11]

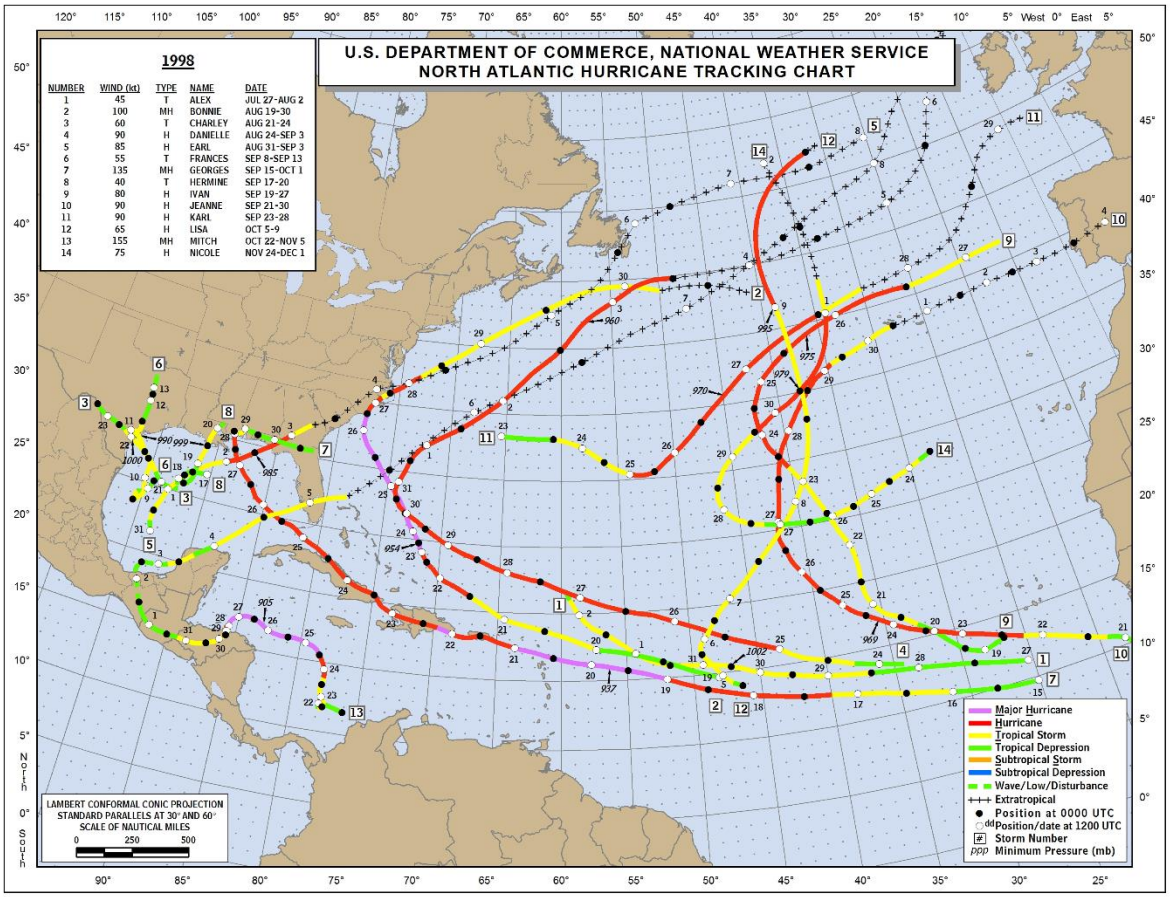


Figure 12 North Atlantic Hurricane Tracking Chart (1998) (NHC) [11]

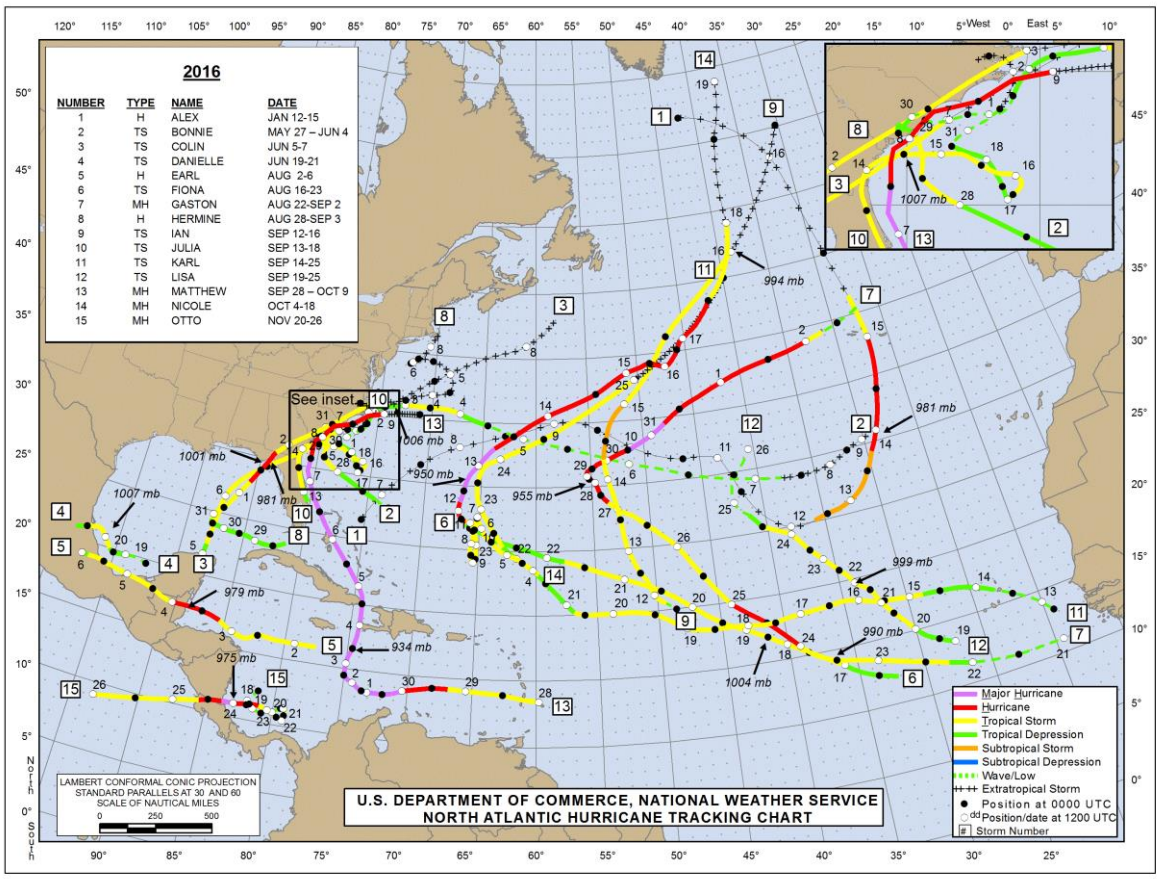


Figure 13 North Atlantic Hurricane Tracking Chart (2016) (NHC) [11]

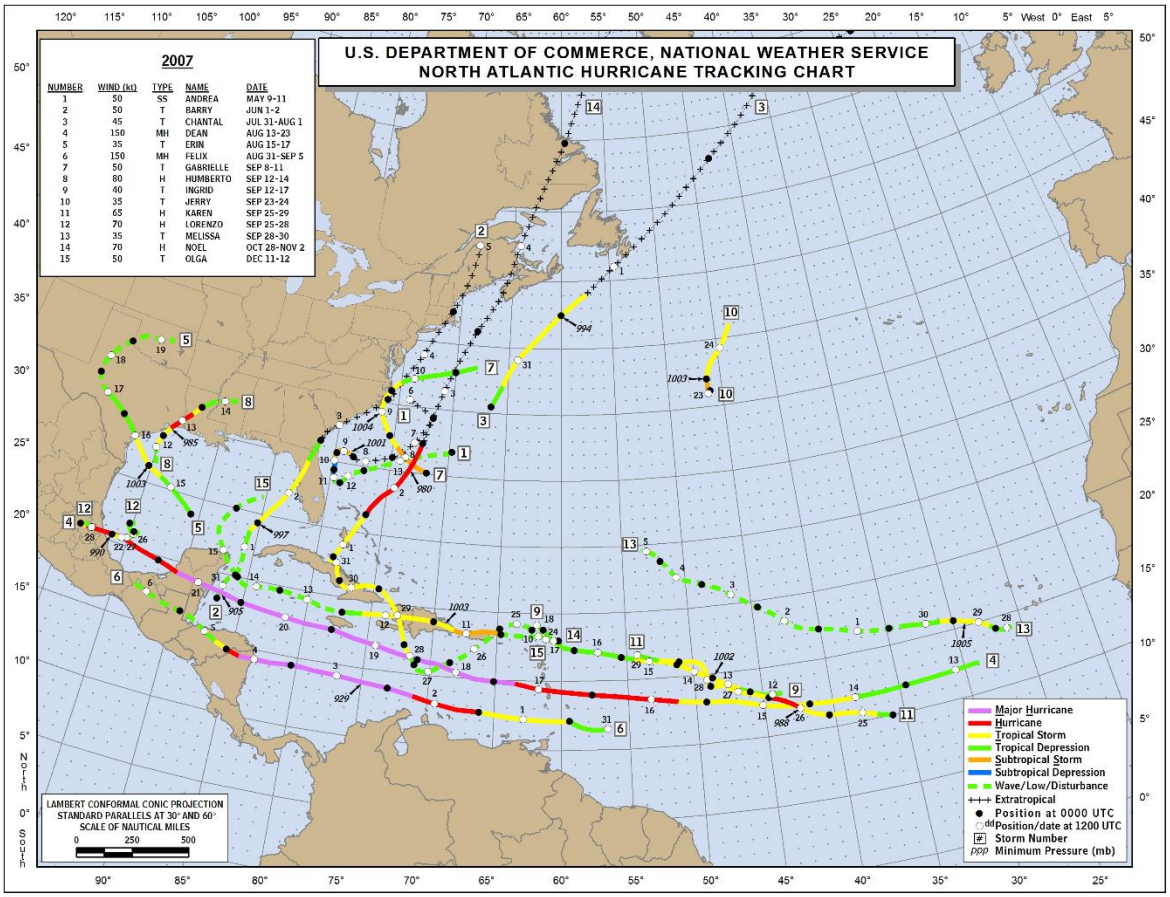


Figure 14 North Atlantic Hurricane Tracking Chart (2007) (NHC) [11]

4 NEWFOUNDLAND AND LABRADOR HURRICANE SEASON OUTLOOK 2024

WSP anticipates an above normal season for the province, with the greatest risk of tropical storms, hurricanes, and strong post-tropical storms across eastern Newfoundland, including St. John's (Fig. 15). These types of storms carry the associated risk of high wind gusts of more than 100 km/h, heavy rain of more than 100 mm with associated flooding, and storm surge flooding on exposed coastline near sea level. For areas in the lower risk zone in central and western Newfoundland and southeast Labrador, there is a much lower risk of very high wind gusts and storm surge, but there is a still a considerable risk of heavy rain and associated flooding as weak storms merge with other lows.

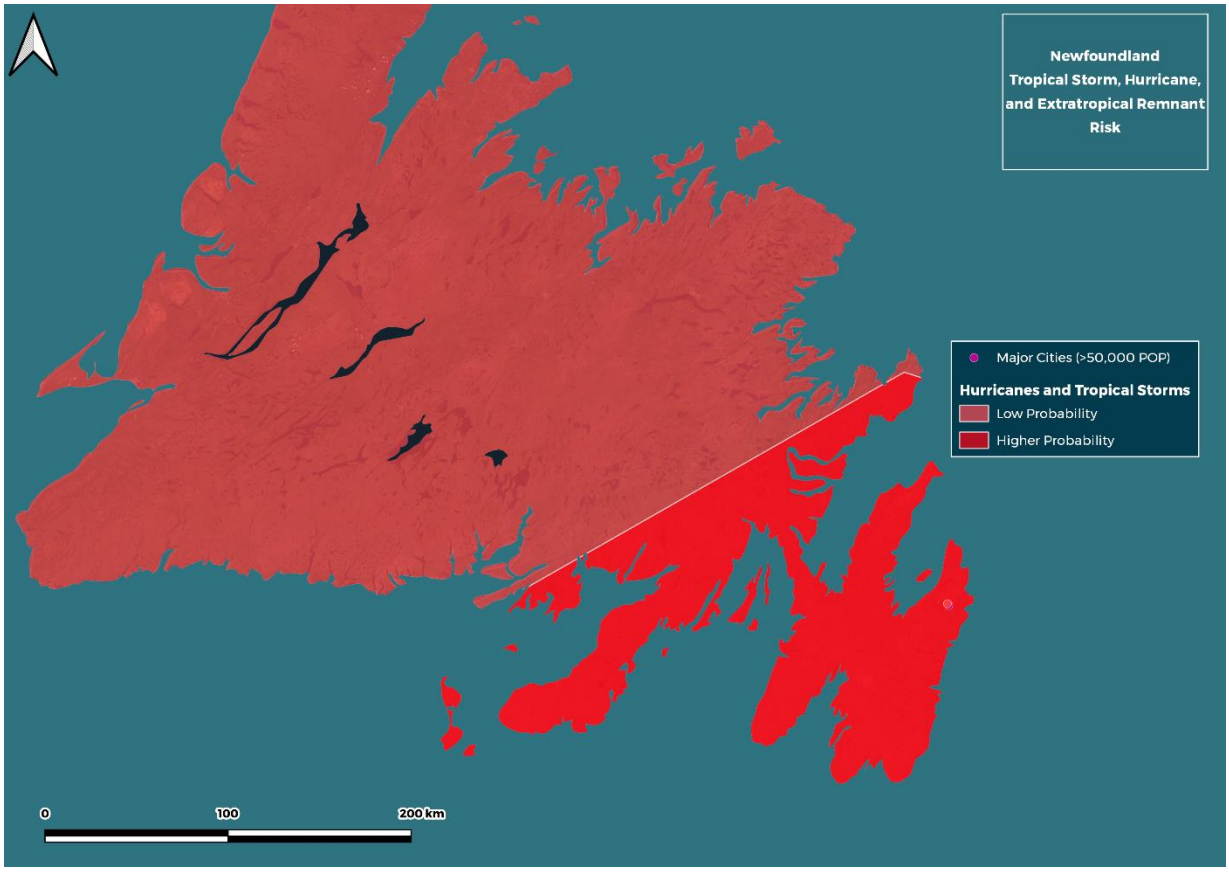


Figure 15 Newfoundland Hurricane Season Risk Map

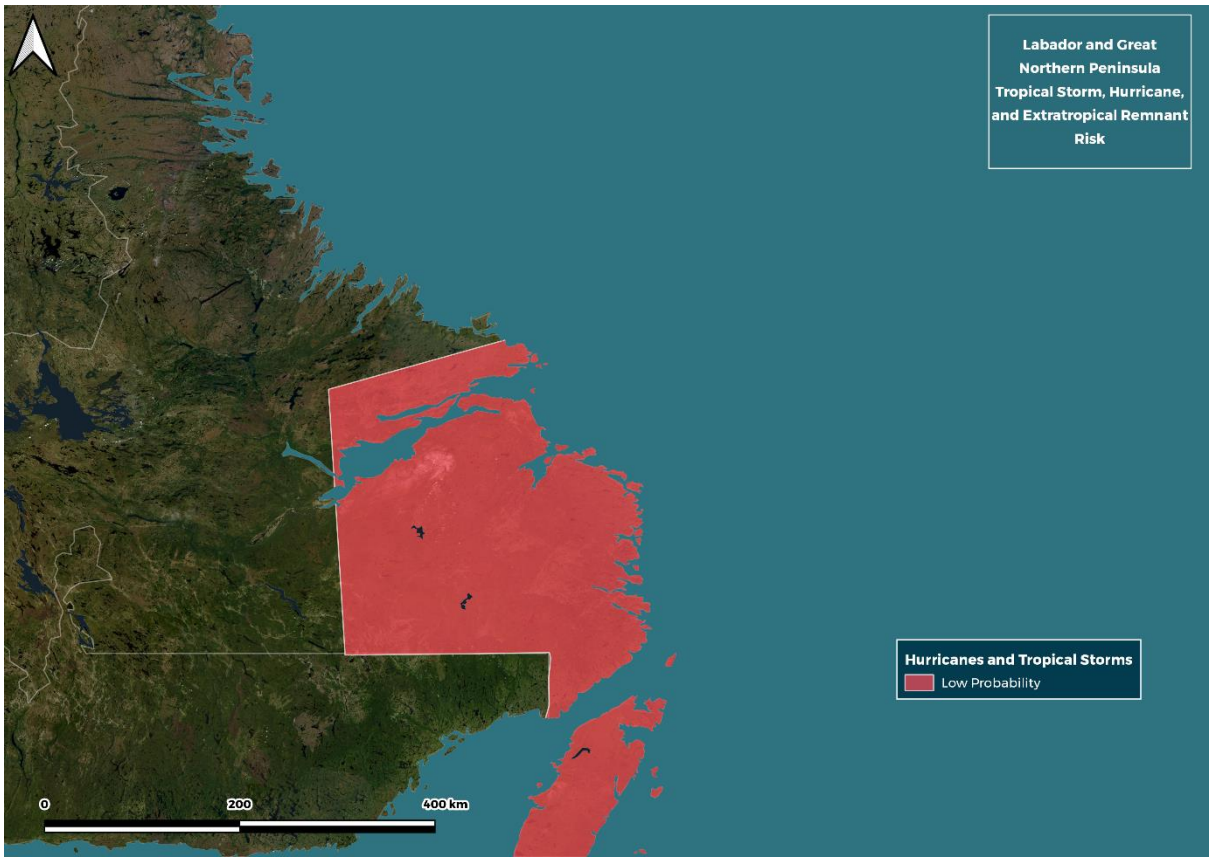


Figure 16 Labrador and Great Northern Peninsula Hurricane Season Risk Map

5 CLOSURE

We trust that this report meets your needs. Please do not hesitate to contact the author if you have any questions or comments regarding the hurricane season outlook.

Yours sincerely,

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