Confidential

NL Water Resources Management Division

2025 Hurricane Season Forecasting Outlook

2025-06-01

QUALITY MANAGEMENT

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1 ATLANTIC HURRICANE SEASON OUTLOOK 2025

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 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 most significant impacts of the hurricane season tend to be felt in the tropics 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).

Numerous sources of weather data are used in this hurricane outlook, with the major sources based on the prediction of the El Niño-Southern Oscillation (ENSO) condition, Sea Surface Temperatures (SSTs), model predictions, and weather patterns. Models have limited long-range skill in predicting SSTs, vertical wind shear, moisture availability, stability, and weather patterns in the coming months. The seasonal weather pattern prediction provides an overview of the entire season, but it cannot fully convey the daily and weekly fluctuations 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 2025 Atlantic Hurricane Seasonal Outlook predicts a 60% chance of an above-normal season, followed by a 30% chance of a near-normal season and a 10% chance of a below-normal season. Both Colorado State and Tropical Storm Risk forecast Accumulated Cyclone Energy (ACE), which is an 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 155, which is above the 1991-2020 average of 123. Meanwhile, Tropical Storm Risk (TSR) is predicting a seasonal ACE of 120, near 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 32% with a 19% probability of a hurricane impact. These are both slightly above normal. An impact is defined as a storm centre passing within 80 km of the province.

Table 1. Atlantic Basin 2025 hurricane forecast by NOAA, CSU, and TSR

	NOAA	CSU	TSR
Named Storms	13-19[1]	17[2]	14[3]
Hurricanes	6-10	9	7
Major Hurricanes	3-5	4	3

[1] NOAA's Outlook was issued May 22nd

[2] CSU's forecast was issued April 3rd

[3] Tropical Storm Risk's forecast was issued April 7th

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 phase of the ENSO is typical defined by the persistence of warm SST anomalies (>0.5 °C) for 5 consecutive 3-month periods in the Niño 3.4 region (Figure 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.

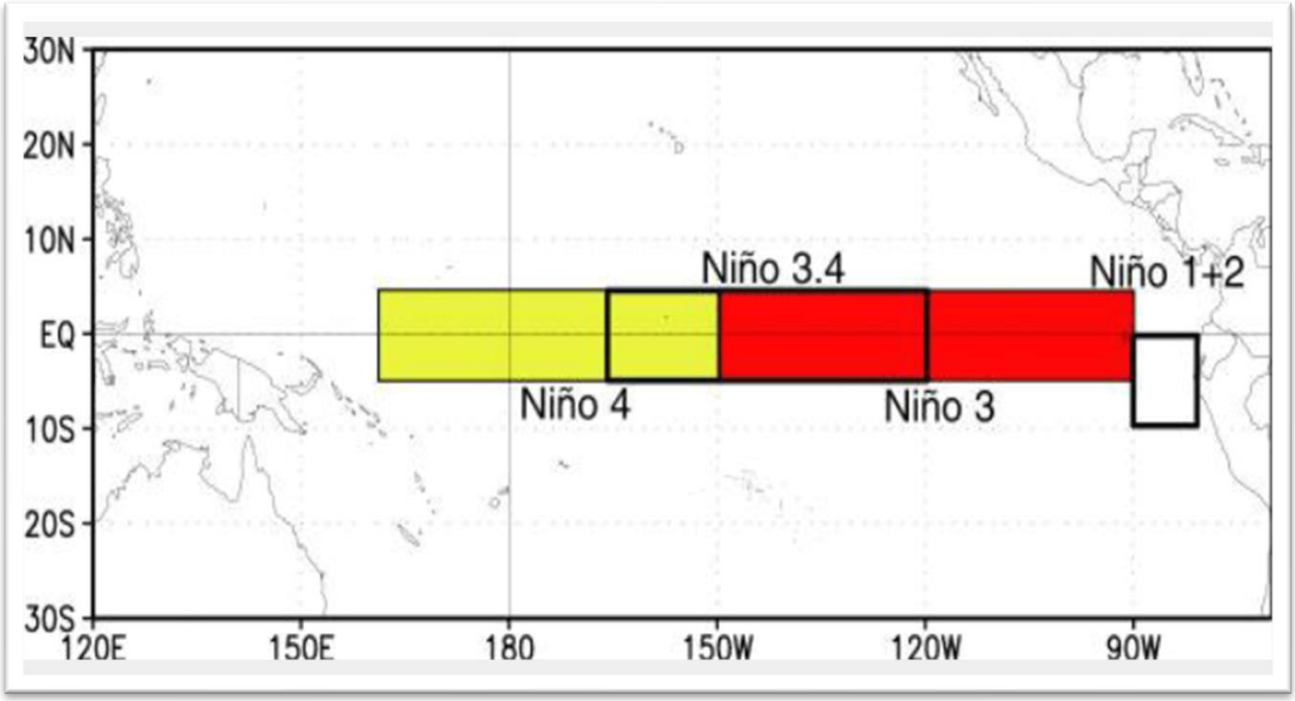


Figure 1. NESO Regions

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 Neutral conditions are most likely to persist into this summer and fall, with a 52% risk at the peak of hurricane season (ASO). There is a 31% risk of La Niña and a 17% chance of El Niño conditions.

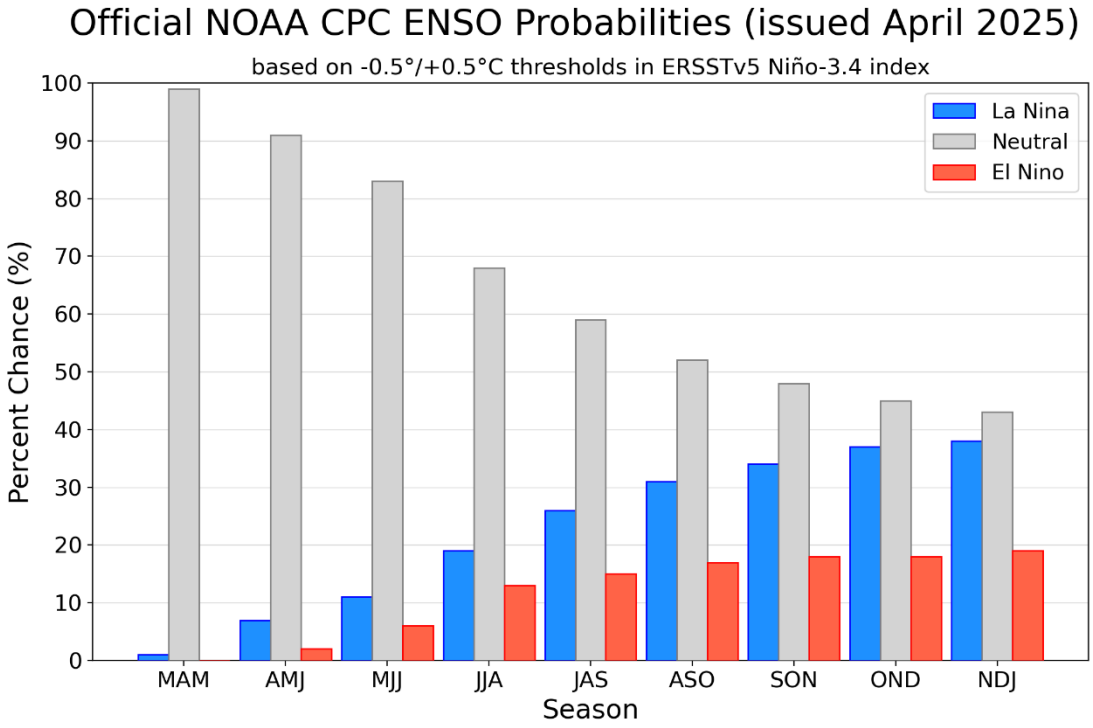


Figure 2. Official CPC ENSO Probability Forecast (IRI/NOAA) [4]

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 consequently, more hurricane activity.

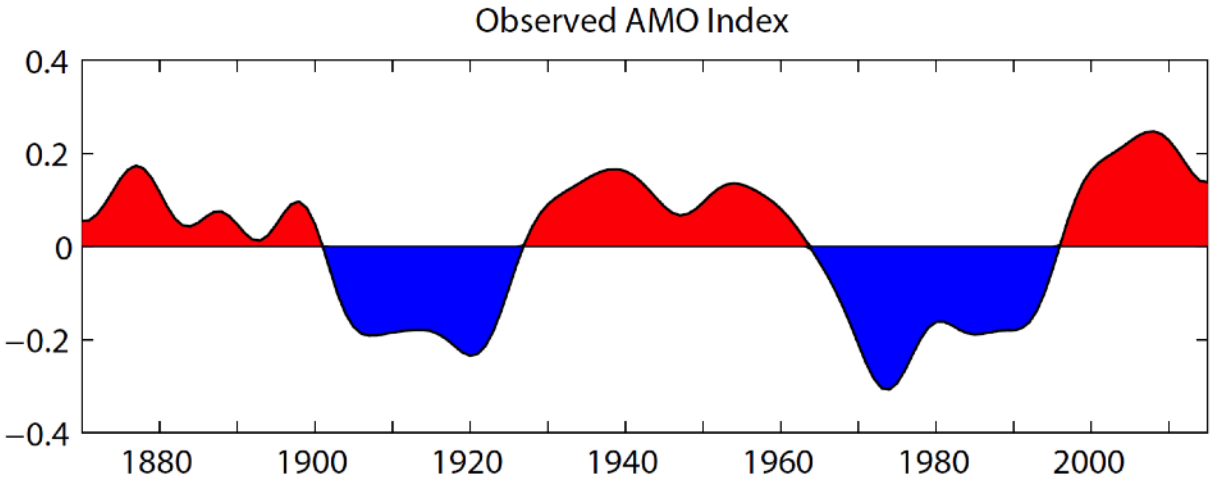


Figure 3. Smoothed AMO Index [1870-2021 (NCAR) [5]

The latest SST observation (Figure 4) shows above normal SSTs in the tropical Atlantic, in the Main Development Region (MDR), 10-20 °N, and 20-60 °W (right red box). Warmer than normal water in the MDR and, likewise, a positive Atlantic Multidecadal Oscillation is associated with a more active than normal Atlantic Hurricane Season. The SSTs in the Niño 3.4 region (5 °N-5 °S, and 120-170 °W) are neutral, with the latest weekly anomaly of +0.1 °C. The combination of these factors is generally favourable for an above normal hurricane season but less so than last year since the Atlantic tropical SSTs are not as above normal and the ENSO phase is expected to be neutral as opposed to a La Niña.

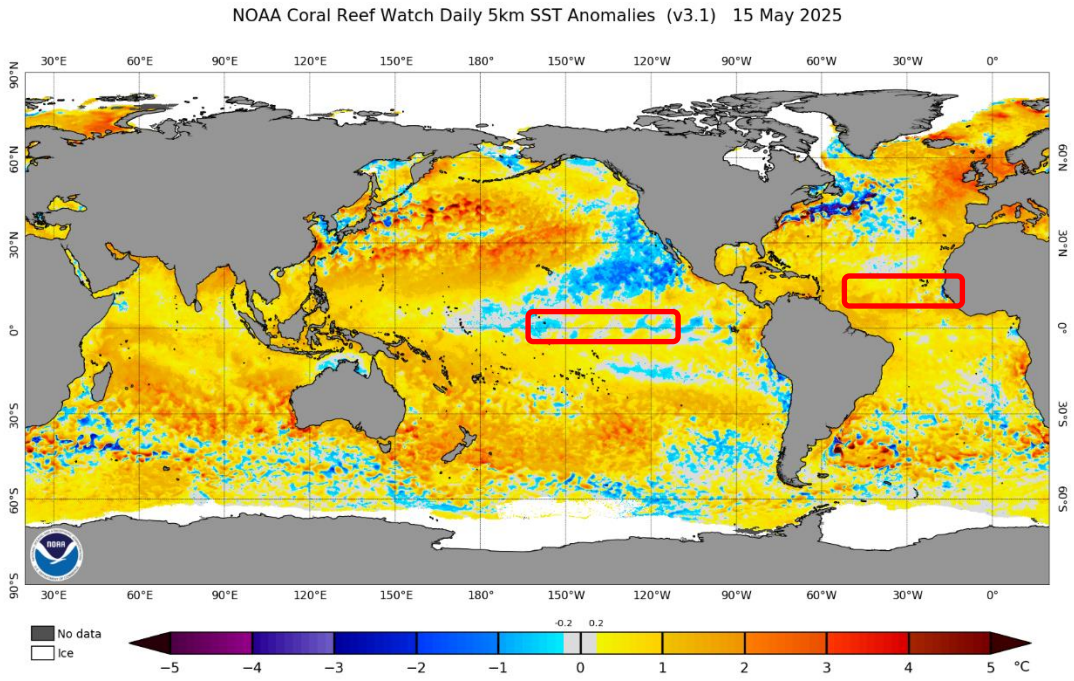


Figure 4. Global SST Anomaly on May 15th [6]

The WSP Seasonal Outlook Team is anticipating a slightly above normal Atlantic Hurricane Season. This is due to the moderate signal for ENSO neutral conditions, which favours neither above nor below normal tropical activity, plus the above normal SSTs in the tropical Atlantic Ocean, which favours an above normal activity. In contrast, the seasonal models indicate less precipitation than normal across the MDR, the Caribbean, the Gulf of Mexico, and the southwest Atlantic (Figure 5), which is generally associated with less than normal hurricane activity. Given the projected ENSO conditions, the best analog years are 1996, 2001, 2006, and 2013. 2013 saw no hurricane landfalls and one tropical storm impact in Florida and the Carolinas. 1996 had two hurricane landfalls in the Carolinas, one of which was major (Hurricane Hortense), which had a significant impact on Atlantic Canada, especially Nova Scotia. The 2001 and 2006 hurricane seasons saw a considerable percentage of the development in the central Atlantic with fewer landfalls.

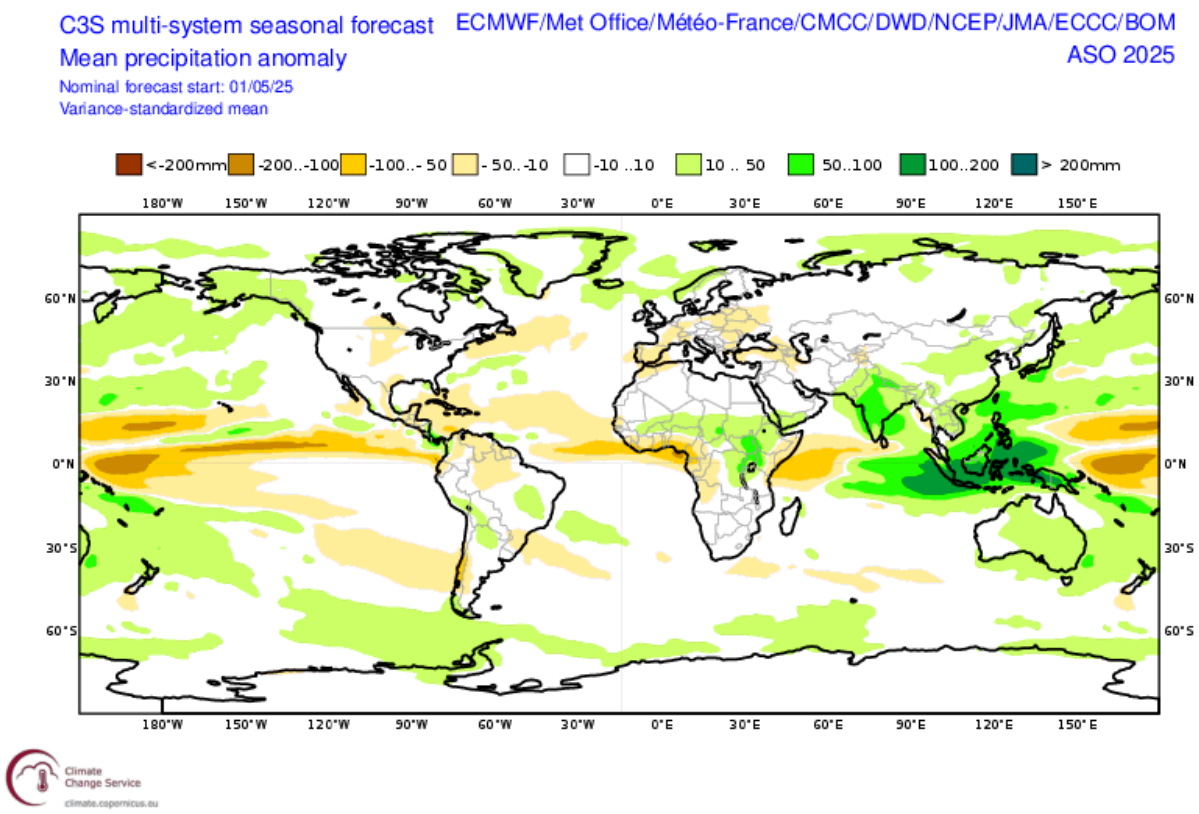


Figure 5. CS3 Multi-system Seasonal Forecast Aug-Sep-Oct Precipitation Anomaly [7]

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 post-tropical remnants than Labrador, as seen in Figures 6 and 7. This year's report continues to use a further expanded historical data set that better accounts for post-tropical 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. 8) 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 same records reveal the month of September as the peak month for activity in the province, followed by October, and then August (Figure 7).

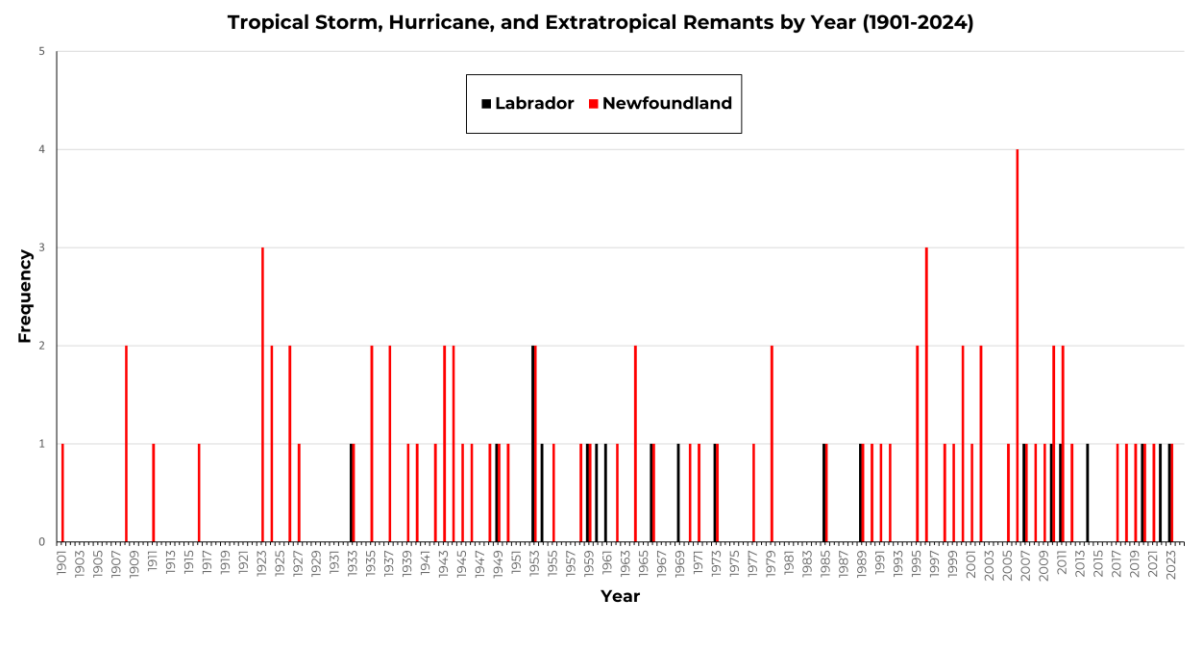
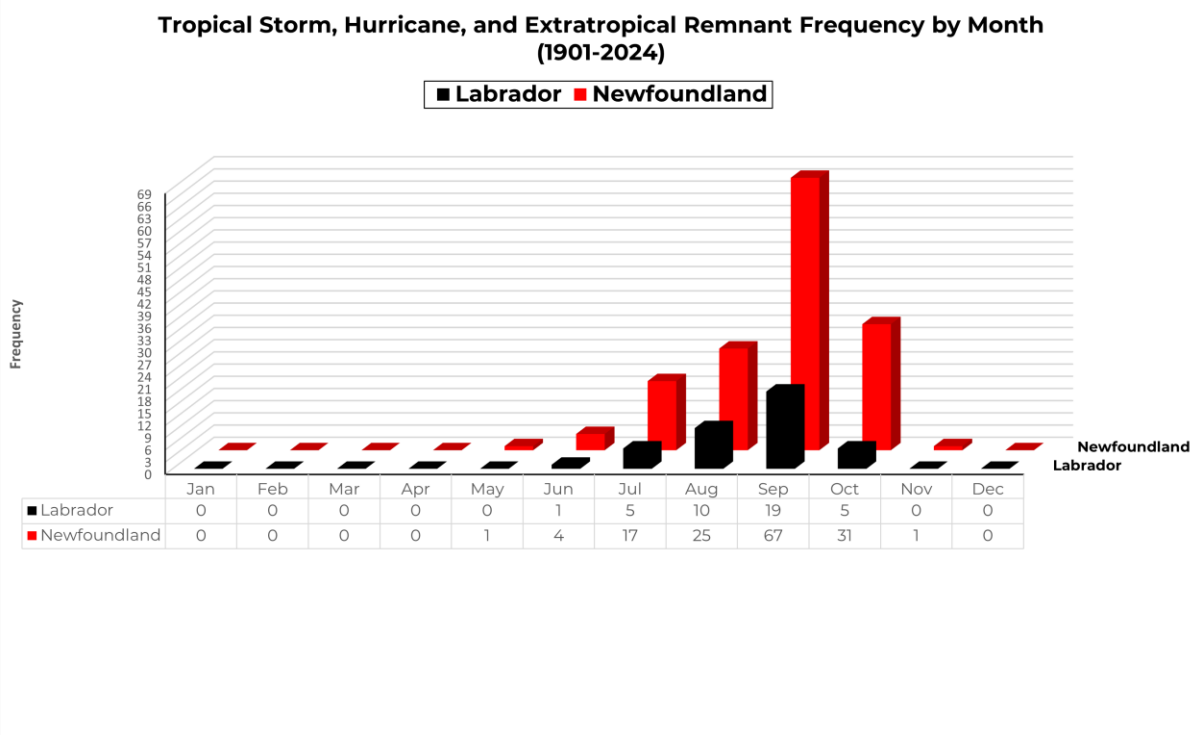


Figure 6. Tropical Cyclone and Post-Tropical Remnants by year for NL between 1901 and 2024 (NOAA) [8]



	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 7. Tropical Cyclone and Post-Tropical Remnant Frequency by month for NL between 1901 and 2024 (NOAA) [8]

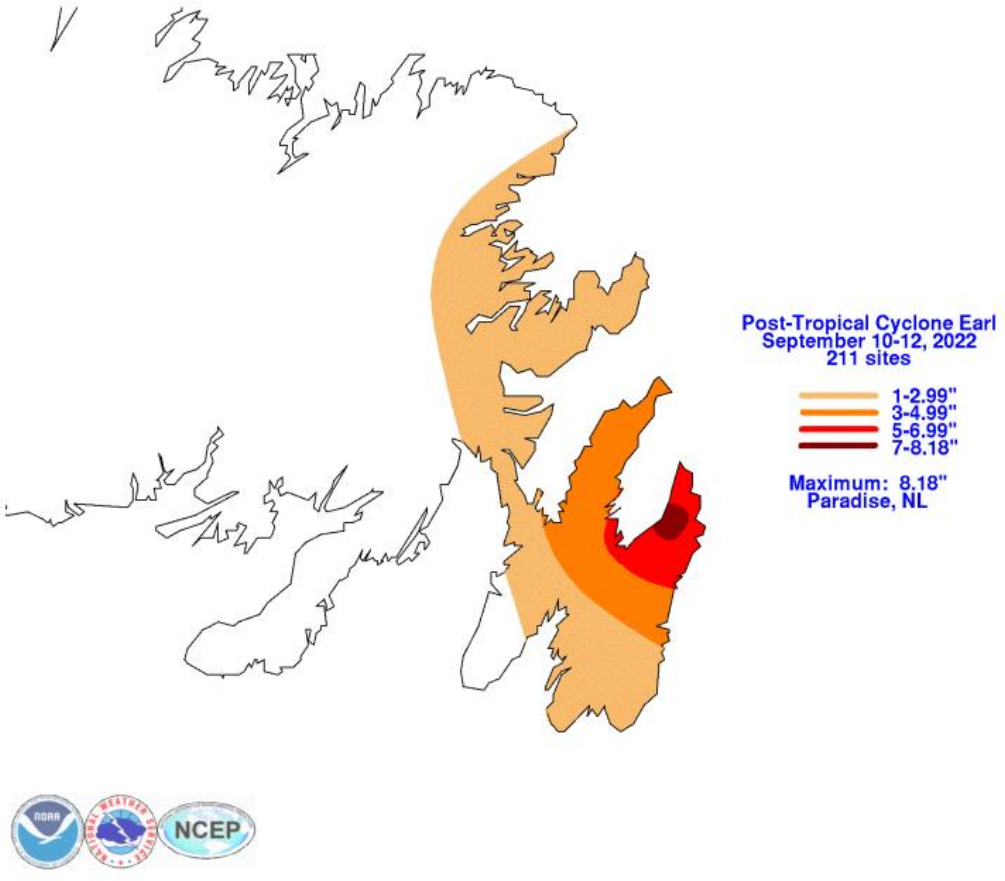


Figure 8. Rainfall Totals in Eastern Newfoundland from Earl (2022), 1 inch = 25.4 mm (NHC) [9]

Figure 9 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.

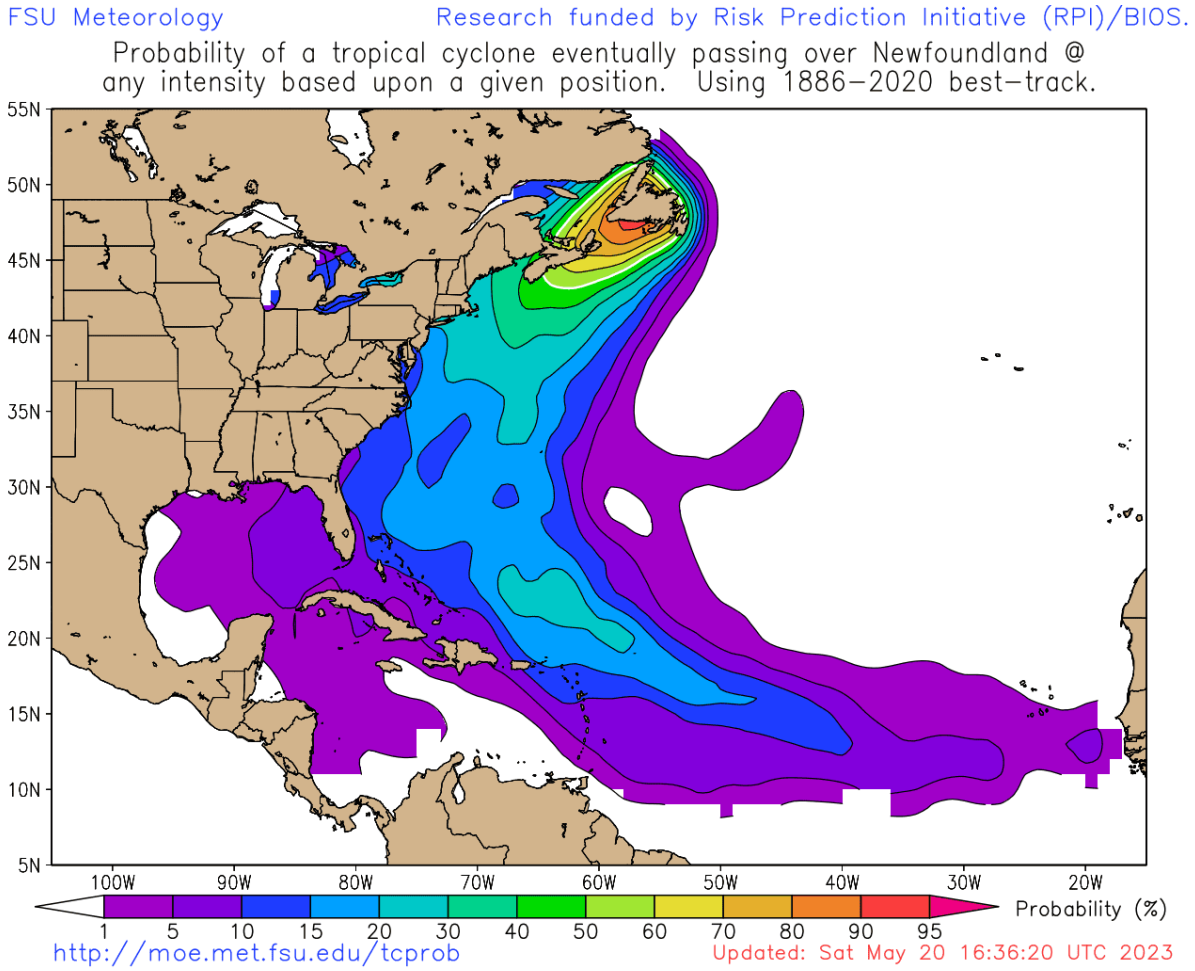


Figure 9. Newfoundland tropical cyclone probability using 1886-2020 best-track [10]

3 ANALOG YEARS AND HISTORICAL TRACKS

Given the projected ENSO conditions, the best analog years are 1996, 2001, 2006, and 2013. Figure 10 shows the upper air (500 hPa) geopotential height (m) composite anomaly based on 1991-2020 climatology for the period from June through November for the combined analog years. Figure 11 shows the same 10 except for just September (peak season). There are a few interesting pattern findings here, with a great deal of troughing over the eastern US and Newfoundland, especially near peak season (Figure 11), which is less conducive for tropical storm and hurricane landfalls for both the eastern United States and Atlantic Canada overall. It is important to note that a weather pattern only needs to be conducive for a few days when a hurricane is nearby to produce a landfall or a significant impact.

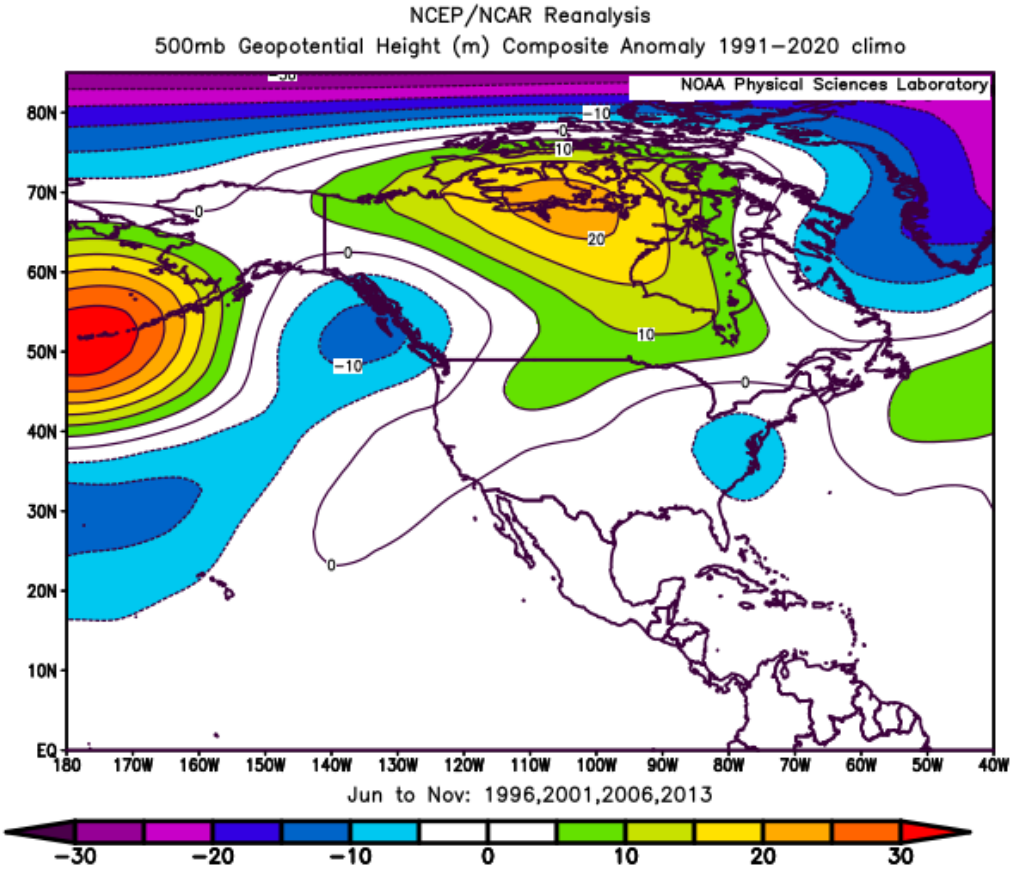


Figure 10. Upper air (500 hPa) Geopotential Heights (m) composite anomaly for June through November of the analog years (NOAA PSL) [11]

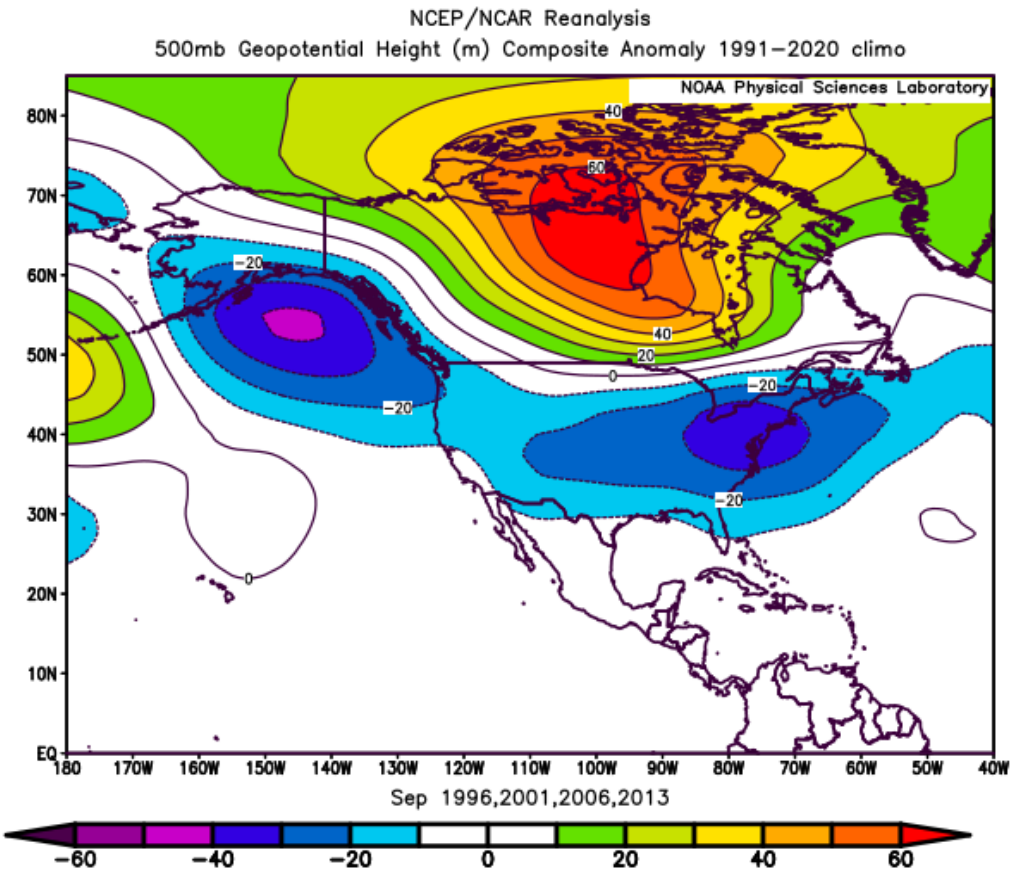


Figure 11. Same as Figure 10 except September only (NOAA PSL) [11]

The hurricane track charts for the analog years are given in Figures 12 through 15. Generally, the analog years depict a near normal hurricane season but with high variability. The analogs range from 10 to 14 named storms, of which 2 to 9 became hurricanes, and of which 0 to 6 became major hurricanes. ACE ranged from as low as 36.1 (well below normal) in 2013 to as high as 166.2 (above normal) in 1996 [12].

Impacts during the analog years to select Newfoundland municipalities are shown in more detail in Tables 2, 3, and 4 below. The only major impact was observed with Gabrielle (Table 3), where St. John's received major flooding and several million dollars worth of damage [13]. Peak wind gusts reached 130 km/h at Cape Race.

Table 2. 1996 Tropical Storm, Hurricane, and Remnant Impacts to Select Municipalities

	Bertha (Jul 14)		Hortense (Sep 15)		Josephine (Oct 10)	
	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h	Rainfall (mm)	Peak Wind Gust (km/h)
St. John's	44.1	74	31.9	56	27.2	85
Gander	52.4	69	2.0	37	16.2	80
Stephenville	68.2	46	11.2	63	16.8	104

Table 3. 2001 Tropical Storm, Hurricane, and Remnant Impacts to Select Municipalities

	Dean (Aug 28-29)		Erin (Sep 14-15)		Gabrielle (Sep 19)	
	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h	Rainfall (mm)	Peak Wind Gust (km/h)
St. John's	25.0	54	50.0	83	118.6	87
Gander	40.6	54	48.4	52	2.0	63

Table 4. 2006 Tropical Storm, Hurricane, and Remnant Impacts to Select Municipalities

	Alberto (Jun 15)		Not Named (Jul 17-18)		Beryl (Jul 21-22)		Florence (Sep 12-14)		Isaac (Oct 2-3)	
	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h)	Rainfall (mm)	Peak Wind Gust (km/h)
St. John's	21.4	54	Trace	61			49.0	102	17.4	54
Gander	24.6	59	0.4	44			58.8	74	18.2	52
Stephenville	4.0	41	1.4	44	16.6	50			18.8	72

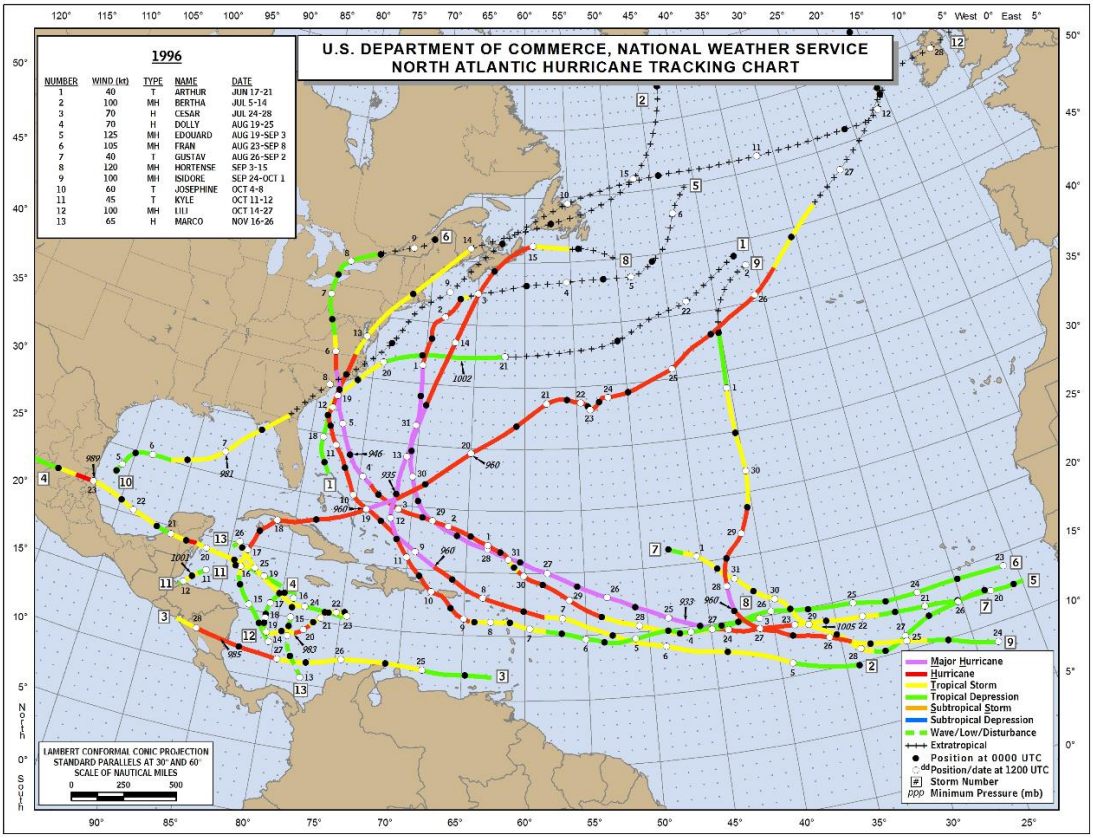


Figure 12. North Atlantic Hurricane Tracking Chart (1996) (NHC) [14]

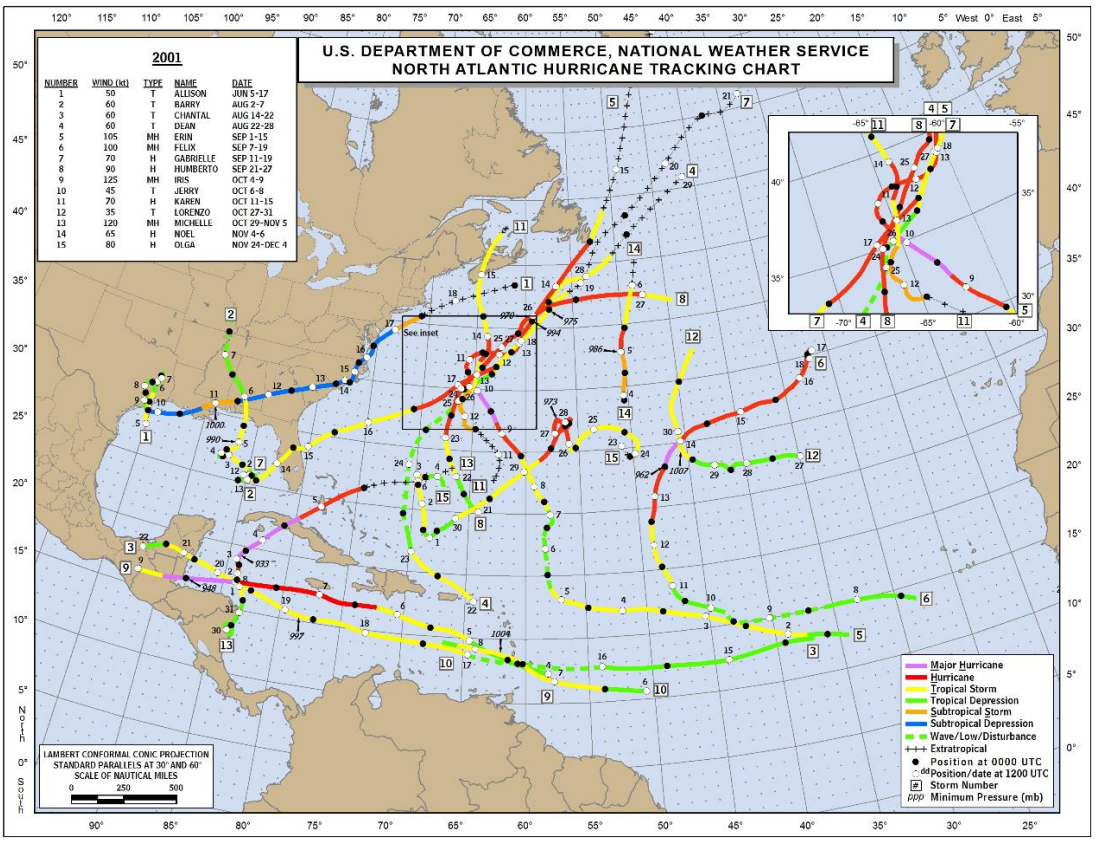


Figure 13. North Atlantic Hurricane Tracking Chart (2001) (NHC) [14]

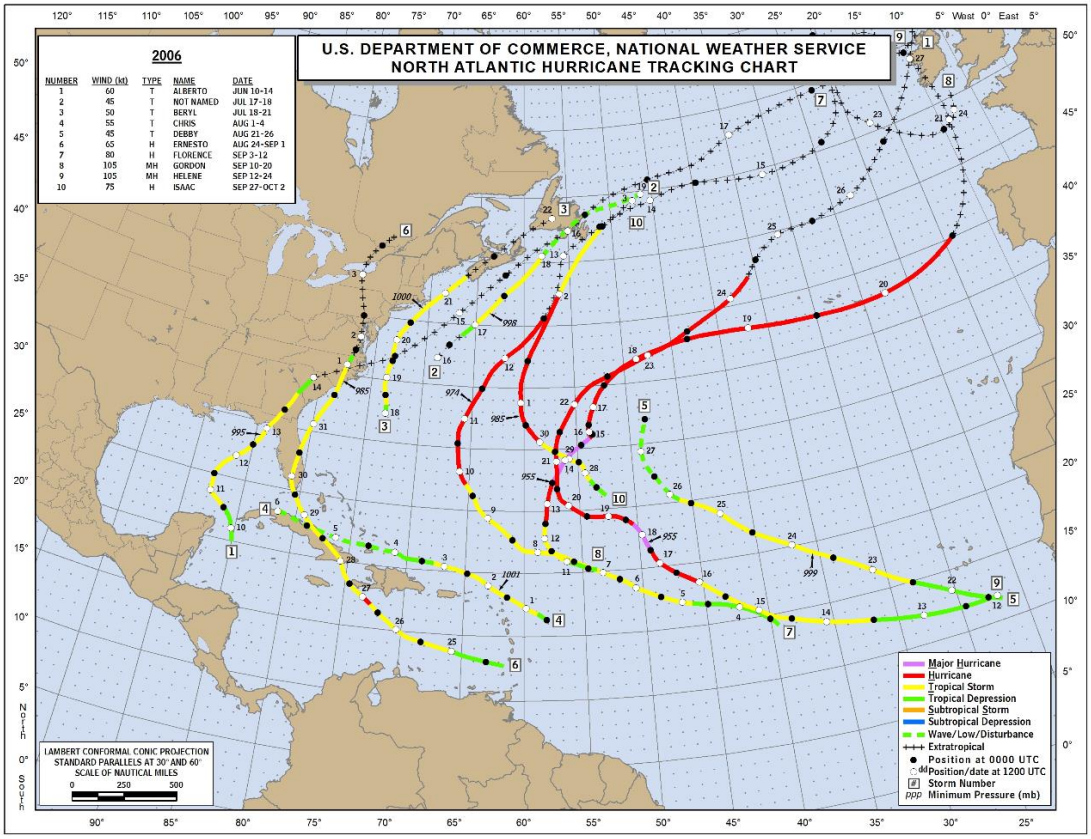


Figure 14. North Atlantic Hurricane Tracking Chart (2006) (NHC) [14]

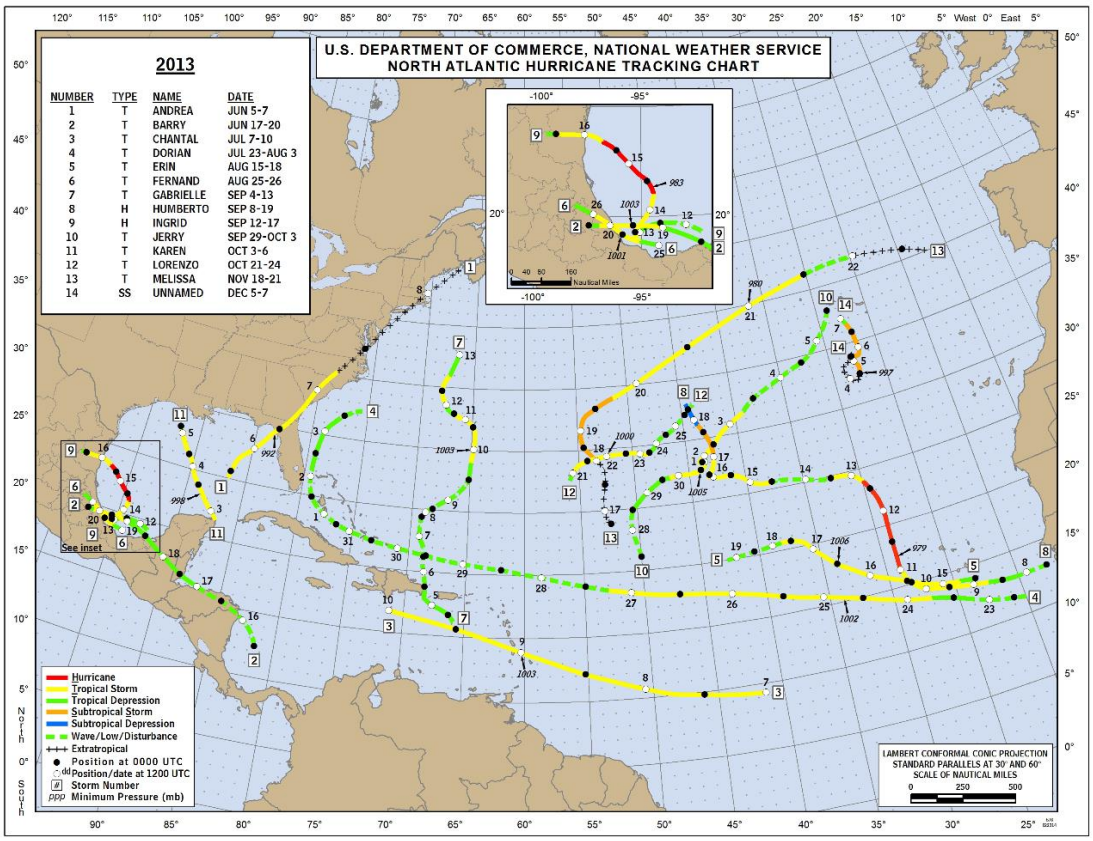


Figure 15. North Atlantic Hurricane Track Chart (2013) (NHC) [14]

4 NEWFOUNDLAND AND LABRADOR HURRICANE SEASON OUTLOOK 2025

WSP anticipates a near normal season for Newfoundland, with a typical low risk of tropical storms, hurricanes, and post-tropical remnants across the island (Figure 16). There is moderate to high confidence for some impacts from tropical storm, hurricanes, and post-tropical remnants, but low confidence for more significant impacts (wind gusts >=100 km/h, rain >= 100 mm, storm surge flooding). For the areas highlighted as no risk in Labrador (Figure 17), we are anticipating a below normal season. Significant tropical storm, hurricane, and post-tropical storm impacts are not expected, but some rain is possible at any time a tropical system merges with an post-tropical low. While not the subject of this report, it is important to note that a good deal of flooding that occurs in Newfoundland and Labrador on a year-to-year basis is not the result of tropical systems but from a combination of showers, thunderstorms, and rain from typical post-tropical lows, especially in the fall.

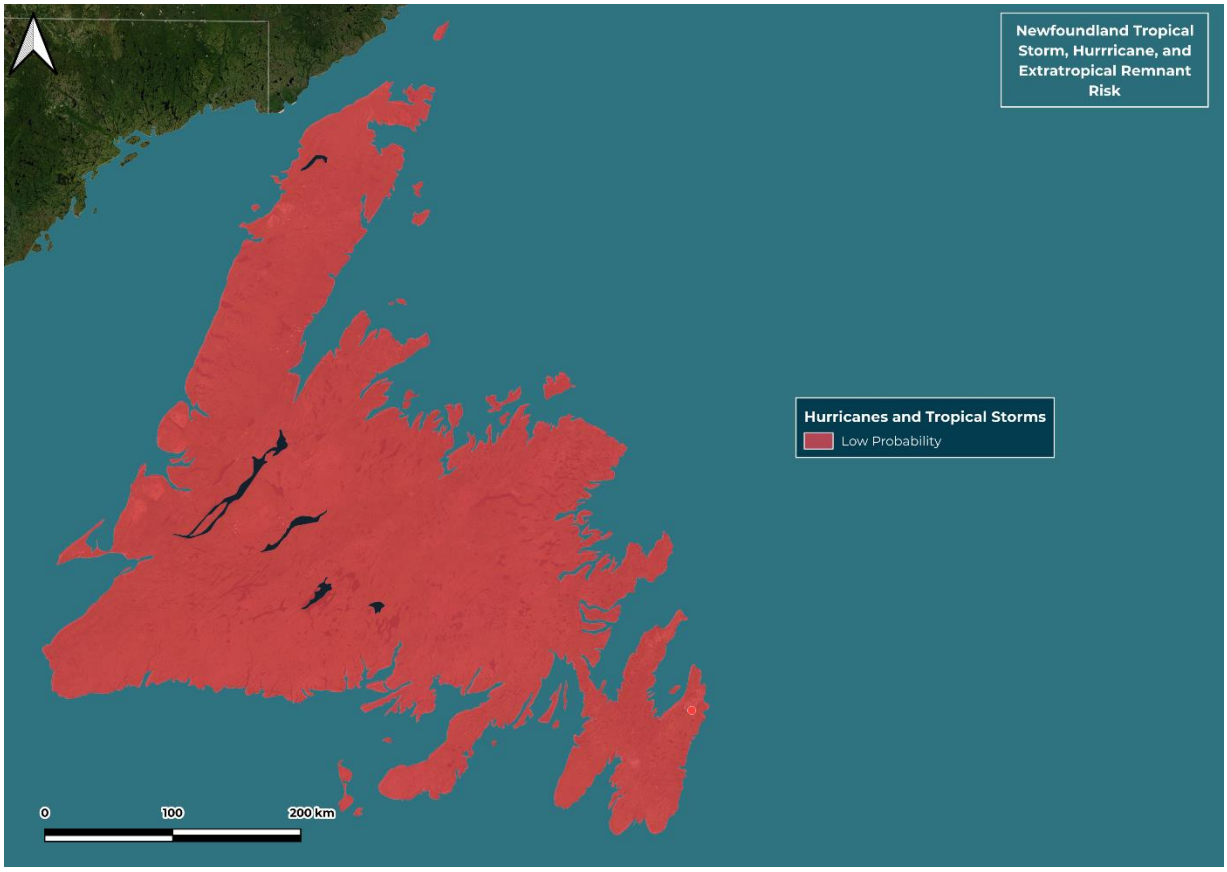


Figure 16. Newfoundland Hurricane Season Risk Map

Figure 17. Labrador 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,

WSP Canada Inc.

Nicholas Camizzi

Meteorologist/Weather and Climate Consultant

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