

July Forecast Update for North Atlantic Hurricane Activity in 2024

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by Dr Adam Lea
EuroTempest Ltd, London, UK

TSR continues to predict North Atlantic hurricane activity in 2024 will be hyper-active and a small chance the basin ACE index could be record breaking.

Summary: The TSR (Tropical Storm Risk) July forecast update for North Atlantic hurricane activity in 2024 continues to anticipate a hyper-active season with activity almost double the 1991-2020 climate norm. Very high oceanic heat content across the tropical North Atlantic and Caribbean Sea waters is expected to continue throughout the hurricane season. Weak La Niña conditions are very likely to develop and persist through August-September 2024 and into the autumn. Although some uncertainties remain, especially regarding intra-seasonal elements, these two factors are both expected to have a strong enhancing influence on the upcoming Atlantic hurricane season.

1. TSR July North Atlantic Seasonal Hurricane Forecasts

Further information on the TSR statistical prediction models and adjustments that are used to generate the forecasts below can be found in [Section 2](#) of Supplementary Information.

1.1 Forecast North Atlantic ACE Index and System Numbers in 2024:

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2024	240	6	13	26
30-yr Climate Norm	1991-2020	122	3.2	7.2	14.4
10-yr Climate Norm	2014-2023	132	3.4	7.6	16.9
Forecast Skill at this Lead	2003-2023	23%	25%	27%	27%

The forecast tercile probabilities (1991-2020 data) for the 2024 North Atlantic hurricane season ACE index are as follows: an 89% probability of being upper tercile (>156), an 11% likelihood of being middle tercile (75 to 156) and no chance of being lower tercile (<75).

1.2 Forecast US ACE Index and US Landfalling Numbers in 2024:

		US ACE Index	Hurricanes	Tropical Storms
TSR Forecast	2024	5.6	4	7
30-yr Climate Norm	1991-2020	2.7	1.6	3.8
10-yr Climate Norm	2014-2023	3.5	2.1	4.5
Forecast Skill at this Lead	2003-2023	0%	12%	23%

USA landfalling intense hurricanes are not forecast since we have no skill at any lead.

The forecast tercile probabilities (1991-2020 data) for the US ACE index in 2024 are as follows: a 67% probability of being upper tercile (>3.19), a 26% likelihood of being middle tercile (1.18 to 3.19) and only a 7% chance of being lower tercile (<1.18).

1.3 Forecast Probability of Exceedance Plots for the North Atlantic Hurricane Season in 2024:

See [Section 3](#) in the Supplementary Information for motivation behind probability of exceedance charts. Figure 1 displays our July forecast PoE plots for the 2024 North Atlantic hurricane season. The forecast PoE curves are computed using the method described in section 3 of Saunders et al. (2020) while the climatology PoE curves are computed directly from observations. The two forecast PoE plots specify the current chance that a given ACE index and/or hurricane total will be reached in 2024 and how these chances differ to climatology.

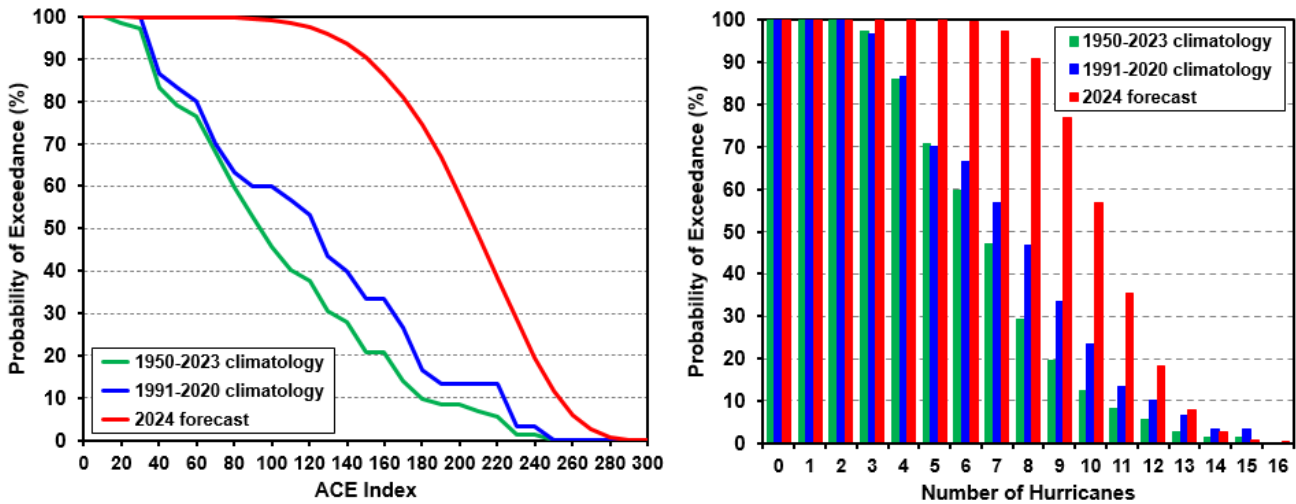


Figure 1. Forecast probability of exceedance (PoE) plots for the North Atlantic ACE index in 2024 (left panel) and for the number of North Atlantic hurricanes in 2024 (right panel). Each plot displays three sets of PoE data comprising the TSR forecast PoE curve issued in early July and two climatology PoE curves.

[2. Factors Influencing the July 2024 TSR Forecasts](#)

Atlantic MDR SST: August-September sea surface temperatures in the tropical North Atlantic (region 10°N–20°N, 20°W–60°W) are expected to be much warmer than normal, and the oceanic heat content in the western portion of the tropical Atlantic and across the Caribbean Sea is currently at levels normally seen in September during peak hurricane season. Warmer than normal waters provide additional heat and moisture to help power the development of more storms within the hurricane main development region.

Trade Wind Speed: The July-September forecast trade wind at 925mb height over the Caribbean Sea and tropical North Atlantic (region 7.5°N–17.5°N, 30°W–100°W) is forecast to be weaker than normal due to a developing weak La Niña and expected above average sea surface temperatures across the Caribbean Sea. Weaker than normal trade winds during July-September in the tropical north Atlantic are associated with higher cyclonic vorticity and decreased vertical wind shear over the hurricane main development region. This in turn favours increased hurricane frequency and intensity.

Pre-August activity: Three tropical storms have developed in June, two in the Gulf of Mexico and one in the Atlantic MDR. The latter (hurricane Beryl) strengthened into a category 5 hurricane after making landfall on Canouan island, St Vincent and the Grenadines as a category 4 hurricane with 150 mph 1-min sustained winds and has recently impacted Jamaica after weakening to category 4 strength. This is an unprecedented event so early in the season and can be partly attributed to the exceptionally high oceanic heat content in the western part of the MDR and the Caribbean Sea, more typical of peak hurricane season. Such an extreme event implies very favourable conditions for strong hurricanes in the tropical Atlantic have occurred much earlier than normal, implying a very active hurricane season is

imminent. It can also be noted that the only other year since 1851 which saw a hurricane develop east of the Windward islands in June was 1933 which holds the record for the highest seasonal north Atlantic ACE index (259); caveats regarding reliability of observations prior to the satellite era and aircraft reconnaissance notwithstanding.

ENSO: Weak La Niña conditions are developing and are expected to persist through summer and autumn 2024. La Niña conditions typically result in weaker trade winds and decreased vertical wind shear which typically enhances North Atlantic hurricane activity, especially in the second half of the season.

Spring NAO: During neutral ENSO years, when the April-June North Atlantic Oscillation (NAO) is negative, the upcoming Atlantic hurricane season tends to be active and vice versa. Despite being weakly negative through April to June, the spring NAO is therefore not anticipated to have a significant influence on Atlantic hurricane activity in 2024 because the ENSO state has been transitioning from a moderate El Niño to a weak La Niña.

Analogue Years: The two primary large-scale predictors used to forecast north Atlantic hurricane activity are both aligned towards a hyper-active hurricane season in 2024. Previous years where both predictors were strongly enhancing for hurricane activity are 1998, 2005, 2010 and 2016. Three out of these four years were hyper-active seasons with ACE indices ranging from 141 to 245. However, tropical cyclone landfalling impacts were very different across these years. 2005 was one of the most destructive hurricane seasons on record whereas 2010 had no U.S. hurricane landfalls. Whilst a very active hurricane season does not guarantee high hurricane landfall impacts there is a modest correlation with total seasonal ACE and U.S. landfalling ACE, so we expect U.S. landfalling hurricane activity to be higher than normal to high probability.

3. Confidence and Uncertainties

There is high confidence that the 2024 Atlantic hurricane activity season will be very active although some uncertainties remain. Contributions to uncertainty due to other factors are described below:

Atlantic MDR SST: There is high confidence that sea surface temperatures in the tropical Atlantic will be much warmer than average which is an enhancing effect for hurricane activity. Oceanic heat content across the western MDR and Caribbean Sea is very high and comparable to levels normally seen during peak hurricane season. There are currently no indications this heat content will decrease significantly in the near future.

ENSO: There is high confidence for a weak La Niña to be in place through summer and autumn which is an enhancing effect for hurricane activity. There remains the possibility that sea surface temperatures in the equatorial east Pacific may not quite reach the La Niña threshold or that a moderate strength La Niña could develop; however, either of these alternative scenarios are becoming increasingly unlikely.

Trade Wind Speed: There is high confidence that Atlantic and Caribbean Sea trade wind speed will be weaker than normal through the upcoming summer. Trade wind speed is weaker than normal when La Niña conditions are in place and Caribbean sea surface temperatures are warmer than normal. We have good confidence both these factors will be present through peak hurricane season in August and September.

Intra-seasonal factors: Other factors which are impossible to predict such as the strength and frequency of Saharan air outbreaks, and the frequency of tropical upper tropospheric troughs (TUTT) across the

tropical Atlantic (both of which inhibit hurricane activity) are not accounted for. In addition, for a given set of climate factors, a spread in hurricane activity levels can still ensue.

Skill: Historically the skill of the July forecast update for North Atlantic hurricane activity is moderate (see [section 4a](#) in the Supplementary Information). With both primary climate factors very likely to be strongly enhancing for hurricane activity in 2024 combined with the unprecedented development of a category 4 hurricane in June east of the Caribbean, the confidence in the forecast for a very active hurricane season is higher than what the moderate skill scores would imply.

[4. Forecast Archive and Next Forecast,](#)

The archive of all the TSR publicly released North Atlantic seasonal hurricane forecasts (from 1998 to 2023) may be viewed at https://www.tropicalstormrisk.com/for_hurr.html. The final TSR forecast update for the 2024 North Atlantic hurricane season will be issued on Tuesday 6th August. A review of the 2024 north Atlantic hurricane season and a verification of the TSR seasonal forecasts will be issued in early December 2024.

[5. List of Predictions Issued for the 2024 North Atlantic Hurricane Season](#)

1. Atlantic ACE Index and System Numbers:

Atlantic ACE Index and System Numbers 2024					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1991-2020)		122	14.4	7.2	3.2
Average Number (2014-2023)		132	16.9	7.6	3.4
TSR Forecasts	5 July 2024	240	26	13	6
	30 May 2024	226	24	12	6
	8 April 2024	217	23	11	5
	11 December 2023	160	20	9	4
CSU Forecast	11 June 2024	210	23	11	5
	4 April 2024	210	23	11	5
NOAA Forecast	23 May 2024	145-237	17-25	8-13	4-7

2. US ACE Index and US Landfalling Numbers:

US Landfalling Numbers 2024				
		ACE Index	Tropical Storms	Hurricanes
Average Number (1991-2020)		2.7	3.8	1.6
Average Number (2014-2023)		3.5	4.5	2.1
TSR Forecasts	5 July 2024	5.6	7	4
	30 May 2024	4.9	5	3
	8 April 2024	4.6	5	3