

August Forecast Update for North Atlantic Hurricane Activity in 2024

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

Summary: The TSR (Tropical Storm Risk) August forecast update for North Atlantic hurricane activity in 2024 continues to anticipate a hyper-active season. There continues to be very high oceanic heat content across the tropical North Atlantic and Caribbean Sea waters, combined with cold-neutral or weak La Niña conditions which are expected to develop and persist through August-October 2024. These two factors are both expected to have a strong enhancing influence on the upcoming Atlantic hurricane season, although some uncertainties remain (see S3).

1. TSR August 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	230	6	12	24
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	30%	43%	47%	57%

The forecast tercile probabilities (1991-2020 data) for the 2024 North Atlantic hurricane season ACE index are as follows: an 85% probability of being upper tercile (>156)), a 15% likelihood of being middle tercile (75 to 156)) and no chance of being lower tercile (<75)).

1.2 Forecast U.S. ACE Index and U.S. Landfalling Numbers in 2024:

		U.S. ACE Index	Hurricanes	Tropical Storms
TSR Forecast*	2024	7.2	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	31%	44%	53%

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

The forecast tercile probabilities (1991-2020 data) for the U.S. ACE index in 2024 are as follows: a 90% probability of being upper tercile (>3.19), a 10% likelihood of being middle tercile (1.18 to 3.19) and no chance of being lower tercile (<1.18).

* Includes Alberto, Beryl, Chris and Debby.

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 pre-season 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.

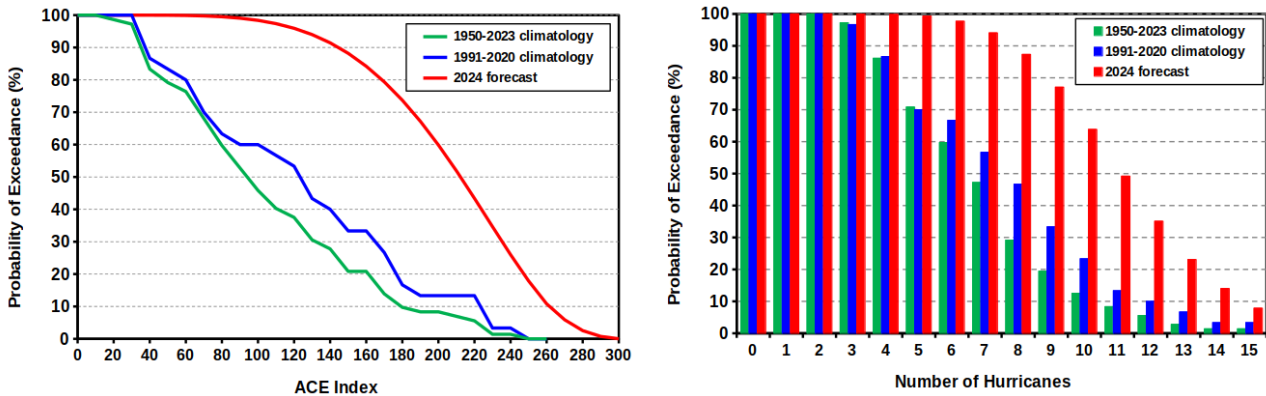


Figure 1. Forecast probability of exceedance (PoE) plots for the North Atlantic ACE index in 2024 (left panel) and for the number of North Atlantic hurricanes in 2024 (right panel). Each plot displays three sets of PoE data comprising the TSR forecast PoE curve issued pre-season and two climatology PoE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

[2. Factors Influencing the August 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 remains at levels normally seen 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.

Climate Model Outlooks: Some of the available climate models which can be used to predict oceanic and atmospheric conditions known to influence tropical cyclone activity are predicting very favourable conditions through the peak season in August and September. These conditions include persistence of warm sea surface temperatures in the tropical Atlantic and Caribbean Sea, above average rainfall across the Atlantic Main Development Region and Caribbean Sea, weaker than normal low-level trade winds and weaker upper-level westerly winds. The former two conditions imply increased heat and moisture available for developing tropical cyclones. The latter two conditions imply favourable atmospheric conditions in the form of increased cyclonic vorticity across the tropical Atlantic and reduced vertical wind shear. A minority of models have more mixed and less favourable conditions overall.

Pre-August activity: Hurricane Beryl formed east of the Windward islands and 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. All seasons since 1900 with a hurricane forming in the tropical Atlantic prior to 1st August were classified as active hurricane seasons historically based on the ACE index. Note that although activity through July (post-Beryl) has been absent, this is normal even for very active seasons historically. Based on the 1991-2020 climatology, around 88% of the North Atlantic ACE index is generated after the 15th August.

Current Tropical Cyclone Activity: Hurricane Debby formed at the beginning of August, made landfall in north-west Florida as a category one hurricane yesterday, and is weakening whilst moving inland across Georgia. A disturbance located in the eastern Caribbean Sea is being monitored and has a 30% chance of development into a tropical cyclone as it moves across the Caribbean Sea towards the Yucatan Peninsula. Aside from this there is minimal support from the available forecast models for tropical cyclone development over the next week or so; however, there are indications in some forecast models for development during mid-August.

ENSO: Cold-neutral or weak La Niña conditions are developing and are expected to persist through the rest of summer and through autumn 2024. La Niña or cold-neutral 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.

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 in early August are 1995, 2005, 2010, 2017 and 2020. Three of these years had an ACE index over 200 and all years except 2010 were very destructive for hurricane landfalls. Given that two hurricanes have made U.S. landfall so far with the peak season still to come, it is very likely that 2024 will see above-average U.S. hurricane landfalls and U.S. ACE index. However, the possibility cannot be ruled out that U.S. hurricane landfalling activity through peak season will be lower than expected if steering winds become favourable for storm recurving at sea, as occurred in 2010.

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 comparable to levels normally seen during peak hurricane season. There are currently no indications this heat content will decrease significantly.

ENSO: There is high confidence for cold-neutral or weak La Niña to be in place through late summer and autumn which is an enhancing effect for hurricane activity. The probability of a moderate or strong La Niña event developing is very low.

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 high 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. For example, in 2013, large scale climate factors were implying an active season; however, widespread subsidence and dry air across the tropical Atlantic, which was unpredictable, countered these otherwise favourable factors. In addition, even in the absence of significant intra-seasonal factors, for a given set of climate factors, a spread in hurricane activity levels can still ensue.

Skill: Historically the skill of the early August forecast for North Atlantic hurricane activity is high (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 early formation of a category 4 hurricane in the tropical Atlantic, the confidence in the forecast for a very active hurricane season is high.

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. This is the final TSR forecast update for the 2024 North Atlantic hurricane season. A summary of the 2024 North Atlantic hurricane season, a verification of the TSR seasonal forecasts and an extended-range forecast for the 2025 North Atlantic hurricane season will be issued in 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	6 August 2024	230	24	12	6
	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 Forecasts	9 July 2024	230	25	12	6
	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:

U.S. 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	6 August 2024	7.2	7	4
	5 July 2024	5.6	7	4
	30 May 2024	4.9	5	3
	8 April 2024	4.6	5	3