

April Forecast Update for North Atlantic Hurricane Activity in 2024

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TSR raises its forecast issued in December and predicts North Atlantic hurricane activity in 2024 will be hyper-active and around 70% above the 1991-2020 30-year norm. This forecast has higher confidence than normal at this lead time.

Summary: The TSR (Tropical Storm Risk) April forecast update for North Atlantic hurricane activity in 2024 raises its forecast and anticipates a hyper-active season with activity around 70% above the 1991-2020 climate norm. Although some uncertainties remain, we consider that the more likely scenario is for tropical North Atlantic and Caribbean Sea waters to be warmer than normal by August-September 2024, and for moderate La Niña conditions to develop and persist through August-September 2024 and into the autumn. These two factors are both expected to have a strong enhancing influence on the upcoming Atlantic hurricane season.

[1. TSR April 2024 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	217	5	11	23
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	0%	0%	0%	0%

The forecast tercile probabilities (1991-2020 data) for the 2024 North Atlantic hurricane season ACE index are as follows: a 83% probability of being upper tercile (>156), a 16% likelihood of being middle tercile (75 to 156) and only a 1% 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	4.6	3	5
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%	5%	5%

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 68% probability of being upper tercile (>3.19), a 25% 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 April 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.

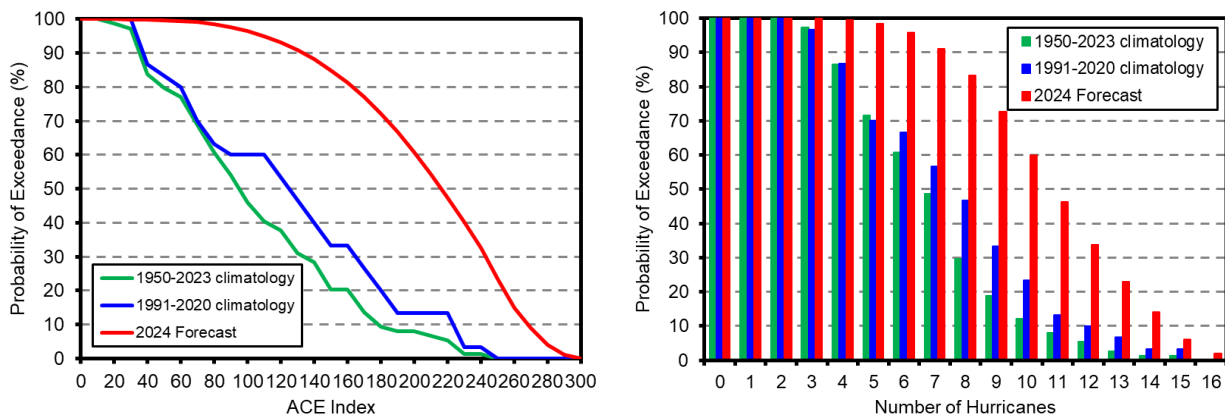


Figure 1. Forecast probability of exceedance (PoE) plots for the North Atlantic ACE index in 2024 (left panel) and for the number of North Atlantic hurricanes in 2024 (right panel). Each plot displays three sets of PoE data comprising the TSR forecast PoE curve issued early April and two climatology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

[2. Factors Influencing the April 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 forecast to be warmer than normal. The current forecast is for $0.8 \pm 0.34^{\circ}\text{C}$ warmer than normal (1991-2020 climatology). 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. The current forecast for the July-September trade wind is for $1.48 \pm 0.79 \text{ ms}^{-1}$ weaker than normal (1991-2020 climatology). 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 increases hurricane frequency and intensity.

ENSO: Moderate La Niña conditions are expected to develop during late Spring and persist through August-September 2024 and into the autumn. 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.

Analogue Years: The current sea surface temperature pattern globally is similar to 1969, 1998, 2005 and 2010. All these years had very active hurricane seasons (ACE index > 160) and the average ACE index over these four years is 190. 1998 and 2010, as is predicted this year, saw a transition from moderate or strong El Niño conditions in winter to moderate or strong La Niña conditions in summer, the ACE indices were 182 and 165 respectively. Impacts from landfalling tropical cyclones were very different between these two years. 1998 was a destructive season for the Caribbean, U.S. and Honduras/Nicaragua; however, the 2010 hurricane season saw no U.S. hurricane landfalls with the majority of storms recurving into the open Atlantic. This demonstrates that years with similar levels of total hurricane activity can have very different monetary and humanitarian impacts, so the expectation of a very active hurricane season in 2024 does not imply a high impact season is imminent but may make it more likely. It is not possible to predict whether large-scale atmospheric winds will be favourable for steering storms over land, so the U.S. landfalling activity at this lead time is predicted by regressing from the total activity.

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. Sea surface temperatures across much of the Atlantic Ocean have been well above average for several months and there is currently no indication these sea surface temperature anomalies will cool significantly, if at all, over the Spring (see [Spring NAO](#)).

ENSO: There is high confidence for a weak or moderate La Niña to be in place through summer and autumn which is an enhancing effect for hurricane activity.

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 factors will be present through peak hurricane season in August and September.

Spring NAO: The sign of the April to June NAO has an inverse correlation with upcoming Atlantic hurricane activity i.e. a positive spring NAO tends to be followed by a less active Atlantic hurricane season through enhancement of trade wind speed leading to cooling of tropical Atlantic SSTs. This relationship is much stronger during neutral summer ENSO years which this year is not expected to be, so it is unlikely the spring NAO will have a significant influence on 2024 Atlantic hurricane activity.

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 early April forecast for North Atlantic hurricane activity is low (see [section 4a](#) in the Supplementary Information), however with the primary climate factors very likely to be strongly enhancing for hurricane activity in 2024, the confidence in the forecast for a very active season is higher than what the low 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://tropicalstormrisk.com/for_hurr.html. This next TSR forecast update for the 2024 North Atlantic hurricane season will be a pre-season forecast issued on the 30th May.

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	8 April 2024	217	23	11	5
	11 December 2023	160	20	9	4
CSU Forecast	4 April 2024	210	23	11	5

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 Forecast	8 April 2024	4.6	5	3