July Forecast for North Atlantic Hurricane Activity in 2020

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Forecast Summary

TSR maintains its pre-season forecast and predicts North Atlantic hurricane activity in 2020 will be 30% above the long-term norm. Forecast uncertainty is presented in terms of robust probability of exceedance plots for Accumulated Cyclone Energy and hurricane numbers.

The TSR (Tropical Storm Risk) early July forecast update for North Atlantic hurricane activity in 2020 anticipates a season with likely above-norm activity. Based on current and projected climate signals, Atlantic basin tropical cyclone activity is forecast to be 30% above the 1950-2019 long-term norm and 10% above the recent 2010-2019 10-year norm. The forecast spans the period from 1st June to 30th November 2020 and employs data through to the end of June 2020. TSR maintains its earlier outlooks due to updated climate signals pointing to environmental fields in August-September 2020 that are little changed from earlier projections. These anticipated fields - which are both slightly enhancing for hurricane activity - are slightly warmer than normal tropical North Atlantic water temperatures and weak La Niña ENSO (El Niño Southern Oscillation) conditions. The updated uncertainty in our hurricane outlook is presented in terms of robust probability of exceedance plots. These data give the current chance that a given hurricane number/activity outcome will occur in 2020.

North Atlantic ACE Index and System Numbers in 2020

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2020	137	4	8	18
70yr Climate Norm	1950-2019	104	3	6	12
10yr Climate Norm	2010-2019	122	3	7	16
Forecast Skill at this Lead	1980-2019	32%	20%	39%	4%
Forecast Skill at this Lead	2010-2019	27%	37%	34%	0%

Key: ACE Index = Accumulated Cyclone Energy Index = Sum of the Squares of 6-hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength. ACE Unit = $x10^4$ $knots^2$.
Intense Hurricane = 1 Minute Sustained Wind > 95Kts = Hurricane Category 3 to 5.
Hurricane = 1 Minute Sustained Wind > 63Kts = Hurricane Category 1 to 5.
Tropical Storm = 1 Minute Sustained Winds > 33Kts.
Forecast Skill = Percentage Improvement in Mean Square Error over Running 10-year Prior Climate Norm from Replicated Real Time Forecasts for 1980-2019 and 2010-2019.

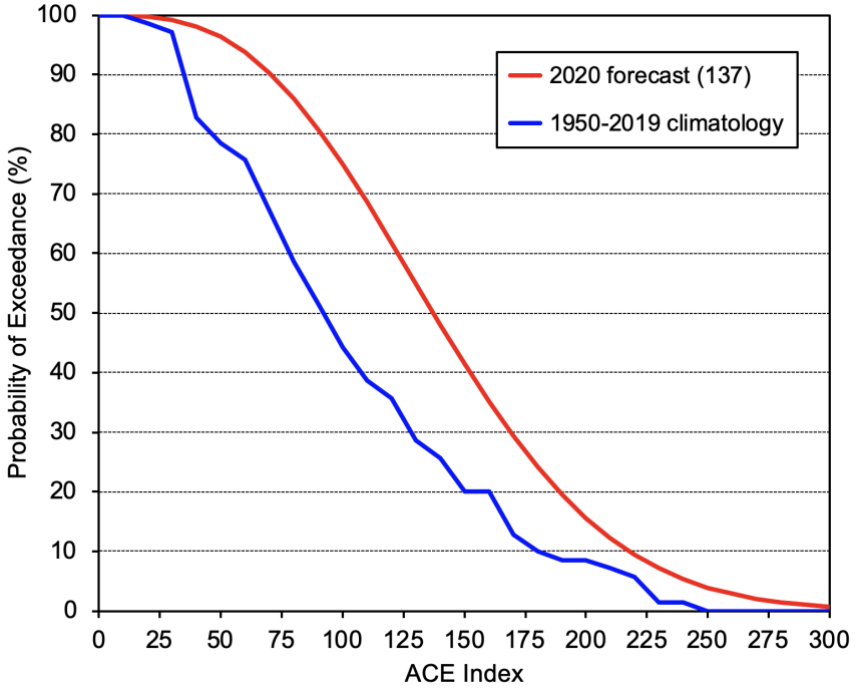
There is a 59% probability that the 2020 Atlantic hurricane season ACE index will be above-average (defined as an ACE index value in the upper tercile historically (>125)), a 31% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (71 to 125) and a 10% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<71)). The 70-year period 1950-2019 is used for climatology.

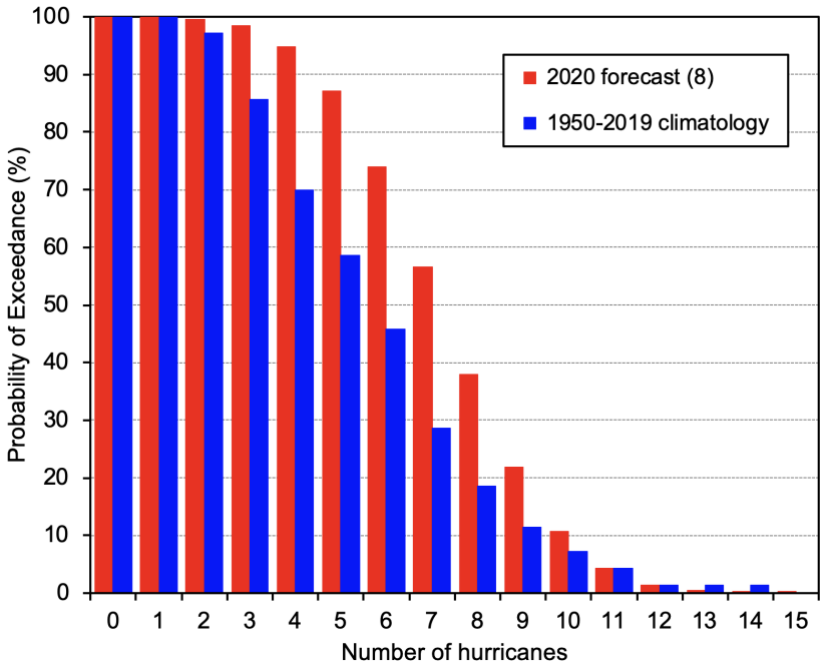
Key: Terciles = Data groupings of equal (33.3%) probability corresponding to the upper, middle and lower one-third of values historically (1950-2020). Upper Tercile = ACE value greater than 125. Middle Tercile = ACE value between 71 and 125. Lower Tercile = ACE value less than 71.

Forecast Probability of Exceedance Plots for the 2020 North Atlantic Hurricane Season

Seasonal outlooks for North Atlantic hurricane activity contribute to the anticipation of risk for insurance companies, other weather-sensitive businesses, and local and national governments. However, the uncertainty associated with such forecasts is often unclear. This reduces their benefit and contributes to the perception of forecast 'busts'. The robust assessment of risk requires a full and clear probabilistic quantification of forecast uncertainty with the forecast issued in terms of probability of exceedance (PoE). In this way the chance of each hurricane number/activity outcome occurring is clear for the benefit of users. Going forward TSR will be including robust forecast probability of exceedance (PoE) information based on the recommendation and methodology described in Saunders et al. (2020).

The plots below display our early July forecast outlooks for ACE (upper panel) and the number of hurricanes (lower panel) in terms of PoE. Each plot displays two sets of PoE data comprising the forecast PoE curve and the 1950-2019 climatology PoE curve. The forecast PoE curves are computed using the method described in section 3.3 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 2020 and how these chances differ to climatology.





Reference: Saunders, M. A., Klotzbach, P. J., Lea, A. S. R., Schreck, C. J., & Bell, M. M. (2020). Quantifying the probability and causes of the surprisingly active 2018 North Atlantic hurricane season. *Earth and Space Science*, *7*, e2019EA000852. https://doi.org/10.1029/2019EA000852

ACE Index & Numbers Forming in the MDR, Caribbean Sea and Gulf of Mexico in 2020

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2020	117	3	6	12
70yr Climate Norm	1950-2019	81	2	4	8
10-yr Climate norm	2010-2019	97	2	5	10
Forecast Skill at this Lead	1980-2019	33%	28%	49%	35%
Forecast Skill at this Lead	2009-2019	25%	51%	57%	29%

The Atlantic hurricane Main Development Region (MDR) is the region 10$_o$N-20$_o$N, 20$_o$W-60$_o$W between the Cape Verde Islands and the Caribbean Lesser Antilles. A storm is defined as having formed within this region if it reached at least tropical depression status while in the area.

There is a 62% probability that the 2020 Atlantic hurricane season ACE index for these regions will be above-average (defined as an ACE index value in the upper tercile historically (>96)), a 29% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (45 to 96) and a 9% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<45)). The 70-year period 1950-2019 is used for climatology.

USA Landfalling ACE Index and Numbers in 2020

		ACE Index	Hurricanes	Tropical Storms
TSR Forecast	2020	2.6	2	5
70yr Climate Norm	1950-2019	2.4	1.47	3.11
10yr Climate Norm	2010-2019	2.1	1.20	2.80
Forecast Skill at this Lead	1980-2019	13%	17%	6%
Forecast Skill at this Lead	2010-2019	1%	41%	28%

Key: ACE Index = Accumulated Cyclone Energy Index = Sum of the Squares of hourly Maximum Sustained Wind Speeds (in units of knots) for all Systems while they are at least Tropical Storm Strength and over the USA Mainland (reduced by a factor of 6). ACE Unit = x10^4 knots^2.
Strike Category = Maximum 1 Minute Sustained Wind of Storm Directly Striking Land.
USA Mainland = Brownsville (Texas) to Maine

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

There is a 51% probability that in 2020 the USA landfalling ACE index will be above average (defined as a USA ACE index value in the upper tercile historically (>2.5)), a 29% likelihood it will be near-normal (defined as a USA ACE index value in the middle tercile historically (1.1 to 2.5)) and a 20% chance it will be below-normal (defined as a USA ACE index value in the lower tercile historically (<1.1)). The 70-year period 1950-2019 is used for climatology.

Methodology and Key Predictors for 2020

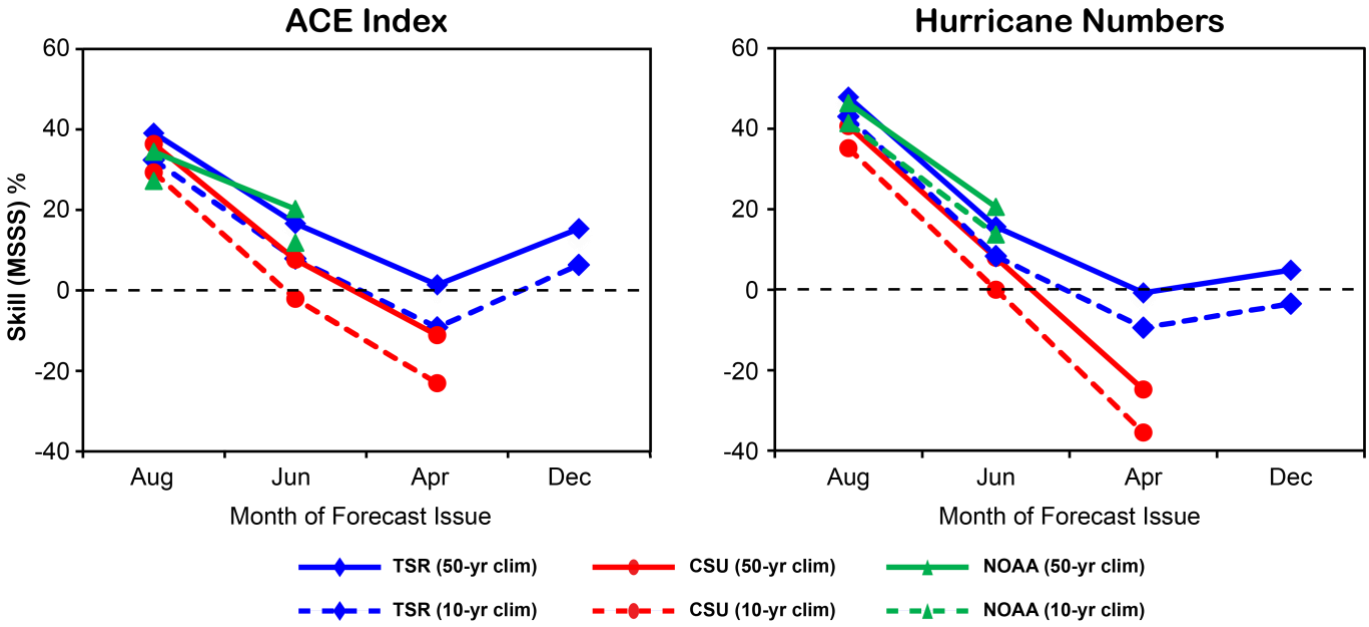
The TSR statistical seasonal hurricane forecast model divides the North Atlantic into three regions and employs separate forecast models for each region before summing the regional hurricane forecasts to obtain an overall forecast. For two of these three regions (tropical North Atlantic, and the Caribbean Sea and Gulf of Mexico) the forecast model pools different environmental fields involving August-September sea surface temperatures (SSTs) and July-September trade wind speed to select the environmental field or

combination of fields which gives the highest replicated real-time skill for hurricane activity over the prior 10-year period. The nature of this process means that the details of the seasonal forecast model can vary subtly from year-to-year and also with lead time within the same year. Separate forecast models are employed to predict the July-September trade wind speed and to predict the August-September SSTs. Finally, bias corrections are employed for each predictand based on the forecast model performance for that predictand over the prior 10 years. All regressions are performed using normalized data. This ensures that the requirements of linear regression modeling are met, namely, that observations are drawn from normal distributions and that regression errors are normally distributed with a mean of zero.

The main factor underpinning the TSR forecast for 2020 hurricane activity being 30% above the long term norm is the anticipated enhancing effect of the July-September 2020 forecast trade wind at 925mb height over the Caribbean Sea and tropical North Atlantic region (7.5^{o}N – 17.5^{o}N, 100^{o}W – 30^{o}W). The current forecast for this predictor is 0.67±0.59 ms^{-1} is weaker than normal (1980-2019 climatology) which is similar to its 0.60±0.64 ms^{-1} weaker than normal value in May 2020. Weaker than normal trade winds during July-September are associated with more cyclonic vorticity and decreased vertical wind shear over the hurricane main development region. This in turn increases hurricane frequency and intensity. The July-September 2020 trade wind prediction incorporates the current expectations for weak La Niña conditions during August-September 2020 and for tropical North Atlantic SSTs in August-September 2020 being 0.21±0.20°C warmer than normal (1980-2019 climatology). The current consensus of dynamical and statistical model ENSO outlooks published by the International Research Institute for Climate and Society on the 19th June 2020 is used for the ENSO (El Niño Southern Oscillation) outlook. However, it should be stressed that although uncertainties are reducing as the main hurricane season approaches there remain sizeable uncertainties in the forecast for July-September 2020 trade wind speed and in the forecast for August-September 2020 tropical North Atlantic SST.

The Precision of Seasonal Hurricane Forecasts 2003-2019

The figure below displays the seasonal forecast skill for North Atlantic hurricane activity for the 17-year period between 2003 and 2019. This assessment uses the seasonal forecast values issued publicly in real-time by the three forecast centres TSR, NOAA (National Oceanic and Atmospheric Administration) and CSU (Colorado State University). Skill is assessed as a function of lead time for two measures of seasonal hurricane activity: ACE and basin hurricane numbers.



Forecast precision is provided using the Mean Square Skill Score (MSSS) which is the percentage improvement in mean square error over a climatology forecast. Positive skill indicates that the model performs better than climatology, while a negative skill indicates that it performs worse than climatology. Two different climatologies are used: a fixed 50-year (1951-2000) climatology and a running prior 10-year climate norm.

It should be noted that NOAA does not issue seasonal hurricane outlooks before late May and that CSU stopped providing quantitative extended-range hurricane outlooks from the prior December after 2011. It is clear that there is little skill in forecasting the upcoming ACE and numbers of hurricanes from the previous April for the period 2003-2019. Skill starts to climb as the hurricane season approaches with moderate-to-good skill levels being achieved, on average, by early August.

Although there are mostly only small differences in skill between the three forecast centres, the TSR model has been either the near-equal best or the best performing statistical seasonal forecast model at all lead times for the period 2003-2019.

Further Information and Next Forecast

Further information about TSR forecasts and verifications may be obtained from the TSR web site *http://www.tropicalstormrisk.com*. The final TSR forecast update for the 2020 North Atlantic hurricane season will be issued on the 5th August 2020.

Appendix – Predictions from Previous Months

1. Atlantic ACE Index and System Numbers

Atlantic ACE Index and System Numbers 2020					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1950-2019)		104	11	6	3
Average Number (2010-2019)		114	14	7	3
TSR Forecasts	7 July 2020	137	18	8	4
	28 May 2020	135	17	8	3
	7 April 2020	130	16	8	3
	19 Dec 2019	105	15	7	3
CSU Forecasts	4 June 2020	160	19	9	4
	2 April 2020	150	16	8	4
NOAA Forecast	21 May 2020	104-180	13-19	6-10	3-6

2. MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers

MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers 2020					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1950-2019)		81	8	4	2
Average Number (2010-2019)		97	10	5	2
TSR Forecasts	7 July 2020	117	12	6	3
	28 May 2020	116	11	6	3
	7 April 2020	108	11	6	3

3. US ACE Index and Landfalling Numbers

US Landfalling Numbers 2020				
		ACE Index	Named Tropical Storms	Hurricanes
Average Number (1950-2019)		2.4	3.11	1.47
Average Number (2010-2019)		2.1	2.80	1.20
TSR Forecasts	7 July 2020	2.6	5*	2
	28 May 2020	3.4	5	2
	7 April 2020	3.2	4	2

* Includes tropical storms Bertha and Christobal.