# August Forecast Update for North Atlantic Hurricane Activity in 2020

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by Professor Mark Saunders and Dr Adam Lea
Dept. of Space and Climate Physics, UCL (University College London), UK

## Forecast Summary

**TSR increases its July forecast and anticipates North Atlantic hurricane activity in 2020 will be above normal to 79% probability and 'hyperactive' to 61% likelihood.**

The TSR (Tropical Storm Risk) early August forecast update for North Atlantic hurricane activity in 2020 anticipates a season with above-normal and likely hyperactive activity. Based on current and projected climate signals, Atlantic basin tropical cyclone activity is forecast to be 60% above the 1950-2019 long-term norm and 40% 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 early August 2020. TSR increases its forecast from early July due to the July trade wind speed over the Caribbean Sea and tropical North Atlantic region being unusually enhancing for activity and because early season tropical storm and hurricane activity point to an above-normal season. The forecast increase is supported by other favourable factors including the expectation during August-September-October 2020 for weak La Niña ENSO (El Niño Southern Oscillation) conditions and for warmer than normal sea surface temperatures in the eastern and central hurricane main development region. US landfalling tropical storm and hurricane numbers are also forecast to be above-normal as they have been during the hurricane season to date. We present our forecasts in terms of robust probability of exceedance plots.

### North Atlantic ACE Index and System Numbers in 2020

| | | ACE Index | Intense Hurricanes | Hurricanes | Tropical Storms |
|---|---|---|---|---|---|
| TSR Forecast | 2020 | 166 | 4 | 10 | 24 |
| 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 | 45% | 45% | 47% | 39% |
| Forecast Skill at this Lead | 2010-2019 | 27% | 48% | 37% | 21% |

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.

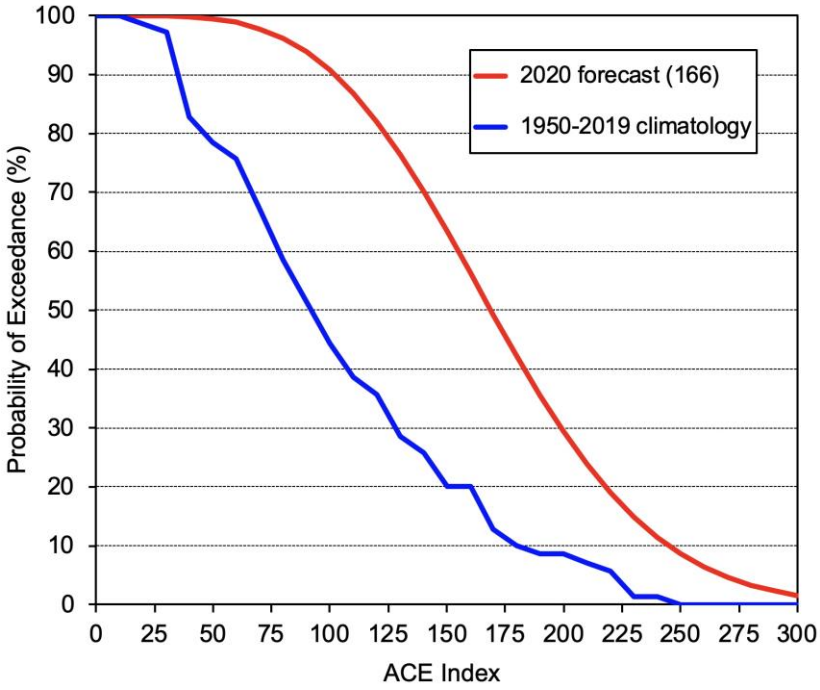
There is a 79% probability that the 2020 Atlantic hurricane season ACE index will be above-normal (defined as an ACE index value in the upper tercile historically (>125)), a 19% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (71 to 125) and only a 2% 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. There is a 61% likelihood that the 2020 Atlantic hurricane season will be 'hyperactive' defined as an ACE ≥ 165% of the median ACE for 1981-2010.

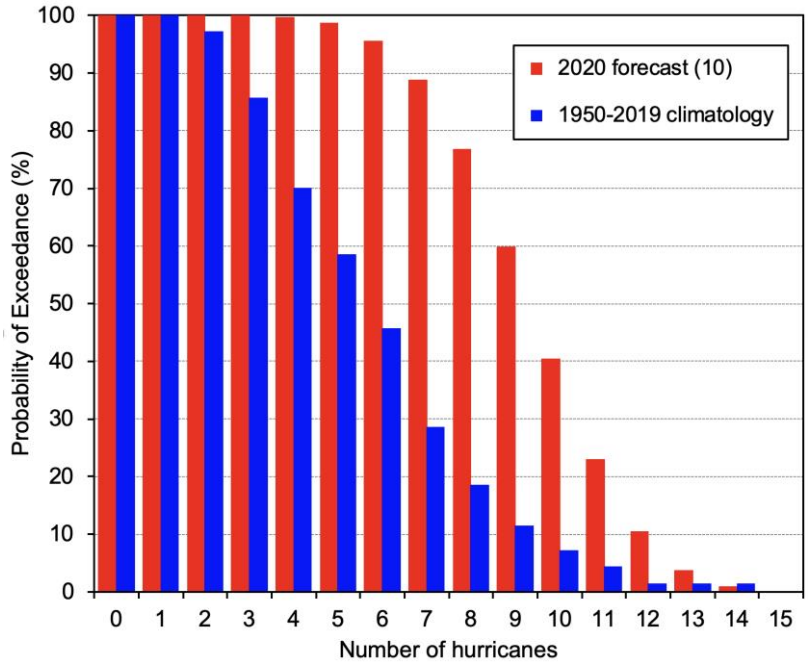
Key: Terciles = Data groupings of equal (33.3%) probability corresponding to the upper, middle and lower one-third of values historically (1950-2020). Upper Tercile = ACE value greater than 125. Middle Tercile = ACE value between 71 and 125. Lower Tercile = ACE value less than 71.

## 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 August 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.



There is a 61% likelihood that the 2020 Atlantic hurricane season will be a 'hyperactive' season defined as an ACE ≥ 165% of the median ACE for 1981-2010 (an ACE value of 152.5).

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 | 140 | 4 | 8 | 17 |
| 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 | 37% | 50% | 63% | 62% |
| Forecast Skill at this Lead | 2009-2019 | 25% | 39% | 76% | 74% |

The Atlantic hurricane Main Development Region (MDR) is the region 10°N-20°N, 20°W-60°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 78% 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 19% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (45 to 96) and a 3% 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 | 5.0 | 4 | 9 |
| 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 | 28% | 7% | 12% |
| Forecast Skill at this Lead | 2010-2019 | 3% | 0% | 32% |

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 100% 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 0% 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 0% 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 above-normal and likely hyperactive 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°N – 17.5°N, 100°W – 30°W). The forecast for this predictor is 1.05±0.39 $ms^{-1}$ weaker-than-normal (1981-2010 climatology) which is more enhancing for hurricane activity than its 0.67±0.59 $ms^{-1}$ weaker-than-normal value forecast in early July 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 speed is forecast using persistence of the July 2020 trade wind speed. Our expectation for slightly warmer than average August-September 2020 sea surface temperatures for the eastern and central hurricane main development region (10–20°N, 20–60°W) – a value of 0.18±0.14°C warmer than normal (1981-2010 climatology) is forecast – further supports our outlook for an above average 2020 hurricane season.

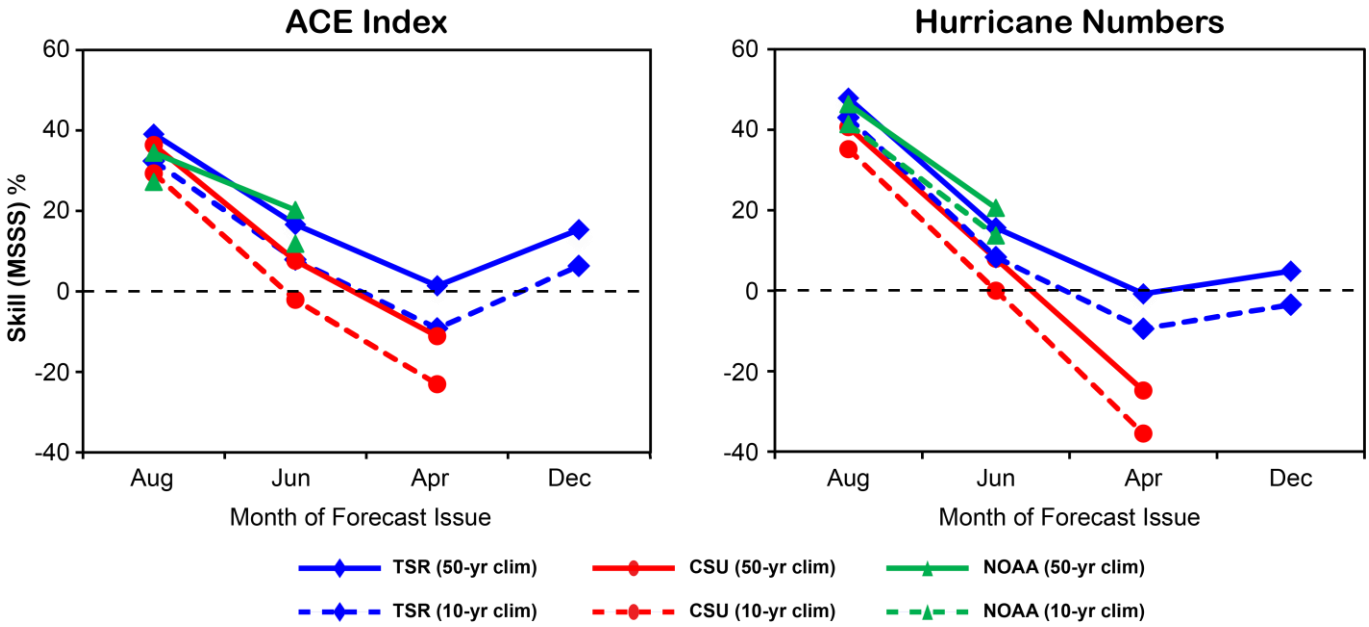
## Forecast Model for US ACE Index and US Landfalling Hurricane Numbers

The TSR early August forecast for the US ACE index and US landfalling hurricane and tropical storm numbers in 2020 is predicted from an ensemble of two models: (1) the July 2020 tropospheric wind anomalies between heights of 925 hPa and 400 hPa over North America, the east Pacific and the North Atlantic (Saunders and Lea, 2005). Wind anomalies in these regions in July are indicative of persistent atmospheric circulation patterns that either favour or hinder evolving hurricanes from reaching US shores during August and September; (2) thinning from the forecast of total Atlantic basin activity for 2020.

Saunders, M. A. and A. S. Lea, Seasonal prediction of hurricane activity reaching the coast of the United States, *Nature*, 434, 1005-1008, 2005.

## 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.

Additional information about the accuracy of the TSR seasonal outlooks and of the long-term validity of the TSR seasonal model may be obtained from these two publications:

1. Klotzbach, P. J., M. A. Saunders, G. D. Bell and E. S. Blake (2017), North Atlantic seasonal hurricane prediction: underlying science and an evaluation of statistical models, in *Climate Extremes: Patterns and Mechanisms*, Geophys. Monogr. Ser., vol 226, edited by S-Y. Wang et al., pp. 315-328, American Geophysical Union, John Wiley & Sons. doi/10.1002/9781119068020.ch19 (Please see section 19.2.5 – pages 323-325).

2. Saunders, M. A., P. J. Klotzbach and A. S. R. Lea (2017), Replicating annual North Atlantic hurricane activity 1878-2012 from environmental variables, *J. Geophys. Res. Atmos.*, *122*, 6284-6297, doi:10.1002/2017JD026492.

## Further Information and Next Forecast

Further information about TSR forecasts and verifications may be obtained from the TSR web site *http://www.tropicalstormrisk.com*. This is the final TSR forecast update for the 2020 North Atlantic hurricane season. TSR will issue its extended range outlook for the 2021 North Atlantic hurricane season in December 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 | 5 Aug 2020 | 166 | 24 | 10 | 4 |
| | 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 | 7 July 2020 | 160 | 20 | 9 | 4 |
| | 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 | 5 Aug 2020 | 140 | 17 | 8 | 4 |
| | 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 | 5 Aug 2020 | 5.0 | 9** | 4*** |
| | 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
** Includes tropical storms Bertha, Christobal, Fay, Hanna and Isaias
*** Includes hurricanes Hanna and Isaias