Pre-Season Forecast for North Atlantic Hurricane Activity in 2017

Issued: 26th May 2017

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Forecast Summary

TSR increases its forecast and predicts Atlantic hurricane activity in 2017 will be close to the long-term average. However, forecast uncertainties remain sizeable.

The TSR (Tropical Storm Risk) pre-season forecast for North Atlantic hurricane activity in 2017 is raised compared to the TSR early April forecast. The forecast anticipates that hurricane activity in 2017 will be about average compared both to the long-term norm and to the recent 2007-2016 10-year norm. The forecast spans the period from 1st June to 30th November 2017 and employs data through to late May 2017. The TSR forecast has increased since early April 2017 due to the recent trend towards negative North Atlantic Oscillation conditions which favour warmer hurricane main development waters in August-September, and to the decreased likelihood that El Niño conditions will develop by August-September. The latter means that there is an increased likelihood for lower trade wind strength, increased vorticity and lower vertical wind shear where hurricanes form; factors which all translate into increased hurricane activity. Despite the expectation for more hurricane activity than thought previously, sources of uncertainty remain concerning whether El Niño conditions will develop and how warm the tropical North Atlantic will be in August-September.

Atlantic ACE Index and System Numbers in 2017

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2017	98 (±48)	3 (±2)	6 (±3)	14 (±4)
67yr Climate Norm	1950-2016	101	3	6	11
10yr Climate Norm	2007-2016	99	3	7	14
Forecast Skill at this Lead	1980-2016	36%	20%	29%	29%

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 1980-2016.

There is an 33% probability that the 2017 Atlantic hurricane season ACE index will be above-average (defined as an ACE index value in the upper tercile historically (>119)), a 40% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (69 to 119) and a 27% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<69)). The 67-year period 1950-2016 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 (1950-2016).
Upper Tercile = ACE index value greater than 119.
Middle Tercile = ACE index value between 69 and 119.
Lower Tercile = ACE index value less than 69.

ACE Index & Numbers Forming in the MDR, Caribbean Sea and Gulf of Mexico in 2017

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2017	80 (±44)	2 (±1)	4 (±2)	9 (±2)
67yr Climate Norm	1950-2016	79	2	4	7
10-yr Climate norm	2007-2016	82	2	5	10
Forecast Skill at this Lead	1980-2016	41%	26%	45%	48%

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 39% probability that the 2017 Atlantic hurricane season ACE index will be above-average (defined as an ACE index value in the upper tercile historically (>92)), a 41% likelihood it will be near-normal (defined as an ACE index value in the middle tercile historically (43 to 92) and a 20% chance it will be below-normal (defined as an ACE index value in the lower tercile historically (<43)). The 67-year period 1950-2016 is used for climatology.

USA Landfalling ACE Index and Numbers in 2017

		ACE Index	Hurricanes	Tropical Storms
TSR Forecast	2017	1.5	1	3
67yr Climate Norm	1950-2016	2.3	1	3
10yr Climate Norm	2007-2016	1.6	1	3
Forecast Skill at this Lead	1980-2016	3%	4%	5%

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 40% probability that in 2017 the USA landfalling ACE index will be above average (defined as a USA ACE index value in the upper tercile historically (>2.48)), a 27% likelihood it will be near-normal (defined as a USA ACE index value in the middle tercile historically (1.03 to 2.48)) and a 33% chance it will be below-normal (defined as a USA ACE index value in the lower tercile historically (<1.03)). The 67-year period 1950-2016 is used for climatology.

Caribbean Lesser Antilles Landfalling Numbers in 2017

		ACE Index	Intense Hurricanes	Hurricanes	Tropical Storms
TSR Forecast	2017	0.9	0	0	1
67yr Climate Norm	1950-2016	1.3	0	0	1
10yr Climate Norm	2006-2016	0.9	0	0	1
Forecast Skill at this Lead	1980-2016	26%	4%	19%	6%

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 within the region 10°-18°N, 63°-60°W (reduced by a factor of 6).
ACE Unit = $x10^4$ $knots^2$.
Strike Category = Maximum 1 Minute Sustained Wind of Storm Directly Striking Land.
Lesser Antilles = Island Arc from Anguilla to Trinidad Inclusive.

Methodology and Key Predictors for 2017

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.

The main factor underpinning the TSR forecast for 2017 hurricane activity being close the long term norm is the anticipated near-neutral July-September 2017 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 current forecast for this predictor is 0.10±0.70 ms^{-1} weaker than normal (1980-2016 climatology). This is notably weaker than the early April forecast value of 0.81±0.86 ms^{-1} stronger than normal. The July-September 2017 trade wind prediction uses the current expectation for neutral ENSO or weak El Niño conditions in July-September 2017 as forecast by the consensus of dynamical and statistical model ENSO outlooks (*http://iri.columbia.edu/climate/ENSO/currentinfo/SST_table-.html*) provided by the International Research Institute for Climate and Society, and the current expectation for August-September SSTs in the tropical North Atlantic and Caribbean Sea to be 0.30±0.22°C warmer than normal (1980-2016 climatology). Near-neutral trade winds during July-August-September are associated with average vorticity and average vertical wind shear over the hurricane main development region, and thus with average hurricane activity. However, it should be stressed that the uncertainties in August-September ENSO and in August-September SSTs in the tropical North Atlantic remain sizeable in late May still two months before the start of the peak hurricane season in August.

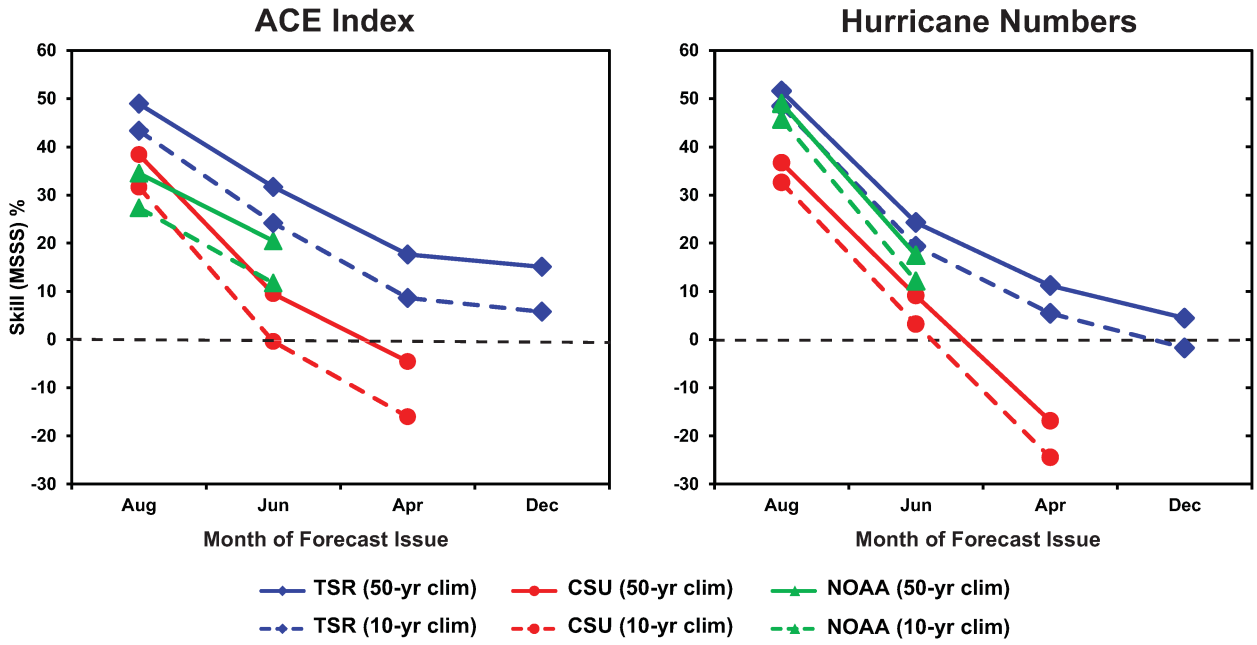
The Precision of Seasonal Hurricane Forecasts

The figure on the next page displays the seasonal forecast skill for North Atlantic hurricane activity for the 14-year period between 2003 and 2016. 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 hurricane activity: ACE and basin hurricane numbers.

Forecast precision is assessed 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 in 2011. It is clear from the figure that there is little skill in forecasting the upcoming number of hurricanes from the previous December. Skill climbs slowly as the hurricane season approaches with moderate-to-good skill levels being achieved from early August.

TSR was the best performing statistical seasonal forecast model at all lead times for 2003-2016.



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 next TSR forecast update for the 2017 Atlantic hurricane season will be a pre-season forecast issued on the 4th July 2017.

Appendix – Predictions from Previous Months

1. Atlantic ACE Index and System Numbers

Atlantic ACE Index and System Numbers 2017					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1950-2016)		101	11	6	3
Average Number (2007-2016)		99	14	7	3
TSR Forecasts	26 May 2017	98 (±48)	14 (±4)	6 (±3)	3 (±2)
	4 Apr 2017	67 (±57)	11 (±4)	4 (±3)	2 (±2)
	13 Dec 2016	101 (±58)	14 (±4)	6 (±3)	3 (±2)
CSU Forecast	6 Apr 2017	75	11	4	2
NOAA Forecast	25 May 2017	75-155	11-17	5-9	2-4

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

MDR, Caribbean Sea and Gulf of Mexico ACE Index and Numbers 2017					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1950-2016)		79	7	4	2
Average Number (2007-2016)		82	10	5	2
TSR Forecasts	26 May 2017	80 (±44)	9 (±2)	4 (±2)	2 (±1)
	4 Apr 2017	49 (±52)	6 (±3)	2 (±2)	1 (±2)

3. US ACE Index and Landfalling Numbers

US Landfalling Numbers 2017				
		ACE Index	Named Tropical Storms	Hurricanes
Average Number (1950-2016)		2.3	3	1
Average Number (2007-2016)		1.6	3	1
TSR Forecasts	26 May 2017	1.5	3	1
	4 Apr 2017	1.0	2	0

4. Lesser Antilles ACE Index and Landfalling Numbers

Lesser Antilles Landfalling Numbers 2017					
		ACE Index	Named Tropical Storms	Hurricanes	Intense Hurricanes
Average Number (1950-2016)		1.3	1	0	0
Average Number (2007-2016)		0.9	1	0	0
TSR Forecasts	26 May 2017	0.9	1	0	0
	4 Apr 2017	0.5	1	0	0