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SHORELINES – January 2018

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The 2017 Hurricane Season Review

A "record breaking season" might best describe the 2017 Hurricane season, which officially runs annually for a 6-month window opening on June 1st and sun-setting on November 30th. Forecasters were predicting a "near normal" hurricane season for 2017 based predominantly on possible *El Niño* conditions, and anticipated warming of tropical Atlantic waters (i.e., fuel for cyclones) relative to the seasonal norm during the peak of the hurricane season. Granted there was stated uncertainty of *El Niño* conditions ever forming. As a quick primer or reminder if you will; *El Niño* is actually a component of *El Niño* Southern Oscillation (ENSO) occurring in the Pacific Ocean basin. ENSO "warm phase" or *El Niño* conditions generally produces atmospheric conditions suppressing the formation of tropical cyclones in the Atlantic. Conversely the "cool phase" of ENSO, or *La Niña* tends to produce atmospheric conditions more favorable for tropical cyclone development. And lastly as you might expect, "ENSO Neutral" conditions are somewhere in between.

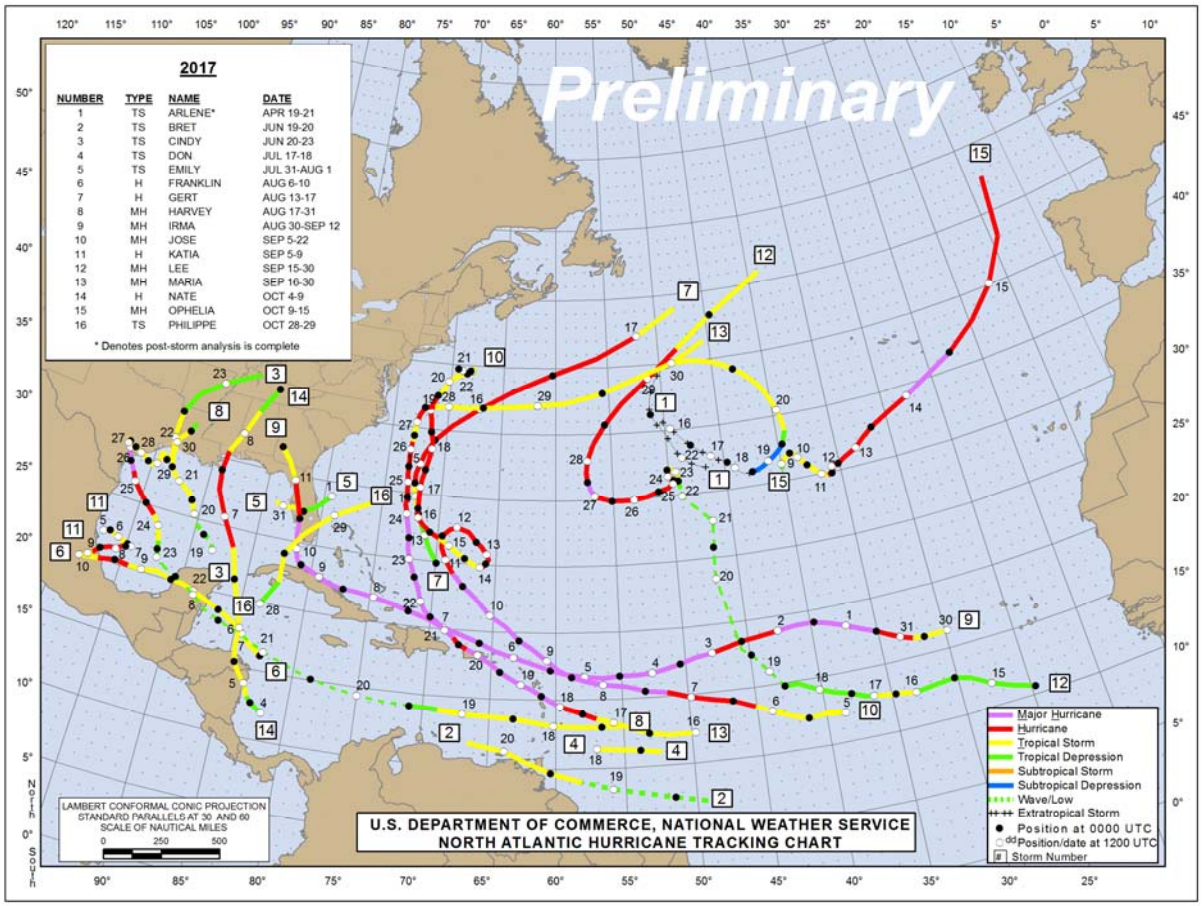

Figure 1 – Graphic prepared by the National Weather Service (NOAA) depicting cyclone tracks and intensities reported for the 2017 hurricane season.

Rather than *El Niño* conditions developing as originally forecasted, tropical cyclone conducive *La Niña* conditions took command instead this summer. When coupled with well above-average sea surface temperatures in the tropical Atlantic, the results included epic rains (max. over 60") and flooding in the Houston metropolitan area via hurricane *Harvey* and pure devastation to Caribbean and Atlantic Islands in the wake of hurricanes *Irma* and *Maria*. *Irma* also made landfall in the Florida Keys as a Category 4 hurricane before traveling almost due north up the entire Florida peninsula. The 2017 hurricane season was also the first season on record to have two Category 4 hurricanes (*Harvey* and *Irma*) make continental U.S. landfall in the same year. September 2017 alone broke Atlantic calendar month records for named storm days (53.5), hurricane days (40.25), and major hurricane days (18). The U.S. hurricane damage estimate is $206.6 Billion, which is now the highest on record. Somewhat amazingly, the Mid-Atlantic and Northeast States did not experience any tropical cyclone landfalls and were only minimally impacted by wind, rain, surge, waves, etc. (Figure 1).

2017 "Preseason" Forecasts Undershot the Mark

There are a spate of hurricane preseason predictions available each year but we usually focus on those that make not just their prediction public, but verify their prediction skill in the public arena as well. This short list therefore includes; **(1)** the Tropical Meteorology Project at Colorado State University, **(2)** the University College London, U.K. for Tropical Storm Risk, and **(3)** our Federal voice for climatology/meteorology matters, the National Oceanic & Atmospheric Administration (NOAA). We then take these groups' last prediction just before or near the start of hurricane season on June 1st and compare the predictions to the actual results at the end of the season (November 30th).

The forecasters were off the mark this year to be honest, and drastically underestimated tropical cyclone activity. As the accompanying prediction summary chart indicates (Table 1), the average prediction included 14 total cyclones (the actual was 17), 6 of which were predicted to generate into hurricanes (the actual was 10), with 3 of these becoming major hurricanes (the actual was 6). This means 7 tropical storms were predicted and the actual number was indeed 7.

	NOAA (median) 5/25/17	Colorado State University, US 6/1/17	University College London, UK 5/26/17	Average of Predictions	ACTUAL 2017	Historical Average (1981-2010)
Total No. of Named Tropical Cyclones	14	13	14	14	17	12
Tropical Storms	7	7	8	7	7	6
Hurricanes / Major	7/3	6/2	6/3	6/3	10/6	6/3
Accumulated Cyclone Energy (ACE) Index	103	99	98	100	223	104

Table 1 - Summary comparing publicly available pre-season predictions for the 2017 Hurricane Season with actual results and average activity.

However, the most glaring discrepancy between the pre-season forecasts and actual activity is for perhaps the most important metric provided in Table 1 - the Accumulated Cyclone Energy Index (**ACE Index**). The ACE Index is simply a measurement taking a storm's wind speed strength for each 6-hour period of its existence into account. The larger the ACE Index value, the more active the season. The ACE Index is actually one of the more revealing parameters we can use and serves as a better indicator of whether or not a hurricane season is truly "active" or not. The longer duration and/or more intense each cyclone (tropical storm or hurricane); the more contribution to the ACE Index Value – and *vice versa*. The average forecasted ACE Index for 2017 was 100 - the actual was 223! That's more than double the historical 1981-2010 average.

The ACE Index Value for 2017 was significantly more than forecasted, and can also be utilized to determine that we had a "hyperactive" season. "Below normal" is <68, "near normal" is 68 to 106, "above normal" ranges from 106 to 168, and "hyperactive" is >168). Below (Table 2) is a summary of the past 15 years with respect to the ACE Index – again, it's a great barometer (no pun intended) of tropical cyclone activity.

The 2017 ACE Index Value was also historical in several respects. For one, it was the 7th highest value ever recorded for a season and was bolstered by the month of September, which had the highest ACE Index Value contribution ever for a *single month* – 175. That's higher than any of the ACE Index Values recorded for an *entire season* since 2005. Also, hurricanes *Irma*, *Jose'*, and *Maria* contributed more than 40 to the ACE Index Value a piece – that's the first time on record that three tropical cyclones each produced >40 ACE Index points in a single season.

YEAR	ACE Index	Notes
2017	**223**	7th highest ACE index on record punctuated by September, which had the highest ACE contribution ever for a single month (175). Hurricanes *Irma*, *Jose'*, and *Maria* contributed more than 40 ACE a piece – first time three tropical cyclones each produced >40 in a single season.
2016	**134**	Uncommonly prolonged (January 12 to November 25) yet very little activity in the climatological peak of the season as October had a higher ACE Index input (69) than August and September combined. Matthew alone had an ACE Index of 49.
2015	**62**	Somewhat surprising near average numbers of tropical storms and hurricanes despite the 2015-16 moderate to strong *El Niño* event. ACE Index higher than forecasted yet still "below normal" and skewed by *Joaquin* which had an ACE Index of 27 alone.
2014	**66**	Fewest amount of total cyclones (8) since 1997 (7). Hurricanes *Edouard* and *Gonzalo* accounted for over 60% of the ACE Index. Hurricane *Arthur* crossed Shackleford Banks.
2013	**33**	6th lowest ACE Index since 1950; 13 cyclones with 2 that developed into hurricanes - fewest number of hurricanes since 1982.
2012	**128**	Third consecutive year with 19 cyclones that ties record for 3rd-most most cyclones ever for a season (2011, 2010, 1995, and 1887 all had 19 cyclones). Eight cyclones formed in August alone, which tied 2004 for the most to form in that particular month, and only 7 seasons had more hurricanes than 2012 (10).
2011	**119**	Tied with 2010, 1995, and 1887 for the 3rd-most most cyclones for a season at 19, but fewer of the cyclones developed into hurricanes (7 hurricanes in 2011 compared to 12 in 2010), yielding a lower ACE value. *Irene* was the first U.S landfalling hurricane since *Ike* in 2008.
2010	**163**	Tied for 3rd-most most cyclones for a season at 19, and tied for 2nd-most hurricanes for a season at 12. *Igor* had an ACE Index of 42 alone - highest since *Ivan* (2004).
2009	**51**	*El Niño* year - 15th lowest ACE Index since 1950, 12 cyclones (most short-lived), 3 hurricanes.
2008	**145**	*Ike* and *Gustav* were two major hurricanes that impacted Tx. and La., *Bertha* was an extremely long-lived cyclone, and collectively accounted for 60% of the total ACE Index for 2008.
2007	**72**	Five more tropical cyclones than average, but most were very short-lived or rather weak, with the exception of two category 5 hurricanes that impacted Central America (*Dean* and *Felix*).
2006	**79**	Ten cyclones total (lowest number since the 1997 season)
2005	**248**	Highest ACE Index on record and included the most cyclones (28), hurricanes (15), and category 5 hurricanes (4) in a single season, and the most intense hurricane on record (*Wilma*).
2004	**225**	4th highest ACE Index value on record, hurricane *Ivan* alone had an ACE Index of 70, 2004 had six major hurricanes.
2003	**175**	Hurricane *Isabel* will long be remembered in Carteret County for Down East flooding, and for the island breach near Hatteras Village in Dare County. *Isabel's* ACE Index alone was 63, one of the highest recorded for an individual cyclone.

Table 2 – ACE Index summary chart (2003 – 2017).

As implied earlier, the perceived activity level for a Hurricane season is sometimes all about location, location, location. That can be a cause for complacency and reason to be not as prepared as we should. This year is a perfect example - despite all the records that fell this year for hurricane activity; the Mid-Atlantic and Northeast States will probably look

back at 2017 as a benign year. Unfortunately and as suggested before, it only takes one cyclone to make or break a hurricane season, with 1992 being a perfect example – just 7 named cyclones, 4 of which were hurricanes, with one of those classified as major, and an ACE Index Value of 75. Sounds like a very quiet year, except the one major hurricane was *Andrew*, which struck Florida and was the costliest natural disaster in U.S. history until *Katrina* in 2005. So again and as always - be prepared and be safe.

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Colorado State University Tropical Meteorology Project