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SHORELINES – January 2016

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The 2015 Hurricane Season Review

The month of December usually means two things for many of us at and near the coast – (1) the holiday season here, and perhaps even more comforting, (2) the 2015 hurricane season is behind us. The hurricane season officially runs for a 6-month window opening on June 1st and sun-setting on November 30th.

However the formation of a cyclone outside the 6-month designation is not outside the realm of possibility as evidenced quite nicely this year with *Ana*, which transitioned from a subtropical storm to a tropical storm in May. The climatological record also demonstrates that early season cyclone activity is <u>not</u> necessarily a foreshadow for an active hurricane season. This was especially projected for 2015 with the onset of a moderate to strong *El* Niño that typically reduces Atlantic hurricane activity by increasing wind shear over the tropical Atlantic. The end result is an unfavorable atmosphere (no pun intended) for tropical cyclones to organize and strengthen. This precept basically held true for 2015 but the extent of high wind shear did not reach as far east in the Atlantic as usual providing a window for the formation of several tropical storms to form (and even strengthen) near the African coast in near-record warm waters (Figure 1). In fact the number of tropical storms, hurricanes, and major hurricanes were slightly closer to the 1981 – 2010 average than might have been expected.

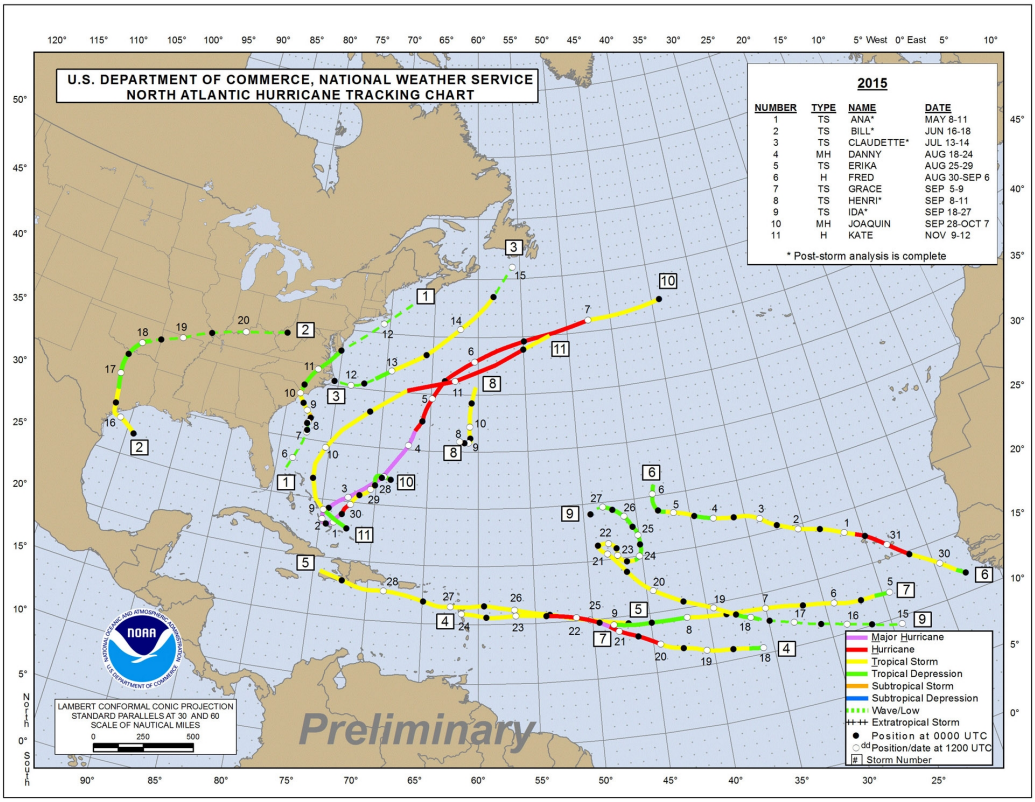

Figure 1 – Graphic prepared by the National Weather Service depicting cyclone tracks and intensities reported for the 2015 hurricane season.

As a friendly reminder, the term tropical cyclone refers to an atmospheric closed circulation rotating counter-clockwise in the Northern Hemisphere – they can develop into Tropical Storms and Hurricanes. Major Hurricanes are considered as Category 3 or higher, and all of these designations are determined using different thresholds of maximum sustained surface wind (e.g. – a tropical storm develops when winds range from 39 mph to 73 mph).

2015 "Pre-season" Forecasts Were Pretty Close to the Mark

Hurricane forecasters were close to their target in 2015 based a few different metrics. How can we objectively make all this assessment? If you're a frequent reader of the *Island Review*, then you will know our personal preference is to review the predictions generated by groups that make not just their prediction public, but verify their prediction skill in the public arena as well. This really leaves us with; **(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).

As the accompanying prediction summary chart indicates (Table 1), the average prediction included 9 total cyclones (the actual was 11), 4 of which were predicted to generate into hurricanes (the actual was indeed 4), with 1 of these becoming major hurricanes (the actual was 2). This means 5 tropical storms were predicted and the actual number was 7.

	NOAA (median) 5/27/15	Colorado State University, US 6/1/15	University College London, UK 5/27/15	Average of Predictions	ACTUAL 2015	Historical Average (1981-2010)
Total No. of Named Tropical Cyclones	9	8	10	9	11	12
Tropical Storms	**4**	**5**	**6**	5	7	6
Hurricanes / Major	**5/1**	**3/1**	**4/1**	4/1	4/2	6/3
Accumulated Cyclone Energy (ACE) Index	**56**	**40**	**37**	44	62	104

Table 1 - Summary comparing publicly available pre-season predictions for the 2015 Hurricane Season with actual results and average activity.

As can be quickly gleaned from this prediction chart, the key elements for the 2015 hurricane season were generally lower with the 1981-2010 *historical* average, yet slightly higher than what was *predicted* earlier in the year. But all in all – pretty close.

Technically speaking, we did indeed have a "below normal" hurricane season, which is actually determined by looking at a term we haven't discussed yet - 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 barometer of whether or not a hurricane season is truly "active" or not. This past decade and even this year (2015) have some great examples to support this assertion.

For instance 2012, 2011, and 2010 tied the years of 1995 and 1887 for the third-most named cyclones in one year at nineteen. However the ACE Index Values were different in each year of that 2012 to 2010 stretch. Why? In 2012 we had ***10*** of the nineteen cyclones develop into hurricanes (ACE = 128), while only ***7*** of the nineteen cyclones developed into hurricanes in 2011 (ACE = 119). 2010 had the highest ACE value of these three years (ACE = 163) with ***12*** of the nineteen cyclones developing into

hurricanes, including the particularly intense and long-lasting hurricane *Igor* that had an ACE value/contribution of 42 in itself. This all makes sense because again the mathematical formula takes each cyclone's wind speed and duration into account. Also as an interesting note, the highest ACE Index ever recorded was roughly a decade ago in 2005 – a hurricane season punctuated by more tropical storms, total hurricanes, and category 5 hurricanes than in any season previously recorded; and included *Ophelia* for North Carolina and the infamous major hurricanes of *Katrina*, *Wilma*, and *Rita* in the Gulf of Mexico. The ACE Index was 248 (that's not a typo). Table 2 includes the ACE Index for the past thirteen years and a few notes justifying the value.

YEAR	ACE Index	Notes
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 – 2015).

The average ACE Index for the period of 1981 – 2010 is 104 and the average prediction for 2015 was 44. The actual ***ACE Index was 62***, which is significantly higher than what was predicted but hurricane *Joaquin* by itself had an ACE value/contribution of 27 – equivalent to 47% of the entire ACE value for 2015! The next highest value for an individual hurricane was *Danny* at 9. This makes the ACE value for *Joaquin* quite an outlier, which otherwise would have made the spread between the forecasted and the actual ACE values a lot closer for 2015.

In closing, the ACE Index is also used to determine whether a hurricane season is termed as "below normal" (<68), "near normal" (68 – 106), "above normal" (106 – 168) or even "hyperactive" (>168). Hence why ***below normal*** is used here as an objective term to characterize the 2015 hurricane season – again, the ACE Index for 2015 was 62.

Unfortunately and bringing things back home, it only takes one cyclone to make or break a hurricane season, with 1992 being a perfect example − 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. This underscores the need to be prepared for each and every hurricane season regardless if it is an "active" season or not. June and the start of the 2016 hurricane season is just a several months away − it's never too early to start preparing.