carteret county Shore protection office
protectthebeach.com

SHORELINES – February 2015

As presented to the *Island Review* magazine

The 2014 Hurricane Season Review (belated)

Although we're a few weeks into 2015, perhaps it's still not too late to entertain one last "year in review" story, which smartly leads us to our annual recap of the 2014 hurricane season (June 1st – November 30th). The 2014 hurricane season started with a bang (or a blow) as Hurricane *Arthur* crossed the very eastern tip of Shackleford Banks as a category 2 hurricane on July 3rd. It was the strongest hurricane to strike the U.S. since 2008 - Hurricane *Ike* was also Category 2 at landfall. However the impacts from *Arthur* were very minor thanks to the rapid forward speed of the hurricane – there simply wasn't enough time for the seas to develop along the oceanfront or the wind to pile water up on our sound and creek shorelines. After crossing Shackleford Banks, *Arthur* whisked away rather quietly across Pamlico Sound and into the Atlantic Ocean as the July 4th weekend festivities were as celebratory and full of visitors as usual (perhaps even more so).

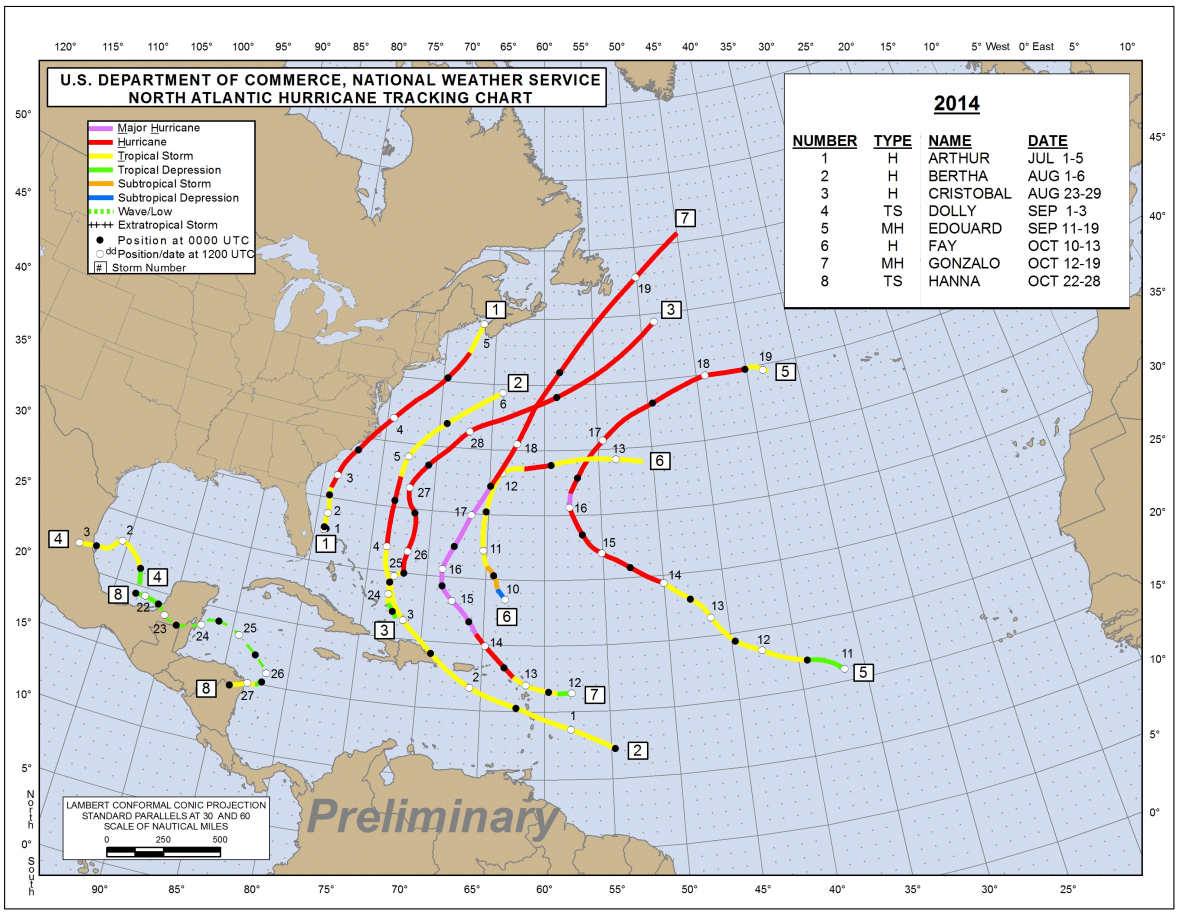

Figure 1 – Graphic prepared by the National Weather Service depicting cyclone tracks and intensities reported for the 2014 hurricane season.

From a broader perspective most experts agree the Atlantic Ocean basin continues to be in a heightened trend of tropical cyclone activity compliments of cyclical ocean-atmosphere interactions; however a convergence of factors helped suppress cyclone formation in 2014 (Figure 1). Atmospheric circulation favoring dry, sinking air in the tropical Atlantic and high wind shear over the Caribbean dominated the summer 2014 weather pattern. Cyclones need moist air, not dry air to develop and when coupled with wind shear - the conditions were almost exactly opposite of what cyclones need to form. And lastly the West African monsoon season was near to below average, which made it more difficult for African easterly waves to develop. These are the low pressure systems we see all the time emerging from west Africa near the Cape Verde Islands that can subsequently develop into tropical cyclones and possibly ride the "hurricane express" across the Atlantic.

2014 "Pre-season" Forecasts Were On The Mark

Hurricane forecasters were right on target in 2014 after a complete miss in 2013 – a near hyperactive season was predicted in 2013 but in reality the season ended as the 6th weakest since 1950. How can we objectively make all these assessments? 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 11 total cyclones (the actual was 8), 4 of which were predicted to generate into hurricanes (the actual was 6), with 2 of these becoming major hurricanes (the actual was 2). This means 7 tropical storms were predicted and the actual number was 2. Remember 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).

	NOAA (median) 5/22/14	Colorado State University, US 6/2/14	University College London, UK 5/27/14	Average of Predictions	ACTUAL 2014	Historical Average (1981-2010)
Total No. of Named Tropical Cyclones	11	10	12	11	8	12
Tropical Storms	7	6	7	7	2	6
Hurricanes / Major	4/2	4/1	5/2	4/2	6/2	6/3
Accumulated Cyclone Energy (ACE) Index	63	65	73	67	66	104

Table 1 - Summary comparing publicly available pre-season predictions for the 2014 Hurricane Season with actual results and average activity.

As can be quickly gleaned from this prediction chart, the key elements for the 2014 hurricane season were generally lower with the 1981-2010 *historical* average, and maybe ever-so-slightly lower than what was *predicted*. Even more technically speaking, we had 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 (2014) 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 twelve years and a few notes justifying the value.

YEAR	ACE Index	Notes
2014	**66**	Fewest amount of total cyclones (8) since 1997 (7). Hurricanes Eduoard 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 were 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 – 2014).

The average ACE Index is 104. This year (2014) the ***ACE Index was 66***, which again makes a lot of sense upon further inspection. We had a relatively "low" amount of tropical cyclones develop, and actually hurricanes *Eduoard* and *Gonzalo* accounted for over

60% of the ACE Index in themselves. As depicted in Table 1, the average ACE Index of all the pre-season predictions was ***67*** – wow, just one point of the actual value of 66. Sure, the precise number of hurricanes and tropical storms were slightly off when comparing the predictions to the actual numbers; but again in terms of overall activity, the predictions were on the mark.

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 2014 hurricane season – again, the ACE Index for 2014 was 66. 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 2015 hurricane season is just a several months away – it's never too early to start preparing.