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2015 Hurricane Season Preview

Although helping to underscore the need to be prepared, it's not difficult to find yourself overwhelmed with hurricane predictions this time of year. To help demystify all the prediction terminology so we can ascertain what type of season we should expect and why, the following is presented as tropical cyclone primer and a one-stop synthesis of all those "pre-season" predictions.

Of course the hurricane season officially runs for a 6-month window that opens on June 1st and sunsets on November 30th, yet the formation of a cyclone outside the 6-month designation is not outside the realm of possibility – see *Ana* earlier this year that transitioned from a subtropical storm to tropical storm status (see below for the difference between these two "storms"). However climatology shows that early season cyclone activity does not foreshadow an active hurricane season. In fact, forecasters are predicting a "below normal" hurricane season for 2015 based predominantly on the anticipated development of a moderate to strong *El Niño* and generally cool water conditions in the tropical Atlantic – remember hot water is considered as fuel for cyclones and hence cooler waters equate to "low fuel".

Because *El Niño* is considered as the main driver for this year's hurricane season, it's worth diving into this phenomenon a little more. "*El Niño*" is actually a component of the ***El Niño Southern Oscillation (ENSO)*** that occurs in the Pacific Ocean basin. ENSO "warm phase" or *El Niño* occurs once every 2 to 7 years and generally produces atmospheric conditions that suppress the formation of tropical cyclones in the Atlantic. That's big for us obviously. Interestingly, the term "*El Niño*" means Little Boy or Christ Child, which was coined by South American fishermen noting the appearance of unusually warm water in the Pacific Ocean occurring near Christmas. As you may have guessed by now, "*La Niña*" (the girl child) is the "cold phase" of ENSO and tends to produce atmospheric conditions more favorable for tropical cyclone development.

So how do we know when *El Niño* or *La Niña* is upon us? Traditionally, ENSO cycles were determined empirically based upon the differences in surface air pressure between Tahiti and Darwin, Australia. Today, scientists use sea surface temperature measurements along the equatorial pacific as an indicator of *El Niño* or *La Niña* (particularly in a region known as *Niño* 3.4). If the sea surface temperature variance is greater than or equal to +0.5° C in region *Niño* 3.4, then the conditions are classified as *El Niño* and vice-versa (i.e., if the temperature variance is lower than or equal to -0.5° C, then *La Niña* conditions are prevalent). And finally if the temperature variance is between +0.5° C and -0.5° C, then ENSO neutral phase is dominant (neither *El Niño* nor *La Niña*).

And lastly a full-fledged *El Niño* or *La Niña* is only officially designated if the sea surface temperature thresholds are exceeded for a period of at least 5 consecutive overlapping 3-month seasons (roughly 7 months). Hence we may have *El Niño* or *La Niña* "conditions", but the history books may never reveal that an *El Niño* or *La Niña* episode ever took place. At the time this edition of *Shorelines* is being prepared, we are officially in an *El*

Niño that is expected to persist for the remainder of the year and perhaps even reach a moderate to strong *El Niño* status, which is objectively defined as;

(1) A strong *El Niño* = sea surface temperature (SST) anomaly greater than or equal to +2.0 degrees C.
(2) A moderate *El Niño* = SST anomaly between +1.0 and +1.9 degrees C.
(3) A weak *El Niño* = SST anomaly between +0.5 and +0.9 degrees C.

Again, *El Niño* produces atmospheric conditions that suppress the formation of tropical cyclones in the Atlantic and is the main cause for the "below average" prediction for 2015. We are currently in a "weak" *El Niño* and this could transition to a moderate to strong *El Niño* by the end of the year.

Hurricane Vocabulary

There are plenty of terms that you will likely hear or have already heard this hurricane season - cyclones, tropical storms, hurricanes, and more. For instance, *Sandy* in 2012 turned *extratropical* – what does this mean? The following should help in our general understanding of this and other terms.

Tropical cyclone - warm-core, atmospheric closed circulation rotating counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Tropical storm – a tropical cyclone with a maximum sustained surface wind speed ranging from 39 mph to 73 mph using the U.S. 1-minute average.

Hurricane - a tropical cyclone with a maximum sustained surface wind speed reaching 74 mph or more.

Saffir Simpson Scale – a scale including a 1 to 5 rating based upon wind speeds, again utilizing the U.S. 1-minute average. A category 1 hurricane has winds ranging from 74 to 95 miles per hour (mph), category 2 ranges from 96 to 100 mph, category 3 ranges from 111 to 130 mph, category 4 ranges from 131 to 155 mph, and a category 5 hurricane has sustained winds exceeding 155 mph.

Major Hurricane – a hurricane reaching category 3 or higher on the Saffir Simpson Scale. Interestingly, category 5 hurricanes very rarely make landfall while maintaining their category 5 intensity - only three have ever done so in the U.S. – the Labor Day hurricane (1935), *Camille* (1969), and *Andrew* (1992).

Now to account for some of the weather oddballs, we also need to include;

Extratropical Storm - a *cold-core* atmospheric cyclone deriving its energy when cold and warm air masses interact, not as part of the positive feedback loop identified with tropical storms as warm, moist air rises causing continual heat exchange. Unlike tropical storms, extratropical storms can have one or more fronts connected to them, and can occur over land or ocean. Extratropical cyclones can have winds ranging to levels associated with a tropical depression, or as strong as a hurricane and examples include blizzards and nor'easters, which often form in winter and fall months off the mid-Atlantic and drift slowly along the north Atlantic seaboard and eventually east. If it drifts back west towards land, it is called a retrograded nor'easter.

Subtropical Storm - occurs if waters under an extratropical cyclone are warm, followed by thunderstorms that gradually build inside the storm. The storm core may subsequently and gradually go from cold to warm, and the storm will be called subtropical.

Note: Both subtropical and extratropical cyclones have the highest winds and thunderstorms a good distance away from the center, and may have frontal boundaries associated with the systems. The two (extra- and subtropical) are usually broader systems than a tropical system, but the subtropical system will produce more rain compared to an extratropical one.

Post-tropical Cyclone – a hybrid term describing a cyclone no longer possessing the characteristics to be considered a tropical cyclone, and are further divided into either "extratropical" (see above) or "remnant lows".

What to Expect for 2015

If you're a frequent reader of the *Island Review*, then you will already know that our preference is to review the predictions produced by groups that make not just their forecasts 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 before or near when the hurricane season starts and begin to crunch the numbers. As the accompanying prediction summary table indicates, we could expect 9 named cyclones, 4 of which will generate into hurricanes, with 1 of these becoming a major hurricane (on average).

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

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

The average of the predictions result in a forecast of a "below normal" hurricane season, which is actually determined by looking at 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 has some great examples to support this assertion.

For instance 2012, 2011 and 2010 are tied with 1995 and 1887 for the third-most named cyclones in one year at nineteen. However the ACE Index Values were different. 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 past consecutive 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) compared to the historical 1981-2010 average of 104. Table 2 includes the ACE Index for the past twelve years and a few notes justifying each 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).

In closing, by reviewing the ACE Index we can determine whether a hurricane season is termed as "below normal" (<68), "near normal" (68 – 106), "above normal" (106 – 168) or even "hyperactive" (>168). And while most experts are indeed forecasting a ***below normal*** season for 2015 (average predicted ACE Index of 44), these forecasts do not represent landfall probabilities because cyclone paths are dependent on short-term factors such as interactions with other weather systems and fluctuating steering patterns. 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 be prepared and be safe.