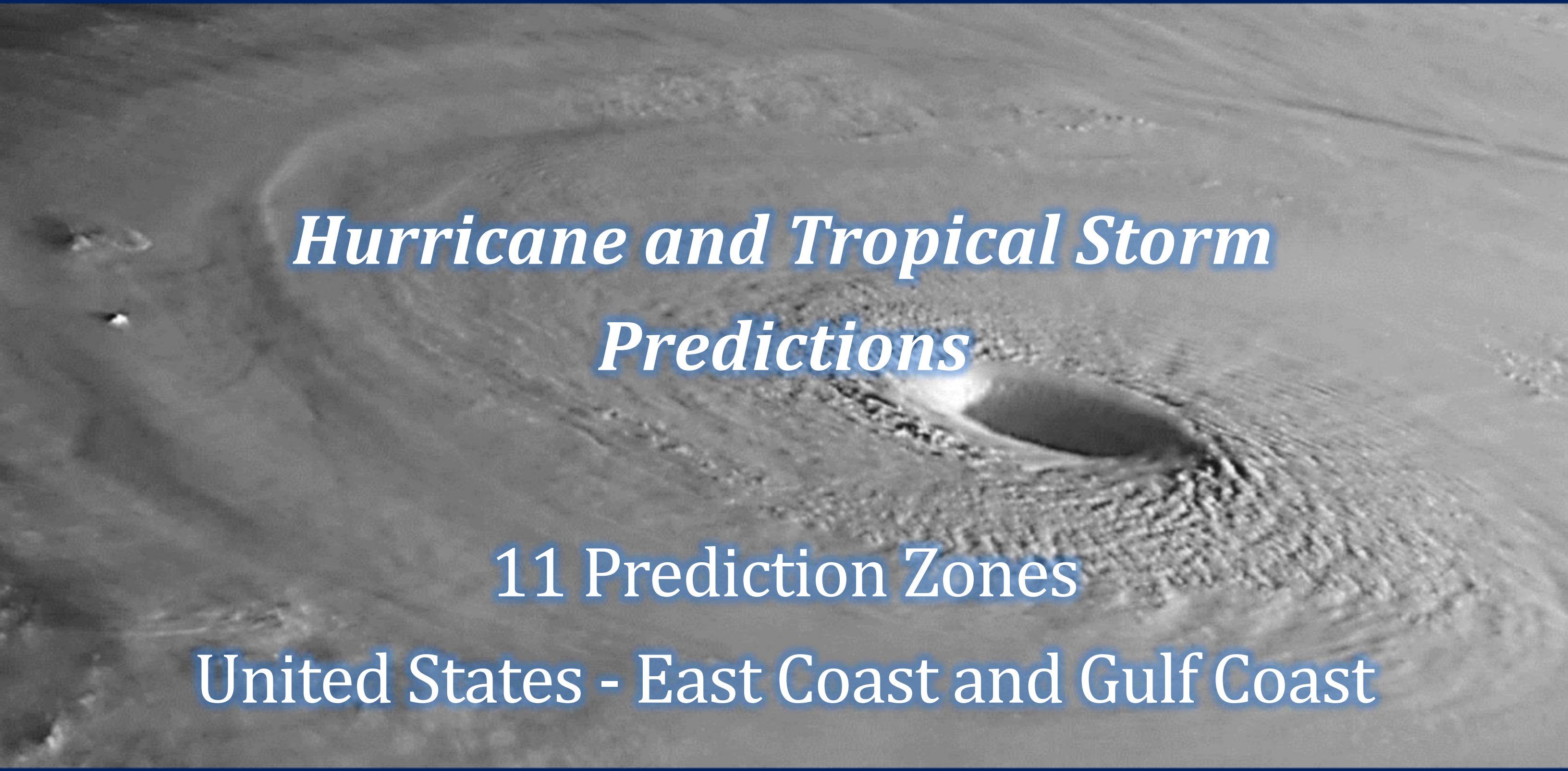

Hurricane and Tropical Storm Predictions

11 Prediction Zones

United States - East Coast and Gulf Coast

Issued January 1, 2017

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Predictions for 2017

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1.0 Background and Introduction

There are a number of factors that are related to the formation and tracks of tropical cyclones during the hurricane season for the North Atlantic Basin which includes the tropical and sub-tropical Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico.

One factor is the temperatures of the sea surface; are they running near normal, above normal, or below normal? Warmer temperatures are more favorable conditions for development of stronger storms and more major hurricanes, whereas colder ocean temperatures would lead to less intense storms.

A second factor in predicting the number of storms for the season is the three phases of the ENSO (El Niño Southern Oscillation). Will there be extensive warming of the Tropical South Pacific Ocean water in the eastern Pacific to cause an El Niño to form? Will there be too much cooling of the ocean water in this region to cause a La Niña, the opposite phase of an El Niño? Or, will it be a period in which neither is present? This is referred to as ENSO Neutral conditions.

The El Niño is a global coupled ocean-atmosphere phenomenon, and when an El Niño is in place, Atlantic Ocean tropical cyclone activity is typically less than average. Conversely when a La Niña or Neutral conditions are in place, Atlantic Ocean tropical cyclone activity is enhanced (see section 3.1 for the GWO El Niño, La Niña outlook).

Another major factor in predicting seasonal hurricane tracks is the average position and strength of the “Azores-Bermuda High”, which is also known as the North Atlantic (Subtropical) High Pressure Center (Anticyclone). Much like the North Pacific High off of the west coast of the United States, the Bermuda-Azores high is what meteorologists call a large “semi-permanent” area of high pressure center. Semi-permanent means it is normally in that location, but does meander from time to time. The Bermuda-Azores High is found south of the Azores in the Atlantic Ocean.

As seen in Figure 1.1, the clockwise wind flow and atmospheric steering currents around the high determines the eventual path of tropical cyclones during the Atlantic Hurricane Season. However, the High Pressure center meanders in position from season to season, thus influencing the tracks of tropical cyclones (hurricanes and tropical storms). For example; if the ridge of the High is displaced to the north, this can lead to devastating storm paths such as the one taken by the New England Hurricane of 1938.

If the High is strongly displaced to the south such as it did in 2014, the strong ridge of high pressure will also displace the Inter-tropical Convergence Zone (ITCZ), a favorable area for storm development, too far to the south. This displacement in turn causes more sand to be blown off the African coast, making a hostile eastern Atlantic environment that causes abnormally fewer storms to form in the middle and eastern tropical Atlantic region.

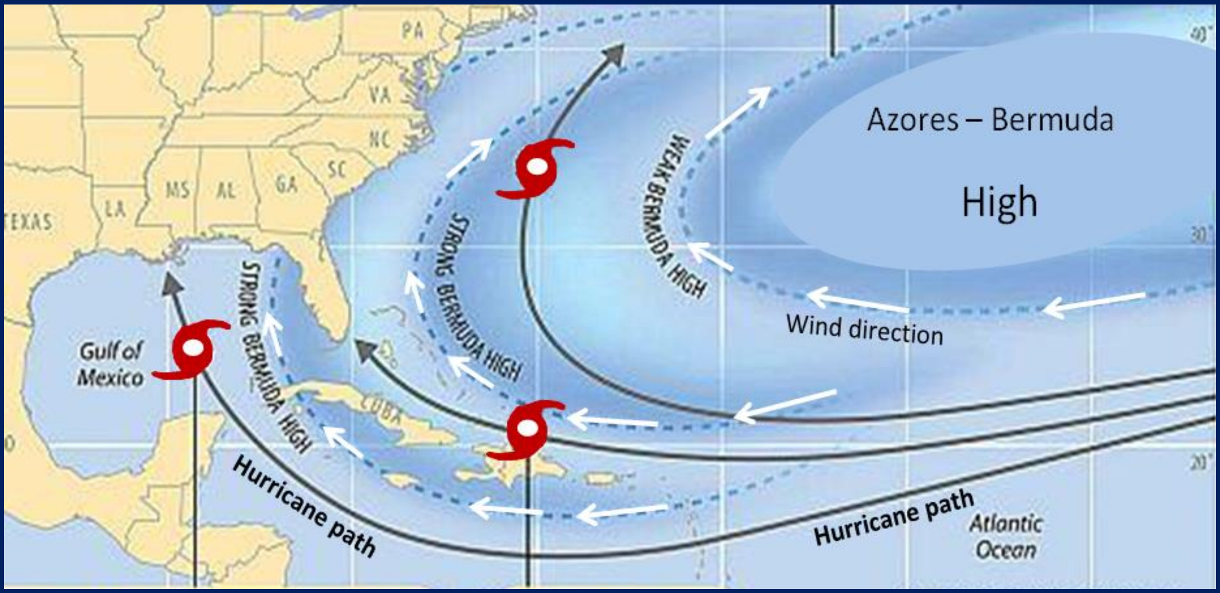


Figure 1.1 - Depicts the Azores-Bermuda semi-permanent area of high pressure that meanders in latitude and longitude from one season to the next. Clockwise wind circulation around the high sets up steering currents for hurricanes. Changes in position of the high in latitude and longitude will change the steering currents from year to year, and also determine how much Sahara Desert sand is blown off of Africa.

The variables discussed in the paragraphs above are very important when it comes to predicting what will happen during upcoming hurricane seasons. But the major variable has not been discussed yet, the one that is the primary mechanism that puts all these variables in place for a given season, and what changes these variables from one season to the next.

GWO has pioneered in identifying the Primary Forcing Mechanism (PFM) that controls the Earth's Natural Climate Pulse, which in turn influences the average location of the Bermuda High and the formation or non-formation of the ENSO El Niño and La Niña. The Climate Pulse is associated with many climate cycles, and GWO has noted a direct correlation of the Climate Pulse Cycles to periods of higher or lower tropical activity, such as the low activity in 2013, 2014 and during the El Niño of 2015. GWO has also correlated historical hurricane landfalls to the Climate Pulse Cycles to perfect highly accurate hurricane landfall models for 11 prediction zones along the coastal areas of the United States from New England to northern Mexico.

2.0 2016 Hurricane Season Review

As predicted by GWO, this was the first above-normal season since 2012 – and the most destructive and expensive in 10 years. The Atlantic saw 15 named storms during 2016, including 7 hurricanes (Alex, Earl, Gaston, Hermine, Matthew, Nicole, and Otto), 3 of which were major hurricanes (Gaston, Matthew and Nicole). GWO's preseason prediction called for an above normal season with 17 named storms, 9 hurricanes and 4 major hurricanes – very close to what did occur in 2016.

More importantly – GWO predicted there would be a Category 1 hurricane in the Upper Gulf zone (Hurricane Hermine) and a Coastal Hugger (Hurricane Mathew) likely from Florida to the Carolina's, and in addition a total of 4 to 5 named storms would make landfall in the United States.

The GWO Climate Pulse Tracking Model Hurricane indicates that Hurricane Mathew (2016) occurred on the same type of cycle that caused Hurricane David in early September of 1979. David was also a coastal hugger along the Florida coast and then made a direct landfall near the South Carolina – North Carolina borders.

Five named storms made landfall in the United States during 2016, the most since 2008 when six storms struck. Tropical Storm Bonnie and Hurricane Matthew struck South Carolina. Tropical Storms Colin and Julia, as well as Hurricane Hermine, made landfall in Florida. Hermine was the first hurricane to make landfall in Florida since Wilma in 2005. Several Atlantic storms made landfall outside of the United States during 2016: Tropical Storm Danielle in Mexico, Hurricane Earl in Belize, Hurricane Matthew in Haiti, Cuba, and the Bahamas, and Hurricane Otto in Nicaragua.

The strongest and longest-lived storm of the season was Matthew, which reached maximum sustained surface winds of 160 miles per hour and lasted as a major hurricane for eight days from September 30 to October 7th. Matthew was the first category 5 hurricane in the Atlantic basin since Felix in 2007. Matthew intensified into a major hurricane on September 30 over the Caribbean Sea, making it the first major hurricane in that region since Poloma in 2008. It made landfall as a category 4 major hurricane in Haiti, Cuba and the Bahamas, causing extensive damage and loss of life. It then made landfall on Oct. 8 as a category 1 hurricane in the U.S. near McClellanville, South Carolina.

Matthew caused storm surge and beach erosion from Florida through North Carolina, and produced more than 10 inches of rain resulting in extensive freshwater flooding over much of the eastern Carolinas. The storm was responsible for the greatest U.S. loss of life due to inland flooding from a tropical system since torrential rains from Hurricane Floyd caused widespread and historic flooding in eastern North Carolina in 1999.

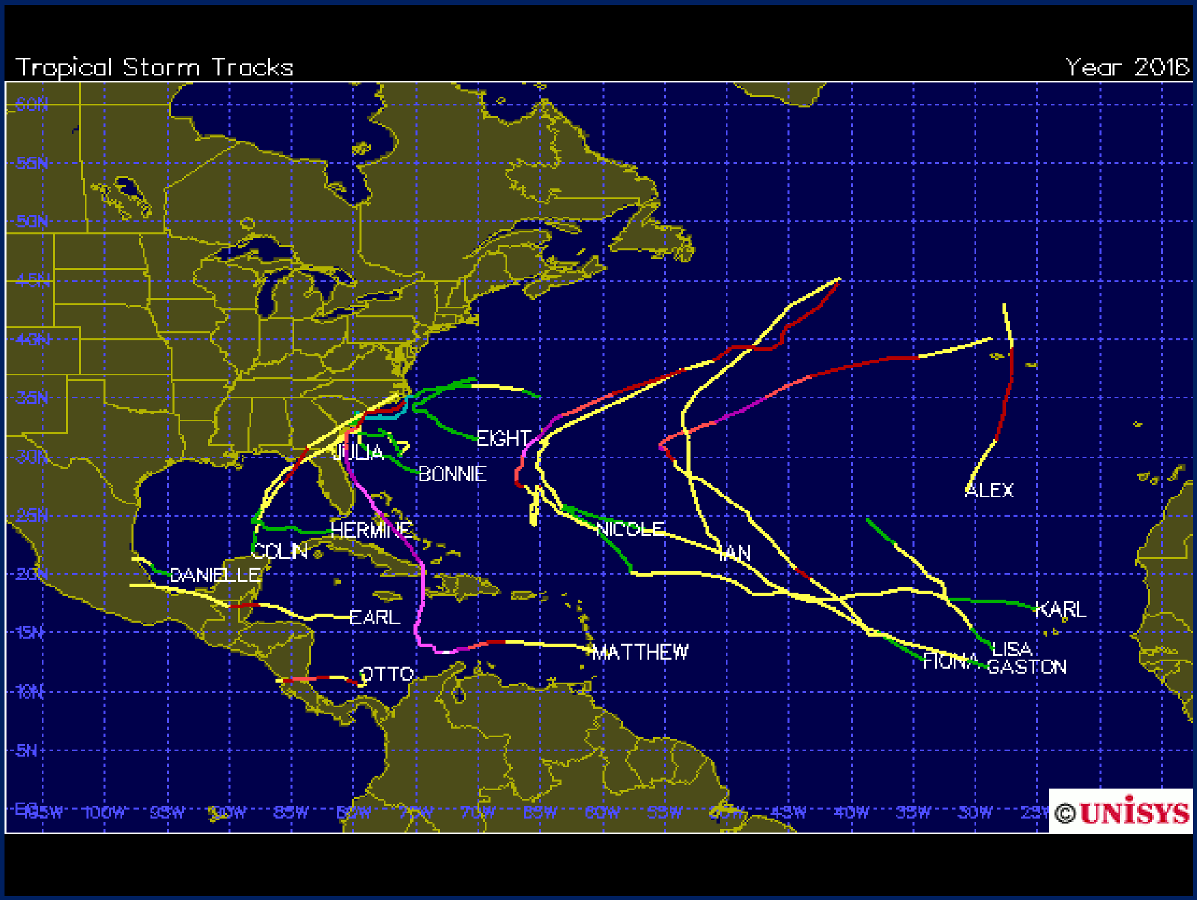


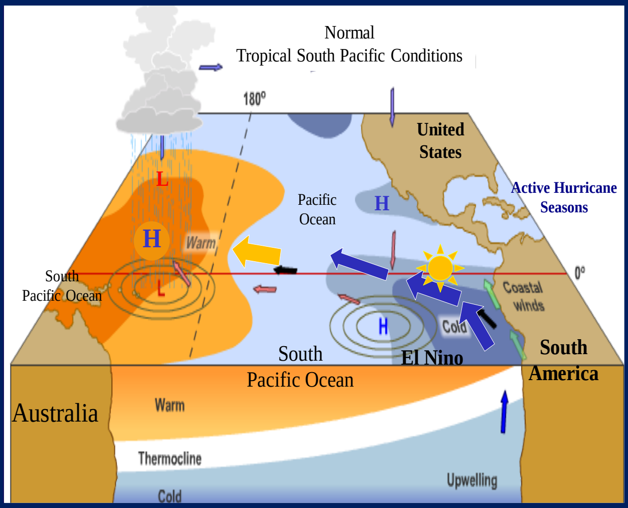
Figure 2.1 - Shows the 2016 tracks for named storms (hurricanes and tropical storms). There were 15 named storms, 7 hurricanes and 3 major hurricanes. Category 3 Hurricane Mathew hugged the Florida coast as it moved northward and finally made landfall on October 8 as a category 1 hurricane near McClellanville, South Carolina. Weak Category 1 Hurricane Hermine made landfall near the big bend of the Florida Panhandle.

3.0 GWO 2017 Prediction - El Niño, La Niña or Neutral

Overview - El Niño, La Niña and Neutral Conditions:

The occurrence or non occurrence of a moderate to strong El Niño often displays a major influence on the Atlantic Basin hurricane season. The El Niño Southern Oscillations (ESNO) has three phases; El Niño, La Niña and the ENSO Neutral phase defined as a period in which neither an El Niño or La Niña is present.

The typical Neutral phase (see Figure 3.1) displays a strong area of atmospheric high pressure in the eastern Tropical Pacific, and very cold ocean temperatures from South America westward into the Central Pacific, and a very warm pool of water in the western Pacific. This pattern is conducive for strong hurricane seasons in the Atlantic Basin from the Caribbean eastward across the Atlantic.



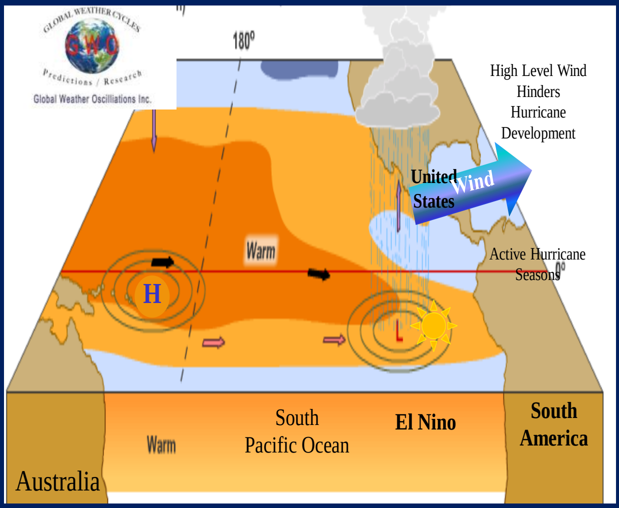


Figure 3.1 - Shows typical Tropical Pacific sea surface temperatures observed during what is called "Neutral El Niño Southern Oscillation" conditions.

Figure 3.2 - Shows Tropical Pacific sea surface temperatures observed during El Niño Southern Oscillation" conditions (ENSO). Notice the warm water in the Eastern Pacific.

The La Niña phase is much like the ENSO Neutral phase, with the exception that it has much colder water in the tropical eastern Pacific. This typically does not produce fewer hurricanes in the Pacific Basin, but may change atmospheric steering currents enough in inhibit hurricane and/or tropical storm landfalls along the United States coastal areas.

About every 3 to 5 years the Earth's Natural Climate Pulse induces dramatic changes in the atmosphere and oceans. Suddenly the area of High Pressure over the Eastern Pacific becomes displaced well to the west and north. This causes a rapid change in the atmospheric circulation and essentially discontinues the pooling of warm water in the western Pacific. With these changes, much warmer water moves east all the way across the central Pacific to South America (see Figure 3.2). The warmer water causes atmospheric low pressure to form off of South America, and dramatic changes in the atmospheric circulation to the north across much of North America.

This rapid and dramatic change in the atmospheric circulation is of great importance to the Atlantic Basin hurricane season. As seen in Figure 3.2 (blue arrow) strong high altitude westerly winds form in the atmosphere across the Caribbean and much of the Atlantic as well. These winds are usually very disruptive to the hurricane season by causing higher than normal upper atmospheric wind shear. This shear inhibits explosive development of tropical storms and hurricanes and thus a reduction in the number of hurricanes and named storms.

Developing tropical cyclones that would normally become a Category 3 hurricane, may only development into a category 1 hurricane due to El Niño wind shear that tends to tear apart the developing storms. On the same note, a potential category 1 or 2 hurricane may be hindered enough by El Niño wind shear to only develop into a tropical storm. As an example of years with an El Niño and without an El Niño: during the 2009 El Niño season, only 3 hurricanes and 8 named storms formed, but during the 3 seasons from 2010 through 2012 when Neutral and/or La Nina conditions occurred, each season had 19 named storms. The El Niño season of 2015 had 11 named storms (near normal), 4 hurricanes and 2 major hurricanes. The number of hurricanes and major hurricanes were slightly below the long-term average due to the El Niño.

2010 Through 2016 Seasons: El Niño and Climate Pulse Hurricane Suppression Cycles

Referring to the graph in Figure 3.3 on the next page; GWO was the only organization to correctly predict that the 2009 hurricane season “would” have an El Niño, and that the 2010, 2011, 2012, 2013 and 2014 seasons would “not” have an El Niño. GWO was also the only organization to predict that 2013 and 2014 hurricane seasons would be weaker than normal, with this not being due to an El Niño, but rather by what GWO refers to as a cyclical Climate Pulse Hurricane Suppression Cycle (CPHSC).

The CPHSC is a cyclical 2-year cycle that returns approximately every 4 to 7 years and is often associated with El Niño events, but if it occurs without an El Niño it normally causes abnormally strong wind shear and diminished hurricane seasons much like an El Nino does. For example; although an El Niño did not occur in 2013 , persistent winds shear caused by the CPHSC suppression cycle caused the weakest hurricane season since the 2009 El Niño, and the 5th weakest season in 60 years. Then the second year of the CPHSC cycle caused a relatively weak (but near normal) number of hurricanes and major hurricanes in 2014, and no El Niño occurred.

Cycles of the ENSO (El Nino Southern Oscillation)

An El Niño typically forms every 3 to 5 years, on occasion it takes an 8-year hiatus. The last two El Niño events occurred back in 2009 and in 2015, a separation of 6 years. Every El Niño event is typically followed by what is termed ENSO (El Niño Southern Oscillation) Neutral Conditions, which are conditions that are neither El Niño nor La Niña. The El Niño events typically form in the eastern Tropical Pacific when ocean waters warm to about 1 degree Celsius above the long-term average. Figure 3.3 shows the dramatic warming with the 2009 El Niño, followed by dramatic sea surface cooling that in turn caused a La Nina to occur from the summer of 2010 through 2011. The Tropical Eastern South Pacific Ocean again warmed in 2012, 2013 and 2014 – but not enough or long enough to cause and El Niño to form. These warming events maintained what is called ENSO Neutral Conditions (defined as a period in which neither an El Niño nor La Niña is present).

Status of the ENSO (El Nino Southern Oscillation) as of February 2017
Refer to GWO’s web site for current ENSO status – updated weekly

As seen in Figure 3.3, the Tropical Pacific sea surface temperatures in the Niña 3.4 region in the Eastern Pacific were much colder than normal in December 2016, thus signaling that a Weak La Nina was occurring in late December of 2016, but it ended in early February 2017 as it transitioned to ENSO Neutral Conditions by February 2017.

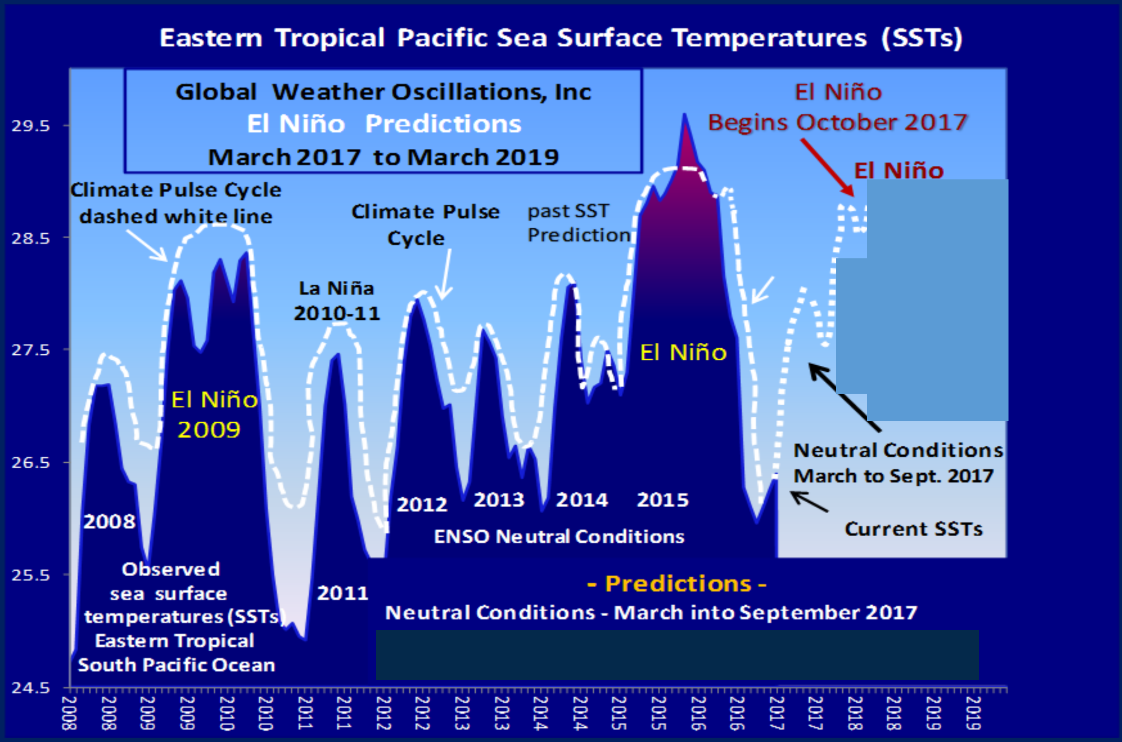


Figure 3.3 - Shows Tropical Eastern South Pacific sea surface temperatures (blue area) from 2008 through 2016. Note the very warm ocean temperatures during the 2009 El Niño Southern Oscillation. The dashed white line is the power of the Climate Pulse Model from 2008 into October 2017. The dashed blue line on the right is the GWO prediction for the Nino 3.4 Region in the Eastern Tropical Pacific where El Nino events typically form. Notice that GWO is predicting the Pacific to warm during the 2017 Hurricane Season – ENSO Neutral Conditions transitioning to El Niño around mid-September to October 2017.

ENSO Prediction for the 2017 Hurricane Season: prepared by GWO

El Niño – La Niña – Neutral Conditions

GWO is predicting that ENSO Neutral Conditions will continue through the summer of the 2017 Hurricane Season- then transition to El Niño conditions around mid-September to October 2017. GWO does not expect the formation to be earlier enough to disrupt the 2017 hurricane season. Neutral Conditions and approaching El Nino conditions occurred during the active 2008, 2009 and 2016 hurricane seasons. Neutral Conditions are favorable for another active hurricane season.

The ENSO Neutral and La Niña Conditions are typically favorable for an active hurricane season if there is not a Climate Pulse Hurricane Suppression Cycle in place, such as in 2013 and 2014.

5.0 Predictions for Specific Coastal Zones - for hurricane or tropical storm conditions occurring somewhere within the zone

GWO Prediction Model and Climatology:

In the sections that follow, GWO presents annual risk probability predictions for 11 United States zones for the period covering the next 4 Atlantic Hurricane seasons. The zones extend from New England on the northeast Atlantic Coast southwest to Texas on the Gulf of Mexico Coast. Although each zone has an identical format, 11 different prediction zones are required due to weather and climate cycles controlled by earth's natural climate pulse. This is because every zone is located at a different latitude and longitude, and each zone has its own unique hurricane cycle with hurricane tracks and landfalls changing from one year to the next in conjunction with the Climate Pulse Cycles.

GWO's unique predictions are based on GWO's Climate Pulse Technology Model (GWO-CPTM). The CPT model incorporates the natural Primary Forcing Mechanism (PFM) that controls cycles of the Earth's climate pulse and other variables to produce reliable zone predictions for future events during the next 4-years.

GWO has computed at least 100 years of historical tropical cyclone climatology for each zone to produce the Climatological Average Annual Return Risk (CAAR) for tropical cyclone events. This allows the reader to compare the GWO predicted risk probabilities for either a hurricane or tropical storm, to the long-term average annual return risk (CAAR) for the zone. This puts the GWO predictions and outlooks in perspective to what has occurred in the past.

Risk Prediction Definitions:

Global Weather Oscillations (GWO) "Climate Pulse Technology" Model (GWO-CPT) assigns a risk probability expressed in percent for the likelihood that a predicted event will occur.

The upper value is 65% to 80% and denotes a high risk that the predicted event is expected to occur. The low end of the scale is 5% to 40% and denotes a predicted low risk the event will occur. GWO also issues risk predictions for major hurricanes. If a hurricane does occur in the zone that year, the upper value that it will be a major hurricane is 50% to 70% and denotes a high risk that a major hurricane event will occur.

The GWO-CPTM predicted risk is compared to the CAAR (average - annual return risk) to the right of the prediction in the prediction table. This provides a reference point for the user to quickly compare the prediction risk for that specific year to the long-term average annual risk.

5.7

Zone 7 - Extreme South Florida Peninsula - South of a line from Miami to Marco Island

Predicted Hurricane and Tropical Storm Risks – by GWO

Year: 2017

Climatology

Based on 111 years of record (1903-2013) for either hurricane conditions occurring somewhere within the zone during that year, or if no hurricane, a year with tropical storm conditions occurring somewhere within the zone.

During the 111 year period, there were 58 tropical cyclone years in which either hurricane or tropical storm conditions affected at least a portion of the zone (52% annual risk). Of the 58 years, there were 30 years in which hurricane conditions occurred somewhere within the zone, with a total of 38 hurricanes due to years with multiple strikes. Of the 38 hurricanes, 20 were major category 3 to 5 hurricanes. Tropical storm conditions (without hurricane conditions in the zone during the year) occurred on 28 years with a total of 47 tropical storms due to years with multiple strikes and/or in years that hurricanes also occurred.

Based on the long term average, the climatological average annual risk frequency (CAAR) is for 2 to 3 hurricanes years every 10-years, and 2 to 3 tropical storm years during a 10 year period. But the averages can be misleading in that some 10 year periods are quite active, and other 4 to 8 year periods are very inactive with little or no tropical cyclones within the zone. GWO's Climate Pulse Technology Model (GWO-CPTM) identifies these cycles and incorporates them into the predicted risks.

Average Annual Risk:

A total of 58 years had tropical cyclones during the 111 year period, and a total of 77 tropical cyclones due to some years having multiple events.

Climatological average annual risk (CAAR) for Hurricane and/or Tropical Storm Conditions	= 52 %
Climatological average annual risk (CAAR) for Tropical Storm "only" conditions	= 25 %
Climatological average annual risk (CAAR) for hurricane conditions	= 27 %
Climatological average annual risk (CAAR) for major hurricane (CAT 3 or greater)	= 18 %
Percent of hurricanes that were major hurricanes (CAT 3 or greater)	= 53 %

The GWO-CPTM predicted risk is compared to the CAAR (climatological average annual risk) to the right of the prediction in the prediction table below. This provides a reference point for the user to quickly compare the prediction risk for that specific year to the long-term average annual risk. The color red is assigned when there is a high risk that the predicted event will occur. The high risk category ranges from 60% to 80% and indicates GWO expects the event is likely to occur.

Definitions: Risk Prediction Categories

Global Weather Oscillations (GWO) assigns a risk category and probability expressed in percent for the likelihood that a predicted event will occur, or not occur.
Risk percent ranges define three categories of risk; Low, Moderate and High.

Hurricanes - Tropical Storms:

Category	Probability	Prospect
High Risk	60% to 80%	will likely occur
Moderate Risk	40% to 55%	possible – but not likely
Low risk	5% to 35%	will not occur

Major Hurricane: If a hurricane actually occurs – risk it will be a major hurricane

Category	Probability	
High Risk	50% to 70%	(if a hurricane occurs)
Moderate Risk	25% to 45%	(if a hurricane occurs)
Low Risk	less than 25%	(if a hurricane occurs)

Zone 7 Predictions for 2017

		Predicted Risk	Average Annual Risk
2017	Hurricane conditions	65 % High	27 %
	Major Hurricane - if a hurricane occurs	60 % High	53 %
	Tropical Storm conditions	75 % High	52 %

* When GWO-CPT model predicts a zone has at least a 20% risk for a major Category 3-5 hurricane landfall, it is shown in the indicated forecast and/or outlook period(s) for that particular zone.

Analysis and Summary

This Zone is Now in the Most Dangerous Hurricane Cycle in 65 Years

The annual return risk (ARR) for hurricane conditions in this zone is 27 percent. This means an average of 1 hurricane occurs approximately every 4 years. But, this zone has not experienced a hurricane landfall or hurricane conditions since the very active 2004 and 2005 seasons, a period going back 12 years from this year (2017).

GWO is tracking 10 quiet periods since the 1870s in which no hurricanes occurred in this zone. Of the 10 quiet periods, only two periods lasted more than 10 years. One was a 12-year span from 1967 through 1978. The other is the current 11-year span from 2006 through 2016, making this the second longest quiet period during the past 145 years. Quiet periods on the average last only 4 to 9 years.

Predictions:
GWO predicts the current quiet period will finally end during the 2017 season as this zone enters the strongest and most active hurricane cycle since the period from 1945 to 1950 (65 to 70 years ago). During this 6-year active period from 1945 to 1950, five out of the 6 years had hurricanes, and some years had multiple landfalls. There were a total of 8 hurricanes during this 6 year period, and 6 of the 8 hurricanes were major Category 3 to 5 hurricanes.

The GWO-Climate Pulse Model is tracking 4 historical analog years which are like the upcoming 2017 season. The 4 analog years had a total of 6 hurricanes making landfall in this zone. Three of the 6 landfalls were Major hurricanes, with 2 of them being strong Category 4 hurricanes. There were also two category 3 hurricanes – and only one hurricane was a Category 1.

The analog years listed below indicate that when a hurricane strikes - there is about a 75 percent likelihood it will be a Category 2 or greater, and a 65 percent likelihood it will be a major Category 3 or greater. GWO is assigning a high risk for hurricane conditions in 2017.

Historical Climate Pulse Analog Years Most Similar to the 2017 Season:

In 1999 a Category 1 Hurricane Irene moved from southwest to northeast up the Keys to near Miami in mid-October.

In 1964 this zone was hit by two hurricanes.
The first was the Category 2 Hurricane Cleo that moved northward from Cuba and over the entire Florida east coast from August 27th and 28th.

In 1964 The second was Category 3 Isbell crossing South Florida from the southwest to northeast - exiting near Homestead and Miami on October 25th.

In 1950 Category 4 Hurricane King moved north making landfall near Homestead on October 18th then weakened rapidly to a Category 1 as it moved north over Orlando, Ocala and Gainesville – becoming a Tropical Storm in south central Georgia.

In 1928 a Category 2 hurricane moved from southeast to northwest making landfall between Miami and Cape Canaveral early in August, possibly causing hurricane conditions in the extreme north portion of this zone.

A second hurricane – a Major Category 4 made landfall near Miami in mid- September.

In 1924 A Category 3 hurricane made landfall near Marco Island (which is on the border of this zone and the zone to the south) on October 22nd and then moved east as a category 1 to just south of Miami.

In 1910 a Category 4 made a loop near the western tip of Cuba and then moved northeast across the outer Keys to near Tampa and then weakened to a Category 1 as it moved northeast (up now Interstate 75) and further weakening to a tropical storm near Ocala Florida in mid-October.

Bottom Line: This zone has entered the most active and dangerous cycle in 65 to 70 years. About 70% of the hurricanes that strike this zone are Major Hurricanes – and GWO expects hurricane and tropical storm conditions in this zone during the 2017 season, and there is a high risk for multiple landfalls.

Disclaimer for Tropical Cyclone, Tropical Storm and Hurricane Risk Probabilities for the East Coast and Gulf Coast of the United States for 2014*

OFFICIAL SOURCES (US GOVERNMENT NATIONAL HURRICANE CENTER - NHC) SHOULD BE CONSIIDERED BEFORE ANY PLANS ARE MADE REGARDING IN-PROGRESS TROPICAL STORMS OR HURRICANES. THE LINK TO THE NHC IS http://www.nhc.noaa.gov/

*Standard type of disclaimer for the meteorological services industry