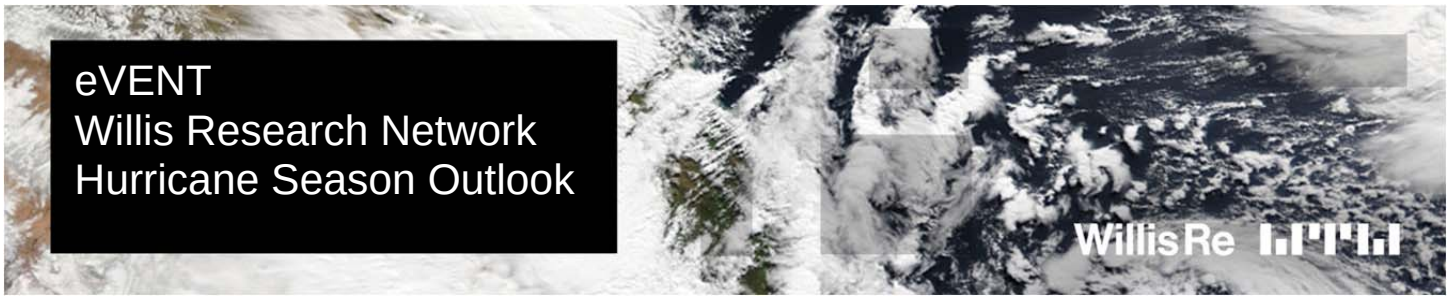

2019 Atlantic Hurricane Season Outlook: June 6, 2019

This seasonal forecast briefing is the first in this season's series to be released as new information becomes available. In this briefing, we provide an initial overview of how the season appears to be shaping up.

Current situation

The 2019 North Atlantic hurricane season started ahead of schedule, with Subtropical Storm Andrea. Andrea was weak and short-lived, remaining out over the open North Atlantic during its short life-span. However, Andrea marks the fifth consecutive year with a storm forming ahead of the official hurricane season start date of June 1. There are currently no tropical disturbances to keep an eye on, but as the Atlantic Ocean follows its annual warming trend into the summer, what levels of hurricane activity can we expect?

Forecasts

Available forecasts from the major forecasting centers call for a quieter season than last year, but still range from average to slightly above average hurricane activity for 2019 (**Table 1**). The forecast numbers of named storms across the major forecasting centers are confined to a fairly narrow range from 12 to 14.5 with an average of 13.6 (compared to an historical average of 12). For hurricanes, the numbers also fall within a narrow range from 6 to 7 with an average of 6.2 (compared to an historical average number of 6.4), and for major hurricanes (Saffir-Simpson category 3-5) they range from 2 to 3 (compared with an historical average of 2.7). The rather narrow ranges appear to be a result of a large amount of agreement on the predicted environmental conditions for 2019. However, as discussed later, there still remains substantial uncertainty and forecast agreement does not necessarily imply forecast accuracy.

The National Oceanic and Atmospheric Administration (NOAA)'s prediction for near-normal activity is based on a balance of competing hurricane drivers. An expected continuation of the current El Niño is balanced by an expectation for continued warmer-than-normal North Atlantic Ocean temperatures. Tropical Storm Risk (TSR) caution that their forecast for near-normal conditions contains some uncertainty due to uncertainty in the progression of El Niño through the hurricane season. In their early June forecast, Colorado State University (CSU) raised their expectations above their early April forecast. This is based on their increased confidence for a weakening El Niño through the hurricane season and additional anomalous Spring warming having occurred in the North Atlantic Ocean. Despite these forecasts for near-normal activity, wunderground.com cautions that 2004 - one of the most active U.S. landfalling seasons - was also preceded by weak El Niño conditions.

Table 1. Summary of 2019 Atlantic Seasonal Hurricane Forecasts

Data Source	Date Issued	# Named Storms (% of normal)	# Hurricanes (% of normal)	# Major Hurricanes (% of normal)	ACE[1] (% of normal)
1981-2010 average (*Source CSU*)		12.1	6.4	2.7	106
Average of 5 analog years (*Source CSU*)	June 4, 2019	14.0 (116%)	6.0 (94%)	2.0 (74%)	100 (94%)
Colorado State University[2]	June 4, 2019	14.0 (116%)	6.0 (94%)	2.0 (74%)	100 (94%)
NOAA/CPC[3]	May 23, 2019	12.0 (99%)	6.0 (94%)	3.0 (111%)	109 (103%)
Tropical Storm Risk[3]	May 30, 2019	12.0 (99%)	6.0 (94%)	2.0 (74%)	88 (83%)
The Weather Company	May 6, 2019	14.0 (116%)	7.0 (109%)	3.0 (111%)	n/a
North Carolina State University[3]	Apr 16, 2019	14.5 (120%)	6.0 (94%)	2.5 (93%)	n/a
Average of the all of the above		13.4 (111%)	6.2 (96%)	2.4 (90%)	99 (94%)

Analog years

An alternative view to forecast models is provided by hurricane activity in past years that had similar pre-season climate conditions and forecast conditions to this year. CSU uses this approach to qualitatively correct the output from their empirical forecast technique. CSU's selected analog years — 1990, 1991, 2012, 2014 and 2018 — are characterized by weak El Niño conditions and near-average North Atlantic sea surface temperatures for the peak of the hurricane season. The average activity among these 5 analog years is shown in the above table and indicates about average numbers of named storms, hurricanes and major hurricanes, the same as their official forecast.

Climate signals: sea surface temperatures

The formation and development of hurricanes is highly dependent on the available energy in the upper layers of the ocean. This is why ocean temperatures are often used as a proxy for available energy as a major factor in determining seasonal activity. This year, waters across the deep tropical North Atlantic are currently slightly cooler than usual (**Figure 1**). However, NOAA expects this cool anomaly to disappear for the peak of the hurricane season.

Waters in the Gulf of Mexico and off the U.S. East Coast are currently much warmer than normal. Should this anomalous warmth persist it would promote the development and maintenance of 'homegrown' hurricanes close to the U.S. coast. If this occurs it would be a continuation of a shift of activity away from the remote deep tropics and closer to the U.S.

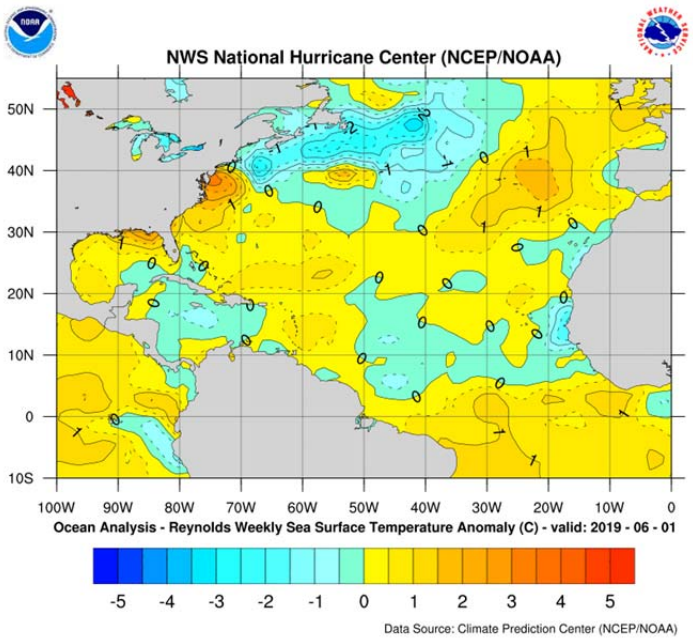

Figure 1. Departure of weekly average sea surface temperature from a long-term average (°C) on June 1 2019.

Source: https://www.nhc.noaa.gov/tafb/atl_anom.gif: NCEP/NOAA

[1] Accumulated Cyclone Energy (ACE) is a combined measure of hurricane intensity, duration and frequency. ACE is calculated as the sum of the square of the maximum wind speed in each 6-hour period during the life of a tropical cyclone from the time it reaches tropical storm strength (wind speeds ≥ 65 kmph (39 mph)) in units of 10^4; ACE = $10^{-4}\sum v^2 max$, where v is measured in knots.

[2] The CSU forecast includes named storm Andrea.

[3] NOAA/CPC, TSR and NCSU forecast likely ranges rather than single values. The values presented here are the middle of the forecasted ranges.

Climate signals: El Niño?

The cooling and warming of the equatorial Pacific associated with El Niño Southern Oscillation (ENSO) exerts the strongest known control on Atlantic hurricane activity by driving an overturning of the tropical atmosphere; air rises over warm waters and sinks over cool waters.

A weak El Niño emerged in late 2018 and persists today. There is some uncertainty whether this weak El Niño will endure into the peak of the hurricane season, or whether ENSO will slide into warm-neutral conditions. The latest forecasts are about evenly split on these two scenarios, with a slight preference for continued weak El Niño conditions (**Figure 2**).

Continued El Niño will damp down hurricane activity by driving strong winds across the Caribbean and the tropical North Atlantic. However, El Niño generally has less influence over the Gulf of Mexico and off the U.S. East Coast where the warmer-than-normal waters may provide a breeding ground for these homegrown storms.

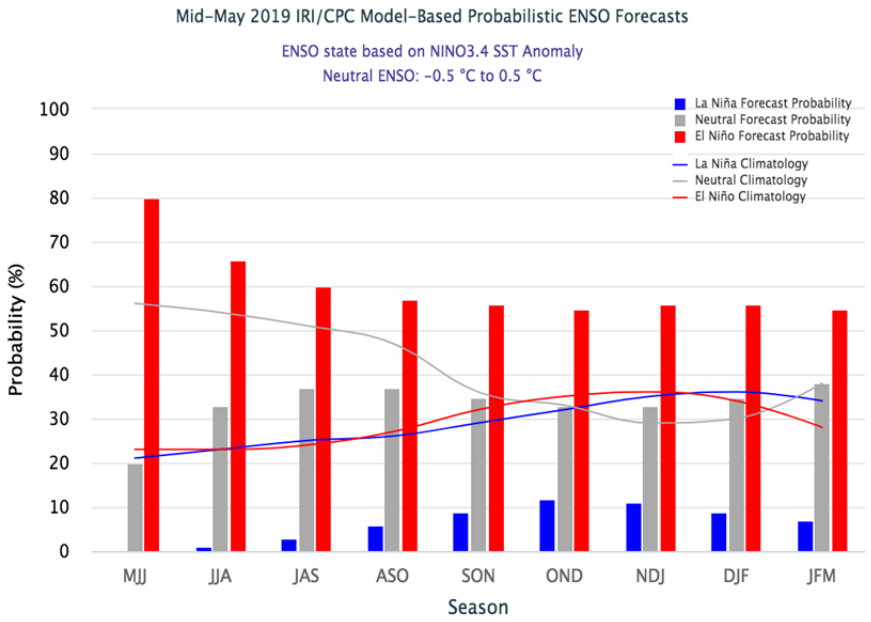

Figure 2. The official CPC/IRI ENSO probability forecast, based on a consensus of forecasters using human judgment and model output.

Source: International Research Institute for Climate and Society. Published May 20, 2019

New Experimental Landfall Forecasts for the Gulf of Mexico and Florida

Forecasting U.S. landfall is still an emerging science with much to learn about the drivers of hurricane landfall. The challenge arises from the small number of historical events and the complex and highly sensitive interactions between storm formation, track and coastal orientation that result in landfall.

The Willis Research Network has developed a new experimental landfall forecast product. This collaboration between the National Center for Atmospheric Research and Willis Re is being tested for the first time this year and points to increased likelihood of above average landfall activity for the Gulf Coast and Florida for 2019.

Our approach uses the predicted daily weather patterns to infer landfalling tropical cyclone activity. These weather patterns are similar to weather maps seen in weather forecasts. They promote or inhibit landfall through their large-scale wind patterns and also though surface pressure patterns that can sustain or weaken hurricane activity. Throughout the hurricane season we tend to see repeating daily weather patterns. The more a favorable weather pattern repeats, the higher the likelihood of a hurricane landfall. ENSO enters our forecasts through its control on the frequency of occurrence of these weather patterns.

Our model predicted landfall rates compare favorably with historical observations (not shown), with a useful and statistically significant correlation. Further details of the method and validation will be presented in a forthcoming publication.

For the 2019 forecast, daily weather patterns are taken from an ensemble of dynamical model forecasts issued by NOAA. **Figure 3** shows the 2019 forecast distribution of named storm landfall anomalies compared to an historical distribution. The forecast distribution is shifted to the right of the historical distribution, indicating increased likelihood of above normal Gulf Coast and Florida landfall activity for 2019. The forecast high activity is due to a prediction of higher-than-normal number of days of favorable weather patterns.

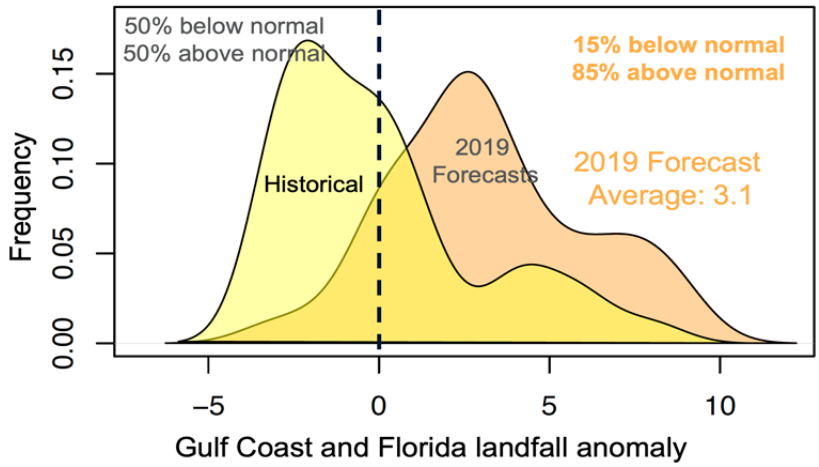

Figure 3. Named storm landfall anomaly for the Gulf Coast and Florida. The historical distribution is shown in yellow and the forecast distribution for 2019 is shown in orange.

Confidence

The forecasts issued this early in the year tend to be relatively poor (all seasonal forecasts should be read with caution), yet they generally outperform the standard benchmark of the so-called “persistence” forecast (a forecast of average activity every year) and therefore provide useful guidance on likely scenarios. The reasons for the general low confidence of actual numbers in these early forecasts are primarily uncertainty in the progression of ENSO, the timing and magnitude of potential intra-seasonal variability, and also the range in the hurricane response to these conditions.

Summary

The latest forecasts for the 2019 hurricane season point to a quieter season than last year, but still point towards near normal or slightly above normal activity. The main uncertainties are whether El Niño will persist and whether today’s warmer-than-normal waters in the Gulf of Mexico and off the US East Coast will continue. We also note that while forecasts for the North Atlantic are near-normal, forecasts for the East Pacific strongly point towards a very active season. This would continue the run of active hurricane seasons for the region of Hawaii.

Next briefing and additional advice

This briefing will be updated late-June to include the latest round of seasonal forecasts. These forecasts are likely to offer increased confidence as the predicted El Niño or neutral condition comes into focus. Further comments are provide in our 2019 Hurricane Season Webinar recording, available here – to view the recording, you will need to enter the password WRe2019.

The Willis Re Analytics Team will report on all tropical storms and hurricanes in the North Atlantic and the Gulf of Mexico. This includes briefings and updates to our clients during hurricane events. These will contain the latest information from the National Hurricane Center, commentary on likely tracks and intensities and, when available, updates and modeling guidance from the catastrophe modeling companies.

Forecast information sources

Klotzbach, P. J., Bell, M. M. and J. Jones: "Extended Range Forecast of Atlantic Seasonal Hurricane Activity and Landfall Strike Probability for 2019", June 4, 2019, Department of Atmospheric Science, Colorado State University, Fort Collins CO, U.S.

Saunders, M. and A. Lea: "Pre-Season Forecast for North Atlantic Hurricane Activity in 2019", May 30, 2019, Department of Space and Climate Physics, University College London, London, U.K.

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