Climate Forecast Applications Network (CFAN)

Overview of the 2019 Atlantic Hurricane Season and Forecast Verification

November 26, 2019

Summary

A brief review of the 2019 hurricane season is provided here, with an assessment of CFAN's forecasts issued in November 2018 and updates in March, May and August of 2019. The table below provides a summary of CFAN's forecasts, relative to observations.

	ACE	#HR	# US landfalls
Observed	**130**	**6**	**2**
Fcst: 11/18	163 (±37)	7.7 (±1.8)	3 (±1)
Fcst: 3/19	126 (±31)	6.2 (±1.5)	2 (±1)
Fcst: 5/19	167 (±42)	8 (±2.1)	1 (±1)
Fcst: 8/19	150 (±40)	8 (±3)	2 (±1)
Avg: 95-17	132	7.5	1.7
Avg: 80-17	107	6.5	1.5

The observations for the 2019 indicate that CFAN's November, May and August forecasts for ACE and # of hurricanes were too high, although within the expected range given statistical forecast uncertainty. CFAN's March forecast was close to the observed activity.

Season overview

The National Hurricane Center defines an 'above normal' (active) hurricane season as having a seasonal ACE value exceeding 111, with at least two of the following three conditions: 13 or more named storms, 7 or more hurricanes, and 3 or more major hurricanes. 2019 met the conditions of an 'above normal' season with ACE of 130, 18 named storms and 3 major hurricanes (Dorian, Humberto, Lorenzo). 2019 tied as the fourth most active season on record in terms of the number of named storms, although many of these were weak and short lived. 2019 was one of seven seasons to feature multiple Category 5 hurricanes (Dorian, Lorenzo).

In terms of impacts, the 2019 Atlantic hurricane season will primarily be remembered for Hurricane Dorian, which devastated the northwestern Bahamas at Category 5 intensity before making landfall near Cape Hatteras, North Carolina as a Category 1 hurricane. Tropical Storm Imelda deluged southeast Texas with tremendous amounts of rainfall.

In general, pre-season Atlantic hurricane forecasts called for slightly below average activity, based primarily on expectations of an El Nino. Some forecast agencies increased their forecasts during Jun/Aug. CFAN was one of several organizations predicting above normal activity for 2019.

Discussion of CFAN's seasonal forecasts for 2019

CFAN began making seasonal forecasts of Atlantic hurricane activity in May, 2017. The basis for our seasonal forecasts is a statistical method an innovative data mining approach guided by climate dynamics analysis. A different forecast model is developed each year to account for the most recent data. Further, a different forecast model is used for each lead time, to account for different windows of predictability that open up over the annual cycle. Our methodology is the subject of ongoing research, with improved insights (and hopefully improved skill) for each successive year.

A primary basis for our forecast issued in November 2018 was a strong pattern in the stratosphere that was comparable to recent years with high hurricane activity. Upper tropospheric patterns were also consistent with several recent years with high hurricane activity. At the time, we regarded these signals as providing relatively high confidence in our forecast, although we recognize that any long-lead forecast needs to be regarded as having substantial uncertainty that is not always easily quantifiable.

In March 2019, CFAN issued an ENSO forecast that expected El Nino conditions to wane in early summer, with a transition to El Nino Modoki conditions during the peak of the hurricane season. This forecast turned out to be correct, while most other forecast teams were expecting El Nino conditions to continue.

CFAN's seasonal hurricane forecast in late March 2019 identified conflicting signals from the stratosphere and the troposphere, reducing the level of forecast activity and the overall confidence in our March forecast of ACE and # of hurricanes. Landfall predictors, which rely more on lower tropospheric and surface predictors, were more confident during the March forecast.

CFAN's seasonal hurricane forecast in late May 2019 returned to the high levels of activity predicted in the November 2019 forecast, suggested by positive anomalies of Arctic sea level pressure and geopotential heights and physically consistent anomalies of Arctic westerly winds. Northern Hemisphere and Global sea level pressure anomaly patterns of in April-May 2019 bore a generally strong resemblance to those in April-May 2017, which were followed by a very active 2017 hurricane season.

By the end of June, typically there are pretty strong signals for number of U.S. landfalls, and regionally for Florida. However, for June 2019 these signals did not emerge, and we

deferred our next and final forecast until mid August. By mid August, the El Nino Modoki pattern was established in the Pacific, along with above normal sea surface temperatures in the Caribbean, Gulf of Mexico and tropical Atlantic. Favorable stratospheric patterns continued to indicate an active hurricane season.

The 2019 hurricane season finished lower than expected in part due unusual persistence of anomalous warmth in the extratropical NE Pacific that appears to have counteracted the cool SST anomalies south of the equator, which typically enhance hurricane activity from the eastern tropical Pacific.

Another feature that influenced the2019 Atlantic hurricanes season was an unusually persistent and strongly positive Indian Ocean Dipole (IOD) feature. While the IOD features prominently in the variability of the Asian monsoon rainfall, Australian droughts, and tropical cyclones in the North Indian Ocean, it doesn't usually impact Atlantic hurricanes. During the peak of the hurricane season, the IOD interfered with the expected pattern of the Madden Julian Oscillation (MJO). The MJO pattern begins in the Indian Ocean and propagates eastward through the Pacific and eventually into the Atlantic. As the MJO moves east, it can influence tropical cyclone activity in both the eastern Pacific and Atlantic basins. When the enhanced phase of the MJO enters the Gulf of Mexico or Atlantic, tropical activity is typically increased for a period of up to two weeks. Major hurricanes are five times more likely to develop in a favorable MJO phase, and hurricane formation is four times more likely. Since the MJO pattern was perturbed by the IOD, the expected 'kick' from the MJO didn't materialize during the peak period of the season.