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2020 Hurricane Season Prediction for Trinidad and Tobago's Area of Interest for Tropical Cyclone Activity

Forecast

The Trinidad and Tobago Meteorological Service (TTMS) is predicting above-normal tropical cyclone (TC) activity in the Area of Interest (AoI) for Trinidad and Tobago, during the 2020 hurricane season, June to November. The AoI is the waters to the east of Trinidad and Tobago, spanning the area south of 15^{o} north latitude, between the Eastern Caribbean and West Africa.

Area of Interest for Trinidad and Tobago

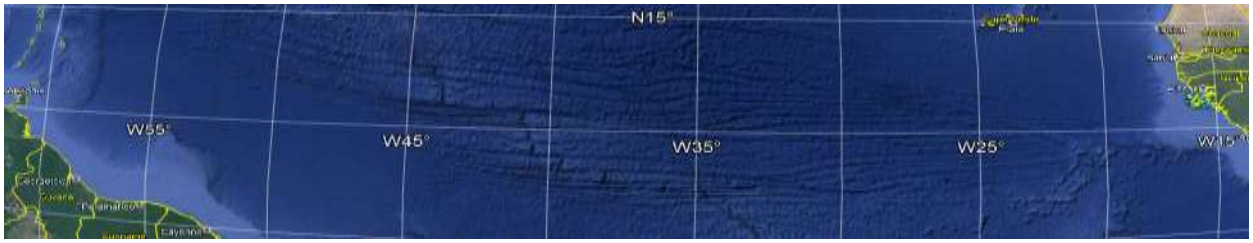
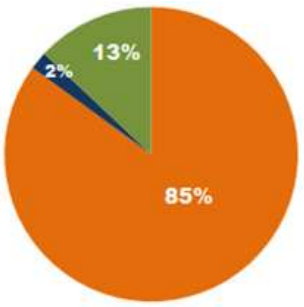


Figure 1. Area of Interest (AoI) for Trinidad and Tobago for tropical cyclone activities.

The TTMS seasonal hurricane forecast shows an 85% chance for above-normal, a 13% chance for near-normal and a 2% chance for below-normal tropical cyclone activity in the area of interest for Trinidad and Tobago.

The TTMS is predicting that the most likely number of named tropical storms (winds of at least 34 knots / 39 mph) to occur in the Area of Interest during the June to November period is 6, with an 85% chance that the number will be in the range of 4 to 8 named storms. The 1981-2010 long-term average for the AoI is 3. The most likely number of hurricanes (winds of at least 64 knots / 74 mph) predicted to occur in the AoI during the June to November period is 2, with an 85% chance that the number will be in the range of 1 to 3. The 1981-2010 long-term average is 1.

TTMS 2020 Hurricane Season Outlook for Area of Interest for T&T



Above-normal
Below-normal
Near-normal

Most Likely Number of Named Storms	Likely Range of Named Storms
6	4 to 8
Most Likely Number of Hurricanes	**Likely Range of Hurricanes**
2	1 to 3

Figure 2. The 2020 AoI hurricane season probability and number of named storms (TTMS).

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Confidence in the forecast

The TTMS is 76% confident that based on the existing and forecast environmental conditions, the forecast for an above normal season will occur.

The skilfulness of the forecast can be seen in the Relative Operating Characteristic (ROC) curve (see figure 3) bowing to the top left corner of the plot, which demonstrates that the hit rates exceeded the false alarm rates, considerably, during the model hindcasts (i.e. model hurricane season forecasts over a 56 year period 1964-2019, over the Area of Interest for Trinidad and Tobago).

The hit-rate versus the false-alarm rate curve or the ROC curve is used to measure the skill of the forecasts. It shows that in past seasons with sea surface temperature (SST) patterns similar to the existing April 2020 pattern, the model used by the TTMS was able to forecast above normal seasons 76% of the times prior to above normal seasons being later observed; while the model was able to forecast below normal 86% of the times, prior to below normal seasons being later observed.

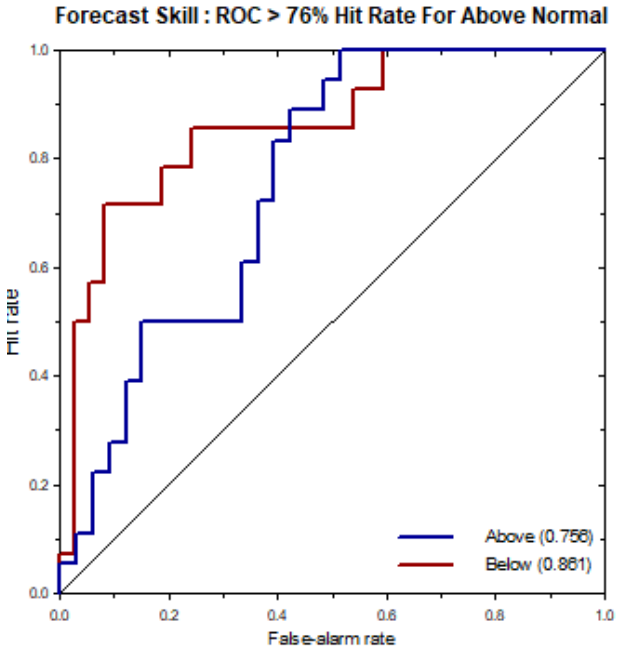

Figure 3. Shows the Relative Operating Characteristic curve verification of a set of hurricane season hindcasts (here, model hurricane season forecasts over a 56 year period 1964-2019), over the Area of Interest for Trinidad and Tobago for the period 1964 to 2019.

Forecast Background

Since 2013, the Trinidad and Tobago Meteorological Service has been issuing seasonal forecasts for Trinidad and Tobago's AoI for tropical cyclone activity. The AoI is that area spanning south of 15^{o} north latitude, between the eastern Caribbean and West Africa, within the North Atlantic Hurricane basin. The AoI was chosen based on the following: Only tropical cyclones forming within this area have been known to directly or indirectly threaten Trinidad and Tobago.

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Characterising Seasonal Activity & Climatology

The season's classification is determined from the median and terciles based on the number of named tropical storms forming in the AoI for the 30-year climate normal period 1981-2010, which is the period during which satellite observation of tropical storms allows for more accurate historical records.

The seasonal tropical cyclone activity is characterised as follows:

- The median number of tropical storm/hurricanes for the AoI 1981-2010 is 3 named tropical cyclones.
- An above-normal season (above the 66th percentile): 4 or more named storms in the area of interest.
- A below-normal season (equal or below the 33rd percentile): 2 or fewer named storms in the area of interest.
- Near-normal season: (equal to the median or > 33% to < = 66th percentile): 3 named storms in the area of interest.
- The maximum number of named tropical storms in one year during the 1981-2010 climate normal is eight (8), which occurred in 2010.

Forecast Methodology

The TTMS seasonal tropical cyclone activity predictions for the AoI for Trinidad and Tobago are based on:

(1) Canonical Correlation Analysis and Principal Component Analysis to predict the number of storms based on sea surface temperatures in oceanic regions which are known to have strong correlations with tropical cyclone activity in the Area of interest.

(2) Analogue years. The ten (10) best analogue years based on SST gradients for April 2020 were: 1952, 1959, 1970, 1977, 1978, 1980, 1988, 1995, 2003, 2005, and 2007.

The TTMS's methodology considered three primary climate drivers in the form of SST gradients which are known to be responsible for annual tropical cyclone variability in the North Atlantic Ocean. The three SST drivers of TC's are the El Niño-Southern Oscillation (ENSO), which is the known primary cause of variability in TC activity in the Area of Interest for Trinidad and Tobago; the SSTs during March and April in the waters surrounding Trinidad and Tobago, which is that portion of the extension of the North Atlantic Warm Pool to the east and southeast of Trinidad and Tobago; and, the SSTs gradients within the Atlantic Meridional Mode (AMM), which is north/south gradient in SSTs near the location of the mean Inter-Tropical Convergence Zone. In arriving at the forecast, SST data for March and April 30, 2020 were used.

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The main reasons for the above-normal forecast are:

(1) ENSO-neutral warm condition in the form of above average SSTs in the tropical Pacific Ocean is predicted to decline with the likelihood of transition to La Niña conditions by the peak of the hurricane season (August to October). This means that upper level westerly wind speeds are likely to be near average to weaker than average over the AoI; and subsequently, the vertical wind shear in the AoI will likely decrease and be relatively weak. Transition to La Niña conditions are also likely to decrease upper-level temperatures in the AoI region, and this can increase the instability in the atmosphere, thereby enhancing deep convection and TC development and intensification.

(2) SST gradient in the portion of the Atlantic Warm Pool (AWP) which extends in waters just to the east and southeast of Trinidad and Tobago are currently at 28.0^{o}C and warmer than usual by 0.5^{o}C. This portion of the AWP is forecasted to extend further east and strengthen. When this portion of the AWP strengthens and extends, the subtropical high to the northeast is weakened somewhat, thus reducing the strength of the Caribbean low-level jet in the vicinity of Trinidad and Tobago. At the same time, heating from an extended AWP also drives a reduction in upper-level westerlies, thus reducing vertical wind shear throughout the AoI. Also associated with an extended AWP are lower sea level pressures and enhanced convection, which imply a more favourable dynamic and thermodynamic environment for TC formation in the AoI. Overall, warmer than usual waters to the east of Trinidad and Tobago often translates into lighter than usual trade winds and lower vertical wind shear in the region– both very conducive for above normal TC activities in the AoI for Trinidad and Tobago.

(3) The third SST gradient which is likely to influence TC activity is the influence of a positive Atlantic Meridional Mode (AMM). The AMM is trending towards its positive phase. A positive AMM is typically associated with warmer-than-normal SSTs in the tropical Atlantic north of the equator and cooler-than-normal SSTs in the tropical Atlantic south of the equator. This SST arrangement corresponds to a sea level pressure gradient that reduces the trade wind strength in the AoI which forms a coupled loop which preserves the warm SST anomaly. A positive-phased AMM also enhances low-level convergence and low-level vorticity.

An area of uncertainty for the current outlook is the rate at which the current cooling in tropical Pacific is likely to evolve. La Niña favours above-normal storm activities. At this time La Niña only has a 30% chance of developing and this could be a negating climate factor for the upcoming season, as current atmospheric conditions in the Tropical Pacific suggest neutral-warm ENSO conditions. Given, the competing climatic factors, confidence in the outlook is somewhat reduced but strong enough to hold out for an above-normal season in the Area of Interest.