GUY CARPENTER

2019 Western North Pacific Basin Tropical Cyclone Predictions

The Guy Carpenter Asia-Pacific Climate Impact Centre (GCACIC) at the School of Energy and Environment, City University of Hong Kong, has released its 2019 predictions for tropical cyclone formations and landfalls using a regional climate model focusing on East Asia. This model uses information from a global climate prediction model made available in April 2019.

Consistent with that of a typical weak El Niño year, the number of tropical cyclones predicted to form between May 1 and October 31 is near normal. Consequently, the number of tropical cyclone landfalls is also expected to be near- to below-normal in all regions of East Asia.

Highlights of findings:

- The number of tropical cyclone formations predicted for the six-month period from May 1 to October 31 is approximately 18, which is close to the 1977-2018 six-month average of 16.
- Of the 18 formations predicted, fewer than eight will make landfall, which is below the 1977-2018 average of approximately 11.

Landfall predictions by region are shown in Table 1.

TABLE 1: **Historical and Predicted Averages of Tropical Cyclone Landfalls from May to October**

Location	1977-2018 Average	GCACIC Regional Climate Model Forecast, 2019
Japan and Korea	5.2	Below Average
Eastern China and Taiwan	3.8	Below Average
South China	4.3	Near Average
Vietnam and the Philippines	3.2	Near Average

Source: GCACIC

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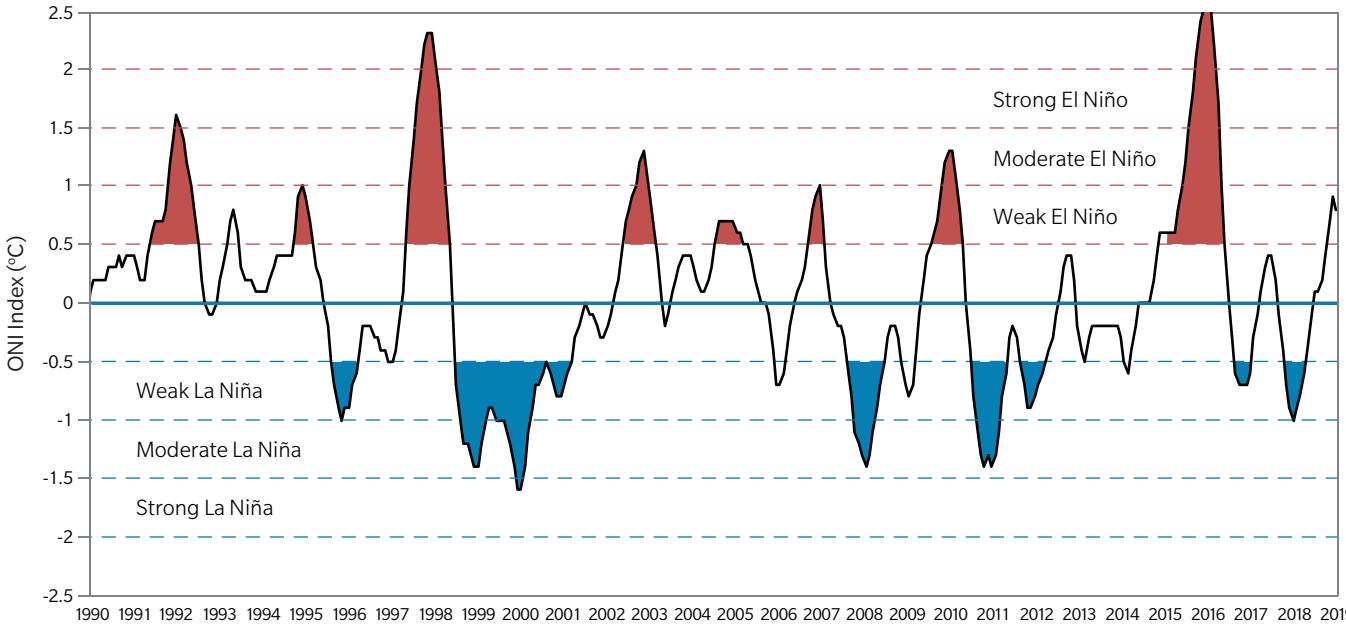
Currently, weak El Niño conditions are present with above-average sea surface temperatures (SSTs) across the central and eastern equatorial Pacific along with patterns of anomalous upper-ocean heat and winds consistent with El Niño. Since June 2018, the Pacific Ocean has experienced near- to above-average SSTs and in February 2019 these positive SST anomalies further strengthened. The U.S. National Oceanic and Atmospheric Administration (NOAA) predicts that the weak El Niño conditions will continue (Figure 1) through the first half of 2019.

There are many dynamical and statistical models used for El Niño–Southern Oscillation (ENSO) predictions. Many of these models predict the Oceanic Niño Index (ONI), which is based on SSTs that diverge from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing and predicting ENSO. ONI is defined as the three-month running mean SST anomalies in the Niño region 3.4 that correspond to latitudes of 5°N-5°S and longitudes of 120°W-170°W. ONI is expected to remain in the 0°C to +1.5°C range, corresponding to weak-to-moderate El Niño conditions for several months during mid-2019. After this period, there is considerable forecast uncertainty due to the lower prediction capabilities for forecasts made at this time of year.

FIGURE 1. **Oceanic Niño Index (ONI)**



Source: NOAA

Based on tropical cyclone data from the Regional Specialized Meteorological Centre (RSMC) Tokyo-Typhoon Center, Table 2 displays the number of landfalls during weak El Niño years (1987, 1997, 2004, 2009 and 2018) compared with the long-term average from 1977-2018. The number of landfalls is compared for tropical cyclones of 34 knots and higher.

Based on the five weak El Niño years, the average number of tropical cyclone landfalls predicted to make landfall is below-normal for the entire region. For each sub-region, the average number of tropical cyclone landfalls is predicted to be near-normal for Japan and Korea and below-normal for all other regions.

TABLE 2: **Historical Averages of Tropical Cyclone Landfalls from May to October for 1977 to 2018; Weak El Niño Years (1987, 1997, 2004, 2009 and 2018)**

Number of Tropical Cyclone Landfalls				
Region	**1977-2018 Average**	**1987, 1997, 2004, 2009 and 2018 Average**	**Difference**	**% Difference**
Japan and Korea	5.2	5.3	0.1	2.6%
Eastern China and Taiwan	3.8	2.5	-1.3	-34.2%
South China	4.3	2.2	-2.1	-49.6%
Vietnam and the Philippines	3.2	2.0	-1.2	-37.5%
Total	11.1	9.8	-1.3	-11.4%

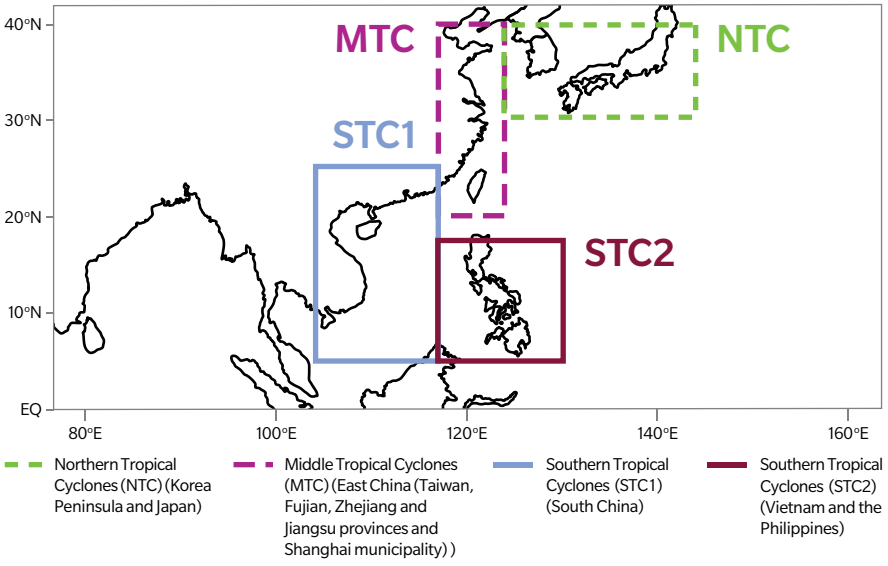
Source: GCACIC

Details of Findings

A 2014 study[1] by Huang and Chan shows it is possible to use a regional climate model to more accurately predict the number of tropical cyclone formations compared to predictions based solely on a global climate model. In this briefing, *RegCM3* refers to the GCACIC's Regional Climate Model, Version 3, while *CFSv2* refers to the global Climate Forecast System, Version 2, from the U.S. National Centers for Environmental Prediction.

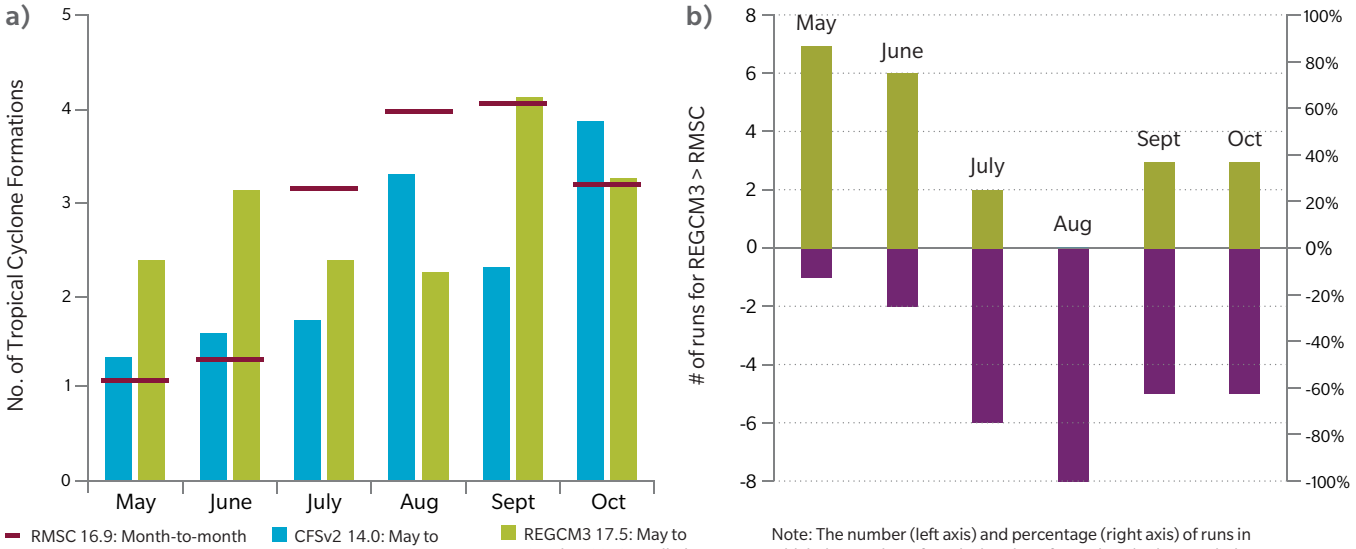
The global Climate Forecast System is used by the RegCM3 as initial and boundary conditions for a dynamic downscaling model to predict the number of tropical cyclone formations and the number of landfalls with a lead time of one to six months. Predictions are for landfall in the four regions shown in Figure 2.

FIGURE 2. **Four Regions in which the Number of Tropical Cyclone Landfalls is Predicted**



The RegCM3 model is run eight times, each using slightly different initial conditions on Apr 1-2, 2019, so that the predicted numbers shown are the average of these eight runs. For the early season from May to June 2019, RegCM3 predicts the monthly number of tropical cyclone formations (Figure 3a) to be well above the climatology, and CFSv2 predicts a near-normal number of formations. For the peak season of July to September, the number of tropical cyclone formations is predicted to be near- to below-normal compared with the climatology. This pattern is also seen in the spread of the eight RegCM3 runs (Figure 3b). The majority of the eight runs for the early season of May and June are above the average number of tropical cyclone formations. For the peak season, there are a below-normal number of formations.

FIGURE 3. **Predictions for May to October 2019 Based on April 1-2, 2019 Initial Conditions**



RMSC 16.9: Month-to-month evolution of the number of tropical cyclone formations obtained from the climatology of the RSMC Tokyo-Typhoon Center from 1977 to 2018 .

CFSv2 14.0: May to October 2019 predictions from global CFSv2.

REGCM3 17.5: May to October 2019 predictions from RegCM3.

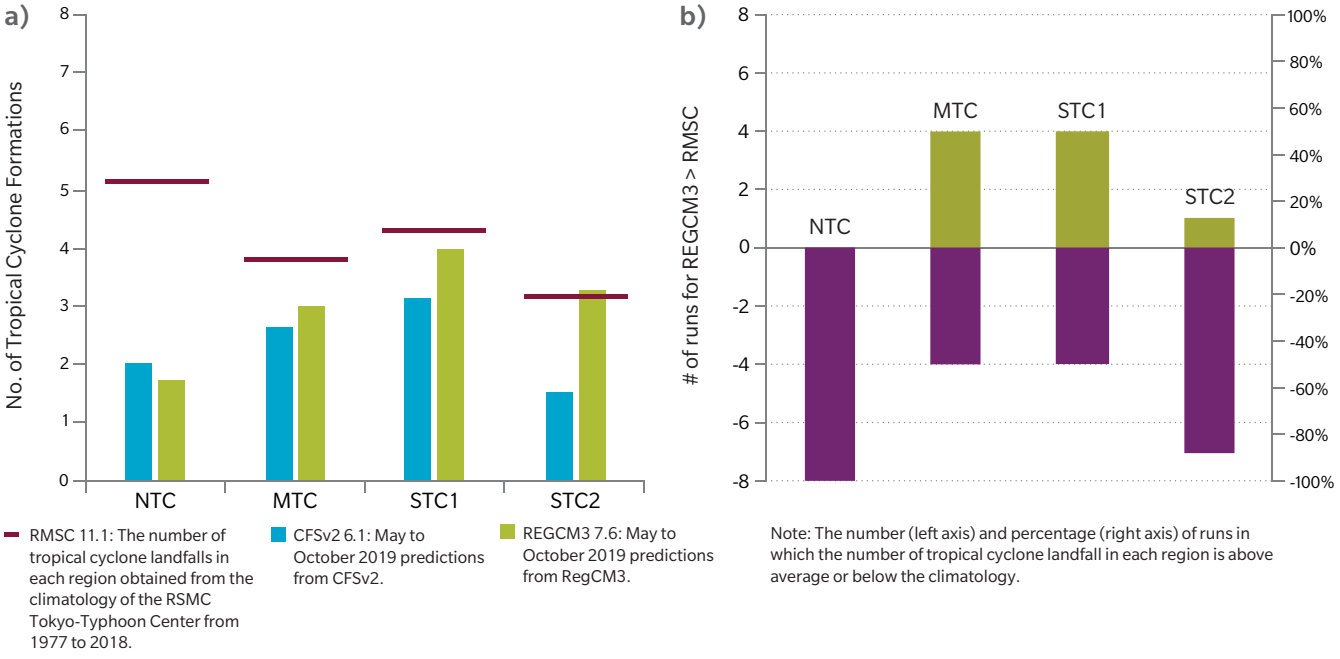
Note: The number (left axis) and percentage (right axis) of runs in which the number of tropical cyclone formations is above or below the climatology.

Source: GCACIC

1. Huang, W.R. and J. C. L. Chan, 2014: Dynamical downscaling forecasts of western North Pacific tropical cyclone genesis and landfall. Climate Dynamics, 42, 2227–2237.

Given the high probability of a below-normal number of tropical cyclone formations in the peak season, it is likely that the number of landfalling tropical cyclones in each of the three East Asia regions will be near- or below-normal (Figure 4a). The average number of landfalling cyclones predicted for the NTC region is well below the RSMC climatology. In addition, 100 percent of the runs for the NTC region and 88 percent of the runs for the STC2 region are below the average number of landfalls. The MTC, STC1 and STC2 region averages are near-normal while 50 percent of the MTC and STC1 regions have below-normal predictions (Figure 4b).

FIGURE 4. **Predictions for May to October 2019 Based on April 1-2, 2019 Initial Conditions**



RMSC 11.1: The number of tropical cyclone landfalls in each region obtained from the climatology of the RSMC Tokyo-Typhoon Center from 1977 to 2018.

CFSv2 6.1: May to October 2019 predictions from CFSv2.

REGCM3 7.6: May to October 2019 predictions from RegCM3.

Note: The number (left axis) and percentage (right axis) of runs in which the number of tropical cyclone landfall in each region is above average or below the climatology.

Source: GCACIC

Summary

Based on the regional climate model, it is expected that the number of tropical cyclone formations in the western North Pacific and the number of tropical cyclone landfalls in all parts of East Asia during the period May to October 2018 will likely be near- to below-normal. This is consistent with a near- to below-normal number of tropical cyclone formations in weak El Niño years.

The regional climate model has been modified and validated for the Australian region and will be run in September-October for the upcoming 2019/2020 Australia cyclone season.

About Guy Carpenter

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