

June 2017

2017 WESTERN NORTH PACIFIC BASIN TROPICAL CYCLONE PREDICTIONS

INTRODUCTION

The Guy Carpenter Asia-Pacific Climate Impact Centre (GCACIC) at the School of Energy and Environment, City University of Hong Kong has released its 2017 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 May 2017.

Consistent with the typical situation in an El Niño / Southern Oscillation (ENSO) neutral year, the number of tropical cyclones between May 1 and October 31 is predicted to be below-normal. Because of this, the number of tropical cyclone landfalls is also expected to be below-normal in all regions of East Asia. Some of the findings are:

- The number of tropical cyclone formations for the six-month period from May 1 to October 31 is around 24, which is slightly below the 1968 through 2015 six-month average of 26.
- Of these, less than 13 will make landfall, which is slightly below the 1968 through 2015 average of approximately 16.
- Landfall predictions by region are shown in Table 1.

T-1 | HISTORICAL AND PREDICTED AVERAGES TROPICAL CYCLONE LANDFALLS FROM MAY TO OCTOBER

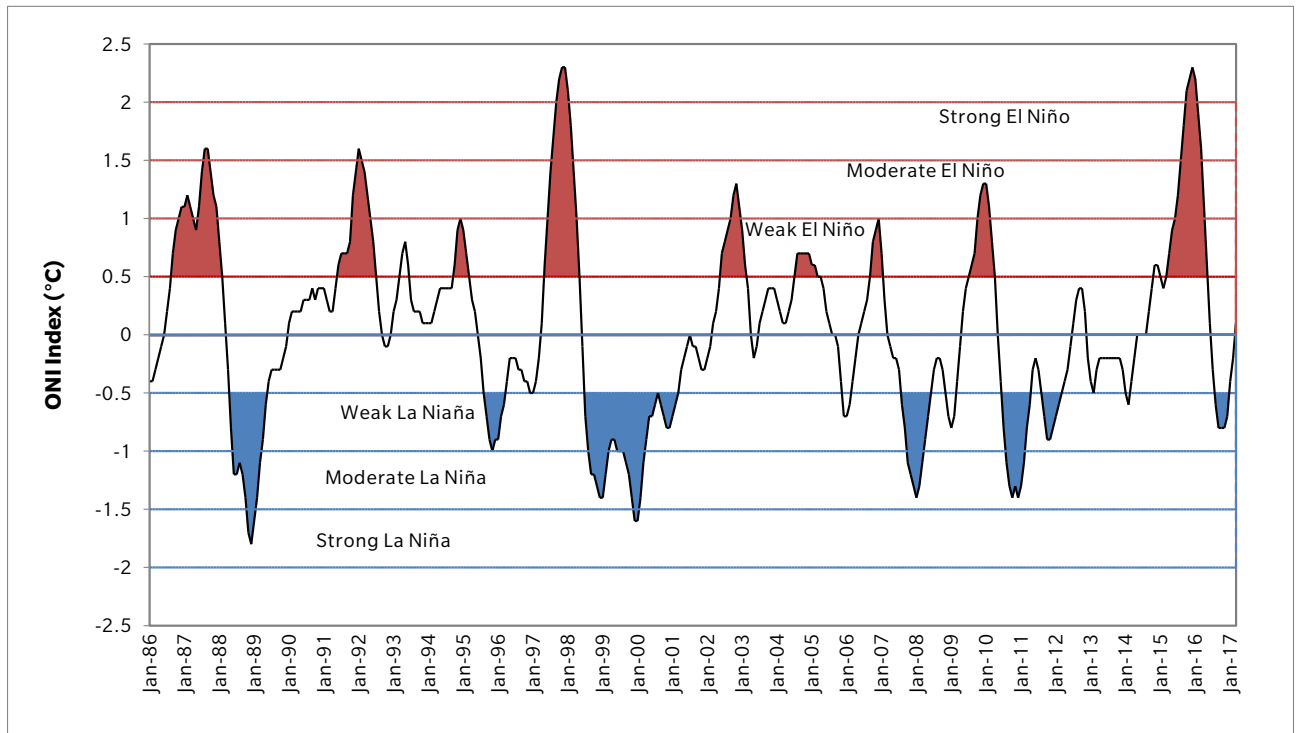
Location	1968-2015 Average	GCACIC Regional Climate Model Forecast, 2017
Japan and Korea	4.9	3.0
Eastern China and Taiwan	3.6	2.6
South China, Vietnam and the Philippines	7.3	7.1

(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

The U.S. National Oceanic and Atmospheric Administration (NOAA) predict the ENSO-neutral conditions (Figure 1) will continue through late 2017, with equally likely chances of ENSO-neutral or El Niño conditions development thereafter. Currently, the ocean and atmosphere system is consistent with ENSO-neutral conditions with near-average sea surface temperatures (SSTs) across the central equatorial Pacific, above-average SSTs in the eastern Pacific and near-average lower-level and upper-level winds over most of the tropical Pacific.

There are many dynamical and statistical models used for ENSO predictions. Many of these models predict the Oceanic Niño Index (ONI), which is the 3-month running mean SST anomalies in the Niño region 3.4 that corresponds to latitudes of 5°N-5°S and longitudes of 120°W-170°W, to approach or exceeding +0.5°C for several months during the Northern Hemisphere summer, suggesting the onset of a weak El Niño. However, the models predict the SST warming may not last long enough to qualify as an El Niño episode, which happens when the duration of above average SST exceeds five months.

F-1 | OCEANIC NIÑO INDEX (ONI)



(Source: NOAA)

Based on tropical cyclone data from the Joint Typhoon Warning Centre (JTWC) using the Saffir-Simpson scale, the number of landfalls during these ENSO-neutral years that follow a La Niña and precede an El Niño event (1986, 1990, 1996, 2001, and 2008) is compared with the long-term average from 1986-2015. The number of landfalls is compared for tropical cyclones of 34 knots and higher.

In South China, during these five transition years, the average number of tropical cyclone landfalls is 12.3 percent above average.

In Japan and Korea, during these five transition years, the average number of tropical cyclone landfalls is 17.8 percent below average.

In Eastern China and Taiwan, during these five transition years, the average number of tropical cyclone landfalls is 13.7 percent below average.

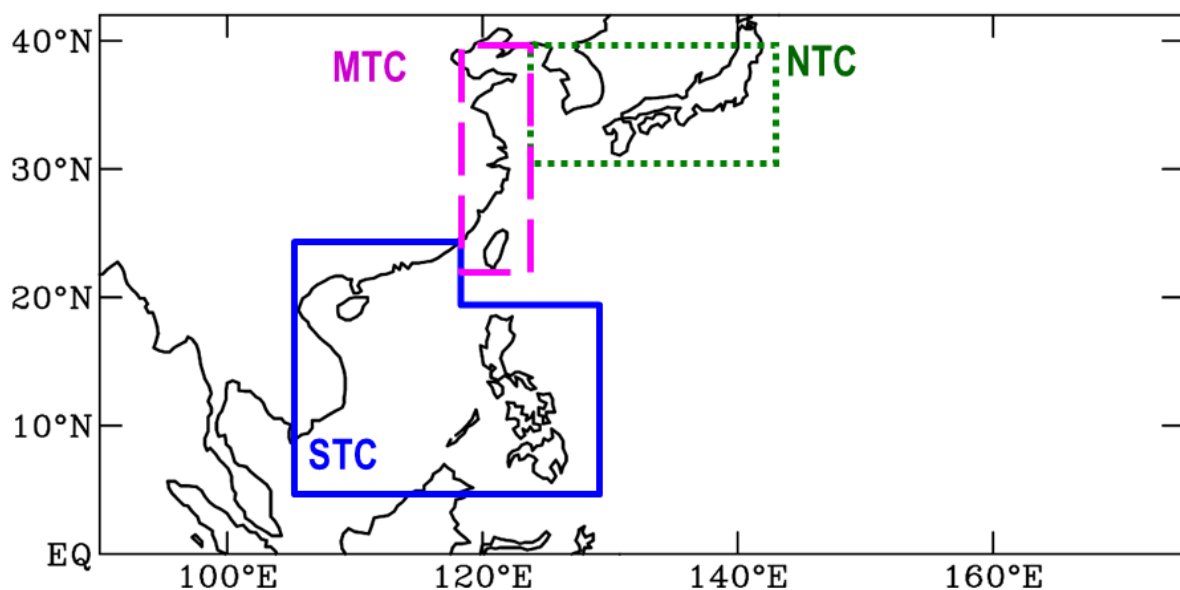
DETAIL OF FINDINGS

A 2014 study¹ 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 is 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 three regions listed below and shown in Figure 2.

- Northern Tropical Cyclones (NTC) – those making landfall in the Korean Peninsula and Japan.
- Middle Tropical Cyclones (MTC) – those making landfall in East China (Taiwan, Fujian, Zhejiang and Jiangsu provinces and Shanghai municipality).
- Southern Tropical Cyclones (STC) – those making landfall in South China, Vietnam and the Philippines.

F-2 | THE THREE REGIONS IN WHICH THE NUMBER OF TROPICAL CYCLONE LANDFALLS IS PREDICTED

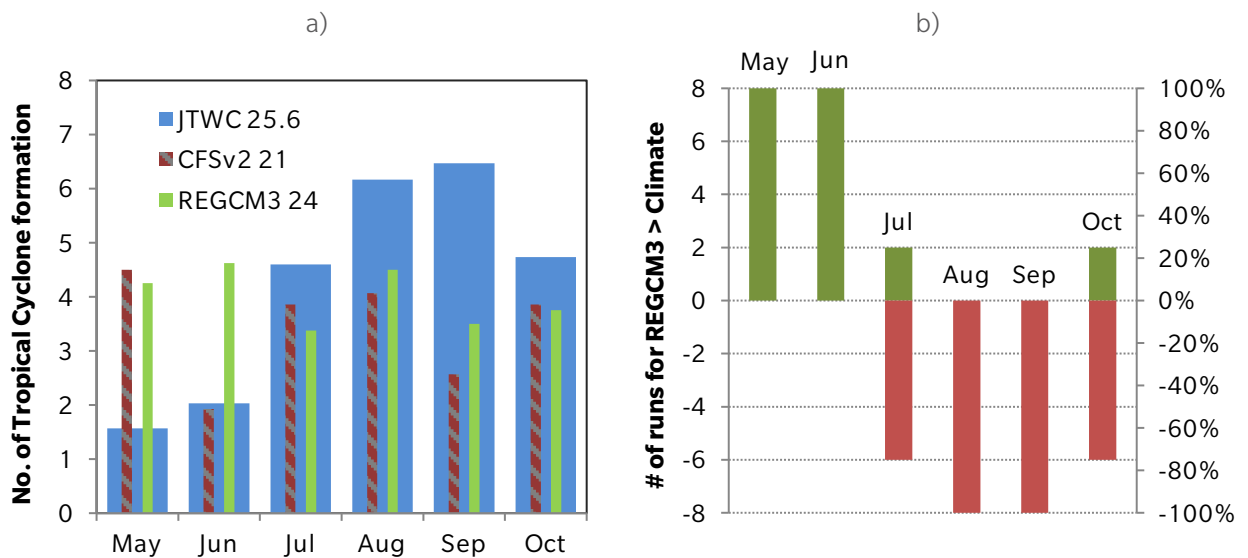


(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

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.

The RegCM3 model is run eight times, each using slightly different initial conditions so that the predicted numbers shown are the average of these eight runs. For May to June 2017, both the CFSv2 and RegCM3 predict the monthly number of tropical cyclone formations (Figure 3a) to be well above the climatology of the Joint Typhoon Warning Center. For the peak season of July to September, the number of tropical cyclone formations is predicted to be less than the climatology. The spread of the eight RegCM3 runs (Figure 3b) indicates that during this peak season, there are a below-average number of formations. For the early season of May and June, there are an above-average number of tropical cyclone formations.

F-3 | PREDICTIONS FOR MAY TO OCTOBER 2017 BASED ON APRIL 1-2, 2017 INITIAL CONDITIONS

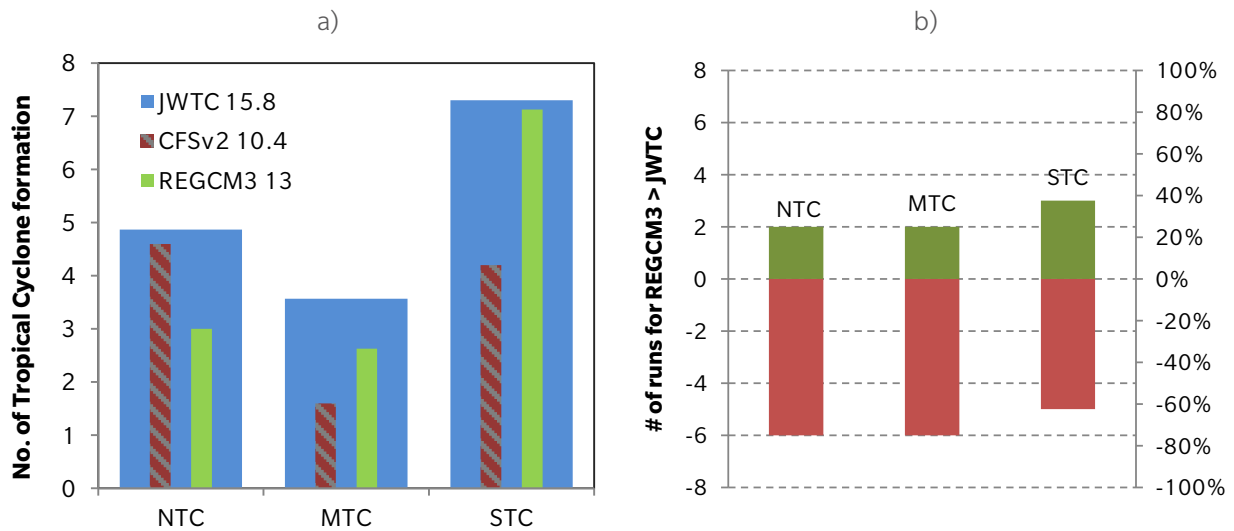


(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

(a) Month-to-month evolution of the number of tropical cyclone formations obtained from the climatology of the Joint Typhoon Warning Center from 1968 to 2015 (blue bar), May to October 2017 predictions from global CFSv2 (red striped line) and those from RegCM3 (green line). (b) The number (left axis) and percentage (right axis) of runs in which the number of tropical cyclone formations is above average or below average.

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 is to be near or below-average (Figure 4a). Indeed, the majority of the eight ReGCM3 runs indicate a below-normal number of landfalls in all three regions (Figure 4b).

F-4 | PREDICTIONS FOR MAY TO OCTOBER 2017 BASED ON APRIL 1-2, 2017 INITIAL CONDITIONS



(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

(a) The number of tropical cyclone landfalls in each region obtained from the climatology of the Joint Typhoon Warning Center from 1968 to 2015 (blue bar), May to October 2017 predictions from CFSv2 (red striped line) and those from RegCM3 (green line). (b) 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 average.

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 cyclones making landfall in all parts of East Asia during the period May to October 2017 will likely be below-normal. This is consistent with a below-normal number of tropical cyclone formations (Liebmann et al. 1994²; Kim et al. 2008³) in an ENSO neutral year coupled with a weak Madden-Julian Oscillation phase that will likely inhibit tropical cyclone formations.

² Liebmann, B., H. H. Hendon, and J. D. Glick, 1994: The relationship between tropical cyclones of the western Pacific and Indian Oceans and the Madden-Julian Oscillation. *J. Meteor. Soc. Japan*, **72**, 401–411.

³ Kim, J., C. Ho, H. Kim, C. Sui, and S. K. Park, 2008: Systematic variation of summertime tropical cyclone activity in the western North Pacific in relation to the Madden-Julian oscillation. *J. Climate*, **21**, 1171–1191.

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