



June 2016

# 2016 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 2016 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 early April 2016.

Consistent with the downward trend in the average number of tropical cyclone formations and the typical situation in a post-El Niño year, the number of tropical cyclones between May 1 and October 31 is predicted to decrease. Because of this, the number of tropical cyclone landfalls is also expected to decrease 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 18, which is below the 2000 through 2010 six-month average of 22.
- Of these, less than 10 will make landfall, which is again below the 2000 through 2010 average of approximately 16.
- Landfall predictions by region are shown in Table 1.

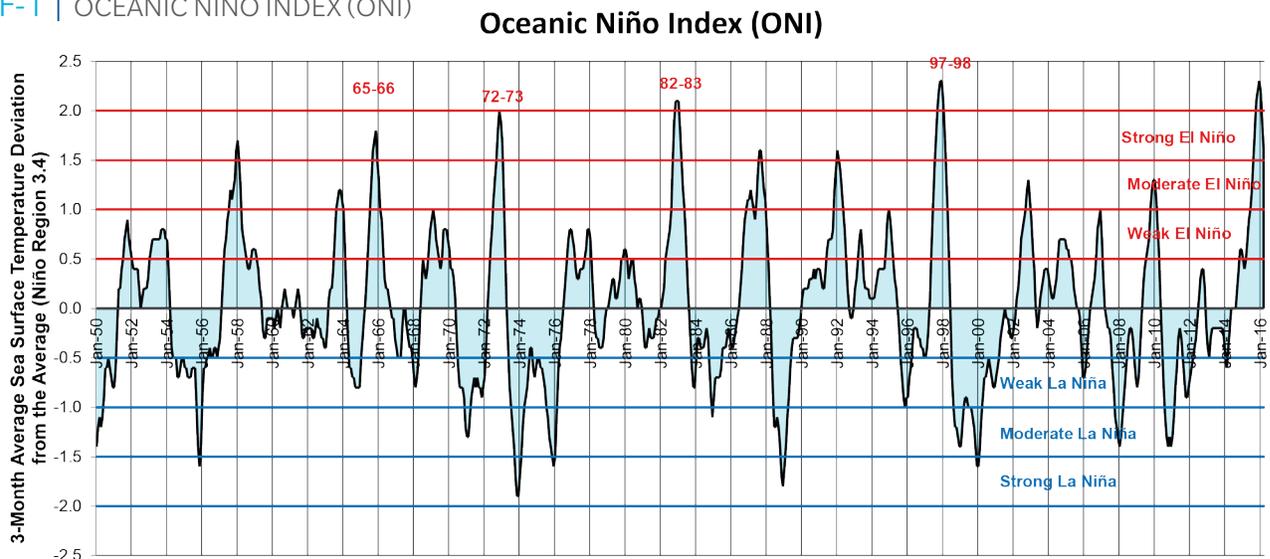
T-1 | HISTORICAL AVERAGES AND PREDICTED TROPICAL CYCLONE LANDFALLS FOR MAY THROUGH OCTOBER

Location	2000-2010 Average	GCAC Regional Climate Model Forecast, 2016
Japan and Korea	4.6	3.3
Eastern China and Taiwan	4.2	2.0
South China, Vietnam and the Philippines	7.4	4.3

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

The U. S. National Oceanic and Atmospheric Administration (NOAA) predicts that the current severe El Niño event will transition into La Niña in the next six months. Since 1950 there have been four similar years – 1966, 1973, 1983 and 1998 – that transitioned from a strong El Niño event to a La Niña event.

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 and their intensity during these transition years is compared with the long-term average from 1945-2014. The number of landfalls is compared for tropical cyclones of Category 1 and higher and severe tropical cyclones of Category 3 and higher.

In China, during these four transition years, the average number of tropical cyclone landfalls is 12.5 percent below average while the number of severe tropical cyclones is higher by 15 percent.

In Japan during these four transition years, the average number of tropical cyclone landfalls is 15 percent below average. For severe tropical cyclones, there have been no landfalls during these four transition years.

In Taiwan, the average number of landfalls is approximately 0.4 per year, or roughly two landfalls every five years. During these four transition years there have been two land-falling tropical cyclones, one of Category 4 and one of Category 5.

## DETAIL OF FINDINGS

A 2014 study<sup>1</sup> by Huang<sup>2</sup> and Chan<sup>3</sup> 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 US 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.

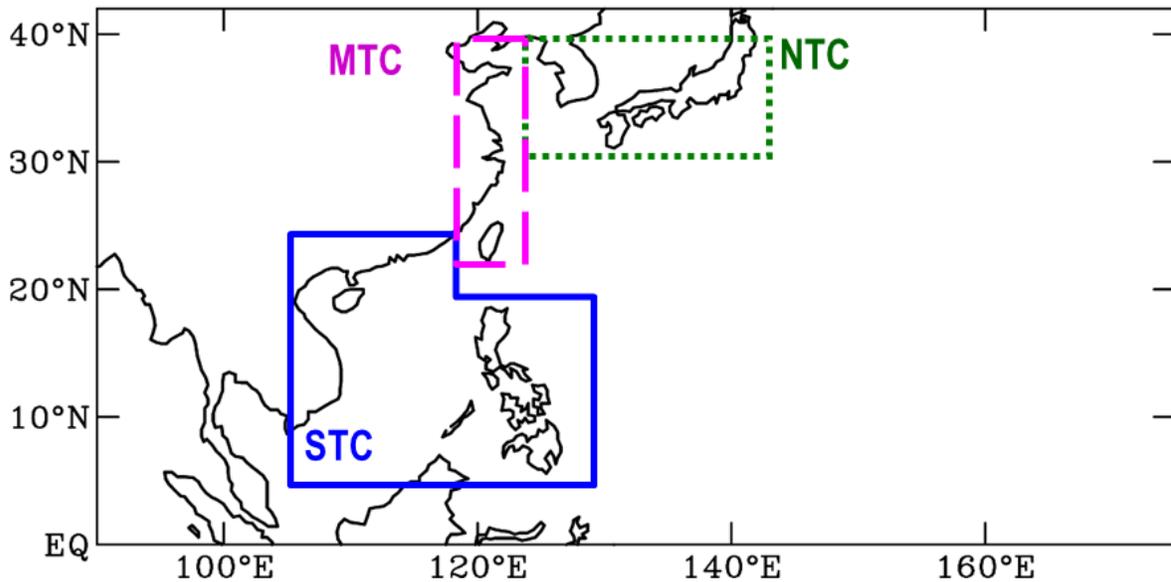
- Southern Tropical Cyclones (STC) – those making landfall in South China, Vietnam and the Philippines.
- Middle Tropical Cyclones (MTC) – those making landfall in East China (Taiwan, Fujian, Zhejiang and Jiangsu provinces and Shanghai municipality).
- Northern Tropical Cyclones (NTC) – those making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

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

2 Department of Earth Sciences, National Taiwan Normal University

3 Guy Carpenter Asia-Pacific Climate Impact Centre and the School of Energy and Environment, City University of Hong Kong

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

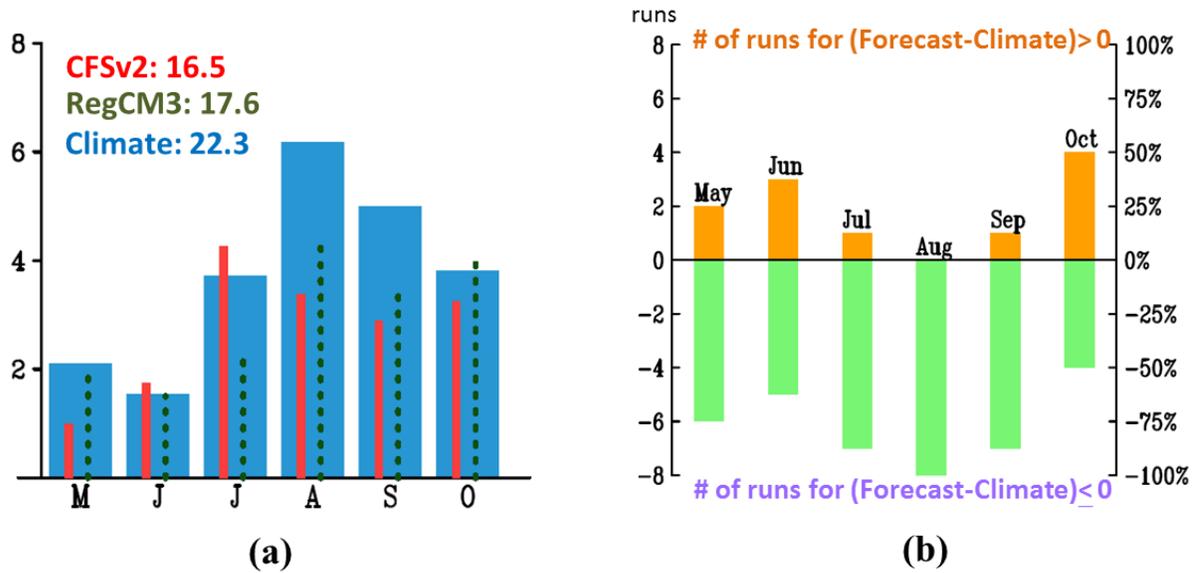


(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

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 all the months between May and October 2016, both the CFSv2 and RegCM3 predict the monthly number of tropical cyclone formations (Figure 3a) to be less than the climatology of the Joint Typhoon Warning Center, especially in the peak season of July to September. The spread of the eight RegCM3 runs (Figure 3b) shows that during this peak season, most or all of the runs indicate a below-normal number of tropical cyclone formations. For the early and late seasons, the probability is not as high. For July, seven of the eight predictions are below normal and for August all eight of the predictions are below normal.

F-3 | PREDICTIONS FOR MAY TO OCTOBER 2016 BASED ON THE APRIL 1, 2016 INITIAL CONDITIONS

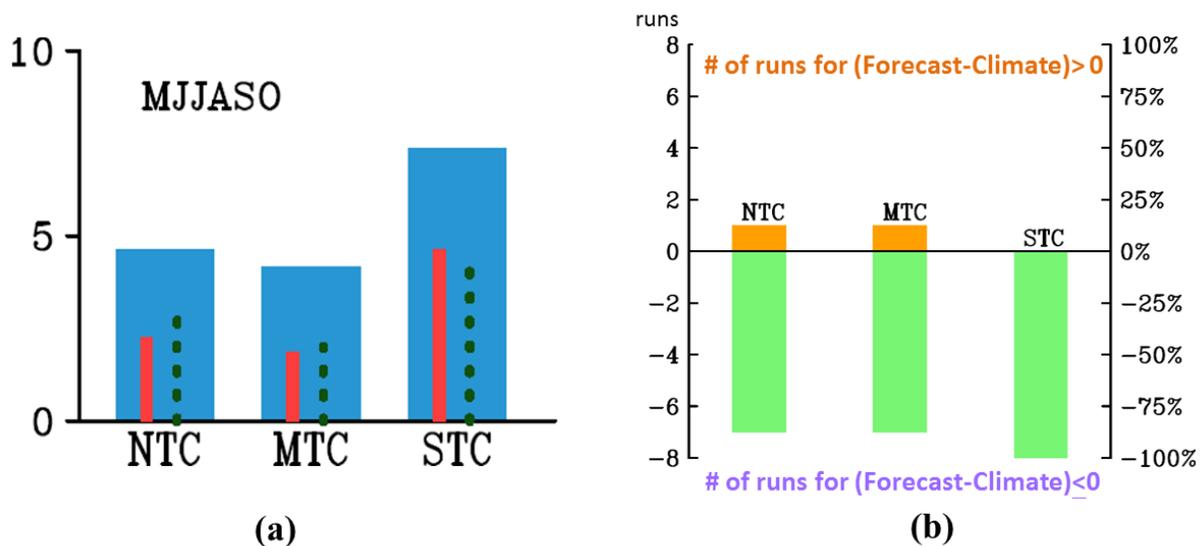


(Source: Guy Carpenter Asia-Pacific Climate Impact Centre)

(a) Month-to-month evolution of the number of tropical cyclone formations obtained from the climatology of the Joint Typhoon Warning Center (blue bar), predictions from global CFSv2 (red line) and those from RegCM3 (green dotted line). (b) The number (left axis) and percentage (right axis) of runs in which the number of tropical cyclone formations is above average [ $\#$  of runs for (forecast - climate) > 0] or below average [ $\#$  of runs for (forecast - climate) < 0]. In the equations, climate refers to the average from 2000 through 2010.

Because of the below-normal number of tropical cyclone formations, it is likely that the number of landfalling tropical cyclones in each of the three regions is less, especially for the southern part of East Asia (Figure 4a). Indeed, all of the eight runs in the RegCM3 indicate below normal number of landfalls in the southern region.

## F-4 | PREDICTIONS FOR MAY TO OCTOBER 2016 BASED ON THE APRIL 1, 2016 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 (blue bar), predictions from CFSv2 (red line) and those from RegCM3 (green dotted 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 [ $\#$  of runs for (forecast – climate) > 0] or below average [ $\#$  of runs for (forecast – climate) < 0]. In the equations, climate refers to the average from 2000 through 2010.

## 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 2016 will be below normal. This is consistent with the current downward trend in the number of tropical cyclone formations (Liu and Chan 2013)<sup>4</sup> and the typical situation in a post-El Niño year.

These forecasts will be updated in June using the CFSv2 forecasts from May 2016 and will be posted on the Guy Carpenter Asia-Pacific Climate Impact Centre website.

<sup>4</sup> Kin Sik Liu and Johnny C. L. Chan, Guy Carpenter Asia-Pacific Climate Impact Centre, School of Energy and Environment, City University of Hong Kong, Hong Kong, China : Inactive Period of Western North Pacific Tropical Cyclone Activity in 1998–2011

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