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Research Brief 2011/02

2011 Predictions of
(1) Seasonal Tropical Cyclone Activity over the Western North Pacific,
(2) Number of Tropical Cyclones Making Landfall in South China, and
(3) Number of Tropical cyclones Affecting Korea and Japan

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1. Introduction

Real-time predictions of the annual number of tropical cyclones (TCs) affecting the western North Pacific (WNP) and the South China Sea (SCS) were first issued in 2000 by the Laboratory for Atmospheric Research (LAR) at City University of Hong Kong (CityU) and annually thereafter until 2008 when such predictions were issued by the Guy Carpenter Asia-Pacific Climate Impact Centre, also at CityU. Verifications of the predictions for the past ten years have shown that the predictions are mostly correct within the error bars. We also began to predict the number of TCs making landfall in South China (SC) and the Korea and Japan region (KJ) in 2009 and 2010 respectively.

These are all statistical predictions with predictors drawn from a large group of indices that represent the atmospheric and oceanographic conditions in the previous year up to the spring of the current year. The most prominent ones include the proxies for El Niño/Southern Oscillation (ENSO), the extent of the subtropical ridge, and the intensity of the India-Burma trough. Details can be found in Chan et al. (1998, 2001), Liu and Chan (2003), and Goh and Chan (2010a, b).

2. ENSO conditions in 2011

As an important determinant is the status of the ENSO condition, it is useful to have a discussion on the possible ENSO situation in 2011. A moderate La Niña event that developed in the summer of 2010 is showing signs of weakening in recent months. In March, SSTs remain colder than normal in the central and eastern equatorial Pacific Ocean. The Niño3.4 and Niño4 index in March are -1.00 and -0.78 respectively. A summary of the various ENSO model forecasts from different climate centres suggests that La Niña is likely to continue through the spring but a transition to ENSO-neutral condition is expected during the summer (Table. 1). Based on these results, it appears that 2011 will likely be an ENSO-neutral year.

Table 1. Summary of model forecasts extracted from the Australian Bureau of Meteorology homepage[1].

MODEL / GROUP	1-3 MONTHS (May to Jul)	5-7 MONTHS (Aug to Oct)
POAMA (Australian Bureau of Met.)	Neutral	Neutral/Warm
System 3 ECMWF (EU)	Neutral	Neutral
GloSea UK Met. Office	Neutral	Neutral
CSF NCEP (US)	Neutral	Neutral
CGCMv1 NASA Goddard GMAO (US)	Neutral/Warm	Neutral
JMA-CGCM02 Japan Met. Agency	Neutral/Warm	Warm/Neutral
KMA-SNU Korean Met. Administration	Neutral	Neutral

3. Predictions for the WNP

All the predictors (HIB and NINO4 index) suggest a normal overall TC activity (Table 2). The final forecast is therefore for a normal overall TC activity (31 tropical cyclones). It should be noted that the index of the westward extent of the subtropical high over the western North Pacific (HWNP) is not included in the forecast this year because the subtropical high during

[1] http://www.bom.gov.au/climate/ahead/ENSO-summary.shtml

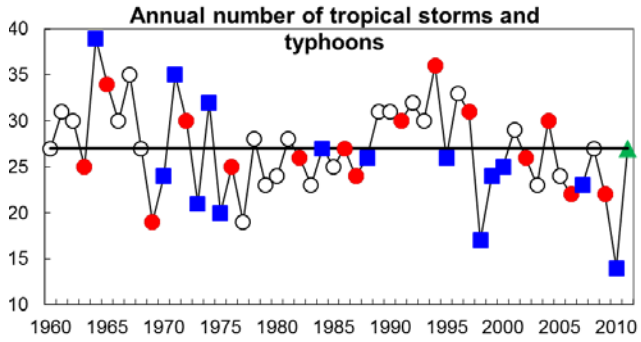
the recent months is too weak (Fig. 2) and the monthly values of this predictor in these months are not defined.

For the number of tropical storms and typhoons, all the predictors also consistently forecast a normal activity (ranging from 27 to 28) and therefore a normal TC activity (27 tropical storms and typhoons) is expected for this category (Table 2 and Fig. 1).

A slightly difference between non-ENSO and ENSO predictors is found for the number of typhoons. The ENSO predictors (NINO3.4 index and equatorial SOI index) suggest a slightly below-normal TC activity (predicted numbers being 14 and 15 respectively) while the other predictors forecast a slightly above-normal TC activity, with predicted numbers ranging from 18 to 19. Therefore, the final forecast is 16 typhoons, which is near the normal number.

Thus, it is expected that the overall TC activity, the number of tropical storms and typhoons as well as the number of typhoons are likely to be normal. The quantitative predictions are given in Table 2.

Fig. 1. Time series of the annual number of tropical storms and typhoon. Red circle and blue squares indicate the El Niño and La Niña years respectively. The thick horizontal line indicates the normal number of tropical storms and typhoons. The green triangle indicates the predicted number in 2011.



It should be noted, however, that the TC activity over the WNP appears to enter an inactive period since 1998 (Fig. 1). In the last 13 years, only two years (2001 and 2004) have the above-normal TC activity. The activity in most of the other years is below normal. Indeed, the 2010 TC season has only 14 tropical cyclones with at least tropical storm intensity, which is the lowest since the reliable record beginning in 1960. Therefore, it is possible that because this downward trend was not included in the prediction scheme, the predictions this year could suffer from the same problem as in the last few years in that they are all over-predictions. Nevertheless, as we do not have a new scheme that incorporates this downward trend, we will need to assume that the same forcings would apply for this year and issue the predictions as given by the regression equations. Work is currently underway to identify the possible factors for this downward trend. If factors can be identified, we could include them in the predictions for next year.

Table 2. Forecasts of the annual TC activity in the WNP from various predictors and the weighted average of the forecasts.

All TC		
Predictor	Prediction	Weight
HIB	31	0.68
NINO4	31	0.73
Final forecast	***31***	
Normal	***31***	

Tropical storms and typhoons		
Predictor	Prediction	Weight
HIB	28	0.67
WP	27	0.58
NINO3.4	27	0.66
Final forecast	***27***	
Normal	***27***	

Typhoons		
Predictor	Prediction	Weight
HIB	19	0.57
WP	18	0.59
NINO3.4	14	0.77
ESOI	15	0.66
Final forecast	***16***	
Normal	***17***	

WNP	Index of the westward extent of the subtropical high over the western North Pacific
HIB	Index of the strength of the India-Burma trough (15°-20°N, 80°-120°E)
WP	Primary mode of low-frequency variability over the North Pacific
NINO3.4	Sea surface temperature (SST) anomalies in the NINO3.4 region (5°S-5°N, 170°-120°W)
NINO4	Sea surface temperature (SST) anomalies in the NINO4 region (5°S-5°N, 160°E-150°W)
ESOI	Equatorial Southern Oscillation Index (Equatorial SOI) Equatorial Eastern Pacific SLP - Indonesia SLP (standardized anomalies)

The possible error in the current predictions is given by an envelope of the possible errors, which are based on the predictions from individual predictors. The smallest and largest numbers among the individual predictions may be considered as the lower and upper bound of the final predictions. A larger (smaller) difference between the lower and upper bound might then

indicate lower (higher) predictability. Based on this concept, we could see that for this year, prediction for the overall TC activity and the number of tropical storms and typhoons has the smallest spread and thus the highest predictability.

As in previous years, we will provide an updated forecast sometime in June.

Fig. 2. 500-hPa geopotential height anomalies between February and March in 2011. Thick contours indicate the geopotential height (contour interval = 10 m) ≥ 5860 m.

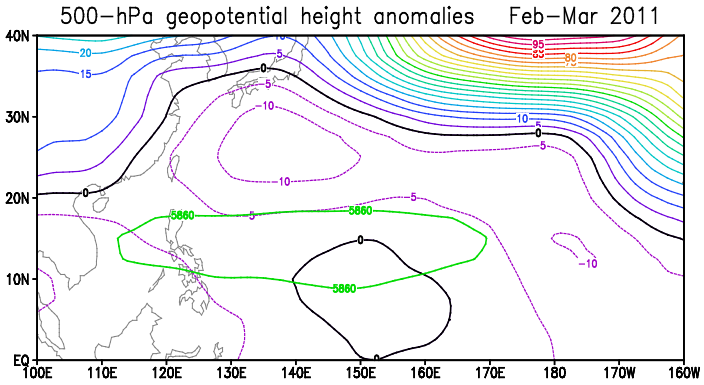


Table 3. Summary of all forecasts.

	Forecast	*Normal*
Entire western North Pacific		
All TC	**31** *(normal)*	31
Tropical storms and typhoons	**27** *(normal)*	27
Typhoons	**16** *(normal)*	17
No. of landfalling TCs over South China		
Early season (May to Aug)	**5** (above normal)	3
Late season (Sep to Dec)	**2** (normal)	2
Whole season	**6** (above normal)	5
No. of TCs affecting Korea and Japan		
Whole season	**6** (above normal)	4

4. Predictions for the number of landfalling TCs over South China

As discussed in section 2, the ENSO will be returning to near-neutral conditions as the tropical cyclone (TC) season progresses. Thus, the current year, a year after a La Niña event (LN+1 year), is very likely to be an ENSO-neutral year.

Table 3 is a summary for this year's predicted number of TCs making landfall on the coast of Southern China. The predicted number for the early season (May to August) is 5, which is above the normal value of 3. On the other hand, the forecast for the late season (September to December) is 2, which is equal to the normal value. This gives a total number of 7 TCs forecasted to be making landfall along the South China coast over the whole season, which is above the normal value of 5.

The current prediction seems to agree with previous studies. For example, Chan (2000) pointed out that TC activity is enhanced in the South China Sea in a LN+1 year, especially between months of May and July. At the same time, Liu and Chan (2003) also found that in such years, the chance of TCs landfalling along the South China coast increases significantly.

At the same time, as ENSO is forecasted to return to neutral in the latter part of the year, it is likely that the effect of ENSO on landfalling TCs during the late season might not be very prominent, thus explaining a normal number being forecasted.

As in the last two years, an updated prediction for the late season will be issued in June.

5. Predictions for the number of TCs affecting Korea and Japan

The number of TCs predicted to affect Korea and Japan (KJ) is 6 for the whole TC season, which is above the normal value of 4 (Table 3). Chan (2000) discovered that in LN+1 years, TC activity in the entire western North Pacific basin is higher than normal. Specifically, an anomalous low is seen at the 500-hPa level to the south of Japan during the peak season of these years (July to September) (Fig. 3). The associated southeasterly flow could help steer TCs towards KJ.

Similar to typical LN+1 years, the 500-hPa geopotential height has mostly seen negative anomaly in 2011 over the western North Pacific south of Japan (between 120ºE and 140ºE) (Fig. 4). If this situation continues into the peak season, it is very possible that the number of TCs making landfall over KJ would be above normal, which is as predicted.

As in last year, an updated forecast for KJ will be issued in June.

References

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Fig. 3. Anomaly of 500-hPa geopotential height in LN+1 years during the peak season (July to September).

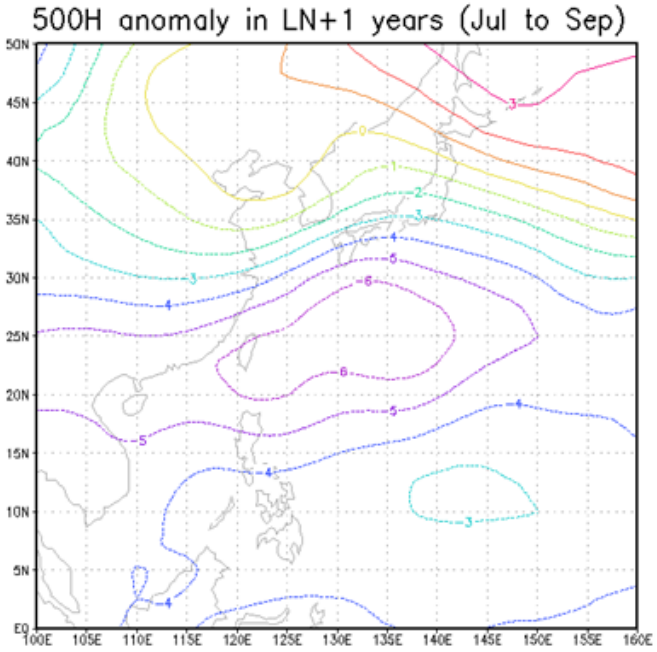

Fig. 4. Time-longitude section plot of 500-hPa geopotential height anomalies from January 2010 to April 2011 over the western north Pacific. (Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at http://www.esrl.noaa.gov/psd/.)