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*Research Brief 2013/01*

# Verification of Forecasts of Tropical Cyclone Activity in the Australian region in 2012/13

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## 1. Introduction

Since the 2009/10 season, the Guy Carpenter Asia-Pacific Climate Impact Centre (GCACIC) at City University of Hong Kong has been issuing real-time forecasts of the annual number of tropical cyclones (TCs) affecting the Australian region (90°E-160°E, 40°S-0°N) and its sub-region (western Australian region, 90°E-135°E, 40°S-0°N). The prediction for the eastern Australian region (135°E-160°E, 40°S-0°N) is also included in the 2010/11 season. These are all statistical predictions with predictors drawn from a large group of indices that represent the atmospheric and oceanographic conditions during the pre-season (Liu and Chan 2012). The most prominent ones include the proxies for the El Niño/Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). Hindcasts for the period of 1983-2008 have shown that the predictions are mostly correct within the error bars.

**Table 1. Forecasts of TC activity in 2012/13 issued in November.**

| *2012/13* | *Forecast* | *Observed* | *Normal* |
|---|---|---|---|
| Entire Australian region | **12** | **11** | **12-15** |
| Western Australian region | **9** | **6** | **9-10** |
| Eastern Australian region | **4** | **5** | **5-6** |

## 2. Verification of the 2012/13 forecasts

***a. Summary of the forecasts issued***

Our November forecasts (issued on 03 December 2012) suggested "***near-normal activity in the entire Australian region and the western Australian region***", and "***slightly below-normal activity in the eastern Australian region***". These forecasts were based on the observed ENSO-neutral conditions and the positive Indian Ocean Dipole (IOD) event in the summer and fall of 2012. Detailed numbers are summarized in Table 1, together with the observed numbers based on the warnings from Joint Typhoon Warning Center (JTWC) and Australian Bureau of Meteorology (BoM) (Table 2).

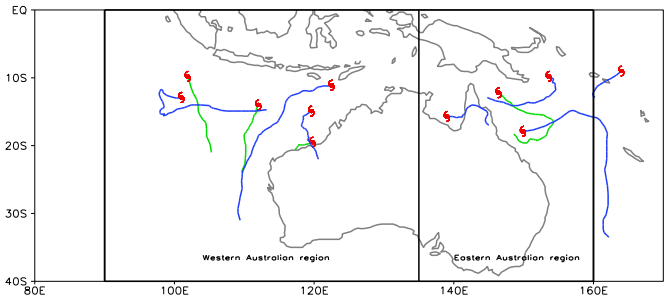
**Table 2. Summary of 2012/13 tropical cyclones in the Australian region**.

| | *Entire Australian region* | *Western Australian region* | *Eastern Australian region* |
|---|---|---|---|
| | 01. Freda<br>02. Mitchell<br>03. Narelle<br>04. Oswald<br>05. Peta<br>06. Rusty<br>07. 18S*<br>08. Tim<br>09. Victoria<br>10. Sandra<br>11. Zane | 01. Mitchell<br>02. Narelle<br>03. Rusty<br>04. Peta<br>05. 18S*<br>06. Victoria | 01. Freda<br>02. Oswald<br>03. Tim<br>04. Sandra<br>05. Zane |
| **Total number** | **11** | **6** | **5** |
| **Predicted number** | **12** | **9** | **4** |
| * 18S was considered by JTWC as having reached tropical storm intensity but were not named by BoM | | | |

***b. Verification and discussion***

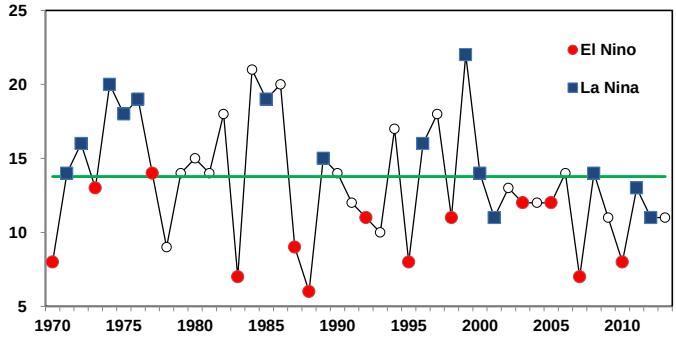
Based on the JTWC and BoM warnings, 11 TCs occurred in the 2012/13 season within the Australian region, which is slightly below the normal range (12-15) (Table 1). Of these 11 TCs, 6 are found in the western Australian region and 5 in the eastern Australian region, with no TC moving through both the western and eastern Australian regions (Table 2 and Fig. 1). The TC activity in the western Australian region is below normal while the TC activity in the eastern Australian region is normal. The prediction for the whole Australian region is correct as the predicted number is only one less than the observed number. However, our forecast cannot correctly predict the distribution of the TC activity, with an over-estimation the TC number in western Australian region and an under-estimation of the TC number in the eastern Australian region, the possible reasons of which are discussed below.

**Fig. 1. Tracks of the tropical cyclones affecting the Australian region in the 2012/13 season. Typhoon symbols indicate the genesis positions.**



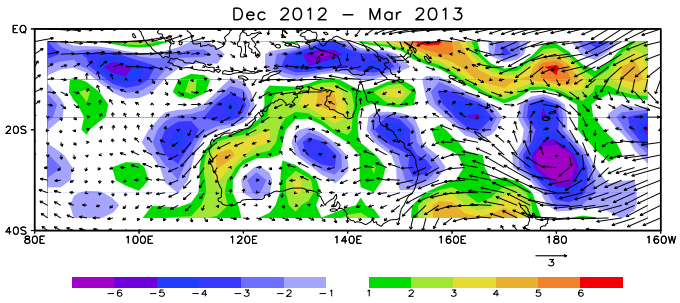

The ENSO was in its neutral status during the Australian TC season (November-April), with the mean Nov-Apr Niño3.4 index of -0.31, and therefore the ENSO effect on the TC activity should be insignificant. A positive IOD event occurred in the summer and fall of 2012 and appeared to be related to the low TC activity in the western Australian region, which is consistent with the results of the previous study (Liu and Chan 2012). Indeed, the IOD related predictor (dipole mode index) gives the best prediction (the predicted number being 7) among the four predictors. Thus, the IOD event may be the major factor affecting the TC activity in the western Australian region and the over-estimation may be due to the predictions from the ENSO-related predictors. On the other hand, it is worth to note that the inactive period starting from 2000 tends to persist into the 2012/13 TC season (Fig. 2). In the last 14 years, all the TC seasons had near-normal or below-normal TC activity.

**Fig. 2. Annual number of tropical cyclones in the entire Australian region between 1970 and 2013. The year 1970 denotes the TC season spanning from July 1969 to June 1970. The horizontal line indicates the climatological mean. Red circle and blue squares indicate the El Niño and La Niña years respectively.**




The TC activity is primarily related to the changes of atmospheric conditions. Low-level westerly anomalies are generally found over the tropical South Pacific east of Australia (between 150°E and 160°W), resulting in the increase in cyclonic relative vorticity (Fig. 3) and hence a relatively higher TC activity in the eastern Australian region. In the western Australian region, the negative relative vorticity anomalies are confined to the area between 100°E and 120°E, where most of the TCs are found there (see Fig. 1). The TC activity in the area between 120°E and 140°E is very low, which partly explain the low TC activity in the western Australian region.

**Fig. 3. 850-hPa wind (vector) and relative vorticity (shading) anomalies between December and March in 2013. (Shading interval = $10^{-6}$ $s^{-1}$).**




## References

Liu, K. S. and J. C. L. Chan, 2012: Interannual variation of Southern Hemisphere tropical cyclone activity and seasonal forecast of tropical cyclone number in the Australian region. *International Journal of Climatology,* DOI: 10.1002/joc.2259.