Verification of Forecasts of Tropical Cyclone Activity in the Australian region in 2013/14

26 August 2014

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 2013/14 issued in November.

2013/14	*Forecast*	*Observed*	*Normal*
Entire Australian region	**13**	**10**	**12-15**
Western Australian region	**9**	**5**	**9-10**
Eastern Australian region	**5**	**7**	**5-6**

2. Verification of the 2013/14 forecasts

a. Summary of the forecasts issued

Our November forecasts (issued on 18 November 2013) suggested "***near-normal activity in the entire Australian region, the western Australian region and the eastern Australian region***". These forecasts were based on the observed ENSO-neutral conditions in the summer and fall of 2013. 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).

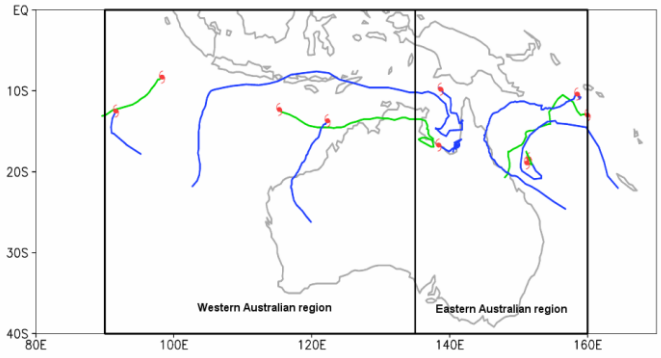
Table 2. Summary of 2013/14 tropical cyclones in the Australian region.

	Entire Australian region	*Western Australian region*	*Eastern Australian region*
	01. Alessia* 02. Bruce 03. Christine 04. Dylan 05. Edna 06. Flectcher 07. Gillian* 08. Hadi 09. Ita 10. Jack	01. Alessia* 02. Bruce 03. Christine 04. Gillian* 05. Jack	01. Alessia* 02. Dylan 03. Edna 04. Flectcher 05. Gillian* 06. Hadi 07. Ita
Total number	**10**	**5**	**7**
Predicted number	**13**	**9**	**5**
*** The TC moves through both the western and eastern Australian regions**			

b. Verification and discussion

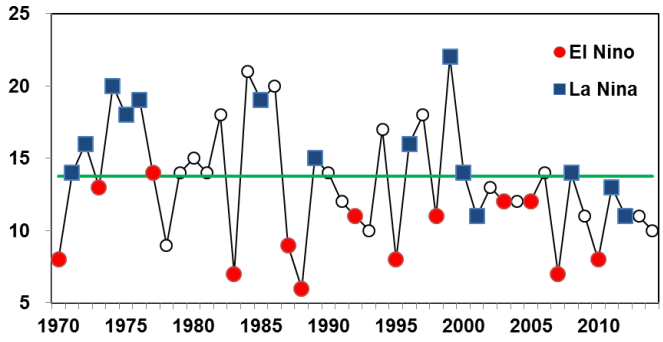
Based on the JTWC and BoM warnings, 10 TCs occurred in the 2013/14 season within the Australian region, which is below the normal range (12-15) (Table 1). There are 5 TCs in the western Australian region and 7 TCs in the eastern Australian region, with 2 TCs (Alessia and Gillian) moving through both 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 above normal. It is rare that the number of TCs in the eastern Australian region is higher than that in the western Australian region, the normal ranges being 5-6 and 9-10 respectively. Our forecast overestimates the TC activity in the whole Australian region and 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 2013/14 season. Typhoon symbols indicate the genesis positions.



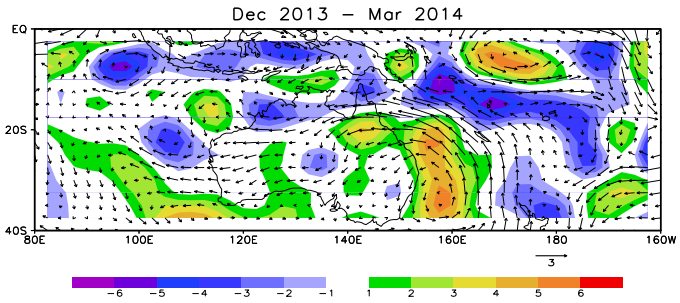
The ENSO was in its neutral status during the Australian TC season (November-April), with the mean Nov-Apr Niño3.4 index of -0.45, and therefore the ENSO effect on the TC activity should be insignificant. The IOD was also in its neutral condition, as suggested by the small values of the Dipole Mode Index (DMI). Since both ENSO and IOD are not the major factor affecting the TC activity in the Australian region, the performance of the ENSO and IOD related predictors is not good. On the other hand, it is worth to note that the inactive period starting from 2000 tends to persist into the 2013/14 TC season (Fig. 2). In the last 15 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 2014. 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 160°E and 160°W). At the same time, the anomalous high east of Australia results in the easterly anomalies along 20°N. As a result, an increase in cyclonic relative vorticity is found along 10°N (Fig. 3). The atmospheric conditions are favourable for TC genesis and hence a relatively higher TC activity in the eastern Australian region. In the western Australian region, positive relative vorticity anomalies are found in the area between 110°E and 140°E, which are related to the low-level easterly anomalies in the tropical area. The TC activity in the area between 110°E and 140°E is low, which partly explains 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 2014. (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.