

**Verification of Forecasts of Tropical Cyclone Activity
in the Australian region in 2010/11**

23 May 2011

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 2010). 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 2010/11 issued in November.

2010/11	Forecast	Observed	Normal
Entire Australian region	19	13	12-15
Western Australian region	14	9	9-10
Eastern Australian region	7	4	5-6

2. Verification of the 2010/11 forecasts

a. Summary of the forecasts issued

Our November forecasts (issued on 12 November 2010) suggested “*above-normal activity in the entire Australian region and the western Australian region*”, and “*slightly above-normal activity in the eastern Australian region*”. These forecasts were based on the observed La Niña event in summer. 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 2010/11 tropical cyclones in the Australian region.

	Entire Australian region	Western Australian region	Eastern Australian region
	01. Anggrek 02. Abele 03. Tasha 04. Vince 05. Zelia 06. Anthony 07. Bianca 08. Yasi 09. 14S* 10. Carlos 11. Dianne 12. 20S* 13. Errol	01. Anggrek 02. Abele 03. Vince 04. Bianca 05. 14S* 06. Carlos 07. Dianne 08. 20S* 09. Errol	01. Tasha 02. Zelia 03. Anthony 04. Yasi
Total number	13	9	4
Predicted number	19	14	7
* 14S and 20S were 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, 13 TCs occurred in the 2010/11 season within the Australian region, which falls within the normal range (12-15) (Table 1). Of these 13 TCs, 9 are found in the western Australian region and 4 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 normal while the TC activity in the eastern Australian region is slightly below normal. Our forecasts over-estimated the TC numbers in these regions, the possible reasons of which are discussed below.

Table 3. Annual number of tropical cyclones in the entire, western and eastern Australian regions in a La Niña year. Green and blue shadings indicate the above-normal and below-normal TC activity respectively.

TC season with La Niña event	Entire Australian region (90°-160°E)	Western Australian region (90°-135°E)	Eastern Australian region (135°-160°E)
1970/1971	14	9	7
1971/1972	16	6	11
1973/1974	20	11	9
1974/1975	18	14	5
1975/1976	19	11	10
1984/1985	19	12	10
1988/1989	15	10	5
1995/1996	16	13	6
1998/1999	22	16	6
1999/2000	14	12	3
2000/2001	11	9	5
2007/2008	14	11	4
2010/2011	13	9	4

Fig. 1. Tracks of the tropical cyclones affecting the Australian region in the 2010/11 season. Typhoon symbols indicate the genesis positions.

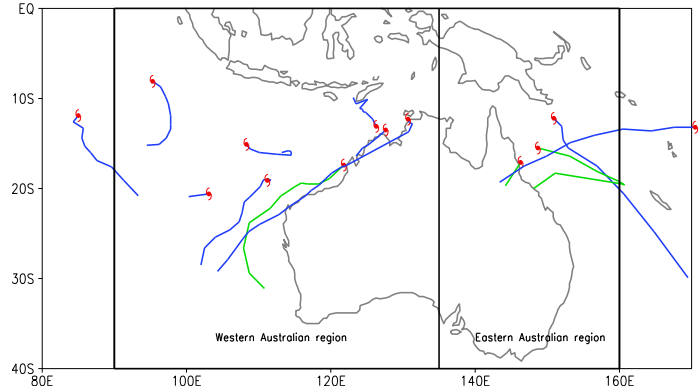
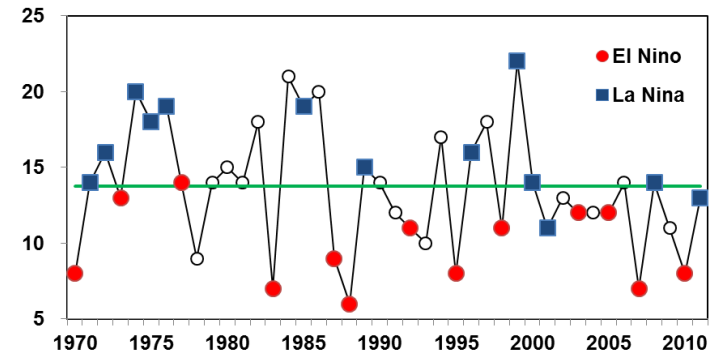


Fig. 2. Annual number of tropical cyclones in the entire Australian region between 1970 and 2011. The year 1970 denotes the TC season spanning from July 1969 to June 1970. The horizontal line indicates the climatological mean. Red circle and blue squares indicate the El Niño and La Niña years respectively.



A La Niña event developed in the summer of 2010 and persisted into the Australian TC season (November-April). The mean Nov-Apr Niño3.4 index is -1.31 and the strength of this El Niño event is considered to be moderate. Previous studies (Nicholls 1984; Liu and Chan 2010) suggested that TC activity in the Australian region tends to be enhanced in a season associated with a La Niña event (see also Table 3). However, the TC activity in this year is not as active as other TC seasons associated with La Niña event (Table 3 and Fig. 2). The overestimation of our predictions may be related to the inactive period starting from 2000 (Fig. 2). In the last 12 years, all the TC seasons had near-normal or below-normal TC activity, even for the four TC seasons associated with

La Niña events (1999/2000, 2000/01, 2007/08 and 2010/11). Our prediction model was apparently not able to capture the interdecadal changes of the TC activity and therefore over-estimated the TC numbers.

The TC activity is primarily related to the changes of atmospheric conditions associated with the La Niña event. Low-level westerly anomalies are generally found over the areas extending from the eastern part of the tropical South Indian Ocean (east of 80°E) to northwest Australia, resulting in the increase in cyclonic relative vorticity (Fig. 3a) and hence a relatively higher TC activity in this region. However, such westerly anomalies are not extended to the eastern Australian region as found in some TC seasons associated with La Niña events (Fig. 3b). Instead, easterly anomalies are found in this region and the associated band of positive relative vorticity anomalies are less favourable for TC genesis and development. Thus, the unfavourable atmospheric conditions partly explain the slightly below-normal TC activity in the eastern Australian region.

References

Liu, K. S. and J. C. L. Chan, 2010: 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.

Nicholls, N., 1984: The southern oscillation, sea-surface temperature, and interannual fluctuations in Australian tropical cyclone activity. *J. Climatol.*, **4**, 661–670.

Fig. 3. 850-hPa wind (vector) and relative vorticity (shading) anomalies between December and March in (a) 2011 and (b) other La Niña years. (Shading interval = 10^{-6} s^{-1}).

