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Research Brief 2012/02

Verification of Forecasts of Tropical Cyclone Activity in the Australian region in 2011/12

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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 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 2011/12 issued in November.

2011/12	*Forecast*	*Observed*	*Normal*
Entire Australian region	**15**	**11**	**12-15**
Western Australian region	**10**	**8**	**9-10**
Eastern Australian region	**6**	**3**	**5-6**

2. Verification of the 2011/12 forecasts

a. Summary of the forecasts issued

Our November forecasts (issued on 01 December 2011) 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 La Niña event in the boreal 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 2011/12 tropical cyclones in the Australian region.

	Entire Australian region	*Western Australian region*	*Eastern Australian region*
	01. Alenga 02. Grant 03. Fina 04. Heidi 05. Iggy 06. Jasmine 07. Hilwa 08. Koji 09. Lua 10. 19S* 11. 21P*	01. Alenga 02. Grant 03. Heidi 04. Iggy 05. Hilwa 06. Koji 07. Lua 08. 19S*	01. Fina 02. Jasmine 03. 21P*
Total number	**11**	**8**	**3**
Predicted number	**15**	**10**	**6**
* 19S and 21P 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, 11 TCs occurred in the 2011/12 season within the Australian region, which is slightly below the normal range (12-15) (Table 1). Of these 11 TCs, 8 are found in the western Australian region and 3 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 and the eastern Australian region is slightly below normal. Our forecasts slightly 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
2011/2012	11	8	3

Fig. 1. Tracks of the tropical cyclones affecting the Australian region in the 2011/12 season. Typhoon symbols indicate the genesis positions.

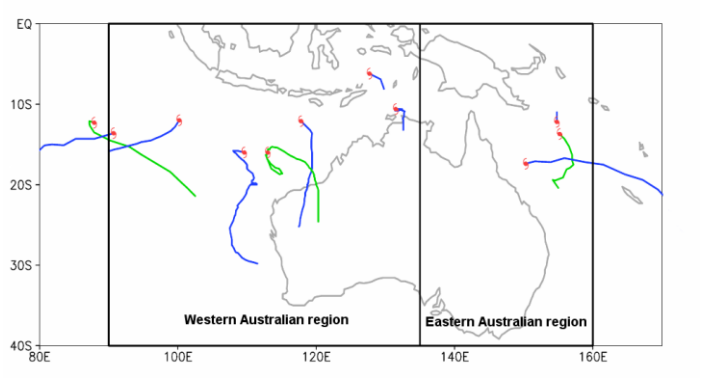
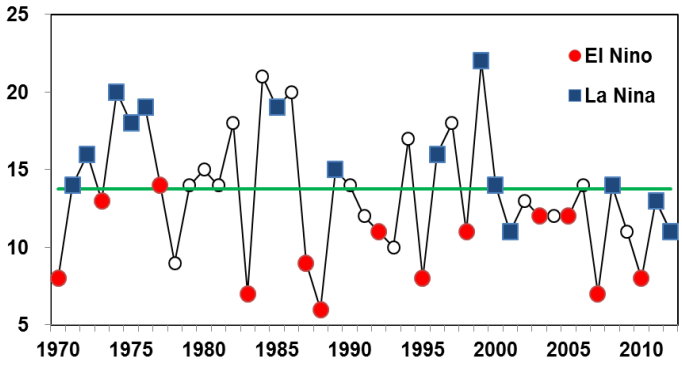


Fig. 2. Annual number of tropical cyclones in the entire Australian region between 1970 and 2012. The year 1970 denotes the TC season spanning from July 1969 to June 1970. The horizontal line indicates the climatological mean. Red circle and blue squares indicate the El Niño and La Niña years respectively.

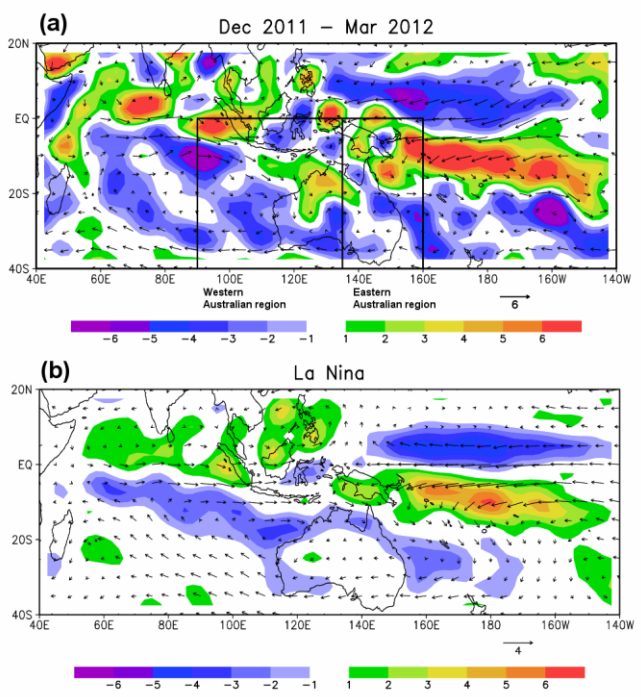


A La Niña event developed in the boreal summer of 2011 and persisted into the Australian TC season (November-April). Previous studies (Nicholls 1984; Liu and Chan 2010) suggested that TC activity in the Australian region tends to be enhanced in a season associated with a La Niña event (see also Table 3). The mean Nov-Apr Niño3.4 index is -0.73 and the strength of this La Niña event is therefore considered as weak, and weaker than expected. The effect on the atmospheric circulations may be less significant and therefore the TC activity in this year is not as active as other TC seasons associated with La Niña event (Table 3 and Fig. 2). On the other hand, the overestimation of our predictions may be related to the

inactive period starting from 2000 (Fig. 2). In the last 13 years, all the TC seasons had near-normal or below-normal TC activity, even for the five TC seasons associated with La Niña events (1999/2000, 2000/01, 2007/08, 2010/11 and 2011/12). 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 weak La Niña event. Low-level westerly anomalies are generally found over the tropical South Indian Ocean (between 60°E and 110°E), resulting in the increase in cyclonic relative vorticity (Fig. 3a). However, such westerly anomalies are not extended to northwest Australia and the eastern Australian region as found in some TC seasons associated with La Niña events (Fig. 3b). The associated negative relative vorticity anomalies are therefore confined to the western part of the western Australian region. Low-level easterly anomalies are found over the tropical South Pacific and a band of positive relative vorticity anomalies extends from the tropical South Pacific to northwest Australia, resulting in the atmospheric conditions less favourable for TC genesis and development, which partly explain the slightly below-normal TC activity in the western and eastern Australian regions.

Fig. 3. 850-hPa wind (vector) and relative vorticity (shading) anomalies between December and March in (a) 2012 and (b) other La Niña years. (Shading interval = 10^{-6} s^{-1}).



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.