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Research Brief 2010/03

Verification of Forecasts of Tropical Cyclone Activity in the Australian region in 2009/10

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1. Introduction

Starting from the 2009/10 season, the Guy Carpenter Asia-Pacific Climate Impact Centre (GCACIC) at City University of Hong Kong will issue real-time forecasts of the annual number of tropical cyclones (TCs) affecting the Australian region (90°E-160°E, 40°S-0°N) (N_A) and its sub-region (western Australian region, 90°E-135°E, 40°S-0°N) (N_{WA}). 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.

2. Verification of the 2009/10 forecasts

a. Summary of the forecasts issued

Our November forecasts (issued on 10 December 2009) suggested "*below-normal activity in the entire Australian region and the western Australian region*", which were based on the observed El Niño event in summer and the neutral IOD condition between September and October. 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 1. Forecasts of TC activity in 2009/10 issued in November.

2009/10	*Forecast*	*Observed*	*Normal*
Entire Australian region	8	8	11
Western Australian region	5	4*	8

* Tropical storm Paul formed as a tropical depression in the western Australian region and intensified into a tropical storm in the eastern Australian region (see Fig. 1). This storm is therefore not counted as a tropical storm occurring in the western Australian region.

Table 2. Summary of 2009/10 tropical cyclones in the Australian region.

	Entire Australian region	Western Australian region
	01. Laurence 02. Neville 03. Magda 04. Olga 05. Ului 06. Sean 07. Paul 08. Robyn	01. Laurence 02. Magda 03. Sean 04. Robyn
Total number	**8**	**4**
Predicted number	**8**	**5**

b. Verification and discussion

Based on the JTWC and BoM warnings, TC activity in the 2009/10 season in the Australian region was below-normal, with 8 TCs reaching at least tropical storm intensity which is 3 less than the normal number (the normal being 11) (Table 2). Of these 8 TCs, 4 are found in the western Australian region (Table 2 and Fig. 1) which is 4 less than the normal number (the normal being 8). Our forecast was near perfect, which correctly predicted the number of TCs in the Australian region and only slightly over-estimated the TC number in the western Australian region.

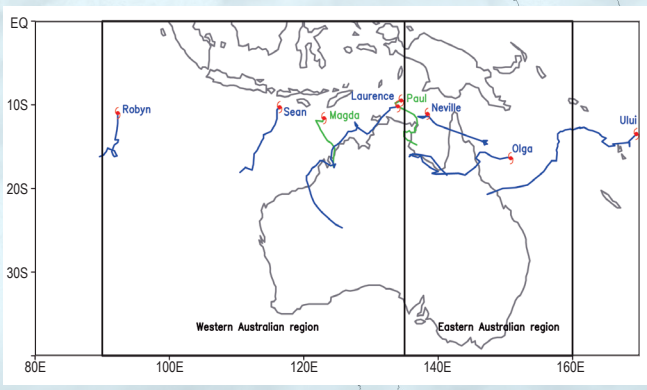

Fig. 1. Tracks of the tropical cyclones affecting the Australian region in the 2009/10 season. Typhoon symbols indicate the genesis positions.

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An El Niño event developed in the summer of 2009 and persisted into the Australian TC season (November-April). The mean Nov-Apr Niño3.4 index is 1.36 and the strength of this El Niño event is considered to be moderate and its influence on the TC activity should be significant. Previous studies (Nicholls 1984; Liu and Chan 2010) suggested that TC activity in the Australian region tends to be suppressed in a season associated with an El Niño event (see also Table 3) and this is true for the 2009/10 season. The IOD is in its neutral state and therefore its effect on TC activity should be insignificant. Thus, the El Niño event is the main factor responsible for the below-normal TC activity in the Australian region. Our prediction model was apparently able to capture the El Niño signal and therefore could make the correct predictions.

Table 3. Annual number of TCs with tropical storm intensity or above in the entire Australian region and the western Australian region in an El Niño year. Green and blue shadings indicate the above-normal and below-normal TC activity respectively.

TC season with El Niño event	Entire Australian region (90°-160°E)	Western Australian region (90°-135°E)
1982/83	7	5
1986/87	7	5
1987/88	5	3
1991/92	11	5
1994/95	6	4
1997/98	11	6
2002/03	6	5
2004/05	11	10
2006/07	5	4
2009/10	8	4

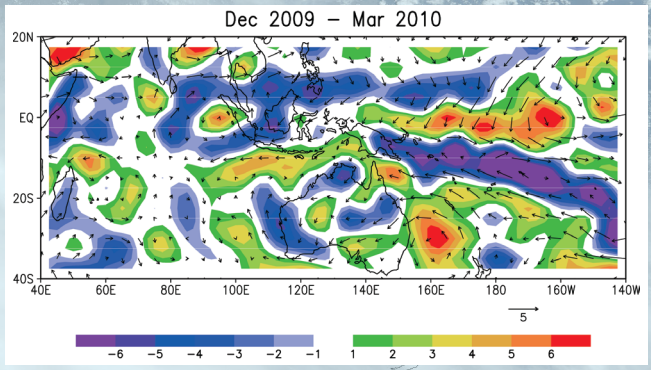

Fig. 2. 850-hPa wind (vector) and relative vorticity (shading) anomalies between December 2009 and March 2010. (Shading interval = 10^{-6} s^{-1}).

The suppression of TC activity is primarily related the changes of atmospheric conditions associated with the El Niño event. Low-level westerly anomalies are generally found over the eastern part of the tropical South Pacific (east of 160°E), resulting in the increase in cyclonic relative vorticity (Fig. 2) and hence a higher TC activity in this region (not shown). However, easterly anomalies are found along 10°N in the Australian region and a broad band of positive relative vorticity anomalies is found just north of Australia (Fig. 2). The atmospheric conditions are therefore less favourable for TC genesis and development. Thus, the eastward shift in the mean genesis location and the unfavourable atmospheric conditions in the Australian region partly explain the below-normal TC activity in the 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. (*to be submitted*)

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