2.8 INTER-EL NIñO VARIABILITY OF THE SOUTHERN HEMISPHERE CIRCULATION
PART I: OBSERVATIONAL DATA

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1. INTRODUCTION

The typical response of the Southern Hemisphere (SH) circulation to El Niño (EN) events consists in wave trains extending southeastward from the tropical Pacific before they turn equatorward into South America (Karoly 1989). They share features of the second (PSA1) and third (PSA2) leading modes of SH circulation variability on interannual time scales which are characterized by well-defined wave trains emanating from central and western tropical Pacific respectively (Kidson 1999; Mo 2000).

The wavelike response during EN events is particularly noticeable over the SH circulation during the austral winter and more amplified during austral spring while it becomes more zonally symmetric during the austral summer (Kiladis and Mo 1998).

Based on previous knowledge that SST variations over the subtropical south central Pacific (SSCP) region produce strong modulation among EN events (Barros and Silvestri 2002), a stratification of the springs associated with those events was performed according to SST conditions over El Niño 3.4 sector and over the SSCP region (Fig.1). EN events associated with cold (warm) SST anomalies in the SSCP are named as WC (WW). The respective SST of both cases are depicted in Fig.2.

2. DATA

NCEP-NCAR reanalysis fields for the period 1958 to 2000 are used here to examine the circulation features. The Global Sea-Ice and SST dataset (GISST) from the United Kingdom Meteorological office were used for the period 1958 to 1994 and the NCEP optimum interpolation SST analyses were considered from 1995 to 2000. EN events were considered as those defined by Trenberth (1997).

3. RESULTS AND CONCLUSIONS

Recently Vera et al. (2002) showed that during the austral springs (October-November-December, OND), WC events exhibit enhanced convection not only in equatorial but also in the subtropical regions of the southeastern Pacific Ocean which maintains a strong PSA-1 like wave train stretching between the equatorial central Pacific and the SH midlatitudes (Fig. 3c). Neither the diabatic-heating source nor the related PSA1-like circulation patterns are present during WW events (Fig. 3d). Moreover, in both cases there is present a PSA2-like pattern initiated off the west of Australia and ending at the same mid-latitude anticyclonic center of the PSA-1 pattern, becoming a common circulation feature of all EN events.

The seasonal evolution of the circulation patterns was explored. Composite fields averaged over all the EN events show that the PSA2-like pattern is clearly noticeable from June-July-August (JJA) while the PSA1-like structure begins to be distinguished from August-September-October and acquiring its conspicuous structure in the following trimesters. Moreover, during WC (WW) events, a clear manifestation of PSA1 (PSA2)-like circulation anomaly is evident from the austral winter while the PSA2 (PSA1)-like signal is not that evident (Figs. 3a, b). It can be then concluded that the differences in the austral spring SH circulation between EN events occurring under different conditions in SSCP are already discernible from the previous winter. On the other hand, in all the EN composites, regardless the SST conditions in the SSCP, the wavelike structure of the SH circulation break down by the austral summer of the next year (January-February-March, JFM). The exception are the anticyclone anomaly located at the tropical central Pacific and the cyclone anomaly over the SSCP region, still present in the summer circulation resembling a PSA1-like structure but with no evidences of PSA2 characteristics (Figs. 3e, f).

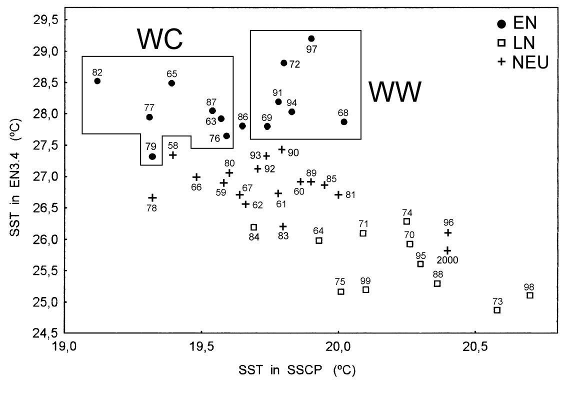

Fig. 1: *Scatter diagram between SSTs in the SSCP and in EN3.4 region.*

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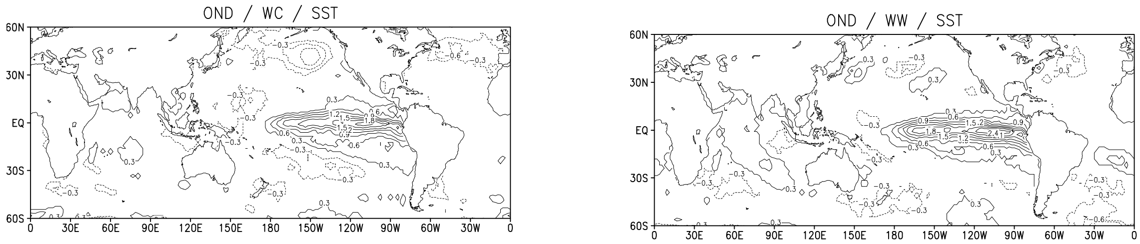

FIG. 2: *Composites fields of SST anomalies* calculated with respect to neutral years.

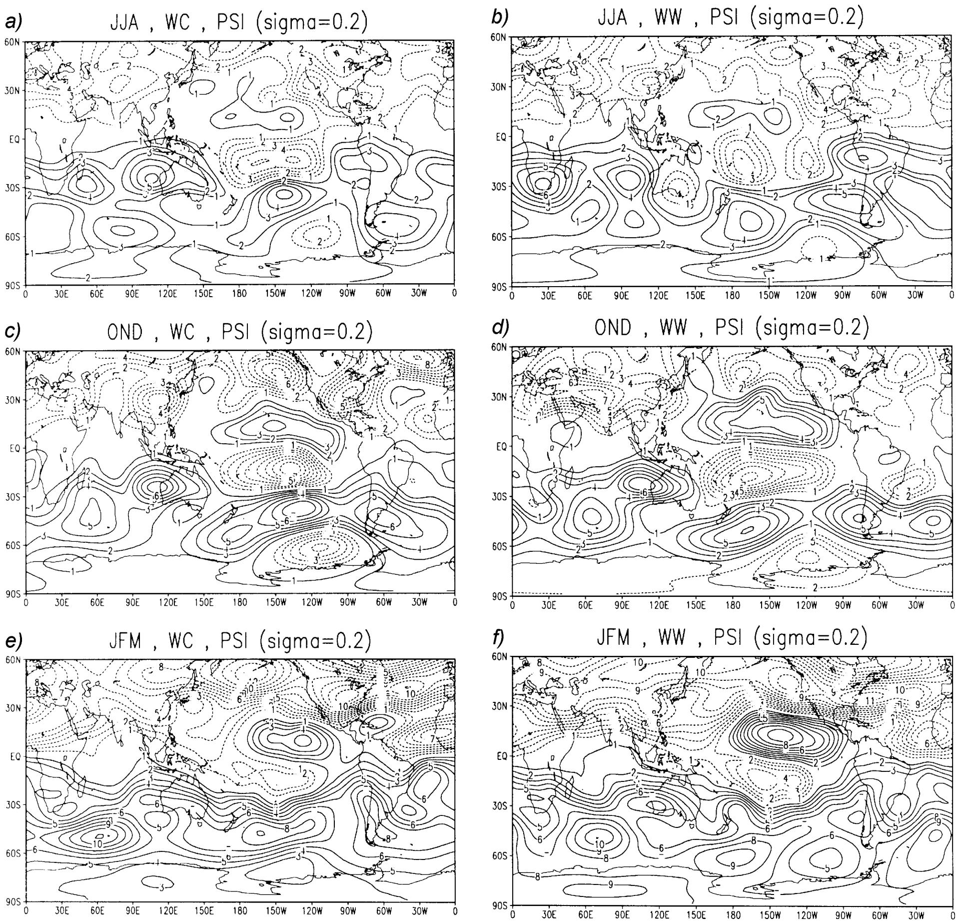

Fig. 3: *As in Fig. 2 except for streamfunction anomalies at s = 0.2. The contour interval is* $1.0x10^6$ m^2 s^{-1}.