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ON THE DIPOLAR BEHAVIOUR OF CONVECTIVE CLOUDINESS OVER SACZ AND SOUTHEASTERN SOUTH AMERICA DURING AUSTRAL SUMMER

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1 . INTRODUCTION

The general tendency for the occurrence of convective cloudiness and rainfall anomalies of opposite sign over the South Atlantic Convergence Zone (SACZ) and the South-eastern portion of South America (SESA) has been extensively documented and described in previous studies (see Diaz and Aceituno 2003, and the bibliographic review therein). This behavior has been related to specific circulation anomalies along the eastern margin of the continent that seems to be part of quasi-barotropic Rossby wave trains stretching from the South Pacific domain. Intraseasonal variability in rainfall and convective cloudiness over SACZ has also been related to the Madden-Julian oscillation in the Indian Ocean.

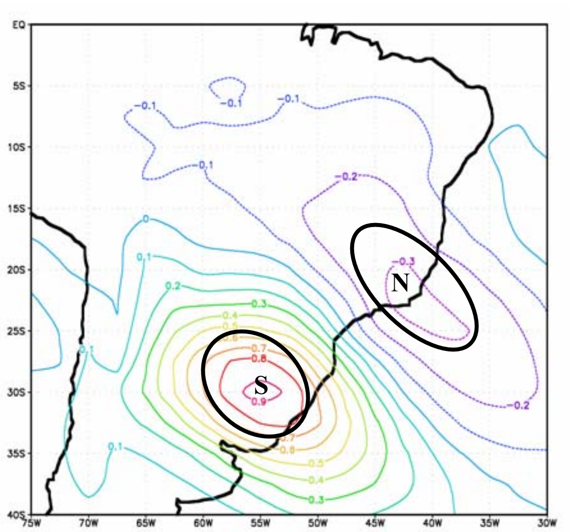

Figure 1: Correlation between outgoing longwave radiation (OLR) in gridpoint 30ºS - 55ºW and OLR elsewhere, for Oct-Mar 1974-2002. N and S indicate the two regions used to define the index of convective cloudiness.

Different techniques (Spectral Analysis, Wavelet Analysis and Singular Spectrum Analysis) are used to characterize the dipolar structure in the outgoing longwave radiation (OLR) anomaly over SACZ and SESA (Fig. 1). Particular attention was given to the interannual variability and persistence of this behavior throughout the austral summer semester (Oct - Mar).

2. DATA AND METHODOLOGY

A daily convective cloudiness index was defined for each center (N and S) by averaging daily OLR data obtained from the Climate Diagnostics Center (NOAA-CIRES) with a 2.5º by 2.5º special resolution, from 1 October to 31 March, 1974 – 2002 (excluding the 1977-78 and 1978-79 summer seasons). To filter variability at the synoptical time scale, a 5-day moving average was applied on each standardized index.

Continuous wavelet transform (CWT) using the Morlet function (Torrence and Compo, 1998) and singular spectral analysis (SSA) (Vautard et al., 1992) were used to identify the dominant pseudo-cycles present in each time series.

3. RESULTS

In only 10 of the 26 analyzed seasons a dipolar structure, characterized by opposite phase OLR anomalies over SESA and SACZ, was detected at some intraseasonal time scale suggesting that this behavior is not a permanent one. According to Table I the dipole was mostly detected during the austral summer (Dec – Jan – Feb) with a wide range of associated periodicities going from 20 to 50 days, although mostly in the 40-50 days range.

Year	Period (days)	Prevalent timing
75-76	50	J-F-M
76-77	30	D-J
81-82	50	D-J-F-M
83-84	40	D-J
84-85	40	J-F-M
86-87	20	N-D-J
87-88	25	J
93-94	50	J-F-M
94-95	50 40	D-J F-M
97-98	30	D-J-F

Table 1: Years with dipolar behavior in OLR over SESA and SACZ detected with CWT, dominant pseudo-periods, and months when it is present.

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The dipolar behavior was best noticed during the 1997-98 season, at the high of an intense El Niño phenomenon (Fig. 2). The dominant period for both centers is around 30 days.

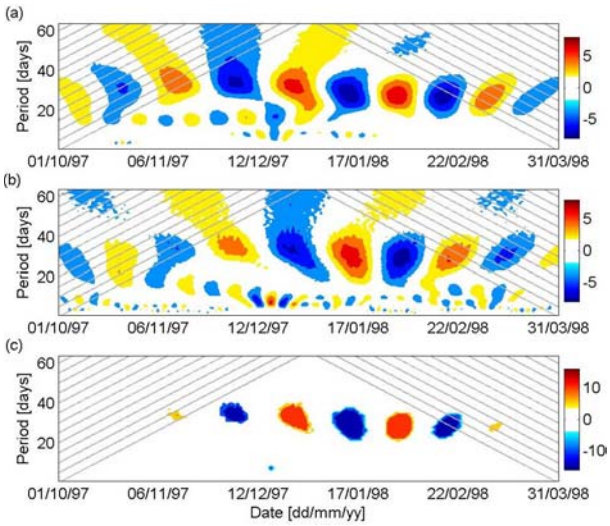

Figure 2: Morlet Wavelet spectrum for daily OLR indices in SACZ (a) and SESA (b) during Oct-Mar 1997-98. Panel (c) shows differences between panels (a) and (b) exceeding 60% the maximum difference in the entire frequency – time domain. Results should not be considered in the hatched area.

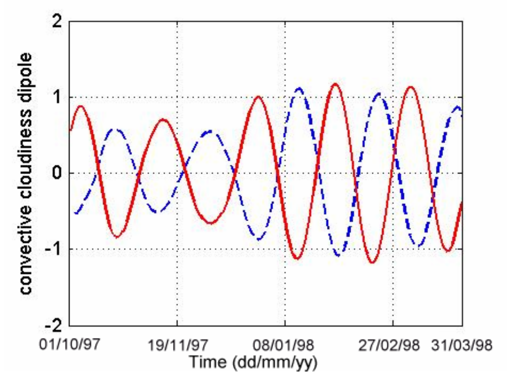

Figure 3: Partial SSA reconstructed series of daily OLR indices for SACZ (solid line) and SESA dashed line) associated to a dominant quasi-period of 37 days for October-March 1997-98.

Application of SSA to both 1997-98 OLR indices reveals that the most dominant quasi-periodic signal corresponds to 37 days. The associated partial reconstructed components are shown in Fig. 3, where it can be seen that the signal is more intense between December and February, which is consistent with what was found with the CWT analysis (see Fig. 2)

4. CONCLUSIONS

The spectral characteristics of opposite in phase OLR anomalies over SACZ and SESA exhibit a considerable interannual and intraseasonal variability. A dipolar behavior was particularly well defined in just 10 out of the 26 considered seasons, with a wide range of associated quasi-periodicities (20-50 days), although the range 40-50 days seems to be the most commonly observed. The time when the dipolar behavior is observed during a single season changes considerably from year to year, but the phenomenon seems to be more prevalent during the austral summer (DJF). Although El Niño conditions prevailed in 6 out of the selected 10 seasons when a well defined dipolar structure was observed, it is not clear that ENSO is a key factor modulating this phenomenon. In fact the dipolar behavior was quite contrasting during the most intense 1982-83 and 1997-98 El Niño episodes, being very weak during the 1982-83 event but well defined from December 1997 to February 1998 when opposite in phase OLR anomalies were observed over SACZ and SESA, with an associated pseudo-period of 30 days.

5. ACKNOWLEDGMENTS

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6. REFERENCES

Díaz, A. and P. Aceituno, 2003: Atmospheric circulation anomalies during episodes of enhanced and reduced convective cloudiness over Uruguay. *J. Climate,* **16,** 3171-3185.

Torrence, C. and G. Compo, 1998: A practical guide to wavelet analysis, Bulletin of the American Meteorological Society, **79**, 61-78.

Vautard, R., P. Yiou, and M. Ghil, 1999: Singular spectrum analysis: A toolkit for short noisy chaotic signals, Phys. D, 58, 95-126.