Proceedings of 8 ICSHMO, Foz do Iguaçu, Brazil, April 24-28, 2006, INPE, p. 1997-2001.

AN INTRASEASONAL ANALYSIS OF SEVERE COLD EVENTS IN THE CENTER-SOUTH OF BRAZIL IN THE WINTER PERIOD

Marcelo Schneider

Centro de Previsão de Tempo e Estudos Climáticos Cptec-Inpe, Cachoeira Paulista, São Paulo

Pedro L. Silva Dias

Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, São Paulo

Maria Isabel Vitorino

Division of climatology, Geological Institute, Sao Paulo State, Brazil

Nelson Jesus Ferreira

Centro de Previsão de Tempo e Estudos Climáticos, Cptec-Inpe, Cachoeira Paulista, São Paulo

1.Introduction

Cai and Mak (1990) discuss a mechanism that resemble a symbiotic relation between planetary and synoptic-scale waves, that is, wave interactions in a meteorological scenario.

Some studies for example, Vitorino (2001), Schneider (2004) investigated the intraseasonal oscillation and the associated cold surge events. They found some important contributions. Vitorino gave enphasis in the 30-60 band as responsible for the modulation in the climate scenario. Schneider, in turn, discuss the possible linking between MJO evolution and cold surge events. The author showed cases in the interaction wave context, i.e, synoptic and intraseasonal band oscillating in the same phase, in order to consolidate extreme events. However, there were few examples showing the real part of wavelet coefficients.

In a intraseasonal scenario the Madden-Julian oscillation is one of the most important ways of teleconnection. Madden and Jullian(1971) discovered this intraseasonal global tropical oscillation, a mechanism of teleconnection (a complete review, Madden and Jullian ,1994).

The objective of this work is to investigate atmospheric oscillations related to the severe cold events in the center - south Brazilian region at the winter austral period. It was performed the spectral analysis by mean the wavelet transform.

Corresponding author address Marcelo Schneider, Centro de Previsão de Tempo e Estudos Climáticos Cptec-Inpe, Cachoeira Paulista, São Paulo, CEP 12630-000

2. Data and methodology

The wavelet transform (WT) is a powerfull tool that describes the evolution of an oscillation in the time-space domain. The WT is suitable to study non-linear and non-stationary weather regimes. It has been used the Morlet function.

The WT packet here are adapted from the Torrence and Compo(1998). It was calculated the real part of wavelet coefficients, the energy and the scale averaging in a selected band (say 20-90 days, specially). The Air Mean Temperature (AMT) was the main variable in the study, used in representative places on the center and the south region. The wavelet transform was applied to a series of AMT, data extracted from the reanalisys project. (Kalnay, E. e colaboradores, 1996). It was executed an average in a region 16°S 19 °S, 52°W- 55°W, that covers the center part of Brazil.

The 1979 case was selected due to the MJO influence (Schneider 2004). This MJO event was very active. The MJO index was obtained from the electronical web page www.cpc.ncep.noaa.gov;products;precip;CWLINK;daily_mjo_index,proj_norm_order.ascii

The OMJ index (centered in 40°W) in the 1979 year reflects the global influence of the anomalous divergence. A negative (positive) value means convective (subsidence) active phase.

Also a weather station in South Brazil (Lomba Grande, - 29.7- 51W) placed in the Porto Alegre (RS) neighboarding was used to identify the oscillations in a selected extreme event. The 13 july cold surge event of the Lomba Grande station was responsible for a 0.7 minimum temperature, with heavy frost conditions (lower temperatures for a 2001-2005 winter period)

3. Results and Discussions

From Fig 1. its possible identify 2 or 3 extreme event over Center Region, that took place during the 1979 year, ends of may, middle of july and September. Schneider et al (2001) discuss a mechanism of cyclogenesis enhancement in the southeastern part of South America. The cyclogenesis process associated with the MJO displacement would lead to a cold surge in the center-south region of Brazil.

According to the center region date there was a strong intraseasonal oscillation close to the 50-60 day band. But its very interesting to note that the three episodes had the same spectral structure, that is, an interaction among synoptic, submonthly and intraseasonal scales. The scale averaging (lower panel) reflects in great part the 50-60 day band phase evolution

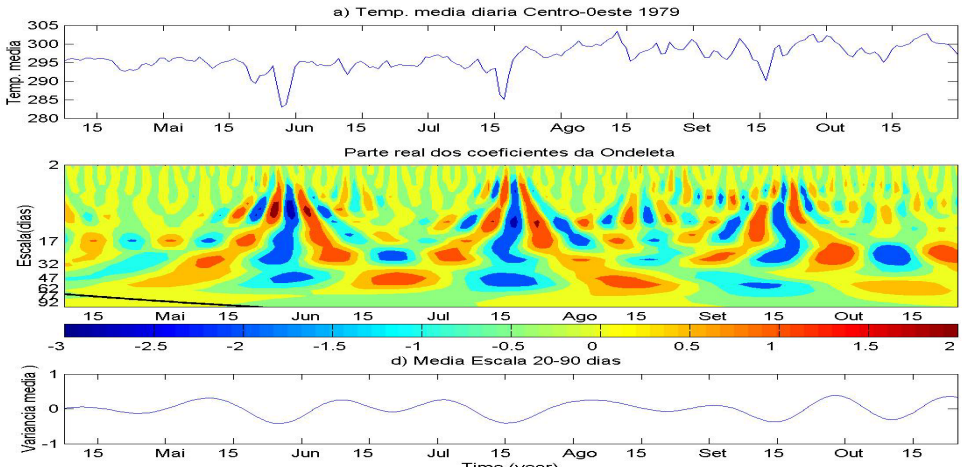

Fig 1 The air mean temperature (mai-oct 1979) series (upper panel), wavelet transform- real part of wavelet coefficients (middle) and the 20-90 days scale averaging (lower). (Scalogram varies from 2 – 92 days).

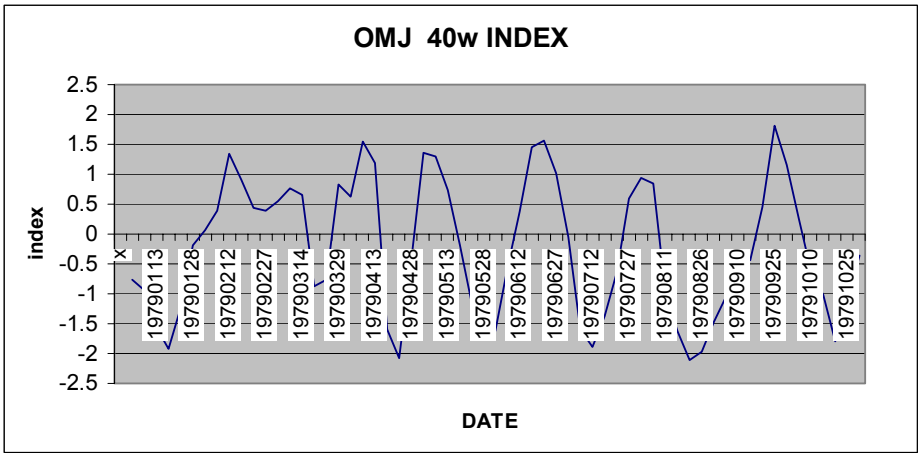

Fig 2. The evolution of the 40°W OMJ index in the 1979 year. A negative (positive) value means convective (subsidence) active phase.

The 1994 extreme event was another case where the scale interaction took place. The AMT reveals the strong case close to the 20th june. In this event the 15 day oscillation was the main responsible for the cold surge. On the other hand, the low frequency band (40-60 day) was present, but with lower amplitude.

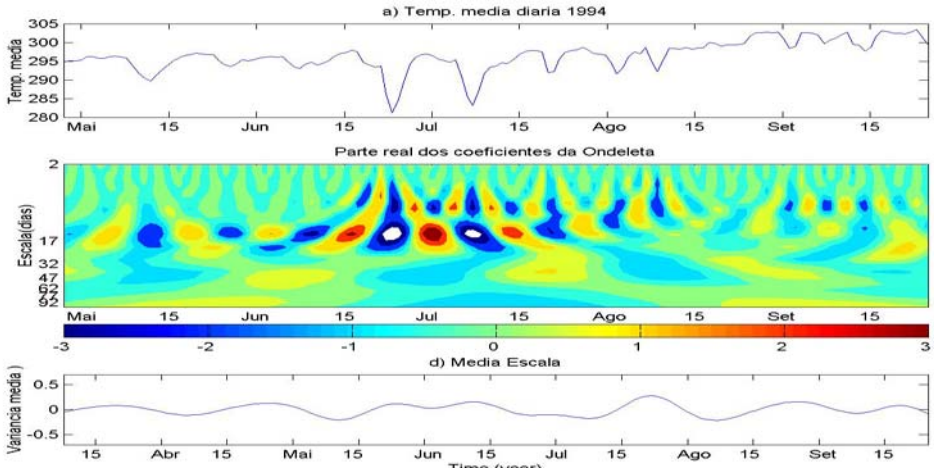

Fig 3. The same as Fig 1, except for the 1994 winter austral period.

3.2 Recent extremes events in southern Brazil

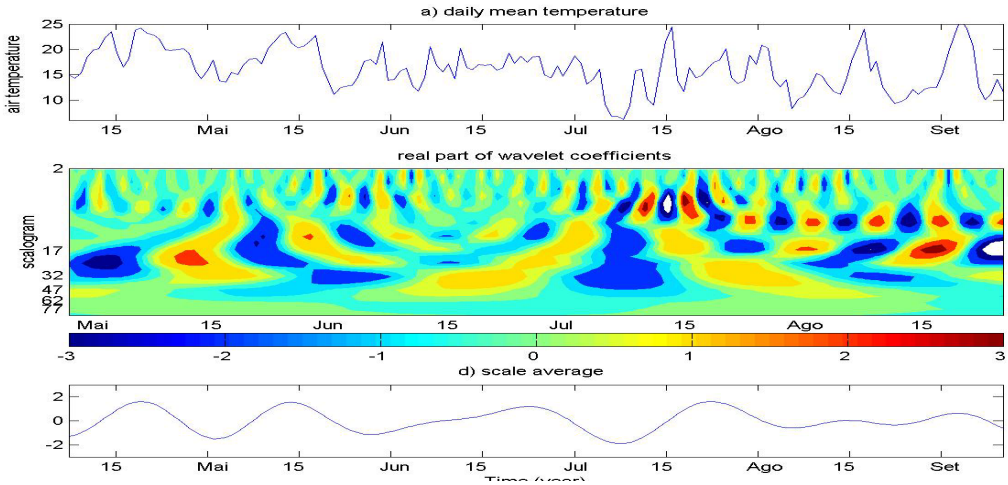

Fig 4. The same as Fig. 1 except for an observed temperature in Lomba Grande weather station in the 2003 year.

In the first half of july 2003 (Fig 4) the 30-45 day oscillation was responsible for the large environmental scenario, in order to the establishment of the high frequency transients. There is a connection between 50-60 days, intraseasonal and synoptic interaction (large band interaction).

It's an example of a symbiotic relation between planetary and synoptic-scale waves (Cai and Mak, 1990). In this event the MJO Index has the minimum values in the june 22 and july 2 days (not showed), that is, just before the consolidation of the cold period.

4.Conclusions

The results indicate that global environmental scale (say 20-90 days) modulate certain phases and favor the occurrence and the consolidation of the severe cold events. The extreme events selected here showed a tendency to occur when exists interaction between large and small scale, that is, lower with higher frequency transients in a symbiotic interaction.

Some results point with respect to a linking between the occurrence of severe cold events associated with the MJO displacement (like the 1979 case). In these situation there is an Inter-hemispheric convection linking through the East Pacific (next to Central America) and the cyclogenesis enhancement in the Southeastern of the South America.

References

Cai, M. e M. Mak, 1990: Symbiotic relation between planetary and synoptic-scale waves. .Atmos.Sci., 47, 2953-2968.

Ferraz, S. E. T., 2000: Oscilações Intrasazonais no Sul e Sudeste do Brasil durante o verão. Dissertação
de Mestrado. Departamento de Ciências Atmosféricas, IAG/USP, 157p. (in portuguese)

Kalnay, E. e colaboradores, 1996: The NCEP/NCAR 40 year reanalisys project. Bull. Amer. Meteor. Soc., 77, 437-471.

Madden, R.A.; Julian, P.R.: Detection of a 40-50 day oscillation in the zonal wind in the tropical Pacific. J.Atmos.Sci., 28, 702-708, 1971.

Madden, R.A.; Julian, P.R.: Observations of the 40-50 day tropical oscillation - a review. .Wea.Rev., 122, 814-837, 1994.

Schneider, M. Everaldo B. de Souza Odon Sanchez-Ccoyllo Pedro L. da Silva Dias, 2001:Impacto da Oscilação de Madden- Julian: Simulações Numéricas com um modelo Barotrópico.Anais do XII Congresso Brasileiro de Meteorologia , Foz do Iguaçu (in portuguese)

Schneider, M, 2004 Analise da Intrasazonalidade nas regiões Sul, Sudeste e Centro-Oeste do Brasil durante os meses de inverno. Dissertação de Mestrado. Departamento de Ciências Atmosféricas, IAG/USP, (in portuguese)

Torrence, Christopher e G.P. Compo, 1998: A practical Guide to Wavelet Analisys. Bulletim of Am. Met. Society, Vol. 79, 61-78.

Vitorino, M.I.,:2002: Oscilações Intrasazonais sobre o Sudeste Brasileiro utilizando-se a análise da Transformada Wavelet. Anais do XII Congresso Brasileiro de Meteorologia, Foz do Iguaçu. (in portuguese)