IAI CRN – 055 Co-Pis FIRST MEETING
Boulder, Co, July 10, 11 & 12, 2000

Tércio Ambrizzi's Presentation Summary

A) INTRODUCTION

My presentation was divided in two different topics. The first one, is related to the wintertime cold surges in the tropical-subtropical South America which is a collaborative study between four different researchers from four different institutions: Brant Liebmann (NOAA/CDC/USA), George Kiladis (NOAA/AL/USA), José Marengo (CPTEC/INPE/Brazil) and myself from USP/Brazil. The second part of my talk, was related to the precipitation patterns relationship over South America with SST's during ENSO. This research involves one of my M.Sc. students from University of São Paulo, Mr. Caio A. Coelho. Some of the main points presented in my talk will be addressed below.

B) TITLE OF THE PRESENTATION: "UPPER-AIR WAVE TRAINS OVER THE PACIFIC OCEAN AND WINTERTIME COLD SURGES IN TROPICAL-SUBTROPICAL SOUTH AMERICA"

An examination is made on the relationship between circulation and convection over South America as related to strong cooling in southern and southeast Brazil during austral wintertime. Correlations between sub-monthly (2-30 days) near-surface air temperature in southeastern Brazil reveal the preferred path of a quasi-stationary Rossby waves impinging on to the region from midlatitudes emanating from the tropical western Pacific. The large amplitude upper-level trough in middle latitudes, which extends into the tropics, has been pointed out as one of the major features of the cold situation. These waves embedded on a westerly flow are an example of wintertime tropical-extratropical interactions leading to cooling in southeastern South America. This is suggested by the results from the observational and baroclinic-modeling studies found in our study.

To establish the relationship between winter surface cooling and lower and upper-air circulation, filtered air temperature is centered at a base point 22.5^{o}S, 60^{o}W, which is representative of the location of coffee growing areas of southern ans southeastern Brazil that may be affected by freezes. A temperature perturbation of –1 standard deviation in temperature (that is –4.5^{o}C) is applied for the region, and this is regressed against the raw 1000 hPa air temperature and geopotential height, and against the 200 hPa zonal and meridional components of the wind, and streamfunction all at each global grid point. Lagged regression relationships were used to examine the evolution of the surface cooling and convection signals over time. The lags are –12 to +12, with day 0 as the coolest day (no lag), and –12/+12 indicate 12 days prior/after the day 0.

To exemplify some of the results presented during the seminar, Fig.1 shows the 200 hPa streamfunction and wind field lag correlation analysis. On day –12, a cyclonic perturbation is detected at 30^{o}S, 90^{o}W, which intensifies and moves closer to Chile off coast 4 days after. On day –8, the cyclonic perturbation intensifies and starts its movement toward southern South America, while now more intense anticyclonic perturbation behind the cyclone one also moves to the east. From days –4 to +1 the couplet of cyclonic/anticyclonic perturbations shows na intensification, and on day 0 de cyclonic perturbation is located over the base point, while the anticyclonic is located over the southern Chile-southern Argentina region. The northward flux indicated in Fig.1 between the cyclonic and anticyclonic perturbations is also an indicator of the intense southerly flux between the ridge and trough that facilitates the inflow of near surface cold air from Argentina into southeastern Brazil.

Using a baroclinic primitive equation model, several experiments have been performed, placing the heating forcing at various longitudes along the 10^{o}N, in order to analyze the sensitivity of the phase and amplitude of the quasi-stationary Rossby wave response to the heating anomaly. To compare the model results with the observational analysis, the streamfunction anomaly at 250 hPa is shown in Fig.2. This figure shows the streamfunction anomalies for the forcing located at the longitudes of 100^{o}E, 120^{o}E, 140^{o}E and 160^{o}E. From the analysis of the stationary wave patterns, we observe that the main wave activity occurs into the subtropical and subpolar jet waveguides, which is in agreement with previous teleconnection studies found in the literature. From these experiments we note that the remote response over our base point region (23.5^{o}S, 60^{o}W) has a stronger signal when the forcing is located at 120^{o}E (Fig.2b). Indeed, when we compare this stationary wave pattern with the lag regression maps shown in Fig.1, we found a good resemblance. Based on this result and some other experiments it was suggested that the location of the maximum tropical convection region during the winter is important to generate Rossby waves with the right phase and amplitude which may contribute to the occurrence of cold events over South America.

In summary, our results indicate that quasi-stationary Rossby waves emanating from the western tropical Pacific during wintertime might represent an important mechanism from tropical-extratropical interaction that affects weather and climate in southeastern South America in general. But together with the right synoptic situation associated to this intermediate modulation, local controls are important on determining the degree of cooling and the occurrence of freezes.

C) TITLE OF THE PRESENTATION: "PRECIPITATION PATTERNS OVER SOUTH AMERICA ASSOCIATED WITH SST's DURING ENSO"

Previous studies on precipitation over South America that strongly support the existence of links between precipitation and SST anomalies in the Pacific Ocean have identified specific regions where the ENSO signal is particularly stronger. Northeast of Brazil and some parts of southern South America are examples of these regions. However, the same attention was not taken to identifying which regions in the Central and East Pacific ocean are better correlated with the South America precipitation during extreme ENSO events, and also which are the transition regions of the precipitation signal over South America during these events.

Coincident periods of ENSO events for both SST over the tropical Pacific ocean and monthly accumulated precipitation data from many observational stations over South America were selected and analyzed. Two statistical methods were used for the data analysis: Singular Value Decomposition (SVD) and simple linear correlation (SLC). The SVD results for warmer events in the Pacific corroborate previous ones and also clearly identified a transition region between the drier conditions in the Northeast of Brazil and the wetter conditions in the Southeast/South of Brazil. Transition regions were also determined over Peru and central Amazon. The SLC results indicated that the SST anomalies in the Niño 3 region in the tropical east Pacific ocean has the strongest influence in the South American precipitation during El Niño events. During La Niña events the central area of the Niño 4 region, around 180º, has shown a remarkable influence.

As an example of some results already found on our study, Fig.3 shows the first mode of the heterogeneous correlation map between the precipitation (Fig.3a) and the SST (Fig.3b) during December to May of El Niño episodes. The number at the top left of the SST map is the correlation coefficient between the SST and the precipitation expansion coefficients and the one at the top right, the squared covariance fraction of this mode in percentage. Isolines are on 0.1 interval. Dashed (solid) isolines are negative (positive) values. Shaded areas represent regions with positive correlation. Correlation coefficients higher than +0.4 and lower then –0.4 are statistically significant at the level higher or equal to 90%.

Based on Fig.3 and many other results, it was shown that the precipitation over part of the Northeast Brazil, extreme west of northern Brazil and Bolivia are negatively correlated to the SST, thus experiencing a reduction of rainfall during El Niño episodes. On the other hand, northern Peru, central and southern Brazil, Paraguay and northern Argentina experience an increase of precipitation during El Niño.

D) FINAL COMMENTS

As can be seen above, from the brief discussion of some studies that I am involved nowadays, there is already a good research collaboration between different institutions and colleagues scientists. Also, the participation of students are very important for the development of many relevant studies inside our main project, and they are already part of our team.

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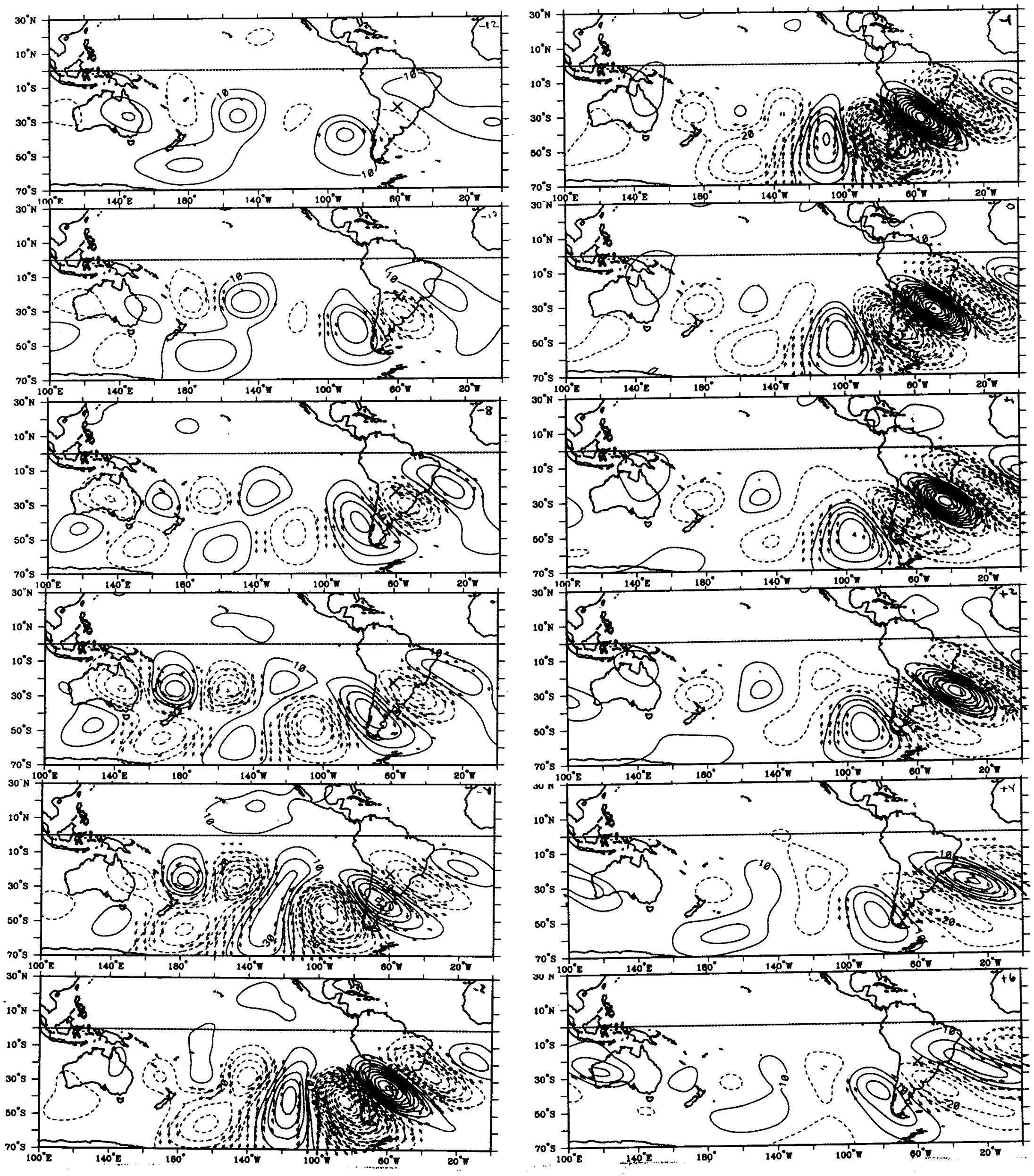


FIGURE 1: See text for details

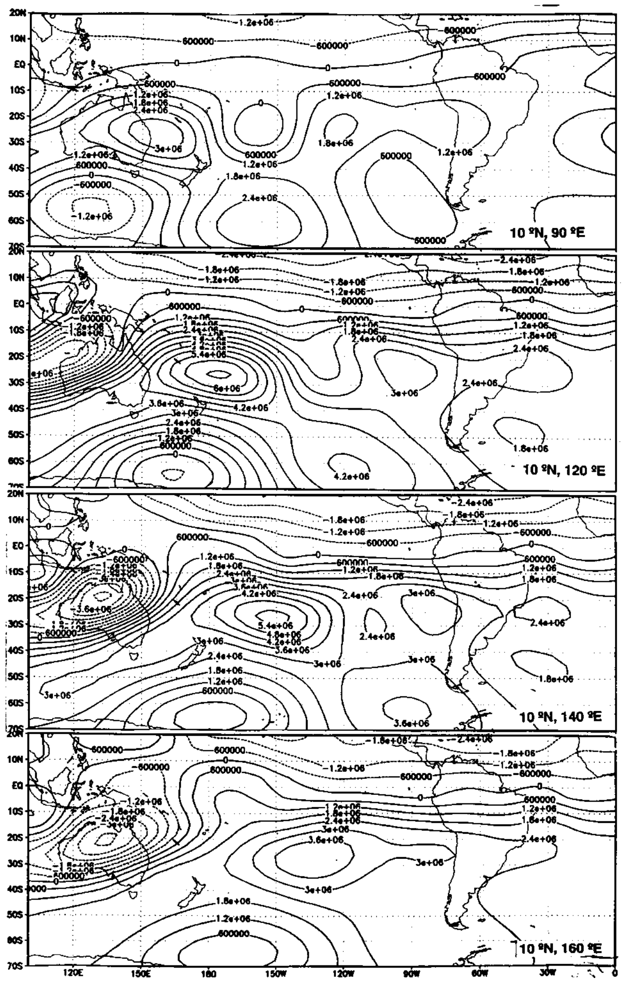
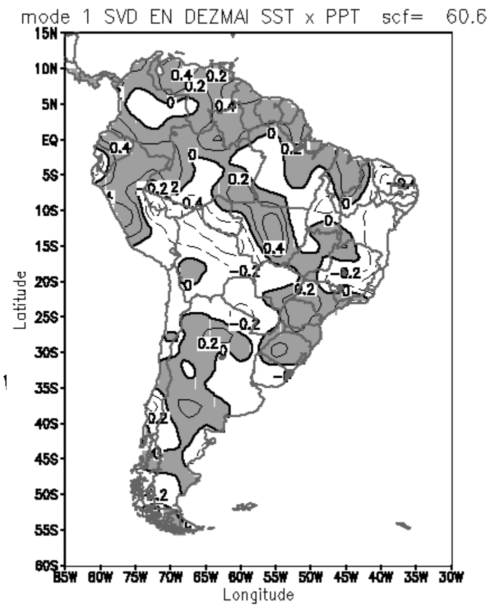
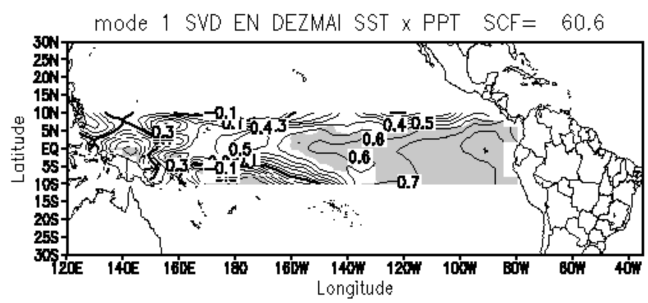


FIGURE 2: See text for details



(A)



(B)

FIGURE 3: See text for details