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ATMOSPHERIC CIRCULATION AND SEA SURFACE TEMPERATURE ANALYSIS, FOR CASES OF ANOMALOUS POSITIONING OF THE INTER TROPICAL CONVERGENCE ZONE ASSOCIATED WITH THE NORTH ATLANTIC OSCILLATION

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1-INTRODUCTION

The near-surface winds of tropical Atlantic are dominated by the southeast and northeast trade wind systems, which converge at the Intertropical Convergence Zone (ITCZ). The influence of the ITCZ displacements on regional rainfall in the northern part of the Northeast Brazil region has been shown by several authors (e.g. Hastenrath and Heller, 1977; Hastenrath and Lamb, 1977; Moura and Shukla, 1981). In this region, the seasonal distribution of rainfall shows a sharp peak for March-April, when the ITCZ is in its extreme southerly position.

There are many studies suggesting that the variability in tropical Atlantic has a strong influence on the ITCZ latitudinal positioning. Some studies have suggested a variety of potential mechanisms by which variability is produced by local interactions within this sector. Other studies have indicated remote forcing as ultimate source of variability. Sutton et al (2000) suggested that the main atmospheric forcing is the North Atlantic Oscillation (NAO).

NAO is a large-scale alternation of the atmospheric mass between the Iceland Low and Azores High and is an important source of seasonal to decadal-state climate variability in the Atlantic sector (Rogers, 1984). It is the dominant mode of atmospheric behavior in the North Atlantic throughout the year, although it is most pronounced in DJF, during boreal winter. The NAO Index (NAOI), which expresses the temporal behavior of this oscillation, is defined as normalized sea level pressure difference between Akureyri, Iceland, and Ponta Delgada, Azores (Rogers, 1984). A “high-index” pattern is characterized by an intense Iceland Low with a strong Azores ridge, associated with a stronger than average northeast trade winds across tropical region of the Atlantic. In the “low-index” case the signs of these anomaly-cells are reversed.

The objective of this study is to analyze global circulation and behavior of TSM in periods when the ITCZ is in its extreme position southward in April, preceded by a NAO positive phase in DJF.

2-DATA AND METODOLOGY

The variables used are monthly mean data of NCEP-NCAR reanalysis for wind, geopotential height (HGT), sea level pressure (SLP), sea surface temperature (SST) and observational data of outgoing longwave Radiation (OLR) (NOAA). The data cover a period of 29 years (1975-2003). Monthly raw NAOI available at http://bprc.mps.ohio-state.edu/glp/NAO is also used.

The first step in this study is finding the probable position of the ITCZ using both the region of minimum OLR and the region of confluence of southeast and northeast trade winds at 925hPa. The second step is to select years with anomalous displacements of ITCZ southward in April, after occurrence of NAOI positive above 0.8 of standard deviation, in DJF. The selected years are: 1984, 1989 and 1995. The last step is to generate composite fields with these years.

3-RESULTS

Sea Level Pressure (SLP) anomalies in DJF indicate the low-high pair typical of positive phase of NAO (Fig.1a). Looking the SLP field (Fig.1b) and the anomalies, the composite shows intensification of the North Atlantic Subtropical High and of the Iceland Low. At the same time it is possible to identify the South Atlantic Subtropical High (SASH) and a Low pressure center to the south. Both centers present lower than normal pressure, characterizing the weakening of the SASH and strengthening of the high latitude low pressure.

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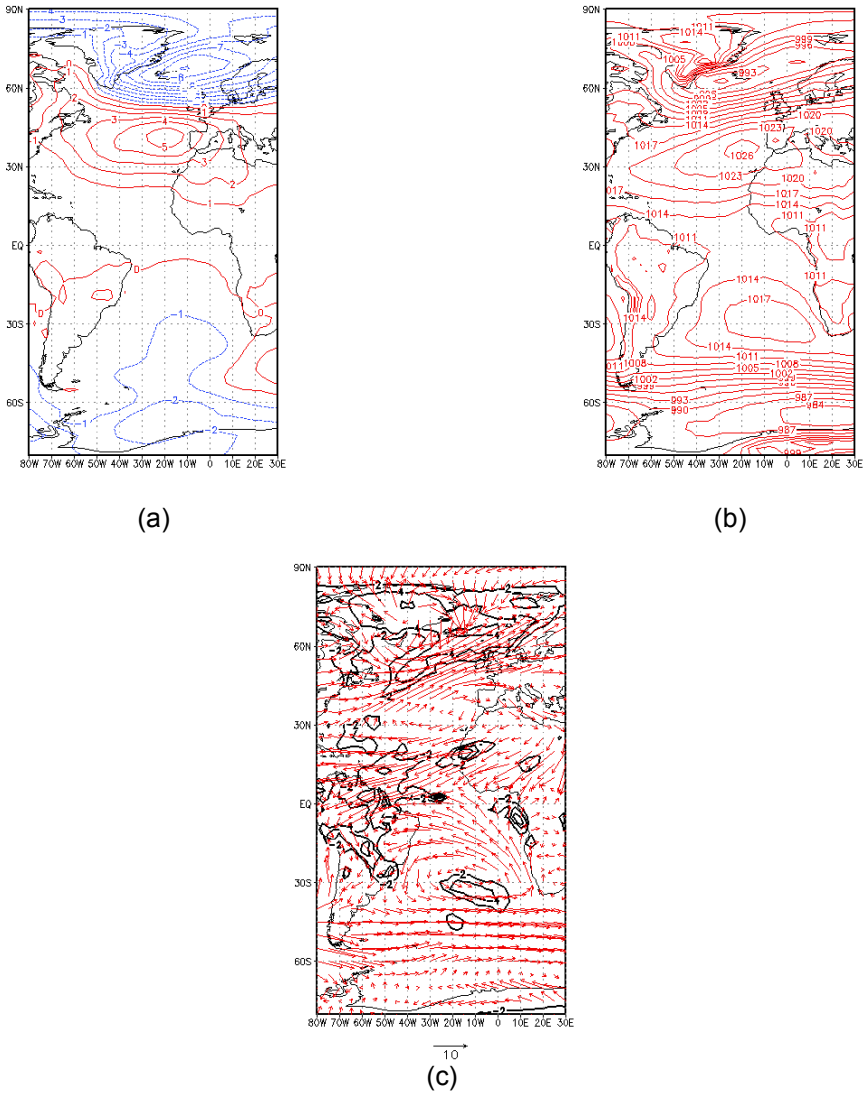

Figure 1 - Composites of DJF: (a)-SLP anomaly; (b)- SLP field; (c)- Wind at 925hPa; OLR anomalies (contours).

Wind field at 925 hPa and OLR anomalies of April composites show an intensification of ITCZ south of equator (Fig.2c). The SLP field and anomalies indicate a displacement southward of both North Atlantic and South Atlantic Subtropical Highs (Fig.2a,b). These behaviors are consistent with the winds confluence southwards of the region found in DJF. SST anomalies in Fig.2d display warmer than normal waters south of equator and opposite condition north of equator, in the tropical region. This SST gradient is also consistent with the intensification of ITCZ south of equator.

4- CONCLUSION

Extreme cases of positive phase of NAO in DJF resulted in occurrence of an intensified ITCZ south of equator, in April. The favorable tropical SST gradient in April was related to the intensification of the North Atlantic Subtropical High in DJF, and to the South Atlantic Subtropical High displaced southward of the mean position. In April, both North Atlantic and South Atlantic Subtropical Highs were displaced southward, contributing to the confluence of winds south of equator.

Additional analyses are in development to investigate in details the influence of atmospheric anomalies on the ITCZ position.

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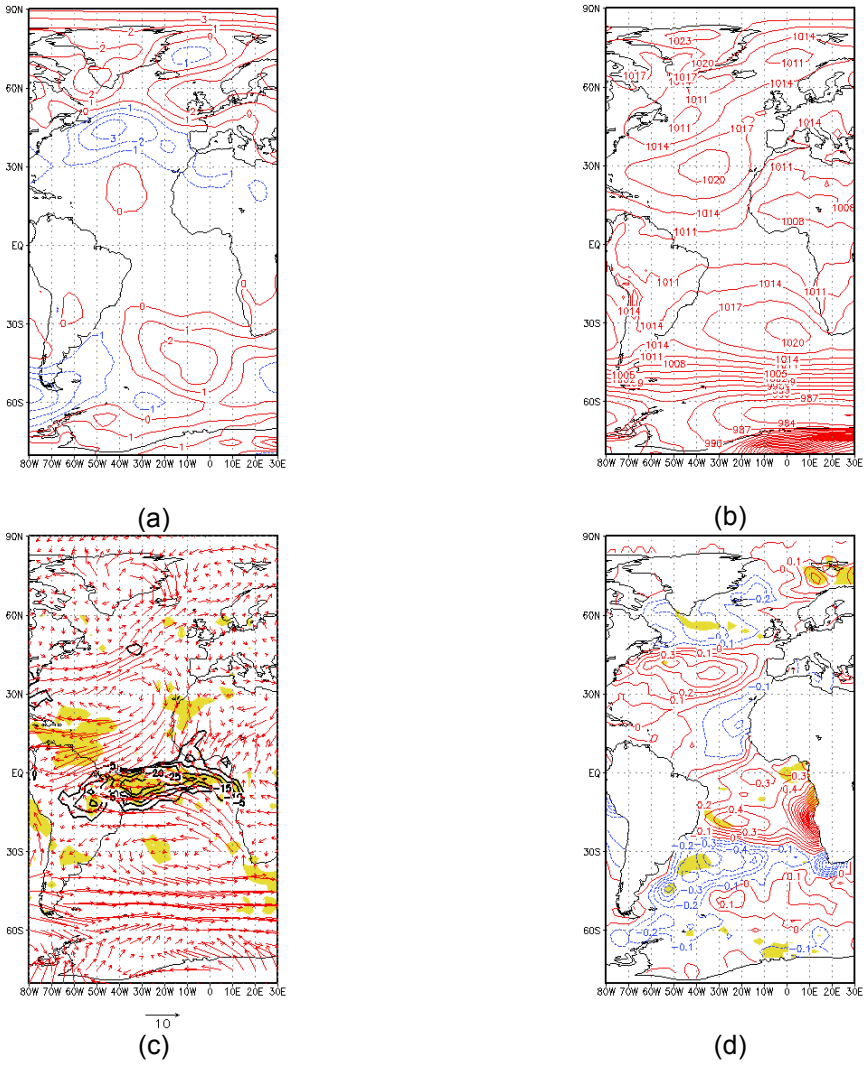

Figure 2 - Composites in April: (a)-SLP anomalies; (b)- SLP; (c)- Wind at 925hPa; OLR anomalies (contours); (d) SST anomaly. Shaded areas indicate 95% confidence.

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