P2.36 Climatology of upper level cyclonic vortices over northeastern South America

Nuri O. Calbete, Luis Gustavo G. Gonçalves, Prakki Satyamurty
Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) – Instituto Nacional de Pesquisas Espaciais (INPE) – Cachoeira Paulista, SP, Brazil

1. Introduction

Cold core cyclonic vortices over Northeast Brazil and the adjoining tropical Atlantic, along with the anticyclonic circulation centered over Bolívia over the Amazon region, is a common feature of the upper tropospheric circulation in austral summer. One of the important characteristics of this system is that subsiding motion in the center of the vortex inhibits convection and rising motion on the periphery of the vortex favors cloudiness and rain (Kousky and Gan 1981). Therefore the position and intensity of the vortex determines the spatial distribution of rain on the daily basis over Northeast Brasil during the prerainy season (Jan-Feb) of the smiarid and northern Northeast Brazil (Kousky 1979).

2. Data analysis and results

The Northeast Brazil has several distinct subregions with their characteristic rainfall regimes. To understand the effect of the Upper Level Cyclonic Vortex (ULCV) over Northeast Brazil we considered four subregions A, B, C and D shown in Fig. 1. A is the eastern coastal region, B is the northern coastal region, C is the western region, and D is the central region. The monthly rainfall anomalies from climatology for January, February and March of nine years from 1989 to 1997 for the four subregions are categorized into five types: much higher than normal (++), higher than normal (+), normal (+-), lower than normal (-) and much lower than normal (--), and the result is shown in Table 1.

The longitudinal position of the center of the ULCV can vary from 20°W to 50°W. Depending on the position, one subregion or the other, shown in Fig. 1, may receive more rain or less rain. Using the NCEP reanalysis data for the nine year period the number of days with ULCV in three different positions, namely, east of 30°W, between 30° and 40°W, and west of 40°W. The criterion used for the presence of ULCV is that the maximum cyclonic vorticity should exceed $4X10^{-5}$ s^{-1}, and on a given day only one vortex or none is present.

The results of the interannual variation of the number of days with vortex during the months of Jan, Feb and Mar are shown in Fig. 2. The total number of days with ULCV, irrespective of their postion, for Jan, Feb and Mar are shown in Fig. 3. The years 91 and 96 have peaks in January with more than 20 days. In general the midsummer month January presents more days with vortex than February and March. A steady increase of the number of days in Feb and Mar from 1989 to 1995 is indicated, but a longer period statistics are required to know about decadal or interdecadal variations.

One important and alarming observation is that there is no association of the number of days with vortices shown in Figs. 2 and 3 with the rainfall anomaly characteristics shown in Table 1. Perhaps a more detailed and careful study is needed to understand the interannual variability of the ULCVs and their effect on the monthly and seasonal rainfall patterns over Northeast Brazil.

References

Kousky, V. E., Gan, M. A., 1981: Upper tropospheric cyclonic vortices in the tropical South Atlantic. *Tellus*, **33**, 538-551.

Kousky, V. E., 1979: Frontal influences on Northeast Brazil. *Mon. Wea. Rev.*, **107**, 1140-1153.

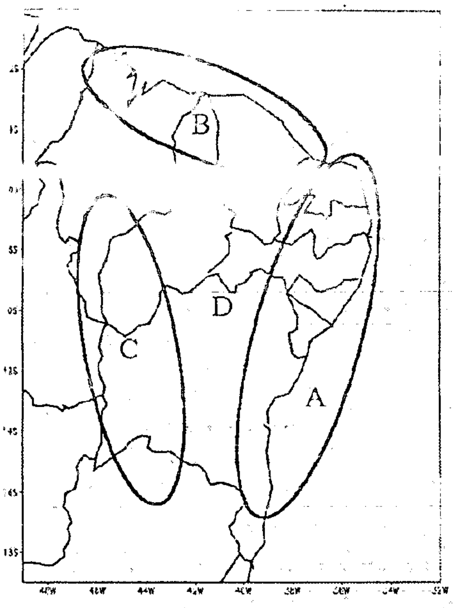

Fig.1 – homogeneous regions of Northest Brazil. A: east coast, B: north coast, C: western region, D: central regior

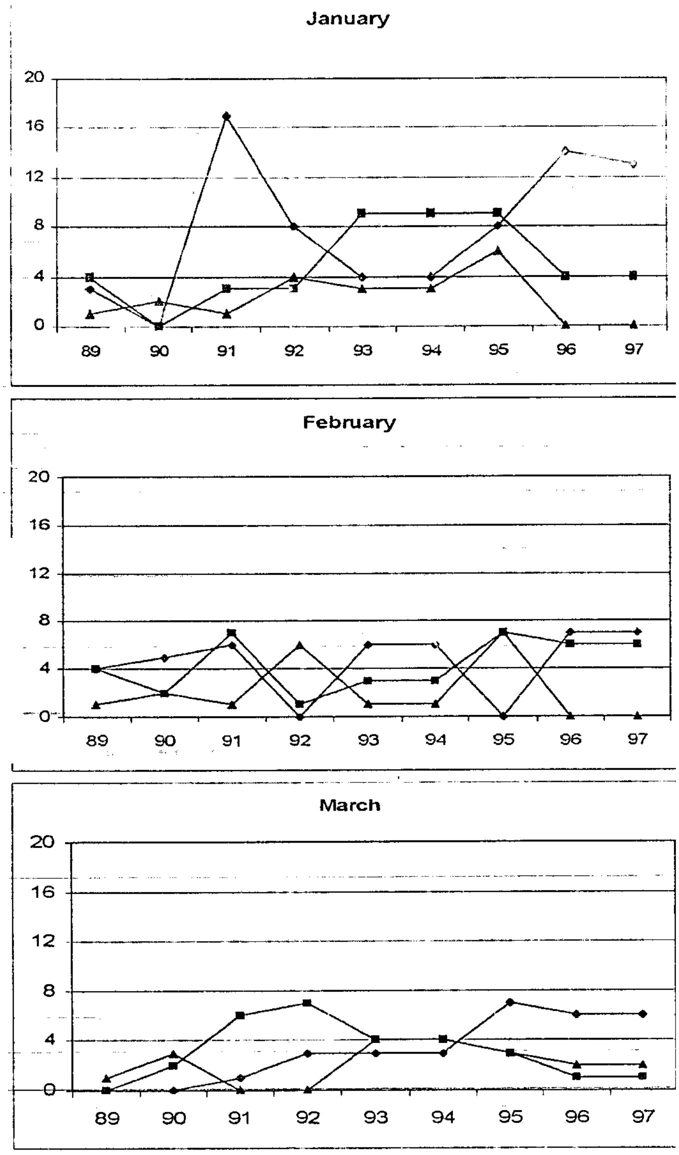

Fig. 2 – Number of days with 250 hPa cyclonic vortex over Northest Brazil and neighborhood.
West of 40W; - Between 40W and 30W; East of 30W.

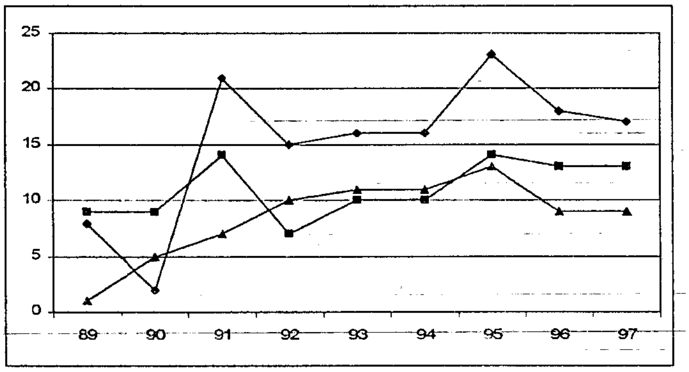

Fig. 3 – Total of 250 hPa cyclonic vortex over Northest Brazil and neighborhood.
- January; - February; - March.

Table 1. Monthly precipitation anomaly in different regions shown in fig.1.

Year	January				February				March			
	A	B	C	D	A	B	C	D	A	B	C	D
89	+ -	+ -	- -	+ -	- -	- -	- -	- -	+	+	–	+
90	--	--	--	--	-	+-	--	-	-	-	--	--
91	-	-	+	+-	+-	+-	--	+-	+-	+	+-	+-
92	+-	+-	++	+	+-	+-	-	-	+-	+-	--	--
93	--	--	--	--	--	+	-	--	+-	+	--	-
94	+ -	+ +	+ +	+	+ -	+ -	+ -	+ -	+	+	+ +	+
95	–	- -	–	–	- -	+ +	+ +	+ +	+ -	- -	–	–
96	–	+	- -	- -	–	–	- -	- -	–	+	+ -	–
97	+ -	–	+	+ +	+ +	- -	- -	–	+	–	+	+ +