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14. Abstract/Notes

The rainy season in northern Northeast Brazil, which normally occurs between February and May, was in 1981 charaterized by extremes. Very little rainfall was recorded until 15 March. During 15-30 March excessive rainfall occurred over nearly the entire region. April experienced a return to abnormally dry conditions. By compositing tropospheric wind fields for the contrasting periods we attempt to determine the salient features associated with these extremes. Streamline, divergence and vertical motion fields are produced for the composite fields and on a daily basis. Preliminary results indicate that the Southern Hemisphere mid-latitude circulation pattern was the primary factor in initiating the convective activity.

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CONTRASTS BETWEEN WET AND DRY PERIODS WITHIN THE 1981 RAINY SEASON IN NORTHEAST BRAZIL

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1. INTRODUCTION

The region of Northeast Brazil has received considerable attention by researchers due to its large interannual rainfall variability. Early studies (e.g. Mossman, 1919; Walker, 1928) linked this variability to meteorological events at distant locations within the tropics and subtropics of both hemispheres. More recently, Namias (1963) showed that tropical rainfall variations over the Americas are, at times, related to mid- and high latitude atmospheric circulation changes during the Northern Hemisphere Winter and Spring months. Namias (1972), extending his earlier work, showed that wetter than normal conditions over Ceará, Northeast Brazil are positively correlated with lower than normal 700 mb geopotential heights over the North Atlantic in the region of Newfoundland. North Atlantic blocking, on the other hand, leads to drier than normal conditions over Northeast Brazil. Hastenrath and Heller (1977) demonstrated that the intensities of the northeast and southeast trades are related to rainfall variations in Northeast Brazil. They determined that the Intertropical Trough Zone is north of its normal position when the northeast trades are weaker and the southeast trades are stronger than normal. Under these conditions northern Northeast Brazil experiences drier than normal conditions. As pointed out by Moura and Shukla(1981), the latitudinal position of the Intertropical Trough Zone (ITZ) is probably not the only factor involved in causing interannual rainfall variation since the differences in the position of the ITZ, obtained by Hastenrath and Heller(1977) between the composite of 10 extremely wet years and that for 10 extremely dry years, are quite small.

By using daily data, some of the weather producing systems have been studied for the region of Northeast Brazil. The influence of Southern Hemisphere cold fronts on rainfall in the Northeast has been studied by Kousky (1979). Upper tropospheric cold lows and their effects on cloudiness in eastern Brazil have been investigated by Kousky and Gan (1981). Each of these systems organizes convective cloudiness on the synoptic scale. Another important factor which produces daily variations in rainfall is the way in which the local wind circulation regimes interact with the synoptic scale flow pattern. The importance of the local wind systems in producing diurnal rainfall variation over the Northeast has been treated by Kousky (1980).

The rainy season in Northeast Brazil is rather short extending from February to May with the rainfall rarely being well distributed. Instead, periods of rain, sometimes only a few days in length, are separated by longer intervals of no rain. The realtively small number of precipitation events in the interior Northeast has been noted by Ramos (1975) in his description of the 1972 rainy season.

In this paper we focus on the extremely wet and dry periods which characterized the 1981 rainy season. The differences in the atmospheric circulation pattern during these periods will aid in understanding the causes for the extremes and may well provide important information on the circulation patterns associated with extreme interannual variations.

2. ANALYSIS METHOD

Composites of the circulation patterns for each standard level from 1000-200mb were constructed for the periods 11-20 February, 21-28 February, 1-10 March, 11-20 March and 21-31 March. These periods were chosen to facilitate comparison of circulation features with observed total rainfall data which are available in the *Bulletim de Agroclimatologia* published by the Brazilian Instituto Nacional de Meteorologia. Streamline and isotach analyses as well as fields of vertical motion at 500 mb were drawn for each composite.

3. SYNOPTIC DESCRIPTION

During February the 250 mb the mid-latitude circulation pattern over the North Atlantic was characterized by a strong ridge centered at 40-45°W (Fig. 1). This ridge weakened towards the end of the month. Associated with this ridge, a strong 850 mb anticyclone was located at 35-40°N in the central Atlantic. During March the Northern Hemisphere mid-latitude flow pattern was considerably different. A 250 mb trough and associated 850 mb cyclone formed in the central and western Atlantic near 55°W (Fig.2). The North Atlantic 850 mb subtropical anticyclone was displaced substantially southward from its February position.

In the South Atlantic, February was characterized by a circulation regime, which in some respects was similar to that over the North Atlantic. A mid-latitude 250 mb ridge existed over the central South Atlantic. A fairly large 250 mb cyclonic circulation existed near 10-15°S and 30°W at the beginning of the month but gradually weakened during the month as the mid-latitude ridge to the south also weakened. Associated with the mid-latitude ridge, an 850 mb anticyclone was situated at 30-35°S and 20-30°W. During March the 250 mb flow over the western and central Atlantic became cyclonic and the 850 mb anticyclone was displaced to near 5°W. This eastward displacement of the South Atlantic high was accompanied by a weakening of the southeast trades over much of the eastern Atlantic and the appeareance of winds with a northerly component over Northeast Brazil. During the first two weeks of March a vigorous cloud band, associated with Southern Hemisphere cold frontal systems, steadily penetrated to lower and lower latitudes over eastern Brazil.

Rainfall over Northeast Brazil was relatively light throughout February with the greatest amounts occurring during the first half of the month. March, on the other hand, was extremely dry during the first 15 days and extremely wet during the last 15 days.

4. DISCUSSION

Most circulation features and related rainfall noted here agree with features noted in climatological studies using monthly and seasonal means (see the Introduction). The dry period (February) was characterized by a strong ridge and possibly blocking in the North Atlantic, which as shown by Namias (1972) is related to drier than normal conditions in northern Northeast Brazil. What little rainfall that did occur seems to be associated with the upper tropospheric cyclonic circulation near eastern Brazil (see Kousky and Gan, 1981 for characteristics of this type of system).

The wet period (March) showed nearly the inverse pattern in both hemispheres. Strong tropospheric cyclonic activity was present in the western and central North Atlantic, a feature which Namias (1972) showed is linked to wetter than normal conditions in northern Northeast Brazil. At the same time the North Atlantic 850 mb subtropical high was displaced equatorward while the South Atlantic high was displaced poleward and eastward. These features are consistent with the results obtained by Hastenrath and Heller (1977) for wetter than normal periods in the northern part of Northeast Brazil. The appearance of northerly low level winds over the Northeast is another feature observed during very wet periods (Markham and McLain, 1977). The penetration of a mid-latitude frontal system, similar to those documented by Kousky (1979), was instrumental in initiating and organizing the intense convective activity and in producing the observed changes in the low level wind field.

5. CONCLUSION

The extreme wet and dry periods observed during February-March 1981 over Northeast Brazil are apparently due to the fortuitous alignment of circulation features in both hemispheres. For those rainy seasons characterized by extreme wet or extreme dry conditions we might expect that the Northern and Southern Hemispheric circulation patterns show considerable persistence with features similar to those presented here for March and February 1981, respectively.

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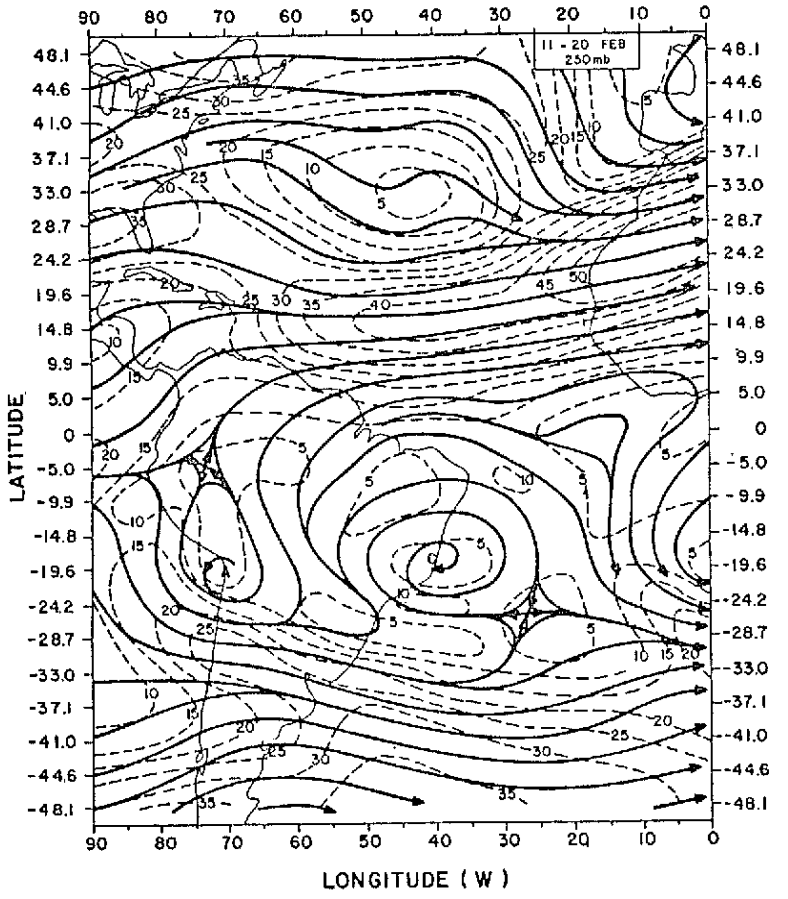

Fig. 1. *Mean 250 mb stream lines and isotachs (ms^{-1}) for 11-20 February 1981.*

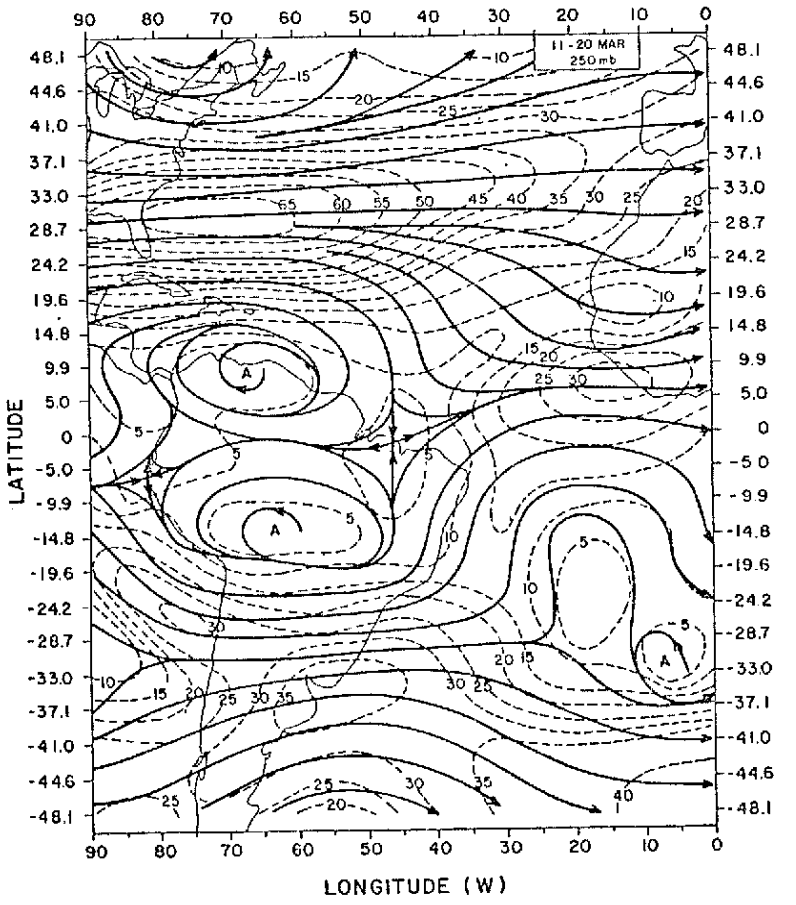

Fig. 2. *Mean 250 mb stream lines and isotachs (ms^{-1}) for 11-20 March 1981.*