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TELECONNECTIONS BETWEEN SOUTH AMERICA AND WESTERN AFRICA AS REVEALED BY MONTHLY PRECIPITATION ANALYSES

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14. Abstract/Notes

The spatial distribution of monthly precipitation deviations from the normal over tropical South America and Western Africa was investigated using the available data up to the seventies. The spatial scales associated with these deviations were determined for dry and wet years in Northeast Brazil. It was found that, on the average, the NE Brazil drought spatial scale is not confined to that region but extends from South America to Africa, and perhaps more to East, in accordance with GCM simulations by Moura and Shukla (1981). The results also show an inverse relationship between NE Brazil and Guyanas rainfall, in agreement with Hastenrath and Heller (1977). It was found that years of drought in NE Brazil are also extremely dry over the south equatorial region of Africa, west of 20°E. In addition, time series of sea level wind divergence for March in the Atlantic, from 1948 up to 1972, correlated with precipitation in NE Brazil (Fortaleza and Quixeramobim) shows a negative area of correlation in South Atlantic and a positive area in tropical North Atlantic. This seems to be associated with interannual variations in intensity and position of the ITCZ and anomalous SST patterns as shown by Moura and Shukla (1981) and further evidenced by Oliveira (1982) using satellite imagery. The conclusion is that the spatial scale of atmospheric and oceanic phenomena associated with droughts in NE Brazil is not regional, but seems to extend from South America to Africa.

15. Remarks *Will be presented at the First International Conference on Southern Hemisphere Meteorology, July 31 - August 6, São José dos Campos, 1983.*

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TELECONNECTIONS BETWEEN SOUTH AMERICA AND WESTERN AFRICA AS REVEALED BY MONTHLY PRECIPITATION ANALYSES

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The objective of the present work is to investigate the spatial and temporal scales of precipitation anomalies in tropical South America and Western Africa which seem to be associated with variations in intensity and displacement of the ITCZ.

In a recent work, Moura and Shukla (1981) have shown, using the GLAS (Goddard Laboratory for Atmospheric Sciences) GCM, that severe droughts over Northeast Brazil are associated with anomalous SST patterns in the tropical Atlantic which, in turn, reflect in variations in the ITCZ and reduces precipitation over NE Brazil. Their figure 12.b as simulated by the GLAS GCM, shows that the spatial scale, associated with the occurrence of NE Brazil severe droughts, is very large and extends from South America to Western Africa throughout the tropical Atlantic.

In order to verify this result of Moura and Shukla (1981), we have used monthly precipitation time series of 65 stations in Western Africa and 27 stations over tropical South America, extracted from the Monthly Climactic Data (U.S. Department of Commerce). In addition, sea level wind divergence over tropical Atlantic, from 1948 to 1972, was computed from the data prepared by Bunker (1976).

The monthly precipitation deviations for each month and total for the rainy season (February to May) over NE Brazil were normalized by the standard deviation of each time series. The anomaly patterns were constructed for the years of severe droughts (1915, 1919, 1932, 1942, 1951, 1953, 1958; Aldaz, 1971) and very wet years (1912, 1917, 1921, 1963, 1964; Serra, 1981).

Fig. 1a. shows the mean precipitation anomaly pattern for all dry years for the rainy season period, while Fig. 1b. shows the anomaly for 1958 only. It is observed a large area with negative values (greater than 0.6) extending from Fernando de Noronha island up to some part of the Amazon region, positive values appear over Guyanas in agreement with Hastenrath and Heller (1977), which have shown this negative correlation. Over Africa there is a small area (west of 15°E between 10°N and 15°S) with negative values, while in the northern part there is a positive region. Fig. 1b., for 1958 only, shows more clearly these anomalies, with extensive negative areas over South America (from NE Brazil up to great part of the Amazon) and Africa (Southward of the equator up to 15°S westward of 30°E and also between 20°S and 30°S).

Fig. 1c. for the mean precipitation anomaly for wet years shows a pattern essentially reversed when compared to Fig. 1a for dry years.

Over the Atlantic, we have correlated March sea level wind divergence with normalized precipitation from 1948 to 1972 over NE Brazil (Fortaleza and Quixeramobim). Fig. 2a. shows a positive area northward of the equator and a negative area southward of the equator, indicating a possible occurrence of a local anomalous meridional cell linking variations in intensity and position of the ITCZ and drought accurrence over NE Brazil, as suggested by Moura and Shukla (1981) and confirmed by Oliveira (1982). Fig. 2b. shows a strong correlation between the series of divergence differences in the two regions, indicated in Fig. 2a. and precipitation series over Fortaleza and Quixeramobim.

All the pieces put together, we are led to conclude that drought occurrences over NE Brazil are not of a local nature, but seem to be associated with large scale interannual fluctuations in the atmosphere and oceanic systems. The ITCZ response to these fluctuations seems to establish some teleconnetions between tropical South America and Western Africa as revealed by the precipitation anomalies.

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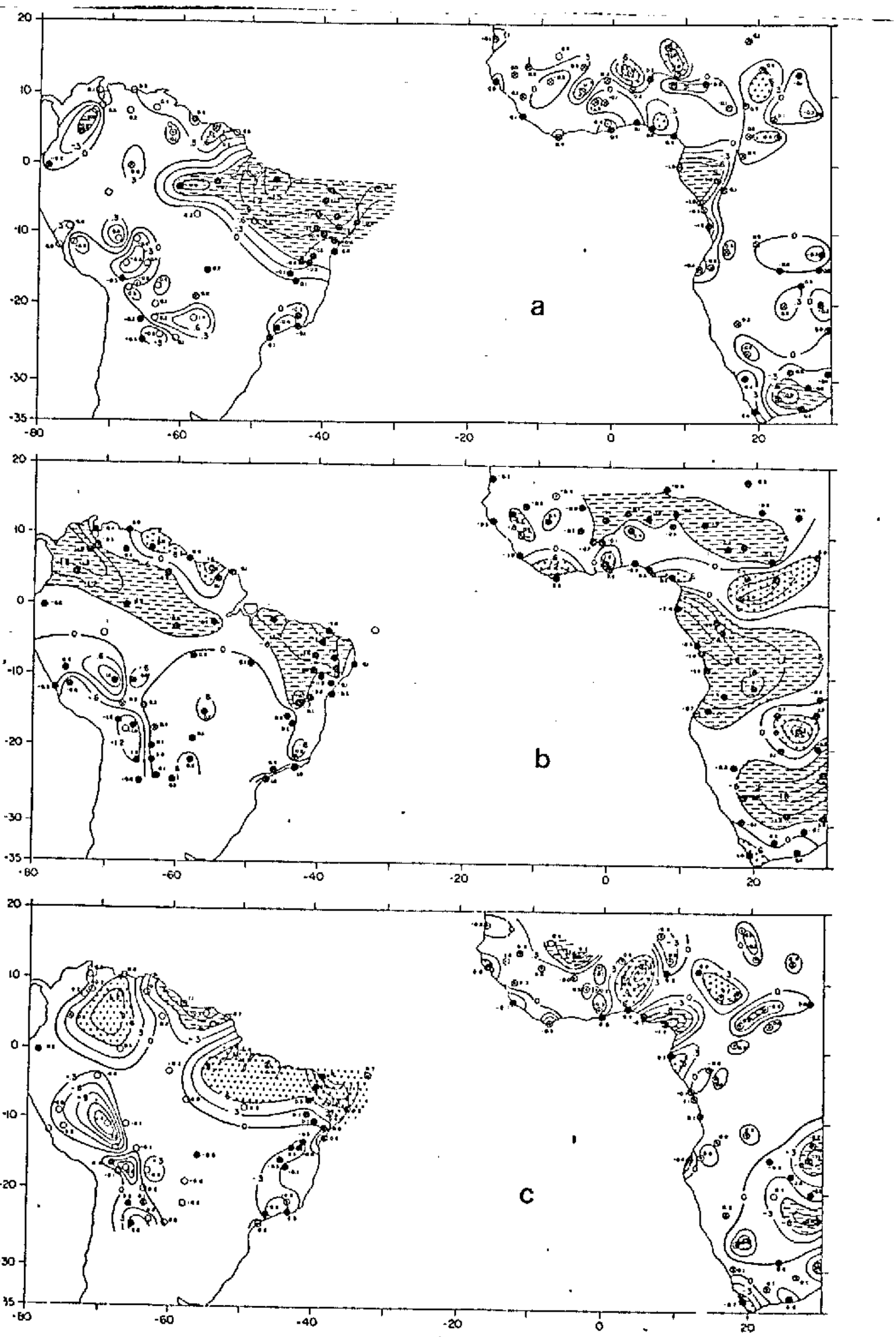

Fig. 1. *a) Mean precipitation (February, March, April, May) anomaly pattern for dry years (1915, 1919, 1932, 1942, 1951, 1953, 1958).*

b) as in a), except for 1958 only.

c) as in a), except for wet years (1912, 1917, 1921, 1963, 1964).

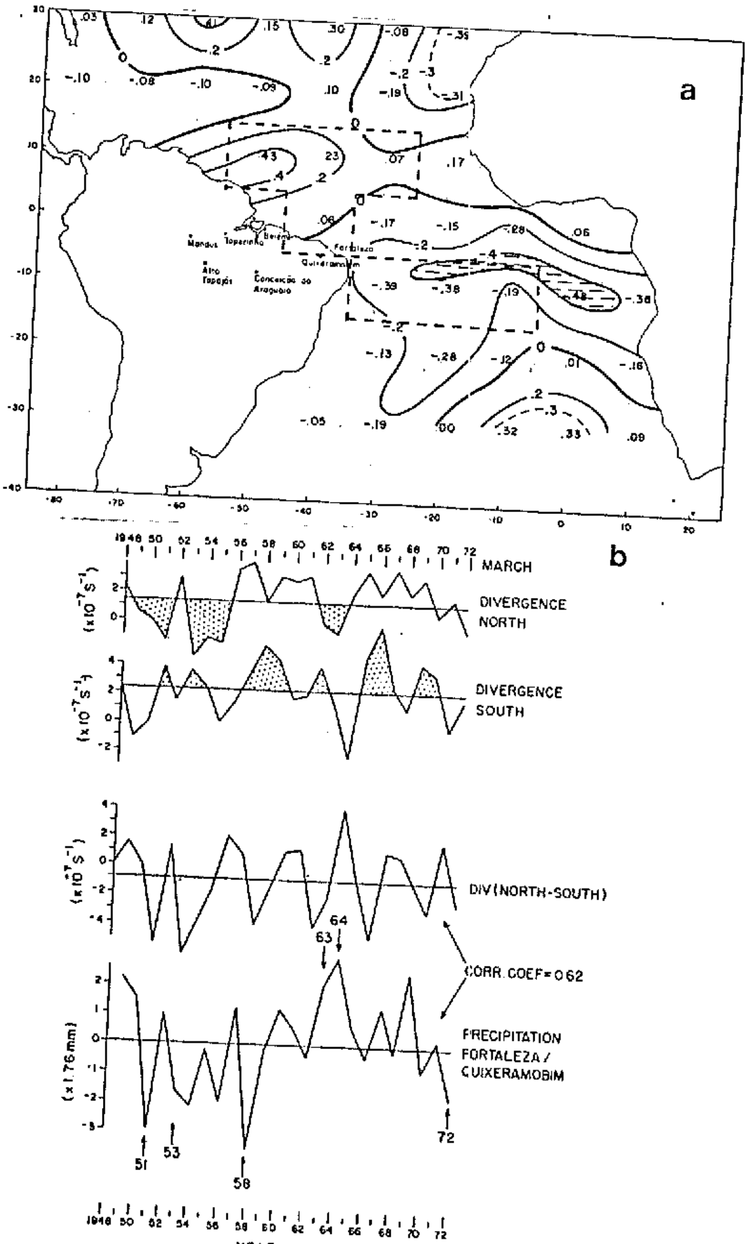

Fig. 2. *a) Map of correlation between March sea level wind divergence over Atlantic and normalized (March, April, May) precipitation over Northeast Brazil (Fortaleza and Quixeramobim) from 1948 to 1972.*

b) Series of mean wind divergence anomaly for March over North and South Atlantic calculated for the areas indicated in a). This figure also shows the series of divergence differences in these two areas and the series of normalized precipitation (March, April, May) deviation for Fortaleza and Quixeramobim.