

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

Antonio D. Moura
Mary T. Kagan
Instituto de Pesquisas Espaciais - INPE
Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq
São José dos Campos - SP - Brazil

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 Climatic 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 occurrence 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 teleconnections between tropical South America and Western Africa as revealed by the precipitation anomalies.

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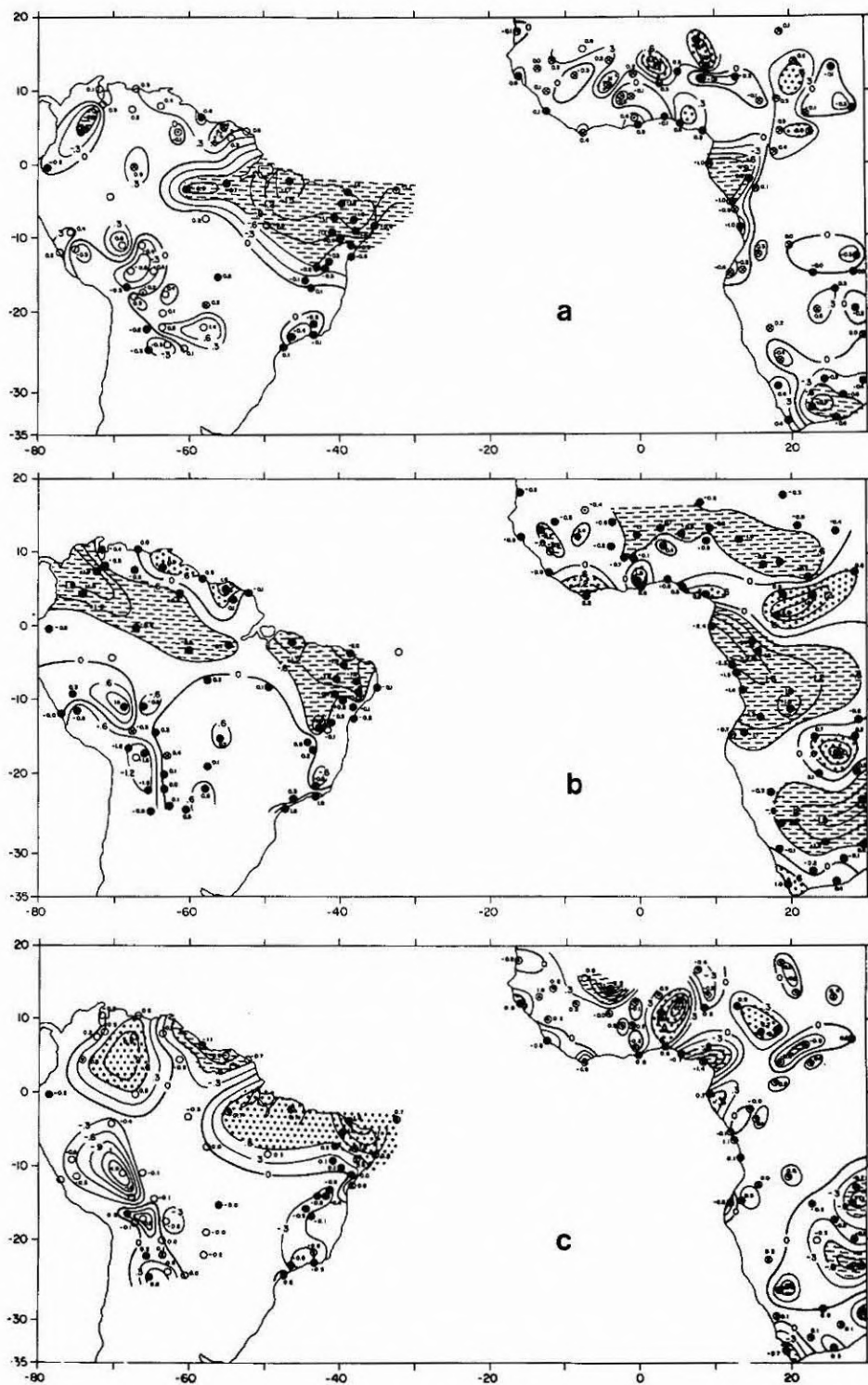


Fig. 1. a) Mean precipitation (February, March, April, May) anomaly pattern for dry years (1915, 1919, 1932, 1942, 1951, 1953, 1958).

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

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

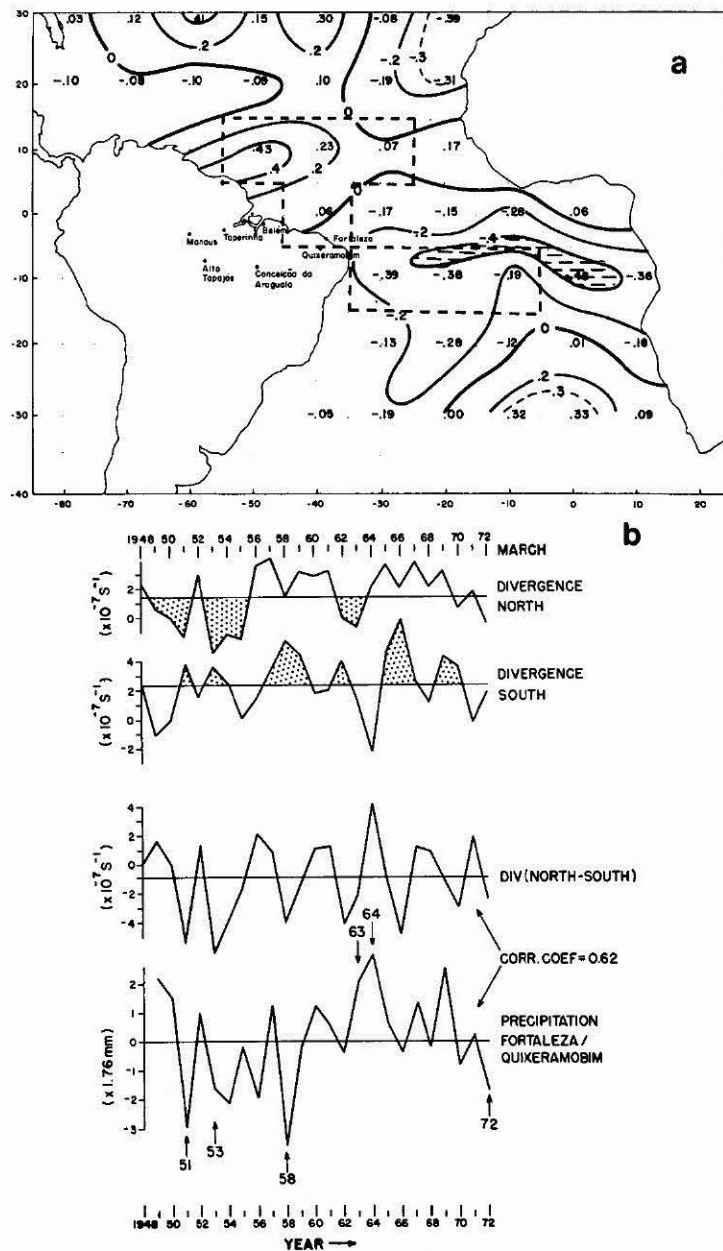


Fig. 2. a) Map of correlation between March sea level wind divergence over Atlantic and normalized (March, April, May) precipitation over Northeast Brazil (Fortaleza and Quixeramobim) from 1948 to 1972.

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.