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TÍTULO: ON THE EXISTENCE OF POSSIBLE DISTURBANCES OVER A SELECTED AREA IN BRASIL

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ON THE EXISTENCE OF POSSIBLE DISTURBANCES OVER A SELECTED AREA IN BRASIL

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ABSTRACT

Due to paucity of data over Amazon region it is difficult to make definitive studies of synoptic scale disturbances through customary methods of analysis, though few studies (Dean 1971) made in this direction point a way to persistent synoptic features. An attempt is made to detect in the time series data of precipitation any possible disturbances with the time scale longer than a day which control the rainfall activity over a region. Power spectrum analysis on the lines of Murakami (1971) is made use of in the present study.

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* On lien from Andhra University, Waltair, India.

INTRODUCTION

A statistical analysis to the time - series data of precipitation seems to be a convenient method to investigate the occurrence of disturbances in an area when proper wind data is not available. Yanai (1963) in a case study of large scale disturbances propagating over Tropical Pacific noted a good agreement between the upward motion associated with wind disturbances and rainfall.

Rainfall in the tropics always forms an interesting study. Several aspects of this study were dealt by many authors (Riehl 1954, Lin Sien Chia 1970, Ananthakrishnan 1970, Jagan Mohana Rao 1972 and Ramamurti et al. 1972). Rainfall is derived from local topography which effect the region for a short period or duration, where as extended rainfall in time and space is known to occur due to large scale disturbances or synoptic systems. To understand the pattern of rainfall it is better to tackle the study of such disturbances which control the activity over a region. A study towards this aspect is made by Palmer (1951), Wallace and Chang (1969) Yanai and Murakami (1970). A recent study by Murakami (1971) prompted the authors for a follow up in a selected region over Brasil, to locate any possible disturbances of synoptic scale contributing to the more duration of rainfall. Murakami (1971) could find in the rainy region some remarkable and well defined spectral peaks with period of 10 to 15 days, 4 to 6 days and 3 days. These periodicities were also detected in wind variations of tropical troposphere and analyses have been made of their dynamical characters and structure (Yanai and Murakami 1970 a,b, Chang et al. 1970). A statistical approach as suggested by Murakami (1971) is worked out for understanding the characteristics of disturbances.

METHOD

For the present study a region is selected which lies between 2^{o} - 8^{o}S and 52^{o} - 70^{o}W and the network of raingauge stations* is shown in Fig. 1. The daily rainfall reported by these stations for the period 1st January through 30th March 1969 is used in this study. Fig. 2 gives the distribution of amount of rainfall for January to March. In this figure one can see the existence of three areas of maximum rainfall, one located over Belem and another in the western part of Brasil and a third one seems to emanate from central Brasil, in between lies relatively a dry area. The area is so selected due to the fact that data is collected systematically in that area and the months January to March contributed rainfall most of the days for the stations. Fig. 3 gives the cross-section of mean zonal wind for February 1969 which indicates a very weak wind shear in the lower troposphere. Figs. 4 a to h present the time series of daily amount of precipitation for the eight stations and the data are filtered so that they represent the values of deviation from the running averaged value. Figs. 5a to h

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* Location of Stations are shown in Table 1.

give the diagrams of smoothed spectrum of auto-covariances (mm^2/day) for the eight stations. From these figures we can see that there are three prominent peaks of heavy rain among the stations and the correspondence in peaks is reasonably good, specially in the ones corresponding to longwaves which could suggest the existence of disturbances propagating longitudenally through the area. Also the average distance between station to station is about 5^0 longitude or 500km. The peak which has the best correspondence among stations is the one responsible for waves with 16.67 to 25.00 days in period. From the slope of regression line between the phase difference ($\Delta\theta$) and longitudinal difference ($\Delta\lambda$) we can get a crude estimation of the characteristic wavelength of disturbances (Fig. 6). The $\Delta\theta$ - $\Delta\lambda$ relation shows scattered distribution (Fig. 6) and could suggest that the disturbances do not propagate so regularly since wave number 2 is smoothing period, it has no contribution. The waves with 16.67 day period is divided into two component which move eastward and westward respectively (Tanaka and Ryuguji 1971).

CIRCULATION

The mean circulation patterns suggest that the rainfall in the region under study is associated with two mechanisms (Dean 1971).

At the mouth of the Amazon and along the north coast of Brasil the rainfall regime seems to be associated with the location and strength of the upper level through which develops in summer and fall near Belem at 200 - 300 mb. This trough seems to be an extension of upper level trough formed over Northeast Brasil which is associated with upper westerlies. The synoptic weather in such systems is quite varied depending on the strength of the system and the degree to which it penetrates downward into the Trades. This vorticity centre also helps to account for the fact that a dry zone extends northward into the lower Amazon basin to the west side of upper level trough (Fig. 7a, 7a, and 8a, 8b).

In the western part of Amazon basin correspondence between wind circulation and rainfall pattern shows that the rainfall amounts are large in the areas of mean convergence in low troposphere. A pronounced diffluent asymptote emanates in Northeast Brasil and spreads over Amazon basin and only in the western portion does the speed divergence begin to compensate for the directional diffluence. This area is under the influence of pronounced 850 mb and 700 mb mean convergence (Fig. 9a, 9b) and the mean monthly rainfall distribution in mm over South America is shown in Fig. 9c.

CONCLUSIONS

1. The selected region seems not to experience any large scale disturbances for its weather as revealed by the statistical analysis to the precipitation data. The scatter diagram (Fig. 6) does not suggest any systematic movement of waves.

2. In contrast with results obtained by Murakami in Tropical Pacific, the dry area does not show reduction of the Power spectral density of precipitation for short waves, while in the present study, there is reduction for all the waves.

3. Such a heavy rainfall with wavelength of 1000km seems not convincing. Better results may be obtained, if more northerly stations are given a study.

4. The steadiness values of the wind at Manaus (Table II) suggest that the precipitation over tropical Brasil does not seem to be associated with travelling disturbances of synoptic scale in the lower troposphere. This is also confirmed by seasonal distribution of rainfall, the rainfall patterns appear to enlarge and contract in situ (Dean 1971).

5. The importance of such analysis is brought out in addition to synoptic analysis.

ACKNOWLEDGEMENT

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Table I

	E S T A Ç Ã O	LAT. °S	LONG. °W
1	Altamira	- 3° 12'	- 52° 45'
2	Parintins	- 2° 38'	- 56° 44'
3	Alto Tapajos	- 7° 21'	- 57° 31'
4	Manaus	- 3° 8'	- 60° 1'
5	Coari	- 4° 0'	- 63° 05'
6	Porto Velho	- 8° 46'	- 63° 55'
7	Fonte Boa	- 2° 32'	- 66° 00'
8	Benjamin Constant	- 4° 22'	- 70° 02'

Table II

Mean monthly steadiness of wind at Manaus (1969, 1970)

level mb	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
850	74	92	91	72	98	94	95	96	96	91	83	79	84	90	90
700	60	84	90	88	99	97	90	95	94	91	86	76	41	73	85

The table suggests that DJF can have slightly lower steadiness values (< 90%) but this is to be expected with weaker scalar wind speeds (v) at this season.

LEGEND FOR FIGURES

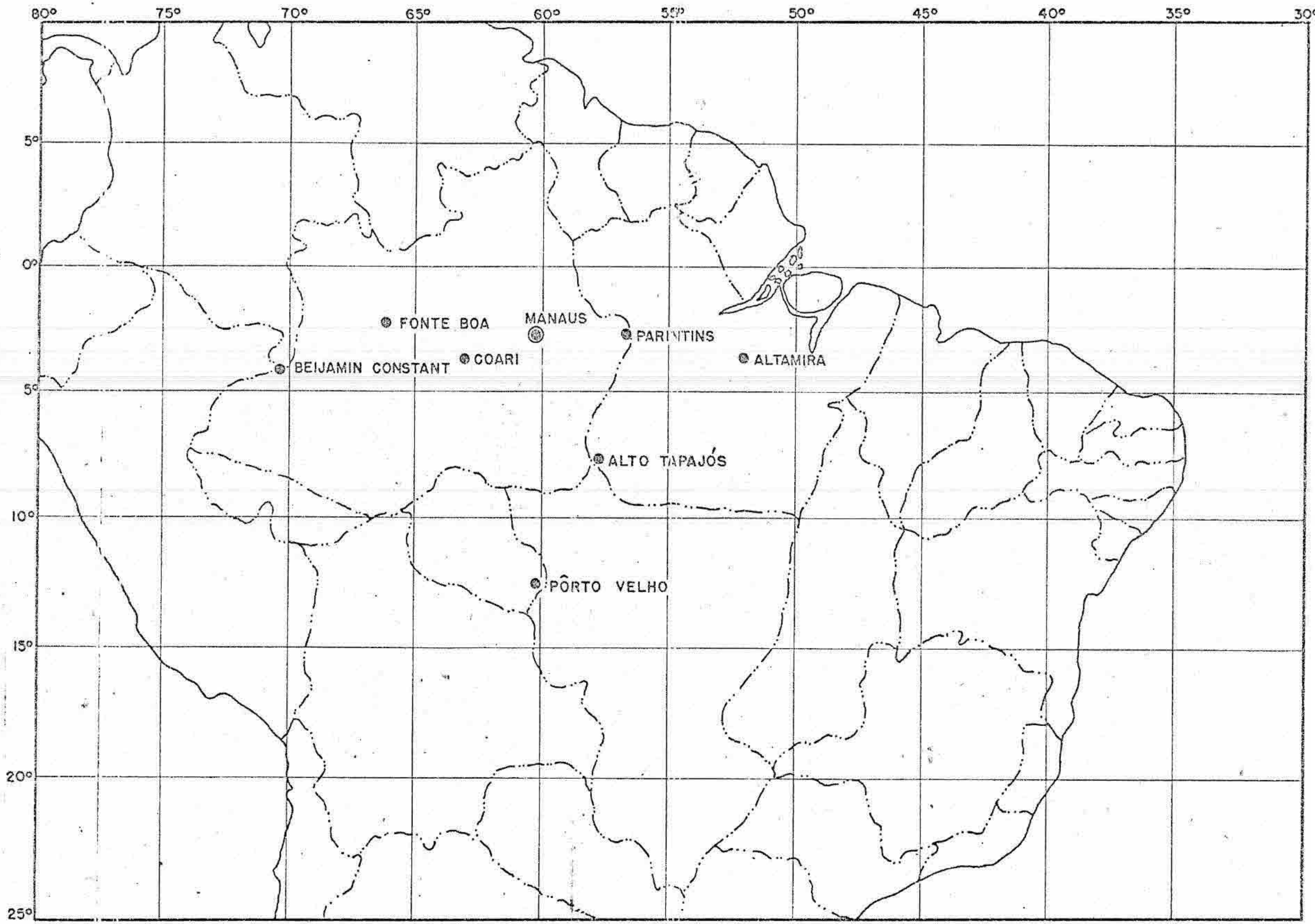

FIG.1 NETWORK OF STATIONS

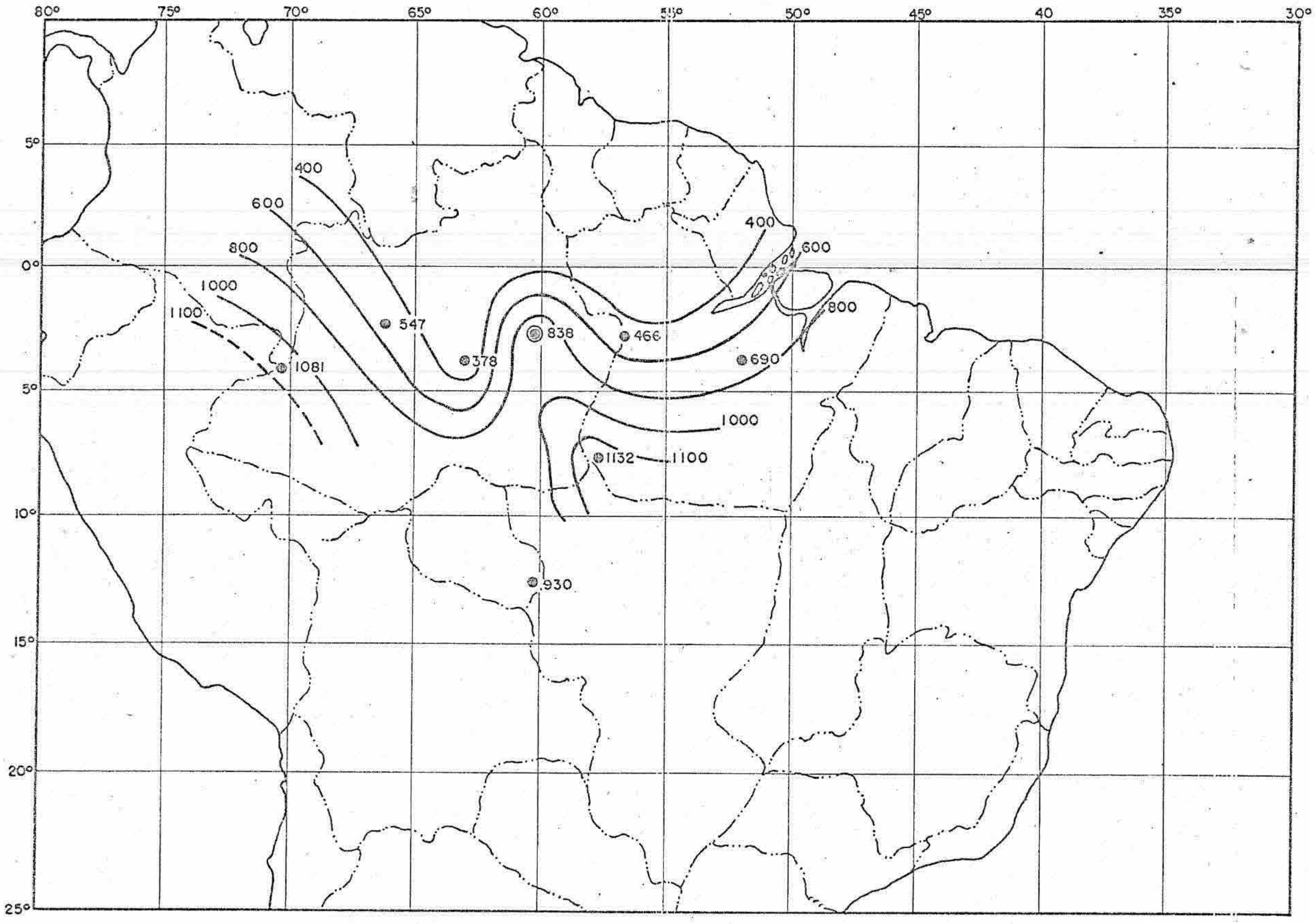

FIG.2 – DISTRIBUITION OF PRECIPITATION FOR JAN-FEB-MARCH 1969 (units in mm)

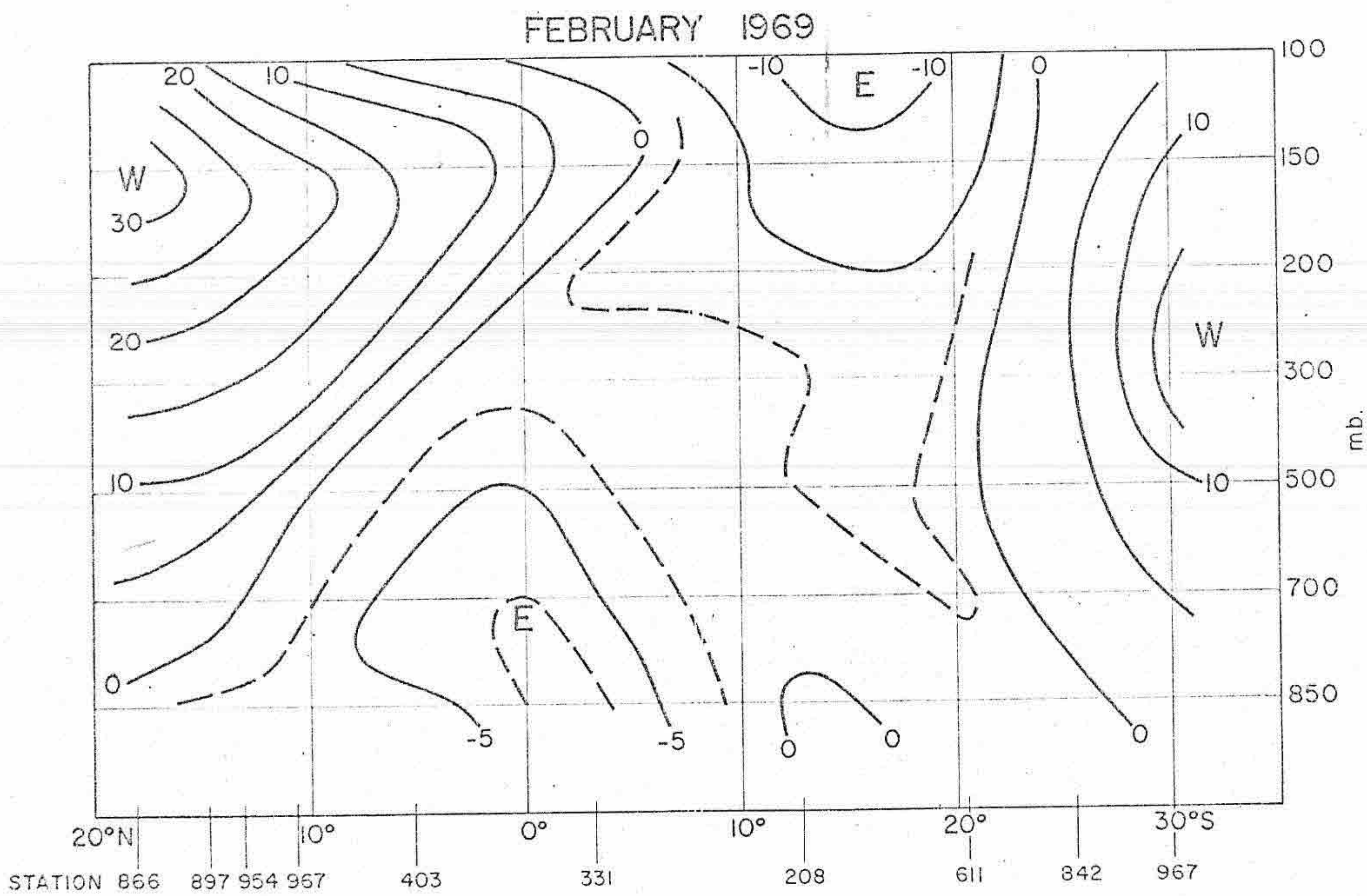

Fig. 3 - Cross-section of zonal winds for Feb. 1969.

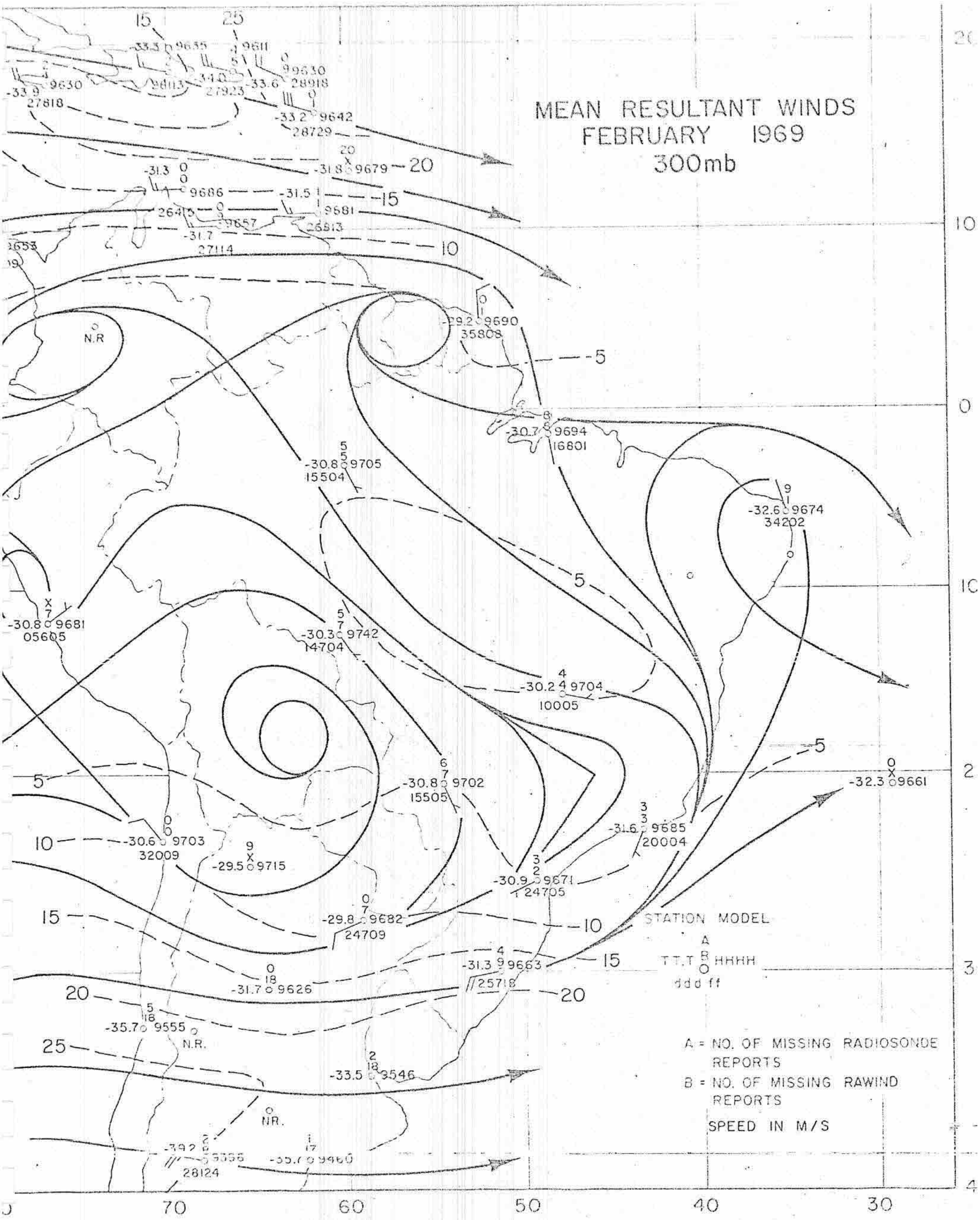

Fig. 7a - 300 mb Stream lines, Feb 1969.

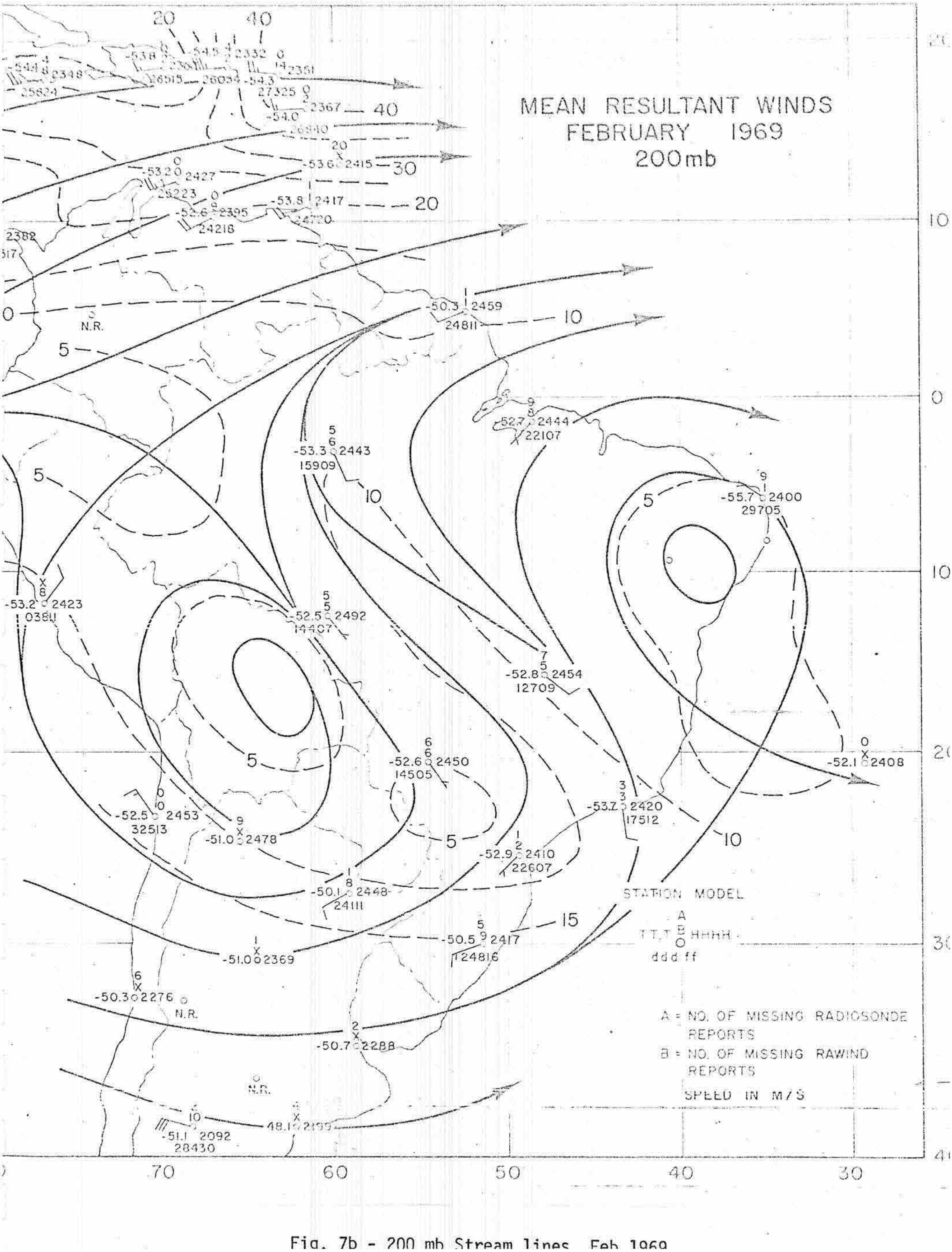

Fig. 7b - 200 mb Stream lines, Feb 1969

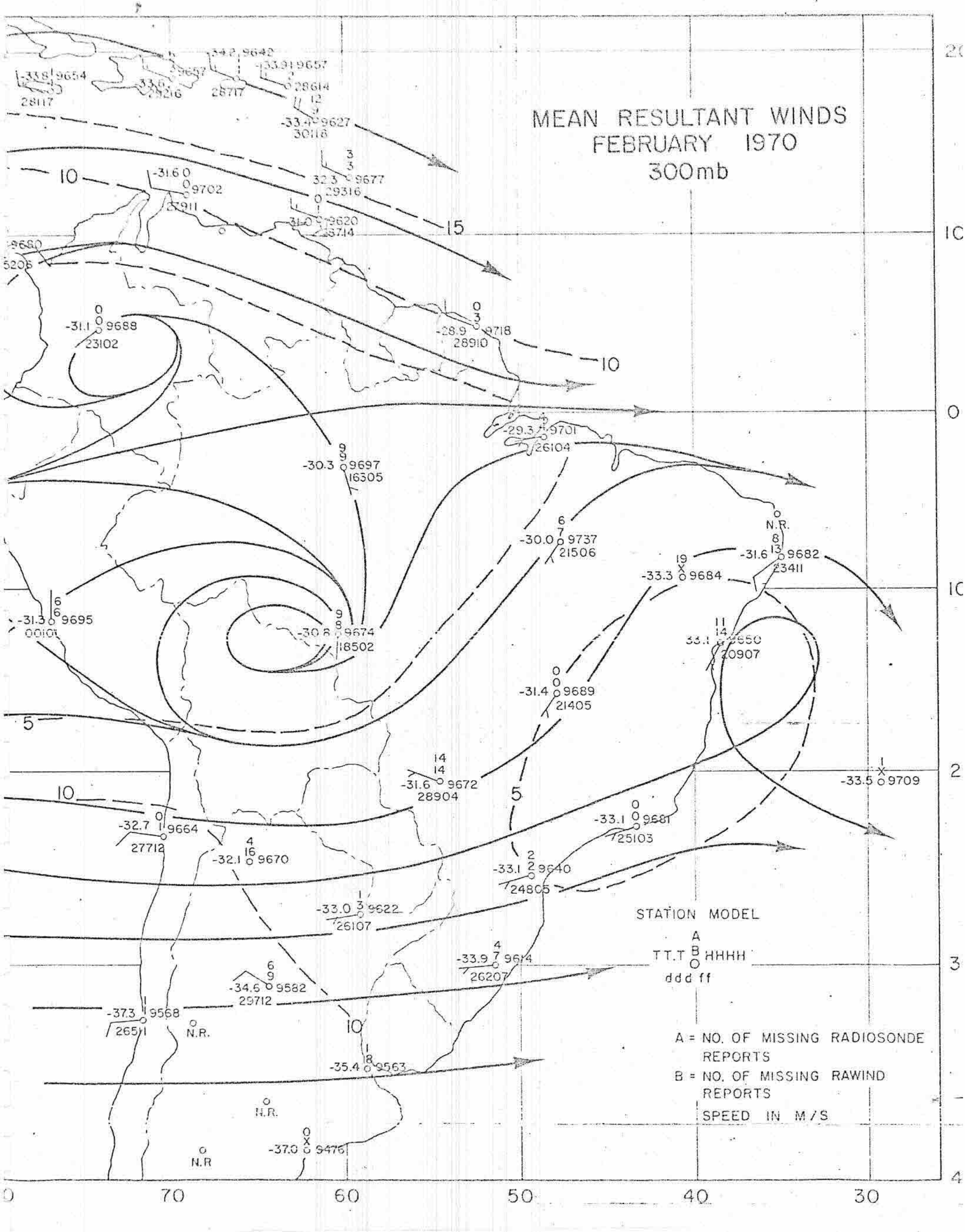

Fig. 8a - 300 mb Stream lines, Feb 1970.

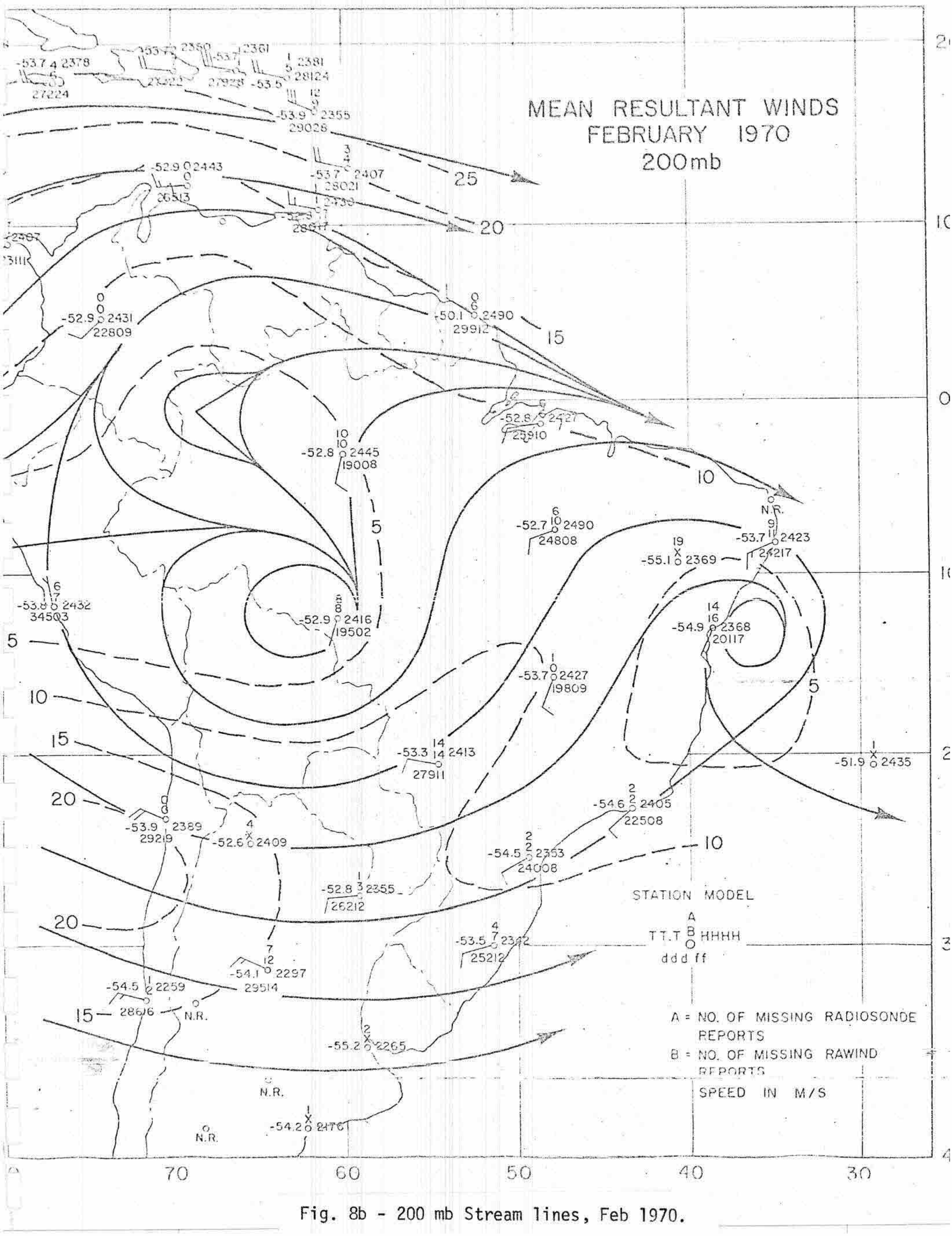

Fig. 8b - 200 mb Stream lines, Feb 1970.

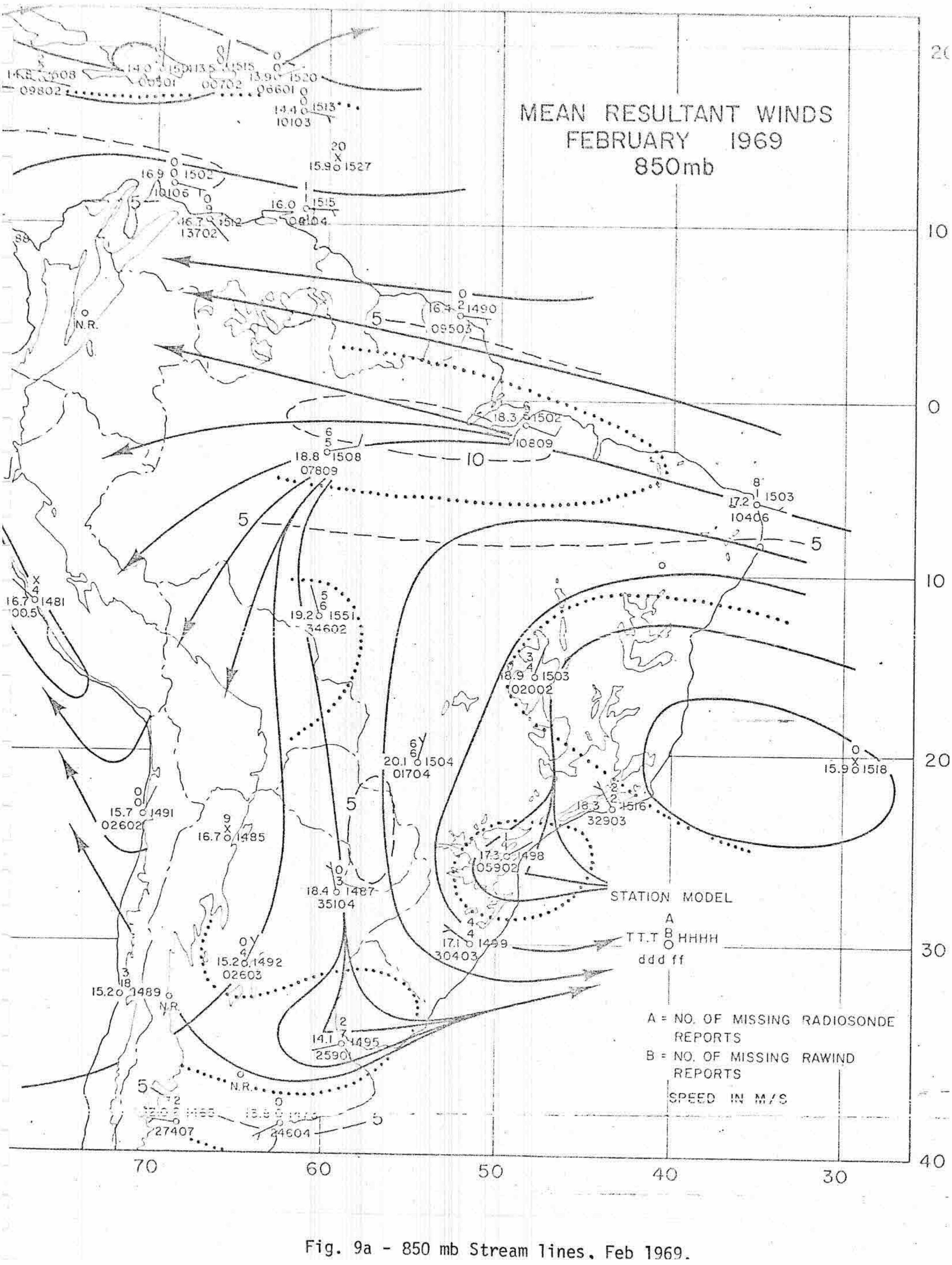

Fig. 9a - 850 mb Stream lines, Feb 1969.

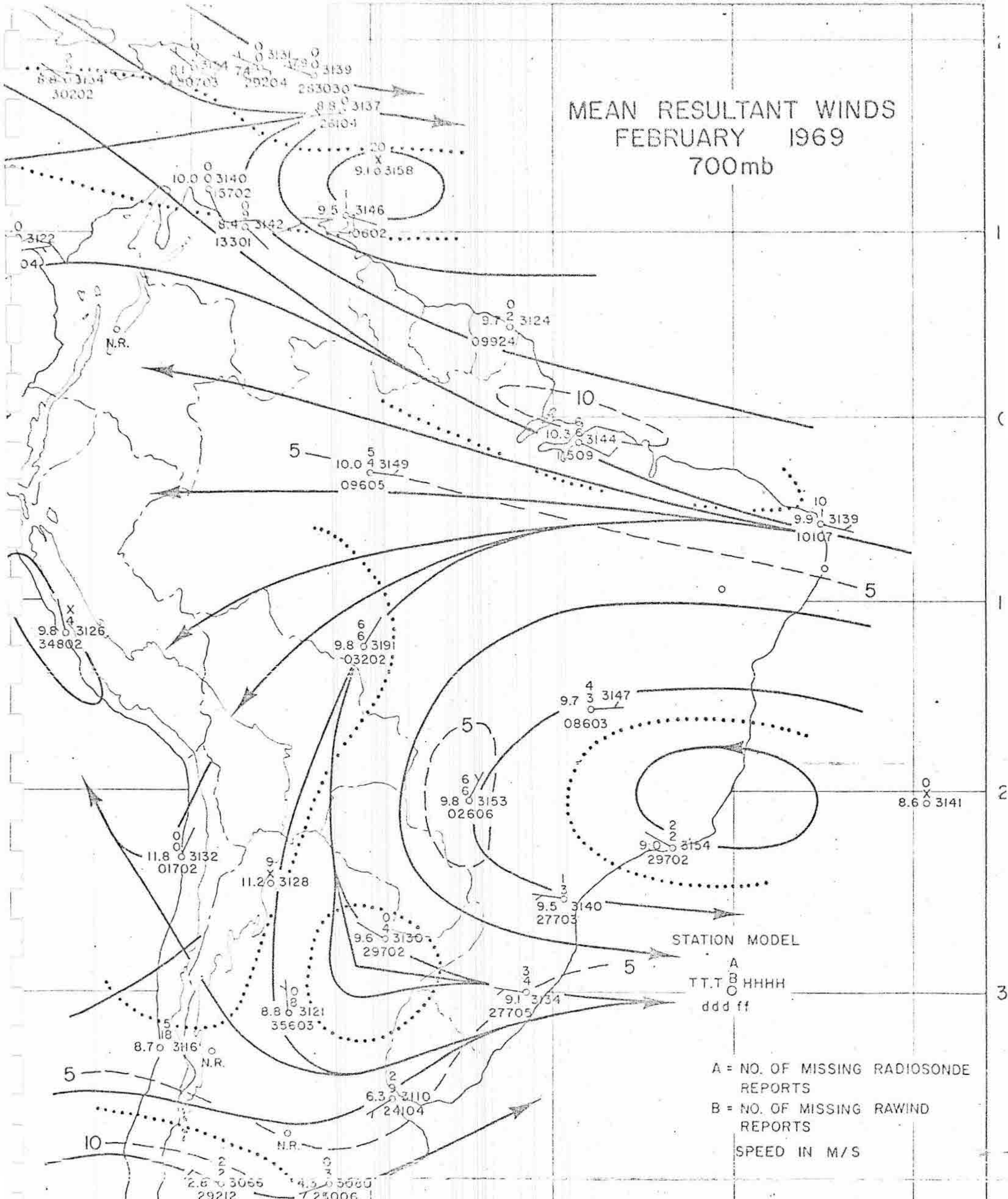

Fig. 9b - 700 mb Stream lines. Feb 1969

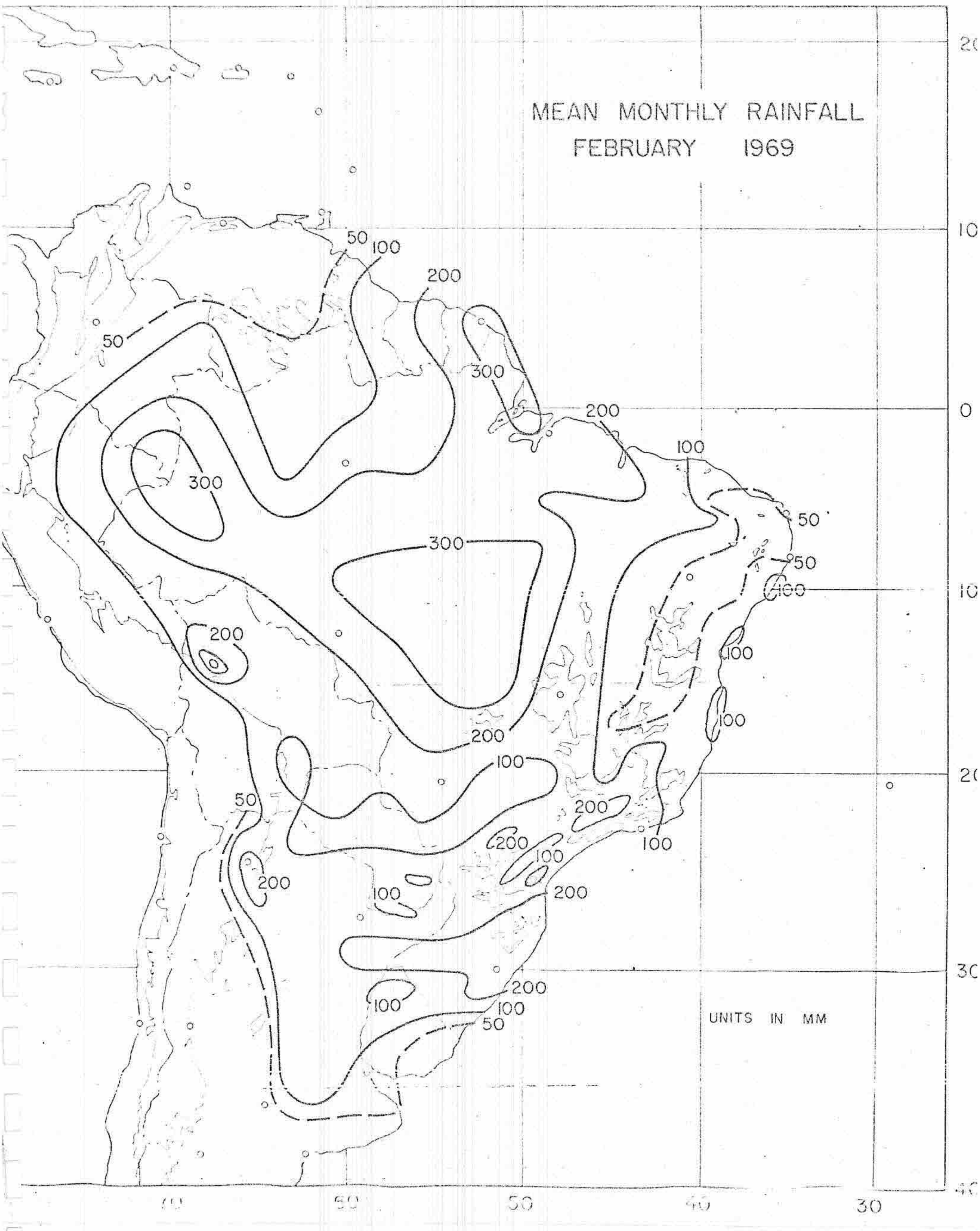

Fig. 9c - Mean Monthly rainfall distribution over South America

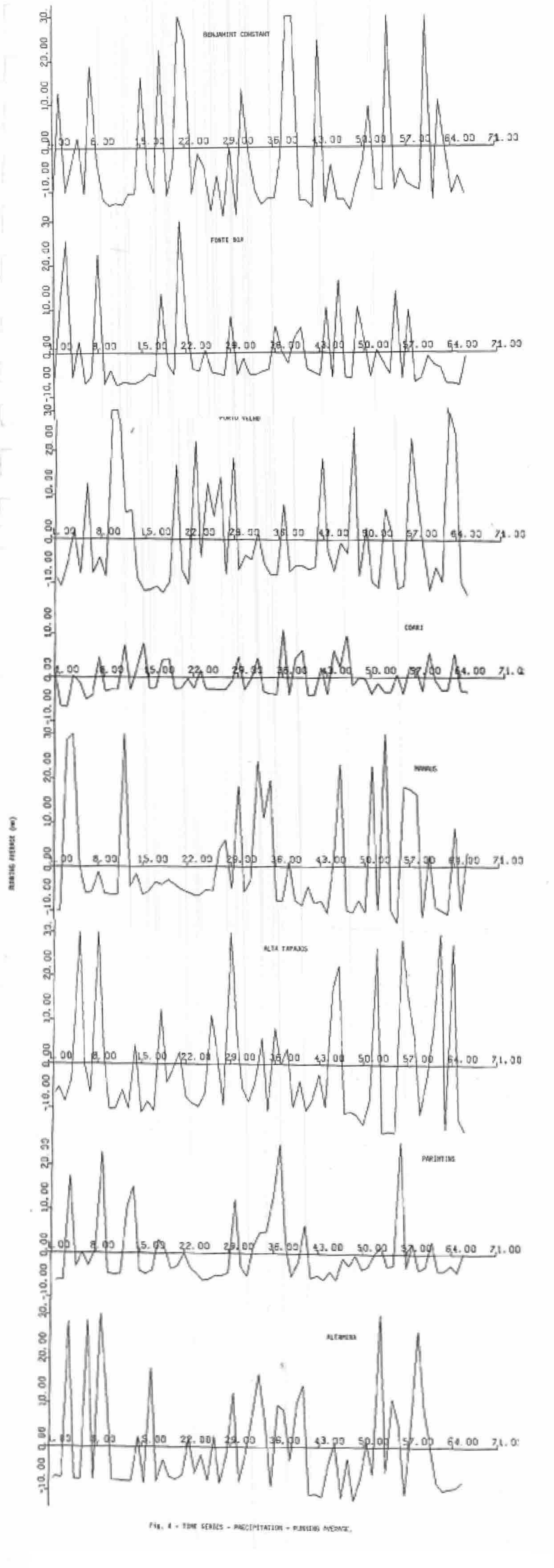

Fig. 4 - TIME SERIES - PRECIPITATION - RUNNING AVERAGE.

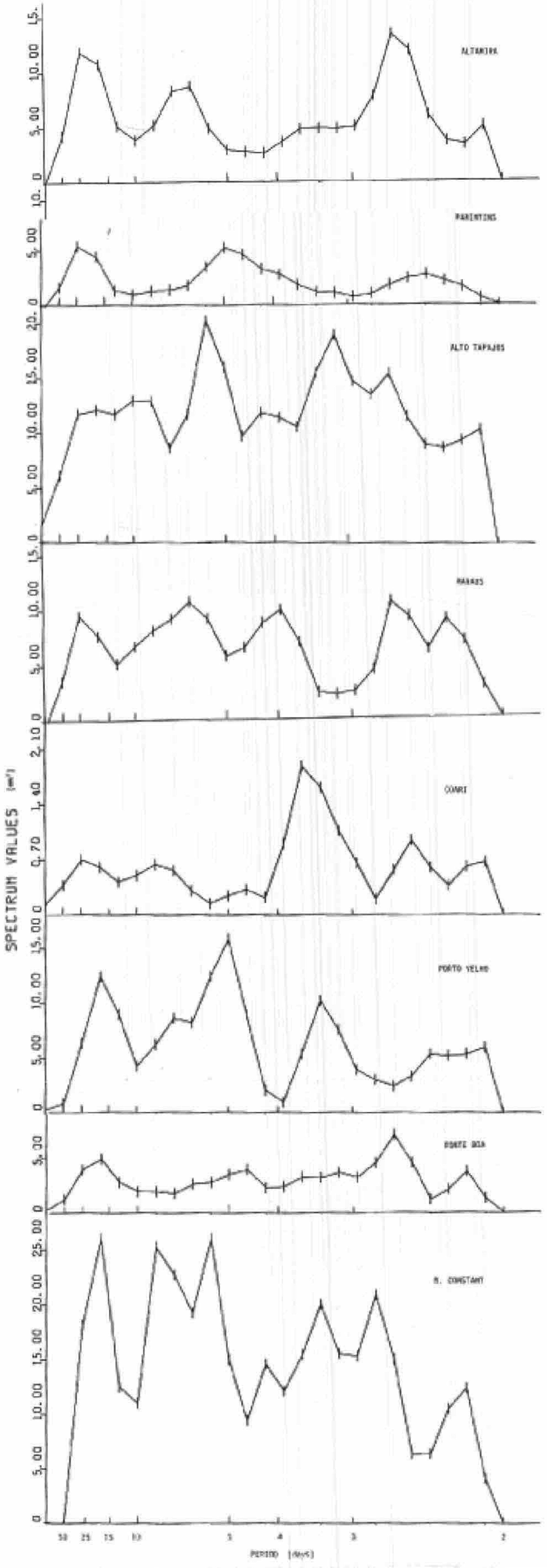

Fig. 5 - SMOOTHED SPECTRUM FOR AUTO COVARIANCE.

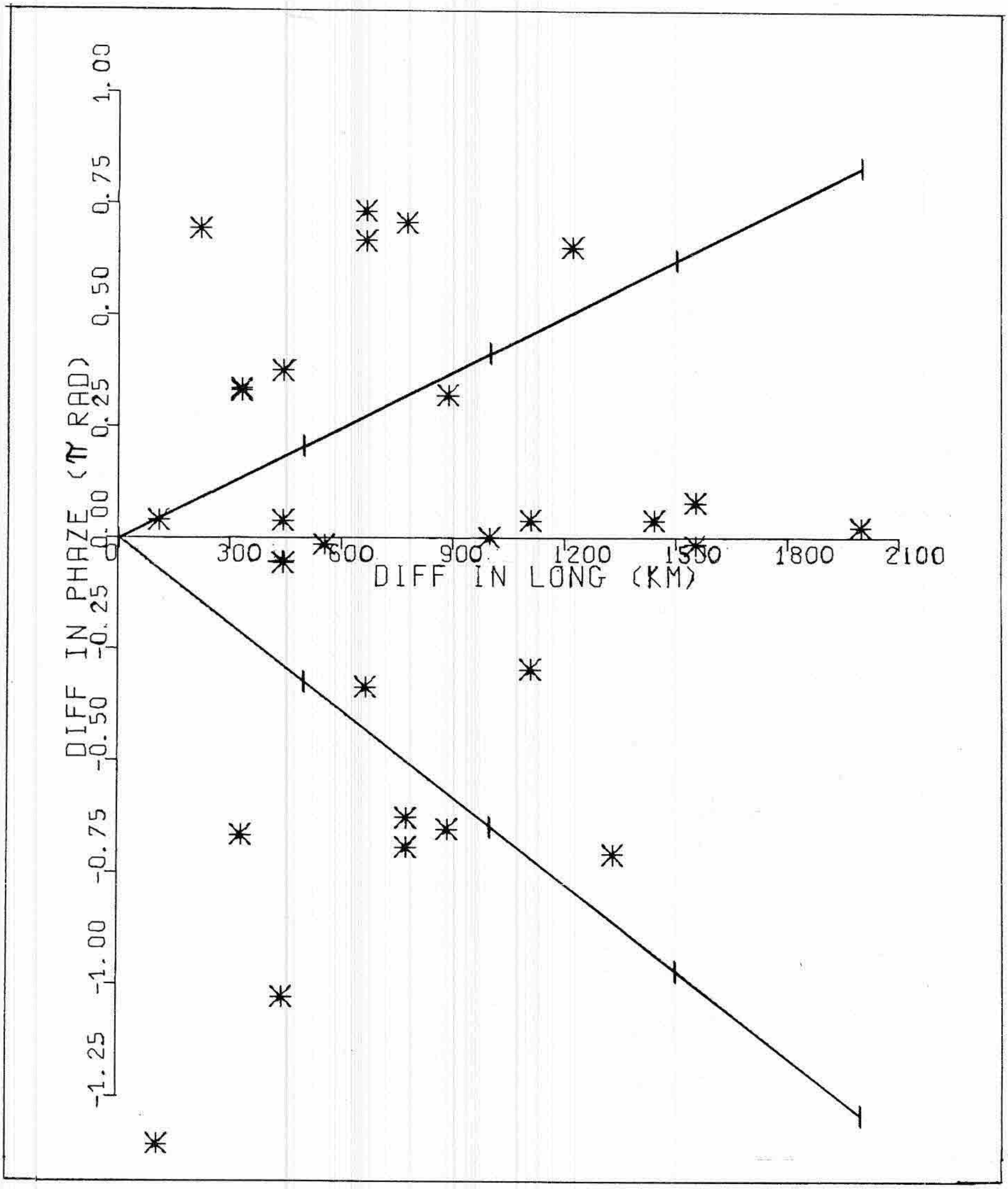

Fig. 6 - RELATION BETWEEN PHAZE DIFFERENCE OF PRECIPITATION DATA AND LONGITUDE DIFFERENCE.