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PROJETO: MESA

TÍTULO: CLOUDINESS OVER TROPICS IN GENERAL AND CIRCULATION PATTERNS OVER BRAZIL IN PARTICULAR

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Coordenador

CLOUDINESS OVER TROPICS IN GENERAL AND CIRCULATION PATTERNS OVER BRAZIL IN PARTICULAR

by

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ABSTRACT

Circulation patterns are described over Brazil in relation to convective activity cloudiness over tropical South America. Since the data are inadequate to compute the energy flux, mean air circulation patterns are used to indicate the mass circulation.

INTRODUCTION

A general feature that one can notice in satellite pictures (Kornfield and Hasler, 1968) is the presence of three prominent areas of cloudiness. They are located over South America, Africa and Indonesia and southwards from it. The present author using the radiation field maps of other workers discusses the prominent area of cloudiness over Brazil in South America in association with patterns of circulation.

METHOD AND DATA

Krueger (1970) presented the mean annual albedo map (Winston and Gray, 1970) to show the above three regions with 30% or higher values of albedo (Fig. 1). In Fig. 2 the annual average long wave cooling is shown. The spatial variation of this variable again indicates the distribution of cloudiness. The inverse relationship between albedo and long wave cooling suggests that the peaks represent the areas of intense convection (Fig. 3). The latest data obtained (Haar, 1972) from satellite coverage of 17 seasons (years 1962 - 70) gave advanced information with more accuracy the areas in study. In view of this systematic distribution, Krueger (1970) computed the values of atmospheric heating by the formula

$$Q = (1 - \alpha)\, S - L - (S_o - L_o) + Q_S + Q_L$$

where α is albedo and S is incoming solar radiation, L is the long

wave cooling, Q_s is the sensible heat flux and Q_L is condensation heating.

He arrived at Fig. 4 which shows (contributes to presence of) maximum values over western Pacific, Indonesia, New Guinea and along a line extending southeastward into Brazil and also over Africa along the Guinea coast toward the Zayre. In compensation for this heating there should be cooling areas over equatorial Pacific and tropical Atlantic because the regions of cooling have important implications concerning the interaction of tropic with higher latitude circulations.

To understand this the present author utilized the systematic study of circulation patterns over Brazil (Dean, 1971). To start with, it is of some interest to examine the map (Fig. 5) of January distribution of precipitable water over Brazil (Ramamurty et al, 1972) calculated by using temperatures from surface to 500mb given at grid points (Taljaard, Van Loon, 1969). The January precipitation map is show in Fig. 6 (Atlas Climatológico do Brasil, 1969). The streamline maps at 850, 500 and 200 mb maps for January 1970 are shown in Figures 7 and 8. The cross-section of zonal winds (Dean, 1971) which show weak shear is presented in Fig. 9. The circulation pattern at lower levels indicates the trades carrying water vapour to the region east of Andes where heavy rainfall is observed. The anticyclonic circulations at 500 mb and 200 mb are predominant. The diffluence at 200 mb takes place over eastern Brazil with two branches, one crossing over the equator into the Northern Hemisphere and the other extending eastwards along the equator.

The region of Northeastern Brazil may be under the descending branch of this circulation. Average cloud brightness values for February 1969 (Krueger, 1970) suggest that sometimes there are variations in distribution of cloudiness, too (Fig. 10).

CONCLUSION

1. The global three-wave pattern in cloudiness as shown by satellite coincides with quasi-stationary troughs at middle latitudes suggesting a possible interaction between middle-latitude and tropical circulations.

2. The heating is maximum in the Eastern Pacific and extends southeastwards into Brazil.

3. Diffluence occurs over Eastern Brazil with part of the flow crossing over into Northern Hemisphere and rest flowing eastward along the equator. The dry area of Northeast Brazil lies probably under the descending branch of this circulation.

ACKNOWLEDGEMENT

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LEGEND OF FIGURES

Fig. 1 - Mean annual albedo (Winston and Gray, 1970).

Fig. 2 - Annual average long wave cooling (Krueger, 1970).

Fig. 3 - The inverse variation of albedo and long wave cooling (Krueger, 1970).

Fig. 4 - Atmospheric heating values (Krueger, 1970).

Fig. 5 - Precipitable water vapour - January (Ramamurty, Jagan Mohana Rao, et al, 1972).

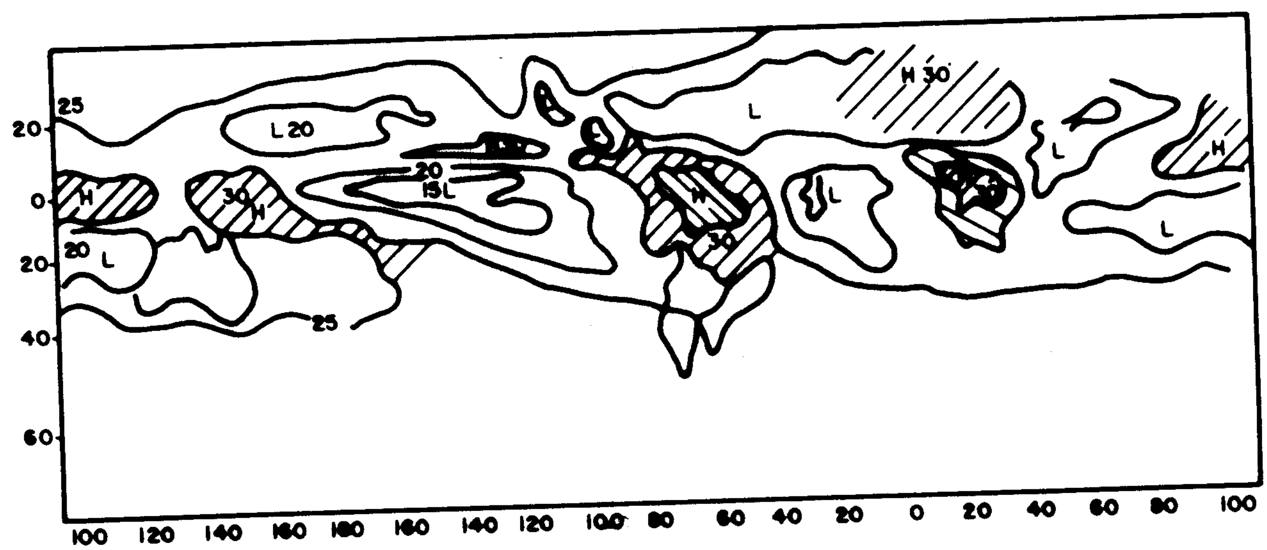
Fig. 6 - Distribution of January Precipitation (Atlas Climatológico do Brasil, 1969).

Fig. 7 - 850 mb, 500 mb, 200 mb } 1969 January (Dean, 1971).

Fig. 8 - 850 mb, 500 mb, 200 mb } 1970 January (Dean, 1971).

Fig. 9 - Cross-section of Zonal winds - February 1969 (Dean, 1971).

Fig. 10 - Cloud brightness Values - February 1969 (Krueger, 1970).



25
L20
H30
L
H
20
15L
H
30
H
L
L
L
30
30
20
L
25
20
0
20
40
60
100
120
140
160
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100

FIG. 1

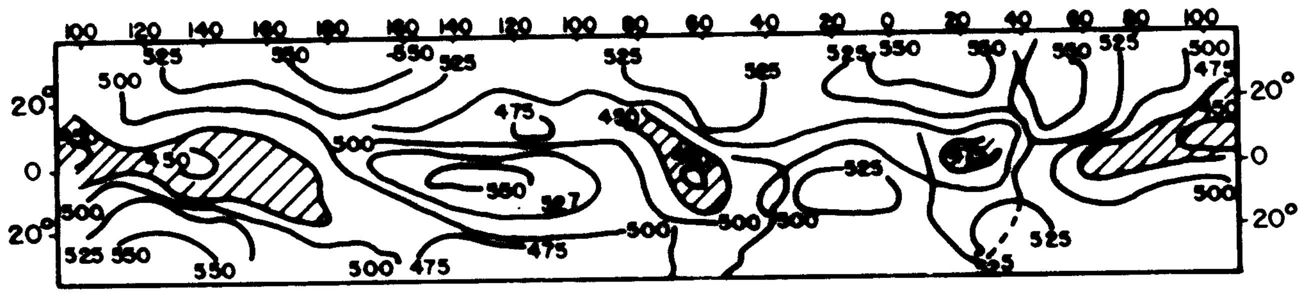


FIG. 2

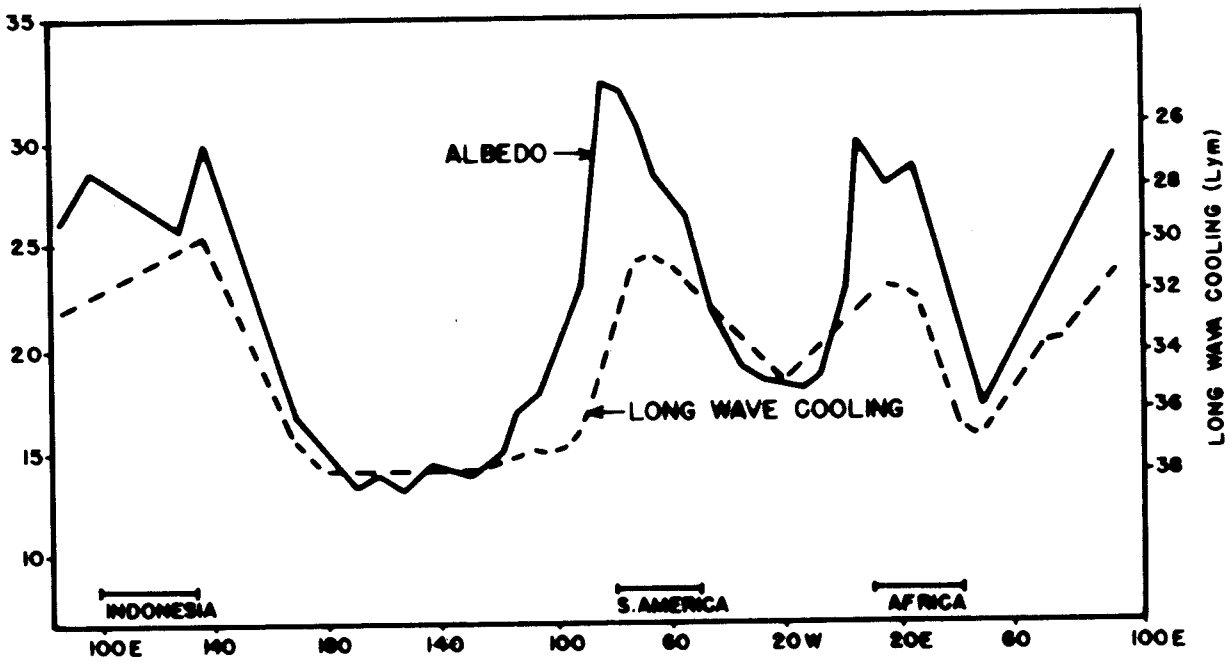

35
30
25
20
15
10
ALBEDO
LONG WAVE COOLING
INDONESIA
S. AMERICA
AFRICA
100 E
140
180
140
100
60
20 W
20 E
60
100 E
26
28
30
32
34
36
38
LONG WAVE COOLING (Lym)

FIG. 3

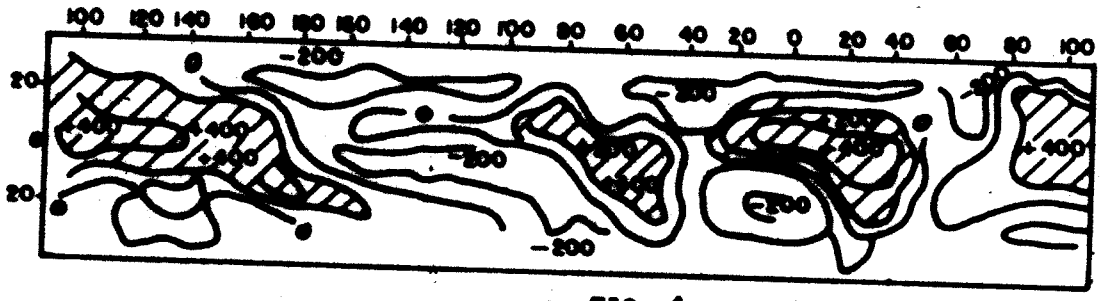

100 120 140 160 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100
20
20
-200
+400
+400
+400
-200
-200
-200
+400

FIG. 4

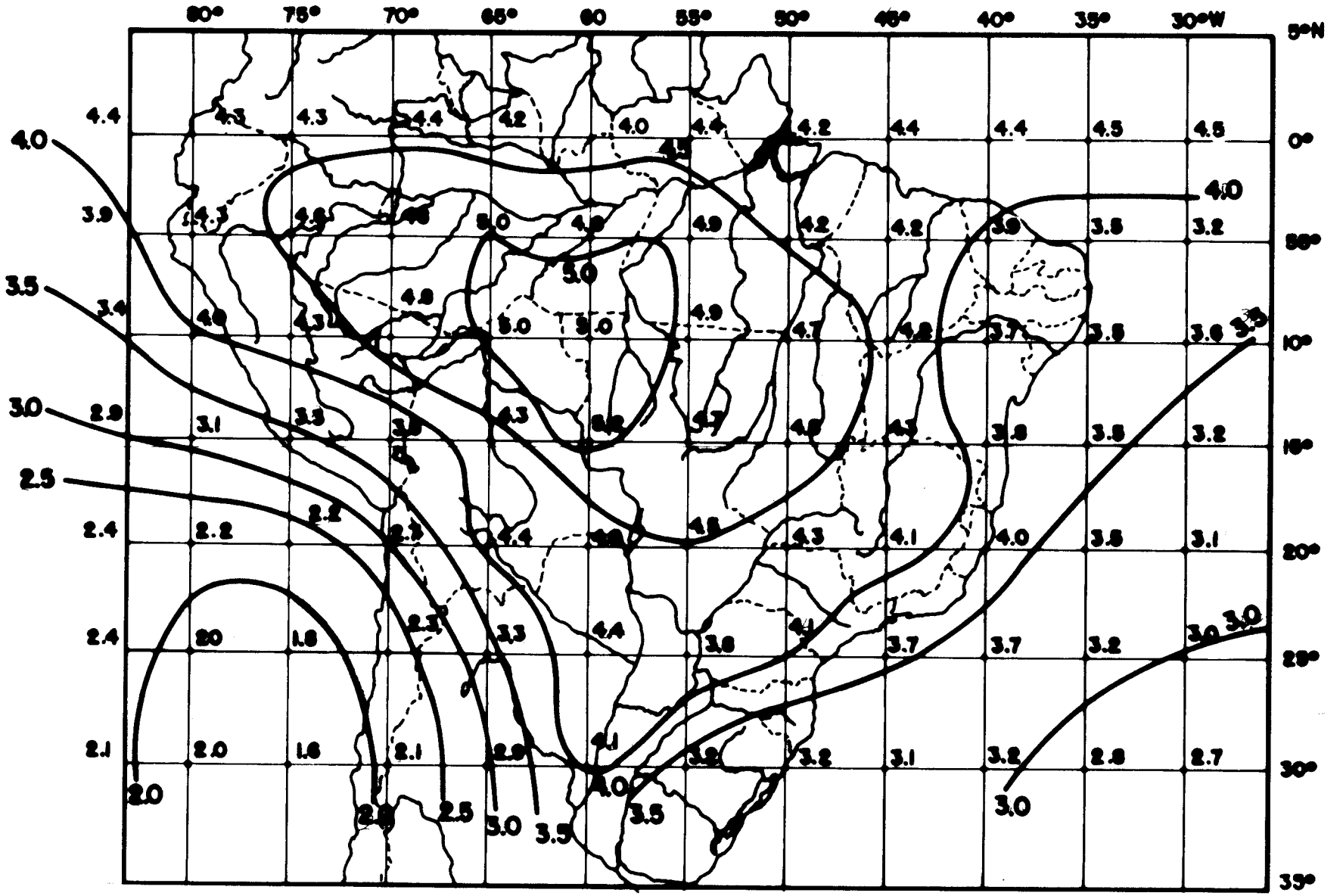


FIG. 5

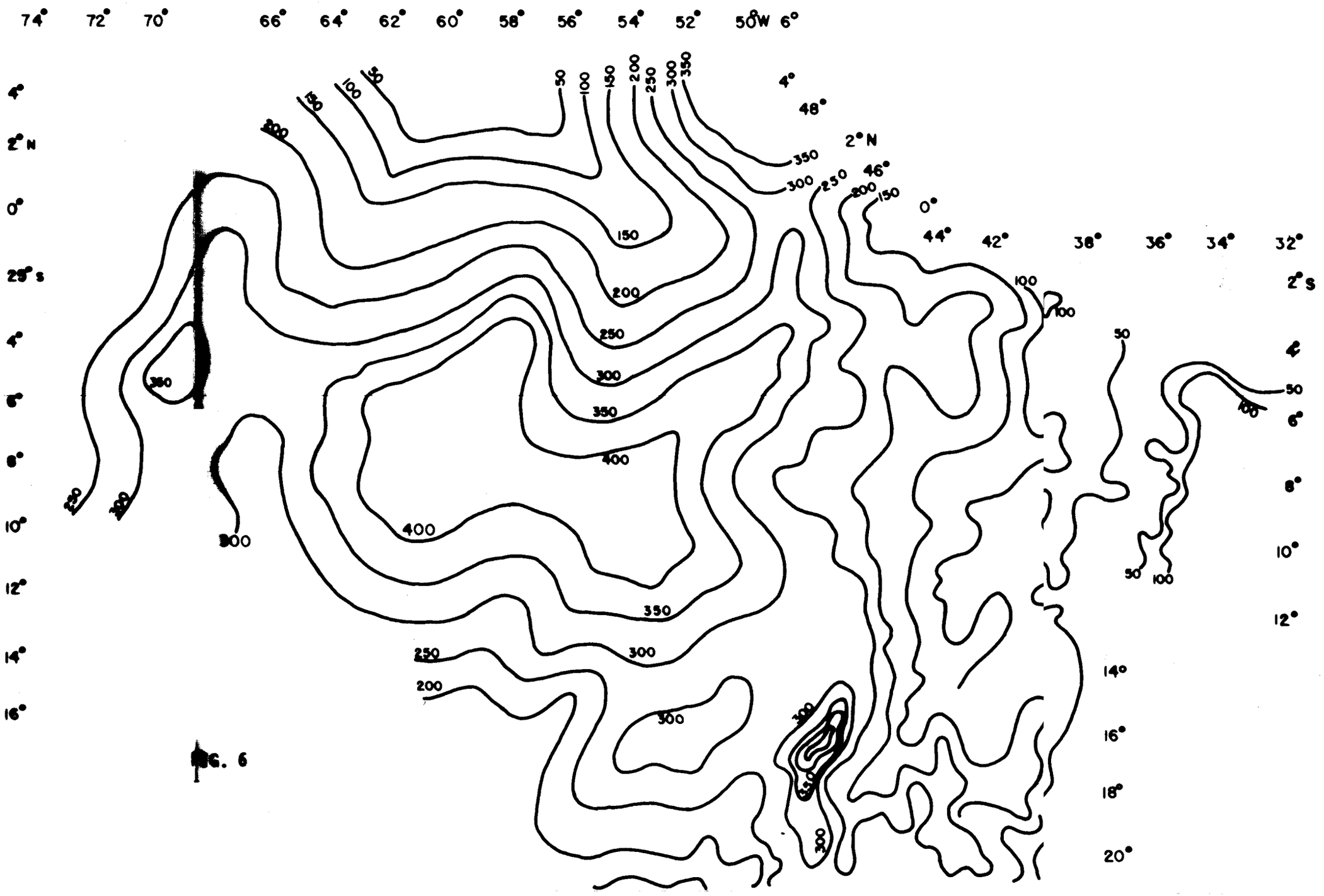

74° 72° 70° 66° 64° 62° 60° 58° 56° 54° 52° 50° 6°
4°
2° N
0°
2° S
4°
6°
8°
10°
12°
14°
16°
18°
20°
48°
46°
44°
42°
38°
36°
34°
32°
50
100
150
200
250
300
350
400

FIG. 6

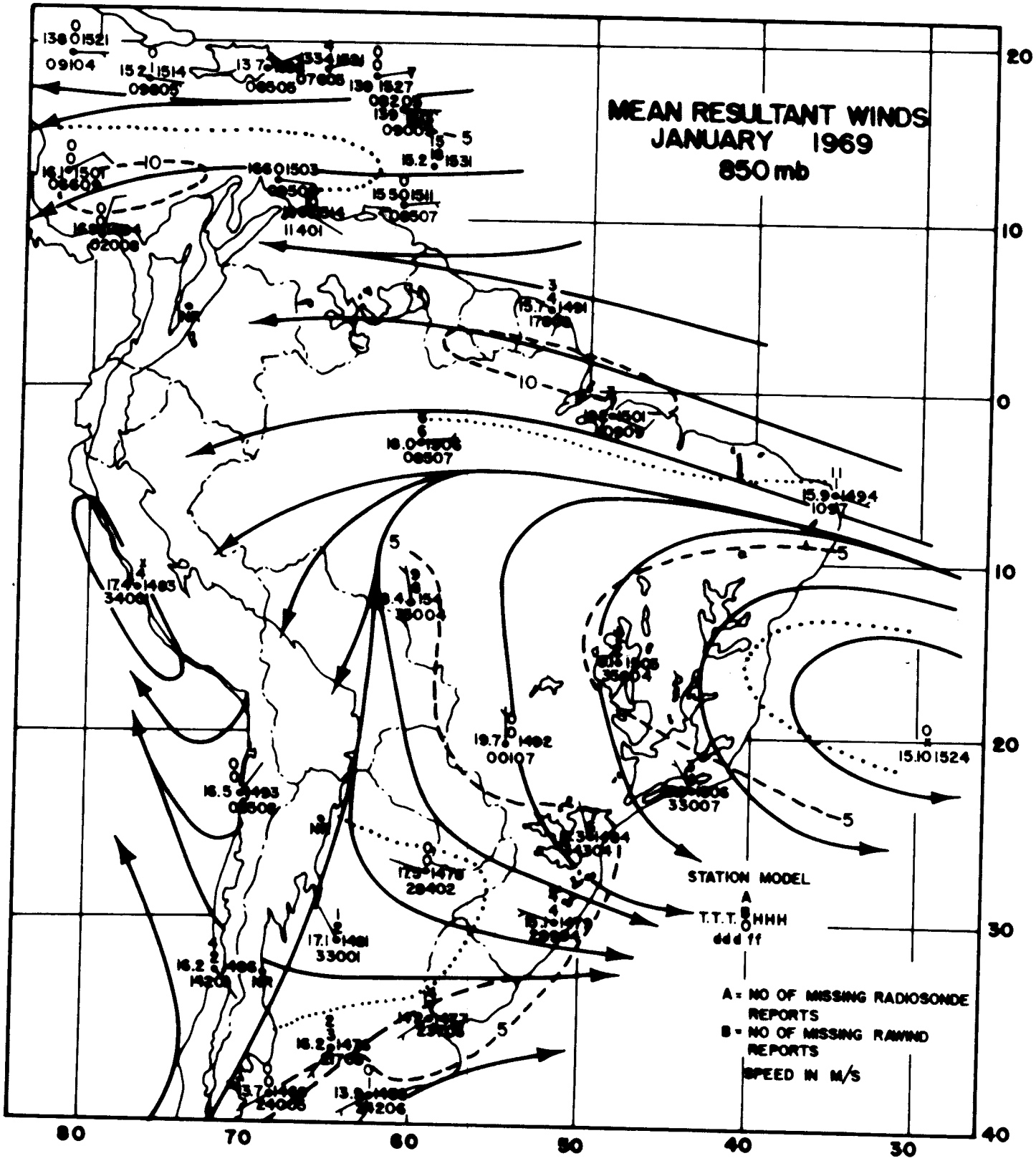

MEAN RESULTANT WINDS
JANUARY 1969
850 mb
STATION MODEL
A
B
T.T.T.
HHH
ddd ff
A = NO OF MISSING RADIOSONDE REPORTS
B = NO OF MISSING RAWIND REPORTS
SPEED IN M/S
80
70
60
50
40
30
20
10
0
10
20
30
40

FIG. 7

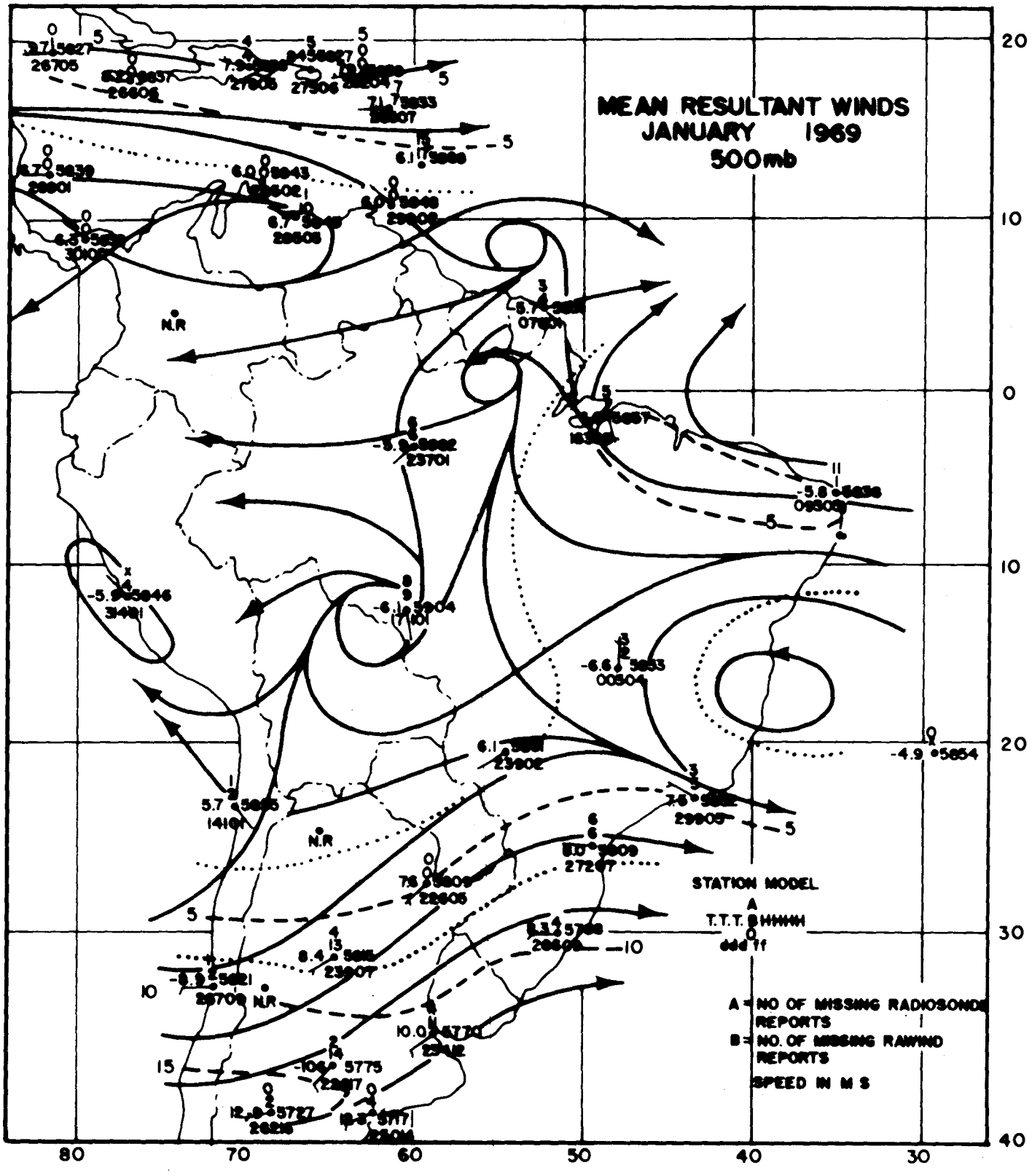

MEAN RESULTANT WINDS
JANUARY 1969
500mb
STATION MODEL
A
T.T.T. BHHHH
ddd ff
A = NO OF MISSING RADIOSONDE REPORTS
B = NO. OF MISSING RAWIND REPORTS
SPEED IN M S
N.R
80
70
60
50
40
30
20
10
0
10
20
30
40

FIG. 7a.

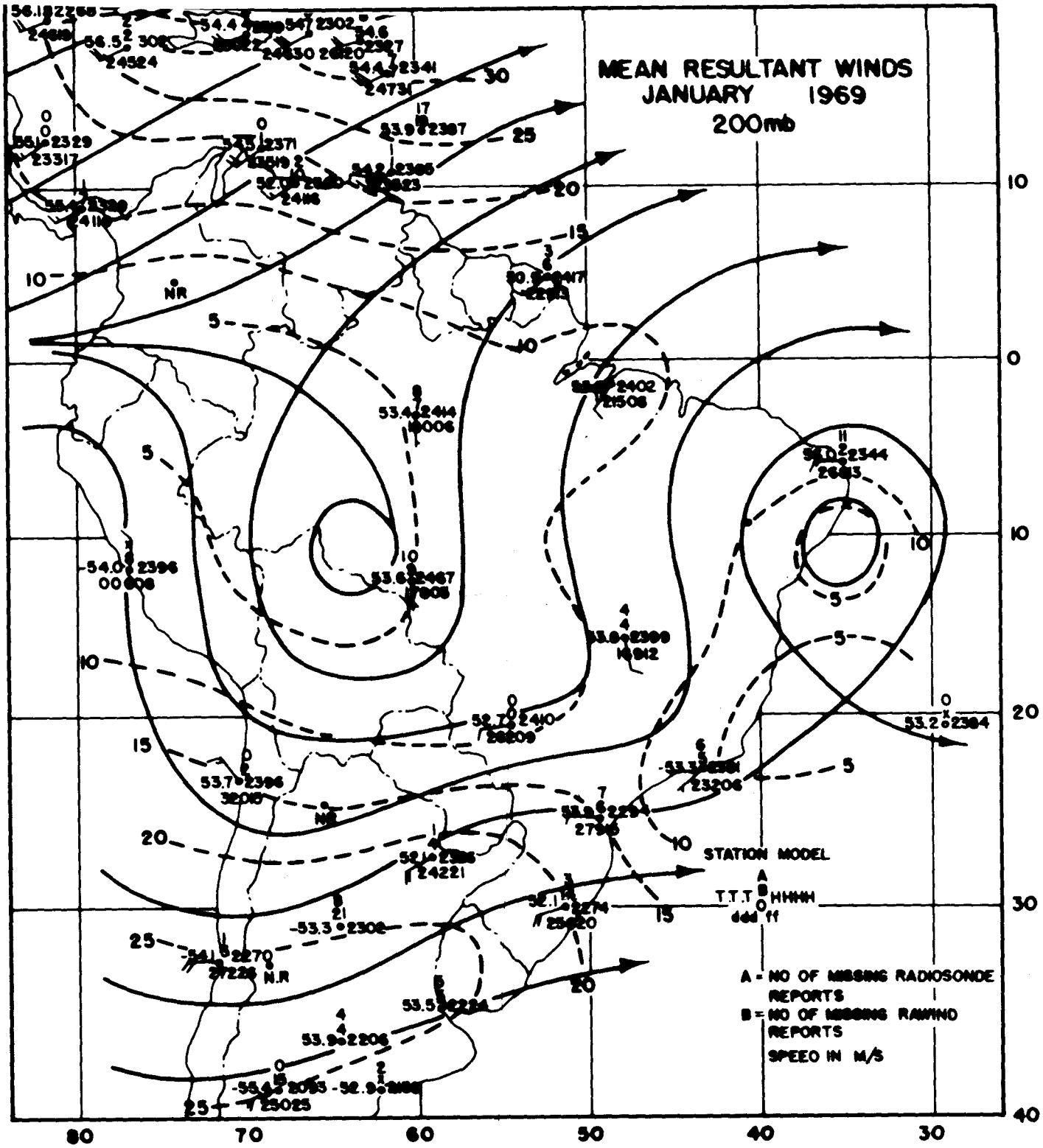

MEAN RESULTANT WINDS
JANUARY 1969
200mb
STATION MODEL
A
B
T T T D HHHH
dd ff
A - NO OF MISSING RADIOSONDE REPORTS
B = NO OF MISSING RAWIND REPORTS
SPEED IN M/S
80
70
60
50
40
30
10
0
10
20
30
40

FIG. 7b.

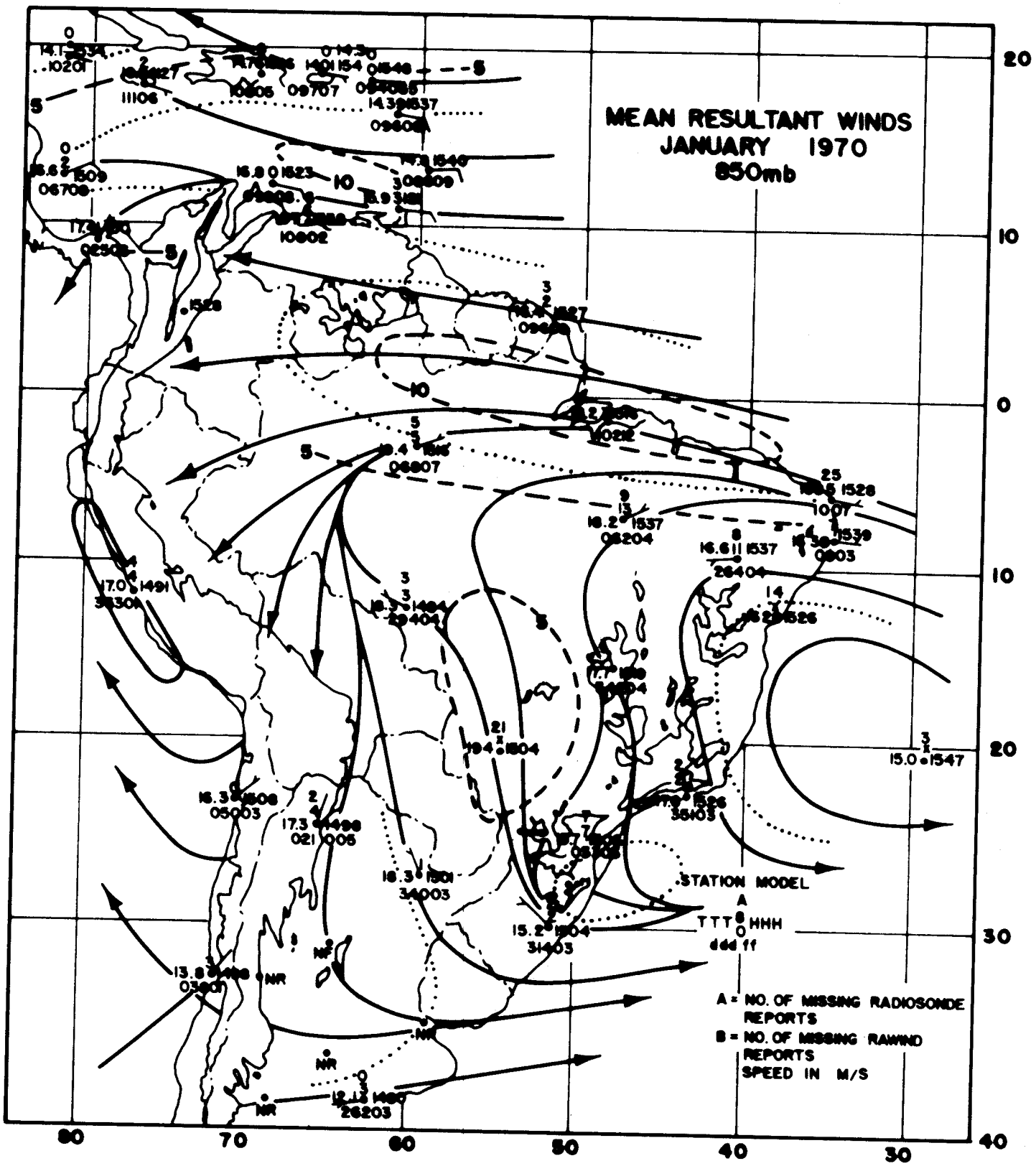

MEAN RESULTANT WINDS
JANUARY 1970
850mb
STATION MODEL
A
TTT HHH
dd ff
A = NO. OF MISSING RADIOSONDE REPORTS
B = NO. OF MISSING RAWIND REPORTS
SPEED IN M/S
80
70
60
50
40
30
20
10
0
10
20
30
40

FIG. 8

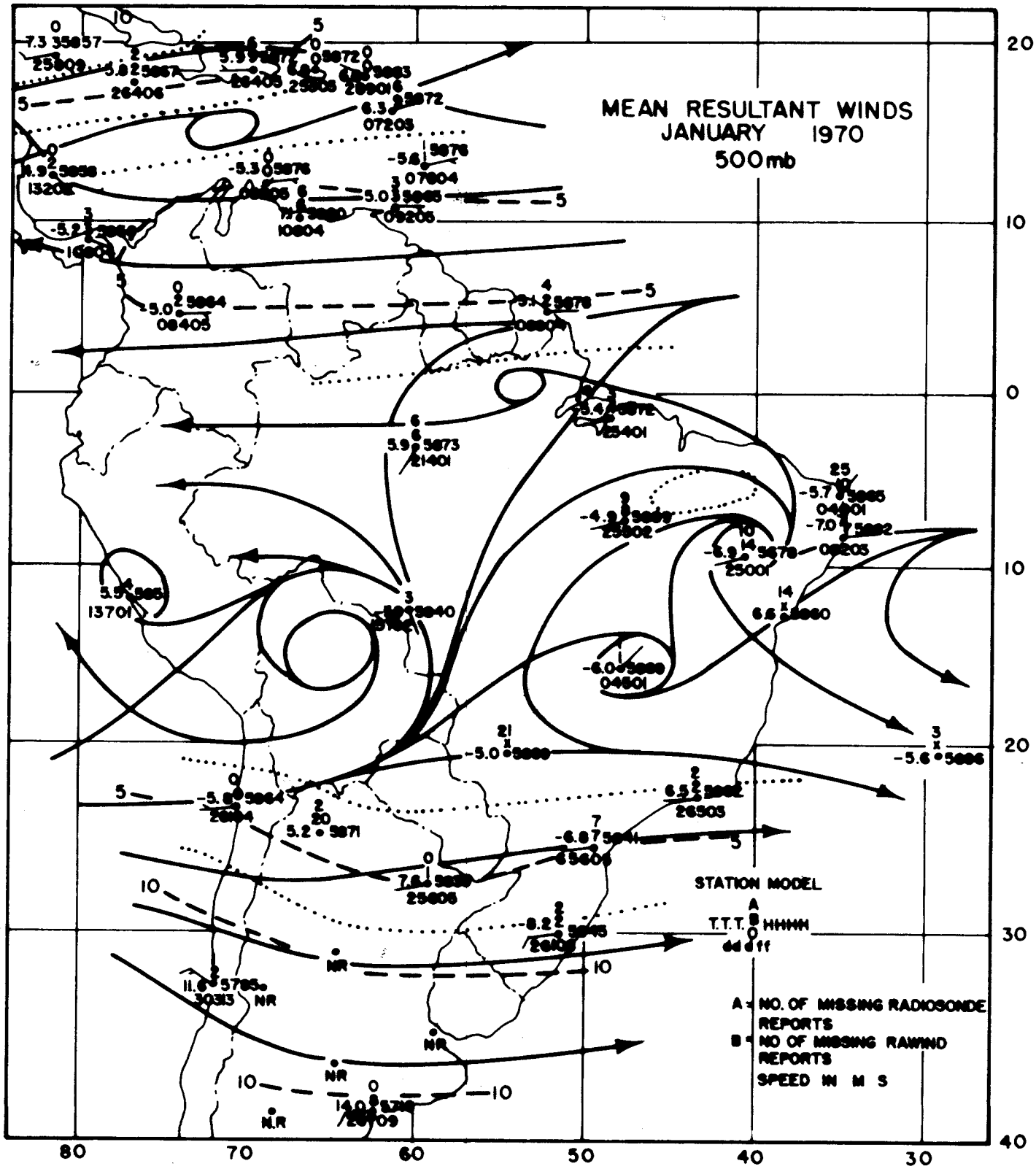

MEAN RESULTANT WINDS
JANUARY 1970
500mb
STATION MODEL
A
T.T.T.D HHHH
dd fff
A = NO. OF MISSING RADIOSONDE REPORTS
B = NO OF MISSING RAWIND REPORTS
SPEED IN M S
NR
N.R
80
70
60
50
40
30
20
10
0
10
20
30
40

FIG. 8a.

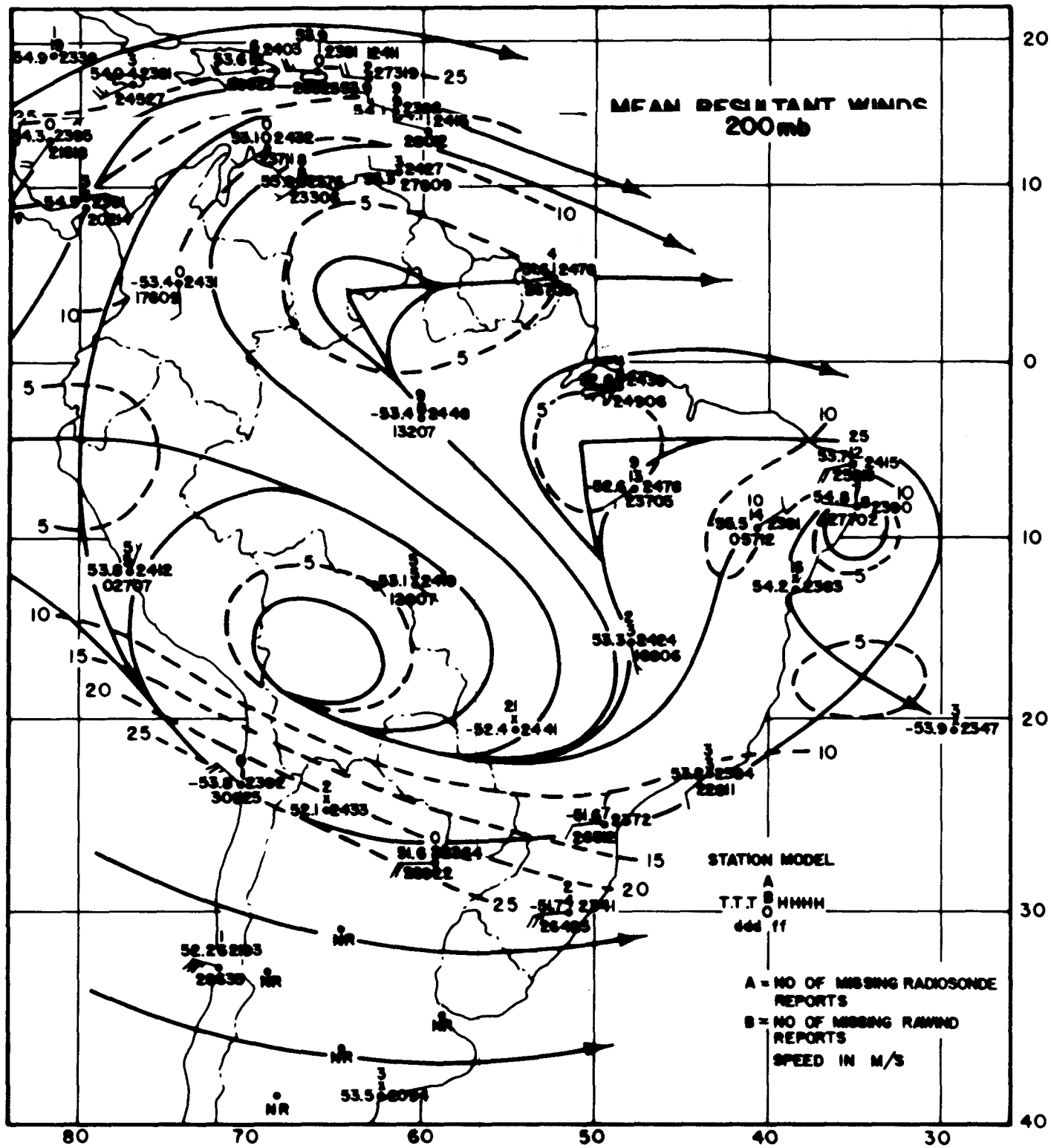

MEAN RESULTANT WINDS
200 mb
STATION MODEL
A
T.T.T B HHHHH
dd ff
A = NO OF MISSING RADIOSONDE REPORTS
B = NO OF MISSING RAWIND REPORTS
SPEED IN M/S
NR
80
70
60
50
40
30
20
10
0
10
20
30
40

FIG. 8b.

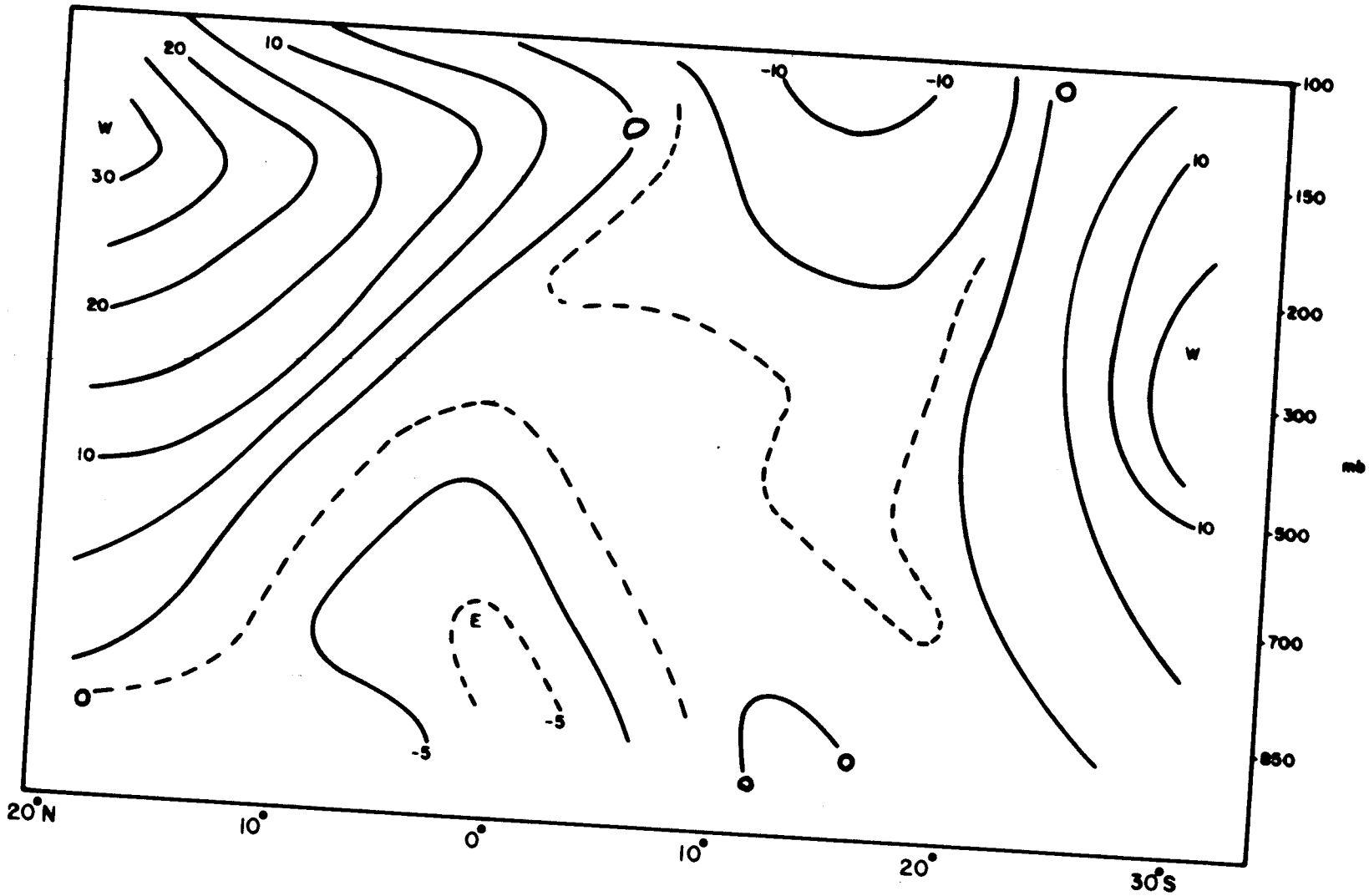

20
10
W
30
20
10
0
-10
-10
0
10
W
10
0
E
-5
-5
0
0
100
150
200
300
500
700
850
mb
20°N
10°
0°
10°
20°
30°S

FIG. 9


20
0
20
100 120 140 160 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100

FIG. 1a