

ABSORPTION MEASUREMENTS WITH RIOMETER
DATA SUMMARY FOR THE PERIOD MARCH
THROUGH AUGUST 1963

by

M. A. SETTE

and

F. DE MENDONÇA

REPORT LAFE-9

DECEMBER 1963

The measurements reported herein
were performed in cooperation with
Stanford Research Institute and
A. F. Cambridge Research Laboratories.

São José dos Campos
São Paulo - Brasil

C

Comissão

N

Nacional

A

Atividades

E

Espaciais

CONTENTS

I - Introduction.....	1
II - Description of the equipment.....	1
III - Measurements technique	2
IV - Type of scaling and data reduction.....	2
V - Absorption effects associated with solar flares	2
VI - Magnetic bremsstrahlung from relativistic electrons ..	3
VII - "Quiet-day" curve errors and corrections.....	4
VIII - Conclusion	4

TABLES

I - Solar flares versus absorption.....	3
II - XIII - Absorption and medians.....	6 - 17

ILLUSTRATIONS

1 - "Quiet-day" curve for SJC.....	18
2 - Monthly medians of absorption.....	19
3 - Disturbed record	20

RIOMETER MEASUREMENTS

DATA SUMMARY

I - INTRODUCTION

This summary is merely a catalogue of reduced riometer data obtained during the initial period of observations from March 16 through August 31, 1963 at São José dos Campos.

We will not attempt here to reach any conclusions. This will be done in a paper which will follow.

This summary will also show (Fig. 1) a "quiet-day" curve, for the SJC station which was obtained from the available data of the period under consideration. The dotted part of the "quiet-day" curve indicates that section of the curve which will need future corrections for errors that became apparent while reduction of the riometer data was performed in terms of daily absorption.

For each month, the value of absorption is tabulated for the first minute of each hour to the nearest 0.05 db, and the total number of readings for the month as well as the median value are indicated in the same table. See for instance Tables II through XIII. Note that Fig. 2 also shows the monthly medians mentioned above.

A listing of the registered solar flares and related absorption effects during the period under consideration is shown in the Table I.

Figure 3 shows a disturbed record where the effect associated with a solar flare on the cosmic noise absorption is quite evident.

II - DESCRIPTION OF THE EQUIPMENT

RIOMETER: The riometer (Relative Ionospheric Opacity Meter) is a device for measuring ionospheric absorption using the cosmic noise method.

A high gain receiver is switched automatically between one antenna and a noise diode at a given switching frequency (340 pcs).

The antenna which in our station is an East-West four elements Yagi, points vertically and receives the cosmic noise. If there is a difference between the antenna power and the noise diode power, a square wave at the switching frequency appears at the detector of the receiver. The detector output is a DC voltage which has an amplitude that is proportional to the difference between the antenna and the diode signal. The voltage is used to adjust the current of a servo diode in order to reduce the above mentioned difference to zero. The diode noise power is proportional to the current which in turn is directly proportional to the antenna noise power. The diode current is recorded in a common pen recorder.

The riometer is calibrated daily by connecting a test noise diode in place of the antenna and passing different values of current through the diode. The values are marked for comparison with the readings of the riometer.

The frequency used of 30 Mc/s is low enough to be sensitive to the non-deviative absorption effects of the lower ionosphere and

yet it is sufficiently high so that a signal is detectable even under heavy ionospheric disturbances.

III - MEASUREMENTS TECHNIQUE

In the cosmic noise method already mentioned, the absorption is measured by comparing the signal actually received with the signal that would be received in the same system at the same sidereal time under conditions of zero absorption.

In order to measure the absorption it is necessary to establish the local "quiet-day" curve. This curve is obtained from the riometer recordings in the hours before the sunrise, when absorption is low. The values of current observed are transferred to the corresponding sidereal time. The highest reliable readings are considered points of the "quiet-day" curve, which is assumed as pointed before to represent values of zero absorption condition.

From the "quiet-day" curve the absorption in db at any time is given by the relation:

$$A \text{ (db)} = 10 \log_{10} P_r/P_q \text{ where}$$

P_r = power noise actually received at a given time;

P_q = power noise from the "quiet-day" curve for the corresponding sidereal time.

IV - TYPE OF SCALING AND DATA REDUCTION

In reducing the riometer data, scaling TYPE I (URSI-AGI Committee 1958) has been used.

The absorption during the first minute of each hour for every day throughout a given period of observation is recorded and then averaged. The results give a picture of the daily and seasonal variation of the absorption.

The data reduction was performed in the following manner:

The "quiet-day" curve, assumed to represent ZERO absorption, was plotted as well as curves of constant ratio (I_0/I), in order to obtain a set of parametric curves for given values of absorption in (db).

The actual values of current for each hour are translated to the correct sidereal time and the value of absorption in db is obtained from the parametric curves mentioned above.

The following qualifying symbols have been used for values obtained indirectly from the record:

C failure of equipment

S interference

U value uncertain

I value interpolated

V - ABSORPTION EFFECTS ASSOCIATED WITH SOLAR FLARES

The Sun's ionizing radiation during solar flares is normally enhanced and reaches the lower level of the ionosphere increasing the absorption through the D-region producing the attenuation of the cosmic noise reaching the antenna. Sometimes prior to the observation of attenuation, and depending on the relative position of the Sun and antenna

beam, one observes an increase in the flux of energy reaching the antenna as a result of the Sun's HF radio emissions.

Some flare occurring during the local sunlight could be clearly related to absorption effect showed in the riometer records.

The information on solar flares, published on the Solar Geophysical Data - Part B - of the Central Radio Propagation Laboratory, was used to analyse the absorption effects on the riometer records. There is a good correlation between the increase in absorption and solar flares accompanied by ionospheric effects S-SWF (sudden drop-out and slow recovery).

Table I lists sudden increase in absorption and related solar flares.

Table I

Date	Excess absorption db	Time UT	Flare Type	Period (UT)		Provisional Ionospheric Effects
				Start	End	
April, 15	1.35	11:28	2	11:21	12:25	S-SWF
15	2.5	16:21	2	16:07E	16:40	S-SWF
May, 23	0.92	12:10	1 +	12:30E	13:05D	S-SWF
23	0.92	15:53	1	15:49	15:53	S-SWF
24	0	-	1	15:19	15:40	S-SWF
25	0	-	1 -	16:23	16:36	S-SWF
30	Interf.					
August, 17	0.73	16:18	1 -	16:10E	16:40	S-SWF
18	0.45	18:03	1	18:00E	18:15D	S-SWF

VI - MAGNETIC BREMSSTRAHLUNG FROM RELATIVISTIC ELECTRONS

We expected to make measurements on the excess signal component from the synchrotron radiation of high energy particles trapped in the earth's magnetic field after the July 9, 62 detonation over Johnston Island. This was not possible however, and one reason for that could be that this riometer was set in operation on March 18, 1963, that is, 8 months after the detonation. Since the decay of the bremsstrahlung radiation has a time constant of about 60 days, the excess radiation component was already reduced by that time to about 20% of its original value.

The possibility of extracting the excess signal component from the riometer records was upset by the fact that at the time that this riometer was put into operation, the portion of the sky of very high temperature, namely the galactic center, was on the antenna beam in the early hours of the morning when the absorption is normally low.

The excess signal, already reduced in its strength, was not noticeable over this high level background signal. However there is still hope that using next years zero absorption levels, one might be able to go back in time and establish the above mentioned contribution.

VII - "QUIET-DAY" CURVE ERRORS AND CORRECTIONS

The "quiet-day" curve for this station has been obtained from data of 6 months of operation during a period of relatively low absorption. However in this procedure it seems that some errors have been included in the "quiet-day" curve.

A portion of the curve which shows low values of current is the result of including values obtained from hours when the absorption was low but could not be disregarded or considered equal to ZERO. A first trial to correct this error has been made using recent data corresponding to local time between 3AM and 6AM, and during the local winter. This correction was done in order to get a first approximation of the "quiet-day" curve. It was a correction which consisted of modified values of current that were to correspond to zero absorption in the new curve.

This riometer has been in operation regularly since March 16, 1963. Some equipment failure occurred for a week during the month of July and the receiver was off. After that the riometer has been recalibrated and reset and the adjustments of the receiver were not exactly as before.

The available data used in deducing the "quiet-day" curve came from the receiver operating with 2 different set of parameters. The increase in the absorption level in the early morning after July can be related to the change in the receiver gain. Corrections on the level of the "quiet-day" curve will be possible with a few more months of observation.

VIII - CONCLUSION

Except for very strong interference produced by thunder storms, typical of the Summer period in this latitude, this station is placed in a very quiet location.

The riometer records are quite free from man made interferences.

Since for reasons mentioned above, there were some errors in the "quiet-day" curve, this first report presents the data as a provisional average of monthly absorption.

A few more months of consistent operation of the riometer will provide data for a detailed study of the seasonal variation of non-deviative absorption.

This station will continue its operation and will provide data on Ionospheric Absorption in a cooperative program for the International Quiet Sun Year (1964-1965).

Data will be sent to the World Data Center, as established in the Guide to International Data Exchange, CIG - IQSY Committee.

Acknowledgement:

The riometer in operation at this site was provide to us by the Air Force Cambridge Research Laboratories (Mr. S. Horowitz) through the Stanford Research Institute, Menlo Park, California (Dr. Rolf B. Dyce). Copies of our recordings are sent regularly to SRI. We do appreciate this opportunity for participating in their program of Global Riometer Measurements.

We want also to thank Miss Maria Leticia P. de Azevedo for scaling most of the data. .

References:

- 1) - Little, C. G., and Leimbach, H. - "The Riometer - A Device for the Continuous Measurements of Ionospheric Absorption" - Proceedings of IRE, Feb. 1959, Vol. 47, pp 315-320.
- 2) - Little, C. G., and Leimbach, H. - "Some Measurements of High-latitude Ionospheric Absorption Using Extra-terrestrial Radio Waves" - Proceedings of IRE, Jan. 1958, Vol. 46, pp 334-348.
- 3) - Mitra, A. P., and Shain, C. A. - "The Measurements of the Ionospheric Absorption Using Observations of 18.3 Mc/s Cosmic Radio Noise" - J. Atmosph & Terrestrial Physics, Vol. IV, 1953, pp 203-218.
- 4) - URSI-AGI Committee - Letter in "Questionnaire on Ionospheric Absorption Measurements" - A2, Appendix A, Sept. 15, 1958.
- 5) - Lusignan, B. B. - "Cosmic Noise Absorption Measurements at Stanford, California and Pullman (Washington)" - J. G. R., Vol. 65, nb 12, Dec. 1960, pp 3896-3902.
- 6) - "Riometer Measurement, Data Summary n° 1, January to December 1958" - Radioscience Laboratory, Stanford Electronics Laboratories, Stanford University, Nov. 1959.
- 7) - Goldman, S. C., and Horowitz, S. - "Global Riometer Measurements".

Month: March
Year: 19 63

TABLE III

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	0.15	S	S	-0.10	-0.10	0.25	0.50	0.75	0.75	0.75	1.60	1.00	0.20	1.00	1.20	1.15	1.40	1.10	0.80	1.35	0.75	1.20	0.10	0.55
17	0.20	S	C	C	C	C	-0.30	-0.20	C	C	C	0.05	0.10	-0.20	0.38	0.45	0.55	0.35	-0.20	0.20	0.20	-0.05	S	C
18	S	S	C	C	C	C	-0.50	-0.20	C	C	C	0.02	0	-0.30	0.25	0	0	C	-0.20	C	S	S	S	C
19	S	-0.70	S	-0.60	-0.50	-0.10	0.20	0.25	0.53	0.68	0.75	0.55	0.70	0.65	S	0.05	0	0.25	1.35	1.00	0.60	0	-0.05	-0.50
20	C	C	0.55	0.65	0.65	0.60	0.80	0.90	1.00	1.50	1.40	1.25	C	1.25	1.25	1.50	1.50	1.50	1.00	1.40	1.75	0.25	0.20	C
21	0.28	-0.10	0.10	C	0.30	0.48	0.65	0.95	1.18	0.50	1.45	1.25	1.30	1.25	1.40	1.45	1.70	2.10	2.00	2.60	0.75	2.40	0.70	0.20
22	0.08	0.10	0.30	0.40	0.75	0.35	0.70	0.70	0.80	0.80	1.05	0.90	1.45	1.50	1.50	1.60	1.65	0	0.20	0.75	1.30	1.55	0.50	0.20
23	0.40	-0.05	0	0	0.20	0.50	0.50	0.98	1.12	1.12	1.45	1.10	1.68	1.50	1.95	1.30	0.10	S	S	S	S	S	S	S
24	S	S	0.75	0.50	0.76	1.15	1.50	1.75	1.50	2.00	2.00	1.45	1.80	1.50	2.10	1.80	1.90	1.50	S	S	S	S	S	S
25	0.25	0.50	0.22	0.30	0.50	1.00	1.40	1.10	1.62	1.58	1.00	1.10	1.25	1.80	2.00	1.90	2.16	1.75	0.75	0.80	S	-0.50	-0.50	0.20
26	0.20	0.50	0.50	0.75	1.05	1.25	1.50	1.25	1.63	1.63	1.65	1.50	1.50	1.50	1.55	1.80	2.40	2.05	2.65	2.00	0.75	-0.18	0.05	0.10
27	0	0.30	0.35	0.28	0.40	0.58	0.60	0.68	0.55	0.42	0.85	1.00	1.60	1.50	1.55	1.80	1.75	1.75	1.85	S	S	1.10	0.75	1.00
28	0.80	0	C	C	C	C	C	C	C	C	C	C	2.10	2.30	S	2.85	2.40	2.70	2.25	1.20	0.25	0.10	-0.10	0.10
29	0.50	0.40	0.50	0.50	0.40	0.35	0.28	0.55	0.42	0.98	0.85	1.60	1.10	1.15	0.80	0.95	1.90	0.55	1.40	1.50	0.85	0.10	1.20	0.15
30	-0.10	0	0	0.30	0.18	0	0.03	0	0.10	0.18	0.10	0.60	1.10	1.25	1.00	1.50	1.35	1.60	1.95	2.10	1.95	0.10	-0.20	-0.20
31	-0.10	-0.20	0.35	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Count	14	12	13	13	14	14	16	16	14	14	14	16	15	17	15	17	17	14	15	14	12	14	15	14
Median	0.15	0.05	0.30	0.30	0.30	0.30	0.50	0.70	0.80	0.95	1.10	1.05	1.30	1.25	1.50	1.55	1.65	1.60	1.55	1.20	0.75	0.10	0.10	0.10

TIME-UT

Comissão Nacional de Atividades Espaciais
São José dos Campos - SP - Brasil

Station.....	- SJ	Lat.....	- 23°12'43"S	Freq.....	- 30 Mc/s
Month.....	- April	Long.....	- 45°51'35"W	Bandwidth.....	- 30 Kc/s
Year.....	- 1963	DIP.....	- 22.5°S	Diode Load Resist..	- 750 ohm
Riometer.....	- Mark II	Mag. Lat.....	- 11.7°S	Audio Threshold....	- By pass
		Alt.....	- 623 m	Time Int.....	- 4 sec
				ACG Time.....	- 2 sec

- 8 -

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Day																								
1	0	0	0	0	0.10	0.15	0.10	0.12	0.10	0.40	0.40	0.85	1.00	1.45	1.45	1.60	1.40	1.45	1.60	1.85	1.00 ^s	0.10 ^s	0	-0.20
2	-0.20	-0.20	-1.00	0.01	0	0.21	0.25	0.25	0.25	0.45	0.60	1.00	1.20	0.95	1.05	1.35	1.40	1.40	1.60	1.95	1.80	0.15	-0.50	-0.50
3	0	-0.20	-0.20	0	0	0.20	0.10	0.10	0.10	0.42	0.35	1.00	1.00	1.20	1.00	1.00	1.30	1.35	1.30	0.85	0.50	-0.50	-0.50	-0.20
4	0	0.05	0.05	0.20	0.05	0.25	0.20	0.22	0.25	0.48	0.55	1.15	1.10	1.30	1.45	1.20	1.30	1.40	1.40	0.65	0.21	-0.30 ^s	0	-0.20
5	-0.10	0	0	0.10	-0.05	0.12	0.10	0.10	0	0.35	0.35	1.15	1.30	1.70	2.15 ^c	2.30 ^c	1.95 ^c	2.20 ^c	2.25 ^s	0.70	0	-0.10	-0.10	-0.40
6	-0.10	-0.10	-0.10	0.05	0.20	0.20	0.05	0	0.10	0.32	0.35	1.20	1.25	1.60	1.55	2.30	2.80 ^a	2.90	2.60 ^s	2.40	1.35 ^s	0.20 ^s	0.40	0.30
7	0.50	-1.00 ^s	0.25	0.60	1.00	0.90	0.10	0.32	0.28	0.55	0.50	1.10	1.50	1.70	2.00	2.80	3.00	2.90	2.60	1.10	-0.10 ^s	-1.30 ^s	-0.50	-0.30
8	-0.10	0	0	0.08	0.35	0.25	0.35	0.32	0.35	0.55	0.70	1.10	1.40	1.65	2.25	2.50	2.10	1.70	1.35	1.10	0.30	-1.00 ^v	-0.50	-0.10
9	0.20	0.25	0.30	0.35	0.35	0.40	0.20	0.25	0.32	0.50	0.60	1.00	1.05	1.50	1.70	1.90	1.50	1.05	0.80	-0.10	-0.30 ^s	-0.30 ^s	-0.50 ^s	-0.20
10	0.25	0.10	0.20	0.28	0.40	0.40	0.42	0.30	0.32	0.40	0.50	0.90	1.40	1.30	2.10	2.70	3.00	2.90	2.60	1.80	0.55	-0.10	0.80	0
11	0.30	0.35	0.40	0.35	0.35	0.45	0.35	0.30	0.40	0.35	0.65	1.05 ^s	1.10	1.45	1.60	1.80	2.40	2.45	2.00	1.80	1.10 ^v	0.05	0.80	0.70
12	0.15	0.20	0	0.18	0.20	0.32	0.30	0.21	0.30	0.49	0.80	1.00	1.40	1.60	1.80	2.40	2.70	2.30 ^s	1.70	1.55	1.40	0.60	0.10	0.20
13	0.15	0.20	0.25	0.15	0.20	0.30	0.20	0.05	0.20	0.25	0.70	1.05	1.70	1.20	1.20	1.20	1.40	1.35	1.50	1.65	1.10	1.05	1.50	1.85
14	1.90 ^c	1.00	0.35	0	0.70	0.98 ^c	c	c	c	0.65 ^c	1.50	2.10	1.85	1.80	1.90	1.70	1.40	1.35	1.50 ^s	1.40	0.35	0.15	0.35	0.50
15	0.20	0	0.35	0.40	0.35	0.35	0.35	0.22	0.60	0.45	0.70	0.65	S	0.75	0.80	1.10	1.40	2.25	2.80	2.95	1.10 ^s	1.10	1.30	1.40

TIME - UT

Month: April
Year: 19 63

TABLE

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	070	040	050	020	035	060	066	125	150	135	130	130	180	175	135	160	140	195	250	200	175	140	105	100
17	095	050	050	040	050	050	043	020	100	065	100	070	080	065	080	030	025	050	020	0	050	0	070	100
18	055	035	025	035	035	040	025	019	030	035	075	070	075	095	100	020	050	075	110	070	060	020	065	060
19	060	030	035	032	035	040	030	035	050	045	090	075	085	040	070	C	C	C	115	020	005	050	020	0
20	040	005	020	020	005	020	010	010	025	020	070	075	060	030	065	050	075	105	145	105	070	020	0	005
21	010	005	0	020	010	015	005	010	020	025	065	085	085	070	060	0	050	080	045	025	050	010	020	005
22	005	010	0	005	0	005	015	015	015	020	060	090	145	115	195	180	165	160	160	100	085	050	050	030
23	018	006	010	013	020	025	017	0	005	010	065	100	145	125	160	150	165	165	110	085	020	030	005	018
24	010	0	010	015	018	005	0	0	010	025	060	050	135	165	075	096	135	105	095	055	0	015	010	020
25	030	030	010	005	013	0	010	005	008	010	050	060	095	130	190	150	160	165	105	105	005	010	0	030
26	0	002	0	020	015	005	0	005	016	025	075	065	070	100	125	300	220	145	185	165	090	010	0	005
27	0	0	020	0	010	008	002	013	020	040	070	095	075	100	120	165	200	200	220	245	105	035	020	035
28	028	028	035	035	030	010	028	029	030	045	095	090	090	100	125	145	160	200	220	190	135	060	045	040
29	015	020	028	025	005	015	005	025	020	065	100	095	105	105	125	115	105	100	145	150	C	C	C	0
30	0	015	003	010	028	025	019	050	040	085	405	070	095	110	110	110	105	100	145	145	085	060	035	030
31																								
Count	30	30	30	30	30	30	29	29	29	30	30	30	29	30	30	29	29	29	29	30	29	29	29	30
Median	015	005	015	020	020	025	020	020	025	045	065	095	110	120	125	150	180	155	155	105	065	040	020	05

TIME-UT

PR - CNPq

MEAN VALUE OF ABSORPTION DURING THE FIRST MINUTE OF EACH HOUR

Station..... - SJ

TABLE

TIME - UT

Month: May
Year: 19 63

TABLE VII

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	030	065	070	040	050	040	060	045	075	080	100	070	080	110	125	105	145	175	140	160	065	120	070	025
17	040	042	070	045	040	060	065	055	090	110	110	080	050	055	075	060	025	020	020	085	110	100	020	040
18	050	042	030	030	060	050	062	050	085	080	100	100	100	130	135	135	105	070	065	065	080	040	035	015
19	030	035	035	035	045	035	050	040	080	085	095	065	100	130	165	135	050	075	025	020	068	080	055	050
20	070	065	050	030	028	020	045	040	100	100	125	110	145	150	200	200	200	105	130	C	C	C	C	C
21	025	0	C	0	040	0	020	035	060	070	075	055	095	075	105	105	055	080	130	095	-060	030	030	0
22	030	0	008	0	004	010	025	030	060	058	065	050	035	075	105	055	065	030	080	150	040	050	035	025
23	040	035	020	014	014	025	025	040	070	080	075	045	050	070	135	115	045	060	055	100	050	080	040	020
24	020	005	0	010	010	0	035	030	070	055	070	10	070	120	135	105	100	065	060	100	075	040	040	025
25	015	010	0	0	010	005	025	025	070	065	040	035	055	065	075	025	0	020	5	030	080	045	030	025
26	020	020	0	0	020	025	035	055	100	095	070	075	075	070	105	075	050	045	070	080	080	045	035	025
27	030	035	0	005	022	015	045	040	090	080	100	125	095	060	075	050	050	070	120	120	035	050	035	030
28	025	030	010	010	015	035	036	065	100	085	090	095	095	085	075	060	055	080	100	109	065	035	030	030
29	035	040	0	020	025	040	030	075	100	095	080	060	090	055	075	050	060	060	125	130	140	080	030	035
30	040	035	011	018	0	025	025	060	055	095	050	055	085	030	100	050	010	5	-020	5	030	040	020	030
31	050	035	040	028	025	040	035	075	070	075	065	080	085	080	080	050	035	060	010	0	075	080	020	035
Count	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	30	31	28	30	29	30	30	30	34
Median	0.30	0.35	0.20	0.20	0.25	0.25	0.35	0.40	0.60	0.80	0.90	0.90	0.95	1.20	1.40	1.40	1.40	1.35	1.20	1.00	0.75	0.50	0.35	0.30

TIME-UT

PR - CNPq

MEAN VALUE OF ABSORPTION DURING THE FIRST MINUTE OF EACH HOUR

Station.....	- SJ	Lat.....	- 23°12'43"S	Freq.....	- 30 Mc/s
Month.....	- June	Long.....	- 45°51'35"W	Bandwidth.....	- 30 Kc/s
Year.....	- 1963	DIP.....	- 22.59S	Diode Load Resist..	- 750 ohm
Riometer.....	- Mark II	Mag. Lat.....	- 11.79S	Audio Threshold....	- By pass
		Alt.....	- 623 m	Time Int.....	- 2 sec
				ACG Time.....	- 4 sec

TABLE VIII

- 12 -

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	040	025	020	010	035	050	030	075	085	085	050	075	080	050	050	025	020	020	015	065	060	050	010	035
2	030	040	030	030	030	060	085	135	105	120	075	075	105	110	110	050	050	020	040	040	060	075	010	020
3	030	025	020	010	010	030	025	065	065	070	070	050	050	050	030	050	075	170	045	0	040	020	0	005
4	005	0	-020	-030	-030	0	005	035	015	045	020	020	020	050	050	030	080	050	045	050	005	025	010	015
5	020	010	-020	-020	-020	0	-005	035	020	035	0	0	020	020	050	030	030	050	050	050	030	030	015	020
6	025	-010	040	-010	0	015	0	050	030	030	005	-005	-005	050	050	040	045	010	005	030	010	035	010	030
7	0	0	010	010	0	015	010	045	045	035	020	055	070	110	135	120	090	060	100	075	055	040	035	040
8	035	030	010	040	0	015	010	055	050	060	040	005	010	020	0	0	045	0	075	080	040	020	030	050
9	040	035	015	010	010	010	0	050	045	040	010	020	035	050	050	075	095	115	125	080	065	030	020	020
10	035	010	020	0	010	015	020	050	055	050	030	050	035	050	050	050	045	070	030	040	065	030	025	025
11	030	030	020	020	020	035	045	070	065	060	030	030	035	050	020	025	050	020	055	0	0	0	0	0
12	030	035	025	030	040	035	045	060	075	055	020	020	040	020	0	-040	-005	075	130	0	110	080	055	040
13	050	035	040	050	050	050	090	120	120	075	065	120	140	075	0	010	-010	010	040	030	040	030	020	020
14	030	010	010	010	030	025	050	070	070	085	040	040	010	0	0	010	-005	050	080	100	125	125	070	030
15	050	035	045	040	050	055	070	080	100	075	055	055	055	050	020	010	010	0	040	075	065	045	020	025

TIME - UT

Month: June
Year: 19 63

TABLE IX

- 13 -

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	0.40	0.25	0.25	0.25	0.30	0.30	0.60	0.40	0.70	0.35	0.30	0.30	0.30	0.75	0.50	1.00	1.50	1.85	1.60	0.60 ⁸	0.90 ⁸	0.90	0.65	0.35
17	0.50	0.40	0.35	0.35	0.45	0.45	0.70	0.75	0.80	0.30	0.25	0.50	0.50	0.75	0.50	0.70	0.70	1.10	1.35	1.25	0.95	0.50	0.70	0.45
18	0.60	0.45	0.30	0.30	0.65	0.65	0.95	0.80	0.90	0.45	0.50	0.50	0.50	0.75	0.50	0.50	0.70	0.70	0.90	0.65	0.60	0.40	0.45	0.25
19	0.50	0.20	0.30	0.40	0.60	0.40	0.80	0.85	0.65	0.40	0.45	0.50	0.50	0.20	0.30	0.25	0.25	0.65	0.50	0.25	0.45	0.25	0.40	0.25
20	0.40	0.60	0.40	0.40	0.55	0.80	0.55	0.50	0.70	0.35	0.40	0.45	0.50	0.50	0.35	0.55	1.00	1.45	1.40	0.90	0.85	0.60	0.50	0.20
21	0.20	0.20	0.20	0.30	0.40	0.30	0.55	0.40	0.50	0.30	0.35	0.20	0.20	0.50	0.35	0.30	0.50	0.50	0.50	0.75	0.35	0.40	0.20	0.20
22	0.20	0.0	0.15	0.25	0.15	0.10	0.50	0.30	0.35	0.10	0.10	0.20	0.20	0.20	0.15	0.60	0.50	0.50	0.50	0.60 ¹	0.60	0.20	0.25	0.20
23	0.15	0.0	0.0	0.0	0.10	0.10	0.50	0.55	0.45	0.20	0.25	0.40	0.20	0.20	0.15	0.40	0.60	0.50	0.80	0.80	0.5	0.20	0.30	0.40
24	0.10	0.05	0.0	0.10	0.15	0.20	0.50	0.60	0.35	0.10	0.0	0.10	0.0	0.0	0.0	0.15	0.40	1.00	1.25	1.10	0.50	0.30	0.30	0.20
25	0.10	0.0	0.0	0.0	0.15	0.20	0.35	0.35	0.10	0.10	0.0	0.05	0.20	0.0	0.0	0.20	0.40	0.75	1.05	1.05	0.75	0.75	0.50	0.30
26	0.50	0.15	0.10	0.15	0.10	0.20	0.45	0.45	0.35	0.0	0.0	0.05	0.20	0.20	0.0	0.0	0.45	1.25	1.50	1.15	0.60	0.60	0.30	0.30
27	0.10	0.10	0.15	0.10	0.0	0.10	0.30	0.40	0.10	0.0	0.70	0.05	0.20	0.20	0.05	0.25	0.50	0.90	1.10	1.20	0.65	0.40	0.35	0.35
28	0.30	0.10	0.15	0.20	0.10	0.40	0.50	0.65	0.40	0.20	0.10	0.05	0.20	0.0	0.10	0.10	0.30	0.90	1.10	0.80	0.50	0.30	0.25	0.25
29	0.10	0.10	0.30	0.20	0.10	0.35	0.50	0.50	0.55	0.10	0.35	0.30	0.20	0.20	0.10	0.55	1.00	0.90	1.40	1.00	0.55	0.75	0.45	0.30
30	0.30	0.20	0.10	0.25	0.20	0.55	0.65	0.75	0.45	0.30	0.35	0.50	0.50	0.20	0.15	0.35	0.80	1.05	1.45	1.05	0.95	0.60	0.50	0.30
31																								
Count	30	30	30	30	30	30	30	29	30	30	30	30	30	30	29	30	29	29	29	28	28	29	29	29
Median	0.30	0.20	0.20	0.20	0.20	0.30	0.50	0.55	0.40	0.35	0.35	0.35	0.35	0.50	0.50	0.50	0.60	0.70	0.80	0.75	0.60	0.40	0.30	0.25

TIME-UT

PR - CNPq

Comissão Nacional de Atividades Espaciais
São José dos Campos - SP - Brasil

MEAN VALUE OF ABSORPTION DURING THE FIRST MINUTE OF EACH HOUR

Station	- SJ	Lat	- 23°12'43"S	Freq	- 30 Mc/s
Month	- July	Long	- 45°51'35"W	Bandwidth	- 50 Kc/s
Year	- 1983	DIP	- 22.5°S	Diode Load Resist	- 750 ohm
Riometer	- Mark II	Mag. Lat	- 11.7°S	Audio Threshold	- By peeps
		Alt	- 623 m	Time Int	- 2 sec
				ACQ Time	- 4 sec

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Day																								
1	0.30	0.30	0.35	0.40	0.30	0.30	0.30	0.35	0.40	0.30	0.35	0.50	0.20	0.20	0.65	0.60	0.65	0.85	0.80	0.70	0.40	0.20	0.20	0.15
2	0.20	0.30	0.40	0.30	0.50	0.40	0.35	0.40	0.40	0	0	0	0	0	0.75	0.62	0.90	1.25	1.25	0.90	0.50	0.20	0.20	0.15
3	0.40	0.55	0.40	0.75	0.60	0.95	1.20	1.35	0.95	0.95	1.00	0.70	0.75	0.90	0.75	0.65	0.65	0.20	0.60	0.20	0.50	0.40	0.30	0.20
4	0.25	0.40	0.40	0.55	0.40	0.55	0.65	1.00	0.60	0.70	0.75	0.80	0.90	0.65	0.20	0.45	0.70	0.90	0.85	0.60	0.85	0.80	0.65	0.40
5	0.30	0.45	0.40	0.65	0.35	0.80	0.75	0.95	0.80	0.65	0.75	0.75	0.90	0.40	0.60	0.95	1.40	1.40	1.15	0.90	0.50	0.50	0.40	0.55
6	0.35	0.40	0.35	0.50	0.40	0.65	0.80	0.75	0.35	0.35	0.50	0.50	0.90	0.50	0.45	1.00	1.45	1.60	1.60	1.30	0.95	0.50	0.35	0.25
7	0.40	0.40	0.40	0.80	0.35	0.60	0.60	0.75	0.45	0.55	0.40	0.50	0.50	0.50	0.80	0.75	1.00	1.25	1.20	0.95	0.68	0.50	0.45	0.50
8	0.25	0.40	0.40	0.65	0.50	0.75	0.75	0.75	0.40	0.55	0.40	0.50	0.25	0.35	0.50	0.75	1.70	2.00	2.00	1.45	1.15	0.80	0.40	0.20
9	0.20	0.20	0.20	0.40	0.20	0.40	0.45	0.60	0.15	0.20	0.35	0.25	0.10	0.60	0.55	0.75	0.75	1.00	0.80	0.85	0	0.40	0.30	0.30
10	0.30	0.30	0.30	0.30	0.40	0.35	0.50	0.50	0.20	0.20	0.40	0	0.05	0.40	0.90	1.00	1.25	1.00	1.05	0.90	0.75	0.35	0.30	0.30
11	0.30	0.30	0.30	0.45	0.35	0.50	0.65	0.40	0.05	0.20	0.40	0	0.05	0.45	0.55	0.75	1.00	1.30	1.65	1.35	1.00	0.85	0.30	0.15
12	0.20	0.30	0.30	0.20	0.40	0.35	0.55	0.35	0	0.20	0.05	0	0	0.25	0.30	0.32	0.80	1.10	0.95	1.00	0.90	0.90	0.40	0.20
13	0.40	0.30	0.35	0.15	0.35	0.55	0.65	0.45	0	0.20	0.05	0	0.15	0.55	0.55	0.85	1.00	1.60	1.45	1.25	1.40	1.05	0.40	0.35
14	0.65	0.50	0.50	0.50	0.75	0.75	0.90	0.50	0.85	0.60	0.80	0.80	0.15	1.15	1.15	1.35	2.00	2.35	2.20	1.95	1.60	1.30	0.95	0.85
15	0.75	0.65	0.75	0.45	1.05	1.45	1.25	0.90	1.00	0.35	0.95	0.80	0	0.35	0.35	0.40	0.85	1.20	1.25	1.15	0.80	0.40	0.35	0.35

TIME - UT

Month: July
Year: 1963

TABLE XI

- 15 -

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	0.30	0.25	0.40	0.10	0.75	0.75	0.75	0.40	0.05	0.35	0.30	0.20	0.20	0.45	0.35	0.85	1.05	0.75	1.10	0.65	0.40	0.20	0.35	0.20
17	0.35	0.40	0.45	0.50	0.60	0.70	0.85	0.30	0.25	0.30	0.25	0	0	0.20	0.15	0.40	0.65	1.00	1.15	0.80	0.20	0.55	0.60	0.60
18	0.65	0.50	0.70	0.60	0.75	0.50	0.60	0.20	0.20	0.25	0	0	0.15	0.35	0.90	0.95	1.10	1.50	1.45	1.30	1.10	0.90	0.75	0.60
19	0.65	0.50	0.60	0.50	0.95	1.00	1.00	0.80	0.70	0.50	0.50	0.50	0.65	1.05	0.95	0.70	1.15	1.80	1.40	0	1.00	0.30	0.60	0.45
20	0.70	0.50	0.50	0.95	0.75	0.65	0.90	0.80	0.60	0.50	0.50	0.20	0.45	0.90	0.70	1.00	1.15	0	0	1.00	1.15	0.85	0.85	0.80
21	0.65	0.75	1.00	0.85	1.15	1.10	1.00	0.75	0.60	0.70	0.80	0.75	0.80	1.10	1.00	1.20	1.40	1.70	1.30	1.10	1.25	0.95	0.95	0.85
22	0.75	0.75	0.80	0.75	1.10	1.00	1.05	0.60	0.60	0.40	0.75	0.55	0.80	1.10	1.50	1.30	2.40	2.65	2.50	2.25	0.80	0.60	0.50	0.50
23	0.40	0	0	0	1.25	1.10	1.05	0.65	0.55	0.65	0.80	0.55	0.50	0.90	0.75	1.20	1.50	1.35	0.205	0	0.50	0.75	0.70	0.75
24	0	0	0	0.55	1.00	1.00	1.00	0.80	0.50	0.35	0.50	0.30	0.35	0.50	0.50	0.75	1.00	1.35	1.00	0.80	0.80	0.50	0.50	0.60
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0.05	0.05	0.20	0.30	0.60	0.90	0.60	0.20	0.10	0	0.10	0
30	0	-0.02	-0.50	-0.50	-0.10	0.45	0.20	0.10	0.10	-0.18	0	0	0.10	-0.105	0.20	0.50	0.65	1.10	0.65	0.25	0	0.50	0.10	0.15
31	0.08	0	-0.40	-0.50	0	0.50	0.18	0.10	0.05	0.05	0	-0.20	0.10	0.05	0.20	0.30	0.65	1.10	0.70	0.50	0.50	0.65	0.20	0.10
Count	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	19	19	18	19	19	19	19
Median	0.35	0.40	0.40	0.40	0.40	0.60	0.60	0.60	0.35	0.35	0.35	0.35	0.35	0.45	0.60	0.75	1.00	1.10	1.15	0.95	0.80	0.50	0.40	0.35

TIME-UT

Month: August
Year: 19 63

TABLE XIII

- 17 -

Hour Day	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	615	005	030	050	110	095	080	075	050	040	015	0	020	020	065	054	100	090	055	020	010	025	030	020
17	030	0	028	065	100	090	075	050	030	020	020	010	005	0	030	060	035	060	025	020	005	020	002	010
18	010	010	005	025	075	060	030	030	025	0	020	005	010	020	050	045	055	035	030	045	0	0	008	010
19	0	015	0	055	065	050	025	025	030	010	020	020	010	0	030	050	080	085	180	075	050	040	030	020
20	040	035	045	055	110	090	060	040	020	020	005	0	010	020	090	125	100	042	020	020	005	030	010	030
21	020	035	065	070	075	065	060	045	010	020	005	0	030	060	095	110	123	170	132	065	030	030	025	030
22	040	0	040	050	095	075	055	040	020	0	010	020	030	020	075	078	070	090	050	030	020	025	010	020
23	015	050	030	060	105	070	055	040	040	005	010	010	010	060	056	125	095	170	141	160	020	045	130	040
24	020	030	050	075	095	065	070	040	020	0	0	010	010	020	060	085	120	110	090	020	020	030	035	030
25	040	020	050	080	085	060	050	065	040	005	0	030	015	040	085	108	125	120	165	140	105	065	060	030
26	040	030	045	050	090	070	040	050	040	030	020	030	030	060	105	110	110	130	115	105	085	090	085	060
27	060	070	080	105	065	090	060	050	040	030	010	035	035	080	108	110	130	095	065	065	050	090	095	035
28	025	020	065	100	075	090	060	050	040	020	010	035	035	065	090	115	118	125	115	175	105	100	065	050
29	048	025	050	090	090	080	080	080	040	010	015	020	035	065	090	100	085	090	098	100	080	085	065	055
30	035	040	075	115	100	080	080	050	040	010	020	020	035	085	115	140	125	115	140	210	215	105	055	055
31	050	000	080	110	095	080	075	050	020	015	0	0	030	050	080	088	095	130	100	080	04	065	055	050
Count	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31
Median	020	025	030	050	075	070	055	045	040	030	020	035	030	030	060	065	100	095	075	035	020	080	025	025

TIME-UT

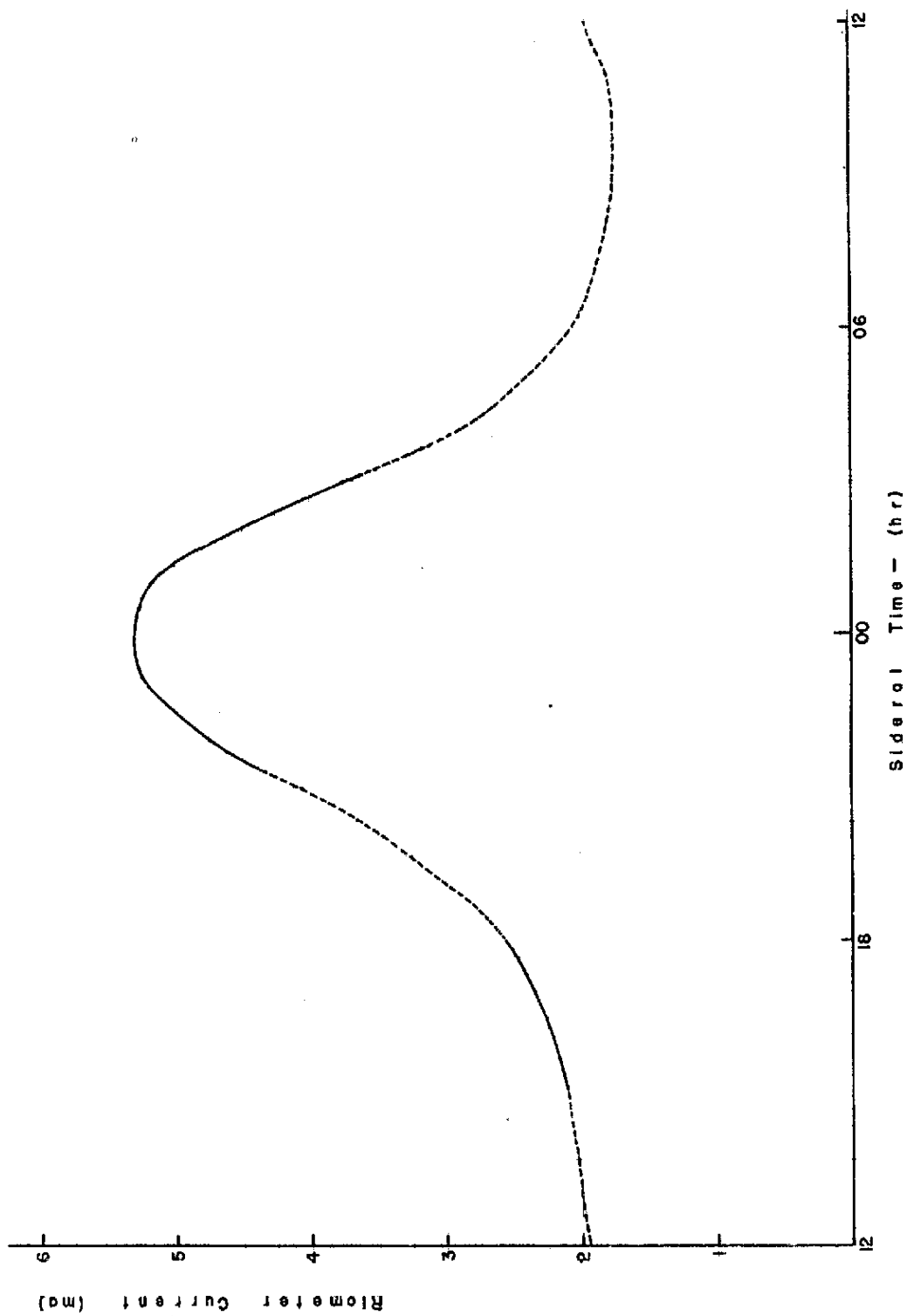


FIG. I - QUIET DAY CURVE

SÃO JOSÉ DOS CAMPOS - SP. (BRASIL)

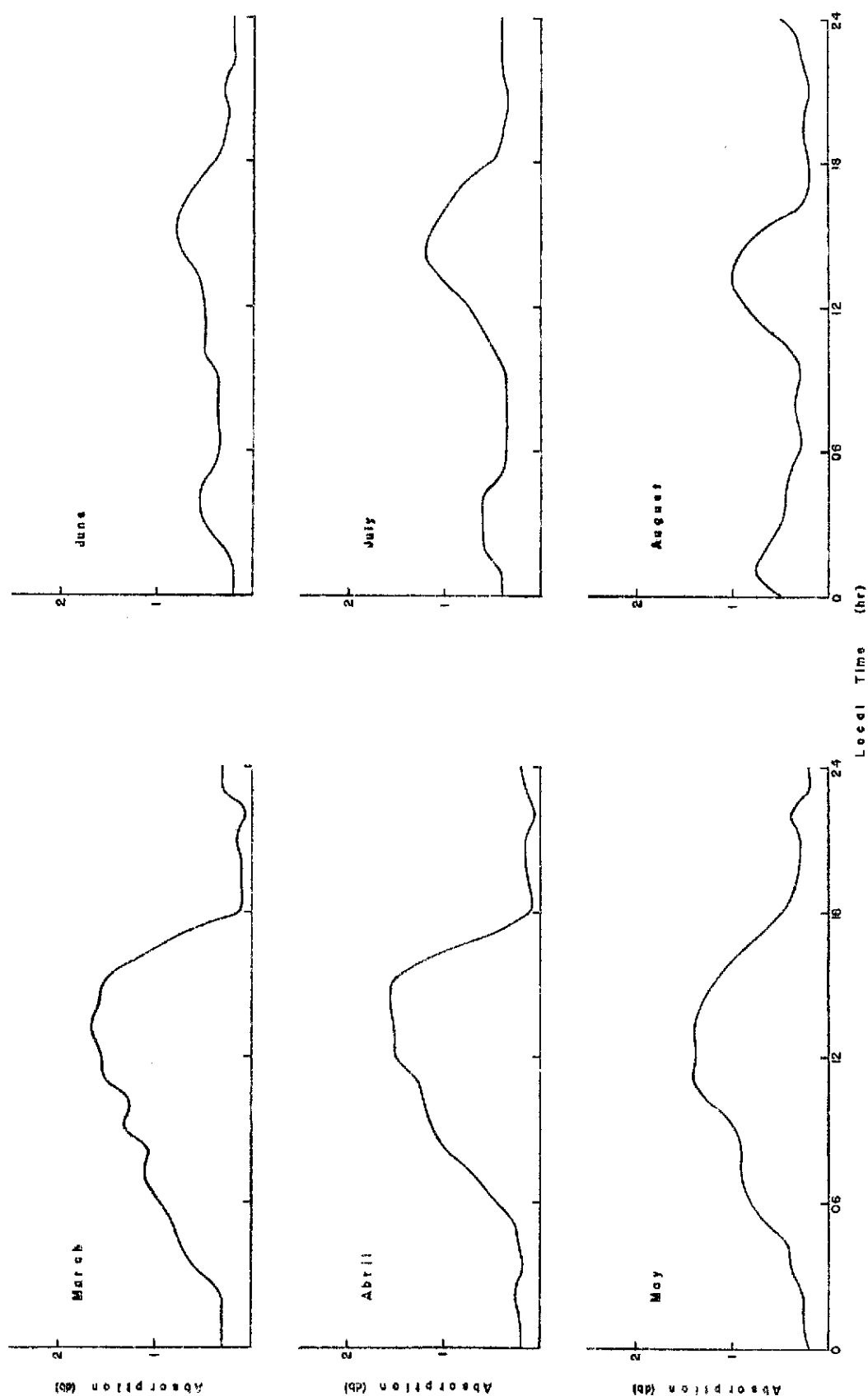
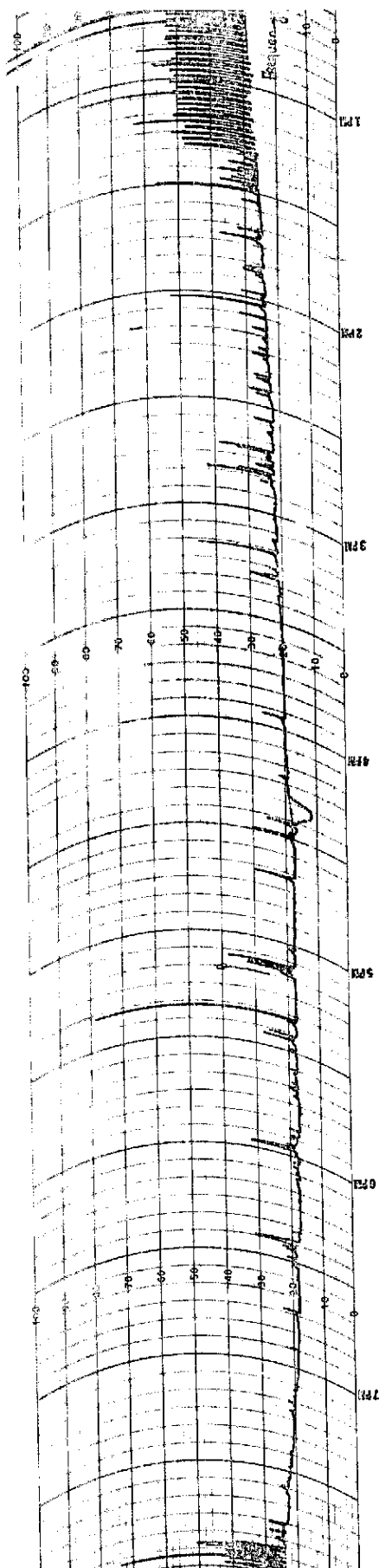
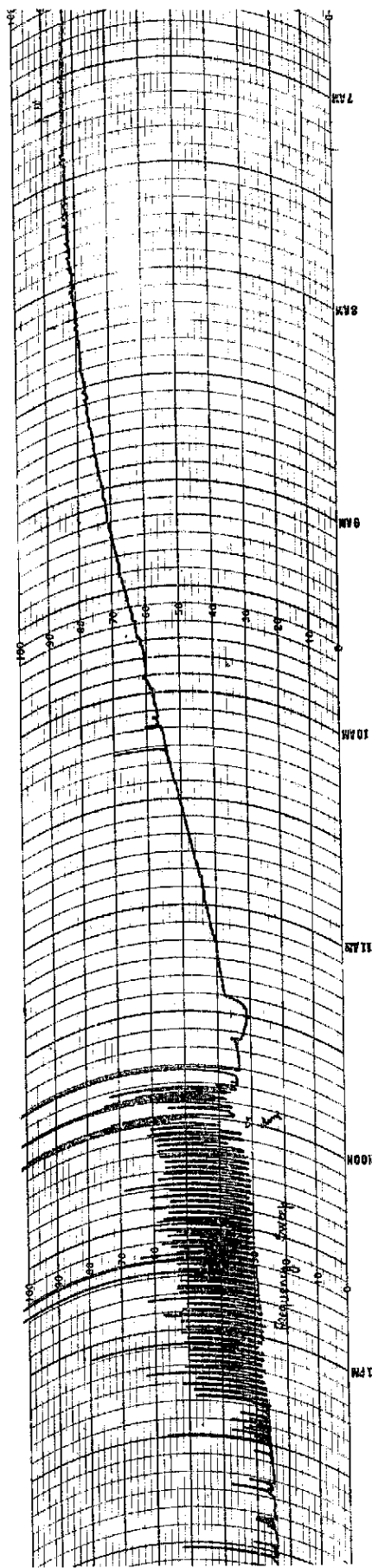


FIG. II MEDIAN MONTHLY ABSORPTION CURVES (March-August — 1963)



b



a

Fig. 3 - Riometer effects on 30 Mc/s at São José dos Campos - S.P. - Brasil, due to Solar Flare of:
a) April 15, at 11:25 UT
b) April 15, at 16:18 UT