ABSORPTION MEASUREMENTS WITH RIOMETER

C.N.Pq.

Data Summary for the period January
through March, 1964

by
M. A. SETTE
and
F. DE MENDONÇA

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REPORT Nº LAFE-16
May, 1964

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

Comissão Nacional de Atividades Espaciais
São José dos Campos
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RIOMETER MEASUREMENTS

DATA SUMMARY Nº 3

I - INTRODUCTION

This summary is a catalogue of reduced riometer data for the period of observations from January 1 through March 31, 1964 at São José dos Campos.

This summary will also show (Fig. 1) a "quiet-day" curve for São José dos Campos station which was obtained from the available data of the period of April 1963 to March 1964 - twelve months of regular operation.

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 0.1 db, and the total number of readings for the month as well as the median value are indicate in the same table. See for instance Tables II through VII. 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.

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 noise diode at a given switching frequency (340 cps).

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 value of current 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 recording in the hours before the sunrise, when absorption is low. The value of current observed are transferred to the corresponding sidereal time. The highest realiable 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:

$$A\ (db) = 10 \log_{10} Ir/Iq$$

where:

Ir = power noise actually received at a given time.

Iq = 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 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_o/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, during solar bursts of intensity over 1.

Some flares occuring 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 accompained by ionospheric effects S-SWF (sudden drop-out and slow recovery).

Table I lists sudden increase in absorption and related solar flares. Also listed together are the bursts events on the range 7 - 41 Mc/s that occurred at about the same time as the flares and that showed some disturbance on the records.

Table I

Date	Flare importance	Period (UT)			Provisional ionospheric effects	Burst		
		Start	End	Max. phase		Type	Time (UT)	Intensity
March 16	2	15:55	17:00	16:11	S-SWF	II IV	155730-1627 160430-1722	1 1+
21	1	15:24E	16:08	15:40	S-SWF	-	-	-
25	1	19:17E	19:27D	19:20	S1-S-SWF	-	-	-

There were no flares with associated ionospheric effects for the months of January and February. For the month of March very few of them occurred during the local daytime period of observation. For the three events indicated on Table I, there were no detectable absorption increase in the record. In the March, 16 event however, the absorption could be masked by the type II burst, which produced a very strong noise in the record.

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 July 9, 1962 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 16, 1963, that is, eight months after the detonation. Since the decay of the bremsstrahlung radiation has a time constant of about sixty days, the excess radiation component was already reduced by that time to about 20% of its original value.

This excess signal already reduced in its strenght was not easily noticeable over the background signal.

In fact the values of the "quiet-day" curve for this station, taken from the riometer records during the hours of low absorption are affected by this excess signal component.

There is still hope, however, 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 twelve 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, '63. 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 two 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 has been introduced in order to make the measurements obtained after the reset of the equipment comparable with those made in the former period.

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 report presents the data as a provisional average of monthly absorption.

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

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São José dos Campos - SP - Brasil

MEAN VALUE OF ABSORPTION DURING THE FIRST MINUTE OF EACH HOUR

Station..... - SJ
Month..... - January
Year..... - 1964
Riometer..... - Mark II

Lat..... - 23°12'43''S
Long..... - 45°51'35''W
DIP..... - 22.5°S
Mag. Lat..... - 11.7°S
Alt..... - 623 m

Freq..... - 30 Mc/s
Bandwidth..... - 30 Kc/s
Diode Load Resist... - 750 ohm
Audio Threshold .... - 3
Time Int..... - 4 sec
ACG Time..... - 4 sec

TABLE II

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	0.20	0.20	0.10	0.20	020	020	020	020	020	020	0.20	0.30	0.30	0.10	0.60	0.60	0.50	0.60	0.60	5	0.10	0.10	0	0
2	0.10	020	0.20	0.30	020	010	020	040	0	010	0.10	0.10	0.20	0.10	0.50	0.50	0.30	0.40	0.30	0.50	0.40	0.20	0.20	0.20
3	0.20	020	020	0.20	020	010	010	0	-010	0	0	0.20	0.10	0.30	0.10	0.60	0.40	0.40	040	0.50	0.30	0.10	0	0
4	0	0.20	0.20	0.20	0.10	010	0	0	-020	-010	0	0	0.10	0.30	0.40	0.40	0.40	0.30	0.30	0.30	020	0.10	0	0.20
5	0.10	0.10	0.10	0.20	010	010	0	0	-010	-010	0	0	0.10	0.30	0.40	0.50	0.60	0.60	0.70	0.50	0.30	0.20	0.10	0.20
6	0.20	030	0.10	040	020	010	0	0	-010	0	0.10	0	0.20	0.40	0.50	0.50	0.50	0.50	0.40	0.60	0.30	0.10	0.10	0.10
7	0.20	020	0.20	0.20	0.20	010	0	0	0	0	0.10	0.10	0.10	0.40	0.50	0.50	0.50	0.60	0.60	0.50	0.60	0.40	030	0.30
8	0.20	040	0.40	0.30	0.20	020	020	010	-010	0	0	0.20	030	0.40	0.60	0.60	0.60	0.70	0.80	0.60	0.30	0	0.10	030
9	0.30	040	070	050	0.60	030	060	050	040	040	0.40	0.40	0.60	0.80	0.60	050	0.30	040	040	0.60	0.50	0.10	0.10	0.20
10	0.30	0.30	0.30	030	0.20	020	0	0	-020	-010	-010	-0.10	0.20	0.40	0.50	050	0.60	0.60	060	0.80	0.10	0.10	0.10	0.20
11	0.30	0.30	0.20	0.20	0.10	020	0	0	-010	0	0	0	C	0.40	0.40	0.40	0.30	040	050	0.70	030	0.30	0.30	0.20
12	0.30	020	0.30	0.30	0.10	010	0	0	0	0	0	0	0.20	0.30	0.30	0.30	0.30	0.40	0.70	0.70	0.20	020	010	0.20
13	0.20	0.30	0.30	020	0.10	020	0	0	-010	0	0	0	0.30	050	050	0.40	040	0.40	0.50	0.60	0.10	0.10	0	0
14	0.30	030	020	020	0	010	-010	-010	-020	0	0	0	0.20	0.30	0.40	0.30	0.30	040	0.50	050	0.20	0.10	0.10	0.20
15	0.30	0.40	030	020	0.10	020	0	-010	0	0	0	0	0.20	0.50	0.40	0.40	0.40	0.40	0.50	0.70	0.40	0	0	0

TIME - UT

Month: January
Year: 19 64

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	0.20	0.30	0	0.10	0	0.20	0.10	0	0	0	0	0	0.20	0.40	0.40	0.30	0.40	0.60	0.60	0.80	0.70	0.60	0.60	0.60
17	0.60	0.30	0.20	0.20	0.10	0.20	0	0	0	0.10	0.10	0.10	0.20	0.20	0.50	0.10	0.20	0.20	0.60	0.60	0.20	0.10	0.10	0
18	0.10	0.20	0.10	0.10	-0.10	0	0	-0.20	-0.20	-0.10	-0.10	0	0.10	0.30	0.30	0.30	0.40	0.40	0.60	0.50	0.30	0.10	0.10	0.20
19	0.30	0.30	0.20	0.10	0	0.10	0	-0.10	-0.20	0	0	0.10	0.20	0.30	0.20	0.20	0.30	0.40	0.70	0.80	0.30	0.20	0.20	0.20
20	0.20	0.40	0.20	0.10	0	0	0	-0.20	-0.10	-0.10	0.30	0	0.20	0.20	0.20	0.20	0.30	0.50	0.60	0.70	0.30	0.20	0.10	0.20
21	0.20	0.30	0.20	0.20	0	0.20	0	0	0	0	0	0.30	0.20	0.30	0.20	0.20	0.30	0.60	0.60	0.40	0.50	0.50	0.40	0.40
22	0.40	0.30	0.20	0.10	0	0.10	0.20	0	0	0.10	0	0.20	0.30	0.20	0.20	0.40	0.50	0.70	0.80	0.60	0.40	0.40	0.40	0.40
23	0.50	0.50	0.50	0.30	0	0.40	0.30	0	0.20	0.20	0.10	0.10	0.20	C	C	C	C	0.40	0.50	0.50	0.30	0.30	0.40	0.30
24	0.40	0.30	0.40	0.20	0.30	0.10	0	0.10	0.10	0	0.10	0	0.20	0.20	0.20	C	0.30	0.40	0.60	0.40	0.40	0.40	0.20	0.40
25	0.40	0.30	0.40	0.20	0.20	-0.10	0	0	-0.10	-0.10	0.20	0	0	0	0.20	0.20	0.30	0.50	0.50	0.30	0.20	0.30	0.20	0.30
26	0	0.30	0.20	0.30	0	0	0.20	0	-0.10	0	0.30	-0.10	0.10	C	C	C	C	0.30	0.40	0.40	0.60	0.60	0.40	0.60
27	0.40	0.50	0.50	0.30	0.10	0.40	0.20	0.10	0	0.20	0.20	0.20	0.40	0.30	C	C	0.30	0.30	0.40	0.20	0.20	0.40	0.30	0.40
28	0.50	0.30	0.20	0.10	0.40	0.20	0	0	0	0	0	0	0.20	0.30	0.20	C	0.20	0.30	0.30	0.10	0.30	0.60	0.50	0.40
29	0.40	0.60	0.60	0.30	0.20	0.40	0.20	0	0	0.20	0.20	0.40	0.50	0.40	0.30	0.20	0.20	0.50	0.40	0.30	0.20	0.40	0.40	0.40
30	0.40	0.40	0.30	0.20	0.40	0.40	0	0	0	0	0.10	0	0.20	0.30	0.20	0.30	0.50	0.70	0.70	0.70	0.60	0.60	0.70	0.60
31	0.60	0.40	0.40	0.10	0.30	0	0.10	-0.10	0	0	0	0.10	0.20	0.30	0.20	0.20	0.50	0.70	0.70	0.40	0.20	0.20	0.40	0.20
Count	31	31	31	31	31	31	31	31	31	31	31	31	30	29	28	26	29	31	31	30	31	31	31	31
UQ	0.40	0.40	0.40	0.30	0.20	0.20	0.20	0	0	0	0.10	0.20	0.20	0.30	0.50	0.50	0.50	0.60	0.60	0.70	0.40	0.40	0.40	0.40
Median	0.30	0.30	0.30	0.20	0.10	0.10	0	0	-0	0	0	0	0.20	0.30	0.20	0.20	0.20	0.40	0.50	0.40	0.20	0.10	0.10	0.20
LQ	0.20	0.20	0.20	0.20	0	0.10	0	0	-0.10	0	0	0	0.20	0.30	0.20	0.20	0.20	0.40	0.50	0.40	0.20	0.10	0.10	0.20

TIME-UT

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MEAN VALUE OF ABSORPTION DURING THE FIRST MINUTE OF EACH HOUR

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Year..... - 1964
Riometer..... - Mark II

Lat..... - 23°12'43"S
Long..... - 45°51'35"W
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Freq..... - 30 Mc/s
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Diode Load Resist... - 750 ohm
Audio Threshold .... - 3
Time Int..... - 4 sec
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TABLE IV

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	0.20	0.10	-0.20	-0.20	-0.20	0	-020	-020	-030	-030	-020	010	030	020	020	040	050	0.80	0.90	080	040	040	040	060
2	070	060	060	040	020	020	020	- 0	-020	-030	-020	010	030	020	020	030	050	S	S	S	S	S	050	050
3	080	030	030	030	030	050	0	-020	-020	-020	-020	0	020	020	020	020	040	060	040	020	0	020	020	030
4	020	020	020	020	-020	0	0	-020	-020	-020	-010	0	020	030	010	020	030	060	040	070	060	020	020	020
5	020	020	010	010	-010	0	-020	-020	-010	-020	- 0	010	010	020	0	040	040	060	040	070	060	040	050	040
6	020	010	010	020	-020	-010	-020	- 0	-020	-020	-010	010	020	020	010	040	050	050	090	070	060	050	050	060
7	050	040	010	010	0	-010	-010	0	0	-020	0	010	020	020	020	010	060	050	050	030	040	060	030	040
8	0.20	0.10	030	0.20	-0.10	0.20	0	0	0	-010	0	0.20	0.20	0.20	0.20	0.40	0.50	0.50	030	0.50	0.40	0.40	0.50	0.40
9	0 60	0.10	0.10	020	020	020	0	0	0	-010	0	020	020	020	030	0.40	040	0 40	0.80	050	030	010	020	0.30
10	030	040	040	020	-010	020	0	-010	0	-010	0	020	020	020	040	040	060	060	040	040	040	060	060	050
11	040	040	020	020	020	020	010	020	020	0	0	020	020	020	040	040	080	060	050	030	020	040	020	050
12	050	040	040	050	0	020	010	020	020	0	020	030	040	040	030	040	060	060	040	040	010	050	040	040
13	030	040	020	030	0	030	020	020	020	0	010	020	020	030	030	050	080	090	080	060	060	080	100	090
14	070	090	040	050	030	040	0	010	010	-010	020	020	040	040	040	060	080	1.20	060	060	060	080	110	100
15	070	070	040	030	0	010	010	010	0	-010	010	040	030	040	030	060	100	1.20	120	110	080	070	110	100

TIME - UT

Month: February
Year: 19 64

TABLE V

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	0.60	040	040	030	0	010	030	0	0	-010	010	020	030	030	010	050	070	100	100	100	090	080	090	060
17	0.60	090	040	020	010	010	0	0	0	0	030	040	030	040	060	060	070	060	100	090	090	080	080	080
18	0.60	020	040	020	010	020	0	020	0	0	020	030	040	030	040	040	070	080	100	090	100	060	030	030
19	0.70	060	040	050	040	040	030	040	030	030	040	060	050	090	050	070	090	100	100	090	100	100	120	120
20	0.70	040	060	050	050	040	040	040	030	040	050	060	060	060	090	090	190	120	100	090	090	110	150	120
21	0.70	060	060	070	080	040	040	040	040	030	040	040	030	020	030	060	110	120	110	090	090	110	060	060
22	0.40	020	020	020	0	0	0	0	-010	-020	0	020	0	0	020	040	050	060	090	090	090	140	140	070
23	0.70	0.70	0.20	0.20	0.30	0	0.10	0	0	0	0.10	0.20	0.20	0.10	0.30	0.50	0.60	0.70	0.80	1.20	1.20	1.30	1.30	0.90
24	0.80	0.50	0.30	0	0.10	0	0	-0.10	-0.10	-0.10	0.10	0.30	0.10	0.20	0.40	0.60	0.80	0.70	0.80	1.00	0.60	0.70	0.80	0.60
25	0.50	0.30	0.20	0	0.10	0	0	0	-0.10	-0.10	0.10	0.10	0.20	0.30	0.30	0.70	1.10	1.00	1.20	1.00	1.00	1.10	1.20	1.20
26	0.80	0.50	0.60	0.40	0.20	0.40	0.40	0.20	-0.10	0	0.20	0.40	0.40	0.10	0.70	1.00	1.40	1.10	0.90	0.50	0.60	0.80	0.70	0.40
27	0.30	0.30	0.20	0	0.10	0	-0.10	0	-0.20	-0.20	0	-0.20	0.10	0.20	0.40	1.00	1.00	1.00	0.50	0.50	0.50	0	0.20	0.20
28	0.30	0.20	0.20	0	0	0	0	0	-0.20	-0.10	0	0.20	0.20	0.20	0.60	0.90	1.00	0.90	0.50	0.50	C	C	C	C
29	0.20	0.20	0.10	-0.10	0	0	-0.10	-0.20	-0.20	-0.10	0	0	0	0.20	0.80	0.90	1.00	1.00	0.50	0.50	0.50	0.40	1.10	0.80
30																								
31																								
Count	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28	28	28	28	27	28	28
UQ	0.70	040	040	030	0.20	0.20	010	020	0	0	020	030	030	030	040	0.60	1.00	1.00	100	0.90	0.90	080	1.10	0.90
Median	0.50	040	0.30	020	0.10	010	0	0	0	-010	0	020	020	020	030	0.50	0.70	075	080	070	060	060	065	060
LQ	0.30	0.20	0.20	0.20	0	0	0	0	-020	-020	0	0.10	020	0.20	0.20	040	0.50	0.60	0.50	0.50	0.40	0.40	0.30	0.40

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
Month..... - March
Year..... - 1964
Riometer..... - Mark II

Lat..... - 23º12'43''S
Long..... - 45º51'35''W
DIP..... - 22.5ºS
Mag. Lat..... - 11.7ºS
Alt..... - 623 m

Freq..... - 30 Mc/s
Bandwidth..... - 30 Kc/s
Diode Load Resist... - 750 ohm
Audio Threshold.... - 3
Time Int..... - 4 sec
ACG Time..... - 4 sec

TABLE VI

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	0.70	0.50	0.60	0.50	0.20	0.40	0.30	0.30	0.30	0.50	0.50	0.40	0.50	0.60	0.70	0.90	1.20	1.00	0.90	0.90	0.50	0.30	0.40	0.30
2	0.30	0.30	0.30	-0.10	0	0.10	0	-0.10	-0.10	-0.10	0.10	0	0	0	0.30	0.80	0.80	0.60	0.90	0.90	0.50	0.50	0.30	0.10
3	0.20	0	0.10	0	-0.20	-0.10	-0.20	-0.20	-0.20	0	0.10	0	-0.10	0.30	0.40	0.70	0.80	0.90	0.90	0.80	0.30	0.60	0.30	0.20
4	0.30	0.30	0.10	0	-0.20	-0.20	-0.20	0.20	-0.20	0	0.10	0	0.30	0.30	0.60	1.00	1.20	1.30	1.50	1.20	1.10	1.00	0.60	0.70
5	0.50	0.20	0.10	0	-0.10	0	0.10	0.10	0.10	0	0.20	0.10	0.20	0.30	0.40	0.80	0.90	1.10	0.90	0.50	0.60	0.30	0.10	0
6	0.20	0.20	0	0	-0.10	0	0	0	-0.20	-0.10	0	0.10	0.20	0.20	0.30	1.00	1.10	1.30	1.20	1.20	1.40	1.10	0.90	0.60
7	0.50	0.30	0.50	0.30	0.10	0.10	0.10	0	0.10	0	0	0.10	0.10	0.20	0.30	0.80	0.80	0.80	0.90	1.20	1.20	1.10	0.90	0.50
8	0.30	C	C	C	C	C	C	C	C	C	C	C	-0.10	0.10	0.50	0.80	0.80	0.80	0.80	0.80	0.80	1.00	0.70	0.50
9	0.20	0	0	0	-0.30	0	-0.10	0.20	-0.20	-0.10	0	0	0	0.20	0.60	1.10	1.20	0.90	0.80	0.60	0.20	0.40	0.30	0.50
10	0.50	0.50	0	0.10	0	0	-0.10	-0.10	-0.20	0	0	-0.20	0	0.10	0.50	0.80	0.80	1.10	1.00	0.60	0.40	0.40	0.20	0.30
11	0.30	0.20	0.20	0	0	-0.10	-0.10	-0.10	-0.20	0.10	-0.10	-0.20	-0.10	0.10	0.50	0.80	0.70	0.90	1.20	0.60	0.50	0.60	0.40	0.30
12	0.30	0.30	0	-0.10	-0.10	-0.10	-0.10	-0.20	-0.20	0	0	-0.10	0	0.40	0.80	1.00	0.70	0.90	0.90	1.00	0.80	0.50	0.20	0.30
13	0.30	0	0	0	-0.10	0	0	-0.30	-0.10	0.10	-0.10	0	0.10	0.40	0.60	1.00	0.90	0.90	0.90	1.00	0.90	0.60	0.80	0.60
14	0.60	0.40	0.30	-0.10	0	0	0	-0.10	-0.10	0	-0.10	-0.10	0	0.30	0.60	1.00	0.90	1.20	1.20	1.00	0.50	0.60	0.80	0.60
15	0.20	0.10	-0.10	0	0	0.30	0.20	0	0	0.20	0.20	0.10	0.10	0.30	0.70	0.90	0.90	0.90	0.90	0.90	0.30	0.30	0.30	0.10

TIME - UT

Month: March
Year: 1964

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	0.20	0.10	-0.10	0	0	0	0	-0.10	-0.10	-0.10	0	-0.10	0	0.10	0.30	1.00	0.80[S]	0.80[S]	0.90	0.90	1.00[S]	0.30	0.40	0.20
17	0.20[C]	0	0	0	0	0	-0.10	-0.10	0	-0.10	0	-0.10	-0.10	0.20	0.50	0.80	0.80	0.90	1.20[S]	1.10	0.90	0.60	0.40	0.20
18	0.20	0	0	0	-0.10	-0.10	-0.10	-0.20	-0.10	-0.10	0	-0.20	0	0.20	0.40	0.60	0.70	0.90	0.90[S]	1.10[S]	0.90[S]	0.60	0.30	0.30
19	0.20	0	0	0	0	-0.10	-0.20	-0.20	-0.10	-0.10	-0.10	-0.10	-0.10	0	0.30	0.60	0.60	0.90	0.90[S]	1.10[S]	0.90[S]	0.60	0.30	0.30
20	0.20[C]	-0.10	-0.10	0	-0.20[C]	-0.10[C]	-0.20[C]	-0.20	-0.10	-0.10	-0.10	-0.20	-0.20	0.10	0.40	0.60	0.70	0.90	0.90	1.10	0.90	0.60	0.40	0.20
21	0.20	-0.20	0	0	0	0	-0.10	-0.10	-0.10	-0.10	-0.10	-0.30	0	0.20	0.50	0.80	0.80	0.90	0.90	1.10	1.00	0.90	0.70	0.30
22	0.30	0.20	0.10	0	0	0	-0.10	-0.10	0	-0.10	-0.20	-0.20	-0.20	0.10	0.40	0.50	0.50	0.40	0.90	1.10	1.10	0.90	0.70	0.70
23	0.30	0	0	-0.10	0.10	0	-0.10	-0.10	0	0	-0.10	-0.10	0	0.30	0.60	0.60	0.80	0.90	1.00	1.20	1.40	1.20	0.70	0.30
24	0.30	0.20	0	-0.30	0	0	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	0	0.40	0.60	0.60	0.50	0.90	1.00	1.00	0.90	0.20	0.20	0.20
25	0	-0.10	0	0	0	0	-0.20	-0.20	-0.10	-0.10	-0.20	-0.10	0	0.10	0.40	0.40	0.50	0.90	0.80	0.50[S]	0.30	0.40	0.30	0.20
26	0	0	0	0	-0.10	0	-0.10	-0.30	-0.10	-0.10	0	-0.20	0.20	0.30	0.90	1.10	1.20	0.90	0.80	0.50[S]	0.30	0.40	0.30	0.20
27	0.20	0	0	0	0	0	-0.20	-0.20	-0.30	-0.10	-0.20	-0.20	0.10	0.40	0.80	0.90	0.80	0.90	1.00	0.80	0.60	0.20	0.20	0.20
28	0.20	0	0	0	0	0	0	0	0	0.10	0	0	0.30	0.50	1.10	1.10	1.20	1.20	1.00	0.60[S]	0.40[S]	0.20[S]	0.20	0.20
29	0.10	0.10	0.10	0.10	0.10	0.10	-0.10	-0.20	0	-0.20	-0.10	0.10	0.50	0.70	1.00	1.00	0.90[S]	0.90[S]	0.90[S]	0.90[S]	0.90	0.50	0.30	0
30	0	0.10	0.10	0.10	0.10	-0.10	-0.10	-0.10	-0.10	0	0	0	0.40	0.40	0.40	0.50	0.50	0.80	0.60	0.30[S]	0.30	0.20	0.20	0
31	0.10	0	-0.10	0.10	0	0	-0.10	-0.10	-0.10	-0.20	-0.30	-0.20	0.10	0.10	0.40	0.60	0.60	0.90	0.90	0.50[S]	0.30	0.10	0.20	0.20
Count	31	30	30	30	30	30	30	30	30	30	30	30	31	31	31	31	31	31	31	31	30	31	31	31
UQ	0.30	0.20	0.10	0	0	0	0	0	0	0	0	0	0	0.20	0.40	0.70	1.00	0.90	0.95	1.00	1.10	0.90	0.75	0.50
Median	0.20	0.10	0	0	0	0	-0.10	-0.10	-0.10	-0.10	0	-0.10	0	0.20	0.50	0.80	0.80	0.90	0.90	0.90	0.70	0.50	0.30	0.20
LQ	0.20	0	0	0	-0.10	-0.10	-0.10	-0.20	-0.20	-0.10	-0.10	-0.20	0	0.10	0.40	0.60	0.65	0.90	0.90	0.60	0.49	0.30	0.20	0.20

TIME-UT

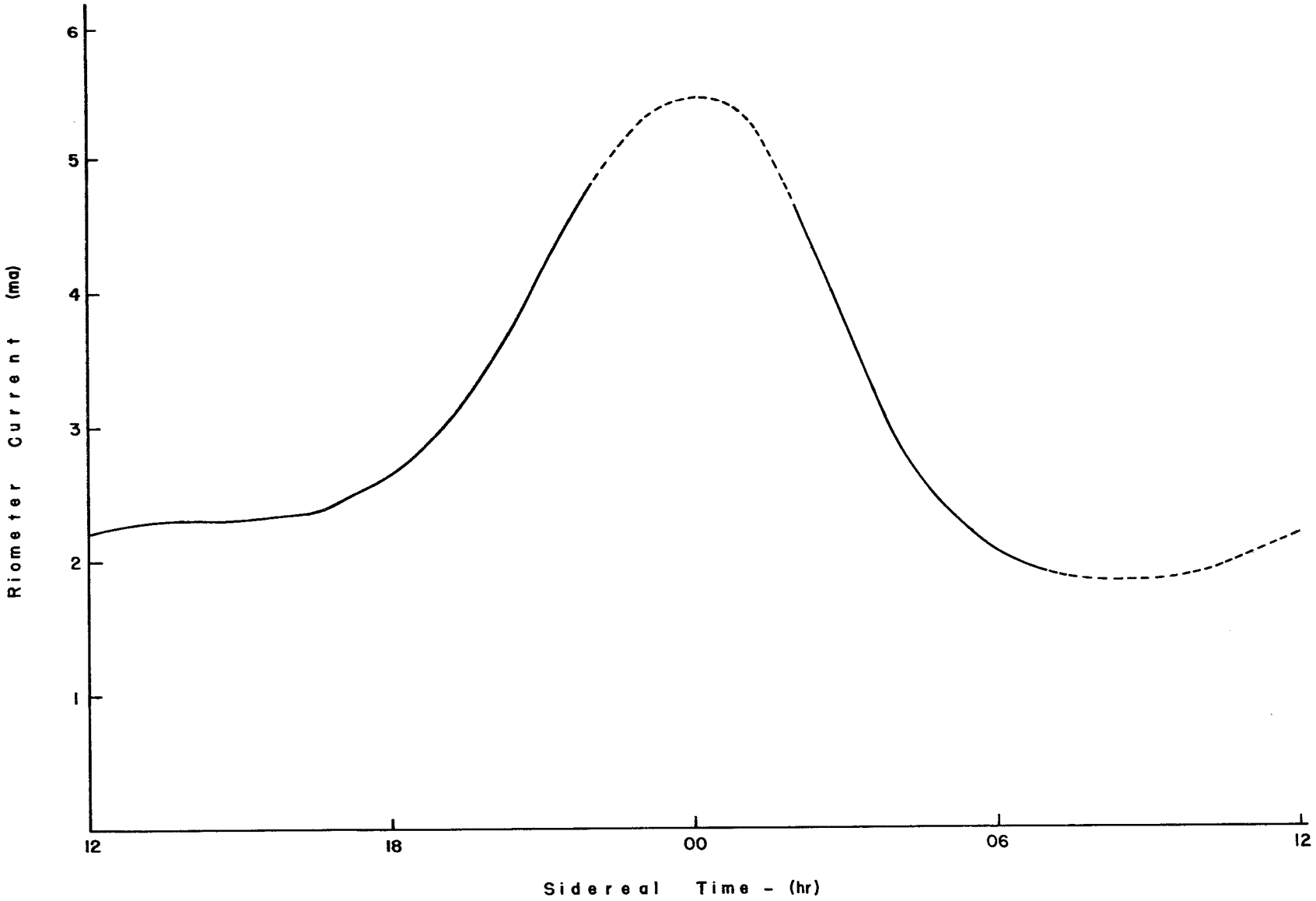

FIG: I QUIET-DAY CURVE

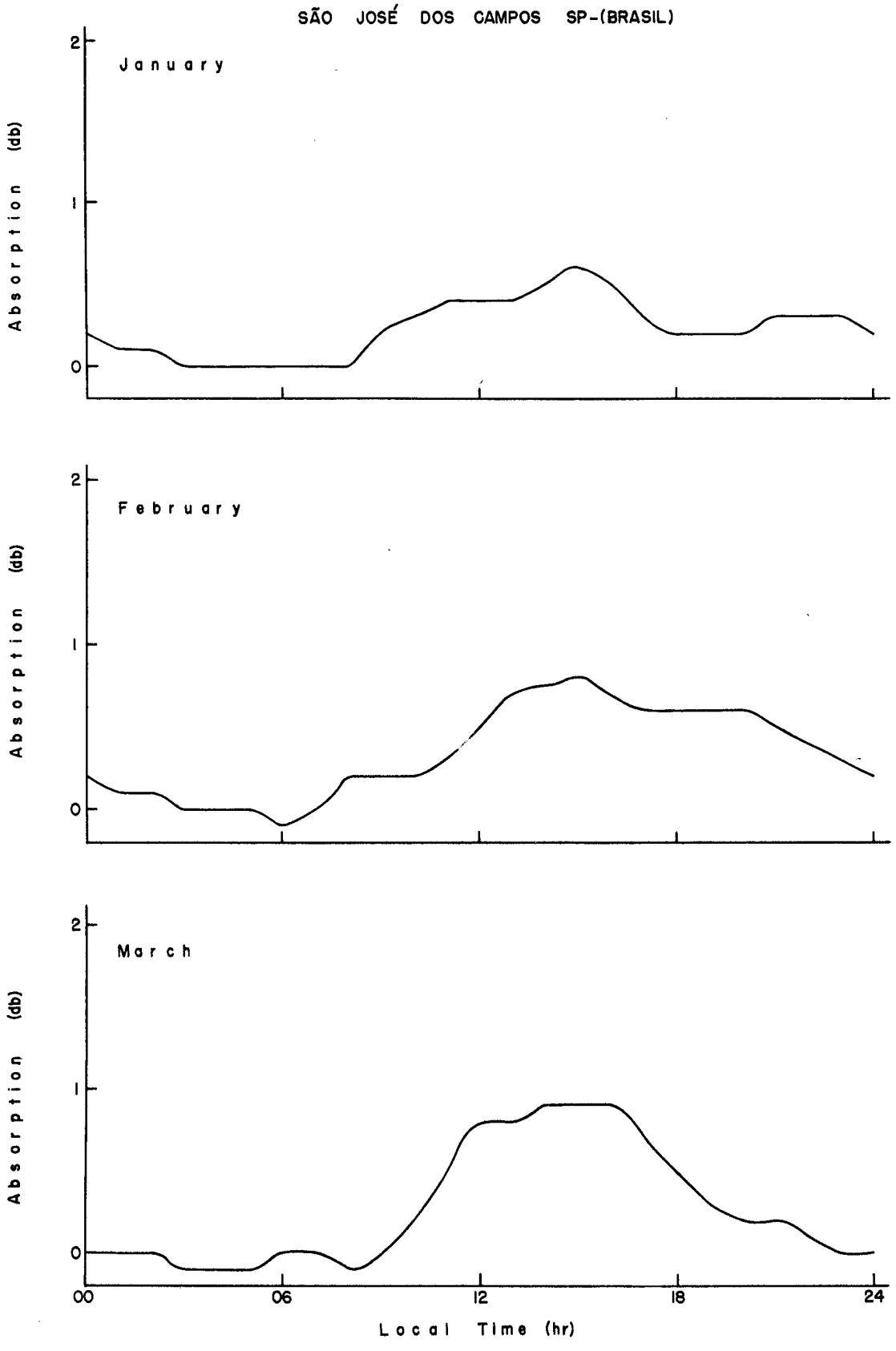

FIG: II MEDIAN MONTHLY ABSORPTION CURVES (January-March—1964)