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Description and Catalog of Ionospheric F-Region Data, Jicamarca Radar Observatory, November 1966-April 1969

World Data Center A for Solar-Terrestrial Physics, Boulder, Colo

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REPORT UAG - 53

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(NOVEMBER 1966 - APRIL 1969)

by

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TABLE OF CONTENTS

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Introduction

This report basically describes equatorial ionospheric F-region data reduced from the Jicamarca Radar Observatory (JRO) incoherent scatter observations for particular periods. It lists in catalog form the times of the observations made during those periods. These F-region data include the electron concentration, Ne, and the electron and ion temperatures, Te and Ti. The data were inferred from the incoherent scatter observations of JRO which is located at S11.95 E283.13. JRO is the only incoherent scatter observatory close to the magnetic equator at 2°N magnetic dip.

For the period 11 November 1966 to 29 April 1969, Ne, Te and Ti data reduced from the JRO observations are now available both in digital form (on magnetic tape) and in graphical and tabular form (on microfilm) from the World Data Center A for Solar-Terrestrial Physics. Some results of similar analyses are already published, in particular the Ne data were presented in graphical form by McClure *et al.* [1970] for the period 27 May 1964 to 1 December 1966. Small amounts of data have appeared in other published papers and reports. Ionospheric drift velocity measurements reduced from the JRO incoherent scatter observations for the period July 1967 to March 1970 are found in an earlier UAG Report, Report UAG-17 [Balsley *et al.*, 1971].

Measurement Techniques and Analysis Methods

In the Faraday rotation experiment as performed at JRO, two pulses are transmitted simultaneously with opposite circular polarization. By comparing the phases of the echoes of the two pulses as a function of time delay between transmission and reception, the Faraday rotation angle as a function of height is determined. The electron concentration profile is obtained from the height derivative of the Faraday rotation angle. This technique is discussed fully by Farley [1969]. See also Evans [1969] for a general review of the incoherent scatter technique.

In addition to the measurements for Ne, the temporal autocorrelation function ρ of the radar echoes is measured at a series of time separations τ. The method by which these measurements are made is described in considerable detail by Farley *et al.* [1967] and Farley [1969] and will not be discussed here. Our concern is with the analysis of the measured autocorrelation function to deduce parameters of the ionospheric plasma.

The JRO measurements of the autocorrelation functions are usually valid only in the ionospheric F2 layer where almost all of the ions are ionized oxygen (O^+). Therefore, the ionic composition has been approximated by pure O^+, so that the only parameters determined by the present analysis are Te and Ti. The presence of appreciable concentrations of ions other than O^+ will, of course, cause errors in the derived values of Te and Ti. In particular, near the top of the analyzed height range, especially at night during solar minimum, there may be appreciable concentrations of ionized hydrogen (H^+). For small fractional concentrations of H^+, the fractional errors in Te and Ti are of the order of -1 and +1 times the fractional concentration, respectively. Since the fractional concentration of H^+ in the F2 layer typically increases with height with a scale height of the order of 150 km, the presence of appreciable concentrations of H^+ leads to a characteristic and obvious decrease in Te and an increase in Ti with height.

Examples of theoretical curves of $\rho(\tau)$ for pure O^+, two values of Te and three values of Te/Ti are shown in Figure 1. Two important laws are illustrated. The first law states that the value of τ at $\rho = -0.08$ varies as $Te^{-\frac{1}{2}}$ with only a negligible dependence on Te/Ti. The second law states that the minimum value of ρ (ρmin) in the first negative loop varies approximately linearly with Te/Ti, as illustrated in Figure 2, but is otherwise independent of Te. The following empirical formula gives Te/Ti to two decimal places:

$$Te/Ti = .2305 - 4.666\,\rho min + 9.23\,\rho min^2 \qquad (1)$$

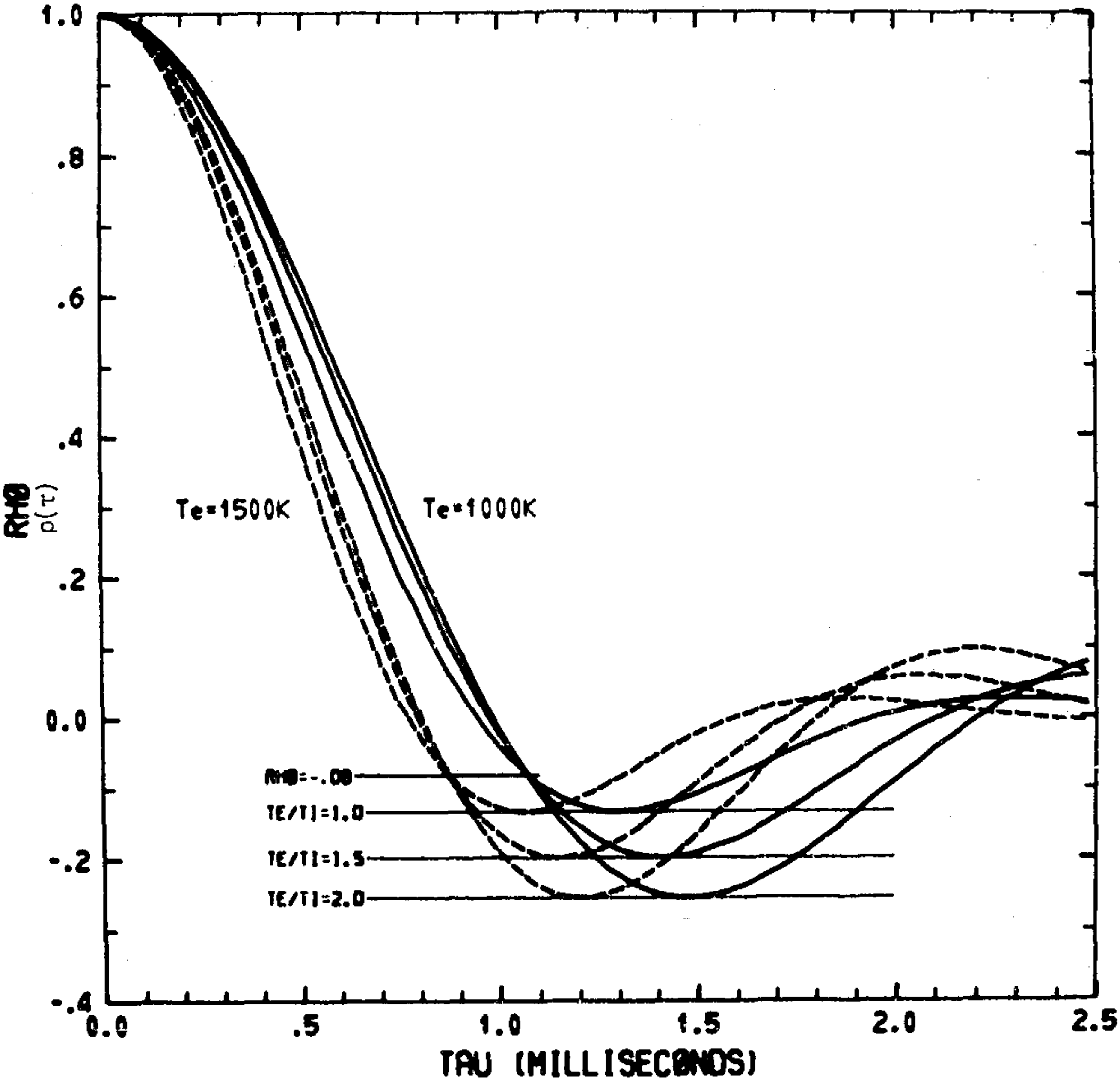


Fig. 1. Examples of the theoretical autocorrelation function $\rho(\tau)$ for Te=1000K and 1500K while Te/Ti = 1.0, 1.5 and 2.0. These curves illustrate that τ at the ρ = -0.08 point is essentially independent of Ti and that the depth of the first negative loop depends only on Te/Ti. These laws assume a constant ion composition, in this case pure O^+.

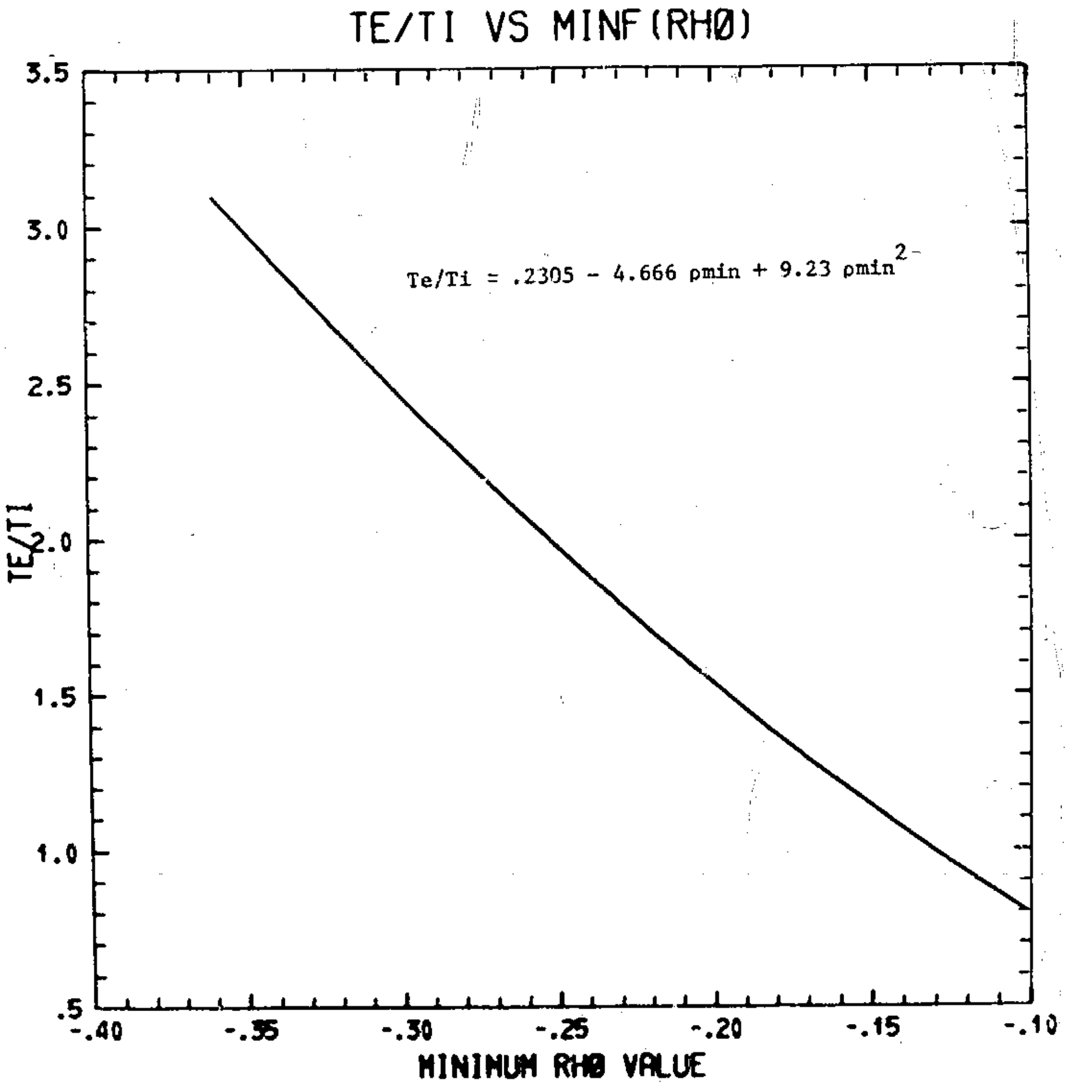


Fig. 2. Te/Ti plotted as a function of ρmin (the minimum value of the autocorrelation function). The quadratic equation gives Te/Ti to two decimal places.

With these two laws, Te and Te/Ti may be found from the autocorrelation data by scaling the value of τ at $\rho = -0.08$ and at ρmin. Alternatively, Te and Te/Ti can be determined by fitting the theoretical curves to the measured values of ρ. The fitting has been done in the present analysis by adjusting the values of Te and Te/Ti until the best fit in a least squares sense is obtained. This method has the advantage of using all the data and so reduces the effects of noise.

Examination of the actual autocorrelation data along with the functions fitted during the analysis can provide valuable insight into the quality of the Te and Ti values found at any particular height and time. Therefore, for each height a plot of measured ρ's versus τ and the corresponding best-fitting function, when actually found, is included on the microfilm. A rather compact format was used to enable easy visual comparison of data from one height to the next. A sample frame is shown in Figure 3.

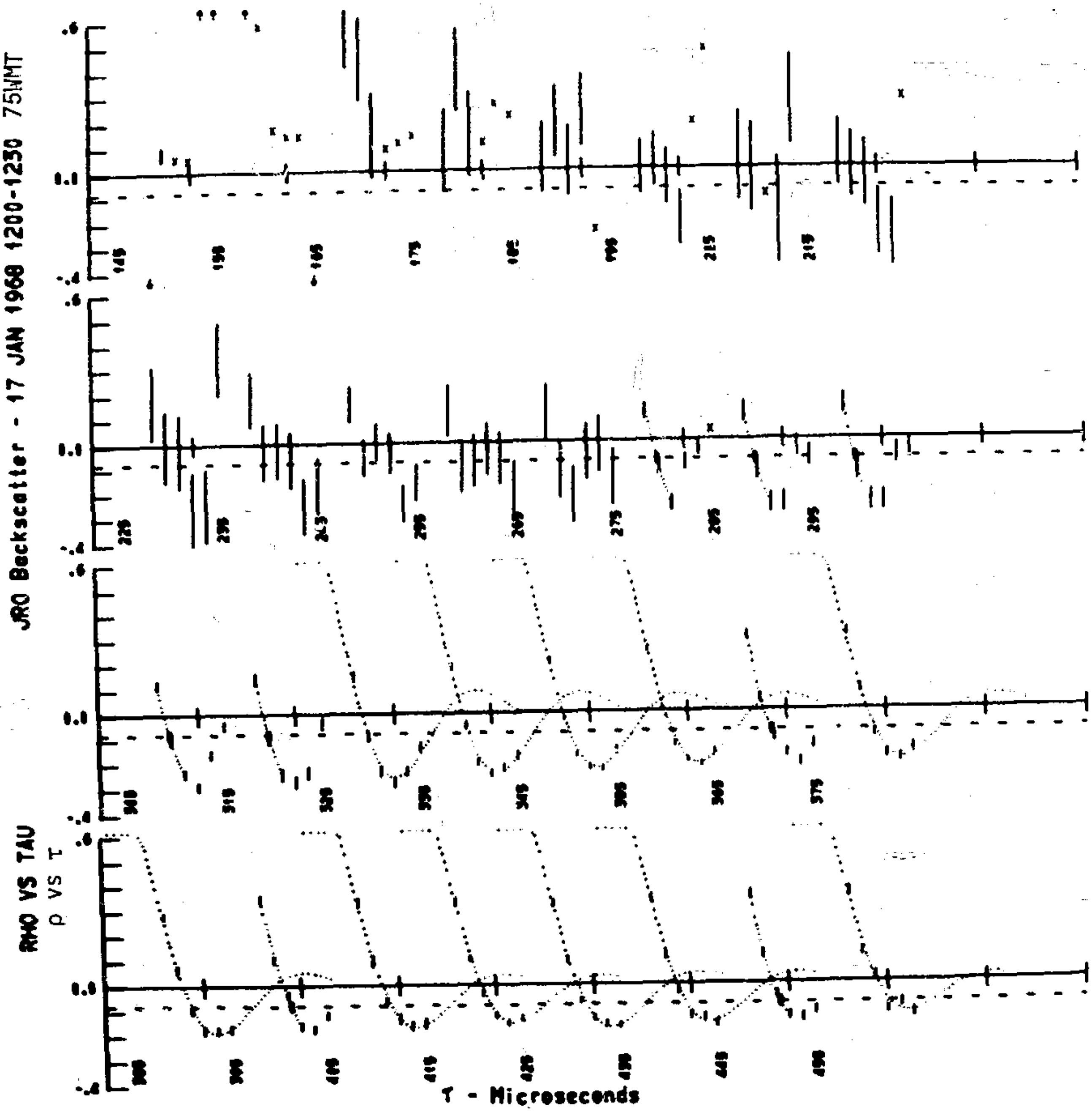


Fig. 3. A sample microfilm frame presenting the autocorrelation function found by the analysis program using the raw data and the best fitting functions. Data for 32 heights are given on each frame. This frame, for 17 Jan., 1968, 1200-1230 (75° W time), presents data for heights between 145 and 455 km in 10 kilometer steps. A much more detailed explanation of this Figure is given in the text.

Figure 3 presents data taken on 17 January 1968 during an integration from 1200 to 1230 hours (75°W time), as indicated by the title along the left margin. The Figure looks very complex because data for 32 heights are presented in overlapping form beginning with a height of 145 km and increasing in 10 km increments to 455 km. This complexity can be avoided by examining one feature at a time. Consider the bottom row of the Figure. The ordinate is the ρ axis, ranging from -0.4 to +0.6, and the abscissa is the τ axis, with a tick every 1000 μs. Each tick mark also denotes $\tau = 0$ for the height printed sideways, below and to the right of the tick. Each measured value of ρ is plotted as a vertical bar centered on the measured value and extending $\pm \sigma$ (± one standard deviation). The sinuous, dotted curves in the plots for 385, 405, 415, 425, 435, and 455 km are the theoretical autocorrelation functions that best fit the measured values of ρ. The flattened part of each curve from 0 to 300 μs is a result of an imposed plot limit just above $\rho = 0.6$; the actual curves in this region are as shown in Figure 1.

Often an autocorrelation function could not be fitted because of some deficiency in the data. If the deficiency was only a lack of data about the first negative loop, a partial analysis was carried out. A parabola was fitted by least squares to all the points up to and including the first point whose value of ρ was ≤ -0.08. Then the value of τ where this parabola intersects the $\rho = -0.08$ line (the dashed line below and parallel to the τ axis inserted for ease in reading values) was used to obtain Te. This parabola, when used, is plotted through the data points as a dotted curve, and the point of intersection is indicated by a circle (e.g., at heights 395 and 445 km in Figure 3). When even this partial analysis could not be completed, only the data bars are plotted, as for the first 13 heights (145-265 km) in Figure 3.

In the first row of Figure 3 some of the measured ρ's are plotted using other symbols. The x's seen throughout the data in the first eight heights (145-215 km) indicate points that have been rejected because the space-time geometry of the JRO configuration implies a high probability of contamination by strong echoes from the equatorial electrojet or by a succeeding pulse. The up and down arrow symbols (↑ ↓) are used for data points that exceed the -0.4 to +0.6 plotter range for ρ, which was imposed to avoid confusion with other data.

The ρ values as used in this analysis and presented on the microfilm have been adjusted in a manner that must be discussed in some detail. When the preliminary Te and Ti values were plotted, it was noticed that at night the ratio Te/Ti was usually less than unity by a significant factor which was statistically independent of height. If this were true, it would require a large heat input to the ion gas with a special height dependence. Since in the nighttime equatorial F2 layer there is not known to be any large heat input with the required height dependence, we have assumed that this effect was caused by systematic errors.

In order to study these systematic errors, we first restricted our attention to data taken between 1900 and 0300 hours (75° W time) since earlier evening data and later morning data often seemed to be in a transition state between day and nighttime conditions. Heights between 300 and 400 km only were considered in order to reduce the possibility of composition effects. The median Te/Ti, denoted (Te/Ti)med, within this height range was found for each integration, and the results were plotted versus time.

Examination of this graph showed periods when the Te/Ti bias seemed to be constant except for statistical fluctuations. For each of these periods the factor RF (ρ Factor) by which the ρ values should be divided so that the median of the (Te/Ti)med's would become 1.0 was calculated. A graph of the RF values versus date is shown in Figure 4.

This normalization method changes Ti much more than Te, because ρmin is changed inversely as RF but τ at $\rho = -0.08$ is changed very little. Indeed, the changes in Te are usually within the estimated standard deviation of Te, although Te always decreases for RF ≥ 1, and vice versa.

This method obviously provides only a first-order correction of Te/Ti. During some periods there was no nighttime data suitable for a determination of RF. For this reason the last two months of 1966 data and the first two and one-half months of 1967 data had to be assigned the mean RF value (namely, 0.9) of all of the other data. The periods when the nighttime values of Te/Ti were obtained are indicated at the bottom of Figure 4. Furthermore, the statistical fluctuations about (Te/Ti)med over the periods for which each RF was determined are not negligible. Therefore, in some studies the user may wish to renormalize Te/Ti according to a physical model of temperature structure. This can be done approximately by changing the RF for each profile or set of profiles, with the aid of Equation (1). Unless the change in RF is large, the changes in Te are negligible, that is, all of the changes in Te/Ti can be attributed to changes in Ti.

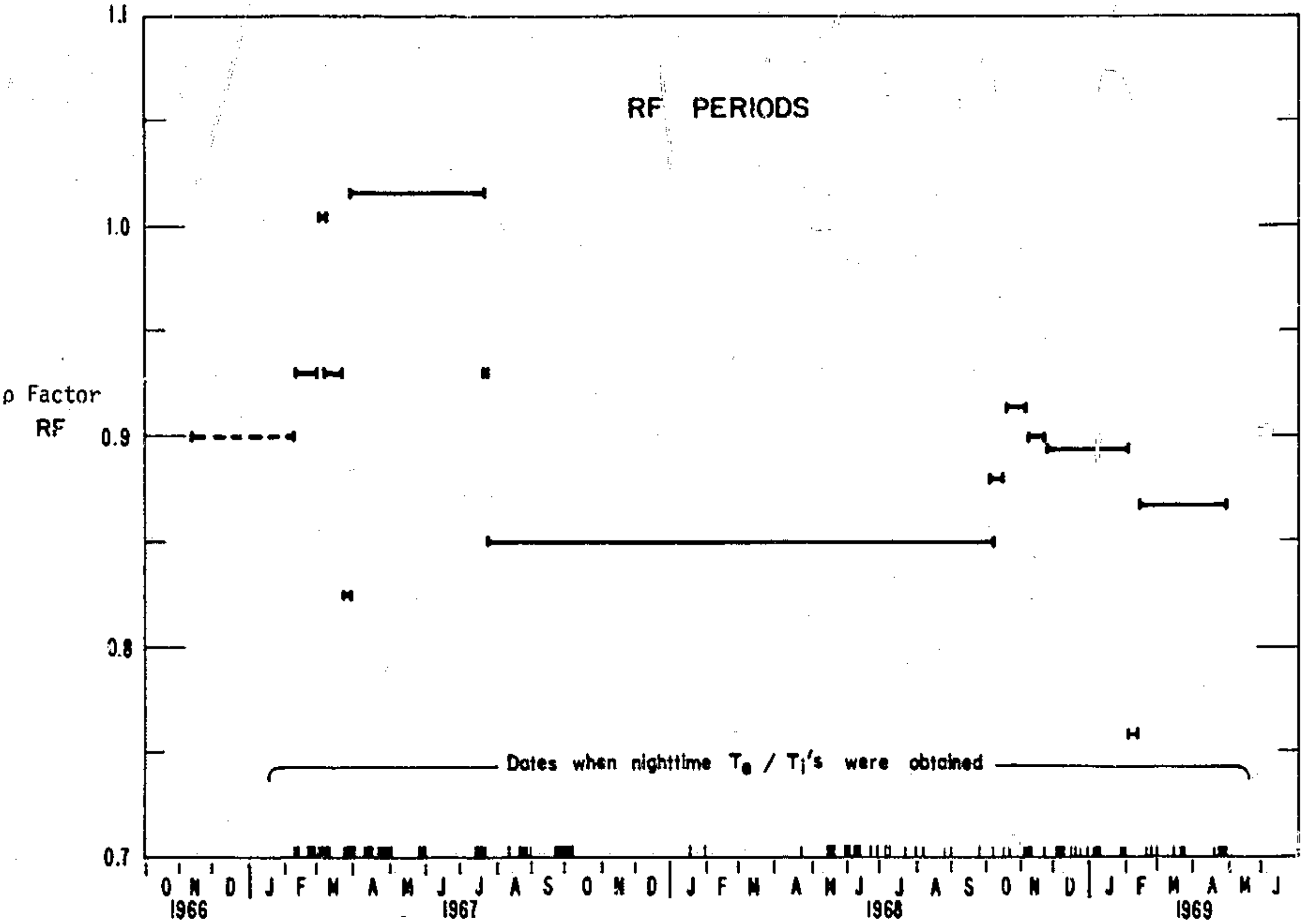


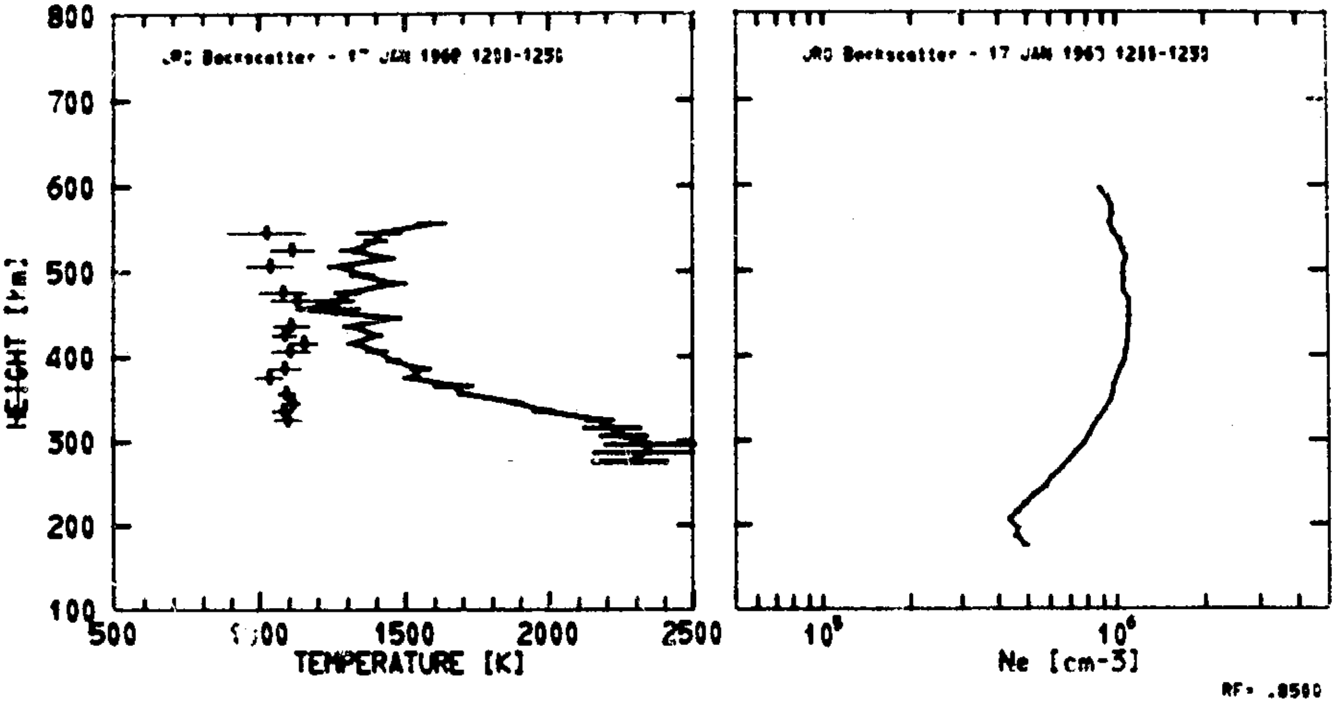
Fig. 4. The RF divisor values applied to the ρ's plotted over the periods of their use. The periods when nighttime Te/Ti values were obtained and used in the determination of RF are indicated at the bottom of the graph. The mean RF value of 0.9 was used until 11 February 1967. The process used to determine RF is described in the text.

Format of Archived Data

An example of the graphical and tabular data as it appears on the microfilm is shown in Figure 5. The electron concentration data is presented in the upper right graph and in the second column of the table, labeled Ne. The calculated standard deviation of Ne resulting from the differentiation of the Faraday angle is shown as a horizontal bar on the graph (too small to be visible in this example) and in the first ε column, just to the right of the Ne column. It must be emphasized that ε is only the standard deviation due to statistical errors, and that the accuracy of Ne can also be affected by systematic errors. In general, rapid variations of Ne with either height or time must be treated with caution. For example, in Figure 5 the rapid increase of Ne with decreasing altitude below 205 km is a systematic error caused by strong scatter from field-aligned irregularities in the E region. At night, when spread-F irregularities are also often present, this kind of error can extend to greater heights. Certain other systematic errors are caused by imperfections in the detectors, particularly at the greatest altitudes where the signal-to-noise ratio is small. Such imperfections probably cause the weak sinusoidal variation in Ne from about 450 to 600 km in Figure 5.

The Te and Ti data are presented in the upper left graph and in columns four and six, respectively, in the table. On the graph, the Te points are connected by a solid line and the Ti points are denoted by circles. The estimated standard deviations resulting from statistical errors in the measured values of ρ are shown as horizontal bars on the graph and are listed in the respective ε columns (i.e., columns five and seven) in the table. The column labeled ICD is a diagnostic code used in the analysis program and can be ignored.

The original magnetic tape archived in the data center is a 9-track, 1600 phase encoded binary tape. A detailed description of the format is available upon request from WDC-A, and other types of tapes (such as 7-track binary) may be made available. The tape contains all the Ne, Te, and Ti results, but does not contain the autocorrelation function data from which they were obtained.



JRO Backscatter - 17 JAN 1960 1200-1250

Ht	Ne X10(5)	ε	Te	ε	Ti	ε	ICD
145	0.00	0.00	0	0	0	0	014
155	0.00	0.00	0	0	0	0	014
165	0.00	0.00	0	0	0	0	114
175	4.95	.14	0	0	0	0	110
185	4.62	.12	0	0	0	0	110
195	4.64	.07	0	0	0	0	110
205	4.36	.04	0	0	0	0	110
215	4.64	.09	0	0	0	0	110
225	4.93	.11	0	0	0	0	110
235	5.31	.11	0	0	0	0	110
245	5.77	.10	0	0	0	0	110
255	6.06	.06	0	0	0	0	110
265	6.94	.01	0	0	0	0	110
275	6.86	.04	2270	156	0	0	40
285	7.25	.04	2551	100	0	0	40
295	7.72	.04	2382	163	0	0	40
305	8.06	.04	2296	86	0	0	40
315	8.55	.05	2215	103	0	0	40
325	8.86	.05	2175	91	1097	48	0
335	9.00	.03	1979	30	1001	40	0
345	9.40	.06	1808	21	1114	24	0
355	9.67	.06	1700	25	1090	36	0
365	9.79	.04	1666	71	0	0	40
375	10.06	.06	1522	35	1032	53	0
385	10.35	.11	1586	57	1086	57	0
395	10.64	.09	1457	20	0	0	40
405	10.75	.08	1413	30	1107	60	0
415	10.84	.07	1322	25	1154	47	0

JRO Backscatter - 17 JAN 1960 1200-1250

Ht	Ne X10(5)	ε	Te	ε	Ti	ε	ICD
425	10.80	.10	1390	25	1087	44	0
435	10.99	.10	1519	55	1112	64	0
445	10.98	.12	1449	30	0	0	40
455	10.96	.12	1173	40	1262	69	0
465	10.95	.10	1275	49	1152	96	0
475	10.57	.09	1383	44	1081	85	0
485	10.58	.10	1461	44	0	0	40
495	10.49	.05	1383	42	0	0	40
505	10.07	.06	1275	43	1057	85	0
515	10.01	.07	1430	31	0	0	40
525	10.46	.16	1317	42	1116	80	0
535	10.25	.15	1400	30	0	0	40
545	9.75	.15	1411	79	1026	159	0
555	9.46	.13	1502	52	0	0	40
565	9.63	.13	0	0	0	0	110
575	9.57	.11	0	0	0	0	110
585	9.32	.08					991
595	0.01	.11					990
605	0.00	0.00					994
615	0.00	0.00					994

Fig. 5. Te and Ti are plotted against height in the graph at the upper left. Te is plotted using connected error bars (± one standard deviation) while Ti is plotted using circles intersected with error bars. Ne is plotted against the same height scale in the graph at the upper right, using connected error bars. The table in the lower part of the Figure presents the same information in tabular form. Zero values indicate that no results were obtained. The ε column gives the estimated standard deviation of the parameter in the column just to the left, in the same units. The "ICD" column contains a computer diagnostic code and may be ignored.

Catalog

Values of Ne, Te, and Ti (normalized as discussed above) along with their associated dates, times and heights and estimated errors are archived at WDC-A on magnetic tape and microfilm. Table 1 is a catalog of the observing periods during which measurements were made. Within each observing period there are one or more radar integrations, each of which is an average of several thousand samples received over 5 to 10 minutes during sunrise, 15 to 30 minutes in the daytime, and 15 to 45 minutes at night. The integrations are usually contiguous in time, but occasionally there are gaps caused by operational difficulties. There are a few time discontinuities on the tape, resulting from integrations being entered on the magnetic tape in non-chronological order. The times written on the magnetic tape and microfilm are correct. Approximately 1600 hours of radar data were analyzed.

Reliability of the Data

The reliability of the present data for any particular aeronomical study can be determined only by careful consideration of the statistical and systematic errors described in this report. The Ne data should be adequate for any study consistent with the statistical errors. On the other hand, the limitation to regions of nearly pure O^+ and the normalization of Te/Ti are especially important to the accuracy of the temperature measurements. Judgment of the adequacy of the data for any particular study or of the correctness of a renormalization procedure must, of course, be the responsibility of the user.

Acknowledgements

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McCLURE, J. P., D. T. FARLEY, JR., and R. COHEN	1970	Ionospheric Electron Concentration Measurements at the Magnetic Equator, 1964-1966, *ESSA Tech. Report ERL 186-AL 4.*

TABLE 1

CATALOG OF NE, TE AND TI MEASUREMENTS AT JICAMARCA RADAR OBSERVATORY

TIME INTERVAL COVERED						
YEAR	DATE	75WMT		DATE	75WMT	NO. OF PROFILES
1966	NOV 11,	0422	TO	NOV 11,	1915	50
	NOV 12,	0315	TO	NOV 12,	1215	55
	NOV 13,	0530	TO	NOV 13,	1145	29
	NOV 14,	1640	TO	NOV 16,	0605	121
	DEC 1,	1210	TO	DEC 2,	0430	45
	DEC 2,	0835	TO	DEC 2,	1130	7
	DEC 7,	1506	TO	DEC 7,	1635	2
	DEC 9,	1353	TO	DEC 9,	1619	3
	DEC 12,	0912	TO	DEC 12,	1240	5
	DEC 13,	1715	TO	DEC 14,	0930	50
	DEC 14,	1500	TO	DEC 14,	1600	3
	DEC 15,	1830	TO	DEC 15,	2300	7
	DEC 16,	1615	TO	DEC 17,	0300	20
	DEC 19,	1745	TO	DEC 20,	0315	20
	DEC 20,	1645	TO	DEC 20,	1845	5
	DEC 21,	1625	TO	DEC 22,	0245	22
	DEC 22,	1430	TO	DEC 22,	1830	10
1967	JAN 2,	1400	TO	JAN 2,	1800	9
	JAN 3,	1036	TO	JAN 3,	1530	6
	JAN 3,	1900	TO	JAN 4,	0330	10
	JAN 4,	1015	TO	JAN 5,	0215	20
	JAN 5,	1020	TO	JAN 6,	0145	19
	JAN 6,	1410	TO	JAN 6,	1845	8
	JAN 10,	1036	TO	JAN 10,	2000	145
	JAN 11,	1555	TO	JAN 12,	0245	17
	JAN 12,	1745	TO	JAN 13,	0245	14
	JAN 13,	1104	TO	JAN 14,	0145	25
	JAN 14,	0922	TO	JAN 15,	0245	31
	JAN 15,	0830	TO	JAN 16,	0245	34
	JAN 19,	1030	TO	JAN 20,	0300	29
	JAN 20,	1425	TO	JAN 20,	1430	2
	JAN 20,	1800	TO	JAN 21,	0300	14
	JAN 22,	1325	TO	JAN 22,	2025	84
	JAN 23,	1520	TO	JAN 24,	0300	20
	JAN 24,	1022	TO	JAN 24,	2200	23
	JAN 25,	0300	TO	JAN 25,	0300	1
	JAN 31,	1903	TO	JAN 31,	1926	3
	JAN 31,	2200	TO	FEB 1,	0840	22
	FEB 2,	0300	TO	FEB 2,	1045	27
	FEB 7,	1330	TO	FEB 8,	0400	24
	FEB 8,	0930	TO	FEB 9,	0500	30
	FEB 9,	0845	TO	FEB 9,	1100	8
	FEB 10,	1000	TO	FEB 11,	0500	30
	FEB 16,	1015	TO	FEB 17,	0245	29
	FEB 17,	0845	TO	FEB 18,	0530	44
	FEB 21,	1545	TO	FEB 21,	1700	4
	FEB 22,	1130	TO	FEB 22,	1505	9
	FEB 23,	0905	TO	FEB 23,	0950	4
	FEB 23,	1200	TO	FEB 24,	0330	31
	FEB 24,	0830	TO	FEB 24,	1315	11
	FEB 24,	1600	TO	FEB 25,	0200	16
	FEB 27,	1200	TO	FEB 27,	1230	2
	FEB 28,	1130	TO	FEB 28,	1230	2
	MAR 1,	0915	TO	MAR 1,	1757	120
	MAR 3,	0900	TO	MAR 3,	0900	1
	MAR 3,	1145	TO	MAR 3,	1330	4
	MAR 3,	1600	TO	MAR 4,	0345	25
	MAR 6,	1215	TO	MAR 6,	1230	2
	MAR 7,	0930	TO	MAR 7,	1230	8
	MAR 22,	1400	TO	MAR 22,	1700	6
	MAR 22,	2030	TO	MAR 22,	2030	1
	MAR 23,	1100	TO	MAR 23,	2230	13
	MAR 24,	0100	TO	MAR 24,	0100	1
	MAR 27,	1045	TO	MAR 27,	1700	48
	MAR 29,	1400	TO	MAR 29,	1400	1
	MAR 29,	1630	TO	MAR 29,	1800	2
	MAR 30,	1530	TO	MAR 31,	0330	24
	MAR 31,	1145	TO	MAR 31,	1230	3
	APR 5,	1000	TO	APR 5,	1730	15
	APR 12,	1430	TO	APR 13,	0330	27
	APR 13,	1030	TO	APR 14,	0115	33
	APR 14,	1115	TO	APR 14,	1445	8
1967	APR 14,	2145	TO	APR 15,	0245	16
	APR 16,	1035	TO	APR [illegible],	1220	8
	APR 17,	1200	TO	APR [illegible],	1330	4
	APR 20,	1345	TO	APR [illegible],	1500	3
	APR 21,	1330	TO	APR 21,	2100	15
	APR 25,	0100	TO	APR 25,	0415	7
	APR 25,	1215	TO	APR 25,	1500	6
	APR 26,	1845	TO	APR 26,	2130	6
	APR 27,	0130	TO	APR 27,	0330	5
	APR 27,	1210	TO	APR 28,	0300	25
	APR 30,	1900	TO	APR 30,	2330	10
	MAY 1,	1900	TO	MAY 1,	2230	14
	MAY 2,	1020	TO	MAY 2,	1605	13
	MAY 3,	1130	TO	MAY 3,	1315	4
	MAY 3,	1530	TO	MAY 3,	1615	3
	MAY 12,	0000	TO	MAY 12,	0530	19
	MAY 12,	1115	TO	MAY 12,	1505	33
	MAY 16,	1600	TO	MAY 16,	1615	2
	MAY 24,	1150	TO	MAY 25,	0330	35
	MAY 25,	1045	TO	MAY 25,	2100	29
	MAY 26,	0030	TO	MAY 26,	0200	4
	MAY 26,	0920	TO	MAY 26,	1715	13
	MAY 27,	1645	TO	MAY 27,	2330	15
	MAY 29,	1210	TO	MAY 29,	1800	109
	MAY 30,	1200	TO	MAY 30,	1800	100
	MAY 31,	0118	TO	MAY 31,	0130	2
	MAY 31,	0415	TO	MAY 31,	0445	3
	MAY 31,	0815	TO	MAY 31,	0930	3
	MAY 31,	1645	TO	MAY 31,	1845	6
	MAY 31,	2230	TO	JUN 1,	0345	7
	JUN 1,	1035	TO	JUN 1,	1035	1
	JUN 1,	1345	TO	JUN 1,	1400	2
	JUN 1,	1645	TO	JUN 1,	1700	2
	JUN 2,	1100	TO	JUN 2,	1100	1
	JUN 2,	1515	TO	JUN 2,	1600	2
	JUN 8,	1122	TO	JUN 8,	1225	2
	JUN 8,	1545	TO	JUN 8,	1545	1
	JUN 9,	1545	TO	JUN 9,	1545	1
	JUN 12,	0910	TO	JUN 12,	0945	2
	JUN 16,	1500	TO	JUN 16,	1808	6
	JUN 22,	1530	TO	JUN 22,	2315	17
	JUN 24,	1315	TO	JUN 24,	1415	3
	JUN 24,	1715	TO	JUN 24,	1945	9
	JUN 27,	1145	TO	JUN 27,	1215	3
	JUL 6,	1100	TO	JUL 6,	1600	9
	JUL 7,	0950	TO	JUL 7,	1550	13
	JUL 11,	2300	TO	JUL 11,	2300	1
	JUL 12,	0200	TO	JUL 12,	0400	2
	JUL 13,	0405	TO	JUL 13,	0405	1
	JUL 13,	0725	TO	JUL 13,	0725	1
	JUL 13,	1550	TO	JUL 13,	1550	1
	JUL 17,	[illegible]	TO	JUL 20,	0750	149
	JUL 21,	0400	TO	JUL 21,	0400	1
	JUL 21,	0800	TO	JUL 21,	0800	1
	JUL 24,	2305	TO	JUL 24,	2305	1
	JUL 25,	2000	TO	JUL 26,	0000	33
	JUL 31,	0920	TO	JUL 31,	0940	2
	JUL 31,	1630	TO	JUL 31,	1730	2
	AUG 1,	2230	TO	AUG 2,	0200	7
	AUG 2,	0500	TO	AUG 2,	0915	12
	AUG 2,	1615	TO	AUG 3,	1200	40
	AUG 7,	2040	TO	AUG 7,	2040	1
	AUG 9,	2330	TO	AUG 9,	2330	1
	AUG 10,	1500	TO	AUG 11,	0115	19
	AUG 11,	0935	TO	AUG 12,	0750	52
	AUG 14,	1300	TO	AUG 17,	1030	157
	AUG 17,	2311	TO	AUG 17,	2311	1
	AUG 23,	1145	TO	AUG 23,	1515	5
	AUG 28,	1745	TO	AUG 29,	1200	48
	AUG 29,	1510	TO	AUG 31,	0900	104
	SEP 1,	1450	TO	SEP 1,	1940	59
	SEP 5,	1845	TO	SEP 6,	0100	16

TABLE 1 (CONT'D)

CATALOG OF NE, TE AND TI MEASUREMENTS AT JICAMARCA RADAR OBSERVATORY

TIME INTERVAL COVERED YEAR	DATE	75WMT		DATE	75WMT	NO. OF PROFILES
1967	SEP 7,	1815	TO	SEP 8,	0100	18
	SEP 8,	1428	TO	SEP 8,	1645	3
	SEP 12,	1700	TO	SEP 13,	0930	36
	OCT 10,	1228	TO	OCT 12,	0800	105
	OCT 12,	1200	TO	OCT 12,	1230	2
	OCT 24,	1600	TO	OCT 24,	2345	16
	OCT 26,	1645	TO	OCT 26,	2345	13
	OCT 28,	1700	TO	OCT 28,	2300	14
	OCT 30,	1555	TO	OCT 30,	1555	1
	NOV 3,	0515	TO	NOV 3,	0830	7
	NOV 16,	1115	TO	NOV 16,	1400	5
	NOV 16,	1740	TO	NOV 16,	2300	10
	NOV 17,	0500	TO	NOV 17,	0715	4
	NOV 17,	1245	TO	NOV 17,	1245	1
	NOV 20,	1535	TO	NOV 20,	1535	1
	NOV 23,	0850	TO	NOV 25,	0800	180
	NOV 28,	1815	TO	NOV 29,	0130	19
	NOV 29,	0830	TO	NOV 29,	0918	2
	NOV 29,	1215	TO	NOV 29,	1245	2
	NOV 29,	1745	TO	NOV 29,	2300	20
	DEC 12,	1140	TO	DEC 12,	1230	3
	DEC 12,	1750	TO	DEC 13,	0330	23
	DEC 13,	1845	TO	DEC 13,	1945	5
	DEC 18,	1300	TO	DEC 19,	2300	84
	DEC 21,	1200	TO	DEC 21,	1300	3
	DEC 26,	1200	TO	DEC 26,	1300	3
	DEC 27,	1145	TO	DEC 27,	1415	6
	DEC 29,	1200	TO	DEC 29,	1330	4
1968	JAN 2,	1145	TO	JAN 2,	1330	5
	JAN 3,	1200	TO	JAN 3,	1230	2
	JAN 4,	1200	TO	JAN 4,	1300	3
	JAN 16,	0930	TO	JAN 16,	1330	9
	JAN 16,	1625	TO	JAN 17,	2345	71
	JAN 28,	2220	TO	JAN 28,	2300	3
	FEB 22,	1200	TO	FEB 22,	2330	28
	MAR 13,	0855	TO	MAR 13,	1330	8
	MAR 13,	1600	TO	MAR 14,	0800	53
	APR 2,	1830	TO	APR 3,	0830	48
	APR 3,	1400	TO	APR 4,	0815	55
	APR 23,	1215	TO	APR 24,	0800	40
	APR 24,	1200	TO	APR 24,	1300	2
	APR 24,	1645	TO	APR 24,	2357	21
	APR 25,	0200	TO	APR 25,	0800	17
	APR 26,	0130	TO	APR 26,	0800	20
	APR 29,	2215	TO	APR 30,	0300	10
	APR 30,	1645	TO	APR 30,	2345	20
	MAY 2,	0100	TO	MAY 2,	0400	6
	MAY 15,	1745	TO	MAY 16,	0745	22
	MAY 16,	1345	TO	MAY 16,	1405	3
	MAY 17,	0930	TO	MAY 18,	0745	41
	JUN 5,	1230	TO	JUN 6,	1430	44
	JUN 11,	0945	TO	JUN 12,	0830	44
	JUN 20,	1250	TO	JUN 21,	1500	54
	JUN 24,	1030	TO	JUN 24,	1200	5
	JUN 24,	1630	TO	JUN 24,	2245	13
	JUN 25,	1245	TO	JUN 26,	1550	67
	JUL 1,	1245	TO	JUL 1,	1300	2
	JUL 8,	1645	TO	JUL 8,	1705	2
	JUL 9,	0800	TO	JUL 10,	1630	69
	JUL 11,	1500	TO	JUL 11,	1500	1
	JUL 12,	1440	TO	JUL 12,	1440	1
	JUL 16,	1515	TO	JUL 16,	1530	2
	JUL 17,	1220	TO	JUL 17,	1250	2
	JUL 22,	1300	TO	JUL 22,	1450	4
	JUL 23,	1100	TO	JUL 23,	1300	5
1968	JUL 23,	1615	TO	JUL 24,	0745	32
	JUL 24,	1145	TO	JUL 24,	2345	23
	JUL 30,	0800	TO	JUL 31,	0730	52
	AUG 6,	1630	TO	AUG 7,	1600	56
	AUG 8,	1415	TO	AUG 8,	1430	2
	AUG 9,	1200	TO	AUG 9,	1230	3
	AUG 26,	1650	TO	AUG 26,	2300	16
	AUG 27,	2145	TO	AUG 28,	1530	42
	SEP 3,	1620	TO	SEP 4,	0830	36
	SEP 4,	1430	TO	SEP 5,	1500	58
	SEP 13,	1200	TO	SEP 13,	1315	3
	SEP 23,	1330	TO	SEP 23,	1530	4
	SEP 23,	1845	TO	SEP 24,	0900	33
	OCT 7,	1330	TO	OCT 7,	1745	9
	OCT 8,	1132	TO	OCT 9,	1607	57
	OCT 15,	1605	TO	OCT 16,	0200	30
	OCT 16,	1515	TO	OCT 17,	0200	34
	OCT 18,	1240	TO	OCT 18,	1610	21
	OCT 21,	1100	TO	OCT 21,	1435	19
	OCT 21,	1720	TO	OCT 22,	0800	47
	OCT 22,	1130	TO	OCT 22,	1200	2
	OCT 22,	1630	TO	OCT 23,	0345	36
	OCT 31,	1315	TO	NOV 1,	1200	58
	NOV 1,	1405	TO	NOV 1,	2345	22
	NOV 2,	0200	TO	NOV 5,	0600	170
	NOV 5,	1015	TO	NOV 6,	0500	43
	NOV 6,	1230	TO	NOV 6,	1250	2
	NOV 6,	1530	TO	NOV 6,	2330	15
	NOV 19,	1110	TO	NOV 21,	0615	97
	DEC 3,	1245	TO	DEC 3,	2045	20
	DEC 3,	2300	TO	DEC 4,	1545	40
	DEC 16,	1545	TO	DEC 16,	2133	11
	DEC 17,	0930	TO	DEC 17,	1100	3
	DEC 17,	1400	TO	DEC 18,	0800	45
	DEC 18,	1130	TO	DEC 18,	1300	4
	DEC 20,	1515	TO	DEC 21,	0000	29
	DEC 23,	1640	TO	DEC 24,	0015	23
	DEC 27,	1530	TO	DEC 27,	2345	18
	DEC 30,	1405	TO	DEC 30,	1405	1
	DEC 30,	1730	TO	DEC 30,	2345	15
1969	JAN 7,	0700	TO	JAN 7,	1003	6
	JAN 7,	1330	TO	JAN 8,	0800	41
	JAN 28,	1020	TO	JAN 28,	1100	3
	JAN 28,	1345	TO	JAN 29,	0800	42
	JAN 29,	1120	TO	JAN 30,	0800	53
	FEB 17,	1530	TO	FEB 19,	1130	105
	FEB 24,	1302	TO	FEB 24,	1323	2
	FEB 26,	0830	TO	FEB 28,	0330	102
	FEB 28,	1145	TO	FEB 28,	1230	3
	MAR 4,	1715	TO	MAR 6,	0800	93
	MAR 17,	1645	TO	MAR 18,	1100	62
	MAR 18,	1650	TO	MAR 19,	0900	62
	MAR 19,	1640	TO	MAR 20,	0900	60
	MAR 25,	1145	TO	MAR 26,	0830	54
	MAR 27,	1315	TO	MAR 27,	1600	4
	APR 3,	0945	TO	APR 3,	1100	5
	APR 10,	1805	TO	APR 10,	2345	24
	APR 11,	1920	TO	APR 11,	2245	14
	APR 12,	2020	TO	APR 12,	2230	10
	APR 13,	2040	TO	APR 13,	2345	14
	APR 14,	2030	TO	APR 14,	2315	12
	APR 15,	1845	TO	APR 15,	2345	21
	APR 16,	2045	TO	APR 16,	2230	8
	APR 22,	1620	TO	APR 24,	1500	115
	APR 28,	1400	TO	APR 29,	1130	50

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UAG-46 "Interplanetary Magnetic Field Data 1963-1974", by Joseph H. King, National Space Science Data Center, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771, June 1975, 382 pages, price $2.95.

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UAG-48A "Synoptic Observations of the Solar Corona during Carrington Rotations 1580-1596 (11 October 1971 - 15 January 1973)", [Reissue with quality images] by R. A. Howard, M. J. Koomen, D. J. Michels, R. Tousey, C. R. Detwiler, D. E. Roberts, R. T. Seal and J. D. Whitney, E. O. Hulbert Center for Space Research, NRL, Washington, D. C. 20375 and R. T. and S. F. Hansen, C. J. Garcia and F. Yasukawa, High Altitude Observatory, NCAR, Boulder, Colorado 80303, February 1976, 200 pages.

UAG-49 "Catalog of Standard Geomagnetic Variation Data", prepared by Environmental Data Service, NOAA, Boulder, Colorado, August 1975, 125 pages, price $1.85.

UAG-50 "High-Latitude Supplement to the URSI Handbook on Ionogram Interpretation and Reduction", by W. R. Piggott, British Antarctic Survey, c/o SRC, Appleton Laboratory, Ditton Park, Slough, England, October 1975, 292 pages, price $4.00.

UAG-51 "Synoptic Maps of Solar Coronal Hole Boundaries Derived from He II 304Å Spectroheliograms from the Manned Skylab Missions", by J. D. Bohlin and D. M. Rubenstein, E. O. Hulbert Center for Space Research, Naval Research Laboratory, Washington, D. C. 20375 U.S.A., November 1975, 30 pages, price 54 cents.

UAG-52 "Experimental Comprehensive Solar Flare Indices for Certain Flares, 1970-1974", compiled by Helen W. Dodson and E. Ruth Hedeman, McMath-Hulbert Observatory, The University of Michigan, 895 Lake Angelus Road North, Pontiac, Michigan 48055 U.S.A., November 1975, 27 pages, price 60 cents.

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