Data Set Catalog # 229

ATS-1, Electron Content data
66-110A-15B 1tape

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP's).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents — To find associated documents you will need to know the document ID number and then click here.
http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

ATS 1

TOTAL ELECTRON CONTENT DATA

66-110A-15C

THIS DATA SET HAS BEEN RESTORED. THERE WAS ORIGINALLY ONE 9-TRACK, 800 BPI TAPE, WRITTEN IN BINARY. THERE IS ONE RESTORED TAPE. THE DR TAPE IS A 3480 CARTRIDGE AND THE DS TAPE IS 9-TRACK, 6250 BPI. THE ORIGINAL TAPE WAS CREATED ON AN IBM 360 COMPUTER. THE DR AND DS NUMBER ALONG WITH THE CORRESPONDING D NUMBER AND TIME SPAN IS AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR002904	DS002904	D008037	1	01/01/70 - 12/30/71

Read Errors occurred on records 399, 617 and 674 of File 1.

REQ. AGENT	RASH NO.	ACQ. AGENT
WTJ	RB0050	LLD

ATS-1

ELECTRON CONTENT DATA

66-110A-15B

This data set consists of 1 800 BPI Binary tape that was produced on the IBM/360. The 'D' tape is 9 track and the 'C' tape 7 track. These tapes contain 1 file where each record contains 596 16 bit words and corresponds to 1 day of data.

D#	C#	START	STOP
D-08037	C-09533	1/01/70	12/30/71

FORMATS FOR THE EXCHANGE OF IONOSPHERIC ELECTRON CONTENT INFORMATION

by

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I. INTRODUCTION

The knowledge of the columnar electron content of the ionosphere is not only of great scientific significance but also plays an important role in the engineering of transionospheric communications and navigations systems [da Rosa, 1970]. The importance of the electron content data, allied with the relative simplicity with which it can be collected, is responsible for the growing number of scientists who in many areas of the world are operating or preparing to operate observatories capable of acquiring such data.

Electron content has almost invariably been measured by means of beacons installed aboard satellites orbiting our planets either in low or in geostationary orbits. Since we are here interested in the temporal behavior of the ionosphere over a given fixed point, we shall focus our attention exclusively on the data collected from geostationary beacons.

Of the various techniques used to measure electron content, the Faraday rotation method has, up to now, been the most popular because it requires no special on-board system (it uses existing VHF telemetry transmitters) and, in addition, employs ground base systems of very modest cost. The principal disadvantages of the method are:

- The accuracy of the results decays with decreasing observer latitude and becomes so low that the method is useless in the vicinity of the geomagnetic equator.

- Even at midlatitudes, the accuracy is limited by the fact that it is impossible to estimate with sufficient precision the parameter which relates the electron content to Faraday rotation angle. We assume that the uncertainty of the results collected at Stanford is about $\pm 5 \times 10^{16}$ e. m^{-2}.
- Owing to the fact that polarimeters measure only increments in Faraday rotation, an "ambiguity" problem arises which has to be resolved by judgement of the data analyst. This makes it more difficult to implement automatic real-time systems.

With the launching of ATS-F/G the use of group delay methods for measuring electron content will be possible. This method has the advantage of great flexibility and can hopefully employ ground based systems of costs comparable to those of the low price Faraday rotation polarimeters. The ATS-F/G beacon transmits, among other signals, two carriers, one at 140 and one at 360 MHz each modulated by a 1 MHz tone. When the phases of the received modulations are compared, it is possible to determine the electron content with accuracies of about 0.5×10^{16} el. m^{-2} with ambiguities of 17×10^{16} el. m^{2}. These accuracies are about one order of magnitude better than those obtainable with the Faraday rotation method while the ambiguities are about the same. On the other hand the use of a 100 kHz modulating frequency, (unfortunately not available on the 140 MHz carrier) although increasing the uncertainty to some 5×10^{16} el. m^{-2} would raise the ambiguity to 170×10^{16} el. m^{-2}, a value of content exceeded only on rare occasions and which therefore would permit a greatly simplified design and construction of the logic necessary to make the system compatible with unattended real-time operation.

Regardless of the method used for obtaining electron content information there is a great interest in building up a synoptic view of the behavior of electron content all over the world. It is, therefore, of great importance that international standards for data presentation and data exchange be agreed upon. We do present here, for initial consideration by all interested scientists, a set of data formats which might be useful for such exchange.

II. GENERAL

2.1 - Modified Julian Day Number

- From the U. S. Nautical Amanac:

"To facilitate chronological reckoning for many purposes, the astronomical days beginning at Greenwich noon are numbered consecutively, from an epoch sufficiently far in the past to precede the historical period; the number which denotes a day in this continuous count is the Julian Day Number. The Julian Day reckoning begins with Julian Day Number 0 for January 1, 4713 B.C., Julian proleptic calendar; the Julian Day Number therefore denotes the length of time that has elapsed, at Greenwich noon at the beginning of the astronomical day, since this epoch."

- For some uses the Julian Day Number (JDN) as defined above has two disadvantages:

1. Present dates are represented by a number which is too large to be stored in a 16 bit word in a digital computer (IBM-360, half precision word).
2. The Julian Day starts at noon, not at midnight UT so that any given universal day corresponds to two different JDN, one for the period 0000 through 1200 and one for the period 1200 through 2400.

- To avoid these difficulties a Modified Julian Day Number (MJD) is defined as

$$MJD \equiv JDN - 2,429,999.5$$

Thus, the Modified Julian Day of number 8761 starts at 0000 UT on 1 Jan 65.

2.2 - Definitions

2.2.1 - Slant columnar electron content, I_s.

$$I_s = \int_0^H n \sec \chi \, dh = \langle \sec \chi \rangle \int_0^H n dh$$

where: n is the electron concentration.

h is the height (a variable).

χ is the zenithal angle of the ray path at height h.

H is the height of the satellite.

$$\langle \sec \chi \rangle \equiv \frac{\int_0^H n \sec \chi \, dh}{\int_0^H n \, dh}$$

, is the weighted mean of the zenithal angle.

2.2.2 - Vertical columnar electron content, I

$$I = \int_0^H ndh = \frac{I_s}{\langle \sec \chi \rangle}$$

2.2.3 - Ionosphere point.

The point at which the ray path crosses the height of the centroid of the ionospheric electron profile. Since this height is not, in general, known, it should be taken arbitrarely as 350 to 400 km.

2.4 - Ground Station Codes

Ground stations are identified by a numerical code which also identifies the satellite used. Codes presently in use at Stanford are indicated in the table below. Codes for other stations should be assigned by common agreement between observers.

STATION CODES

November 10, 1971

ATS SATELLITE STATIONS

Station Code	Station	Time Zone **	Station Coords. Long. °W	Station Coords. Lat. °N	Ionospheric Point (height = 400 km) Long. °W	Ionospheric Point (height = 400 km) Lat. °N	Ambiguity $\times 10^{-16}$
1	Stanford ATS-1	PST	122.16	37.40	125.48	34.20	4.5
2	Stanford ATS-3	PST	122.16	37.40	*	*	*
3	Hawaii - SYNCOM 3	HST	157.88	21.34	*	*	*
4	Flagstaff ATS-1	PST	111.7	35.1	116.44	32.09	4.4
5	Ely ATS-1	PST	114.85	39.3	119.52	35.80	4.1
6	San Diego ATS-1	PST	117.2	32.7	120.85	30.00	4.8
7	Arecibo ATS-3	AST	66.85	18.40	*	*	*
8							
9	Rosman ATS-3	EST	82.88	35.20	*	*	*
10	Clark Lake ATS-1	PST	116.45	33.25	120.25	30.48	4.7
11	Ft. Collins ATS-1	PST	105.40	40.30	112.16	36.54	3.9
12	Edmonton ATS-1	PST	113.50	53.36	121.21	47.43	3.5
13	Stanford ATS-5	PST	122.16	37.40	120.23	34.25	4.9
14	Roverval ATS-1	EST	72.5	49.0	*	*	*
15	Ancon, Peru ATS-3	EST	77.13	-11.775	*	*	*
16	Sagamore Hill ATS-3	EST	70.82	42.63	*	*	*
17	Urbana ATS-3	CST	88.23	40.07	*	*	*
18	Cold Bay, Alaska ATS-1	U11	162.75	55.20			
19	Honolulu ATS-1	HST	157.88	21.34	157.24	19.77	9.0
20	Rio, Brazil ATS-3	U3	43.22	-22.90	*	*	*

Assumes: ATS-1 at 150° W
ATS-5 at 105° W

* Date must be known in order to find location and ambiguity.

Ambiguity is the value of vertical electron content corresponding to 180° of Faraday rotation.

** See Chapter IV.

AST = UT-4
CST = UT-6
EST = UT-5
HST = UT-10
PST = UT-8
U3 = UT-3
U11 = UT-11

III. INSTANTANEOUS VALUES OF ELECTRON CONTENT

3.1 - Observed Values

Observed values of electron content are usually reported on magnetic tapes, one record for each day. The quantity to be reported is the vertical electron content, I, not withstanding the fact that the quantity measured is the slant electron content, I_s, (in the case of the group delay experiment) or the Faraday rotation associated with the slant content. The conversion from I_s to I involves the estimation of $\langle \sec X \rangle$ which is taken as equal to the value of sec X at the ionosphere point. The adopted height of the ionosphere point is indicated in each record.

For convenience in further data analysis, the vertical electron content is split into two parts: the mean value, $\langle I \rangle$, of the electron content taken over a given number of days and centered on the day of interest, and the deviation ΔI from the mean. The observed value of electron content is

$$I = \langle I \rangle + \Delta I$$

The number of days over which the mean is taken is indicated in each record. Since the electron content tends to show a 27-day periodicity due to the same periodicity in solar ionizing radiation, the mean should be taken over a number of days that is short compared with the above period, yet long enough to smooth out most of the day to day variations. An averaging time of seven days has been found adequate.

A total of 288 pair of values per day are recorded, one pair for every five minutes. If data are acquired at more frequent intervals then the average of all measurements made within a five minute period is used. If values of $\langle I \rangle$ are unavailable the number zero is recorded and missing value of ΔI are represented by the Number 9999.

The data are written on IBM-compatible magnetic tapes in the format labeled M-TAPE (see below). Both 7 and 9 levels can be used but the latter is recommended. Each record corresponds to one universal day and consists of 596 (2 byte) words. When a 9-level tape is used with a density of 800 bits/inch, each record occupies 2.25 inches (this includes the end-of-record gap). The record length is 2 x 596 + 4 = 1196 bytes and the block size is 1196 + 4 = 1200 bytes. One year's worth of data occupies 82 ft of tape. Usual tape length is 200 ft.

M-TAPE FORMAT

All words are half precision integers (2 bytes). Station code identifies both ground station and satellite used.

<u>Word No.</u>

Word No.	
1	Station Code.
2	Year - 1900 (Universal Time).
3	Day Number (Universal Time).
4	Modified Julian Day Number ≡ Julian Day Number - 2,429,999.5.
5	Modified Julian Day Number of the next record. If the present record is the last on the tape, this word is set equal to -1.
6	Height of the ionospheric point, km.
7	Latitude of the ionospheric point, radians (positive of north) $\times 10^{-3}$.
8	East longitude of the ionospheric point, radians (0 to 2π) $\times 10^{-3}$.
9	East longitude of the satellite, radians (0 to 2π) $\times 10^{-3}$.
10	$G' \equiv \Omega/I$, degrees $m^2 \times 10^{18}$ (see note 1).
11	Record number.
12	Origin indicator: 0 if content was measured by the Faraday rotation technique; 1 if by the group delay technique.
13	Number of days over which the mean was taken.

14

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-- Reserve Words (filled with zeros).

--

20

21 Mean value of vertical electron content, $\langle I \rangle$, electrons x m^{-2} x 10^{-15}.

22 Deviation of the electron content from the mean, $\Delta I \equiv I - \langle I \rangle$, electrons x m^{-2} x 10^{-15}.

23 $\langle I \rangle$

24 ΔI

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595 $\langle I \rangle$

596 ΔI

NOTE 1: The parameter G' is provided to permit the calculation of the originally observed angle Ω. This angle may be the measured Faraday rotation angle or the measured group delay angle. G' relates Ω to the vertical electron content.

NOTE 2: The 288 values of mean electron content (odd numbered words 21 through 595) and the 288 values of electron content deviation (even numbered words 22 through 596) correspond to the values in each 5-minute of period of the day. The first value of $\langle I \rangle$ and the first value of ΔI are nominally attributed to the time 2.5 minutes after midnight, UT.

A listing of all available observed values of vertical electron content is sometimes useful. Such listings are however very voluminous and, therefore, expensive to produce. For this reason, they are not recommended as a method for routine data exchange. Figure 3.1 is suggested as convenient format for the listing mentioned.

OBSERVED COLUMNAR ELECTRON CONTENT, (EL.M**-2*10**-15)
STANFORD, ATS-1
JAN 1967

DAY OF THE MONTH (UNIVERSAL TIME)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
16: 0	121	114	115	91		117		171				76	174	157	60	96	66	105	74	114	143	106			117	111	135	150	130	134	119
16: 5	123	119	117	92		122		[illegible]				76	175	175	72	96	66	107	77	118	145	106			120	114	143	156	135	137	122
16:10	127	124	125	96		126		163	155			136	149	182	73	102	67	113	83	125	152	110			127		153	156	144	144	130
16:15	123	125	127			131		167	148			134	145	190	75	104	68	117	86	127	151	111			130		157	173	149	147	139
16:20	131	125	135	95		136		159	163			119	207	205	77	111			90	130	158	116			141		162	186	156	152	149
16:25	135	131	136	97		139		164	154			123	210	214	81	113			90	129	159	117					162	189	157	153	153
16:30	139	132	144	107		146		172	167			121	216	232	84	118	65	133	94	132	167	122			151		167	197	161	160	159
16:35	142	132	152	109		157		173	169			125	227	238	87		84		96	135	180	126			154		167	199	162	162	160
16:40	143	137	164	115				178	173			132	237		96	122	67	143	100	142	180	129			158		169	205	167	163	167
16:45	154	139	164	117				174	173			132	247		96	122	87	145	101	147	194	132			159		171	208	170	163	170
16:50	163	142	173	122		171		181	179			146	269	276	100	121	91	152	104	157	189	136			163		179	211	177	167	180
16:55	166	164	174	123		173		182	191			150	294	293	101	118	92	154	106	161	188	138			167		180	214	190	166	183
17: 0	171	153	142	127		175		179	191			157	295	306	104	116	102	155	108	173	194	145			168	160	186	219	181	169	193
17: 5	173	157	123	123		186		[illegible]	194			163	270	311	109	115	106	157	110	179	197	147			167	164	193	221	179	170	195
17:10	179	150	187	132	141	192		174	193			167	291	323	112	114	108	162	113	188	197	148			170	164	191	221	179	176	201
17:15		151	173	135	146	153		177	201			170	283	329	115	114	110	165	115	196	199	148			169	165	194	217	181	179	202
17:20		155	181	141	150	165		172	216			172	297	339	124	117	120	172	121	209	199	150			169	169	200	220	185	183	206
17:25		163	189	164	157	189		192	223			173	400	347	126	119	126	174	123	214	203	150			169	172	203	221	183	182	210
17:30		163	188	181	159	198		187	235				307	362	130	125	13[illegible]	186	124	229	210	155			169	171	204	222	185	182	211
17:35		163	192	185	162	191		183	244				313	366	131	127	140	188	130	236	213	156			169	173	205	223	187	183	212
17:40			172		162	195	311	191	247				316	376	136	135	147	200	132	248	219	159			170	173	203	226	193	189	218
17:45			170		163	194	322	196	245				321	344	144	138	150	200	132	256	220	160			170	171	204	225	195	191	219
17:50			172	163	167	200	347	[illegible]	245				324	394	150	147	164	207	138	274	216	164		158	174	169	204	227	199	196	222
17:55			174	167	171	202	355	193	249				335	397	155	155	159	210	141	282	219	166		159	176	169	205	226	198	195	221
18: 0	263		137	163	176	201	376	202	257			219	342	414	163	170	179	224	149	300	228	171		165	187	178	202	230	201	197	221
18: 5	273		191	170	178	203	395	204	258			221	345	424	171	175	185	228	151	308	233	176		168	195	186	203	232	201	198	219
18:10			201	177	185	234	337	211	267			226	345	447	190	198	198	240	157	324	242	171		180	200	200	203	233	204	199	223
18:15			232	176	150	204	366	216	269			229	344	457		197	201	245	160	329	247	180		188	210	202	203	236	206	200	220
18:20	276		237	175	186	201	402	220	273			240	343	471	231	212	207	252	168	339	258	187		195	222	210	205	238	209	202	224
18:25	286		212	141	182	204	410	214	277			243	347	475	206	217	210	255	174	345	262	188			239	212	205	237	207	202	226
18:30	305		221	181	174	290		244	240			242	330	477	220	232	212	262	194		277	198		203	248	214	205	237	211	206	227
18:35	310		226	192	177	237		250	281			251	336	483	225	240	212	265	188		282	204		205	252	214	206	236	215		220
18:40	321		249	190	173	213		262	281			254	337	490	237	252	219		191		294	207		206	259	214	206	242	230	212	229
18:45	323		243	191		212		269	293			262	333	491	243	257	220		195		301	210		206	261	217	209	244	237	214	234
18:50	335		255	195	185	220		281	294			265	335	499	251	265	227	270	194	365	315	212		212	261	231	215	250	246	218	241
18:55	341		263	196	147	224		287	285			266	333	488	251	267	230	270	192	368	320	213		220	259	236	221	248	248	218	242
19: 0	339		239	175	197	216		300	287			272	327	484	256	272	236	269	191	376	323	218		232	255	261	231	262	253	216	247
19: 5	334		245	190	199	245		304	289			271	331	493	257	274	240	270	192	378	331	220		231	254	242	233	266	257	213	249
19:10	327		259	203	205	262		315	295			267	335	476	265	290	239	272	193	386	332	224		241	255	242	238	272	260	217	254
19:15	322		303	203	207	260		320	296			273	324	472	266	230	239	273	194	393	334	225		242	257	248	242	277	262	219	257
19:20	314		310	211	211	270		321	299			279	329	457	274	278	241	271	198	401	335	230		243	260	251	246	285	270	223	260
19:25	313		310	217	213	282		321	301			279	327	459	276		242	271	199	405	325	233		244	260	250	247	286	271	223	256
19:30	310		312	243	215	260		315	305			277	331	441	274	279	247	276	204	415	333	237		250	273	250	255	290	273	231	255
19:35	312		312	245	219	306		315	306			274	335	439	272	275	248	280	206	419	330	238		250	277	251	256	293	274	235	254
19:40	285		314	249	222	312	430	313	312			267	343	430	264	277	254	282	213	424	319	238		253	278	250	251	295	280	242	255
19:45	295		312	249	225	314	427	312	313			258	347	421	267	279	256	283	216	424	314	238		257	279	252	264	300	281	243	257
19:50	277		310	252	236	319	414	307	314			257	347	399	261	272	259	284	223	422	302	239		259	275	256	266	302	285	249	263
19:55	272		315	252		327	411	337	314			255	358	392	257	270	258	288	227	422	299	238		261	277	257	267	301	284	250	266

DUMPED FROM TAPE C0101

STANFORD ELECTRONICS LABORATORIES

STANFORD, CALIFORNIA 94305

SPONSORS: NASA and SAMSO

3.1 - Tabulation of all observed values of electron content for January 1967. (SAMPLE)

3.2 - Summary of Observed Values

A summary of the observed values of electron content can be conveniently presented in the form of the miniature plots and half-hourly tabulations developed by F. L. Smith and shown in Figure 3.3.

Twenty-four diurnal electron content plots are shown in each page, except that at the end of a year fewer plots appear. Vertical columnar electron content is plotted on the Y-axis in units of 2×10^{17} electrons/m^2 per division. Local standard time is plotted on the X-axis in units of 6 hours per division. Dates are specified by having the year printed at the top of each page and the day number printed at the top of each individual graph.

The plotter pen normally forms a continuous curve connecting all the data points in each day. However, the pen is raised between two consecutive data points whenever either of the following occurs:

a) the time interval between the two data points is greater than or equal to one hour;

b) the difference in the two consecutive Faraday rotation measurements is greater than or equal to 90% of a half rotation.

A page of electron content tabulations corresponding to each page of plots is generated. The left hand column on each page contains a list of local standard times in increments of 30 minutes. The other columns contain the corresponding electron content values in units of 10^{15} electrons/m^2. The number at the top of each column of electron content data is the day number.

The electron content values are all smoothed in that each value is obtained by fitting either a linear or parabolic curve to several experimental observations. Blank spaces appear in the listings for times when there are not enough data available to perform the smoothing. A smoothed electron content value for time T is computed as follows:

a) Locate all experimental data points within the time interval (T-25 min.) $\leq t \leq$ (T + 25 min.);

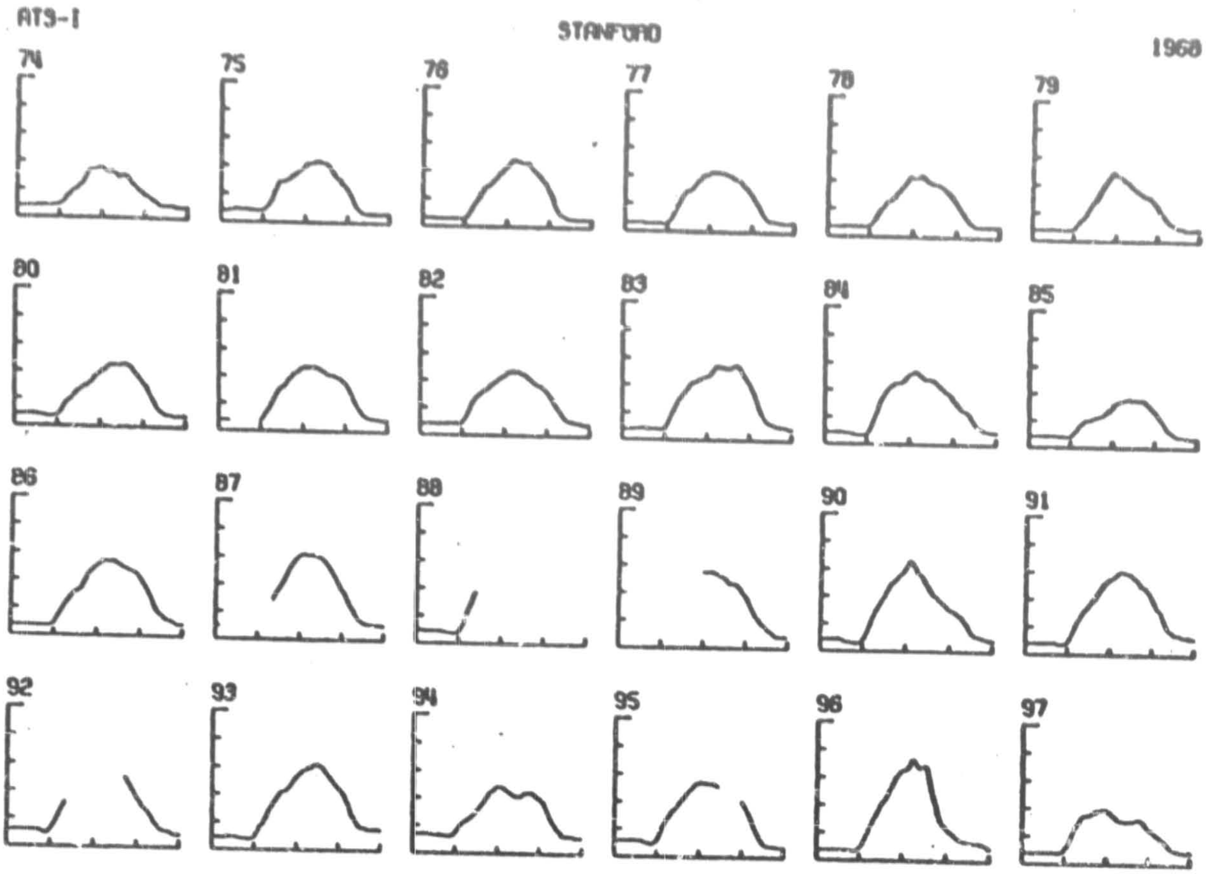
b) Check to see that at least one of the data points in the interval was recorded at a time $t \leq T$, and that another different point was recorded at a time $t \geq T$;

c) If there are more than 8 data points within the interval, discard all except the 8 that occur nearest time T,

d) Assuming that condition (b) is satisfied, if there are 4 or more data points within the interval then use a parabolic curve fit to compute a smoothed electron content value for time T;

e) Assuming that condition (b) is satisfied, if there are only 2 or 3 data points within the interval then use a linear curve fit to compute an electron content value for time T;

f) If condition (b) is not satisfied, then an electron content value is not computed for time T and a blank space will appear on the listing.



ATS-I STANFORD 1968

TIME PST	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97
	ELECTRON CONTENT																							
0003	77	75		55	67		84	77	82	82	86	89	86	87			77	79	122	80	147	114	77	93
0030	75	74	62	59	69		95	75	87								70	77	126	87	141	115	72	82
0100	75	77		63	70	76		76	81		89		71				82	77	119	87	139	115	79	79
0130	78				65	75		79	70	77	88	82			83		94	70	119	86	137	120	79	76
0200	80	87			71		85			79	88				87		84	79	119	87	130	119	76	77
0230	86	92		63	73	78	84			85	83	84					85	79	121		137	119	75	76
0300	79	90		60	74	77	89		80	84	86	84					80	91	121		133	117	76	77
0330	80	87	56	57	75	77	84		80	91	83	83					79	87	119	39	129	115	76	75
0400	83	90	55	57	74	78	81		81	79	75				82		63	81	116	84	129	119	75	79
0430	85	86		60	73		76		83	79		81			77		59	77	113	79	129	102	76	76
0500	83	84	59	58	72	74	77		84		69	78	69		72		56	71	103	77	171	93	69	76
0530	86	79	58	55	71	74	73		81	76	63	74	71		69		57	79	97	70	125	93	69	77
0600	92	80	57	60	76	81	82	72	91	86	72	79	86		85		76	87	116	96	149	121	85	96
0630	109	100	76	86	102	108	111	104	120	128	114	104	139		127		125	133	159	134	180	179	125	139
0700	140	137	119	133	141	128	153	150	184	187	176	134	177		109		190	189	215	172	217	233	178	189
0730	167	189	165	183	180	164	184	193	237	241	250	144	229		250		256	237	209	213	228	277	219	269
0800	191	247	265	232	212	203	208	246	275	288	316	187	257	274	321		309	282	316	275	244	312	298	289
0830	210	286	247	271	246	245	237	290	296	324	360	195	297	323			35	317		322	270	349	361	327
0900	234	291	277	289	261	282	262	315	317	358	397	203	316	363			391	349		359	295	376	356	346
0930	269	303	295	305	282	315	279	318	333	386	421	212	339	407			441	392		395	432	408	432	350
1000	315	326	319	335	312	365	294	374	350	413	440		367	460			487	421		418	368	438	472	357
1030	329	338	346	364	343	406	313	408	376	425	449		420	510			511	458		429	478	469	451	376
1100	344	359	374	391	376	448	344	430	395	441	460	251	469	558			549	497		459	438	498	503	393
1130	352	378	401	405	417	403	372	452	417	454	484	273	487	587			570	526		456	463	524	619	507
1200	356	401	426	415	427	484	394	466	438	467	521	303	508	606			619	549		527	484	541	643	508
1230	335	417	462	630	424	465	416	469	457	484	531	327	527	610		549	650	567		551	484	538	659	570
1300	327	424	476	425	432	447	435	471	469	519	533	370	545	616		550	634	588		572	460	549	699	546
1330	331	430	472	425	426	428	453	472	471	541	511	347	543	611		543	587	604		585	447	531	729	521
1400	330	432	463	421	403	392	490	461	460	535	485	356	539	608		531	558	599		593	425	527	606	519
1430	295	428	455	409	387	380	452	450	457	531	477	350	535	601		516	513	509		610	417	518		507
1500	304	416	448	399	370	364	458	435	436	526	478	349	517	590		503	473	571		617	416		640	504
1530	292	383	417	382	372	348	460	417	412	535	462	348	503	567		401	429	549		606	417		639	509
1600	262	343	353	374	355	331	494	407	392	544	420	345	496	535			394	511		570	439		649	512
1630	226	320	371	352	334	320	421	399	373	544	409	336	478	497		446	377	493	486	537	437		395	376
1700	208	295	339	321	310	307	390	391	360	487	388	319	470	448		440	353	478	445	565	433		329	409
1730	188	266	306	292	279	279	354	372	346	448	364	292	449	403		401	325	457	402	475	419		264	270
1800	167	231	257	259	240	237	315	341	320	404	327	265	410	357		362	304	396	357	446	391	371	237	290
1830	156	183	198	217	199	200	279	300	282	352	298	229	367	310		307	289	350	319	414	356	356	230	239
1900	139	132	137	172	128	177	228	249	236	273	271	192	328	260		257	272	316	280	365	307	302	193	216
1930	119	100	102	133	126	147	182	197	196	207	249	156	276	219		216	256	261	251	302	259	257	169	199
2000	101	80	86	105	100	127	144	156	160	156	229	116	220	174		176	219	195	209	245	299	182	148	177
2030	90	71	70	89	87	112	116	126	129	141	192	103	180	131		163	180	175	180	202	175	131	144	157
2100	85	69	63	83	70	98	102	109	113	129	155	90	155	135		139	139	169	147	173	145	79	130	127
2130	89	65	62	86	75	93	93	101	105	114	129	81	134	120		129	117	147	127	105	120		112	112
2200	92	62	60	75	79	90	88	93	99	105	112	77	119	116		97	107	143	123	159	176	82	129	90
2230	81			72	75	82	82	91	93	101	104	76	109			84	101	135	115	153	127	79	129	89
2300	76	61	58	60		81	82		91	97	90	69	99	109		81	93	139	143	149	119	76	119	87
2330	75	60	55			85	81	83		92			88			78	85	120	93	147	117	76	139	84
2400	75		54	67		89	77	80	82	87	99	66	87			77	79	121	80	144	115	79	98	83

Fig. 3.2 - Summary of observed electron content values.

IV. IONOSPHERIC STATISTICAL ABSTRACTS

The statistics below should be reported in the format indicated in Figure 4.1. Asterisks in any column denote insufficient data; caution must be exerted in interpreting the meaning of statistics under such circumstances. Thus, for instance, when the next to last column (IAVD, daytime average electron content) has asterisks, the value of IMAX (the maximum value of electron content during the day) is the maximum of all available values, but not necessarily the real maximum for the day.

It may be convenient to plot some of the statistics as shown in Figure 4.2.

IMAX, the maximum value of electron content.

IMIN, the minimum value of electron content.

TMAX, the time of occurrence of IMAX.

TMIN, the time of occurrence of IMIN.

IDTN, the rate of change of electron content in the predawn period (a two-hour period ending when the sun reaches a zenithal angle of 100°).

IDTM, the rate of change of electron content in the morning (a two-hour period beginning when the sun reaches a zenithal angle of 90°).

IDTA, the rate of change of electron content in the afternoon (1530 to 1730).

IDTE, the rate of change of electron content in the evening (2200 to 2400).

All the above rates of change are determined by fitting a straight line to the available data by the least squares technique. The standard deviation indicated below is the rms deviation of the data from the straight line:

SIGN, the standard deviation corresponding to IDTN.

SIGM, the standard deviation corresponding to IDTM.

SIGA, the standard deviation corresponding to IDTA.

SIGE, the standard deviation corresponding to IDTE.

IAVD, the daytime average value of electron content (0900 to 1500).

IAVN, the nighttime average value of electron content (2100 to 0300).

All times are local solar times, i.e., they are true solar times at the subionosphere point and include the equation of time correction.

The dates are civil time, i.e., the data used for each day start at 0000 and end at 2400 of a given time zone. The time zones corresponding to each station are indicated in the table in subsection 2.4.

STANFO[illegible] SYNCOM-III OR ATS-1

YEAR	DAY	COLUMN. CONT. EL. M**-2 (*10** -16) MAX	MIN	TIME OF OCCURRENCE (LT) MAX	MIN	AVERAGE RATE OF CHANGE OF ELECTRON CONTENT BETWEEN EL M**-2 SEC**-1 (*10**-12) PREDAWN	MORNING	AFTERNOON	NIGHT	STANDARD DEVIATIONS				AVER. ELECTR. CONT. BETWEEN 9815:00	2103:00 LT
69	12	40.28	2.14	12:28	21:51	0.146	18.048	-12.845	1.407	0.028	0.661	0.576	0.116	32.03	2.55
69	13	31.25	1.79	11:42	22: 3	-0.028	14.234	-13.701	0.985	0.041	0.562	1.021	0.058	24.91	2.18
69	14	40.16	1.97	11:46	1:14	-0.711	25.565	-11.283	0.193	0.111	0.323	0.627	0.076	31.37	2.30
69	15	41.00	2.43	11:37	0: 5	-0.832	22.283	-22.244	-0.719	0.046	0.343	1.365	0.125	35.21	2.94
69	16	35.42	2.26	12:10	6: 1	0.098	18.319	-23.316	0.487	0.054	0.163	1.096	0.067	30.50	3.72
69	17	37.41	3.24	12:33	22:55	-0.877	17.172	-21.007	-0.298	0.060	0.396	0.302	0.148	32.63	4.04
69	18	36.28	1.96	11:57	4:39	0.060	16.248	-15.651	1.507	0.060	1.022	0.601	0.374	29.13	3.01
69	19	35.67	2.16	12:19	0:54	-0.570	19.263	-11.558	0.112	0.061	0.307	0.309	0.131	27.50	2.88
69	20	32.11	1.94	12: 5	6: 3	-0.745	24.592	-9.356	0.989	0.053	0.327	0.514	0.046	26.10	3.09
69	21	31.62	3.12	12:45	6: 5	-0.462	14.446	-18.321	0.562	0.079	0.210	0.278	0.090	25.64	3.71
69	22	29.05	2.90	12:48	6:47	-0.798	17.955	-7.937	1.049	0.058	0.291	0.272	0.056	23.76	3.65
69	23	33.64	3.19	12:30	22:57	0.400	11.374	-10.868	1.451	0.037	0.203	0.515	0.105	26.38	3.80
69	24	41.55	2.75	11:19	3:36	0.414	20.574	-17.937	0.078	0.032	0.574	0.757	0.084	35.82	4.70
69	25	41.99	2.82	11:59	22:47	-2.043	26.978	-7.940	0.925	0.184	0.286	0.306	0.091	33.84	4.67
69	26	37.32	2.90	11:56	1:25	0.215	19.204	-13.588	1.269	[illegible]	0.829	0.624	0.047	30.19	3.21
69	27	38.92	3.54	11:38	3:33	0.139	25.579	*******	*******	0.040	0.340	******	******	32.01	4.12
69	28	36.55	3.49	12:12	21:58	*******	*******	-6.900	-0.158	******	******	0.602	0.064	27.94	3.62
69	29	33.80	2.75	12:32	21:44	-1.309	23.019	-13.407	0.715	0.037	0.320	0.209	0.071	28.88	3.71
69	30	31.56	2.60	13:46	4:24	0.411	16.901	-12.576	-0.090	0.046	0.291	0.086	0.159	23.71	3.18
69	31	41.26	2.82	11:34	1:34	-0.174	24.039	-7.973	0.339	0.060	0.357	0.661	0.066	33.84	3.16
69	32	37.48	2.97	12:44	6:32	-0.697	21.210	-19.494	-0.807	0.047	0.432	0.484	0.177	29.97	3.82
69	33	80.51	3.49	13:15	1: 9	-0.658	22.572	-36.570	-3.890	0.147	0.552	2.206	0.174	59.20	5.02
69	34	53.58	2.31	14:18	6:11	-0.973	26.600	-40.028	1.379	0.077	0.504	0.203	0.112	39.23	3.78
69	35	41.13	3.49	12: 9	6:27	-0.345	25.477	-5.990	0.760	0.048	0.351	1.149	0.053	36.14	3.98
69	36	40.10	3.05	12:10	21: 5	0.086	20.002	-9.412	1.253	0.031	0.203	0.926	0.047	35.45	4.59
69	37	44.91	3.39	12:30	6:24	-0.116	20.793	-25.013	0.073	0.042	0.238	0.684	0.064	38.67	3.93
69	38	42.69	2.97	12:50	4:35	-0.306	25.621	-21.975	0.008	0.095	0.356	0.170	0.073	36.[illegible]	3.89
69	39	42.97	3.12	11:46	5:18	0.177	20.599	-17.256	-0.052	0.048	0.445	1.187	0.074	37.99	3.91
69	40	37.20	3.64	12: 6	23:45	0.316	19.101	-12.108	0.165	0.046	0.256	0.845	0.093	31.46	3.97
69	41	41.96	3.49	12: 6	2: 7	0.744	17.982	-5.632	-1.913	0.068	0.206	0.498	0.219	34.40	4.52
69	42	41.13	3.71	12:17	0: 9	0.237	18.300	-3.445	1.264	0.162	1.150	0.738	0.158	33.95	4.85
69	43	38.22	7.98	11:31	5:15	-6.549	20.438	-6.641	-0.249	0.086	0.287	0.204	0.127	33.16	9.30
69	44	42.89	8.30	12: 8	5: 8	-0.850	24.429	-19.124	-1.417	0.327	0.415	0.617	0.073	37.92	9.45
69	45	42.15	8.01	12:12	5:20	0.676	20.953	-20.454	-0.742	0.032	0.911	0.865	0.170	36.15	8.65
69	46	48.75	4.25	14:24	23:59	0.276	23.287	-26.449	-1.893	0.046	0.285	0.577	0.161	63.15	9.22
69	47	36.43	3.46	13: 7	4:34	-0.089	25.884	-19.201	*******	0.009	0.425	0.595	******	32.40	******
69	48	47.80	11.94	12:22	23:57	*******	22.372	-13.639	-0.694	******	0.196	0.740	0.045	42.40	12.26
69	49	47.26	11.99	13: 2	0:11	-0.191	23.524	-18.091	-0.801	0.043	0.189	0.385	0.033	42.77	12.40
69	50	55.22	12.08	15: 8	5:59	-0.365	30.409	-20.778	-0.532	0.019	0.368	0.522	0.069	47.92	12.93
69	51	53.30	3.88	12:27	5:26	-0.183	27.623	-19.919	-1.583	0.034	0.212	0.473	0.044	43.47	4.37
69	52	52.05	3.83	13:18	6: 0	-2.058	27.196	-16.459	-1.683	0.049	0.188	0.155	0.099	43.01	5.15
69	53	53.25	4.62	13:49	3:37	0.101	25.630	-9.668	-3.696	0.026	0.239	0.862	0.259	45.14	6.26
69	54	59.71	4.99	13:16	5:27	-0.753	33.420	*******	*******	0.066	0.633	******	******	51.16	******
69	55	54.69	5.85	14:19	23:59	*******	*******	-15.508	-3.335	******	******	0.349	0.043	47.64	7.97
69	56	54.04	5.45	14:38	1: 4	0.364	27.010	-12.977	-4.028	0.022	0.351	0.255	0.254	46.18	6.92
69	57	55.19	5.75	13:49	2: 1	0.244	31.907	-15.496	-4.970	0.046	0.338	0.457	0.275	48.80	7.67
69	58	66.66	5.48	11:46	5:44	-0.376	38.326	-6.207	-3.352	0.032	0.743	0.615	0.192	54.45	7.84
69	59	57.06	5.94	13: 4	5:51	-1.335	28.986	-6.723	-2.261	0.075	0.159	0.893	0.079	48.47	7.62
69	60	62.19	5.13	14:18	3:37	0.924	29.482	-14.087	-5.335	0.026	0.366	0.235	0.184	50.49	9.46
69	61	54.53	5.72	13:37	3:26	1.584	32.907	-15.618	-0.944	0.061	0.553	0.285	0.064	47.47	6.96

FIGURE 4.1 Ionospheric statistical abstracts (see text for explanation).

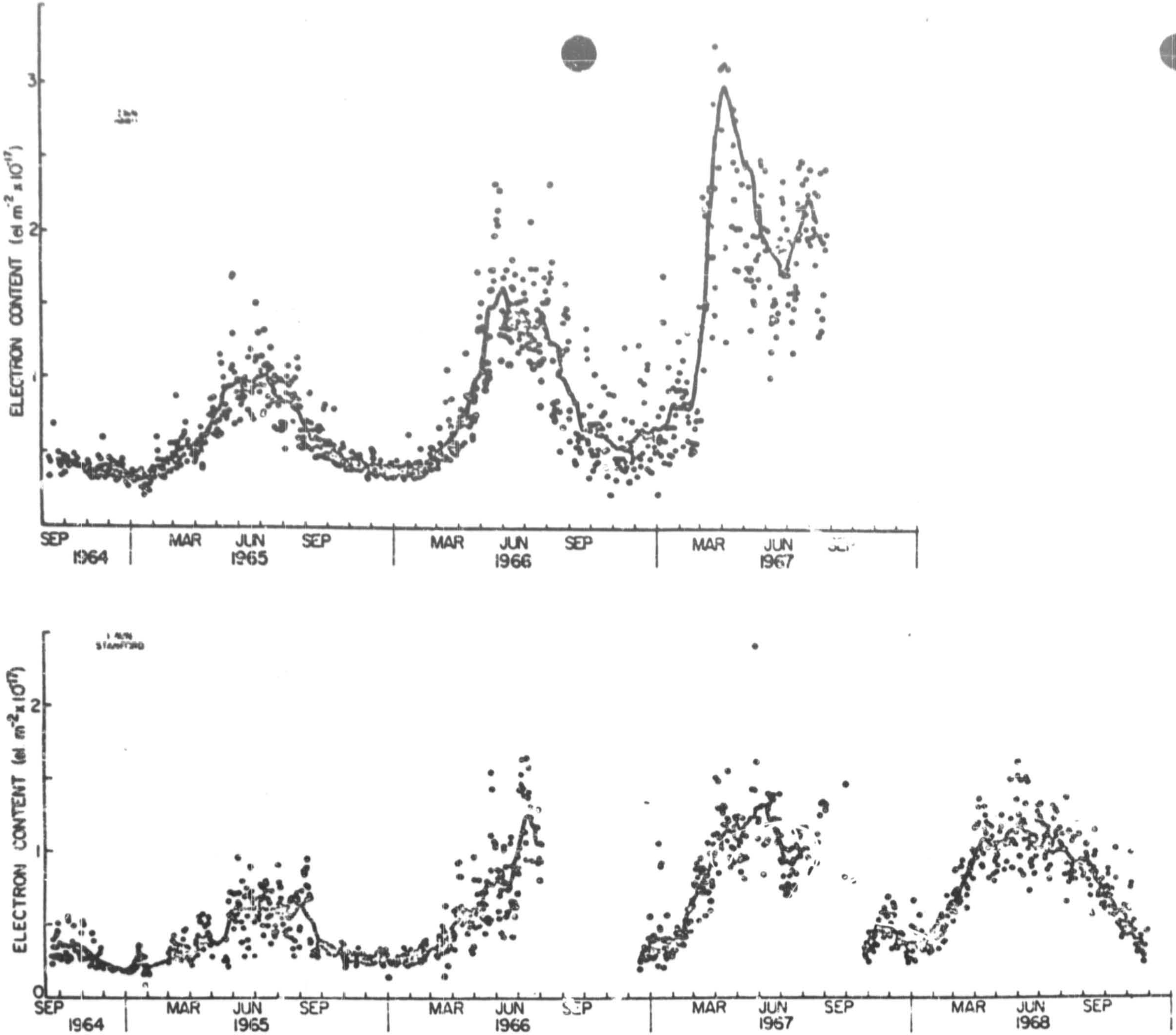


FIGURE 4.2 Daily average nighttime value of electron content at Hawaii and at Stanford. The solid line is a 30-day running mean.

V. MEAN VALUES OF ELECTRON CONTENT

The ionosphere is noted for its erratic day-to-day variations which frequently obscure the longer term trends in its behavior. For this reason, as pointed out in Chapter III, it is convenient to express the electron content as a sum of a seven day running mean plus the deviation of the observed value from this mean. Figure 5.1 illustrates the advantages of such a scheme. On the top of the figure a plot of 2.8 GHz solar radio flux, S, is shown. In the middle, the daily average electron content IMEAN, is plotted for each day and is indicated by a solid dot. One can see a rather chaotic variation from which it is quite difficult to determine a correlation between the solar radio flux and the ionospheric electron content. Still in the middle of the figure, the seven day running mean $\langle IMEAN \rangle_7$, through all the data values has been plotted and it becomes now evident that a reasonable good correlation exists between S and $\langle IMEAN \rangle_7$.

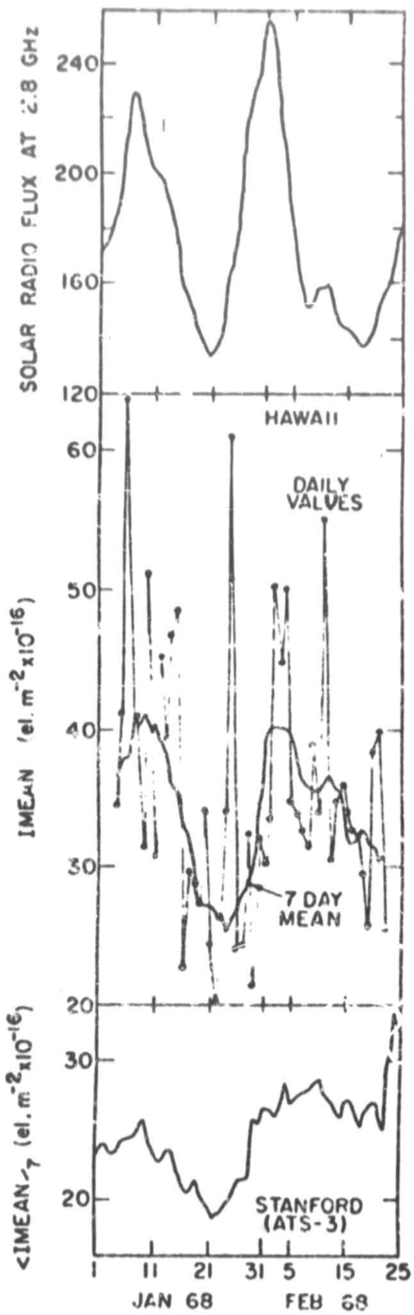


Figure 5.1. The correlation beween the solar radio flux, S, and the electron content becomes apparent only when the seven day mean of the daily average electron content is considered. See plot for Hawaii in middle of the figure.

Thus for the study of the long term behavior of the ionosphere in response to annual effects, solar cycle variation, etc., it is often useful to have available running mean values of electron content.

As discussed in Chapter III, a running mean should be taken over a period of time long enough to remove much of the day-to-day variations and yet short enough compared to 27 days so as not to obscure the solar rotation effects. A seven day running mean appears to satisfy the above criterion.

Figure 5.2 shows a mean diurnal variation of electron content at Stanford. Each point used in the construction of the curve in this figure is the result (in this particular case) of a 31-day running mean. This kind of curve brings out very clearly both the annual and the solar cycle effects on the electron content.

The recommended format for presentation of the mean electron content data is shown in Figure 5.3.

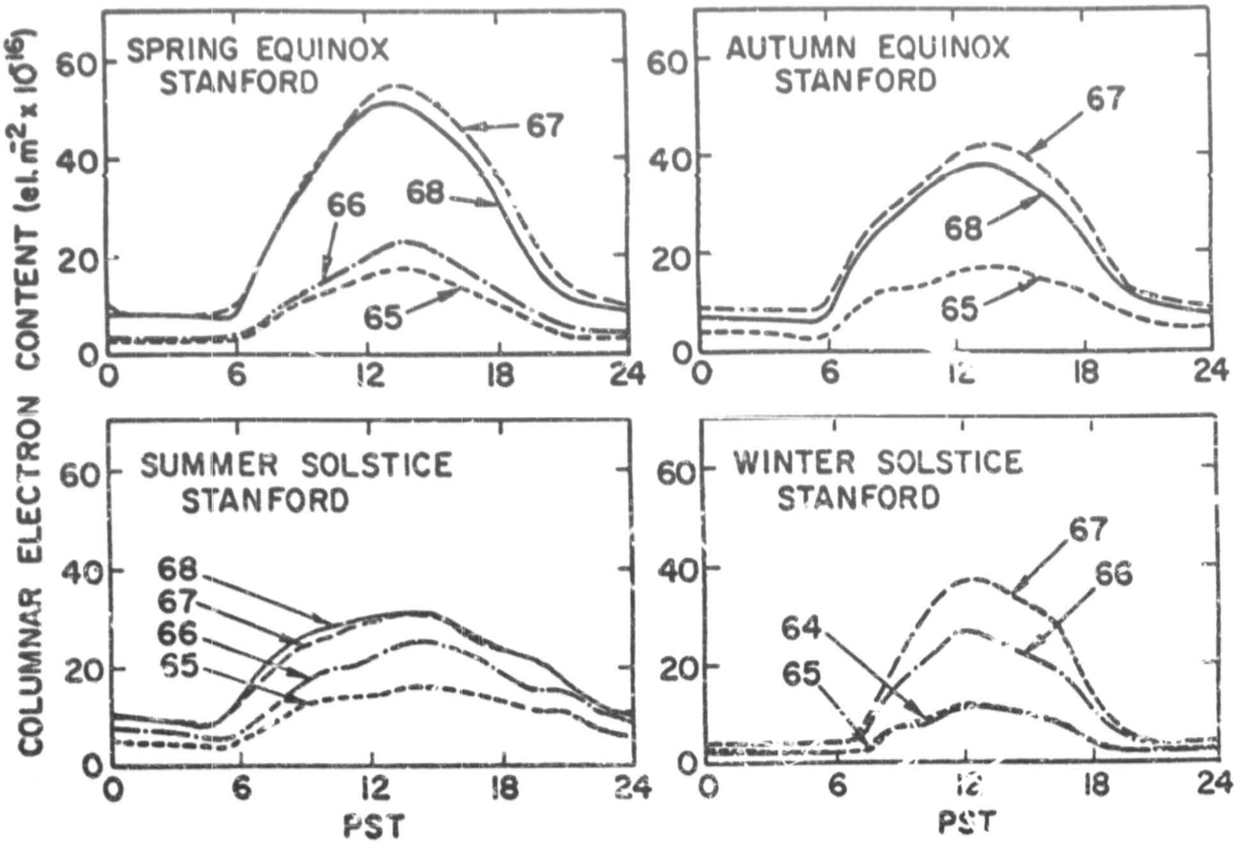


Figure 5.2. Mean electron content at Stanford at different times of the year and different phases of the solar cycle.

STANFORD ELECTRONICS LABORATORIES

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MEAN COLUMNAR ELECTRON CONTENT (EL.*M**-2*10**-15) AT STANFORD, ATS-1
UNFILTERED

69 JAN UT

DAY=>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NUM=>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
12: 0	23	23	24	21	23	24	25	26	26	27	28	28	28	30	30	30	30	31	32	34	32	36	37	39	40	41	39	40	38	39	38
12:15	24	24	24	21											31	30	29	31	32	33	31	35	36	38	39	40	38	39	37	39	37
12:30	24	25	25	22	23	24	25	26	26	27	28	28	28	30	29	30	29	30	31	33	31	35	36	38	39	40	37	38	37	39	37
12:45	26	26	26	23	23				27		28	28	28	30	29	29	28	29	31	32	31	34	35	37	38	39	36	37	37	39	37
13: 0	26	26	26	23	24	24	26	26	26	26	28	28	28	30	29	29	29	29	30	32	31	33	35	37	36	39	36	37	37	38	37
13:15	25	26	26	23	23	23	26								29	28	27	28	30	31	31	33	34	37	38	39	36	37	37	38	36
13:30	26	26	27	23	25	25	26		27	27	27	26		30	28	28	27	28	29	31	30	32	34	37	38	38	36	37	36	37	35
13:45	26	27	27	24	24					28	27	27	27	28	28	27	26	27	29	31	30	32	34	37	37	38	36	36	36	36	34
14: 0	27	27	27	25	26	25	27	27	27	27	26	26	26	27	26	26	25	26	26	30	29	31	33	37	38	38	35	36	35	36	33
14:15	28	28	28	25	27	27							24	27	26	26	26	27	28	31	30	32	33	36	36	37	34	35	34	35	32
14:30	28	29	29	26	27	25	28	26	26	26	26	26	27	28	28	28	27	28	29	31	30	32	33	36	36	37	34	35	34	35	33
14:45	29	29	29	27	28	27						29	29	31	31	31	30	32	31	33	33	35	36	38	38	40	38	38	38	39	37
15: 0	36	36	35	33	34	32								39	38	38	37	39	38	40	40	42	43	45	45	48	46	47	46	47	48
15:15	50	51	50	49	52	52	53	53	53	53	53	52	52	52	53	52	52	52	52	52	53	55	56	58	59	62	61	62	61	63	64
15:30	72	71	70	70	72	71	70	70	71	70	70	69	71	70	71	72	72	72	70	69	71	74	74	78	80	84	84	85	83	86	84
15:45	95	93	91	91	94	93	91	91	91	91	93	91	92	91	93	93	94	92	89	88	92	94	96	99	102	107	107	107	105	107	110
16: 0	114	113	112	113	115	114	111	110	109	108	110	109	109	108	110	112	114	110	106	104	110	114	116	219	122	128	130	130	128	132	134
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16:30	150	145	141	140	141	141	139	138	139	137	144	142	142	140	138	140	147	140	135	131	135	145	145	148	153	162	172	177	170	176	177
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17:15	194	184	181	181	184	187	183	179	186	182	188	185	185	191	192	188	190	181	176	170	172	187	185	188	194	202	216	222	204	212	220
17:30	213	201	196	197	201	205	199	202	211	206	211	207	209	218	212	207	207	196	199	180	183	197	196	210	214	220	231	234	221	227	228
17:45	229	218	213	213	218	228	221	217	225	217	222	219	219	228	233	227	228	216	204	193	196	208	209	222	226	234	246	247	232	240	244
18: 0	245	234	230	227	229	237	233	231	239	232	255	233	236	246	253	247	250	239	224	209	213	223	225	238	241	253	270	270	251	264	267
18:15	264	253	247	244	246	254	252	251	259	252	254	253	258	269	278	271	274	265	243	227	217	225	231	247	250	265	283	283	263	286	289
19:30	285	270	265	261	259	264	263	264	273	266	267	272	279	290	299	292	296	284	263	247	252	260	264	277	277	292	308	257	275	308	307
18:45	306	288	280	275	271	276	280	282	293	286	289	297	303	306	314	307	312	299	277	264	271	277	283	294	293	308	324	310	292	331	332
19: 0	317	299	291	287	284	287	291	295	306	303	307	316	326	329	337	329	332	317	296	281	289	296	301	312	311	326	341	339	323	361	358
19:15	327	309	303	301	291	289	297	305	321	312	319	333	344	346	354	345	349	334	310	299	307	314	320	331	332	348	363	360	344	388	381
19:30	339	320	315	314	311	309	315	321	334	325	331	341	353	355	362	352	357	342	320	312	320	327	335	344	347	362	374	374	357	407	401
19:45	344	324	320	318	308	310				340	350	362	360	360	368	357	361	345	326	322	329	337	344	348	356	371	360	360	345	394	389
20: 0	343	321	316	313	312	306	314	318	336	335	342	354	372	371	370	361	365	352	334	331	327	345	350	354	342	367	356	356	345	382	383
20:15	337	317	314	314	315	309	317	321	339	337	340	352	371	371	367	360	362	351	333	330	334	343	341	346	354	362	351	350	345	394	395
20:30	327	309	309	315	317	308	317	322	339	337	336	347	367	369	366	359	359	350	353	333	335	342	336	342	347	357	347	344	339	424	423
20:45	301	301	305	299	305	296	304	307	329	322	333	345	361	364	360	354	354	345	330	328	331	337	333	339	344	351	343	338	337	417	419
21: 0	295	295	300	309	314	309	317	315	328	330	323	334	352	355	364	354	345	338	321	319	322	327	325	330	334	342	337	333	333	418	422
21:15	307	289	295	302	309	305	313	310	319	315	307	319	334	338	345	334	335	329	312	310	312	317	319	323	328	334	332	328	330	415	421
21:30	302	285	292	298	303	301	308	305	311	305	293	307	319	326	334	323	324	320	299	301	304	308	315	321	324	333	332	326	327	406	417
21:45	284	286	286	271	277	275	273	276	281	278	282	298	312	320	328	320	320	320	301	298	297	300	310	317	317	326	328	322	325	400	416
22: 0	295	281	283	289	293	291	296	294	295	295	272	290	301	310	319	313	311	312	292	290	293	294	306	313	312	320	323	315	316	389	409
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22:30	291	273	271	280	286	285	293	290	290	288	259	278	285	295	301	298	300	302	283	281	286	287	292	299	294	301	303	289	294	364	365
22:45	265	266	264	276	280	285	296	290	290	288	255	278	281	290	296	293	302	302	280	277	265	285	292	292	287	291	291	278	285	346	372
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23:30	259	257	254	260	262	260	259	260	261	259	248	259	271	286	281	277	286	261	265	257	263	258	266	266	258	265	257	238	253	295	326
23:45	266	251	251	257	258	254	252	249	251	249	242	246	259	274	277	267	274	269	257	249	236	249	258	258	261					241	291

PROGRAM "MLIST1"
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Figure 5.3 Seven day mean values of electron content

VI. DEVIATIONS OF ELECTRON CONTENT FROM ITS MEAN

The marked day-to-day variations of electron content mentioned in the previous chapter are in themself an important feature of the ionosphere deserving a careful study. To facilitate this study, it is recommended that the date be presented in the form indicated in the Figure 6.1 in which the following information is given:

The first column (after the date) shows the "Daily Average Value of Electron Content", IMEAN, i.e., the value of electron content averaged over the whole universal day.

The second column shows the "Mean Average Electron Content", ⟨MEAN⟩, i.e., the value of IMEAN averaged over the number of days indicated in the tables.

The third column shows the "Standard Deviation of the Electron Content", IRMS, for the whole UT day. This is the standard deviation of the observed values from the mean value (mean taken over the time period indicated in the tables).

The next eight columns contain the values of IRMS calculated for each 3-hour (UT) interval. These intervals coincide with the periods to which Kp indices are assigned.

The last eight columns contain, in percentage, the ratio between the 3-hour IRMS values and the corresponding mean values of electron content.

It should be noted that the ratio between IRMS (over the whole day) and IMEAN is a convenient disturbance index which might be used as a criterion for classifying ionospheric storms. Figure 6.2 shows a typical distribution of disturbance indices as defined above while Figure 6.3 shows the corresponding cumulative distribution function.

TAPE READ: C0108 TAPE WRITTEN: M0108/7 MEAN TAKEN OVER 7 DAYS

	DATE UT		DAILY AVE	MEAN AVE	STANDARD DEVIATION FROM THE MEAN CONTENT DAILY	0-3	0-6	6-9	9-12	12-15	15-18	18-21	21-24	PERCENTAGE								DISTURBANCE INDEX PERCENT
			ELECTRONS M**-2 *10**-16																		
71	54	(51 TO 57)	17.91	18.38	5.09	5.88	1.37	0.21	0.63	0.30	1.32	1.21	12.93	23	16	3	12	5	6	3	31	28
71	55	(52 TO 58)	19.80	19.56	3.49	7.45	1.47	1.11	0.26	0.30	1.49	2.91	5.28	29	18	20	5	5	7	7	12	19
71	56	(53 TO 59)	22.34	18.63	7.18	10.23	4.92	0.88	0.35	0.45	8.74	13.07	5.91	40	63	15	6	8	44	34	14	39
71	57	(54 TO 60)	18.26	18.76	6.61	6.04	2.32	2.54	0.52	0.36	4.00	13.18	10.55	23	27	45	9	6	20	35	25	35
71	58	(55 TO 61)	17.49	18.67	4.02	0.65	1.39	2.19	1.87	0.70	3.14	3.62	9.76	2	16	39	35	12	16	9	23	22
71	59	(56 TO 62)	17.36	18.78	2.73	2.65	1.60	1.01	0.96	0.38	2.26	3.44	3.66	9	17	18	17	6	11	14	9	15
71	60	(57 TO 63)	17.70	18.60	1.62	2.39	0.74	0.42	0.36	0.65	0.78	2.88	2.24	9	9	7	6	10	4	7	5	9
71	61	(58 TO 64)	17.56	18.59	1.63	2.32	0.92	0.12	0.31	0.38	0.66	2.57	2.77	8	11	2	5	6	3	7	6	9
71	62	(59 TO 65)	20.54	18.54	2.57	3.61	2.21	0.50	0.60	0.82	1.69	2.72	4.83	13	26	9	10	13	8	7	12	14
71	63	(60 TO 66)	21.15	18.58	4.14	5.23	2.38	0.39	0.23	0.50	1.93	8.24	5.77	19	28	7	4	7	9	22	14	22
71	64	(61 TO 67)	18.32	18.80	1.07	1.48	1.46	0.84	0.23	0.16	0.60	1.10	1.59	5	16	15	3	2	2	2	4	6
71	65	(62 TO 68)	17.18	18.82	2.77	1.22	0.77	0.77	0.50	0.25	2.85	6.28	3.33	4	8	13	8	4	13	16	8	15
71	66	(63 TO 69)	17.64	18.68	2.05	0.93	0.16	0.30	0.32	0.24	1.15	4.62	3.11	3	1	[illegible]	5	3	5	11	8	11
71	67	(64 TO 70)	19.20	18.03	3.49	1.95	1.59	1.56	0.95	0.43	2.64	7.80	4.05	8	18	26	15	6	12	20	11	19
71	68	(65 TO 71)	17.92	18.40	3.07	2.91	1.39	1.59	1.60	0.51	0.84	1.63	7.49	12	16	26	25	7	3	4	19	17
71	69	(66 TO 72)	19.50	18.92	3.68	3.95	0.72	0.72	0.52	0.35	3.52	8.75	1.60	17	8	10	8	5	15	21	4	19
71	70	(67 TO 73)	16.52	19.16	4.67	1.56	1.87	1.35	0.79	0.69	3.18	6.60	10.58	7	21	20	12	10	14	15	26	24
71	71	(68 TO 74)	21.01	19.09	6.53	1.87	2.08	0.67	0.13	1.53	2.28	5.16	17.27	8	22	10	2	23	10	12	43	34
71	72	(69 TO 75)	20.61	19.27	4.99	7.11	1.21	2.16	0.95	0.39	1.44	11.21	3.63	32	13	34	15	6	6	26	8	26
71	73	(70 TO 76)	19.31	19.50	1.99	3.93	0.83	0.78	0.57	0.62	1.14	3.26	1.56	17	9	12	8	9	5	7	3	10
71	74	(71 TO 77)	18.78	19.99	3.58	2.17	1.80	0.63	0.57	0.55	3.34	3.34	8.43	9	18	12	8	7	15	7	19	18
71	75	(72 TO 78)	18.89	19.96	2.54	3.70	0.76	0.83	0.69	0.65	2.36	[illegible]	3.66	15	7	12	10	9	10	[illegible]	8	[illegible]
71	76	(73 TO 79)	21.16	19.81	4.49	[illegible]	1.79	0.34	0.53	2.10	[illegible]	2.66	11.00	18	12	[illegible]	7	29	12	6	27	23
71	77	(74 TO 80)	19.90	19.85	10.30	8.29	3.42	2.12	2.72	3.53	10.27	15.03	20.16	32	39	31	39	50	45	36	50	52
71	78	(75 TO 81)	21.24	20.65	10.09	7.37	4.62	2.19	1.82	3.09	10.88	17.47	15.87	28	47	32	27	45	47	43	39	69
71	79	(76 TO 82)	20.21	20.99	9.20	10.64	5.18	2.08	2.76	2.07	9.92	13.98	14.08	38	52	30	40	27	42	34	35	44
71	80	(77 TO 83)	19.75	21.12	10.69	11.68	4.46	2.75	3.25	2.23	9.87	18.71	15.37	43	44	38	46	31	41	46	38	51
71	81	(78 TO 84)	20.93	20.37	6.03	13.42	4.06	2.96	3.20	4.39	6.85	2.23	2.54	50	61	41	45	58	28	5	6	30
71	82	(79 TO 85)	20.63	19.73	2.92	4.42	0.34	1.67	1.22	0.44	1.41	2.45	5.99	17	3	23	17	[illegible]	5	6	16	15
71	83	(80 TO 86)	21.59	19.26	4.59	2.10	0.94	1.70	1.69	1.27	3.18	11.03	4.84	8	9	24	23	11	13	28	13	26
71	84	(81 TO 87)	18.26	19.04	2.92	2.03	1.24	1.06	0.56	0.26	0.33	0.97	7.44	8	12	14	7	3	1	2	20	15
71	85	(82 TO 88)	18.44	18.69	5.13	6.82	1.49	0.28	0.32	0.90	3.69	9.49	7.42	29	15	3	[illegible]	11	16	26	20	27
71	86	(83 TO 89)	16.73	18.41	5.27	3.48	0.53	0.24	1.00	0.93	0.73	10.29	10.05	15	5	3	[illegible]	[illegible]	3	26	28	29
71	87	(84 TO 90)	15.25	18.25	12.35	1.80	0.91	1.31	[illegible]	2.36	3.21	4.16	34.36	4	9	[illegible]	10	27	15	11	100	68
71	88	(85 TO 91)	17.36	17.61	3.40	4.49	2.45	3.99	1.04	0.83	1.73	2.15	6.41	21	24	[illegible]	13	[illegible]	9	6	19	19
71	89	(86 TO 92)	18.58	17.09	3.04	3.57	1.04	0.90	0.88	0.94	0.81	2.02	7.34	17	10	12	13	11	4	6	22	18
71	90	(87 TO 93)	20.60	16.90	5.99	2.15	1.42	1.88	1.84	1.66	4.91	13.64	7.75	10	14	25	23	20	26	43	25	35
71	91	(88 TO 94)	14.37	16.71	3.79	3.79	1.17	0.91	2.60	2.12	3.47	6.38	5.87	17	11	12	34	26	18	20	20	23
71	92	(89 TO 95)	14.84	16.41	4.25	3.41	2.13	0.93	0.97	0.64	3.64	3.84	9.91	16	14	13	13	8	19	12	34	26
71	93	(90 TO 96)	15.79	15.94	1.98	3.58	1.99	0.21	0.39	0.35	2.66	0.95	2.47	17	[illegible]	2	5	7	15	3	9	12
71	94	(91 TO 97)	15.91	15.34	3.56	4.90	2.95	1.81	0.95	1.25	2.56	2.21	7.18	24	28	27	14	17	13	7	28	23
71	95	(92 TO 98)	15.02	15.91	2.88	3.49	0.84	1.59	0.33	1.12	3.77	4.96	3.30	17	9	24	4	14	19	17	11	18
71	96	(93 TO 99)	15.41	16.31	2.17	0.66	0.50	1.92	0.34	0.30	0.84	2.97	4.84	3	4	28	5	3	4	9	17	13
71	97	(94 TO 100)	16.45	16.13	2.71	7.91	1.23	0.61	0.23	0.45	4.53	5.18	0.88	14	12	9	3	5	23	17	3	17
71	98	(95 TO 101)	17.90	15.68	4.92	0.73	0.31	0.27	0.46	1.04	1.88	3.55	13.24	3	3	4	7	13	10	11	46	31
71	99	(96 TO 102)	17.88	16.15	4.56	7.30	0.32	0.22	0.59	0.31	1.20	8.47	6.83	36	3	3	9	4	6	27	22	29
71	100	(97 TO 103)	14.39	16.60	3.96	5.16	0.41	0.41	0.27	0.62	3.86	6.27	3.86	26	4	6	4	7	19	25	12	24
71	101	(98 TO 104)	12.69	18.01	8.43	1.87	0.85	0.29	1.28	1.56	6.06	14.36	17.81	9	8	4	20	18	30	41	47	47
71	102	(99 TO 105)	18.31	18.11	4.42	9.15	2.00	0.27	0.19	0.58	1.40	5.24	6.19	37	18	3	2	6	7	15	17	24
71	103	(100 TO 106)	18.51	17.89	2.21	3.90	0.98	1.69	0.29	0.73	2.66	1.97	2.96	16	8	24	4	8	13	6	8	12

STANFORD, ATS-1 "DEVLIST" FROM PROGRAM MTAPE1

Fig. 6.1 Daily mean values of electron content and standard deviations.

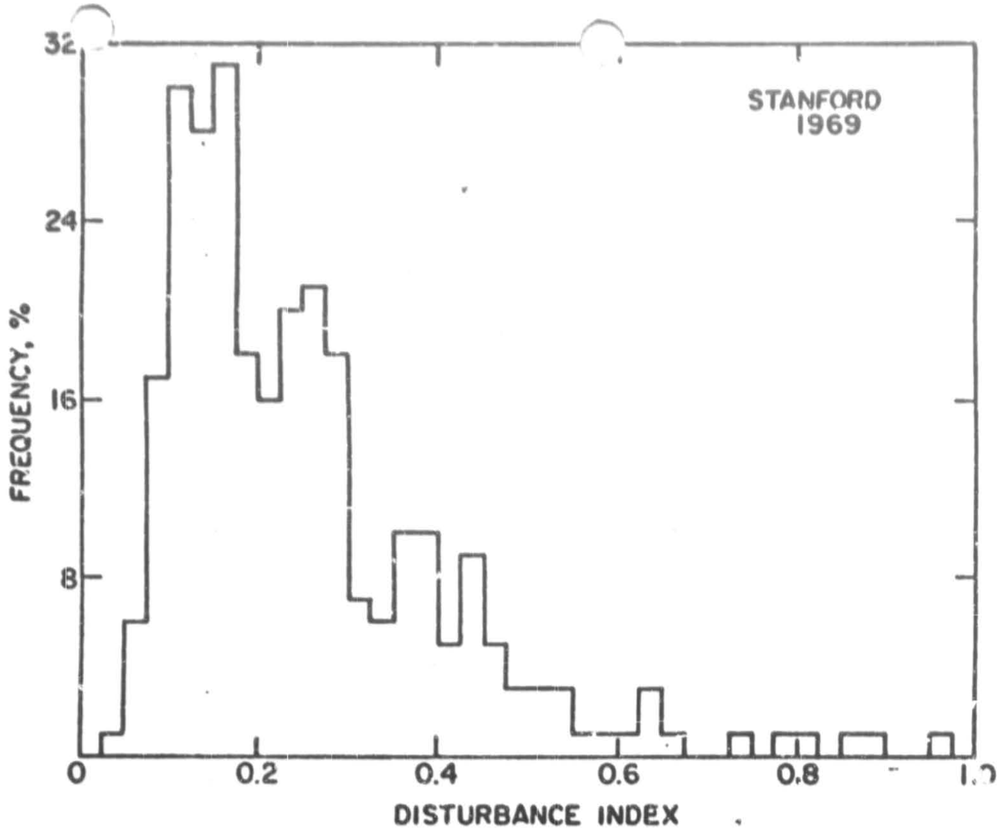

Figure 6.2 Frequency of occurrence of days with a given disturbance index at Stanford (ATS-3) in 1969.

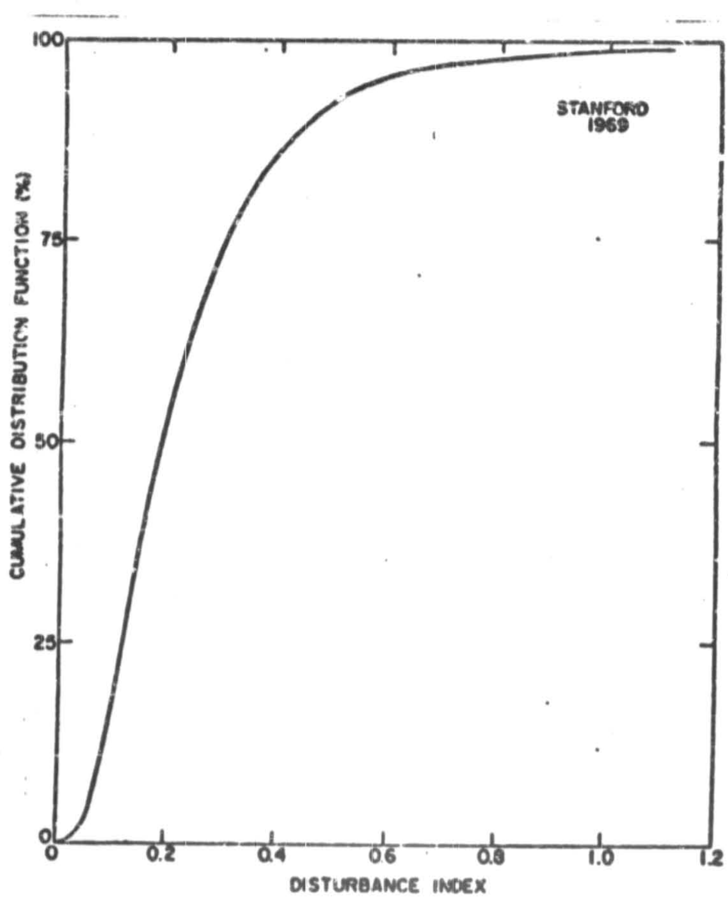

Figure 6.3 Cumulative distribution function corresponding to the data of Figure 6.2.

Reference

da Rosa, A. V., Significance of electron content measurements, symposium on the Future Application of Satellite Beacon Experiments, Lindau/Harz (Germany), 2-4 June 1970.

Acknowledgment

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END OF FILE 00001. THE NUMBER OF UNCORRECTABLE ERRORS IS 00000. THE NUMBER OF RECORDS IS 00728

D-08037

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Dupe of D-08037
START 1/01/70
STOP 12/30/71

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