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Diurnal and seasonal regularities of spread-F and scattered F-traces have been evaluated for one year of high solar activity at midlatitudes by processing and scaling about 900 color ionograms written in ARTIST system (1991, soudning station Roquetes, Spain). The relationship of spread-F and scattering in F-layer with magnetic disturbances is considered. Effect of terminator on the spread-F and scattering clearly defined. Occurrence of blackouts is presented. Comparison of IRI-90 parameters with measured ionospheric parameters at three midlatitude ionospheric stations in Europe was examined.

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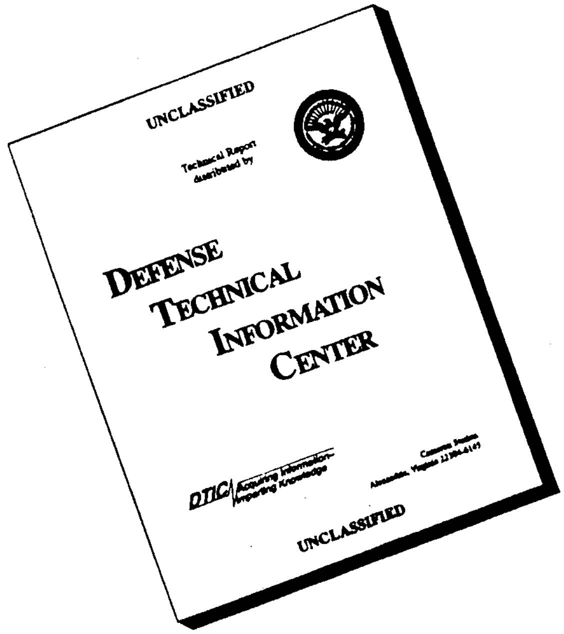

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CORRELATION AND GRADIENT CHARACTERISTICS OF IONOSPHERIC PARAMETERS IN EUROPE

Final Technical Report

by

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CONTENT

I. SPREAD-F AND SCATTERED TRACES

1. INTRODUCTION

The phenomenon of the spread of signals on the ionospheric vertical ionograms, or diffuse broadening of traces in some frequency (frequency spread) or height (range spread) intervals has been studied extensively over the last few decades. Spread of signals strongly influences the propagation of VHF and HF radio waves and the operation work of modern sophisticated radio systems. It is known that the main reason of signal spread is scattering of radio waves by ionospheric irregularities or acoustic-gravity waves [1-6]. The same reason is due to appearance of amplitude scintillations of radio stars [7] and emitted radio satellite signals [8-10]. The role of acoustic-gravity waves or large and medium-scale structures, and small irregularities of different sizes and elongation in the formation of the spread of traces on the ionograms, or of the rate of amplitude scintillations still has not been fully understood [1-3,13,15].

We consider spread-F or scattered signals at midlatitudinal ionospheric sounding station Roquetes, Spain (40^{o} N; $0{,}6^{o}$ E) for the 1991 year of high solar activity. Although spread-F have been investigated for 30-40 last years, its appearance regularities, relations with other geophysical phenomenon and the reasons of its arising have not received properly understanding. Before we consider our results of spread-F study at the European station we briefly conceive the properties of spread-F, known at midlatitude region.

According to references [11-13], spread-F and scintillations appear in this region rather seldom in comparison with highlatitude and lowlatitude regions, where they were studied very active during last years. Meanwhile the number of measurements, observations and studies of irregularities and associating phenomenon, those, as spread-F and scintillations, in this particular region is very limited [14-19].

The basic irregularity properties (or spread-F or scintillation properties) appear to be following:

1. Long - time variation

The type of the connection with solar activity is not definite. According to [16, 19], solar cycle occurrence, in general, is inversely correlated with sunspot number. Thus, Bowman [20] obtained that averaged spread-F occurrence during sunspot minimum is 2-3 times greater than during sun-sport maximum for all months of 1963-1965 and 1957-1959 and is in accordance with equatorial F-spread occurrences. On the contrary, in [14, 21] relatively higher activity of scintillations and spread-F was obtained at sunspot maximum. In [10] enchanted occurrence of scintillations was observed in response to increased solar activity. Any noticeable variations of spread-F occurrence were not received during solar cycle from 1958 to 1966 in Alma-Ata [12].

2. Seasonal variation

Seasonal variation is also not certain. According to [12,16] maximum of occurrence is usually observed in winter or summer solstices or in summer, or for some years in equinoxes or winter [21]. According to [14] maximum is observed in spring or autumn equinoxes. This variation appears to be dependent on magnetic activity in the months considered and on the longitude location of the observation station. Thus, in [19] were picked up two types of spread-F: equinoctial type during high solar activity (seasonal activity maximum in equinoxes) and summer type (maximum of seasonal activity in summer) during low solar activity.

3. Diurnal variation

Strong maximum of spread-F and scintillation occurrence is at nighttime. Sometimes it is observed at pre-midnight hours and sometimes at post-midnight [14,16,19,20]. During the day-time occurrence of irregularities is low, but not negligible.

4. Variation with magnetic activity

Dependence on magnetic activity is rather complicate. It was received in [9,18] that a correlation between scintillations and magnetic activity at midlatitudes, in general, is negative. A positive correlation between scintillations and Kp indexes in winter, no correlation between scintillations and Kp indexes in equinoxes, and negative correlation in summer was obtained in [14]. The delayed occurrence of midlatitude spread-F following times of high AE magnetic indices was investigated in [33]. The results show that peaks in F spread occurrences follow enhanced geomagnetic activity in the sunrise period, with approximately 24-hour intervals.

5. Terminator effect

The connection of scintillations with sunset and sunrise is indicated in [9,14]. In [14] abrupt increase of scintillations was observed just after sunset on the earth in summer months. In winter months such increase was not observed. Significant increase in spread-F just after local sunrise in winter was presented in [9]. The scintillation data do not appear to show this effect during the same time-periods.

6. Waves, spread-F and scintillations

The relationship of spread-F and scintillations with acoustic-gravity and magneto-gravity waves in the ionosphere has been investigated for the last decades very active [3,13,15,20,22,23]. The spread-F has been observed last years with more precision sounding techniques in the HF band. This gives the possibility to observe and study the fine structure of diffuse, duplicate and any other form's traces. Experiments show that waves as patterns in the TEC (total electron contents) are found to be accompanied by shot-period scintillations [24] and also by spread-F [25].

The spread-F appears often after the rise of F-layer and electron-density depletion. The last variations are connected with the AGW (acoustic-gravity waves) passage and negative magnetic storm effects in the ionosphere [26,27].

As a conclusion of these and other experimental facts, Bowman [15] discusses the idea that the formation and type of spread-F is connected with four different scale sizes: day and night large-scale (TIDs), medium-scale (height stratification), and small scale (weak quasi-horizontal (QH) patches) with field-aligned irregularities, embedded in the stratified regions.

7. Other results

During last years the appearance of spread-F and scintillations were studied for individual magnetic storms. As a result of this study the occurrence of the irregularities was supposed to be connected with variations as well as a rate and a direction of variations of electron density in the ionosphere, electric field and ring current [15, 28, 29].

In [30-31] ionospheric irregularities were observed by different methods simultaneously. The results of these observations show that very often irregularities are detected only by one experimental method and not detected by other methods. This fact has not yet received sufficient explanation.

Until recent time the theory of the irregularities and wave at midlatitudes has been not completed [5,32].

The mechanism of formation of F spread on the ionograms is not fully understood although some important ideas emerged. We will point out here that the amplitudes of spread-F signals in most cases are of the same order of value as non spread signals on the regular traces. Only some part of spread-F recordings has the spread signals by 10-20 dB less than undisturbed signals on the ionograms.

Many properties of the irregularities at midlatitudes show that they can appear due to convection flow of electron density from polar or equatorial and crest regions to midlatitude regions. In the same time, only convection connections with polar, equatorial and crest regions can not explain all the occurrence's properties of the irregularities at midlatitudes. Theoretical and experimental investigations in this particular field are still very important.

The most part of this Report introduces the results of study of spread-F and scattered traces on the vertical midlatitude ionograms for one year. We present the experimental data and its relationship with geophysical conditions.

The statistics of full blackouts for the same year is reported and its relationship with geophysical conditions is discussed.

The second small part of this Report deals with the comparison of main ionospheric parameters such as critical frequencies foF2 and foE in the International Reference Ionosphere Model IRI-1990 with measured parameters at midlatitude station.

2. VERTICAL IONOGRAMS AND THEIR PROCESSING FOR 1991

We worked with vertical ionograms obtained at the ionospheric sounding station Roquetes in Spain (40^{o} N; $0{,}6^{o}$ E) at hourly intervals in digital codes. They were received by the aids of computer program ARTIST [11], which outputs not only ionospheric ionogram but also scales many basic parameters of the ionogram. For quit conditions ARTIST also gives the dependence of the distribution of electron concentration versus real height or the profile of electron concentration. Unlike the last programs [34, 35] ARTIST [11] formulates the ionospheric ionograms in terms of ASCII symbols, which were used for recognition of polarization, Doppler shift and angles of arrival of reflected from the ionosphere signals.

These codes and the format used in these ionograms did not allow us to view the ionogram on one computer screen. That is why for processing, studying and printing the ionograms, written in the ARTIST [11] codes, we used our computer program, that was published in the Final Report "Analysis of ionospheric parameters in Europe and creation of the prediction algorithm", Contract DAJA45-92-C0006, 1993. This program transfer each ionogram in color pixels on one computer screen, what makes possible processing and analyzing the ionograms from computer screen.

For the needs of the present processing we had to update our computer program. For instance, the general parameters of the ionosphere layers such as foF2, foF1, foE, foEs, MUF, M300, h'F, h'F2, h'E, h'Es, fmin, fxF, fF, fE, that are determined by the ARTIST program, are presented now on the same computer screen and can be printed together with the ionogram. This program has now the much more convenient interface, and is more friendly to the user, than before.

The ionograms, that this program uses for processing, are now rewritten on the diskettes in archives' codes. As the result of this action the number of diskettes in use is decreased 10-15 times in comparison with the amount of previous diskettes with ARTIST [11] codes. Owing to all these improvements, the processing and analysis of the ionograms, become significantly easier. We performed a detailed analysis of color ionograms directly from computer screen.

We cannot present here examples of color ionograms with which we were working. The examples of the ionograms printed in black-white and in the scale, more merged than on computer screen, are given in APPENDIX, Fig. 1-9. These Figures show the ionograms with F spread and give evaluated indexes for F spread what are presented in Tables 1-11 in APPENDIX (see p. 3 below). One can see in Fig. 1-5 some mistakes in foF2, which makes the ARTIST program because ionograms have breaks in F-traces.

3. THE METHOD OF SCALING OF SPREAD - F AND SCATTERED TRACES

To reveal the scattered conditions of the signals on the ionograms or the spread of the F echoes, we evaluated the special indexes with points and letters. They describe the type of the F echo signals on the ionogram and sometime the whole picture -- the ionogram.

The evaluated indexes and letters in Tables 1-11 in Appendix, which describe the spread and disturbed F traces, are the next ones. Strong disturbed traces in F region with frequency spread are determined by the letters f, ff, and fff. For further calculations we put these letters into accordance with numerical points 4, 5, 6 that describe strong, very strong and very, very strong disturbed traces with frequency spread of signals. The letters ccc, cc, c with points 1, 2, 3 were used for determining the traces with very small, small and close to strong types of spread. Approximately the letters c, f, ff and fff describe the traces with frequency broadening and the echo's width equal to 0.5-0.8 MHz, 0.8-1.0 MHz, 1.0-1.5 MHz, 1.5-2 MHz. We used also evaluative letters such as B - for absorbtion, S - for noises, w - for week signals, A - for breaks in traces, E - for covering F traces by repeating reflections from E region (from E, Es layers), T - for technical reasons of violations. These letters describe the state of F traces on the ionograms as it was recommended, for instance, in [36]. The dash means the absence of the ionogram or the F trace at the ionogram. The absence of the dash or indexes c, f, r means the normal echo without any disturbances. In this case only evaluated letters (B, E, S, W, A, T) can be present in the Tables.

All letters in Tables 1-11, describing the appearance of F spread (c, f, ff, fff, fr, cr), are enclosed in circles. It allows very easily to recognize spread-F occurrences during the year considered.

The results of processing approximately 9000 ionograms are presented here in Tables 1-11 in APPENDIX. The state of F traces in these Tables is given in evaluated letters. We used points (numbers) corresponding to these letters for subsequent calculations.

The findings of analysis of ionograms for one 1991 year of high solar activity are presented below.

4. ANNULAR, DIURNAL AND SEASONAL DEPENDENCIES OF SCATTERING AND SPREAD IN F-LAYER

The method of scaling of F traces on vertical ionospheric ionograms gives us the possibility to investigate the scattering of radio waves by the irregularities of electron concentration or waves in the F-layer (F1 and F2). This problem was studied in papers [37-39]. HF field strength of radio waves over long-distant paths has been analyzed for one solar cycle in these papers. It has been received, as a result of this study, that the additional to collision losses of energy exist in the night and twilight ionosphere. They also take place in the day-time but are less than in other times. These losses were connected with scattering of radio waves by ionospheric inhomogeneities.

Our indication of the state of all F-traces in accordance with the rate of scattering of the reflected signals on the ionograms (a scale with points 0, 1, 2, 3, 4, 5, 6...) allow us to study not only the spread-F but also the conditions of signal scattering in the ionosphere. We do not discuss here the reasons of scattering of signals on the ionograms, which are received by an ionosond with different phase time-delay. Dispersion of time-delay of signals with a particular emitted frequency can be produced by many factors, those as scattering on the irregularities and waves in the ionosphere, regular and irregular horizontal and height variations of electron density, movements in the ionosphere, polarization effects and so on.

The averaged hour indexes of scattering Sh are presented in Table 1. They were obtained using Tables 1-11 from APPENDIX by summarizing and averaging for each hour the number indexes Si for all days of each month: $Sh = \Sigma\, Si / N$, where N is a number of ionograms for considered hour and month, and $\Sigma\, Si$ is the sum of indexes for all available ionograms. The months December and January were studied together because each one from these two months has a small number of ionograms.

One can see from Table 1 that averaged indexes Sh vary from 0.6 to 3.3 during 1991. This means that the indexes Sh or scattering conditions vary in 5.5 times. Indexes $Sh < 1$ correspond to very quiet conditions in the ionosphere. $Sh \approx 1$ conforms to quiet conditions with small disturbances. If $1.5 < Sh < 2.0$, strong disturbed conditions with large possibility of F spread take place, and $2 < Sh < 3.3$ indicates very strong disturbed conditions with spread-F.

Seasonal variations of Sh indexes are demonstrated in Fig. 1. First of all, there is seen the maximum of Sh varying approximately from 1.5 to 3 in dawn hours during all year. Index of scattering is minimum during day-time. The maximum of Sh index does not release so clear during sunset as the maximum during dawn. It stands out clearly only in spring. The variation of indexes in winter is very irregular unlike other seasons. An influence of the terminator on the index of scattering and spread is considered in details in part 6.

Table 1. Mean hour index of scattering Sh of F traces, Roquetes, Spain, 1991

Hour\Mon	Dec -Jan	February	March	April	May	June	July	August	September	October	November	P
01	1.31	1.39	1.33	1.68	1.40	2.25	2.57	2.30	1.74	1.82	1.33	1.74
02	1.25	1.30	1.07	1.60	1.50	2.75	2.61	2.67	1.63	1.83	1.75	1.81
03	1.50	1.65	1.17	1.70	1.60	2.75	2.55	2.33	1.81	1.77	1.88	1.88
04	1.20	1.43	1.68	1.60	1.70	2.75	2.65	2.38	1.85	1.75	2.12	1.92
05	1.90	1.23	1.67	1.90	2.10	2.24	2.71	2.48	2.32	1.72	1.80	2.01
06	1.50	1.14	1.66	2.10	2.70	2.41	3.13	2.74	3.10	2.28	2.00	2.25
07	1.75	1.64	1.07	2.05	2.40	2.16	3.10	2.97	3.30	2.80	2.29	2.32
08	1.50	1.77	1.30	1.60	1.50	1.84	2.24	2.36	2.63	2.81	2.04	1.96
09	2.35	1.61	1.17	1.30	1.40	1.26	1.94	2.07	2.47	1.90	1.93	1.76
10	1.90	1.29	1.17	1.13	1.20	1.00	1.53	1.61	1.83	1.55	1.66	1.44
11	1.30	1.12	1.10	0.94	1.10	1.16	1.92	1.64	1.71	1.74	1.83	1.41
12	1.48	1.28	0.87	0.94	1.20	1.33	1.50	1.63	1.78	1.59	1.79	1.46
13	1.52	1.20	0.83	1.17	0.70	0.90	1.48	1.59	1.71	1.65	1.64	1.31
14	1.50	1.24	0.85	1.16	0.80	1.05	1.16	1.63	1.83	1.71	1.79	1.34
15	1.86	1.16	0.97	1.28	0.90	0.75	1.48	1.65	1.89	1.97	1.86	1.43
16	2.11	1.28	1.00	1.10	0.80	1.31	1.64	1.75	2.00	2.03	1.68	1.52
17	1.35	1.04	1.07	1.80	1.30	1.61	2.15	2.10	2.07	1.97	1.81	1.66
18	0.84	0.60	1.04	1.95	1.80	1.76	2.38	2.18	2.03	1.96	1.64	1.65
19	1.01	1.32	0.75	1.40	1.60	1.86	2.25	1.86	2.03	1.96	1.25	1.57
20	1.02	1.12	0.73	1.25	1.30	1.26	1.92	1.85	1.86	1.93	1.77	1.46
21	1.81	0.83	1.07	1.20	1.07	1.80	2.11	2.11	1.67	1.84	1.12	1.51
22	1.45	1.12	1.00	1.10	1.20	1.86	2.43	2.38	1.83	1.81	1.61	1.62
23	1.25	0.83	0.90	1.25	1.50	2.24	2.31	2.41	1.57	1.93	1.76	1.63
24	1.38	0.67	1.13	1.26	1.70	1.97	2.46	2.31	1.54	1.87	1.48	1.62

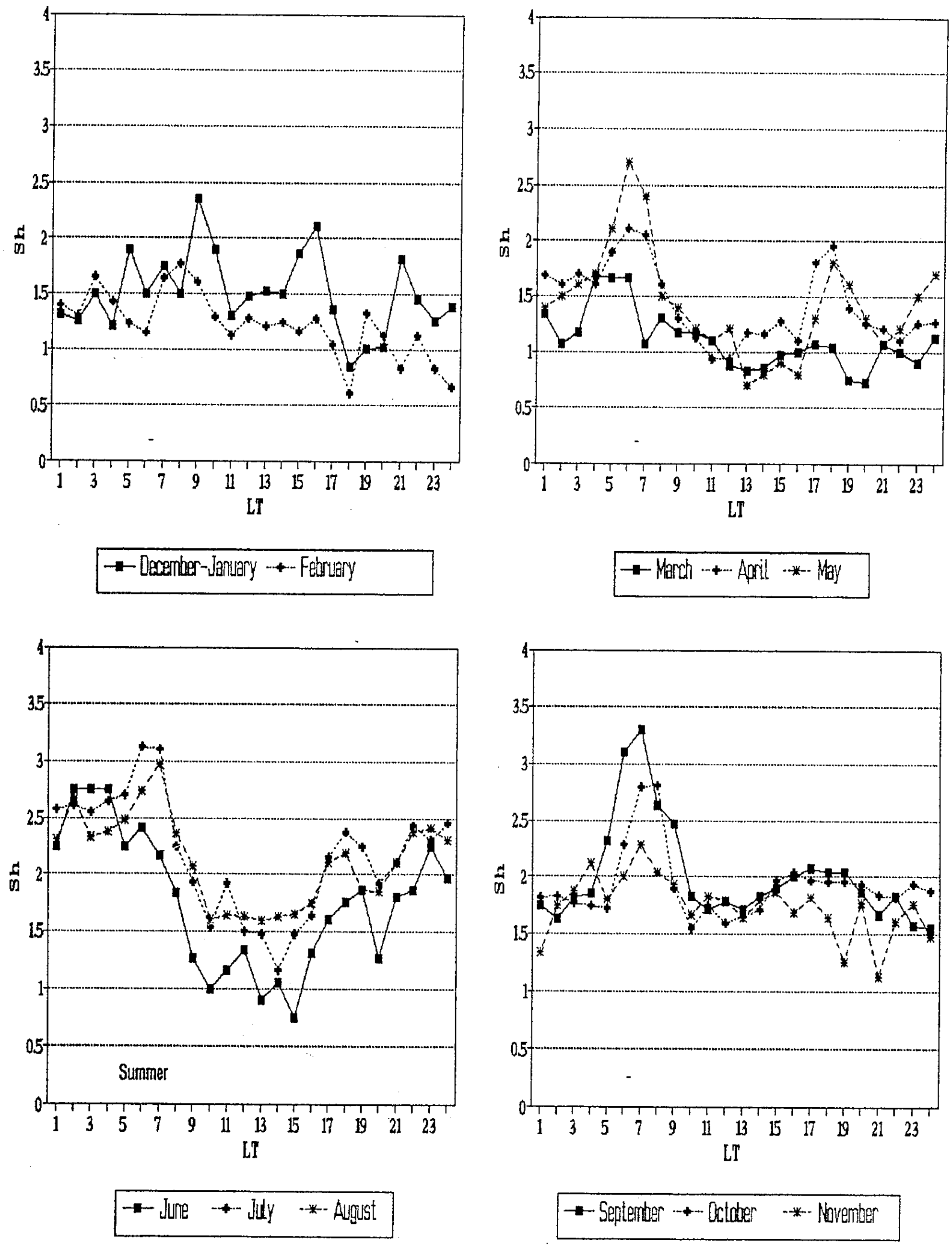


Fig. 1. Mean hour index of scattering Sh for the months of 1991, Roquetes, Spain,1991.

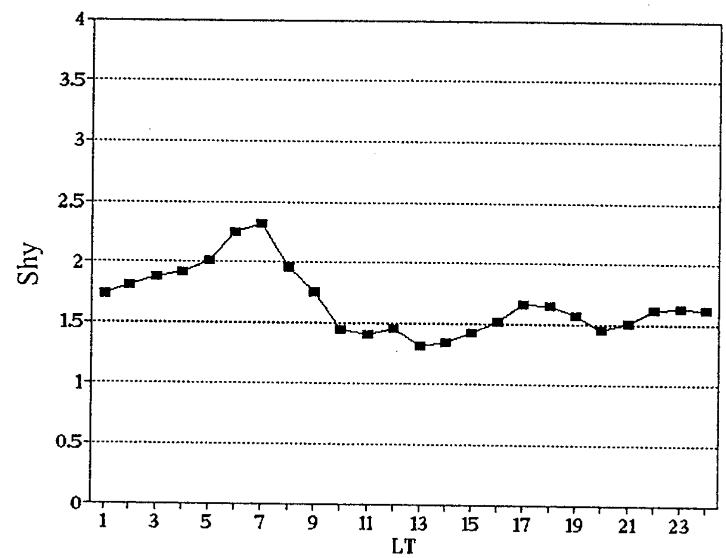


Fig. 2. Mean hour index of scattering Shy for 1991, Roquetes, Spain.

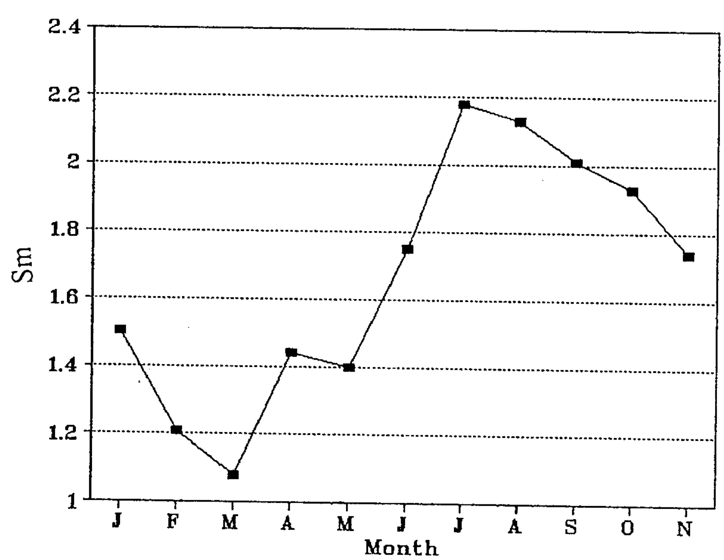


Fig. 3. Mean month index of scattering Sm, Roquetes, Spain, 1991.

Table 2. Mean month index of scattering Sm of F traces and full number Nd of strong disturbed traces (f , ff , fff , fr , r) for 1991; R-mean sunspot number, n - number of days with Σ Kp > 28 .

Month	**Dec-Jan**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**
Sm	1.50	1.21	1.08	1.44	1.40	1.75	2.18	2.13	2.01	1.93	1.74
Nd	23	5	8	15	29	53	90	63	34	30	32
R	140.6	167.9	141.9	140.0	121.3	189.7	173.7	176.3	125.3	144.1	108.2
n	6	2	9	8	10	20	11	18	11	17	15

The magnitudes of the Sh indexes also point out at the probability of F-spread occurrence. For $Sh > 1.5$ probability of F spread is rather high (see text below).

Mean hour indexes Sh for one year (Shy) and each month (Sm) are shown in Fig. 2, 3 and Table 2. It is seen that year index Shy has a maximum of the order of 2.4 in morning hours and month index Sm has a maximum in July with magnitude 2.2. Minimal very low index Sm is observed in March with magnitude 1.15. Summer and autumn indexes are the largest ones. They vary from 1.8 to 2.2.

A total number Nd of cases with strong spread (Nd is the sum of cases with letters f, ff, fff, fr, r or numbers 4, 5, 6) and mean sun spot number R for each month of the year are given in Tab. 2 with Sm indexes. Rather good correlation is seen between Sm and Nd. Some correlation between indexes Sm and spot number R is observed only for summer and autumn months with higher solar and magnetic activities, and higher scattered and spread conditions. Such good correlations between solar activity and Sm indexes do not observe for minimum scattering and spread in February and March when magnetic field was more quiet.

These results about scattered signals on the vertical ionograms are in a good accordance with the results of [37-39] where scattering conditions in the ionosphere over long distant paths were investigated.

5. OCCURRENCE OF THE F SPREAD

Mean hour probability Ps of spread-F occurrence is introduced in Table 3. Here $Ps = Nc / N$, where N is a full number of ionogram with F traces for considered hour and month, Nc is the sum of number of cases with letters c, f, ff, fff, r or points 3, 4, 5, 6,... Thus, Nc represents a number of ionograms with spread-F. It is seen from Table 3 that probability Ps changes from zero to 90 %. Most quiet months are March and February, most disturbed period is from June to September. Only two cases of F spread were observed from 09 to 23 LT for the whole March. On the contrary, F spread was

Table 3. Probability Ps = (Nc / N)×100 % , N-number of days, Nc- Number of cases c, f, ff, fff, r; Roquetes, Spain, 1991.

Hour/Mon	Dec-Jan	February	March	April	May	June	July	August	September	October	November
1	10.0	13.0	6.7	11.0	13.0	46.0	43.0	40.0	19.0	21.0	17.0
2	20.0	13.0	3.3	22.0	14.0	54.0	64.0	57.0	7.4	20.7	29.0
3	20.0	17.0	6.9	11.0	17.0	54.0	48.0	50.0	19.0	20.0	29.0
4	16.0	13.0	21.0	22.0	20.0	50.0	50.0	34.0	30.0	25.0	40.0
5	20.0	4.5	13.0	22.0	33.0	38.0	54.0	52.0	32.0	24.0	28.0
6	16.0	1.5	14.0	44.0	55.0	41.0	80.0	56.0	86.0	41.0	35.0
7	22.0	4.5	3.6	52.0	43.0	32.0	76.0	66.0	90.0	63.0	32.0
8	17.0	18.0	3.7	17.0	17.0	32.0	24.0	32.0	67.0	65.0	39.0
9	44.0	4.3	0.0	5.5	9.7	5.3	21.0	19.0	47.0	20.0	7.4
10	11.0	8.3	0.0	6.3	7.4	5.9	12.0	7.1	17.0	3.4	10.3
11	5.0	4.2	0.0	5.9	0.0	0.0	17.0	12.0	7.1	6.8	10.3
12	5.0	4.0	0.0	5.9	8.0	0.0	17.0	11.0	7.4	0.0	7.1
13	5.0	4.0	0.0	5.5	0.0	0.0	19.0	6.9	14.0	0.0	7.1
14	5.0	4.0	0.0	11.0	3.6	5.3	4.0	17.0	14.0	6.8	3.5
15	20.0	4.0	0.0	5.5	3.4	0.0	16.0	6.5	7.1	9.7	7.1
16	20.0	0.0	0.0	5.0	7.0	11.5	11.0	7.1	10.7	3.2	0.0
17	5.0	8.0	0.0	20.0	3.5	10.6	35.0	13.0	3.6	0.0	3.8
18	5.0	4.0	0.0	30.0	17.0	24.0	45.0	14.0	6.9	7.4	8.0
19	6.0	0.0	0.0	5.0	10.1	27.6	32.0	3.6	6.7	17.0	10.0
20	16.0	0.0	0.0	5.0	7.1	3.7	32.0	7.7	3.4	24.0	19.0
21	26.0	0.0	0.0	0.0	3.7	13.0	38.0	26.0	3.3	19.0	16.0
22	16.0	8.0	0.0	0.0	3.4	17.0	43.0	42.0	21.0	26.0	19.0
23	16.0	0.0	6.7	5.0	14.0	41.0	38.0	44.0	7.1	17.0	20.0
24	24.0	0.0	6.7	5.0	26.0	31.0	36.0	48.0	18.0	27.0	16.0

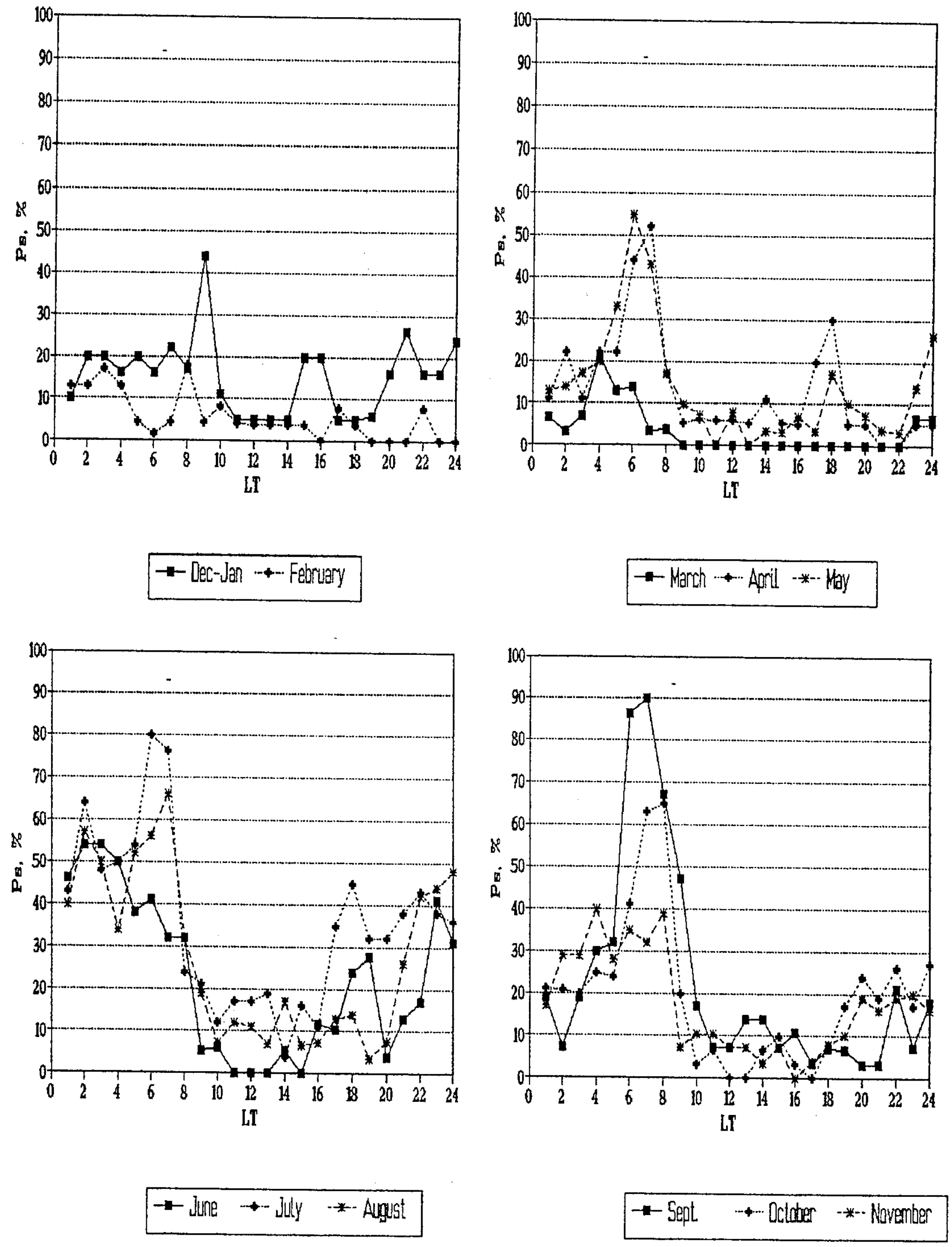


Fig. 4. Season probability Ps of spread-F occurence; Roquetes, Spain, 1991.

Table 4. Number Nd of F traces with strong spread (f , ff , fff , fr , r) ; Roquetes , Spain , 1991.

Hour\Mon	Dec-Jan	February	March	April	May	June	July	August	September	October	November	Σ
01		1		1		5	8	5		4	1	25
02				1	1	7	8	6		4	2	29
03			1	2	3	9	6	6		3	2	32
04	1	2	2	2	4	8	6	5	2	1	3	36
05	2	1	2		4	3	7	4	2		2	27
06	3	1	3	3	5	8	9	7	7	2	5	53
07	2			3	6	3	10	8	11	5		46
08	2				2	1	2	4	4	6	2	21
09	3						1	3	1		1	6
10	1						1	1			1	3
11							1	1			2	4
12								1				1
13							1		2		1	4
14				1					1	1		3
15				1					1		1	3
16									1			1
17					1		1	1	1			4
18				1	2	1	3	1			1	9
19						1	1	3				5
20	1						1				2	3
21	3					1	4	3				8
22	2						5	2		2	2	11
23	2					4	7	2			2	15
24	1					2	6	3	1	2	2	16

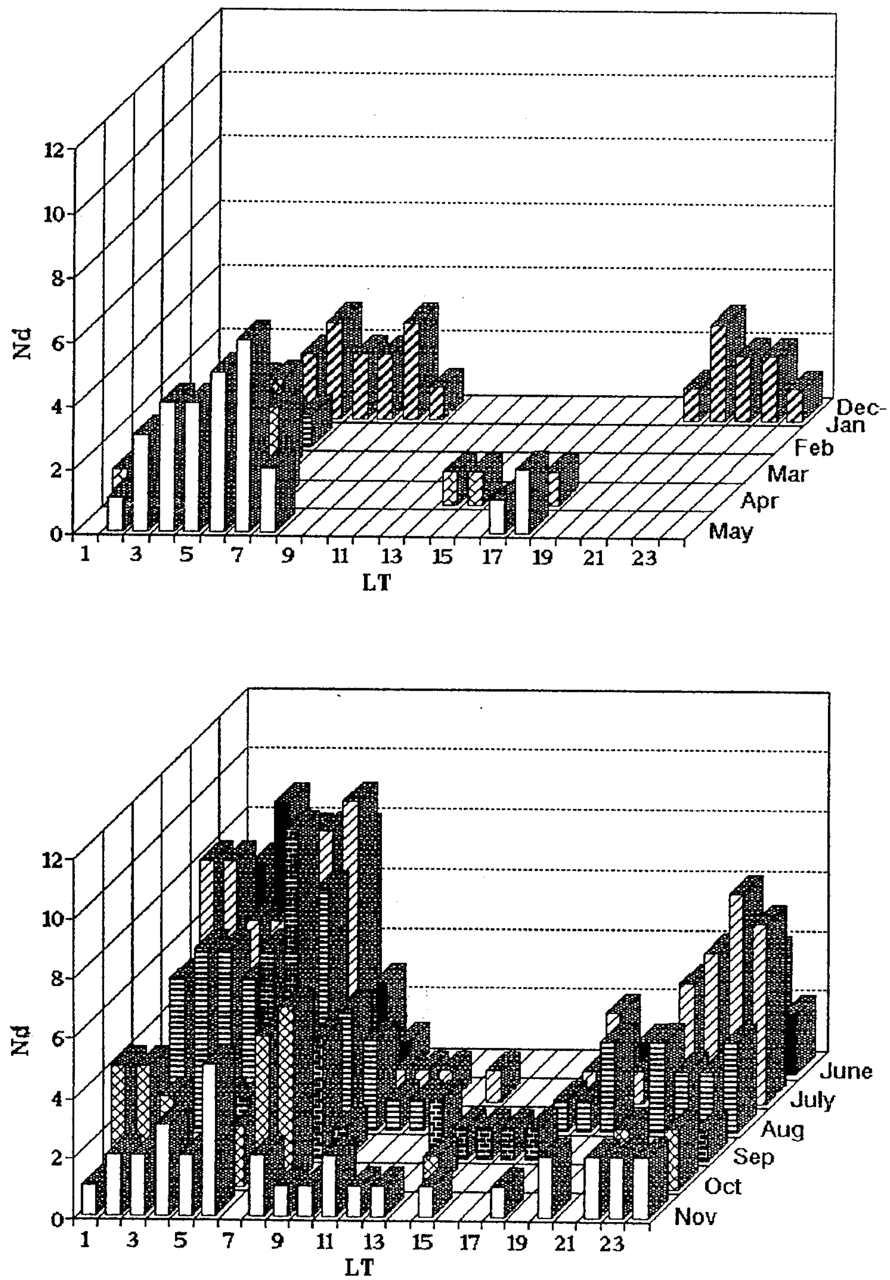


Fig. 5. Number of F traces with strong spread; Roquetes, Spain, 1991.

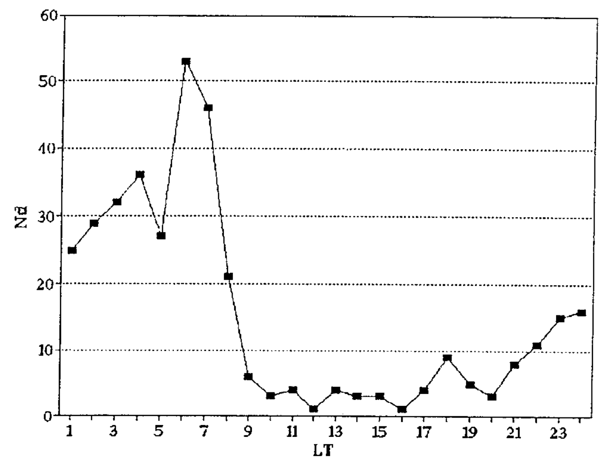


Fig6. Total number Nd of F traces with strong spread (f, ff, fff, fr, r) ; Roquetes, Spain, 1991.

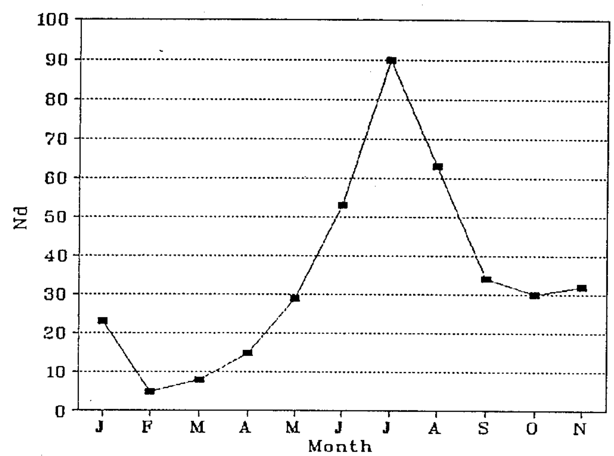


Fig.7. Full number of full disturbed traces; Roquetes, Spain, 1991.

observed very often in the morning hours from July to October with probability from 60 % to 90 %.

One can see that F spread also appears at a day-time (Fig. 3), however with low probability of the order from 5 % to 10 % and always less then 20 %. Nocturnal spread's occurrence reaches 50-60 % in summer.

Seasonal variations of F spread are very well seen in Fig. 4. They are similar to seasonal variations of Sh indexes, Fig. 1.

We discussed above the regularities of F spread, tabulated as strong (index f or r); very strong (ff or ffr); very, very strong (fff) and close to strong with index c. Because this last gradation (c or cr) is not so definite as others, below we give more trustworthy statistics of F spread, which includes only strong F spread with indexes f, ff, fff, r.

Occurrence of strong spread-F is presented in Tables 2, 4 and in Fig. 5-7. Maximum probability of strong spread is equal 13 % in July.

It is seen that the regularities of strong spread to a large extent are similar to the regularities of scattered traces, see p. 4. The main difference appears in the forms of maximums. Maximums of strong-F occurrence Nd are more sharp than the maximums of scattered signals (index Sh). The reason of this is a small number of cases with strong spread.

A number of strong spread Nd correlates rather well with the index Sh of scattered traces what is seen in Tab. 2. Lesser correlation is seen between Nd and mean month sun spot number R as well as it takes place between Sh and R.

6. EFFECT OF TERMINATOR

As it is seen from the obtained data (Fig. 1, 2, 4, 5), spread-F and scattering in F-layer reveals the strong diurnal dependence with large maximum at dawn time and sometime with not so large but noticed maximum at dusk time. To demonstrate this effect of the terminator more clear we calculated the sunrise and sunset time-moments on the

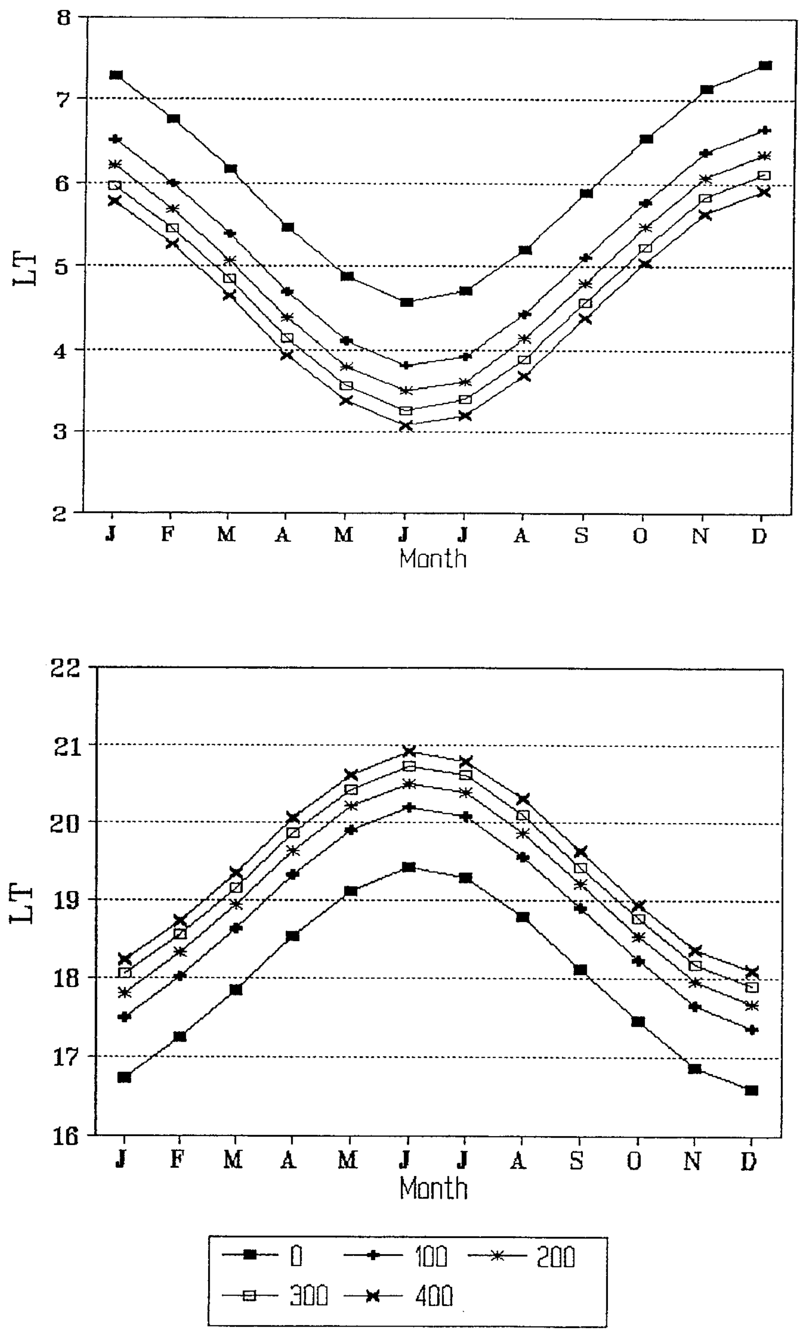


Fig. 8 . The sunrise and sunset time on the Earth and in the ionosphere at the heights 100 , 200 , 300 , 400 km ; station Roquetes , 40.8°N , 0.3°E .

Tab. 5. Mean month index **Sh** of F traces with scattered signals for night (S_N), sunrise (S_{SR}), day (S_D), and sunset (S_{SS}) periods ; station Roquetes , Spain , 1991.

	S_N	S_{SR}	S_D	S_{SS}
January	1.340	1.816	1.593	1.544
February	1.172	1.518	1.273	0.978
March	1.136	1.406	0.995	0.959
April	1.404	1.913	1.242	1.602
May	1.424	2.201	1.258	1.518
June	2.231	2.453	1.344	1.633
July	2.434	2.857	1.877	2.150
August	2.304	2.641	1.803	1.974
September	1.722	2.814	1.992	2.029
October	1.839	2.427	1.768	1.974
November	1.655	2.053	1.762	1.714

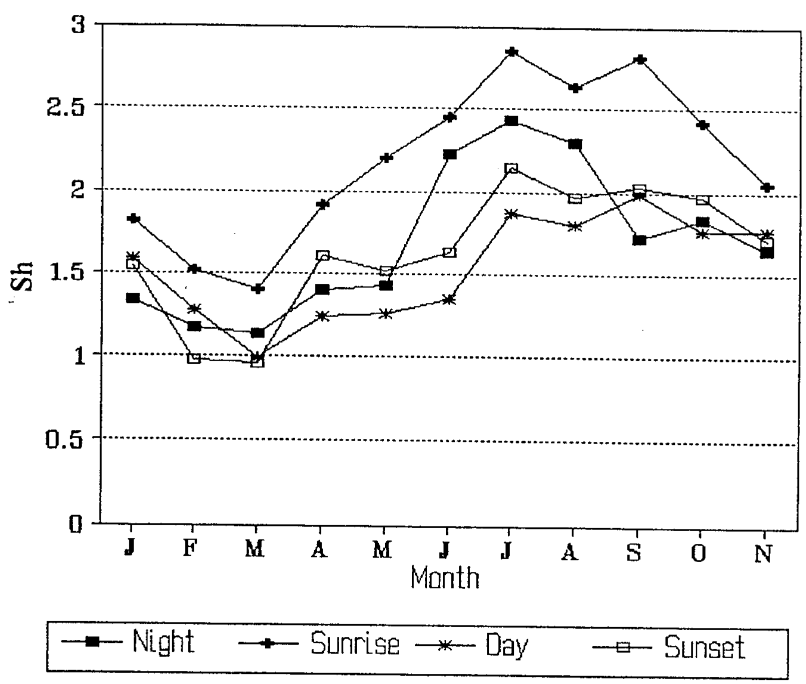


Fig . 9. Mean month index of F traces with scattered signals for night , day and twilight periods ; Roquetes , Spain , 1991.

Tab .6 . Mean month probability P_N in percent of spread echoes c , f , ff , fff , r for night (P_N), sunrise (P_{SR}) ,day (P_D) , and sunset (P_{SS}) periods ; station Roquetes , Spain , 1991.

	P_N	P_{SR}	P_D	P_{SS}
January	16.2	24.2	8.5	11.6
February	6.2	7.1	4.1	4.0
March	5.8	8.1	0.0	0.0
April	9.0	34.4	8.8	15.2
May	13.0	37.0	10.0	10.5
June	36.6	42.6	10.6	16.6
July	44.3	62.9	24.8	35.5
August	38.7	51.9	13.2	8.7
September	14.2	67.6	19.5	5.7
October	21.9	47.7	6.2	6.0
November	22.0	27.5	7.6	3.9

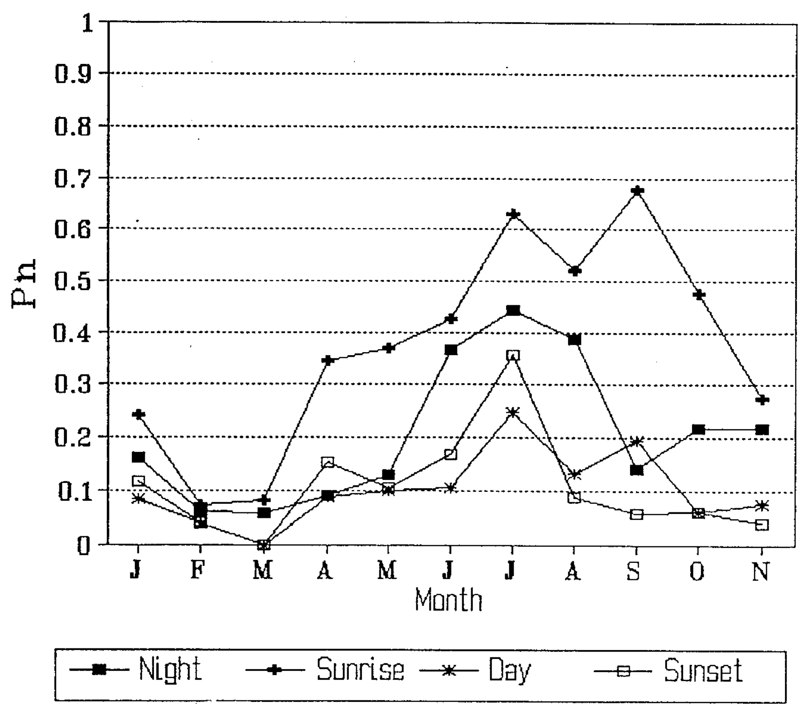


Fig. 10. Mean month probabilities of cases c, f , ff , fff , r for night , day and twilight periods ; Roquetes , Spain , 1991.

Table 7. The correlation coefficients r between Ap and spread-F indexes for 3-hour range; Roquetes, Spain, 1991.

LT	r		
	May	**August**	**October**
0-3	0.216	-0.605	0.534
3-6	0.049	-0.184	-0.194
6-9	-0.248	-0.235	-0.044
9-12	-0.199	-0.268	-0.285
12-15	0.022	0.455	-0.244
15-18	-0.189	-0.088	-0.356
18-21	-0.256	-0.295	-0.002
21-24	-0.165	-0.297	-0.092

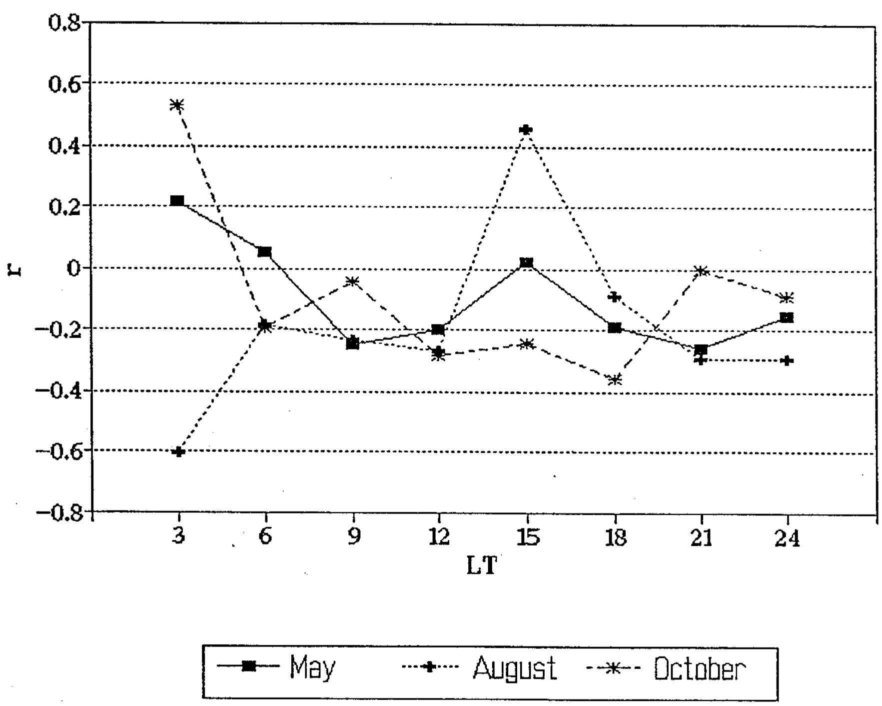


Fig. 11. The correlation coefficients r between Ap and spread-F indexes; Roquetes, Spain, 1991.

Table 8. Month correlation coefficients r between Ap and spread-F indexes; Roquetes, Spain, 1991.

May	**August**	**October**
-0.083	-0.163	-0.029

Table 9. The correlation coefficients r between Ap and spread-F indexes; Roquetes, Spain, 1991.

May		August		October	
day	r	day	r	day	r
2 +□Δ	-0.405	1 +□Δ	-0.004	1 +□	0.457
3 •□Δ	0.496	2 +□	0.536	4 +□Δ	0.143
6	0.546	4 +□Δ	0.008	6 •□Δ	-0.183
7	0.192	9 □	-0.551	7 +□Δ	-0.023
10 •□	-0.241	13 □	0122	8 +□Δ	0.190
11 □Δ	-0.560	15 +□	-0.543	9 •□Δ	-0.504
12 □Δ	0.464	17 +□Δ	-0.272	11 •□Δ	-0.288
14 +□	-0.156	18 □Δ	0.096	12 □	0.363
15 □	-0.317	19 +□	-0.566	13 □	-0.269
17 +	-0.288	23 •□Δ	0.288	14 □	0.060
18	-0.493	24 □Δ	0.469	16 □	0.527
20 □Δ	0.108	25 □	0.486	17 □	-0.520
22 +□Δ	0.270	26 •□Δ	-0.050	21 +□	0.093
23 +□	-0.341	27 •□Δ	-0.480	22 +□	0.418
27 +□Δ	0.487	28 •□Δ	0.507	23 •	-0.322
28 +□Δ	-0.129	30 +□	-0.427	24 +□	-0.173
30 •□Δ	-0.298			25 +□	-0.078
				30 +□Δ	-0.648
				31 +□Δ	-0.352

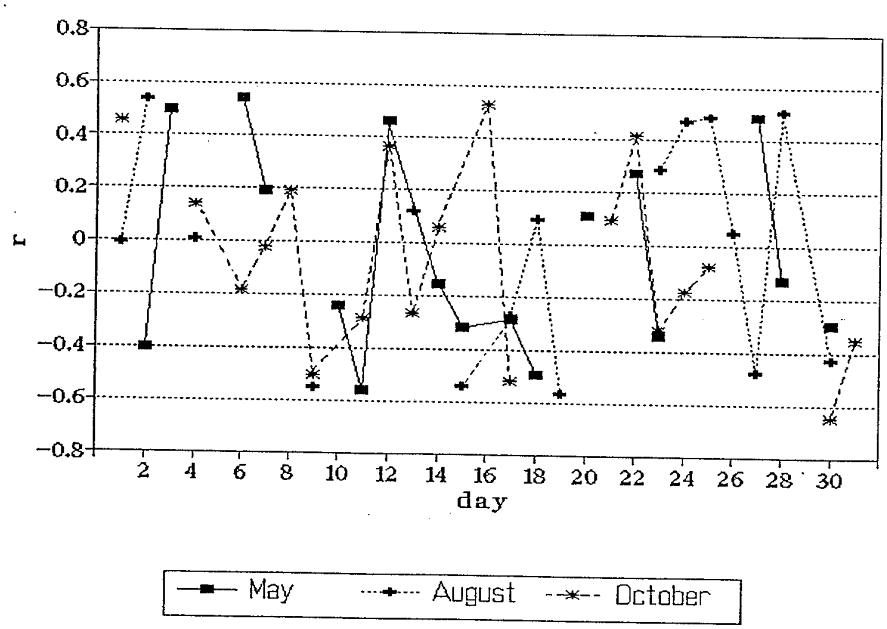


Fig. 12. The correlation coefficients r between Ap and spread-F indexes during three months 1991; Roquetes, Spain, 1991.

Earth and in the ionosphere for Roquetes, Fig. 8. After this we averaged hour indexes of scattering Sh around the sunset and sunrise time and during the day and night hours.

The main indexes Sh for these four periods of time (Sss and Ssr are sunset and sunrise periods, Sd and Sn - day and night periods) are shown in Table 5 and Fig. 9. Sunrise indexes were averaged for 3 hours after sunrise at the height 200 km in the ionosphere, sunset indexes -- for 2 hours before sunset at 200 km. For finding main indexes, intermedium points have been deduced by the spline interpolation of Sh-points with hourly intervals.

It is seen from Fig. 9 and Table 5 that sunrise terminator generates waves and irregularities in the ionosphere and produces F-spread and scattered signals on the ionograms. Main sunrise indexes Ssr are maximum indexes during all months of 1991. Day-time indexes Sd are minimum indexes from April to August. All four indexes are separated from each other in summer. Night indexes Shn are less than sunrise indexes and larger than sunset indexes. Day, night and sunset indexes are mixed in other months and only sunrise indexes always separate from others.

Main probability Pn of the spread echoes with indexes c, f, ff, fff, r for the same night (Pn), sunrise (Psr), day (Pd), and sunset (Pss) periods is presented in Table 6 and in Fig. 10. It has the same regularities as Sh index, Tab. 5 and Fig. 9.

The influence of the terminator on the generation of different size waves and irregularities in the ionosphere has been studied theoretically and experimentally in [40-45].

Our results conform a dramatic impact of terminator on the condition of the ionosphere: the scattering processes are increasing during twilight periods. Sunrise effect of terminator in the most illuminated ionosphere (summer) with many magnetic storms and substorms (also summer period) leads to the spread-F occurrence with a probability in 70-80 %.

The regularities of the index of scattering in the ionosphere and the F-spread appearance are consistent with the results of [37-39].

Table 10. The dates of magnetic storms with $D_{st} \leq -100$ and $-100 > D_{st} \leq -50$ and F spread with indexes c,f,ff,fff, and B.

Month	$D_{st} \leq -100$	$-100 < D_{st} \leq -50$	F spread
January			1-20 data absent 21-23(c) 25(c,f) 26-30(c)
February		1-2	1-2, 4,8,11- 13,17-19, 21,23(c) 20(f) 25(f) 27(c,f,ff)
March	24-27	5 9-10 13 24-28 30	1,7(c) 10(f) 12-13(c,f) 24-26(c,f,ff,fff) 28-29(c,f)
April	29	1-5 27-30	2-4,17-19, 21-22 data absent 5-6,7,8-10(c) 13(c,f,B) 20(fr,B) 23-30(c,f,ff,fff)
May	17	1-2, 14, 17 25, 31	1-5(c,f,rf) 8-31(c,f,r,fr,B)
June	5-6 10-11 13-14	1-7, 9-14 18-19, 23-24 30	1-30(c,f,ff,fff,B)

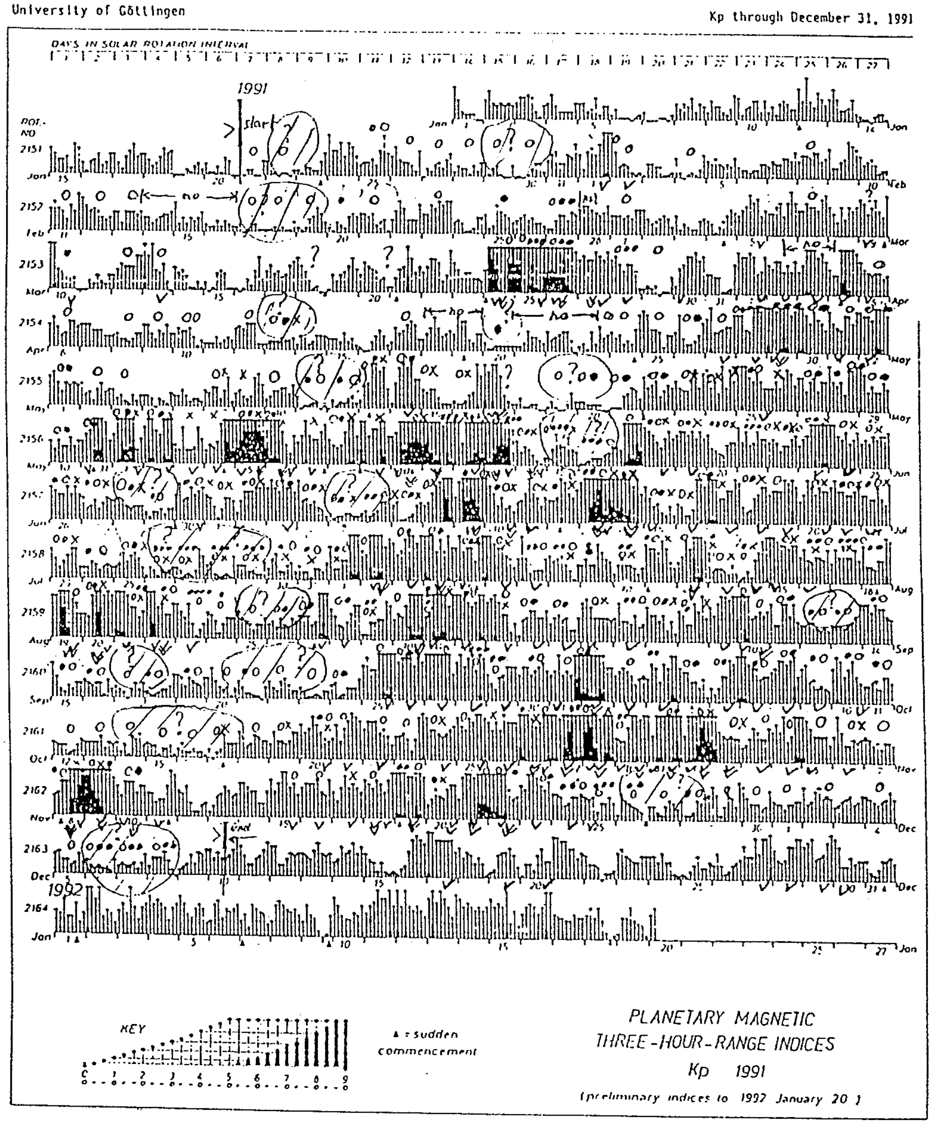
Extention of Table 10

July	9-10 13-15	3 9-11 13-22	1-31(c,f,ff,fff, B)
August	2 4 12 19-21 22 30	2-7 4 12-16 19-23 27-28 30-31	1-31(c,f,ff,fff, B)
September	10	1-6 9-10 25-29	1-30(c,f,ff,fff, B)
October	1-2 27-31	1-4 6-10 20-22 24-31	1-31(c,f,ff, B)
November	1-2 8-10 18-22	1-6 8-11 15-25	1-10(c,f, B) 15-30(c,f,ff,fff,B)
December		17 19-20 27-30	data 1-10 1-8(c,f,ff, B)

PLANETARY 3-HOUR-RANGE INDICES (Kp) BY 27-DAY SOLAR ROTATION INTERVAL

University of Göttingen

Kp through December 31, 1991



|←no→|- no data

O - c (2)
• - f (3)
•• - ff (4)
••• - fff (5)

X - B, W

V $100 > |Dst| \geq +50$, $|Dst|_{max} \approx 50 \div 90$
V̈ $|Dst| \geq +100$, $|Dst|_{max} \geq 100$

Fig. 13

7. CONNECTION WITH MAGNETIC ACTIVITY

The connection of F spread with magnetic activity during the year considered was investigated. In this analysis we used Kp, Ap and Dst indexes which characterize the Earth's magnetic activity.

a) Correlations of Ap, Kp and spread-F indexes

Because we used for correlation's calculations 3-hour indexes Ap, we prepared similar 3-hour Sh indexes for F spread. They are provided in Tables 12-14 in APPENDIX for three months -- May, August and October. The days with an absent of the hourly ionograms even for one hour were not considered (zeros in Tab. 12-14). We gave in this performance to the normal traces instead zero Sh indexes, indexes equal to 0.2.

The correlation's coefficients r between 3-hour Ap and Sh spread-F indexes for May, August and October for every 3-hour period are presented in Table 7 and Fig. 11. One can see that r changes from -0.6 to 0.6. The most number of time-intervals has correlation's coefficients close to 0 except intervals from 0 LT to 3 LT and from 12 LT to 15 LT.

Month main correlation's coefficients for May, August and October are given in Tab. 8. It is seen that they are small and negative.

These data show that there are no correlation's connections between F spread and indexes Ap for the period in one month as well, as for 3-hour periods in the most cases.

Correlation for particular days in May, August and October is shown in Tab. 9 and Fig. 12. Symbols plus and points in Tab. 9 in the column with day's numbers point out accordingly or to the days with Kp > 3 for all hours (pluses), or to the days with Kp ≈ 3 for some hours and Kp > 3 for the last hours of a day (points). Days with no symbols have Kp less than 3 during all hours of these day-nights (quiet days). Days with not strong spread in Tab. 9 are marked off by squares and with strong spread -- by triangles.

These results clearly demonstrate that the day's correlations during every month have quasi-oscillatory character with the periods of variation from plus to minus equal approximately from 2 to 4 days. This fact explains very small correlation's values for the time-periods in one month (Tab. 8). Data in Tab. 9 point out to very low connections between the value of Ap indexes and spread: correlations do not change while Ap is large. A large number of spread correlates with dawn, night or dusk time but does not correlate usually with the value of planetary magnetic index Kp. Nevertheless, some noticed correlation between numbers of strong spread cases (Nd) and days (n) with strong magnetic disturbances with Σ Kp > 28 takes place (see Table 2).

b) Dst and spread-F indexes

Dates for every month of 1991 with ring current disturbances are assigned in Tab. 10. The ring current commitments are divided in two categories -- with maximum indexes of ring current $|Dst|_{max}$ (absolute value) for the commitment reached not less than 100 nT and not less than 50 nT. These categories characterize two types of growth phase of ring current and accordingly magnetic storms --strong and not very strong types. The dates with spread-F and blackouts, and F spread indexes also present in this Table. It is seen that all days with high $|Dst|$ ($|Dst| \geq 100$) agree with the dates with spread-F but not all dates with less $|D_{st}|$ ($50 \leq |Dst| < 100$) follow by F spread. In the same time, F-spread appears more often than the strong disturbances of ring current, what is seen in Tab. 10.

c) Annual appearance of spread-F in connection with the variations of Kp and Dst indexes

We plotted F-spread indexes', blackouts' (see below p. 9) and high Dst indexes' data on the standard map with planetary 3-hour Kp indexes for 1991. All designations are shown on this map (Fig. 13). Studying these data together one can assume that a connection of spread-F with magnetic disturbances is not stable and not certain.

The most surprising effect is the appearance of spread during very quiet periods with duration in many days and with $Kp < 3$ and $|Dst| < 20$ or 30. Such periods were practically observed during every month. They are enclosed in circles and shaded in Fig. 13. It seems that seasons of a year, night-time or terminator produce larger and more determined effects on the spread-F occurrence than magnetic disturbances.

8. ANALYSIS OF MAGNETIC STORM OF 24-26 MARCH 1991

We treat in this paragraph the variations of ionospheric parameters and spread-F during the great magnetic storm of 24-26 March 1991. This magnetic storm started with sudden commencement at 05 UT on the night of March 24. The 3-hour Kp indexes during all period from the start to the end of March 26 were among 5 and 9. They were of the order from 3 to 4 on March 27 and 28, and the 29 March was very quiet day with Kp not more than 1. The Dst index was low till March 24 at 05 UT with main index for March 23 equal to -12. On March 24 and 25 this index reached -200 ÷ -300. It became a bit less on March 26 -- in range of -100 ÷ -150, and on March 27 -- in range of -70 ÷ -100. The Dst index went down to -40 ÷ -75 on March 27 and 28, and to -25 ÷ -40 on March 29.

The ARTIST's ionospheric parameters foF2 and hmF2, h'F and h'F2, or interpolated their values (mark ^ in Tab.) when the ARTIST gives these parameters with errors, are presented in Tables 15-19 in APPENDIX. The frequencies fpF2 = 0.834 foF2 and the heights hpF2 (0.834 fpF2) are given in the same Tables for the cases when ARTIST does not output the profile of electron concentration and the maximum height hmF2 of the F2-layer. We notice that we tried to get maximum heights of F2-layer for these cases using the methods of [45] and [46]. However, the differences between hpF2 (0.834 foF2), maximum heights, received according the formulas from [45], [46], and

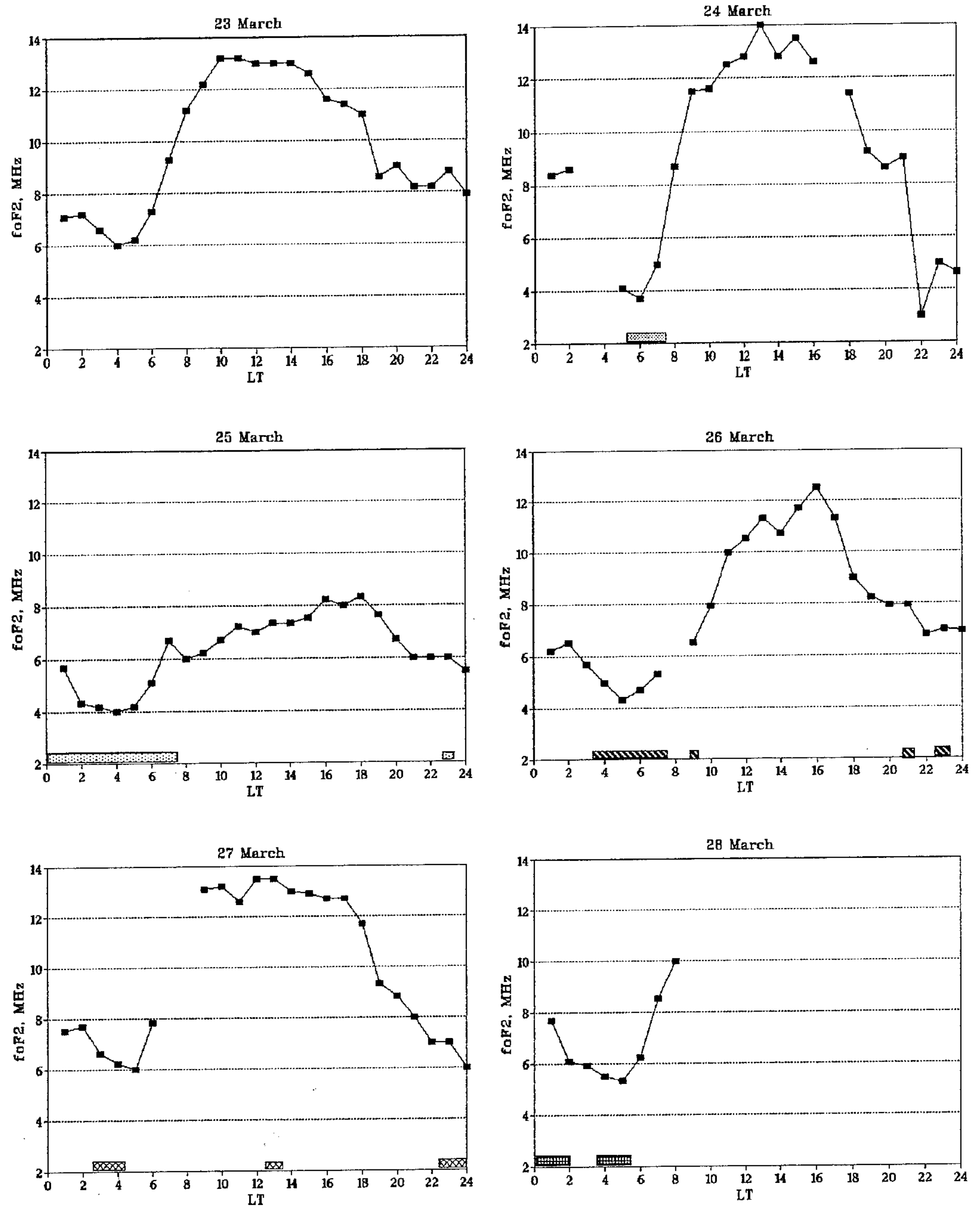


Fig. 14. Critical frequencies foF2 observed at the ionospheric station Roquetes, Spain , 23-28 March 1991.
The bars on the X-axis are symbols of the spread-F .

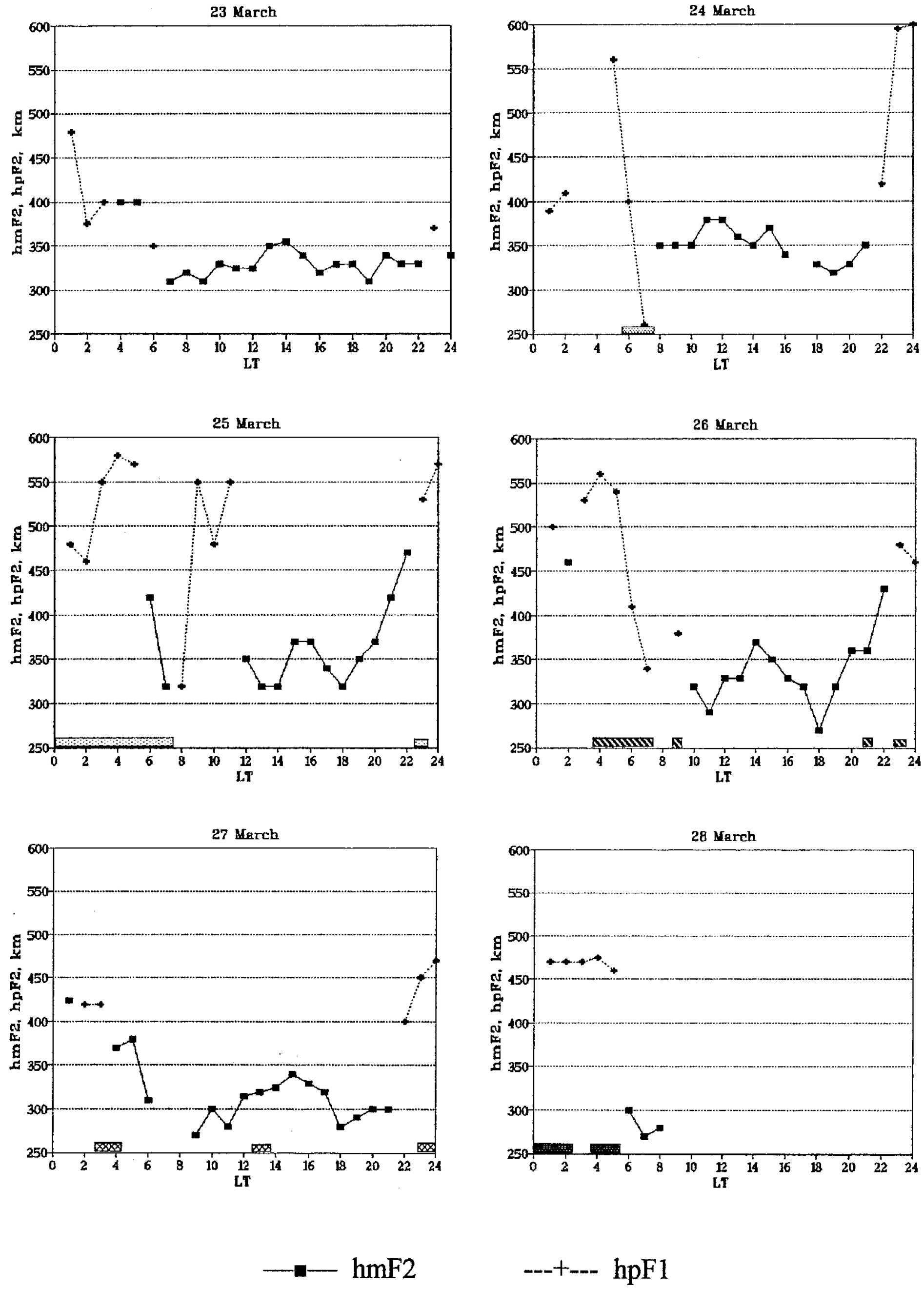


Fig. 15. Maximum heights hmF, hpF2 observed at the ionosheric station Roquetes, Spain, 23 - 28 March 1991. The bars on the X-axis are symbols of the spread-F.

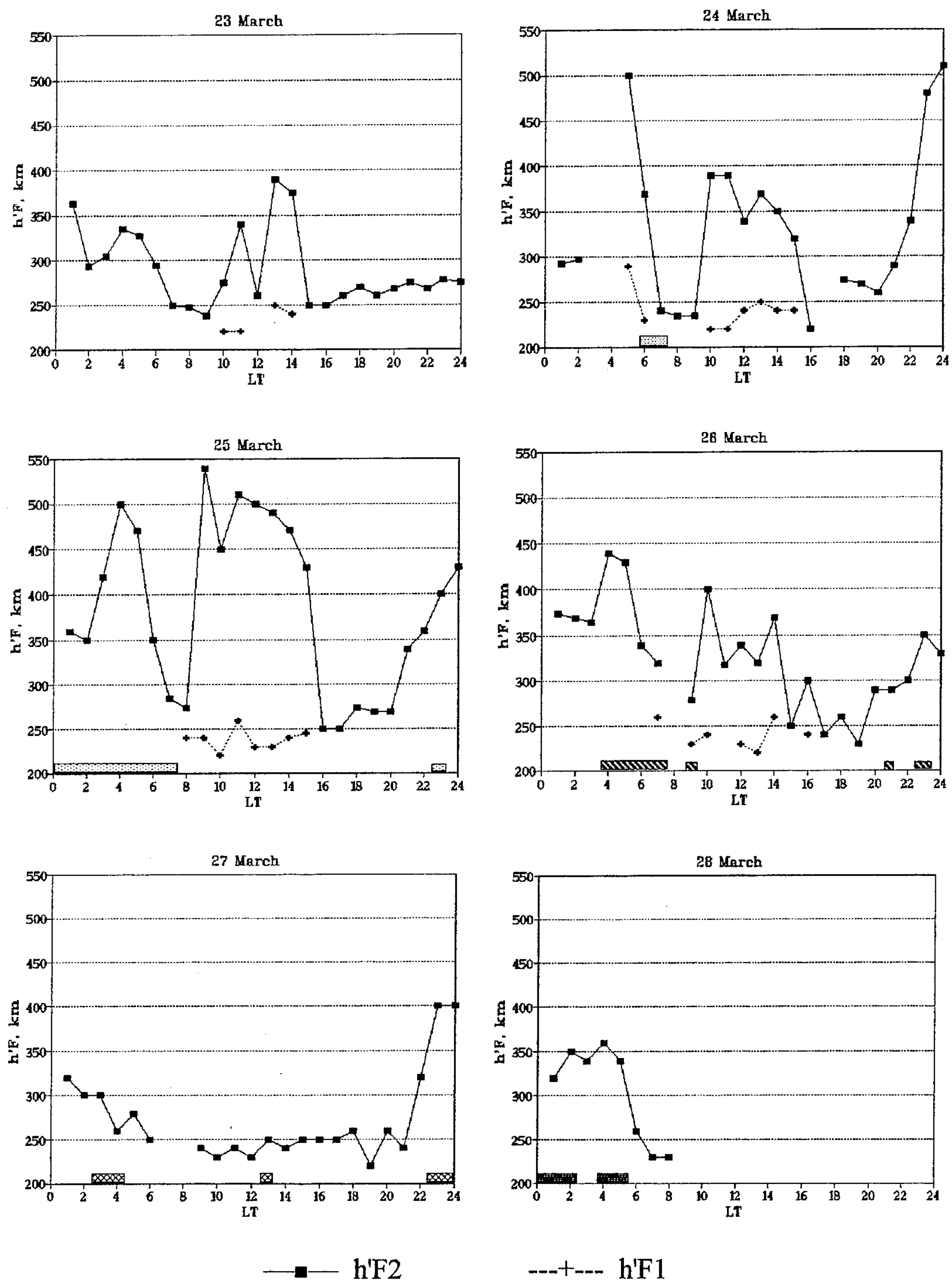


Fig. 16. Minimum heights h'F observed at the ionosheric station Roquetes, Spain, 23 - 28 March 1991. The bars on the X-axis are symbols of the spread-F.

hmF2 (ARTIST) were always very large (until 100 km). That is why, we decided to leave in the Tables 15-20 only the hpF2 values that were recommended in [36] as approximate height for hmF2. The minimum virtual heights h'F and h'F2 also are given in Tab. 15-19.

The variations of all parameters for 23-28 March 1991 are assigned in Fig. 14-16.

The presence of F spread is shown in Tables 15-19 (APPENDIX) by the letter f and in Figures 14-16 by bars.

It is seen from Tab. 15-19 from APPENDIX and Fig. 14-16 that the 23 March was ordinary day. Daily variation of foF2 for this day was close to main variation for all month, Fig. 10, APPENDIX. Some unusual variations of parameters started in the morning of 24 March and continued until 28 March. The decrease of foF2 values on 1-2 MHz and the increase of hmF2 approximately on 70 $\div$ 100 km started in the morning hours immediately after sudden commencement. The variations of the parameters were less at day-time but in the evening and night time they were larger than in the morning.

The most disturbed day in ionospheric parameters was the 25 March. The same depletion of foF2 continued during all 25 March. Decrease of foF2 reached 4-5 MHz during day-time. Variations of hmF2, hpF2, h'F1 and h'F2 were very irregular. Maximum heights reached 500 $\div$ 550 km. The depletion of critical frequencies was less on March 26. All parameters were close to normal on March 27. Only F-spread with less intensity than in previous days have still presented as before.

Weak spread-F (index c) appeared at once after sudden commencement at 05 LT on March 24 and continued with larger intensity from 00 LT to 07 LT on March 25 (subsequent indexes c, c, f, fff, f, c) and on March 26 from 04 LT to 07 LT with indexes c, ff, ff, c and at 09 LT with index c. Spread-F appeared next day only with index c at 03, 13 and 23 LT. It continued to present on March 28 at night and morning hours with larger intensity (indexes c, c, f, c at 01, 02, 04, 05 LT) when magnetic field and ionospheric parameters were rather close to normal.

This storm was reasonable strong and isolated among very quite days before and after disturbed days. It produced significant variations in the ionospheric plasma. However, it is the only one event with such tremendous variations in the ionosphere for the whole 1991 observed at the station Roquetes.

9. BLACKOUTS

It follows from Tab. 1-11 (APPENDIX) that many ionograms do not have at all radio signals reflected from the ionosphere (letter B in the Tables) or these signals are very week (letter W).

A statistics of such cases with lacking traces is presented in Tab. 11 and Fig. 17. It is seen that such events (we will refer to them as "blackouts") take place usually during summer and noon times. In the same time blackouts also appear during other seasons and during morning, evening and night hours but with less probability. There is even the second maximum of blackout occurrences in evening time at 18-20 hours, Tab. 11.

Looking through data in Tab. 1-11 one can see that blackouts, observed in non day-time, appear usually with spread: before, in the middle or after spread-F. It is seen also that blackouts do not appear in rather quiet magnetic period from December to April (see Tab. 2 and Tab. 11). They appear most frequently during the most disturbed period from May to September.

In response to these facts we can conclude that generally blackouts are connected with collision absorption in D and E regions that increases at most illuminated day time-periods in summer solstice, and with the sensitivity limitation of the receiver. Thus, maximum of blackout's occurrences reaches 18 for July at 11 LT, Tab. 11. In the same time they could relate to magnetic disturbances, solar flares and even to terminator. Additional losses of energy because of scattering of radio waves on the irregularities and waves in disturbed ionosphere, may lead to these blackout events. However, these connections require more thorough investigation.

Table 11. Number Na of ionograms with full absorbtion (-B , -W) ; Roquetes , Spain ,1991 .

Hour/Mon	Dec-Jan	February	March	April	May	June	July	August	September	October	November	Σ
01						2					1	3
02						2					1	3
03						2					1	3
04						3	1			1		5
05							1					1
06						1		2	1	1		5
07						3	1	1				5
08					1	6	6	1				14
09						9	11	2		1	1	24
10					1	12	13	2			2	30
11					1	7	18	5	1			32
12					5	12	6	4	2		2	31
13					6	9	9	2	1			27
14			1		2	9	4	1	1			18
15					1	5	5		1			12
16						2	2	2				6
17					1	1	4		1		1	8
18		1				1	1	2	1	3	2	10
19	1					1	1	2		4	2	10
20					1	2	4	4	1	1		12
21					1		2	3				6
22						1	1	4				6
23					1	1		2		2		6
24					1	1	1	1			1	5

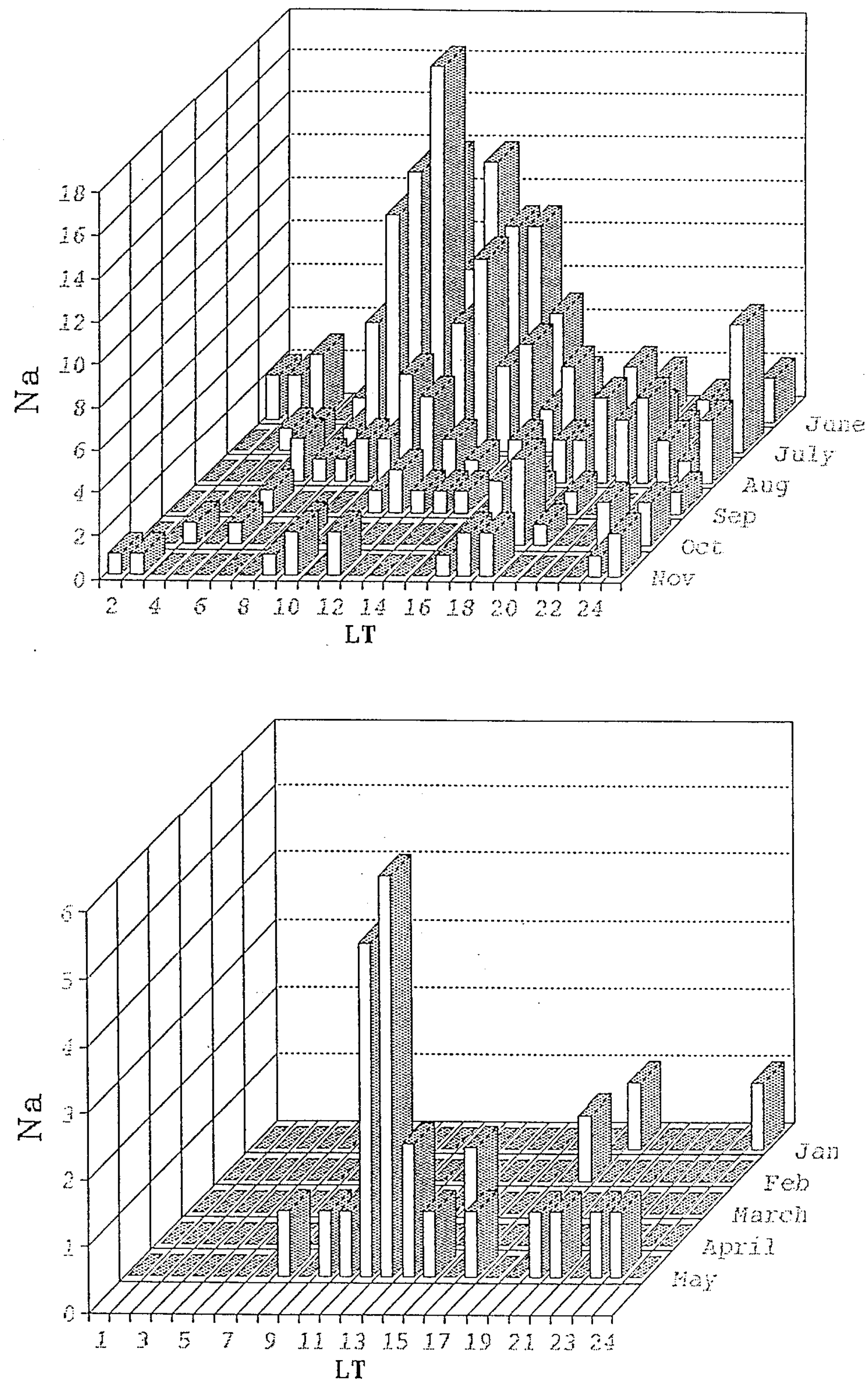


Fig.**17**. Number of ionograms with full absorbtion ;
Roquetes, Spaine , 1991 .

II. COMPARISON OF THE IRI PARAMETERS WITH MEASURED IONOSPHERIC PARAMETERS

The results of a comparison of the International Reference Ionosphere model (IRI-90) with measured ionospheric parameters at three vertical sounding stations with Digisondes (Dourbes, Belgium; Rome, Italy; and Roquetes, Spain) have been reported in the 1th Interim Report, Sep.-Nov. 1994, submitted at the 30th COSPAR Scientific Assembly, Hamburg, 1994, and represented in the paper

1. H. Soicher, F. Gorman, E. E. Tsedilina and O. V. Weitsman, Comparison of the IRI-90 with measured ionospheric parameters at midlatitudes, Adv. Space Res., 16, No 1, (1)129-(1)132, 1995.

A reader can be acquainted with the results of this work through these sources.

General conclusion of the sources mentioned above is that the IRI-90 represents averaged measured principal parameters of F and E layers at midlatitudes with good accuracy.

III. CONCLUSIONS AND RECOMMENDATIONS

During this work we produced:

1. Updated software created for viewing and printing ionograms, written in ARTIST [11] format.
2. Processing approximately 9000 ionograms with hourly intervals for one year of high solar activity.
3. The method of numerical description of the F trace state on the ionograms and theirs scattered conditions in the ionosphere.

4. Hour, month and year indexes characterizing scattered and disturbed conditions of F traces and F spread occurrences for one year of 1991.
5. Diurnal, seasonal and month probability of spread-F occurrences
6. Probability of strong spread-F occurrence.
7. Effect of terminator on scattering and spread-F.
8. Connection spread-F with magnetic activity.
9. Analysis of ionosphere parameters during great magnetic storm of 24-26 March 1991.
10. Blackout evens for one year.
11. Setting in motion the IRI-90 model..
12. Comparison of IRI-parameters with measured parameters at midlatitudinal vertical sounding stations.

CONCLUSIONS

1. Diurnal maximum of scattering and spread-F occurrence in F-region is observed in sunrise period during all 1991. Probability of F spread reaches 70 % or 90 % in summer's dawns.

2. Daily occurrence of spread-F is less than 20 %, nocturnal occurrence reaches 50 ÷ 60 %.

3. Seasonal maximum of scattering and spread-F is exhibited in summer from June to August.

4. Index of scattering is maximum at dawns during all the year.

5. Maximum probability of strong spread-F in July is equal 13 %.

6. Correlation between F spread indexes and magnetic Ap indexes for the periods in one month is negligible small.

7. Subsequent correlation between F spread and Ap indexes for one day-night period during every month has quasi-oscillatory character and changes approximately from -0.6 to 0.6 with a period from 2 to 4 days.

8. During more quiet period from December to May index of scattering and a number of strong spread-F cases were significantly less than during more disturbed period from June to November.

9. Spread-F is observed both during disturbed periods and during very quit periods with Kp < 3 and Dst > -30.

10. Spread-F appeared in morning hours immediately after onset of great magnetic storm of 24-26 March 1991 with big depletion in the ionosphere. It continued to appear in morning and night hours with bigger intensity on 25 and 26 March and two days after the end of the magnetic storm.

11. Most blackout effects take place during summer and day hours.

12. Some blackouts are connected with spread-F occurrences.

13. The IRI-90 model represents averaged principal parameters of F2 and E layers at midlatitudes with rather good accuracy.

RECOMMENDATIONS

This work could be continued in many directions. First of all, it would be interesting to investigate the spread in E-layer (E and Es). An opinion exists that F spread and E spread appear together if E or Es are observed in the time considered. In the same time we do not know the results of such investigations. Our studies have shown that F spread and E spread not always appear in the same time. The subject of E and Es spread in conception with F spread require more detailed examination.

Blackout events should be studied more comprehensively. It would be important to establish the relationship between blackout events and geophysical parameters such as sun radiation, magnetic activity, absorbtion.

Further, it would be interesting to compare the results, obtained in Spain, with other available data about spread, scintillations and irregularities' observations for the same time-period at European continent and at midlatitudes.

In conclusion it may be said that the problem of appearance of spread and scintillations at midlatitudes is far beyond its understanding. It is necessary to develop the theory of irregularities in midlatitude ionosphere and scattering of the radio waves by acoustic-gravity waves and irregularities in the ionosphere.

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V. APPENDIX

Tabl. 1. Febryary 1991 Scattering

day \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
P_s	0,043			0,087	0,045	0,045																		
	1		N_s	2	1	1																		
1	cc	c	c	cc			cc	ccc 6-10	cc 7-12	cc 11-13	ccc		cc	cc	cc 7-11				ccc		cc f0	cc f0	ccc	
2	cc	c	cc 2-4			ccc	ccc	ccc	cc 7-11	cc 8-10	cc 7-12	cc	ccc	ccc 8-12		A ccc 7-11	A ccc	A A	cccA			—	—	—
3	—	—	—	—	—	—	—	—	ccc			cc 12-13							ccc					ccc
4	ccc		ccc	c 3-5	ccc	cc 3-5	cc 4-6	cc 6-9	cc 11	ccc	—	ccc 7-12	ccc 7-12		ccc 7-12	ccc 8-11 A	cc 8-9 A	A	cc 7-8	ccc		ccc	ccc	
5				ccc	ccc	ccc	ccc			ccc 7-11	ccc					A	A	ccc 6-13	ccc	ccc		ccc		ccc
6	ccc	cc	cc 4-5	cc 3-5	ccc		ccc	ccc 6-10	ccc 6-11			ccc	cc 8-10	ccc 8-10	ccc 8-11		ccc 7-9	A	ccc	cc		ccc		
7	cc	ccc	ccc	cc	ccc	cc	cc	ccc	ccc 7-11		ccc 7-12	ccc	cc 10-12	cc 10-12	cc 8-11	cc A	A	A	ccc	ccc	ccc			cc
8	ccc	ccc	ccc	ccc	ccc		cc	cc	c f c f	c	c	cc 10-12	c	cc	cc 8-12	cc	c A		cc	cc	cc f0	c/0		
9		cc	cc	cc	ccc				cc 7-11	cc	cc	ccc	cc 8-11		cc 6-10				ccc		ccc			
10		cc f0	cc f0	cc f0	ccc		cc f0	ccc 7-10	ccc 7-10	ccc 7-10		cc 11-12	ccc 11-12		ccc 7-12	ccc 7-11	ccc 7-9	cc 7-9	cc 7-9	cc 5-8		ccc f0		ff
11		ccc	cc 4-5		cc 3-4	cc 2-4	cc	c	c	c	cc	c	cc	cc	cc 7 f0	ccc	ccc A	ccc 6-7	ccc 4-7	ccc 7-8	cc			
12	c		cc	ccc	—	—	—		—					c A	c	cc	cc	ccc	cc	ccc	cc		cc	cc
13		cc	cc	cc	cc		ccc	c A	cc A	cc	cc	cc	ccc	cc	cc A	cc A	A	A	cc		—	ccc	ccc	ccc
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	c	ccc	ccc A	ccc	cc	cc	cc	cc	cc 7-10	A	ccc	ccc	ccc	cc	cc	cc	c	c A	cc A	cc A	cc	cc	cc	ccc
18	ccc	c	cc	cc	cc	ccc	cc	cc	ccc		A	cc	ccc		—	ccc 7-11	A	A	ccc A	cc 5-7	cccA	ccc A		
19	cc	cc	cc	cc	ccc		cc	c	ccc	ccc	ccc	ccc		ccc	cc	cc	ccc	cc	cc A			cc	cc	cc f0
20		ccc		f	ccc	ccc	cc f0	cc	cc	ccc	cc	ccc		ccc		cc	A	A	cc	cc	cccA	cc 4-6	cc	
21	cc		c	ccc	cc	cc	ccc	c	cc	cc	ccc	ccc	ccc	ccc	ccc	cccA	ccc	ccc	H	cccA	cccA	c	ccc	
22					ccc	ccc	cc	cc	cc	cc		cc 8-11	cc	cc A	ccc	cc	cc	cc	ccc	cc	A	ccc	ccc	
23	cc	cc	c	ccc	cc	ccc	cc	cc	cc	cc	ccc	ccc	ccc	ccc	ccc	cccA	cc	ccc	cccA	cc A	cc A	ccc	cc	cc
24	cc		ccc		cc	ccc	cc 7-9	cc	ccc	cc	cc	cc	ccc	ccc	ccc	ccc	cccA	— B	cc A	cc	ccc	cc	ccc	cc
25	f	ccc	cc	cc	cc	cc	cc	cc 7-9	ccc	cc	cc	cc	cc	cc	cc	cc	cc A	— T	cccA	ccc	ccc		ccc	ccc
26	cc	ccc	ccc	cc	cc	cc	cc	cc	cc	ccc	ccc		ccc	ccc	ccc	ccc	cc	cccA	cccA	cccA	ccc	ccc	ccc	ccc
27	cc	cc	c	f	f	f	c f	cc A	cc f	ccc f		ccc	ccc	cc	cc	cc	ccc	ccc	ccc	ccc	ccc	ccc	cc	
28	—	—	—	—	—	—	—	—	—	ccc	cc	cc	cc	cc		cc	ccc	ccc	ccc	ccc	ccc	ccc		
29	4+6+	9+14	12+20	6+3	5+16	8+14	3+28	10+22	3+26	6+16	3+16	3+20	3+16	3+20	3+16	24+	6+10	3+4	18+	18+	10+	6+10	12	10+
30	18+4	+7	6	18+6	6	+7	+5	+5	8	9	8	9	+11	8	10	8	10	+8	15	+10	10	11	8	6
P_i	1.39	1.30	1.65	1.43	1.23	1.44	1.64	1.74	1.64	1.29	1.12	1.28	1.2	1.44	1.16	1.28	1.04	0.6	1.32	1.12	0.83	1.12	0.83	0.67
ΣN	23	23	23	23	22	22	22	22	23	24	24	25	25	25	25	25	25	25	25	25	24	24	24	24
ΣK_i	32	30	38	33	27	25	36	39	37	31	27	32	30	31	29	32	26	15	33	28	20	27	20	16

days with 2 Strong S

ff - very strong
f - strong
c - not str.
cc - low
ccc - very low
— absent
clean -
- normal

ccc - 1
cc - 2
c - 3
f - 4
ff - 5
fff - 6

$P_m = \frac{29.13}{24} = 1.21$

$N_m = 5$

Tables 1-11. Data of the ionogram processing in evaluated indexes. Circled are hours with F spread (indexes c, f, ff, fff, cr, fr, r).

Tabl. 2 March 1991 Scott

d \ h	01	02	03	04	05	06	07	08	09	10	11	12
1		ccc	cfo	cf	cfA	ccA	ccc	cc	-- c	ccA	ccc	ccc
2	cc	cc	cc	cc	ccc		cc	cc	cc	ccfr	ccc	cc
3	cccfr		cc	ccc	cc	cc	ccA	—	ccA	cc	ccc	ccc
4	cc	ccc	ccc	ccc	ccc	ccc	cccA	ccc			cc	cc
5	ccc	cc	cc		ccc	ccc	cccA	ccc	cc	ccc		
6	ccc	cc	cc	cc		ccc		ccc	ccc	ccc	ccc	ccc
7		ccfo	ccc	cc	cc	cc	HA			ccc		
8	cc		cc	ccc	cc	cc	ccc	ccc	cc	cc	cc	ccc
9			ccc	ccc	ccc	ccc	ccc	ccc	cc	ccc	ccc	ccc
10		cc	ccc	ccc	cc	f	cc	ccc	ccc	cc	ccc	
11	ccc		—	cc		cc	ccc	cc	ccc	ccc	cc	ccc
12	cc	ccA	cc	ccc		ccc	cc	cf	ccc	ccc	cc	cc
13	cc		cc	cf	cc	ccc	ccc	ccc		—	—	—
14	ccc		cc	ccc	cc	—	—	—	cc	cc	ccc	ccc
15	~~cc~~	~~HA~~	~~ccc~~	~~ccc~~	~~ccc~~	—	—	cc	HA	ccc	ccc	ccc
16	ccfo	ccc	cc	cc	ccc	cc	ccc	cc	ccc	ccc	ccc	
17	ccc	ccc	ccc	ccc	ccc	cc	cc	cc	cc	ccc	cc	cc
18		ccc	HA	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc
19	ccc	ccc	ccc		ccc	ccc	ccfo	cc	cc	ccc	ccc	
20	ccc	HA	ccc	ccc	cc	cc	cc	cc	cc	cc	ccc	
21	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc
22	cccfo			—	cc		ccc		ccc	cc	cc	ccc
23	cc	cc			cc	ccc	cc		ccc	ccc	ccc	ccc
24	ccfo	cc	—	—	cc	cf	cfo	ccfo	cc	H		cc
25	cf	cf	f	ff	ff	f	cf	ccf	ccc			
26	ccc	ccc		c	ff	ff	c	—	c /o	ccc/o	cc	cc
27	cc	c	ccc	c	ccc	ccc	cA	HA		ccc	ccc	
28	c	c		f	c	ccc	ccc		ccc	cc	cc	
29	cc		cc	c	ccc	cc	—	—	cc	ccc		ccc
30	cc	cc	ccc	ccA	ccc	ccc	cc	cc	ccc	cc	ccc	ccc
31	ccc	ccc			cccA	ccc	ccc	ccc			ccc	ccc
S_i	12+22+6	11+18+3	10+24	11+14+12+4+2	13+20+1+5+5	14+17+3+5+5	13+3+1+3	10+22+3	13+22	17+18	17+16	16+10
ΣS_i	40	32	34	47	50	48	30	35	35	35	33	26
N	30	30	29	28	30	29	28	27	30	30	30	30
P_i	1,33	1,07	1,17	1,68	1,67	1,66	1,07	1,3	1,17	1,17	1,1	0,87

Ps 0,034 | 1 0,071 | 2 0,07 | 2 0,063 | — NS

d \ h	13	14	15	16	17	18	19	20	21	22	23	24
1	ccc	ccc	ccc	ccc	cccA	cccA	cccA	cccA	cccA			ccc/.
2		ccc	ccc	ccc		HA	HAp	ccc			cccA	cccA
3	cc	ccc	cccA	ccc	—	—	cccA	ccAp	ccA	cccA	ccA	
4	ccc	B –	ccc	ccc	ccc	ccc	HA	cccA				cc
5		ccc	ccc	ccc	ccc	ccA	ccA	HA	HA	cccA		ccc
6	ccc	ccc	ccc	HA	ccA	HA	ccA	cccA	cccA	cc	HA	cccA
7	ccc	HA	ccc	ccc	ccc	ccc	cccA	cccA	H	ccc		c
8	ccc	ccc	cc	ccc	ccc	ccc	cccA	cccA	HA	HA	ccc	cccf
9	ccc	—	ccf/A	ccc	cccA	ccc	ccc	ccc	ccc	cc	ccc	cc
10		ccc	ccc	cc	cc	ccc	HA	cccA	HA	cc		cc
11	ccc	ccc	ccc	ccc	cc	ccc	cccA	ccA	cc	ccA		cccA
12	cc	cc	cc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	cf	ccc
13	—	—	—	—	—	—	~~HA~~	HA	ccc	ccc		
14	—	—	—	—	—	—	—	—	—	—	...	—
15	cc		ccc	ccc	ccA	HA	cccA	ccc	ccc	cc	cccA	ccc/o
16	ccc	cc	ccc	ccc	ccc	ccA	cccA	HA	ccc	cc	ccc	ccc
17	ccc		ccc	—	ccc	ccc	cccA	ccc	ccc	ccc		ccc
18		ccc	ccc	ccc	ccc	ccc			cc	ccc	ccc	ccc
19			ccc	ccc	ccfo	ccA	HA	ccc	ccc	ccc	cc	cc
20		ccc		ccc	ccc	ccA		ccc	cccA	ccA		
21	ccc		ccc	ccc	cc	ccc	ccc	HA	ccc	ccA	HA	ccc
22	ccc	ccc	cc		cccA	HA	HA	HA	cc	ccc	ccc	cc
23		ccc	ccc	ccc	ccc	cccA	ccA	ccc	cc	ccc	ccc	ccc
24	ccc	ccc		ccc	—	cccA		HA	cc	cc	cc	cf
25					ccA	HA	cccA	ccc	ccc	ccc	c	ccc
26	ccc	ccc	ccc	ccc	ccc	cccA	cccA	cccA	c	ccc	c	ccc
27	c	ccc	ccc	cc	c	ccc	ccc	cc	HA	ccc	c	ccc
28	ccc	ccc	ccc	ccc	ccc	cc	—	HA	ccc	ccc	cccA	ccc
29	ccc	ccc	ccc	cc	ccc	cc	ccc	ccA	cc	HA	ccfo	cc
30	ccc	ccc	ccc	ccc	ccc	ccc	cccfo	HA	cccA	ccc	cccA	ccc
31	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	cccA	ccc	ccc	ccc
S_i	18+6	19+4	24+4	22+6	19+10	17+12	17+4	20+2	14+18	20+10	13+8+6	20+8+6
ΣS_i	24	23	28	28	29	29	21	22	32	30	27	34
N	29	27	29	28	27	28	28	20	30	30	30	30
P_i	0,83	0,85	0,97	1,0	1,07	1,04	0,79	1,10	1,07	1,0	0,9	1,13

$P_r = \frac{25{,}9}{24} = 1{,}08$

N = 7

Tabl. 3. April 1997

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	—	ccc	cccw	cccw	ccfxp	sccA	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	cccA	ccA	A	ccc	cc	ccc	HA	cc
2	ccc	cc	ccc	ccc	cc	ccc	cc	sccA	ccc	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	ccc	cccmp	ccc	—	ccc	—	ccc	ccc	—	cccA	cccA	ccA	ccA	ccA	A	A	ccA
5	—	c	ccc	ccc	cc	cr	cc			—	—	—	—	—	ccc	cccA	ccA	cccA	cccA	cccA	cc	cc	A	ccA
6	ccA	ccA	ccc		ccc	c	c	cc	ccc		ccc		cc	ccc	ccc	ccc	cc	ccA	cccA	cccA	A	A	cc	
7	cc	cc	ccc		ccc	ccc	cc	ccc		ccc	ccc		ccc	ccc	cccA	ccc	ccA	ccA	cc	cccA	cccA	cccA	ccc	
8	ccc	cccA	cccA		ccc	ccc	cc	ccc	ccc	ccc	ccc	c	cc	cc	ccc		ccc	ccc	cccA	A	cccA	cccA	ccA	cc
9	ccc	cccA	cc	cc	cc	ccr	cr	ccr	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	ccA	cccA	ccc	cc	cc	A	cccA
10	cc	ccA	ccA	ccc	c	c	c	c	cc	ccc	ccc			ccc	cc	ccc	cccA	cccA	cccA	cccA		A	ccc	ccc
11	cc	ccc	ccc	ccc	ccc	ccfo	ccc	ccc	ccc	ccc		ccc	cc		ccc	cccA	cc	ccc	ccc	ccc		ccc	ccc	ccc
12	ccc	cc	cc		c	cc	ccA	—	cc		cc	ccc	ccc	w	cc	scc	ccc	cccA	cccA	A	cccA	cccA	ccc	B
13	fB	fB	fB	cB	ccA	cB	c	sccA	cB	ccc	scc	sccB w	cccW	cccT	—	ccc	ccA	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	—	cc	c	—	ccw	cccw	cccw	cccw	ccc	cc	ccc	ccc	ccA	ccc	ccc	ccA
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	ccA	A		ccc	cccA	cccA	cccA
20	cccA	—	ccc	ccc	cc	fr	fr	—	ccc	—	B	B	B	—	—	—	—	—	—	—	—	—	—	—
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
23	—	—	—	—	—	—	—	—	—	—	—	ccc	ccc	ccc	ccfxp	ccc	cA	cA	ccA	ccA	ccc	cccA	cc	ccc
24	ccA	cccA	ccA	ccA	cc	ccc	c	cc	cc	—	ccc	cc	cc	ccc	cc	ccc	c	cc	cccA	cccA	cccA	ccc	cc	cBw
25	ccB	c	ccB	ccB	ccB	cc	c	—	—	—	—	—	—	—	—	cc	cc	cc	ccA	cc	ccc	ccc	ccc	A
26	cc	ccA	cc	ccc	cc	fr	cr	ccr	ccc	ccc				ccc		ccc	cc	cA	cc	cc	cccA	cccA	cccA	ccA
27	ccA		—	cc	cc	cc	cc	ccc	cc	c	ccc	ccc	cr	cr		ccc	cc	cA	ccA	cc	cc	ccc	ccw	ccw
28	cc	ccc	ff	fH	c	c	A	cc	ccc	cc		ccc	ccc	ccfo	fz	ccA	cc	fA	ccA	cA	cccA	ccA	ccA	ccc
29	cA	cc	cc	c	cc	cf	cf	c	ccc	ccc	ccc	ccc	ccc	f-fa	ccc	c	cA	c	cA	cc	cc	cc	cc	cc
30	cc	c	ccfxp	f	c	—	ccr	c	cc	ccc	ccc	ccc	ccc	ccc	cc	cc	c	c	cc	ccc	ccc	cc	c	ccc
31	5+12+	6+14+	5+16	7+12	4+20	5+6	3+12+	7+10+	11+10	11+4+	11+2	11+2+	8+10	11+4	c+10	13+6	6+15	6+14	9+16+	10+	10+14	12+10	8+14	7+14
S_i	3+4	6+4	+4+15	+6+4	+12	+15+1	12+12	9	+5	3	+3		+3	+3+4	+1	+3	+12	15 14	+3	12+3			+3	+3
ΣS_i	32	30	33	31	36	48	39	25	24	18	16	16	21	22	23	22	36	39	28	25	21	29	25	24
N	19	19	19	19	14	18	19	18	19	16	17	17	10	19	15	20	20	20	20	20	20	20	20	19
P_n	[illegible]	1,6	1,7	1,6	1,9	2,7	2,05	1,4	1,3	1,13	[illegible]	[illegible]	[illegible]	1,16	1,22	1,1	1,8	1,95	1,4	1,25	1,2	1,1	1,25	1,26
N_S	1	1	2	2		3	3				min			1	1			1						
P_S	0,053	0,053	0,1	0,1		0,17	0,16																	

$N_d = 95$

$P_{\varnothing} = \frac{34{,}46}{24} = 1{,}44$

Tab 64. May 1991 [illegible]

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ccc	ccc	ccc	cc	cc	cf	cc	ccc	cccw	—w	ccc	—w	—w	cc	ccc	ccc	cc	ccc	ccc	cc	ccc	ccc	ccc	—A
2	cc	C	ccw	ccc	ccc	Cf	ffo	B	ccc	Bw	—w	ccw	ccw	—w	cccw	—	cccA	ccc	ccc	ccw	ccw	ccw	cc	ccc
3	cc	ccA	cc	cc	f	rf	f	ccc	cc	w	ccw	ccw	.	ccc	ccc	—	ccc	ccc	Cf	ccc	cc	wB	ccA	cccA
4	ccc	ccc	ccc	cc	cc	Cr	Cr	r	cccw	ccw	cc	fE2	ccA	CF2A	CF2r	C	cccA	cc	cccA	—	—	—	—	—
5	—	—	—	—	—	—	—	—	cc	cccB	cccw	cccw	ccw				ccc	B	ccA	ccA		cccA	ccA	C
6	cc	cc	cc	cc	cccA	cc	ccrA	ccrA	ccc		cc	ccr		ccc		ccc	ccc	ccc		cccA	ccA	A	ccA	ccA
7	ccA	ccc	cc	ccc	ccrA	ccrf	ccc	ccc	ccc	ccc		cc	ccc	ccc	ccc	ccc	cc	cc	B	ccc	cccA	cccA	ccA	cccA
8	A	ccc	cccA	ccA	ccrA	C	cc	cccA	cc	cc	ccc	cccw		cc	cc		ccr	ccr	ccA	ccA	B	B	—B	CAB
9	cc	cc	cc		ccc	cc	cc	ccc	ccc	cccB	ccw	ccc	—T	.	cc		ccc	—B	cA	B—	A	B	CB	—wB
10	ccA			C	C	C	cc	cc	ccc						ccA	Cr	cc	C	ccw	C	cccA	cccA	ccc	
11	cc	ccc	cc	cc	frA	—	f	C	cf	cc	cc	cccA	ccF2	ccc	ccc	cc	ccc	frA	cA	cccA	cccA	ccA	ccA	ccA
12	cccA	ccA	CcA	ccA	cr	Cr	cc	cc	cc	cc	cc	cccw	ccA	cc	ccc	ccc	cc	frA	frA	ccc	cc	cc	cc	cc
13	cc	CA	cc	ccA	cc	f	Cr	cc		cc	ccfo		ccc	ccc	ccc		ccw	ccc	—B	B	C	cc	cc	—
14	cc	cc	C	cc	fA	C	C	ccc	cc	cc	cc	ccc				ccc	cc	cc	—A	B	ccB	ccw		
15	—	B	ccc			cc	cc	cc	cc	ccc	ccc				ccc	ccc	cc	C	ccA	C	cc	C	ccc	cccA
16	cc	ccc	cc	C	cc	Cr	ccc		Cfo	ccfo	cccw	C	ccfo	ccc		A	cc	cc	cc	B—	B=	cc	C	cc
17	ccc	...	ccc	ccc	ccc	ccc	ccc	B	wB	Bw	—w	—w	cccw		ccc		cccB	ccc	ccc	ccc	cccA	ccA	ccA	cc
18			ccc	ccc	cccA	ccrf	ccc	ccc	ccAF2	ccF2	—w	w	—	cccT	ccc	ccc	ccc	ccc	cccA	ccA	cccA	..	—	—
19	ccc	ccc	cccA	cccA	cccf	Crf	ccr	ccrA	ccc	ccw	T=	cccw	ccw	T=	—	—		ccA	ccA	ccA	cccA	ccc	cccA	w
20	ccc	ccA	cccA	cc	ccA	ccA	frfo	Cf	Cf	Tw	—w	cccTw	w	ccc	T=	ccAT	cccA	ccr	cccA	ccA	cccA	ccc	cccw	cccw
21	A	cccA	cccA	cccA	cc	sc	cccA	—w	cccw	cccw	TB	—w	—wT	—wT	cccw	cccw	fr	frA	cccA	cccZA	A	ccA	ccc	Cf
22	Cf	cc	cc	f	Cf	f	Cf	ccf	ccc		ccTA	ccF2	—	—	cc	ccAT	ccc	cccA	ccA	ccA	—B		ccc	cc
23	cc	C	ccc	ccc	ccfo	cc	Cr	Cr	cccfo	cccfo	cccfo	ccc	w	ccrf		cc	cc	cc	cc		ccc		ccc	ccc
24	cc	ccc		cc	ccc	Cr	Cr	cc	ccfr	cccfo	ccc	—w	—w	—w	—w		ccc	—T	ccc	ccc	ccc	ccc	ccc	cc
25	ccc	cc		ccc	ccc	r	r	ccf	ccc	CfrA	cc	—Tw	—w	w	w	ccc	—B	ccc	cc	ccc		cc	ccc	Cf
26	cc	T	cc	cc	cc	cc		ccc	cccw	A—	ccc	—w	—w	w	w	w	cccr	ccr	ccc	ccA	A—	cc	w—	ccc
27	ccc	ccc	f		C	cc	cc	cccw	cccw	Crw	cccw	—w	cccw	cccw	w	cccw		ccc	cc	cc		cc	cc	C
28	ccc	f	f	f	f	f—f	fr	ccc	cccr	cccr	cccr	ccr		cccr	cccr	cccfo		cc	ccc	ccc	ccc	ccc	cc	cc
29	Cf	cc		f	cf	Crf	Crf	ccc	ccc	—w	—w	—w	—w	cccrw	cccrw	cccfF2		cc	ccc		ccc	cc	C	Cf
30	cf	ccf	f	f	cf	ccf	cccf		ccf	ccf	cccf	ccc			cc	cccr	ccc	cc	cccA	cccA	ccc	cccA	cAT	ccA
31	C	cc	ccc		ccc	cc	cc	ff	w	—Tw	cccw	cfF2w	cccF2w	w			cc	cccA	A		ccc	A—	Cf	Cf
S	9+20+	10+20+	11+20+	8+20+	8+22	1+24	6+20	11+16	15+20	10+16	12+20	12+8	7+10	11+8	13+10	13+6	15+20	11+21	11+22	11+20	14+12	8+21	13+18	7+18
ΣS	18+ = 71	9+4 = 43	0+12 = 49	6+16 = 50	18+16 = 64	33+20 = 78	21+24 = 71	9+8 = 42	9 = 44	6 = 32	32	9 = 29	= 17	3 = 22	3 = 26	6 = 25	4 = 39	9+8 = 53	9+4 = 46	6 = 37	3 = 29	3 = 35	12 = 43	21 = 46
N	30	29	30	30	30	29	30	29	31	27	28	25	24	28	29	30	30	29	29	28	27	29	28	27
Ph	1,4	1,5	1,6	1,7	2,1	2,7	2,4	1,5	1,4	1,2	1,1	1,2	0,7	0,8	0,9	0,8	1,3	1,8	1,6	1,3	1,07	1,2	1,5	1,7
$P_m = \frac{142}{24} = 1,42$			3	4	4	5	6	2					min				1	2	1					

N1 = 29

Tab. 5 June 1991

d \ h	01	02	03	04	05	06	07	08	09	10	11	12
1	cc	ccc	(f)W	(f)	ccf	C~	ccc	-A	-W	-..	-A	-W
2	C	C	(f)	(f)	Cf	(f)	CfA	-A	-A	-A	-AK	-AS
3		ccc	cc	ccc	ccc	cc	cc	-AS	AS	-W	cc	ccW
4	cc	cc	cc	cc	ccc		ccW	cccW	BAW	-W	cc	ccW
5	ccc		cc	cc	Cf		fB	cccW	cccW	ccW	cccW	-B
6	-B	-B	-B	-B	Cf	(f)	ccr	-W	-W	-W	-W	-W
7	ccT	cc		ccc		cc~	ccc	W	B	W	W	-B
8	C	fA	(f)	-TB	(f)	Cf	ccF2	cc~	cc	cc	cc	cc
9	ccA	cccA	cc	—	ccc	ccc	cccW	-B	CF2W	W	cccW	cccW
10	ccc	cc		ccc	ccF2	ccF2	cc	Cf	ccF2W	W	W	cccW
11	-B	(fA)	(ff)	(ff)	-BS	-BS	-BS	-B	-B	-B	-B	-B
12	fB	-B	cc	-BS	cc	fS	fB	-B	-WB	-B	-W	-BW
13	cc		ccc	(f)	ccc	cccF2	ccfo	-WBS	-WB	-B	-W	W
14	CSW	C	C	(f)	cc	cc	cc	cc		W	cccW	W
15	fA	ff	(f)	C	cc	ccF1	cc		-B	-B	-WB	-WB
16	fB	fB	ff	(f)	ff	C	cc		cccfo	ccc	ccc	ccc
17	CA	CA	CA	cc	C	ccr	cc	Cf	W	cccB	ccc	cccrW
18	cc	(f)	CB	ccB	cccB	ccB	-BWS	-BSW	-BSW	-B	-B	-BS(f)
19	C	ccW		cc	(f)	(f)	Cf	fB	ccW	CW	ccW	ccW
20	CA	C	cc	cc	cc	ccN	(f)	cc	ccW	ccF1	ccc	ccW
21	(f)	ffAT	(ff)	-B(fB)	CfSB	ccB	—	cc	ccfW	cccW	cc	-W
22	ccA	C	(f)	-B	cc	cc	ccc	cc	cc	cc	ccW	ccW
23	C	C	C	CA	CN	(f)	ccWB	C	-BCC	W	—	—
24	ccc	cc	C	cc	cc	ccNB	CB	-B	-B	ccW	-W	-W
25	cccA	ccA	cc	cc	ccA	fA	ccc	-B	-W	-WT	W	-B
26	cc	C	ccA	cc	cc	(f)	-BT	C	cc	ccc	cccW	ccW
27	cc	fA	cc	(fA)	CA	(f)	CA	ccB	cccW	-W	cccW	-WB
28	ccA	cc	C	C	CB	cc	-W	CBT	cc	-B	-B	B
29	(f)	ccA	(f)	C	ccA	ccA	ccc	ccc	ccB	B	ccNT	cccW
30	ccA	CA	-B	fB	C	(f)	C	cccBW	ccB		ccB	-B
31	~~29~~	~~4~~										
S_i	5+20	3+16	4+18	3+18	5+22	7+24	8+18	4+12	5+16	6+8	8+14	6+14
ΣS_i	21+17= 63	24+34 77	18+40 77	12+33 66	24+14 65	12+33 70	15+13 54	15+4 35	3 24	3 17	22	20
N	28	28	28	24	29	29	25	19	19	17	19	15
P_h	2.25	2.75	2.75	2.75	2.24	2.41	2.16	1.84	1.26	1.0	1.16	1.33

d \ h	13	14	15	16	17	18	19	20	21	22	23	24
1	cccW	-B	-B	-B	-AT		cccA	-B	cc	cc	cc	cc
2		cccW	-W	ccf		ccc	ccc	cc	cc	cc	ccc	cc
3	ccc	AW	ccc	—	cc	cc	cccA	-A	ccc	ccc	Cf	C
4	B	W		ccrf	cc	cc	ccrf	ccc	ccA	ccc		ccc
5	-B	ccc		ccc			ccc		cc	cc	-B	-B
6	-W	ccF2	ccrF2	Cf	ccf	ccf	ccf	cc	cc	ccc	cc	cc
7	ccc		ccc	ccc	ccf	cc	A	ccc	ccc	cc	ccc	cc
8	cccT	C	ccc		-BT	-B	C	cccA	cccA	cc	ccc	C
9	cccW	W	W	cc	cc	ccc	cccA	cccA	cccAT	cccA	cccA	A
10	W	W	cccWT	cccB	ccc	ccc	cccA	cccA	ccc	ccc	CB	CB
11	-BW	-W	-W	W			CBS	-B	fB	CfB	ccW	ccB
12	-BW	-BW			ccA	ccF2A	-B		cc	A	A	
13	-BW	-BWS	B		B	B	ccAB	ccAB	ccAB	ccA	CSB	cc
14	ccC	cc		ccc	cccA	A	ccA	cccA	cc	ccA	CA	(f)
15	-B	ccF2	ccc	ccc	cc	cc	C	cccA	A	CA	fA	C
16	cc			ccc	ccc	cc	ccB	cc	cccA	CA	cc	cc
17	W	ccW	cccA	cccAT	ccA	cc	CfN	cccAT	ccAT	cc	CA	ccA
18	-BS(f)	-BSW	-B	-Bf	ccB	CfN	CfN	cc	cccA	ccA	(C)	ccc
19	ccW	-B	cc	cc	cc	ccN	ccNA	NA	ccA	ccA	CA	fAT
20		ccW	ccc	ccc	cccN	cccNA	cccNA	cccNA	ccA	-BS	fB	(f)
21	ccW	ccW	AWB	Cf	cc	ccA	ccNA	A	A	CfAT	ccT	cc
22	ccW	-WB	WB	ccB	ccN	ccNA	ccNA	cccNA	ccA	cc	CB	C
23	—	—	—	—	C	CNA	ccNA	ccNA	ccA	cccAT	cc	cc
24	-W	-W	cccW	B	ccc	ccN	A	cccA	ccB	ccB	ccA	ccc
25	B	cccB	-B	cc	C	N	ccc	ccN	CA	ccA	cc	ccc
26		W	cc	cccB	ccB	C	ccN	CA	CA	cc	cccA	ccA
27	cccF2	cccW	ccB	ccB	ccc	CNA	(f)	cccNA	ccA	cccA	ccA	cccA
28	cccW	-W	ccc	ccB	cc	CB	C	ccA	ccA	ccA	fAT	CT
29	ccWB	—	cccT		C	CNA	CNA	ccNA	C	C	(f)	C
30	-B	cccB	cccB	C	cc	fA	ccN	ccA	ccA	ccA	cccA	ccc
31												
S_i	8+10	5+12	12+6	9+16	6+30	5+24	7+22	13+18	7+34	7+32	6+18	6+22
ΣS_i	18	3 20	18	9 34	9 45	18+4 51	21+4 54	3 34	9+4 54	15 54	24+17 65	21+8 57
N	20	19	24	26	28	29	29	27	30	29	29	29
P_h	0.9	1.05	0.75	1.31	1.61	1.76	1.86	1.26	1.8	1.86	2.24	1.97

$N_d = 53$

$P_m = \frac{42.2}{24} = 1.75$

$\underbrace{4+1}_{5}$ $\underbrace{3+2+2}_{7}$ $\underbrace{6+2+1}_{9}$ $\underbrace{7+1}_{8}$ $\underbrace{2+1}_{3}$ $\underbrace{7+1}_{8}$ $\underbrace{2+1}_{3}$ $\underbrace{1}_{1}$ ...

$\underbrace{}_{1}$ $\underbrace{}_{1}$ $\underbrace{}_{1}$ $\underbrace{3+1}_{4}$ $\underbrace{}_{2}$

Table 6. July 91

d \ h	01	02	03	04	05	06	07	08	09	10	11	12
1	ccA	c	ccA	cc	cc	cc	ccr		-w	-wB	-B	ccBw
2	f	f	f	cc	cc	cf	fA	cc	ccw	ccw	cc	w
3	ccA	ccA	ccA	cc	cc	c	cc	-w	-Bw	cccw	-w	w
4	f	cc	c	cc	ccc	cc	cc	-wB	-wB	-wB	-wB	-B
5	cA	cA	cc	cc	cc	f	cc	ccw	-B	-B	-w	-B
6	ff	fA	c	c	ccN	cc	c	cc	cccN	ccwB	-B	-B
7	c	cB	cBA	f	c	c	c	cc	ccB	-Bw	-Bw	w
8	cA	cA	ccA	cA	ccA	c	cc	ccc	cccw	-B	-B	cccB
9	ccw	ENA	cc	-B	f	fSB	fSB	fSB	-B	-B	-B	cF2w
10	ccc	cc	cc	cc	f	f	ff	-B	ccNB	-B	ccNB	ccWB
11	ccw	–	–	–	–	ccA	cccA	-wB	ccw	ccw	-B	ccw
12	c	fA	c	f	f	cA	cA	cccw	ccFw	cccw	-B	ccEF2 (WA)
13		cc	cc	f	f	ffE	f	ccF2	-w	ccw	cF2w	cSw
14	cc	cc	cccw	c	c	cE	fE	cc	cS	ccw	ccw	cccw
15		cc	f	cc	cc	f	f	-BSw	-Bw	-Bw	-B	ccw
16	ccA	ccEA	ccA		cccE	cccN	cA	cc	A	ccc	ccA	cccw
17	ccc	c	cc	c	cc	cS	ccw	cSw	-w	-w	-B	cccw
18	cc	c	cc	cc	c	f	-B	cS	-B	A	cccw	cccw
19	cc	–	cc	–	cc	cF	c	cc	cA	ccw	ccw	cF
20	A	ccA	ccc	cc	cc	cE	cE	c	-B	-B	-Bw	-w
21	cc	fNE	cES	–	-BE	cEB	fEB	ccw	ccw	-B	-B	-B
22	cc	c	c	c	c	cE	f	cB	ccr	-B	-wB	-wB
23	ccBEA	cBEA	fBE	cA	f	f	cBE	ccB	–	–	–	–
24	–	–	–	–	–	–	–	ccrB	ccc	ccc	cc	cccw
25	fE	fEA	fE	ccA	c	c	c	ccB	cBA	B	-B	ccw
26	f	f	c	f	cE	cE	fE	ffB	ccE	ccc	f	ccc
27	ffB	ffB	fA	f	f	fEN	ffA	-B	fS	ccwB	cc	
28	fA	cc	ccA	cc	c	f	cE	ccB	ccB	ccc	ccc	cc
29	ffAB	cBEA	EB	ccE	ccEB	cE	cE	ccB	ccB	cc		ccc
30	fBA	fBEA	fBEA	fBE	cBE	ccBE	ccBE	ccBE	-B	-B	-B	cccB
31	ccA	ccA	c	c	f	c	cE	ccEB	ccAB	cccw	-B	cw
S_i	2+24+13+16+20	30+20 28+5	2+24 14+28	24+31 24	2+13 24+28	10+8 45+31+5	11+1+33 29+5+6	2+32 11+14+16	7+10+ 9+24	7+10 3+4	2+14 3+4	8+16 12
ΣS_i	77	73	74	69	76	94	90	56	37	26	23	36
N	30	28	29	26	28	30	29	25	19	17	12	24
P_i	2,57	2,61	2,55	2,65	2,71	3,13	3,10	2,24	1,94	1,53	1,92	1,50
	8 (4+4)	8 (7+1)	6	6	7	9 (8+1)	(10) (9+1)	(2) (1+1)	(1)	1	1	

d \ h	13	14	15	16	17	18	19	20	21	22	23	24
1	-B	ccBw	-B	ccBw	ccc		cccN	cc	c	cc	c	c
2	ccc	w	ccw	cccw	ccA	cccNA	ccNA	ccA	cccB	cAB	ccA	ccA
3	w	w	cccw	cccw	-SN	cccNA	cccNA	cccNA	cccA	ccA	ccA	ccA
4	-B	cccw	cccN	ccw	ccc	cA	ccA	-B	ccA	ccA	ccA	ccA
5	-B	w	ccB	-B	cccBN	cA	cN	ccNA	ccA	fB	f	f
6	-B	-B	-B	ccB	ccB	fA	cA	cAB	cAB	ccAB	cA	ff
7	cccN	cc	cccB	HB	ccB	ccAB	-BS	-BS	fA	cA	ccA	f
8	c	cccw	c	ccNA	ccA	cA	cNA	cccNA	ccA	ccA	ccA	cc
9	fSw	ccF2w	w	ccc	ccN	c	cN	-B	cA	f	ff	-BS
10	ccWB	w	cw	c	c	ccNA	ccNA	ccE	–	–	–	–
11	ccc	cc	cc	ccc	-EBw	-EBw	ccNA (E)	ccNA	cA	ccA	cAS	ccc
12	ccc	cc	ccF2	ccc	cNS	cNS	ccNE	cE	cccAB	ccAE	EA	ccc
13	cF2	ccF2	c	ccNE	c	fEA	fEA	cEA	-E	f	ccE	cc
14	cccA	ccc	A	ccAN	cwE	cNAB	fAE	cAG	ccc		ccc	ccc
15	ccw	-Bw	ccBw	ccB	cc	fNA	cA	ccAE	ccA	ccA	A	ccA
16	ccN	-B	cc	ccA	ccNA	ccNA	ccNA	ccA	ccA	ccA	ccA	c
17	-w	-wB	B	cc	fr	cccN	N	N	ccc	cc	ccc	cc
18	ccN	ccc	-B		ccA	ccAN	ccNA	ccc			ccA	ccA
19	cc	cccw	ccc	cc	cNEA	cNA	ccNA	ccA	ccc	cc	ccA	ccc
20	-w	ccw	ccw	ccS	cS	ccNA	cUL7	cEA	cA	cBA	f	c
21	-B	ccw	-w	f	cE	ccNAE	ccE	ccE	cc	ccA	c	c
22	-wB	-wB	cccwB	-B	cB	cNA	ccA	ccA	fEA (S)	cEB (A)	fEB (A)	ccBE (A)
23	–	–	–	–	–	–	–	–	–	–	–	–
24	cccw	cccw	ccw	ccc	ccc	ccNA	ccAB	fEA	fEA	cE	ccA	ccE
25	w	ccc	ccc	ccA	ccc	ccBEA	ccA	B	fBE	-BS	fB	ff
26	ccc	ccc	c	cc	ccBE	cEA	ccAB (E)	cccA	cA	ff	fEB	fEBA
27			ccB	cccB	-B	cB	ccNE	c	ccA	cA	ccNA	ccEA
28	cc	ccB	B	cS3	ccA	cB	–	–	-B	fAE	fEB	ccBE
29			ccc	cc								
30	-B	cB	ccB	cc	-B	ccBE	fEA	cEA	ccEA	cEB	ccEB	ff
31	cw	ccwS	-Bw	ccB	cccNA	ccBEA	ccA	-B	-BS	cBAE	ceA	ccA
S_i	6+12 9+4	10+16 3	9+16 12	10+26 6+4	ccBE 6+12 24+4	ccBE 3+24 30+4	ccBE 3+30 18+12	ccA 5+18 21+4	cccA 9+12 +8+16	ccA 3+12 24+14+10	ccA 4+24 12+14+5	ccA 5+24 12+12+10+6
ΣS_i	31	29	37	46	56	69	63	48	55	68	63	69
N	21	25	25	28	26	29	28	25	26	28	28	28
P_i	1,48	1,16	1,48	1,64	2,15	2,38	2,25	1,92	2,11	2,43	2,31	2,46
	1				1	3	3	1	4	5 (3+2)	7 (6+1)	6 (2+3)

$P_d = \frac{52.2}{24} = 4,1$

$N_d = 90$

60

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d \ h	0.1	02	0.3	0.4	0.5	0.6	0.7	0.8	0.9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	cc	cc	©	©	(f)	©–	©	ccAB	cccw	cccw	–B	ccE2	ccw	ccw	ccw	ccw	ccNA	©cNA	ccBE	ccBE	©	©A	©	cc
2	–	©			cc	cc	ccr	©B	ccBw	ccBw	cc	ccc	cc	ccA	ccc	ccc	ccf	ccNA	ccNA	ccc	cc	cc	ccA	cc
3	cc	©	©r	–	–		–	ccc	(f)	ccc	sccw	cccwA	©r	ccc	cc	ccc	ccN	ccN	ccNA	ccA	ccAB	©E	(f)AE	©
4	cc	ccc	cc	cc	cc	(f)EB	(f)			ccr	ccw		©	©		©	A	ccA	ccN	A	ccc	©	©	ccc
5	cc	cc	ccc	cc	©	(f)B	©	–B	–	–	–Bw	ccA	cccA		cc	cc	ccBA	(f)E	cccA	ccA	ccA	(f)EB	–	cc
6	©	ccc	cc	cccw	cccw	©B	©EB	–	ccBw	ccB	–B	–B	w	©rw	©E2	ccB	ccAE	ccBE	cc	ccc	©	cc	ccc	cw
7	–w	–w	©w	©w	©rw	ccN	©EB	–T	ccB	cccB	(ff)	ccw	ccw	ccc	ccT	–	–	–	–	–	–	–	–	–
8	–	–	–	–	–	–	(f)E	(f)		–B	ccwA	©	cccw	©	cc	ccB	©	ccBA	cc	–B	cc	–B	©B	©E
9	©	cc	cc		cc	ccA	cc	ccE	ccw	cccB	ccc	ccc	ccc	ccc	cc	ccB	ccB	ccA	ccEB	ccEB	ccEB	ccA	©A	(f)
10	(f)	(f)	(f)	(ff)	(f)	©BE	©BEA	ccBE	cc	ccc	cc	cc	ccc	ccc	ccc	ccB	©BEA	–B	ccA	cc	–B	ccB	ccBE	©B
11	cc	©	cc	cc	©c	©BE	(f)BE	ccBE	ccc	cccA	cccA	ccc	cc	cccA	cccB	ccBA	ccBA	ccBA	ccBA	–B	(f)BS	©c	©B	ccA
12	cc	(f)B	ccBE	©B	cc	©	ccAB	cc	cc	ccB	cc	–w	cccw	–wB	cccw	–B	ccNB	ccNBE	cc	ccw	ccw	ccABE	cc	cc
13	cc	ccc	ccc	ccc	ccc	–B	ccBE	ccE	©	B	B		ccc	ccc	ccc	ccE	ccEA	ccA	ccE	ccEA	ccEA	cc	cc	cc
14	©	©	cc	cc	©	©E	ccE	ccE	(f)A	–B	ccB	ccB	cc	cc	ccc	ccc	ccN	ccA	ccA	cc	ccAB	ccAB	ccAB	cc
15			ccc	cc	cc	©	©E	ccE	ccc	cc	©	cc	ccB	ccc	cc	ccE	©E	©EA	ccA	cccA	cc	cc	–B	©B
16	(ff)EB	(ff)EB	(f)EB	©E	ccc	–B	©B	(f)F2	ccB	ccw	ccw	ccw	ccw	scr	ccB	©	cc	ccEB	ccEB	–BS	©EA	–B	(f)	(ff)
17	(ff)	(fff)	(ff)	cc	©	ccc	(f)EB	ccB	ccB	ccw	ccw	cccw	cccw	cc	ccc	cccA	ccA	ccA	ccA	cccA	ccEA	©AB	©ABE	cccB
18	cccA	(f)	(ff)	(f)	cc	ccBE	ccBE	ccAB	ccc	ccc	cccw	cc	cccw	cccw	w	cccw	ccN	ccNA	ccA	ccAE	ccAE	ccABw	©AE	ccAE
19	cc	©	©	ccc	©A	ccE	cc	cc	cccw	cccwB	cccwB	©F2	ccwB	cc	ccc	ccA	ccA	ccNA	ccNA	cc	cccA	©BF	©B	©B
20	©w	cc	c	©	©	(f)EB	(f)SB	(f)B	–B	©B	ccB	=B	ccwB	©	(f)	–B	(f)BS	©BA	ccBA	–B	(f)E	(f)AE	cc	©
21	(ff)B	©	cc	cc	cccB	ccB	–Bw	©BS	–BW	ccB	ccBW	ccBw	–B	cccB	cccSB	ccB	ccB	ccB	–B	©	cc	ccA	ccA	©
22	cccB	©		(f)	©B	cccB	©B	cc	ccwy	cccww	–w	–w	–w	ccw	ccw	cc	ccAS	–BS	–B	ccSB	©A	©E	–B	©
23	cc	©	(f)	(fff)	ccc	ccE	ccE	ccE	cc	ccw	ccwB	ccwB	ccc	ccB	cc	cc	ccNA	ccNA	ccAE	ccBE	ccBE	©BA	ccA	ccA
24	(f)	(ff)	(f)	(f)	(ff)	(f)E	(f)E	(f)r	©	cc	cc	ccc	ccc		ccc	cc	cc	ccNA	ccAN	ccA	ccA	ccA	cc	ccA
25	ccA	©A	©A	ccA	ccA	©E	©E	©E	ccB	ccB	©	ccc	cc	cc	cc	cc	ccN	ccNE	ccAB	ccAE	ccAE	ccS'	©	ccAB
26	©EA	ccA	©	ccc	©	©E	(f)E	ccE	ccB	cc		ccc	cccB	ccc	ccr	ccc	ccEA	ccAE	©BS	©BA	ccA	©AB	ccAE	©
27	ccA	©A	©	©	©	(f)E	(f)E	©B	ccB	cc	ccwB	cccwB	ccB	©BS'		ccc	ccE	ccB	ccA	ccA	cccA	cc	A	–B
28	©	©	©	cc	cc	cc	cc	ccwB	cccwB	cc	–B	ccw	ccw	ccBw	ccB	cccwB	ccBA	ccBA	ccB	ccA	(f)A	ccAB	ccB	(f)
29	cccE	cc	cc	cc	(ff)	(f)E	©E	ccB	ccB	ccc	ccc	ccc	cc	cc	cc	ccN	ccNE	ccE	ccAB	cc	–B	–B	ccA	©
30	©	cc	ccc	cc	©	cc	ccE	cc	cc	ccc	cccw	cc	cc	ccW	cc	cc	ccNA	ccNA	N	ccB	ccB		ccB	©B
31	cc	cc	cccw	cccw	cccw	ccE	©E	©E	(ff)	(fff)	–	(f)	cccSB	ccSB	ccSB	cccS	ccS	ccA	ccA	ccA	–B	–B	©A	
S_i	3+22+21 +8+15	3+16+33 +12+10+6	5+16+27 +12+10	5+22 +18+19+2	6+16+33 +12+5	2+20 +24+28	12+33 +18+5	4+34 +15+16	5+32 6+8+5	18+19 3+6	8+22 6+5	10+24 6+4	12+28 6	10+24 5	8+36 3+4	9+34 6	50+9 +4	48+9+4	3+46+ 3	4+38 +6	5+28 +12+12	1+16 27+8	1+26 30+8	3+18 +33+8+5
ΣS_i	69	80	70	69	72	74	86	66	56	45	41	44	46	49	51	49	63	61	52	48	57	62	65	68
N	30	30	30	29	29	27	29	28	27	28	25	27	29	30	31	28	30	28	28	26	27	26	27	29
P_h	2,3	2,67	2,33	2,38	2,48	2,74	2,97	2,36	2,07	1,61	1,64	1,63	1.59	1.63	1,65	1,75	2,1	2,18	1,86	1,85	2,11	2,38	2,41	2,31
	2+3	3+2 +1	4+2	3+1+1	3+1	7	7+1	4	2+1	1	1	1					1	1			2	2	2	2+1
	5	6	6	5	4	7	8	4	3	1	1	1					1	1			3	2	2	3

$P_d = \frac{51}{24} = 2{,}13$

$N_d = 65$

Table 8. September 1911

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ccc	cc	©w	ccA	ccA	©	ⒺE	©E	©E	ccBE	©B	ccB	ccB	cccB	cc	ccE	ccWB	ccWA	ccWB	ccVB	ccEB	ccE	©	ccc
2	–	–	–	–	:::	©	ccE	cc	©w	©w	ccw	ccB	–B	ccCS	–BwS	–	cc	ccVAB	ccEA	ccc		ccc	–	–
3	–	–	–	–	Ⓔ	©E	©	©B	©ABE	ccSB	ccSB	ccBw	ccB	ccB	ccBS	ccBS	ccE	ccAN	ccNA	cc	ccEA	cc	cc	©
4	©	ccw	ccE	©B	–B	©	©	©c+	cccB	ccB	ccGw	ccB	cc	ccB	ccB	ccNB	ccN	ccNA	ccVEA	ccBA	ccAB	ccc	ccc	ccc
5	ccc		cc		cc	©HS	©	©	cc	ccw	–Bw	–Bw	cc3	ccB	ccNB	ccBS	ccA	ccNA	cc	ccc	ccc	ccc	cc	©
6	cc	©	©	©	cc	cc	ⒺEB	ⒺB	ccE	ccE	–	–	–	–	–	–	–	ccNA	ccA	ccA	cc	cc	c.c.	©
7	cc	–	cc	©	cc	©6	©	cc	ccB	ccc	cc	cc	B	ccc	cc	ccE	ccE	–BW	ccB	ccA	cc	cc	cc	©
8	ccc	cc	cc	cc	cc	©F	©E	ccB	ⒺB	cccw	ccw	–w	ccBw	cc	ccc	ccN	ccE	cc	ccNA	©	ccB	ce	cc	cc
9	w	cccw	cc	cc	©	©E	cccE	ccc	cc	cc	cc	©	ccc	cc	ccNB	ccN	ccN	ccEB	ccBA	ccE	ccS	©	©	cc
10	©	cc	©	©	cc	©+F	©+F	cc	cc	cc	cccB	cc	cc	ccB	ccS'	cc	ccN	ccN	ccA	ccA	cccA			ce
11	ccc	cc			cc	Ⓔ	©BS	cc	©S	cccw	ccw	©AB	cc	ccS'	ccS	ccNA	ccNA	ccNA	ccA	ccA	ccA	–	–	–
12	–	–	–	–	–	–	ⒺA	©	©	cc	cc	cc	ccc	cc	©	©S	ⒺEA	©EA	ccEA	cc	ccA	ccA	A	cc
13	ccc	ccc	–	ccc	©	Ⓔ	©	©	©	–	cc	cc		cc	cc	ccN	ccNA	ccNA	©EA	ccA	ccA	©A	ccc	ccA
14	ccA	cc	cc	cc	cc	©	©	©	ccBE	ccB	ccB	cccB	ccc	cccA	ccc	cccN	ccAE	ccE	ccN	ccA	cc	©AE	ccAB	Ⓔ
15	©	–	ccc	©	©A	ⒺA	Ⓔ~	ⒺE	©E	©	cc	cc	ccA	cc	ccc	ccN	ccNA	ccA	ccA	ccA	ccA	ccc	cc	cccA
16	©	cc	cc	cc	©	ⒺA	Ⓔ(A)	ⒺA	ccc	cc~	©	cc	cc	ccc	cc	ccNA	ccN	ccA	ccA	ccA	ccA	ccc	ccA	ccc
17	cc	cc	cc	cc	cc	©	©	©	cc	cc	ccc	cc	cc	cc	cc	cccA	ccNA	ccNA	ccA	ccB	ccA	©	ccA	cc
18	©A	cc	ccA	©	©	ⒺA	©A	©	ccN	cc	ccc	cc	cc	ccc	cc	ccNA	cc	ccN	ccA	ccAN	ccAN	ccA	ccA	cccA
19	ccA	cccA	ccA	cccA	cc	Ⓔ	Ⓔ	©N	cc	cc		ccc		ccc	ccc	ccNA	ccNA	ccA	ccA	ccA	ccA	cc	ccA	...
20	ccA	ccA	ccA	A	©	©+	©A	ccTA	©	ccc	cc	cc	ccA	cc	cc	ccNA	ccA	ccc	ccA	ccA	©A	ccA	–	
21		ccc	cc	cc	cc	©A	ⒺAE	©E	ccE		cc~	ccc	ccc	ccc	cccA	ccEB	–B	©EN	©EA	ccc	ccc	cccA		ccc
22	ccc	ccA	cc	cc	cc	cc	cc	cc	cc	ccc	ccc	cc	©~	©~	ccc	ccc	ccE	ccE	ccB	cccA	ccc		ccc	ccc
23	cc	cc	ccc	cccA	cc	©c+	©+	cc	ccT	c.T	cc	ccc	ccc		cc	cc	ccAE	ccAE	ccA	cc	cccA	cccA	ccc	cccA
24	ccA	ccA	cccA	A	©AE	©B	ⒺA	©	©	ccc	cc	cc	ccA	ccA	ccA	ccN	ccNB	ccAB	ccA	ccA	cccAB	©A	cc	ccA
25	cc	cc	cc	cc	ccc	©	©	ccS	ccA	ccAS	ccAS	ccc	ccc	cc	ccA	cc	ccA	ccA	cccBA	ccSAB	ccA	ccAS		cc
26	cc	cc	–	cc	ccw	ccwS	ⒺB	©B	ccCB	©	cc	ccCAT	Ⓔ	©	ccc	ccA	ccA	ccA	ccA	ccc	cccA	ccSA	ccSA	cc
27	cccA	ccA	cc	ccc	ccc	©	©	©	©	ccc	cc	cc	ccN	©	ccN	ccN	cc	ccA	ccwS	ccA	ccA	ccA	ccA	cccA
28	ccc	cc	©AS	(ff)	(fff)	Ⓔ·	Ⓔ	Ⓔ	Cf~	cc		c°	Ⓔ~	cc	ccA	ⒺA	ccA	ccA	ccAS	ccA	cccA	ccA	ccNA	
29	cc	ccc	cccw	ccc	ccw	©	©	©A	©	©	ccB	ccBA	©A	ⒺAB	Ⓔ	ccc	ccAB	ccAB	ccAB	ccAEB	ccB	cc	cc	
30	cc	©	©	cc	ccc	cc	Ⓔ	©	©f	©~	ccc	cc	cccA	ccA	ccA	©NS	ccNA	ccA	ccA	ccA	ccA	©A	ccA	
31																								
S	8:24 15	6:32 6	4:30 15	5:22 18+5	4:30 21+4+6	8 57+28	1+4 48+1+6+10	1+18 4+1+12	3+28 39+4	8:30 15	6+36 6	8+14 6	8+16 6+8	8+32 9+4	7+38 3+5	4+42 6+4	:54 :4	1+52 6	1+54 6	5+46 3	9+38 3	3+28 18	4+34 6	9+18 12+7
ΣS	47	44	49	50	65	90	99	79	74	53	48	48	48	53	53	56	58	59	61	54	50	53	44	43
N	27	27	27	27	28	29	30	30	30	29	28	27	28	29	28	28	28	29	30	29	30	29	28	28
P_h	1.74	1.63	1.81	1.85	2.32	3.10	3.3	2.63	2.47	1.83	1.71	1.78	1.71	1.83	1.89	2.0	2.07	2.03	2.03	1.86	1.67	1.83	1.57	1.54
				2	1 1	7	9 2	4	1				2	1	1	1	1							1
				2	2	7	11	4	1	27			2	1	1	1	1							1

$P_d = \frac{48.21}{24} = 2.01$

$N_d = 34$

Table 9 October 91

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	cc	cc	cc	ccc	cc	C	C	cccE	ccB	ccc	cc	cc	cc	C	cc	ccN	ccNA	ccNA	ccAS	ccA	cc	C	cc	ccc
2	ccc	cc	—	—	ccc	C	CS	f	Cw	-B	ccwB	ccwB	cc	ccA	ccA	ccNA	ccNA	ccA	CA	ccc	C	C	cc	—
3	—	—	—	—	—	—	—	C	ccBA	cc	cc	cc	cc	cc	cc	ccNA	ccNA	ccA	ccA	ccA	ccc	cc	cc	C
4	cc	cc	cc	cc	cc	cc	f	CA	cc	ccc	ccc	ccc	ccc	ccc	ccNA	ccNA	ccNA	ccNA	ccA	CS	ccc	ccc	C	cc
5	ccw	—w	ccw	—	—	Cw	CAw	Cw	ccw	ccc	cccB	ccA	ccwB	fEA	CEA	ccAE	ccNA	CA	ccAB	ccAB	ccAw	ccc	ccc	—w
6	—w	cccw	cc	cc	C	f	CA	fN	Cw	CN	ccB	cc	cc	ccc	ccN	CNA	ccNA	ccAN	CA	CA	ccA	ccAT	cccN	cc
7	C	cc	ccc	cc	cc	C	f	fN	CN	cc	cc	cc	ccN	cc	ccNA	ccAE	ccNA	ccA	ccA	ccAB	C	f	cc	CA
8	—	cc	cc	ccc	ccc	C	fE	CEA	ccE	cc	cc	ccN	ccA	cc	CNr	cc	ccNA	ccA	ccA	cc	cc	cc	cc	
9	cc	—	cc	—	cc	CE	f-N	fE	ccc	ccA	cc	ccA	ccA	cc	ccN	ccNA	ccNA	ccNA	ccSB	CSB	CS	C	—	cc
10	cc	—	—	ccc	cc	C	CA	fA	ccc	—	ccc	ccA	ccA	cccA	ccA	ccA	ccA	-T	-T	-TS	ccc	ccc	cccBw	cc
11	C	C	f	C	cc	fE	C	Cr	cc	ccc	ccc	ccA	ccc	cccA	ccAB	ccEN	ccA	ccNA	cccw	ccAw	ccN	ccc	ccA	ccc
12	ccc	ccc	—	C	ccc	cc	ccA	Cr	cc	cc	ccA	ccc	cccA	ccc	ccA	ccNA	ccA	ccAw	ccAw	ccAw	cc	ccA	cc	cc
13	ccc	ccA	ccA	C	C	C	ccA	C-A	ccA	ccA	ccA	ccA	ccA	cccA	ccA	ccTA	ccNTA	ccNA	ccA	ccA	cc	ccA	ccA	cccA
14	ccc	—	cc	ccc	C	C	C	Cr	cc	cc	—	cc	ccA	—A	ccNA	ccA	ccA	ccA	ccA	CA	CA	ccA	ccA	cc
15	—	—	C	C	CAS	cc	CA	ccA	ccA	cc	ccA	cccA	ccNA	ccA	ccN	ccA	ccNA	ccA	ccA	cccA	ccAw	ccA	cc	ccA
16	cc	cc	C	C	cc	ccA	Cr	Cfr	Cfr	ccc	ccc	cc	cc	cccA	ccA	ccA	ccA	ccA	ccA	ccA	ccA	cccA	ccA	cc
17	—	—	ccc	cc	cc	cc	CAw	ccA	ccc	ccAT	ccA	cccA	—A	ccB	ccB	ccAB	ccAB	-BA	ccBA	CA	ccA	ccA	cc	ccA
18	—	ccc	ccA	cc	—N	ccc	ccA	CrE	ccB	ccAE	ccAB	cccA	cccB	ccAB	ccAB	ccAB	ccAB	ccAB	CBA	cccA	ccA	—A	CA	CAE
19	ccA	ccAE	ccN	cc	—	ccc	ccA	CEA	CE	ccAB	ccAB	ccAB	ccAB	ccNA	ccAB	ccA	ccA	cccAB	-B	ccAE	cccA	ccAw	cccw	CEA
20	fBAE	fBAE	ccBA	CE	cc	cc	ccA	EFA	ccAB	ccAB	cc	cccB	ccB	ccE	ccAB	ccAB	ccAB	ccAB	-By	ccAE	CAE	cccA	ccA	—
21	ccc	ccc	cc	cc	ccc	cc	ccA	CAE	ccAw	ccA	ccA	ccA	cccA	ccEA	ccA	ccA	ccAB	ccABS	ccAB	cccA	cccA	—	cc	—
22	ccc	cc	cccA	—	ccc	cc	C	ccNE	cc	cc	cc	ccc	cc	cc	cccA	ccNA	cccA	ccAB	ccA	cccA	cccNA	cccNA	—	—
23	cc	ccc	cc	—	ccc	cc	cc	ccA	ccc	ccA	cc	ccc	ccN	ccNA	ccNA	ccNA	ccA	ccAT	ccAT	ccA	N	—	C	cc
24	ccc	cc	—	ccA	ccc	ccc	Crf	CrA	cc	ccc	ccA	ccc	ccA	ccA	ccA	ccA	ccA	ccAB	-B	ccAB	ccc	cc	cc	cc
25	cc	ccc	cc	cc	ccc	—	CA	ccAE	ccA	ccA	ccA	ccA	ccA	cc	ccA	ccA	ccA	ccA	ccA	ccA	cccA	cccA	ccAE	CEA
26	ccE	ccE	ccc	ccc	cc	cc	cc	ccE	-BT	cc	ccA	cccA	cccA	ccNA	ccN	ccNA	ccA	A	ccc	—	cc	ccw	ccw	ccE
27	fE	f	—	ccc	C	cc	C	cc	—	ccc	CB	cc	cccw	ccNA	ccNE	ccAN	ccEAB	-BE	ccBw	-EB	ccwB	CBE	-BE	ccSB
28	-BE	CBE	ffEB	-BE	CwE	cc	f	fE	CE	ccB	cc	-B	ccBA	ccBA	ccA	ccA	ccA	-BE	-BE	CEA	ccAE	CEA	-BE	CA
29	ccA	ccA	cc	ccS	—w	-Bw	ccw	ccw	cccwS	-BE	CBE	-Bw	cc	cccw	CMf	ccN	cc	Cw	ccc	ccc	cc	fw	fw	ff
30	f	f	ff	f	Cw	ccc	ccc	cc	cc	—BE	—BE	cccA	ccc	cc	ccc	ccNA	ccAN	cc	ccc	C	C	C	CE	f
31	f	f	CE	cccw	cccw	C	ccA	ccA	cccA	cccA	ccc	cccA	cccA	cccA	cccA	ccA	ccA	ccAB	ccAB	ccc	ccc	—	ccBE	—w
S_i	8+120 6+12+5	5+126 6+16	4+130 9+10	7+20 18+4	9+20 21	4+124 30+8	2+120 42+16+5	1+120 42+24	7+132 18	10+132 3	6+142 6	12+134	9+42	10+130 3+4	4+148 9	2+158 3	1+160	1+46 6	4+38 4	7+128 31	9+130 18	8+22 18+8	4+136 14+4	3+126 18+9
ΣS_i	51	53	53	49	50	66	84	87	57	45	54	46	51	53	61	63	61	53	51	56	57	56	56	56
N	28	29	30	28	29	29	30	31	30	29	31	29	31	31	31	31	31	27	26	29	31	31	29	30
P	1.82	1.83	1.77	1.75	1.72	2.28	2.8	2.81	1.9	1.55	1.74	1.59	1.65	1.71	1.97	2.03	1.97	1.96	1.96	1.93	1.84	1.81	1.93	1.87
	$\frac{3+1}{4}$	$\frac{4}{4}$	$\frac{1+2}{3}$	$\frac{4}{1}$		$\frac{2}{2}$	$\frac{4+1}{5}$	$\frac{6}{6}$				2356 2263 4619		$\frac{1}{1}$								$\frac{2}{2}$		$\frac{1+1}{2}$

$P_d = \frac{46.2}{24} = 1.93$

$N_d = 30$

Tabela November 91

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ccc	cc	cc	c	ccBE	ccc	sc	c	ccw	cc	ccA	cccA	cccA	ccA	ccc	cccA	cccA	ccAB	–B	ccc	ccw	cc	cc	cc
2	ccc	cc	c	c	c	cA	ccA	ccAE	cccA	A	ccA	ccA	cccA	ccA	ccA	ccA	ccA	cccA	–BT	cc	cc			c
3	c	c	cc	cc	cc	cc	cccA	cA	ccA	ccA	cc	ccEA	ccBA	ccAB	ccAB	ccAB	–T	–T	–T	ccA	ccA	ccAE	cECH	–
4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	cc
5	cc	ccc	cc	cc	cc	cc	cc	c H	cccA	ccc	ccA	ccA	ccc	cc	cABE	ccAB	ccA	ccAT	–T	ccN	cc	cE	cE	cc
6	c	c	c	c	ccc	cc	ccA	cc	cc	ccA	ccA	ccA	cccFA	ccA	ccA	ccA	cc	ccAET	–BE	⊕E		ccc	ccc	ccc
7		c	c	cc	cc		ccA	c~	cc	cc	ccc	ccA	ccA	ccA	ccNA	ccA	ccA	ccA	ccA	ccN	cec			cec
8	ccc	w	w	cccw	ccw	⊕(to)	cc	ccA	ccA	cccw	ccAw	ccc	ccAEB	ccA	ccc	ccA	ccA	ccAT	–WB	A	ccc		eB	–B
9	–B	–B	–B	cB	cB	⊕	c	⊕	–B	⊕E		c~	ccA	ccA	⊕NA	A	cccN	ccc	.	cc w	ccc	cc	⊕BE	C
10	w	cw	ccw	ccw	w	w	cc	c~	c	cEB	⊕EB	cEB	cEB	cEB	ccN	ccEN	ccAEN		–	–	–	–	–	–
11	–	–	–	–	–	–	ccEA	ccA	ccA	ccc		ccc	ccA	cc	ccch		ccAw	ccAw	–	–	–	–	–	–
12	–	–	–	–	–	–	cc	cccNE	ccc	cc	cc	ccc	ccc	cckA	ccc	cc	ccB	ccNA		cccA		ccAN	cccA	N
13		ccBE	ccBE	cc	cc		ccA	ccN	ccc	ccc	ccc	ccA	NA	cc	cc	ccc	cc	ccNA	ccNA	ccFA				
14						ce	ccA	cc	cc	cc	cc	cc	cc	ccA	cc	ccN	ccA	ccAN	ccA	cc		ccc		ccN
15	ccc	cc	cc	ecc			cc	–	cc	cc	ccA	ccA	cccA	cc	cc	cc	cc	cc	ccNA	cE	ccc	cc	ccc	ccc
16	ccc	–	ccc	ccc			cc A	cc	cc	cc	cc	ccA	ccA	cc	cc	ccc	ccA	cNB	ccc	ccA	A	cc		cc
17	ccc	ccc	ccc	ccc	ccc	cc	ccA	ccNA	ccA	ccc	ccA	ccA	ccA	ccA	cc	cccA	–B	–B	cccE	cccE	cc	cc	ccBE	cc
18	ccc	ccc	cc	cc	ccc	cc	c	ccA	cccA	ccc	cccA	cccA	ccA	cc	ccA	ccA	ccABS	ccABS	ccA	cc		cc	cc	
19	cc	c	c	c	⊕⊕	c	c	c	ccBA	ccBAE	c	–	–	–	–	–	–	–	–	–	–	–	–	–
20	–	–	–	–	–	–	–	cc	cc	cc	⊕~	cccA	⊕~	ccA	ccA	ccA	ccASB	–BS	ccc			ccc		ccc
21	cccw	cc	ccc	cc	BW	BH	c	cA	–	ccc	ccA	cc	ccA	cc	ccA	ccA	ccAB	ccA	cccA	cccA	cccA	ccA	.	ccc
22	ccc	cc	ccc		cc	cc	c	c	cc	cc	cc	cc	ccc	cc	ccA	ccA	ccBEA	⊕E	C	C	cE		ccc	cc
23	ccc	ccc	cN	⊕	⊕	⊕	c	cc	ccc	ccc	ccN	cccA	ccc	ccc	ccNA	ccNA	cccNA		cc	cc		cc	ccc	⊕
24	cccN	ccc	cc	c	c	cS	cc	ccA	ccA	ccN	ccNA	ccN	ccN	ccNA	ccNA	ccNA	cccNA	cccN	ccc	⊕E	cE	⊕E	⊕⊕	⊕⊕
25	⊕⊕	⊕⊕	⊕⊕	⊕⊕	c	⊕	ce	ccNA	cc	ccc	ccN	ccNA	cccN	ccN	cccNA	ccA	ccN	ccc		ccc	–E	⊕B	cc	ccc
26	c	⊕	⊕⊕	⊕w	c	⊕w	c	cc	ccA	cc	cccN	cc	cc	cc	ccN	ccN	ccNA	cc	cc	ccc		c	cc	
27	cc	ccc		cc	cc	ccc	cc	ccN	ccA	cccN	ccN	cc	cc	cc	ccNA	ccN	c	ccc					ccc	cc
28				ccc	ccc	cc	c	⊕	⊕E	c	cc	ccN	cc		ccA	ccA	ccAN	cc	c	c	cE			cc
29	ccc	–	–	cc	cc	cc	c	cc	cc	ccc	ccc	ccc	ccc	cccE		ccc	ccc		ccc	cc	cE	cE	–	
30	–	–	–	–	–	cS	cc	c	ccNE	cccA	ccNA	ccN	ccNA	ccNA	ccN	ccN	ccNA	cc	E	ccc	cccN	cc	c	
31																								
S_i	12+6 9+5	7+10 15+4+6	5+14 15+5+6	6+16 18+8,5	5+16 15+4,5	2+18 12+20	1+36 27	2+30 17+8	5+40 3+4	12+26 6+4	6+36 3+8	8+36 6	11+28 3+4	5+42 3	5+10 3+4	5+42	6+38 3	6+28 3+4	7+12 6	7+22 9+8	6+10 +12	3+22 9+8	6+10 9+4+5	8+4 6+4+5
ΣS_i	32	42	45	53	45	52	64	57	52	48	53	50	46	50	52	47	47	41	25	46	28	42	44	37
N	24	24	24	25	25	26	28	28	27	28	29	28	28	28	28	28	26	25	20	26	25	26	25	25
P	1.33	1.75	1.88	2.12	1.80	2.00	2.29	2.04	1.93	1.66	1.83	1.79	1.64	1.79	1.86	1.68	1.81	1.64	1.25	1.77	1.12	1.61	1.76	1.78
	1	1+1 = 2	1+1 = 2	2+1 = 3	1+1 = 2	5 = 5		2 = 2	1 = 1	1 = 1	2 = 2		1 = 1		1 = 1 (27,7)			1 = 1		2 = 2		2 = 2	1+1 = 2	1+1 = 2 (14,1)

$P_m = \frac{41.8}{24} = 1,74$

$N_d = 32$

Tab. 11. January 1997 Scattering F
December

d \ h	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	C	cc	C	C 3-5		cc		C	
22	cc					ccc	—	—	—	cc 7-10	cc 7-10	C	cc	cc	C	C		ccc	ccc		ccc	cc	cc	
23	cc 3-4	C	C	ccc	cc	cc	cc	cc	C	cc 6-13	ccc 7-11	ccc 7-11	ccc 7-9	cc 7-5	cc 7-9	C 6-9		ccc	cc	cc	cc 2-4			ccc
24			ccc	cc		ccc		ccc	ccc	cc 8-11	cc 7-11	cc 7-11	cc 8-11	cc 7-10	cc 7-11	cc 5-f₀	ccc 7-9,6₀	ccf		ccf	cc 4-5	ccc	ccc	
25	.		ccf₀	cc 2-4	f,f₀	f,f₀	f,f₀	cc f₀	cc 7-9,5₀	cc 7-11,5₀	cc 8-14	ccc	cc 10-f₀	ccc	cc 7-9,6	cc 7-9	ccc			C 4-5,3	cc	C 4-6	ccc	C 4-6
26	C	cc	cc		ccc	cc	ccc	cc	C	cc 7-12	13	cc 7-f₀	cc 7-f₀	ccc 7-f₀	cc 6-f₀	cc	—	—	—	—	—	—	—	—
27	—	—	—	—	—	—	—	—	—	—	—	—	cc		cc 7-6	—	cc 7-8	ccc 6	ccc		C 2-2	ccc	ccc	ccc
28	cc	ccc	ccc			ccc	cc	ccc 6-7	T	ccc	ccc	cc	ccc	cc 8-f₀	C 8-12	cc 7-9					cc f₀	cc		ccc
29		ccc	cc 2-4				cc 4-6	cc 7-10	C 6,5-12	ccc	ccc	ccc	cc 7-10	ccc	ccc 7-f₀	cc 7-9	cc f₀	ccc 6-7	—		ccc	cc		C
30	C	ccc	ccc			cc	ccc	cc	ccc	ccc	ccc	cc 7-3			cc 7-14	cc 6-8					ccc			
31	ccc		ccc	cccf₀		cc	ccc	ccc 6-10	cc 7-11	cc				cc 7-10		cc		cc 5-8₀		ccc	ccc	ccc	ccc	—
Σkᵢ	6+4+ +1	3+2+ +3	3+4 +5	4+2	4+2+ +1	4+6+ +3	4+6 +3	10+3	9+4+ +2	12+3	2+5	3+6+ 4	10+3	6+5	6+4+ 5	9+10 +2	6+ +2	3+2+ +5	3+2 +2	3+3	3+6+ 6	3+2+ +5	2+4	6+3
Σkᵢ	11	8	12	8	7	13	13	13	15	15	7	13	13	11	15	21	8	10	7	6	15	10	6	9
N	9	9	9	9	9	9	8	8	8	9	9	9	10	10	10	10	10	10	9	10	10	10	10	9
Pₕ	1,22	0,9	1,3	0,9	0,8	1,4	1,6	1,6	1,9	1,7	0,8	1,4	1,3	1,1	1,5	2,1	0,8	1	0,78	0,6	1,5	1,0	0,6	1,0
f					1	1	1				December 1997													
1	ccc	cc	ccc		C N	N	C	(1)A	(1)E	ccA	ccA	ccNA	ccA	ccA	ccNA	ccNA	ccNA		ccc	ccc	ccc		ccc	cc
2	cccN	ccN	C	C	ccc	cc	ccc	ccFA	(C)FA	ccNA	ccA	ccA	ccNA	ccNA	ccNA	ccNA	ccA	ccNA	N	N	ccE	cc	ccc	ccc
3	ccc	ccc	ccc		ccN	ccc	ccc	ccE	ccNEA	ccT	cccN	cccN	ccN	ccN	ccA	ccN	cc		ccNA	ccE	E	cccN	ccc	cc
4	cccN	C		C f₀	C	(f)	cc	cc	ccFA	ccA	ccc	cccN	N	ccN	cc	ccN	ccNA	cccN	ccc	ccc		ccE		
5	ccc		ccc	ccc	cc	ccc	ccc	ccA	ccA	ccc	cc		ccc	ccc	ccN	ccNA	ccN	N	ccc	N	(C)E	ccS	ccE	—
6	cc	C	C		ccc		(f)	(f)E	(f)E	ccN	cc	cc	ccN	ccN	ccNA	ccNA	ccN	N	ccE	ccE	(f)EA	ccc	cc	
7	ccc		cc		ccc	ccc	cc	ccE	(f)EA	(C)—	ccM	ccM	ccM	ccM	(C)AM	(C)AM	(C)AM	ccc	-BE	(f)E	(f)E	(f)NE	(f)E	(C)E
8	ccE	C	C	(f,f)	(f,f)	(f)	C	C	C	(f)E	C	ccN	(C)N	(C)N	(C)NA	ccNA	cONA	ccM	ccE	(C)E	(f)	(f)	(f)	(f)
9	cc	ccc	ccc	ccc	cc		cc	cc	ccA	ccc	ccA	ccA	ccNA	ccc	ccA	ccN	ccA	cccE	ccA			ccc	cc	cc
10	cc	cc	cc	cc	ccc	cc		ccA	ccHN	ccA	ccA	—	—	—	—	—	—	—	—	—	—	—	—	—
Σkᵢ	6+8	3+4+9	4+4+9	2+2+6 +5	5+4+ 6+5	3+4+ 4+5	3+6+6 +4	1+12+ 3+8	10+ 6+12	2+12+ 3+4	3+12+ +3	2+12	1+12+ +2	2+12+ +3	+6 14+	16+3	2+12+ +3	4+2	4+6	3+2+ +3+5	1+2+ +3+8+5	3+6+ 8	3+6+ +8	1+6+ +3+4
Σkᵢ	14	16	17	15	20	16	19	24	28	31	18	14	16	17	20	19	17	6	10	13	19	17	17	14
N	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9	8	9	9	9	9	8
Pₕ	1,4	1,6	1,7	1,5	2,0	1,6	1,9	2,4	2,8	2,7	1,8	1,56	1,78	1,89	2,22	2,11	1,89	0,67	1,25	1,44	2,11	1,89	1,89	1,75
				1/1	1+1/2	2+1/3	2/2	2/2	3/3	1/1										1/1	2+1/3	2/2	2/2	1/1
P_h (J+D)/2	1.31	1.25	1,5	1,2	1.9	1.5	1.75	1.5	2.35	1.9	1.3	1,48	1.52	1.5	1.56	2,11	1.35	0,84	1,01	1,02	1,81	1.45	1,25	1.38

20,46

15,53

$P_d = \frac{36}{24} = 1,5$

$N_d = 23$

Table 12. Spread F 3-hour range indexes for October 1991; Roquetes, Spain.

day/LT	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24
1	5	5	7	4	7	6	6	7
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	6	6	10	4	3	6	7	5
5	0	0	0	0	0	0	0	0
6	3.2	7	11	8	5	7	8	5
7	8	5	11	7	6	6	6	9
8	2.4	4	10	6	6	7	6	6
9	4.2	4.2	11	5	6	6	7	6.2
10	0	0	0	0	0	0	0	0
11	7	9	10	4	4	6	5	5
12	4	4.2	7	6	3	6	6	6
13	4	8	8	6	5	6	6	6
14	3.2	6	9	4.2	4.2	6	7	7
15	0	0	0	0	0	0	0	0
16	6	8	8.	5	5	6	6	5
17	4.2	4.2	6	5	3	5	6	5.2
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	2.2	5	7	6	5	6	5	3.2
22	3.2	2.2	7	6	5	4	5	2.2
23	6	3.2	6	5	5	6	6	3.4
24	6	5	5.2	6	6	6	6	4
25	13	12	4	2.4	4	5	6	9
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	8.2	5	7	3	3	4	5	3.2
31	8.2	5	7	3	3	4	5	3.2

Table 13. Spread F 3-hour range indexes for August 1991; Roquetes, Spain.

Day/LT	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24
1	6	10	8	4	6	6	6	9
2	5.2	2.4	7	6	5	4	5	4
3	0	0	0	0	0	0	0	0
4	4	6	8.2	3.2	6.2	3.4	3.2	7
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	9	4.2	6	4	3	6	6	7
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	5	3	7	3.4	2.2	5	6	6
14	0	0	0	0	0	0	0	0
15	3.4	5	8	6	5	7	6	6
16	0	0	0	0	0	0	0	0
17	12	10	7	6	4	4	5	8
18	7	11	6	3	4	3.2	6	7
19	8	7	6	3	7	5	6	7
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	7	12	6	6	5	6	6	7
24	11	12	12	7	2.2	5	6	6
25	7	7	9	7	5	6	6	7
26	8	7	9	4.2	3	5	8	7
27	7	9	11	6	6	3.2	6	3.2
28	10	7	6	5	6	5	6	8
29	0	0	0	0	0	0	0	0
30	8	6	6	4	6	6	4.2	4.2
31	0	0	0	0	0	0	0	0

Table 14. Spread F 3-hour range indexes for May 1991; Roquetes, Spain.

day/LT	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24
1	0	0	0	0	0	0	0	0
2	6	5	10	1.4	3.2	2.2	4	6
3	5	8	9	4.2	2.2	3	5	4.2
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	6	5	4	3.2	3.2	2.2	2.2	3.2
7	4	5	4	2.2	4	4	3.2	3
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	2.4	6.2	7	1.4	0.6	7	8	3
11	5	8	11	7	4	4	8	5
12	5	8	7	6	5	4	9	6
13	0	0	0	0	0	0	0	0
14	4.2	9	7	6	1.4	3.2	3.2	4.2
15	1.4	1.4	6	4	0.6	4	8	6
16	0	0	0	0	0	0	0	0
17	3.2	3	2.2	0.6	1.4	2.2	3	5
18	0.6	3	4	4.2	1.4	3	4	4
19	0	0	0	0	0	0	0	0
20	4	5	9	4.2	2.2	3	5	3
21	0	0	0	0	0	0	0	0
22	7	10	12	3.2	2.4	5	5	2.2
23	6	4	8	3	3.2	4.2	4.2	2.2
24	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
27	5	7.2	5	5	4	1.4	5	2.2
28	7	12	9	3	2.2	2.2	4	4
29	0	0	0	0	0	0	0	0
30	7	11	3.2	5	1.4	4	4	4
31	0	0	0	0	0	0	0	0

Table 15. Ionospheric data; Roquetes, Spain, 23 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F	h'F2
1	7.1		480	5.9	363	
2	7.2		375	6.0	293	
3	6.6		400	5.5	305	
4	6.0	400			335	
5	6.2	400			328	
6	7.3 ^		350	5.42	295	
7	9.3 ^	310			250	
8	11.2	320			248	
9	12.2	310			238	
10	13.2	330			275	220 F1
11	13.2	325			340	220 F1
12	13.0	325			260	
13	13.0	350			390	250 F1
14	13.0	355			375	240 F1
15	12.6	340			250	
16	11.6	320			250	
17	11.4	330			260	
18	11.0 ^	330			270	
19	8.6 ^	310			260	
20	9.0 ^	340			268	
21	8.0 ^	330			275	
22	8.2 ^	330			268	
23	8.8		370	7.3	278	
24	7.9	340			275	

^ - interpolated values because of the ARTIST program mistakes .

Table 16. Ionospheric data; Roquetes, Spain, 24 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F	h'F2
1	8.4		390	7.0	293	
2	8.6		410	7.2	298	
3						
4						
5	4.1		560	3.4	470	390 F1
6	3.7 ^ f		400	3.1	370	230 F1
7	5.0 ^ f		260	4.2	240	
8	8.7	350			235	
9	11.5	350			235	
10	11.6	350			390	220 F1
11	12.5	380			390	230 F1
12	12.8	380			340	240 F1
13	14.0	360			370	250 F1
14	12.8 ^	350			350	240 F1
15	13.5 ^	370			320	240 F1
16	12.6 ^	340			220	
17						
18	11.4 ^	330			275	
19	9.2 ^	320			270	
20	8.6 ^	330			260	
21	9.0 ^	350			290	
22	3.0 ^		420	2.5	340	
23	5.0 ^		595	4.2	480	
24	4.6 ^ f		600	3.8	510	

f - spread; ^ - interpolated values because of the ARTIST program mistakes .

Table 17. Ionospheric data; Roquetes, Spain, 25 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F	h'F2
1	5.7 ^ f		480	4.75	360	
2	4.3 ^ f		460	3.6	350	
3	4.2 ^ f		550	3.56	420	
4	4.0 ^ f		580	3.3	500	
5	4.2 ^ f		570	3.56	470	
6	5.1 f	400			350	
7	6.7 f	320			285	
8	6.0		320	5.0	275	240 F1
9	6.2 ^		550	5.17	540	240 F1
10	6.7 ^		480	5.6	450	220 F1
11	7.2 ^		550	6.0	510	260 F1
12	7.0 ^ w	350			500	230 F1
13	7.3 w	320			490	230 F1
14	7.3 ^	330			470	240 F1
15	7.5 ^	370			430	245 F1
16	8.2 ^	370			250	
17	8.0 ^	340			250	
18	8.3 ^	320			275	
19	7.6 ^	350			270	
20	6.7 ^	370			270	
21	6.0	420			340	
22	6.0 ^	470			360	
23	6.0 ^ f		530	5.0	400	
24	5.5 ^		570	4.6	430	

f- spread, w - very weak signal, ^ - interpolated values because of the ARTIST program mistakes.

Table 18. Ionospheric data; Roquetes, Spain, 26 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F	h'F2
1	6.2		500	5.2	375	
2	6.5	460			370	
3	5.7		530	5.0	365	
4	5.0 ^ f		560	4.2	440	
5	4.3 ^ f		540	3.6	430	
6	4.7 ^ f	330	410	3.9	340	
7	5.3 f		340	4.4	320	260 F1
8						
9	6.5 f		380	5.3	280	230 F1
10	7.9 ^	320	410	6.6	400	240 F1
11	10.0 E	290			318	
12	10.5	330			340	230 F1
13	11.3	330			320	220 F1
14	10.7	370			370	260 F1
15	11.7	350			250	
16	12.5	330			300	240 F1
17	11.3 ^	320			240	
18	9.0 ^	270			260	
19	8.2 ^	320			230	
20	7.9 ^	360			290	
21	7.9 ^ f	360			290	
22	6.8	430			300	
23	7.0 ^ f		480	5.8	350	
24	6.9		460	5.8	330	

f - spread, ^ - interpolated values because of the ARTIST program mistakes.

Table 19. Ionospheric data; Roquetes, Spain, 27 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F
1	7.5	425			320
2	7.7		420	6.4	300
3	6.6 f		420	5.5	300
4	6.2 ^ f	370			260
5	6.0 ^	380			280
6	7.8	310			250
7					
8					
9	13.1 ^				240
10	13.2	300			230
11	12.6	280			240
12	13.5	315			230
13	13.5 f	320			250
14	13.0 ^	325			240
15	12.9 ^	340			250
16	12.7	330			250
17	12.7 ^	320			250
18	11.7 ^	280			260
19	9.3 ^	290			220
20	8.8 ^	300			260
21	8.0 ^	300			240 E
22	7.0 ^		400	5.8	320 E
23	7.0 ^ f		450	5.8	400 E
24	6.0 ^ f E		470	5.0	400 E

Table 20. Ionospheric data; Roquetes, Spain, 28 March 1991.

LT	foF2	hmF2	hpF2	fpF2	h'F
1	7.7 f		470	6.4	320
2	6.1 f		470	5.1	350
3	5.9		470	4.9	340
4	5.5 f		475	4.6	360
5	5.3 f ^		460	4.4	340
6	6.2	300			260
7	8.5 ^	270			230
8	10.0	280			230

f - spread, E - blanketing by Es, ^ - interpolated values because of the ARTIST program mistakes.

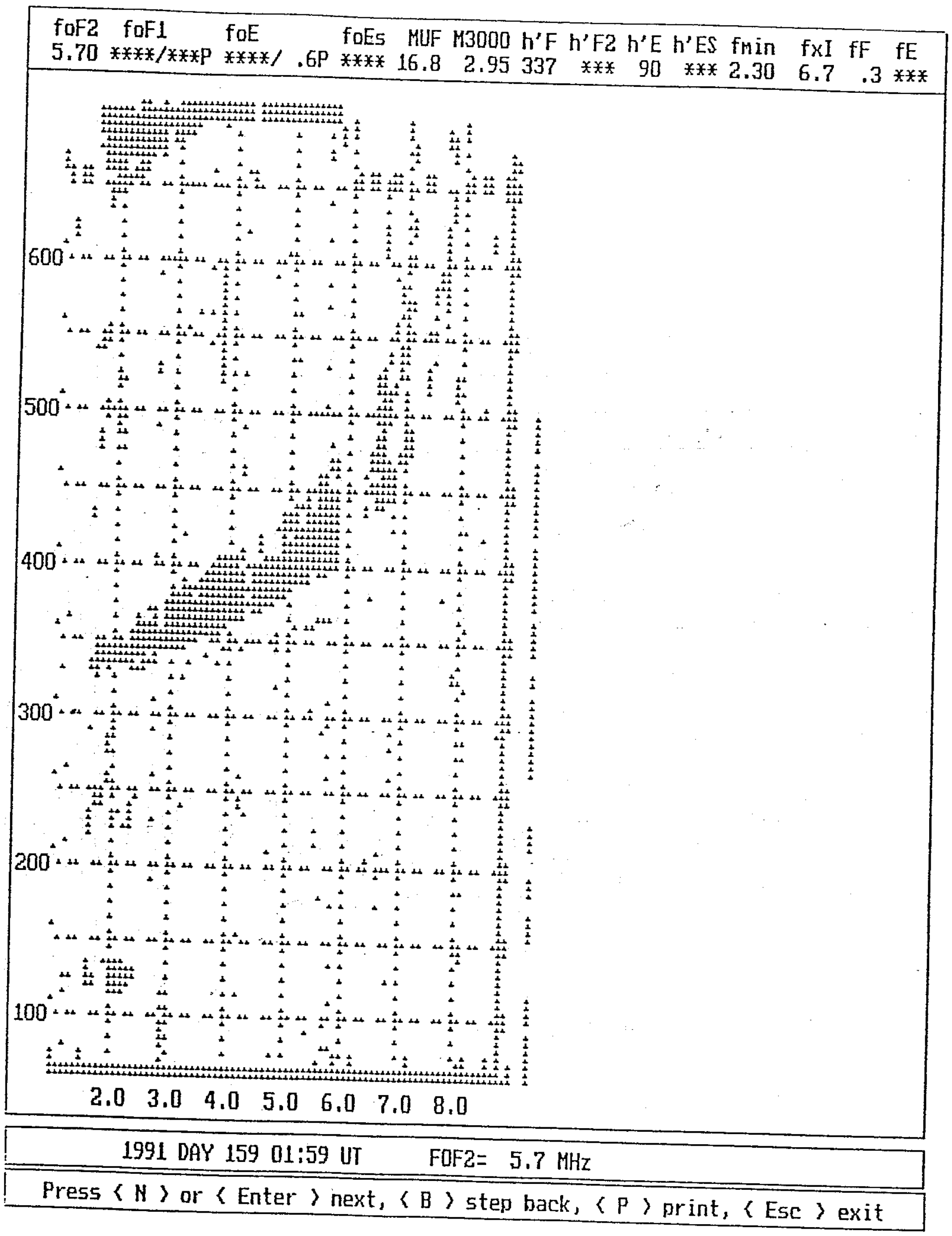

Fig. 1. 8 June 1991, index ffA

Figures 1-9. Examples of ionograms with F spread.

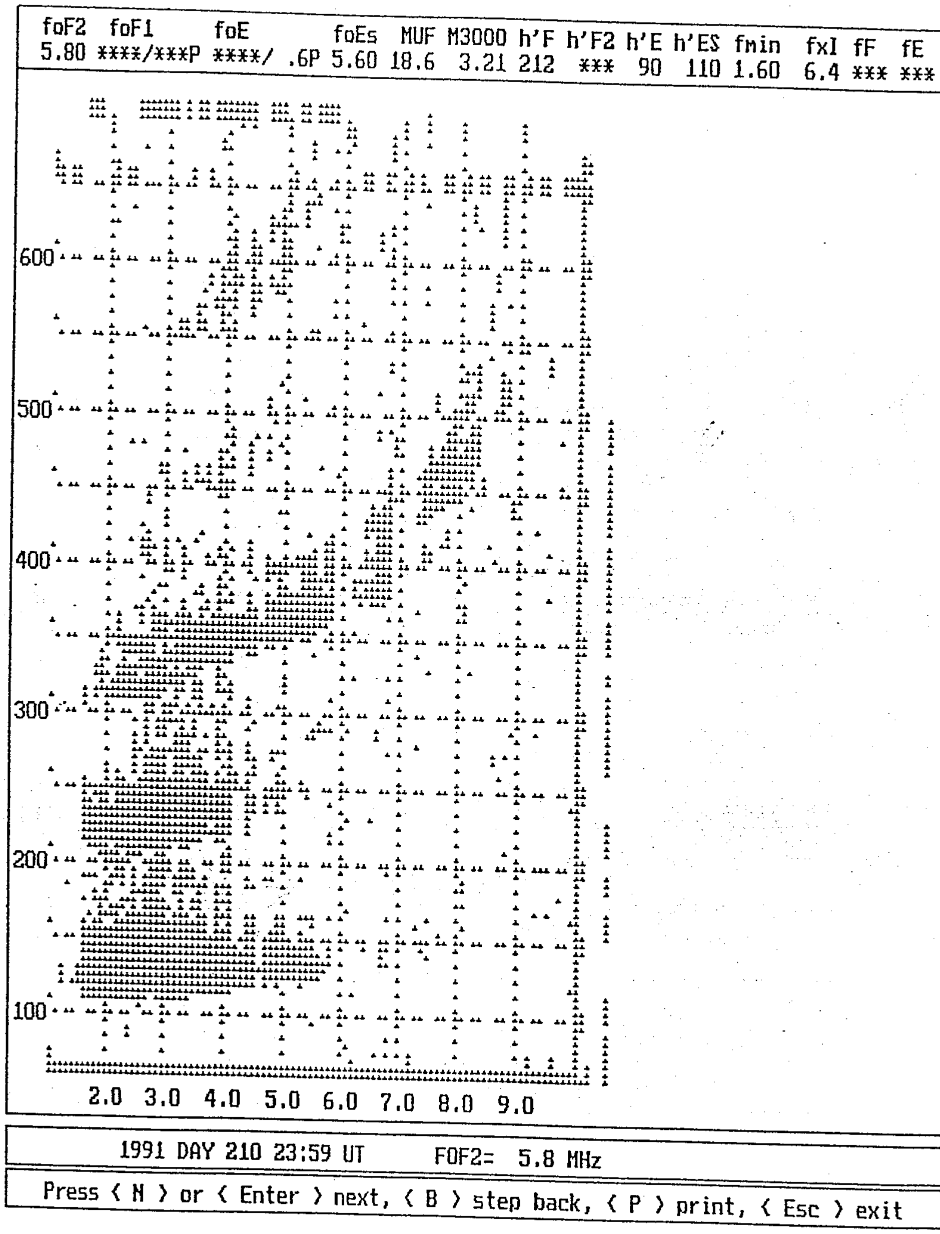

Fig. 2. 29 July 1991, index fffA

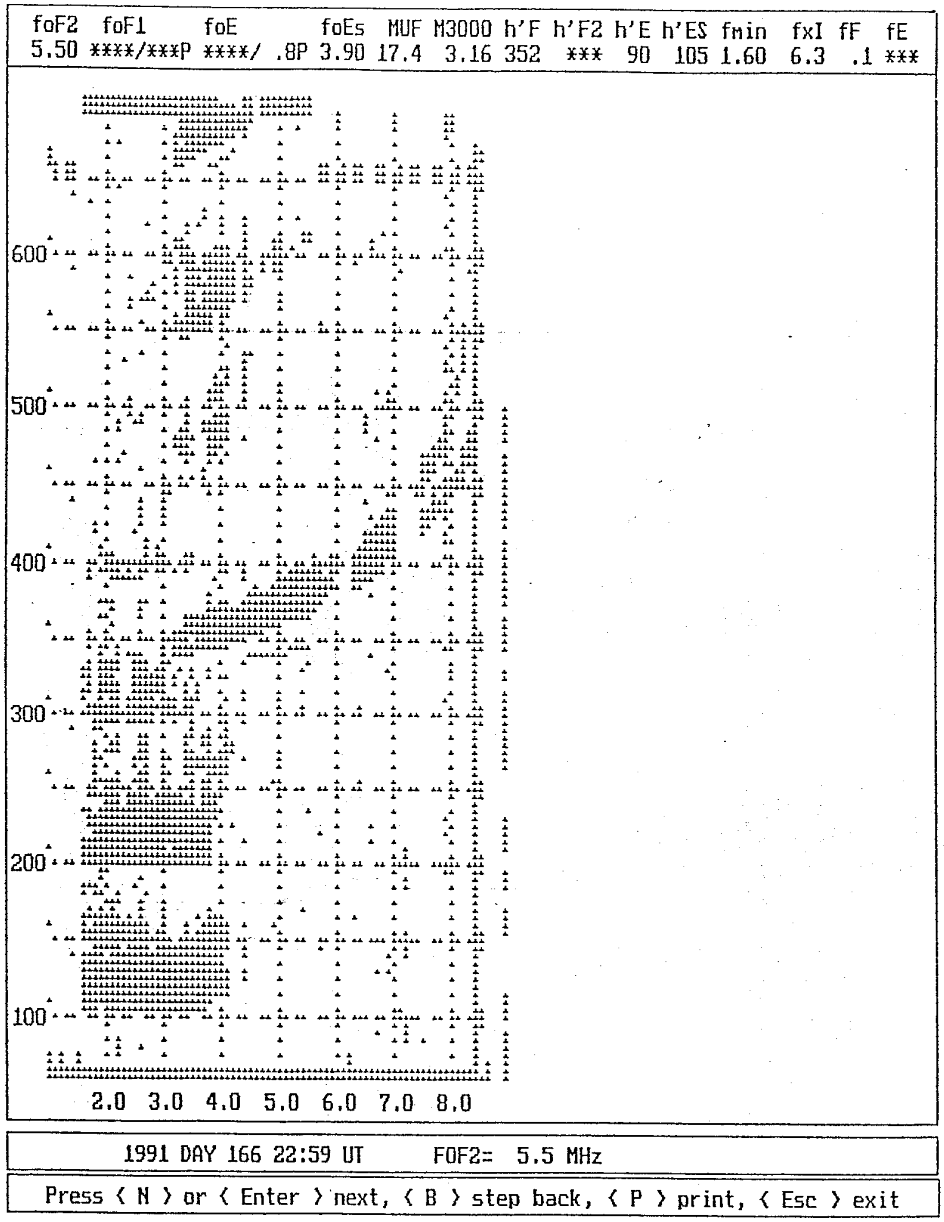

Fig. 3. 15 June 1991, index fA

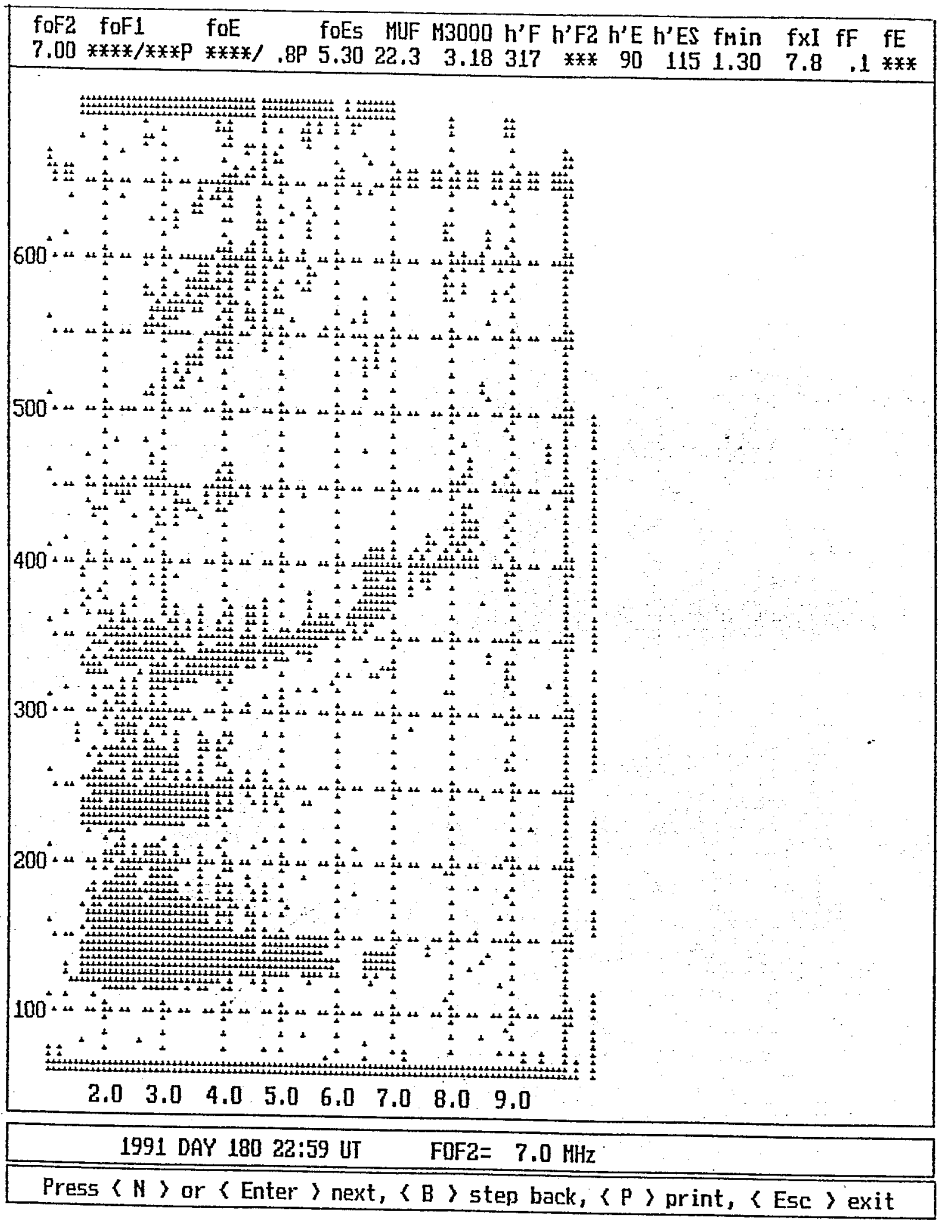

Fig. 4. 29 June 1991, index f

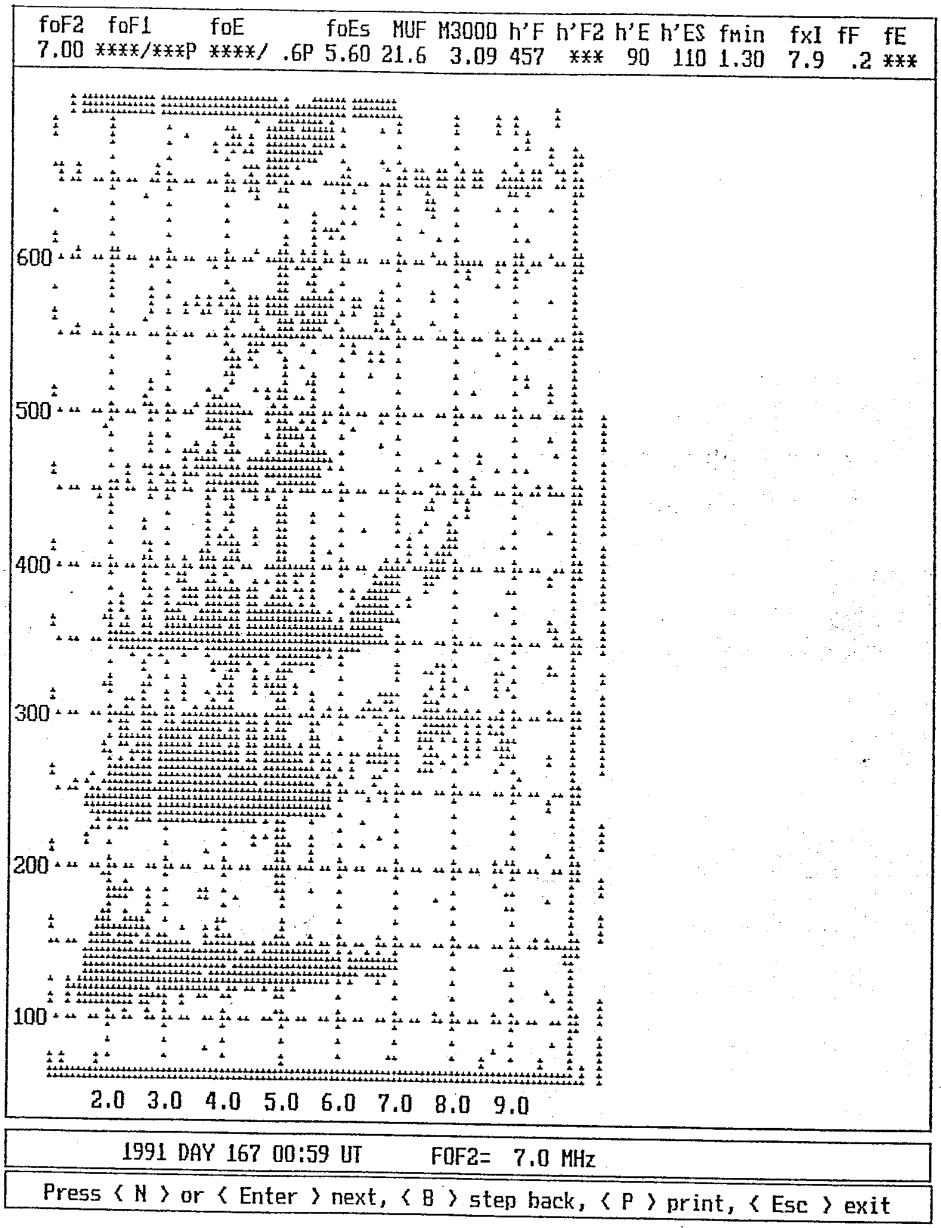

Fig. 5. 16 June 1991, index fBE

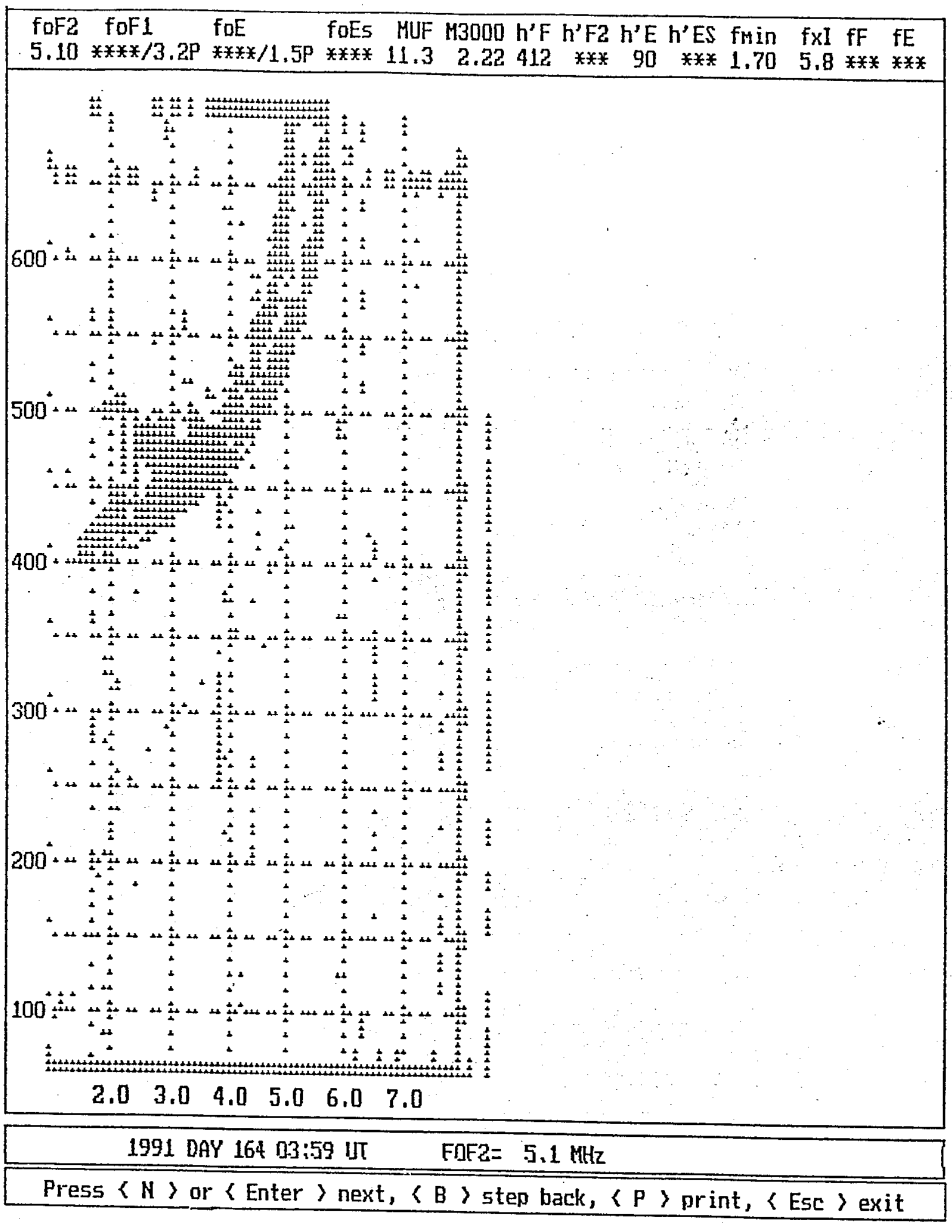

Fig. 6. 13 June 1991, index fr

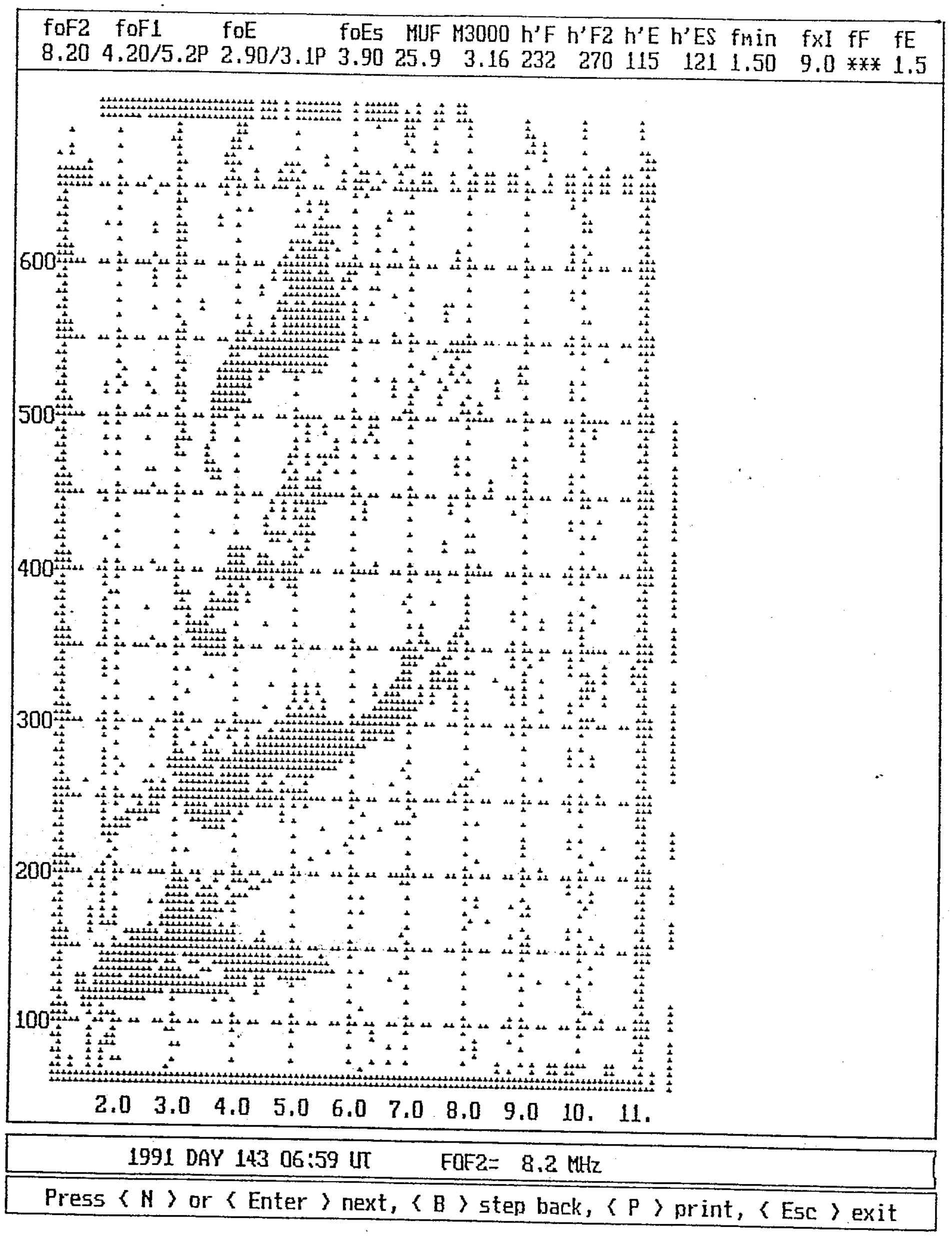

Fig. 7. 23 May 1991, index cr

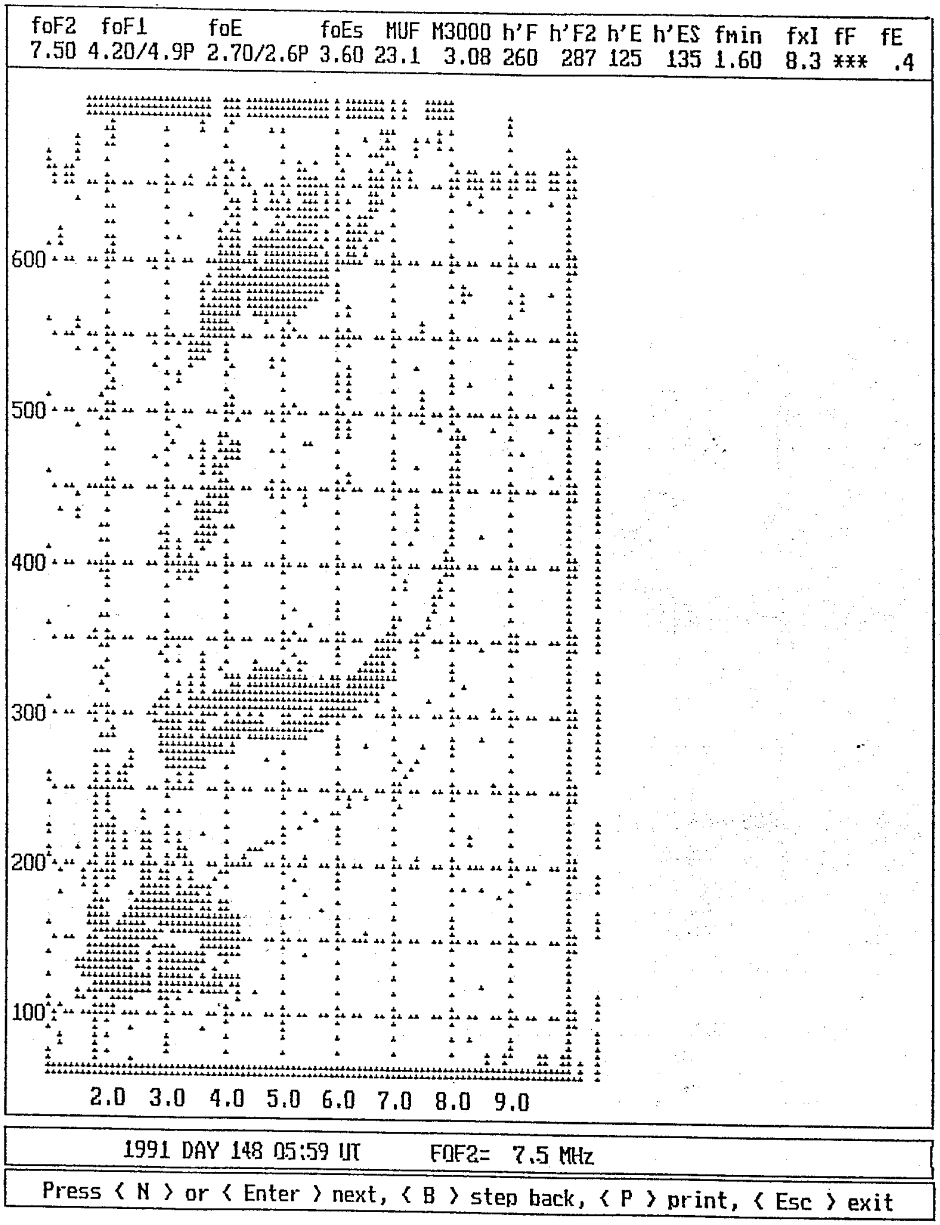

Fig. 8. 28 May 1991, index frE

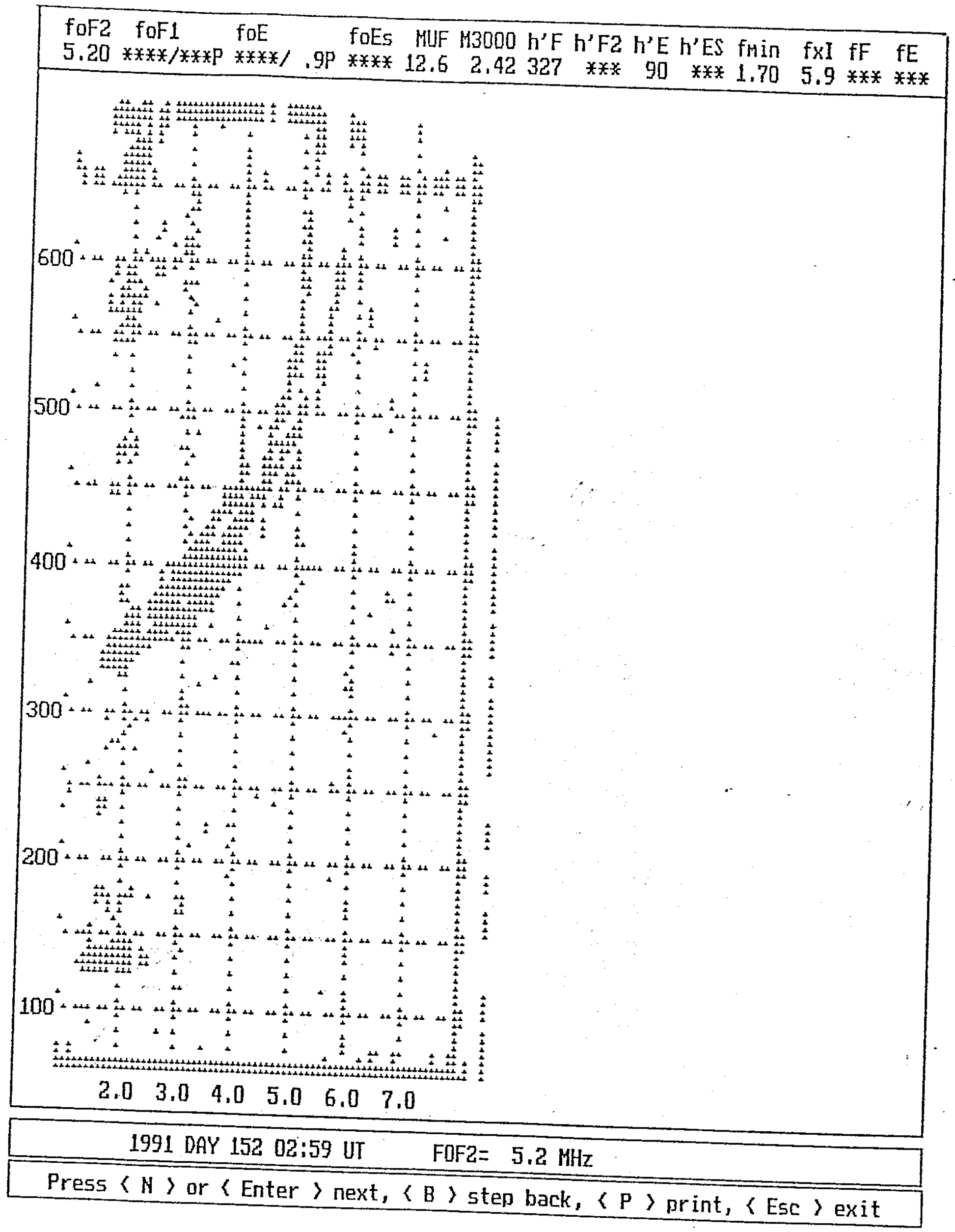

Fig. 9. 1 June 1991, index fw

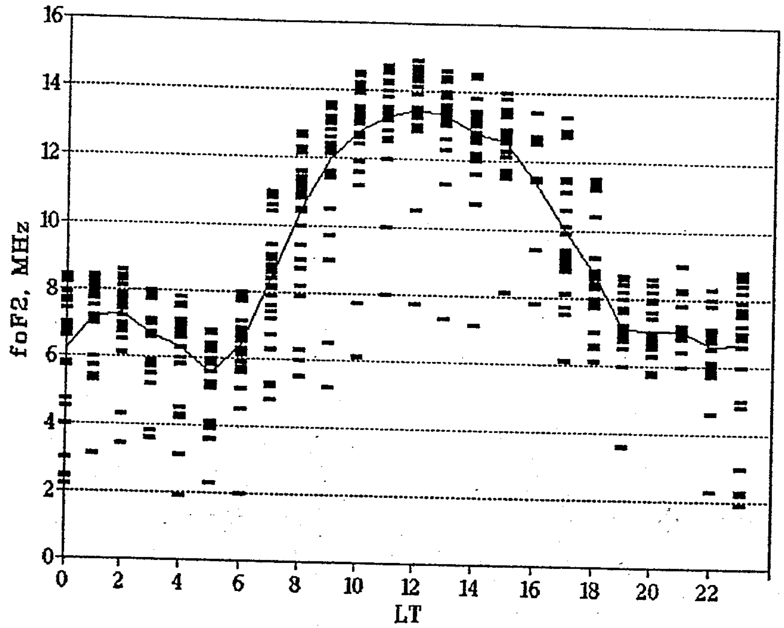

Fig. 10 foF2 values and mean value foF2 for March 1991, Roquetes, Spain.