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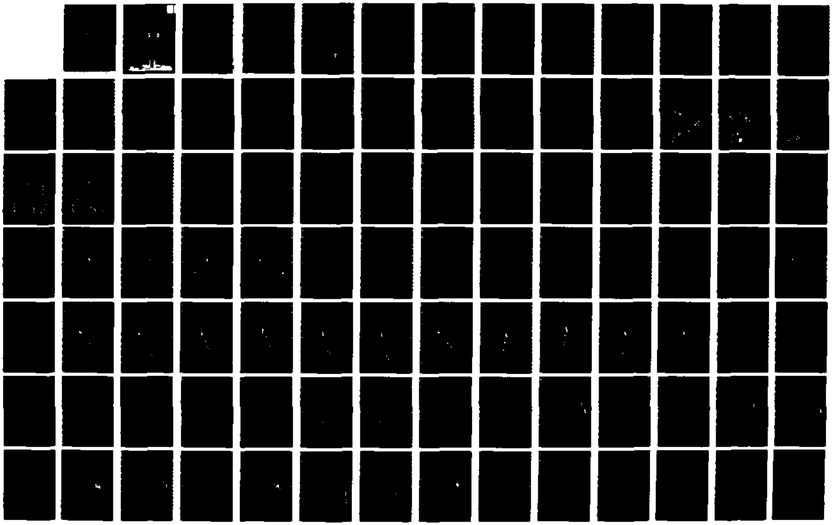

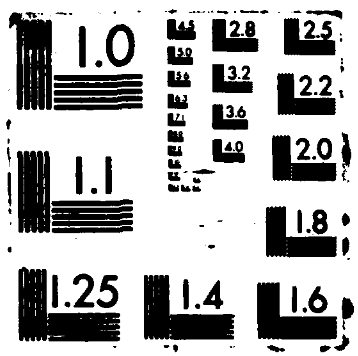
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OWEN R. COTE'
Chief, Geophysics and Space

ROBERT C. WINN, Lt Colonel, USAF
Chief Scientist

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Data report of 1986 cloud measurements of cap cloud on Great Dun Fell. PMS FSS probe measurements of particle size distributions from 0.5 to 47 micron radius. Barnes transmissometer measurements of cloud extinction in three spectral bands. Theoretical extinction coefficients to be derived from droplet spectra detected by PMS FSS probe. More extensive analysis to be reported later as UMIST PhD.

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STUDIES OF ELECTRO-OPTICAL ATTENUATION IN THE VICINITY OF CLOUD BASE

UNITED STATES AIR FORCE

AFOSR-85-0229

Final Technical Report
February 1987

Department of Pure and Applied Physics
U.M.I.S.T. Manchester M60 1QD

1. INTRODUCTION

During the period covered by this report the Barnes transmissometer has been operated at Great Dun Fell in three field projects. The results with the transmissometer in each project are briefly covered. The last project during May 1986 was the most successful and the data from it is still in the process of being analysed. A particular set of data from this project is covered in detail in this report; the results from a complete analysis of these data will be presented as a supplementary report at a later date. The transmissometer has been subject to minor repairs and additions since the last report and these are detailed.

2. MODIFICATIONS TO THE TRANSMISSOMETER

2.1. Introduction

Most of the changes to the measuring instrument have been as repairs to rectify faults that developed in the field during the projects and are detailed below. The recording computer dedicated to the system has remained unchanged, but the logging software has been updated. The present software, as used in the last project of May 1986 is explained below.

2.2. Repairs to the Source Unit

2.2.1. Heater Controller

Although working before it left Manchester, on arrival at Great Dun Fell in May 1985 the source unit of the transmissometer would not heat the black body cavity. The fault was traced to the thermistor sensor that is placed behind the cavity. No replacement thermistor was available so for the experiment of Spring 1985 at Great Dun Fell the heater was controlled by two potentiometers. This system worked fairly well but its stability over a period of time could not be guaranteed.

After the field project finished it was decided to replace the heater controller supplied with the transmissometer by a more recent temperature controller. The controller chosen uses a Type K thermocouple capable of measuring temperature to 1100°C and controls the glower unit heater via a solid state relay. The controller gives a two stage heating cycle, proportioning heating time to keep the sensor within 1% of the set temperature. The controller is Eurotherm type 103-140-03-026-19-04-00 and the sensor Eurotherm type MI-03-PTFE-2.0-F-3.0-150. The controller and sensor were ready for the field project in Autumn 1985.

2.2.2. Glower Unit

Before the start of the last project, in May 1986, the Barnes again ran in Manchester prior to shipment to Great Dun Fell. After operating for a few days the original glower unit developed a short between ground and the heating element. It was not possible to locate this fault as it only occurred when the black body cavity was hot. The replacement glower unit that had been supplied by RSRE since the previous project was installed at Great Dun Fell and worked without fault. Due to the compact insulation of the cavity in asbestos wool, and several cracks in the ceramic material it is made from, no attempt was made on return to Manchester to repair the old glower unit.

2.2.3. Filters

After the Spring 1985 project marks were noticed on the surfaces of all the filters purchased by UMIST. These were returned to the manufacturer, Glen Creston Instruments, to be checked. All three band pass filters proved to only have minor manufacturing blemishes or dirt on their surfaces. However the coatings on the 10.6 micron spike filter were breaking up. This filter was replaced by one of identical specification at reduced cost by the manufacturer. The two filters that were supplied by RSRE show signs of coatings breaking up below the outer surface of the filter. The signal received through them changes in strength across the area of each filter and their signal can no longer be used.

2.3. Receiver

The only change to the receiver unit has been to paint the interior of the cowl surrounding the pyroelectric detector black. This was to prevent a small change in signal seen when the ambient light level changed quickly, as when a small cloud passed across the sun.

2.4. Instrument Housing

2.4.1. Source Shed

After the Spring 1985 project the shed that housed the transmissometer source was replaced by a larger one. This allowed both more room to work on the source and for other instrumentation to be housed in the shed. A controlled heating system was also added which helped keep the temperature inside the shed above 10 °C. This solved the problem of the filter wheel speed changing as the motor and bearings became too cold for smooth running. This new shed was however damaged by rime falling on it during the Autumn 1985 project, which may have affected the alignment of the transmissometer. The shed was completely destroyed by a fall of rime later in the winter. The source unit was in Manchester at the time. It was only when the rime melted, in the second week of May 1986, that the old shed could be reinstated for the last project.

2.4.2. New Summit Building

During all of the projects the transmissometer source has been housed in a shed outside the main building on the summit of Great Dun Fell. The summit building has housed the main UMIST recording system and the transmissometer receiver. See Figure 1 for a plan view of the shed and summit building. The shed had to be removed during the last project due to construction work being carried out for the new building and radar station being built at Great Dun Fell.

In the future all work at the summit will be based in the new building and at the new position of the UMIST 4m platform. A new layout will have to be used for the transmissometer as it will no longer be possible to place the receiver at an open window in the main building. Due to most of the instruments being placed further away from the recording system inside the summit building, and therefore requiring more processing outside, it may be that the receiver could be moved to a new shed at the platform.

2.5. Software

2.5.1. General View

Since the last report, another magnetic tape based logging system has been added to the UMIST instrumentation at the summit. This has allowed more space to record the transmissometer signals. As before the signal from the detector is sent to one A/D channel on the controlling computer. The computer also receives a timing signal on each revolution from a detector beside the rotating filter wheel. From this signal the time when each filter will pass across the source is calculated. A sample is taken on either side of the filter's signal as well as two centred on the signal peak. When the base line value after the filter has been sampled the gain of the receiver is changed, if necessary, for the next filter. Since the program is written in a mixture of machine code and a high level language, Pascal, the rotation of the wheel is limited to below approximately 2 Hz. By using Pascal the minimum time for one A/D conversion is reduced to 1 ms.

2.5.2. Sampling and Recording

The signal strength measured for each filter is passed on to the recording computer as an asynchronous analogue signal. Each filter is given a D/A channel on the transmissometer computer. This is put on to one channel in the magnetic tape record via a peripheral processor with an A/D which is attached to the recording computer. Each A/D channel is updated at 40 Hz. With another logging system operating continuously at the summit, the recording computer is now free to record any required set of instruments for microphysical and transmittance experiments alone. This can include the signal from one or more PMS probes which can be sampled at up to 40 Hz simultaneously with the transmissometer signals. At the maximum data collection rate, a standard 2400 ft magnetic tape will last over eight hours with one PMS probe logged.

2.5.3. Checks

During the experiment the data is checked to see that the signal from the receiver is correctly recorded on the magnetic tape. The transmissometer controlling computer sends a signal pulse out on a spare D/A channel every time a sample is taken from the received signal. This allows the timing of the data collection to be checked against the filter signals using an oscilloscope. The numbers stored on magnetic tape are displayed by a third computer, which is part of the UMIST logging system, and these are checked against the filters' signal level shown on the oscilloscope. The software in the controlling computer also displays the measured period of one revolution of the filter wheel. This allows any problems with sample timing or a mechanical breakdown to be quickly apparent.

3. SUMMARY OF DATA

3.1. Spring 1985

3.1.1. Experiment

After a brief period out of cloud, two days of data were recorded in and out of cloud. The alignment was then disturbed and clear weather, though allowing a much better alignment, did not give any more cloud to measure before the end of the project. The Great Dun Fell instrumentation consisted of the transmissometer, PMS FSS probe (FSSP), measuring particle sizes from 0.5 to 47μm, the UMIST acoustic sounder, a three-dimensional, sonic anemometer and a UMIST disdrometer for measuring raindrop sizes and concentrations. No measurements were available from the SW slope of Great Dun Fell, apart from an infrequent trip by Land Rover to observe the altitude of cloud base. In the valley, time lapse photography monitored the summit, as did a radar further to the south at Wharleycroft, the UMIST valley field station situated 8 km from the summit. A disdrometer and meteorological measurements were also recorded here.

3.1.2. Data

The analysis of the data was hampered by the clear air transmission intensity, Io, collected at the start of the recording being taken by faulty software. Because the air at that time was fairly cloudy, the source temperature was not known after the temporary repair to the controller. There was also the problem of the 10.6 μm spike filter coatings breaking up, and the same fault was suspected for the other filters. A study of cloud growth was not possible as there was only one site measuring the cloud. Because of these various reasons an in-depth analysis of the data was not performed and more time was spent preparing for the next project.

3.2. Autumn 1985

3.2.1. Experiment

Data was collected over two weeks, providing about 2 days worth of data. Alignment was possible, and Io values measured, from one clear period at the start. The start of the project had been delayed by the installation of the transmissometer in the new shed and a few problems in the data gathering software. A check of the system's stability over two weeks could only be done in thin cloud. The project was stopped when snow made travel to the summit difficult. Recording was mostly done during the day time as snow and low temperatures made operation overnight extremely difficult, which was unfortunate as there was considerable construction traffic passing through the transmissometer beam during the day. Instrumentation at the summit was as in the Spring apart from the acoustic sounder which had to be moved for construction work. The UMIST van was operating upwind of the summit, recording FSSP and meteorological instruments. Valley measurements were the same except for the radar which did not operate.

3.2.2. Data

More data analysis was done on this set of data than in the Spring. The main problem encountered was with the change in the base level of the signal between filters. This problem had not been so apparent before as the software had not allowed switching of the receiver gain. Some data was gained but the associated errors were large due to the uncertainty of the zero signal level for each filter. The problem could only be solved by more sampling of the signal before logging. A program was developed to incorporate this requirement for use in the next project.

3.3. Spring 1986.

3.3.1. Experiment

A complete description of the operational instrumentation and data is provided in a subsequent chapter, in which two tapes out of the nine constituting the data set from this project are examined in detail. The installation of the transmissometer had to be delayed until the previous shed for the source unit, which had been destroyed, was replaced. A good alignment of the transmissometer was achieved at night in cold, clear air and a value for Io was obtained during the next day. Observations were continued from this point, on Friday afternoon, until the following Monday evening. The two tapes considered in detail probably contain the best data from this project, taken over the Saturday to Sunday night. Before this period, the wind was southerly in direction, which is not ideal for the experiment as the air flows along, rather than over, the line of hills of which Great Dun Fell is a part. Also, there was some rain and, with this wind direction, rain and water tends to be blown into the transmissometer shed and receiver. Data recorded later has less variation in the cap cloud, the only problem being more construction traffic crossing the beam on the Monday. By Monday evening, the summit was clear of cloud thus permitting a check to be made of the system alignment - no change was found.

4. DATA FROM MAY 1986

4.1. Introduction

4.1.1. Tape Recordings

As stated previously, the data presented covers two from the nine tapes recorded during the experiment. All the data from the experiment came from one weekend, starting on Friday the 16th. The first tape examined ran from dusk on Saturday until early on Sunday morning. The second tape started a few hours after the first had stopped and ran until Sunday afternoon. The tapes cover the development and subsequent decay of the cap cloud which formed on the summit of Great Dun Fell during this period.

4.1.2. Instrumentation

Throughout this period, the Barnes transmissometer ran at the summit of Great Dun Fell. Also at the summit, data from a PMS FSS probe (FSSP) was recorded on to magnetic tape at 40 Hz, whilst the standard meteorological measurements of temperature, wind speed and direction were recorded at 1 Hz. Figure 2 shows the relative positions of these instruments, looking downwind for a SW wind (the wind direction remained within 5^{o} of SW during the period considered. The UMIST instrumented van was placed upwind from the summit at a height of 671 metres where wind speed and direction (at a height of 10 metres) and an FSSP (at 2.5 metres) were recorded. All data was logged at the van at 1 Hz. Observations in the valley upwind of Great Dun Fell were limited to time lapse photography, taking in the view looking towards the summit from 6 kilometres away.

4.1.3. Data

The data shown in this report for all the instrumentation is given as averages over a period of about a minute. The higher resolution that is available for most instruments has only been examined for very short periods when it has been used mainly as a check on the correct recording of each instrument. The theoretical extinction coefficients for the filters used in the transmissometer are still being computed and will be derived from the droplet spectra detected by the FSSP in the range of 1 to 15 micron radius and for the combined filter, detector and black body radiator characteristics. The transmission data for the 10.6 micron spike filter is not included in the data yet as there are unresolved problems in retrieving the signal from the digital recordings. Analysis will also continue to look at the structure of the cloud detected at high sampling rates by both the FSSP and the transmissometer. In all the data that follows the cloud droplets are presented in terms of their radii in micrometres, all times quoted will be GMT.

4.1.4. Synoptic Situation

The clear air, which was associated with a high over Central Europe (see Figure 3), and in which the readings of Io were made on the Friday, was replaced on Saturday by warmer air which came from a low, shown due West of Cornwall and at about 20° West in Figure 4. The low moved NE to pass by the coast of Ireland during the night and continued NE, passing the Hebrides, throughout Sunday (Figure 5). Two fronts associated with the low passed over Great Dun Fell. The first, a warm front, was being occluded by the following cold front. The fronts were separated by roughly six hours in crossing over Great Dun Fell. The air path to Great Dun Fell crossed over the sonde ascent station at Aughton and the ascent at 0000 GMT on Sunday shows stable air up to and above the height of Great Dun Fell. This ascent is in the air immediately following the cold front, see Figure 6. The ascent for Sunday at 1200 GMT, shown in Figure 7, shows that, at about twice the height of Great Dun Fell, the air is topped by a strong temperature inversion of drier air. During Saturday, there had been heavy rain in a southerly wind at Great Dun Fell. Prior to the start of the first tape examined here, the cold front had just passed, the wind had veered to the SW and cloud had left the summit.

4.2. Saturday Night

4.2.1. Cloud Growth

The tape recorded at the summit runs from 2146 GMT until 0415 GMT on Sunday. The FSSP record shows a thin cloud on the summit for about the first 35 minutes with a maximum liquid water content (LWC) of only 0.06 $g.m^{-3}$. This cloud was not present at the van site.

Cloud did not reappear at the summit until 2313 GMT when, within 10 minutes, the droplet size and concentration increased to give an LWC of 0.11 $g.m^{-3}$ and a concentration of ~100 ml^{-1} for the peak channel of 4.5 micron radius, see Figure 8. This cloud was seen at the van site 44 minutes later, see Figure 9, at 2357 GMT when the summit recorded an LWC of 0.23 $g.m^{-3}$. This cloud grows steadily from midnight. The main droplet spectra measured at the summit cover sizes from 2.5 to 11.5μm at 0100 GMT. By the time the maximum LWC is reached, the main spectra extends from 5.5 to 13.5μm, the peak channel being at 9.5μm, with about 500 drops per ml. The van spectra, at the same time (0244 GMT), ran from 4.5 to 12.5μm with the peak at 8.5μm. LWC at the van and summit were 0.57 and 0.62 $g.m^{-3}$, respectively.

The cloud now undergoes a change as shown in Figure 10. The concentration of droplets falls, as the mean droplet size increases, and smaller droplets are detected in the first three channels of the FSSP, resulting in a bimodal spectrum. This process is observed at the van 15 minutes after the summit, after the van LWC had peaked at 0.68 $g.m^{-3}$, see Figure 11. At the summit, the cloud settles with LWC ~0.3 $g.m^{-3}$, main spectra from 7.5 to 14.5μm, minor spectra detected from the first channel up to 3.5μm and total droplet concentration at ~100 ml^{-1} . Apart from detecting drop sizes between the two spectra the cloud stays the same at the summit until the tape finishes, see Figure 12.

4.2.2. Cloud and Transmission.

The cloud parameters are shown separately in Figures 13 to Figure 16. The same format is used for the three band pass filters and the unfiltered radiation,(source), see Figures 17 to 20. The large spikes in the centre of the record are probably due to the synchronisation of the computer sampling being lost for a short period, this has still to be checked. Because of the position of the synchronisation mark, the spikes would not necessarily be seen on the source signal. Figures 21 to 24 shows the parameters plotted against the source signal extinction. In all cases they clearly show two distinct relationships, which correlates to the change in the cloud.

Examining the start of the cloud at higher resolution, with 23 second averages, avoids the timing spikes seen above in the extinction plots and also the change in cloud spectra. The cloud parameters and the extinctions are illustrated from Figure 25 to Figure 32. The parameters are then shown against the extinction for each filter. The LWC plots, Figures 33 to 37, demonstrate the correlation between extinction and LWC. The extinction is not as strongly dependent upon mean radius as upon the LWC, as shown from Figure 37 to 40. The results from the FSSP indicate (in Figure 41) that, apart from the early portion of the sample with very low droplet concentrations, the LWC is strongly related to the cube of the mean droplet radius. The extinction coefficients for all the bands measured (Figures 42 to 45) shows little variation with droplet concentration, as is suggested by the time plots.

4.3. Sunday Morning

4.3.1. Cloud Base Observation

The tape record starts again at 0712 GMT and a record of cloud base position could be kept throughout the daylight hours. A summary of the events shown by the camera based in the valley is given in Table 1. Each comment is taken at roughly equal time intervals throughout the film. Notes were kept at the summit, at the van and when measurements were taken at cloud base, from which a record of cloud base was constructed for the day as shown in Figure 46. The area above the van altitude up to the next dashed line, (marked with a " ? "), shows the area of the SW slope of Great Dun Fell where the road is not close enough to allow an accurate measure of cloud base altitude.

4.3.2. Cloud Development

At first, the recorded droplet spectra show some of the features from the end of the previous tape, see Figure 47. There still appears to be a main spectra separated from smaller droplets seen in the first three channels of the FSSP, however, by now the peak channel has fallen to 8.5μm. Maximum droplet size detected is 11.5μm and LWC is ~0.2 $g.m^{-3}$. As the morning progresses, the spectra continue to decrease in concentration and to exhibit reduced bimodality as may be more readily seen in Figures 48 to 51 of the cloud spectra parameters.

4.3.3. Cloud and Extinction

The measures of droplet size show up a periodic fluctuation that seems to continue until the end of the tape, when the cloud also clears the summit. These show up in the extinction, Figures 52 to 55. The effect is not so easily seen in the LWC plot, Figure 48. The peaks in size parameters seem to coincide with the appearance of the droplets in the next highest channel than is occupied during a trough. In Figure 47 and Figure 56, note the spectra when peaks occur at 0728, 0802 and 0836, with troughs at 0756, 0816 and 0856. The change could be due to the cloud structure noted on viewing the valley time lapse photography. During this morning, the meteorological stations upwind of Great Dun Fell noted cumulus and stratocumulus cloud cover of variable extent at around 1800 m altitude. In the plots, Figures 57 to 60, the two types of cloud spectra do not show up as before , the maximum values reached are less than the values at the point where the effect was apparent before. The only noticeable relationship is the increase in the number of drops as LWC decreases, which is seen in the time plots, Figures 47 to 50.

The plots of the filter extinctions do not show any simple relationship with any parameter, probably due to the plots covering too many variations of parameters, see Figures 61 up to 69. The plot with mean droplet radius shows some preference for greater extinctions at around 4 and 2.5 microns. Again, examination of the higher resolution data as the cloud dissipates allows some detail to emerge. The time plots for 23 second averages are shown in Figures 70 to Figure 76. The parameters show a different relationship from that seen on entering the cloud, without the simple cubic relationship between the LWC and mean radius seen earlier, as may be noted from Figure 77. The plots of LWC and extinction, Figures 78 to 81, mirror the previous plot in showing no singular relationship at low LWC. Of the other two parameters, the number concentration appears to exhibit the best correlation with extinction, Figures 82 to 85, though with considerable scatter. Figures 86 to 89 indicate no simple relationship between extinction and mean droplet size. As a comparison to the mean radius cubed plot, Figure 90 shows LWC and number concentration for the start, and Figure 91 for the end of cloud. The relationships are probably more complex in going out of cloud because of the air which flows into the cap cloud. There is the mixing with existing cloud seen from the valley-based camera and also the chance of entraining drier air from above the inversion shown in the Aughton ascent for 1200 Z.

5. SUMMARY

The data gathered during the Spring of 1986 represents a comprehensive set covering a wide range of meteorological conditions. In particular, data on transmission at the full set of wavelengths has been obtained under conditions of rapid variations in the cloud microphysics associated with :

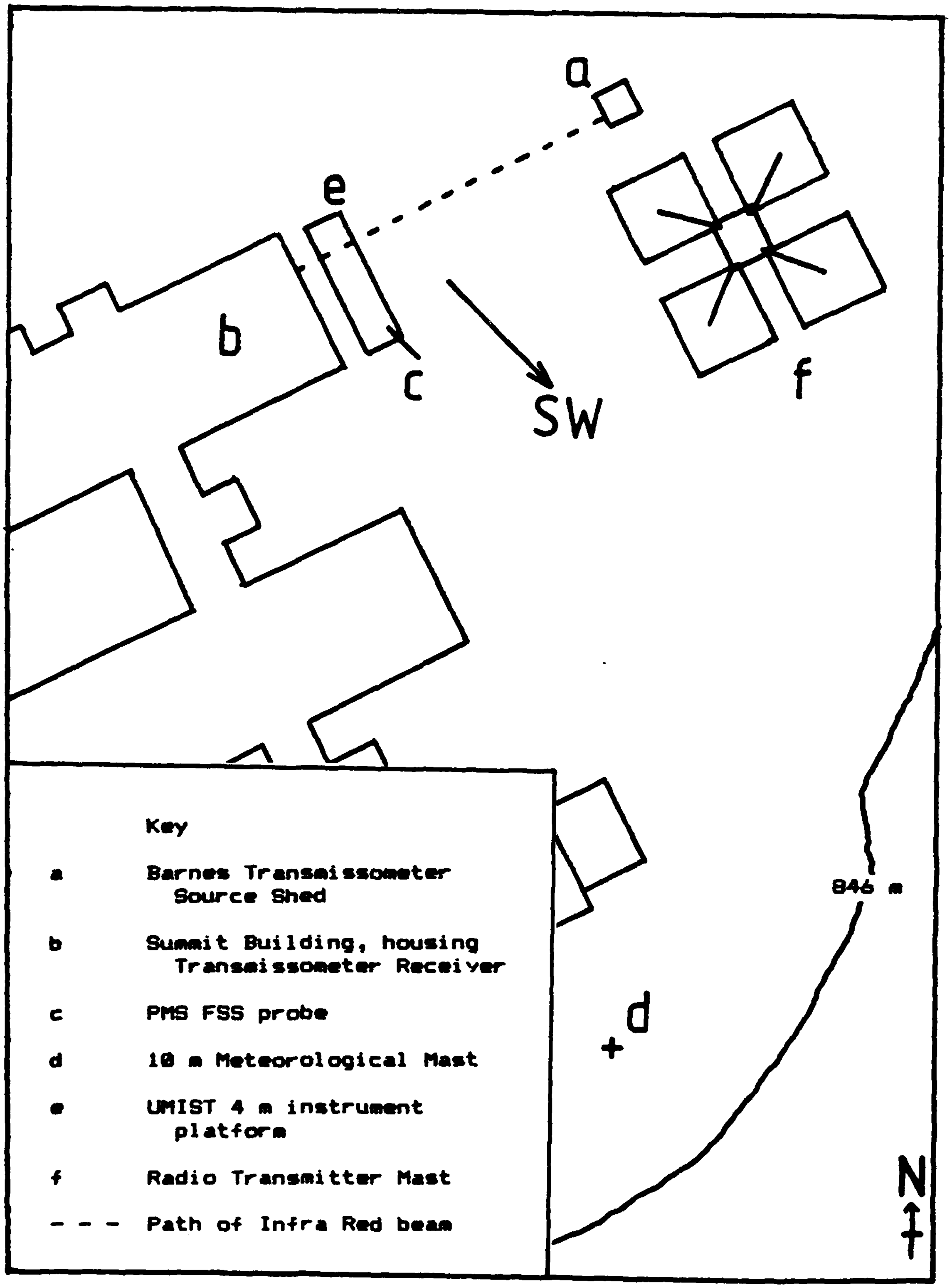
a) Fluctuations in liquid water content close to cloud base as parcels of air of different relative humidity enter the cloud.

b) The mixing into the cloud of dry air from above.

c) The interaction of the hill cap cloud with strato-cumulus and cumulus clouds advected from upwind.

Data analysis and interpretation is continuing and it is anticipated that the data gathered will add considerably to our understanding of the transmission of the range of infra-red wavelengths in the complex, non-ideal, microphysical situation prevailing in most real clouds.

Figure 1.


a
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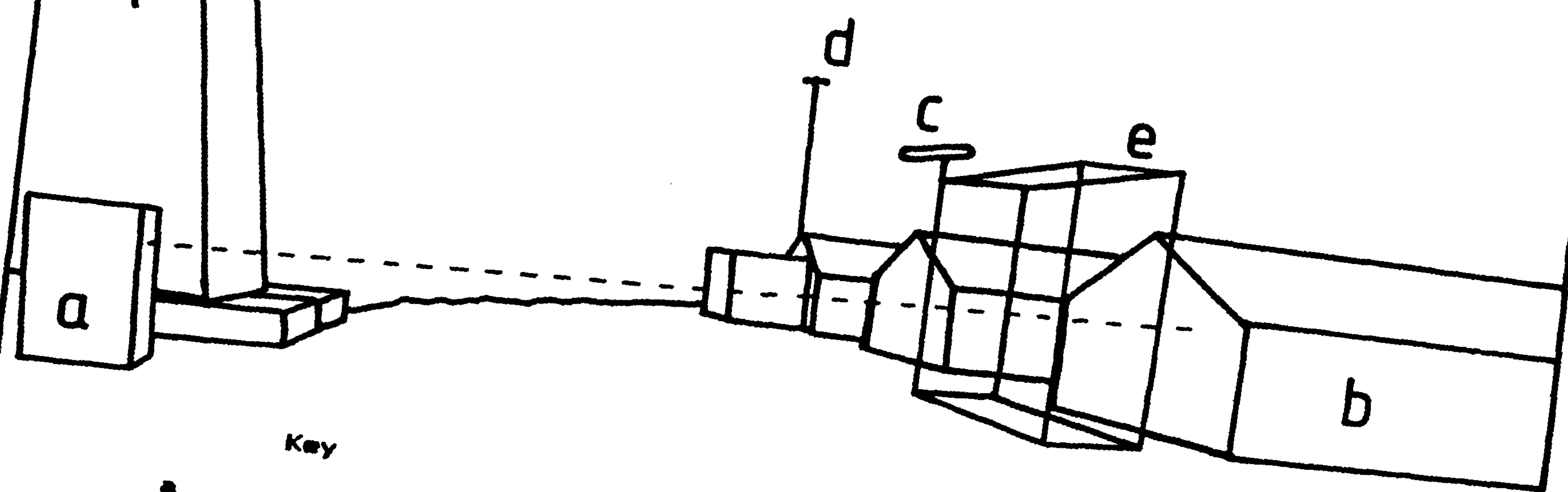
Key
a Barnes Transmissometer Source Shed
b Summit Building, housing Transmissometer Receiver
c PMS FSS probe
d 10 m Meteorological Mast
e UMIST 4 m instrument platform
f Radio Transmitter Mast
- - - Path of Infra Red beam

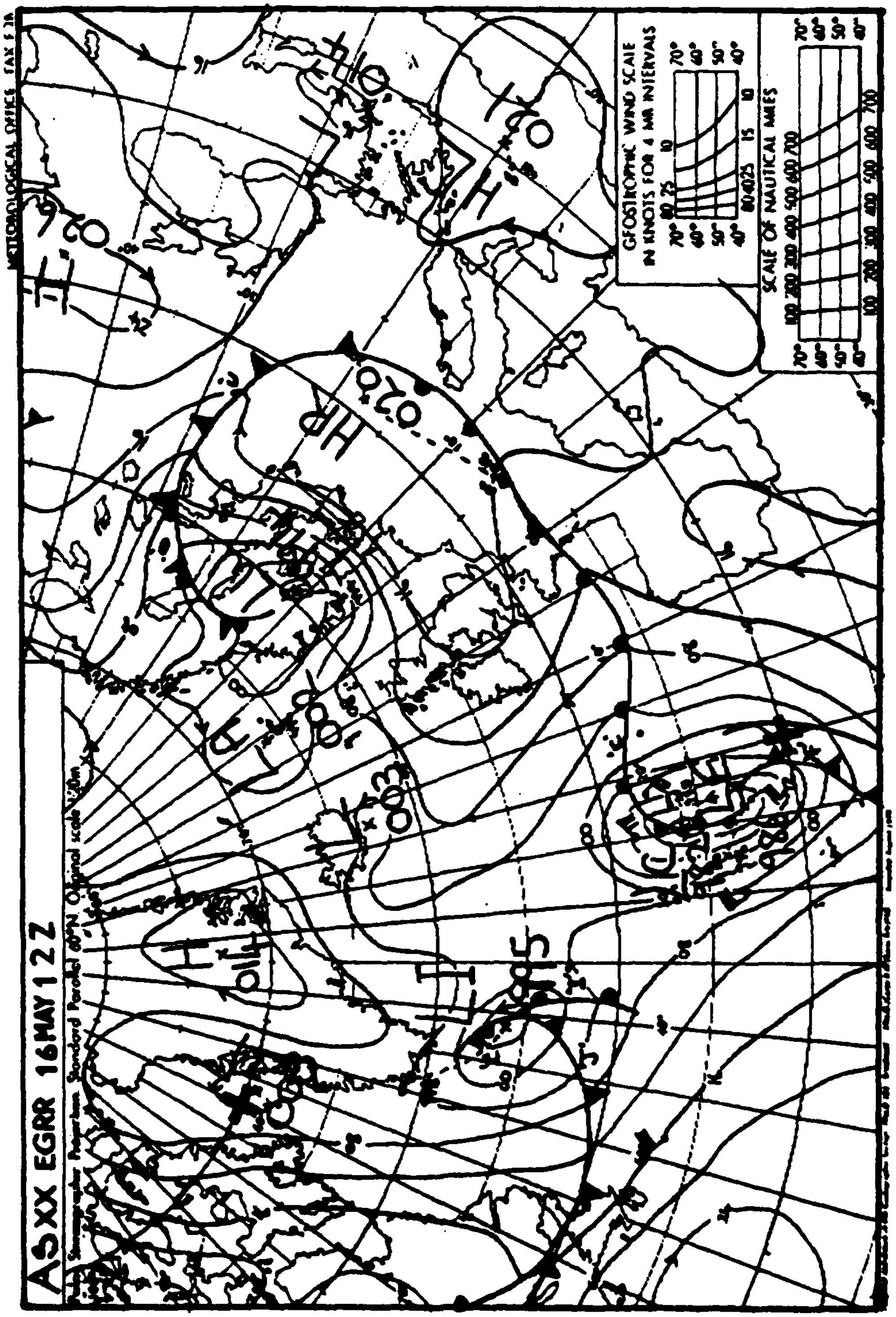


Key

- a — Barnes Transmissometer Source Shed
- b — Summit Building, housing Transmissometer Receiver
- c — PMS FSS probe
- d — 10 m Meteorological Mast
- e — UMIST 4 m instrument platform
- f — Radio Transmitter Mast
- - - - — Path of Infra Red beam

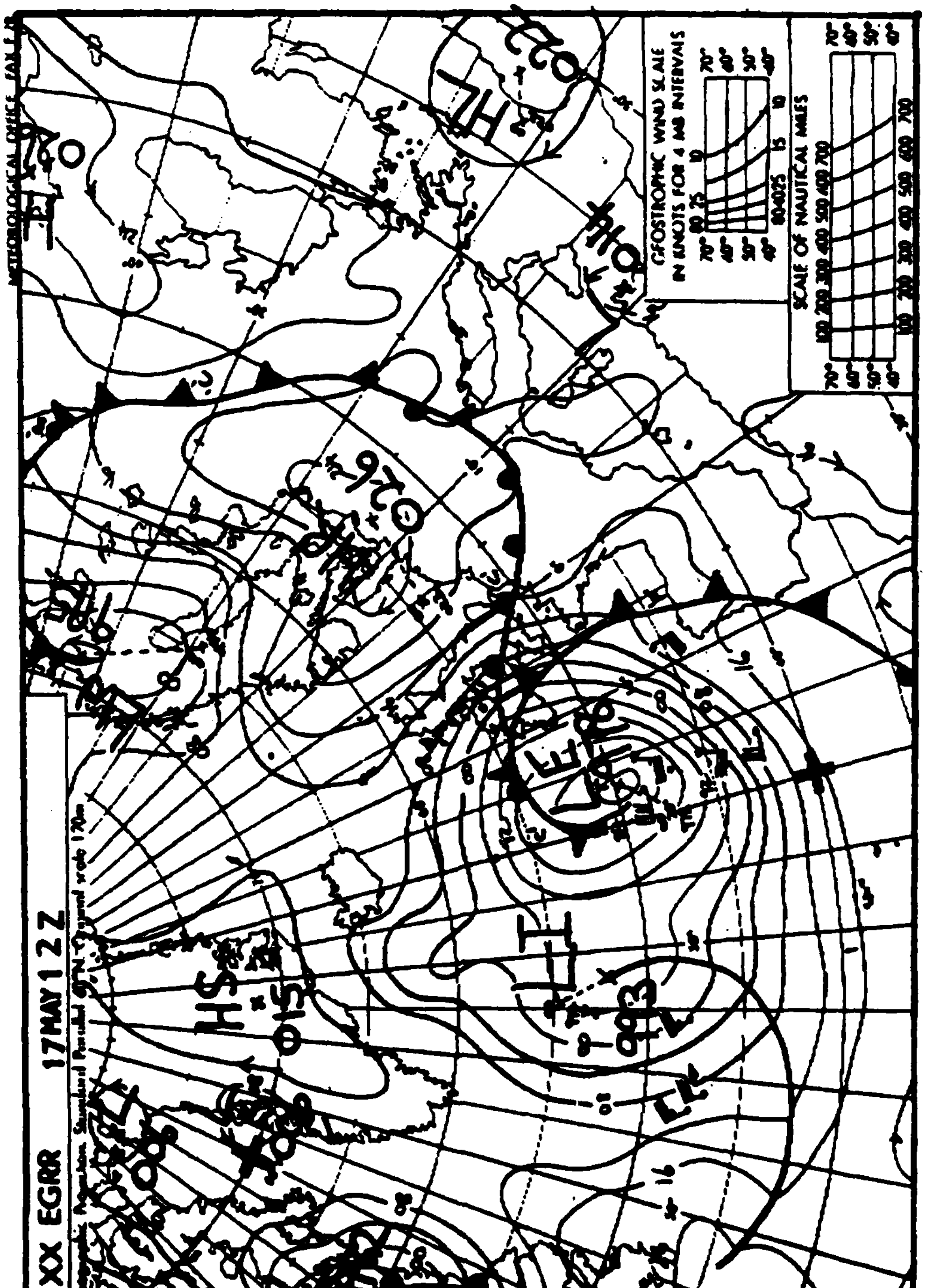
Figure 2.

Figure 3.



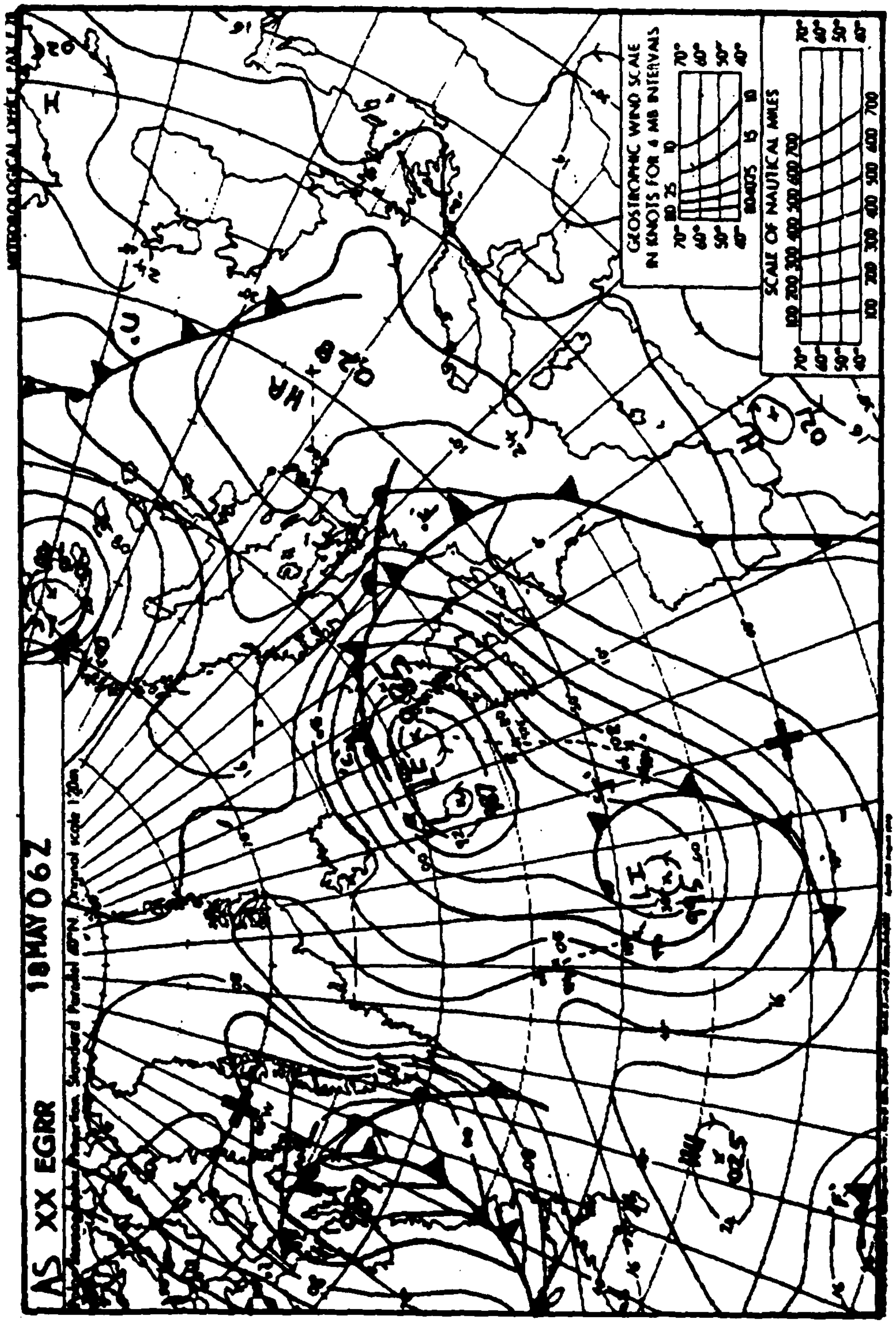
Synoptic Chart for 12 Z, 16th May 1986.

Figure 4.



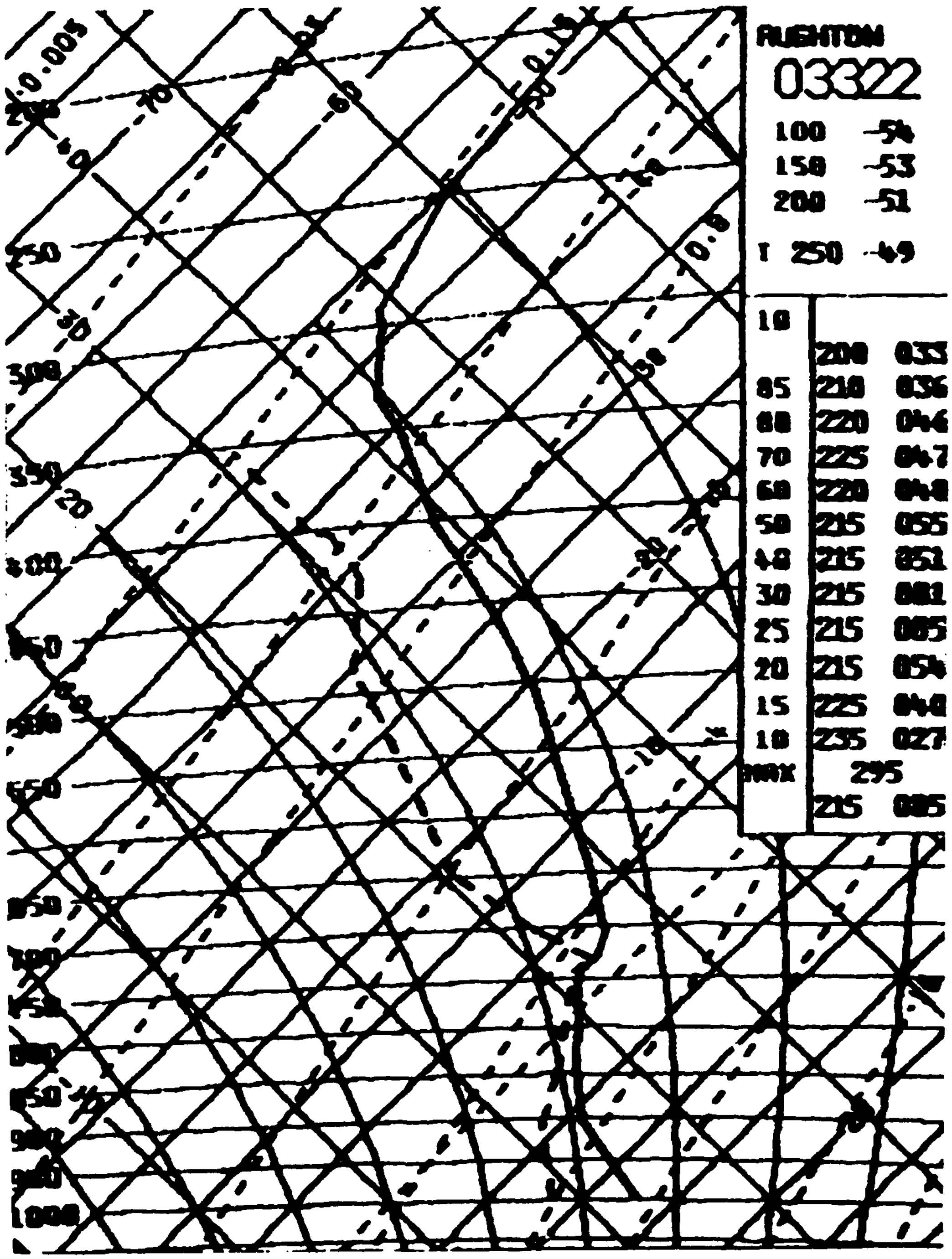
Synoptic Chart for 12 Z, 17th May 1986.

Figure 5.



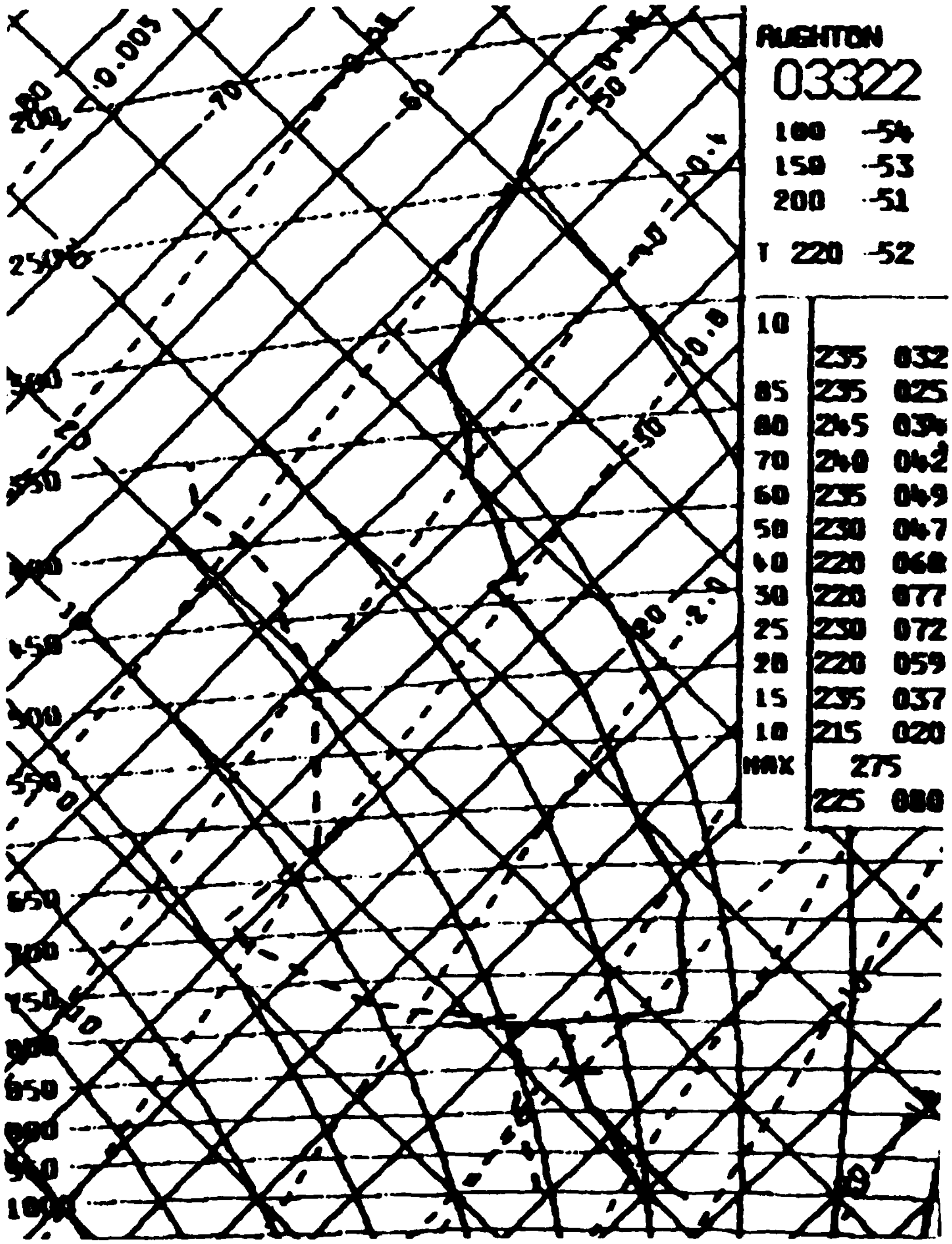
Synoptic Chart for 6 Z, 18th May 1986.

Figure 6.



Aughton Sonde Ascent for 0 Z, 18th May 1986.

Figure 7.

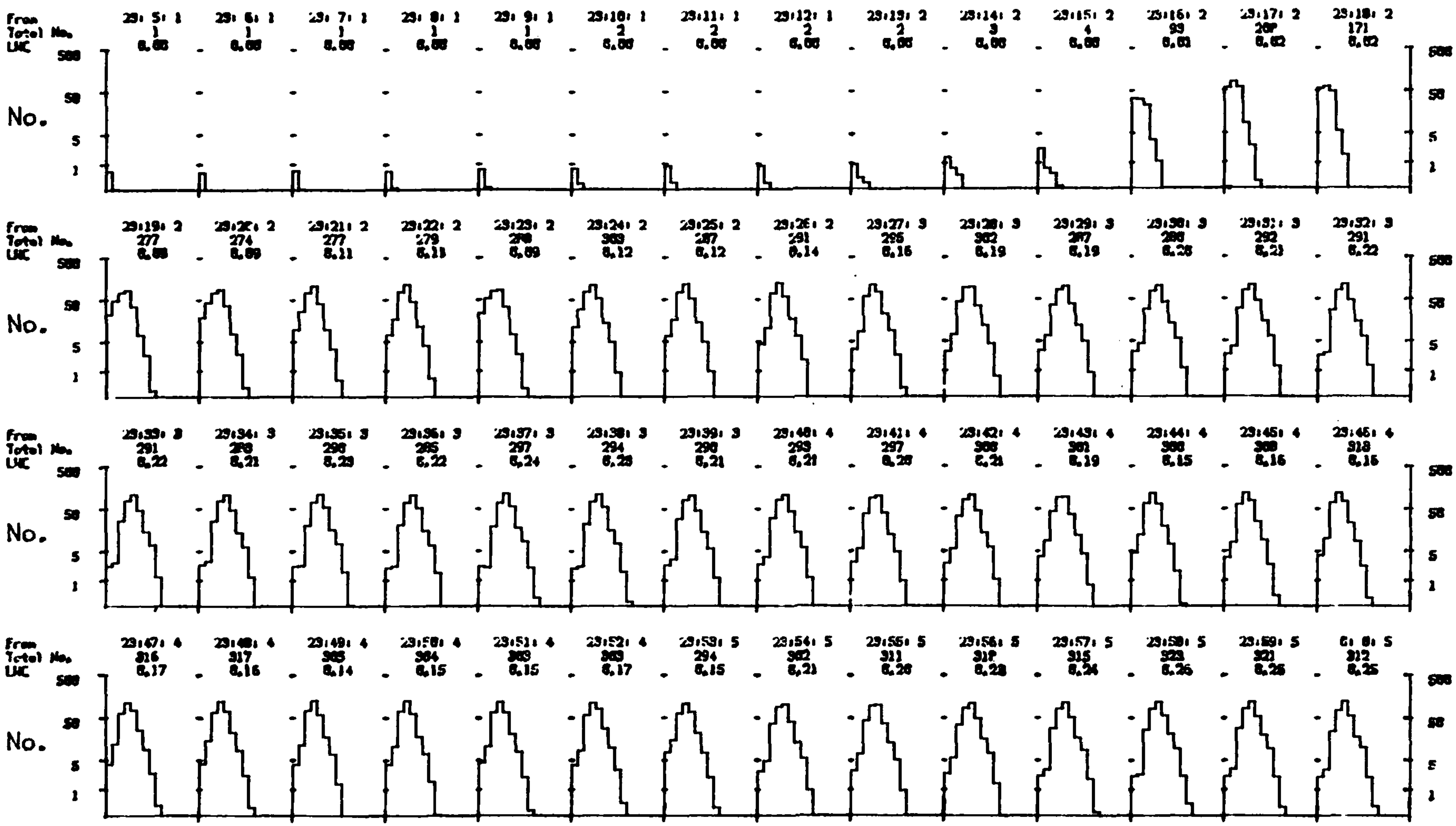


Aughton Sonde Ascent for 12 Z, 18th May 1986.

Figure 8.

GDF FSSP B Spectra for 17/5/86.

Averaging Time
Is 60 seconds.



Droplet Number per cc. Liquid Water Content in g/m3. Times are GMT.

Figure 9.

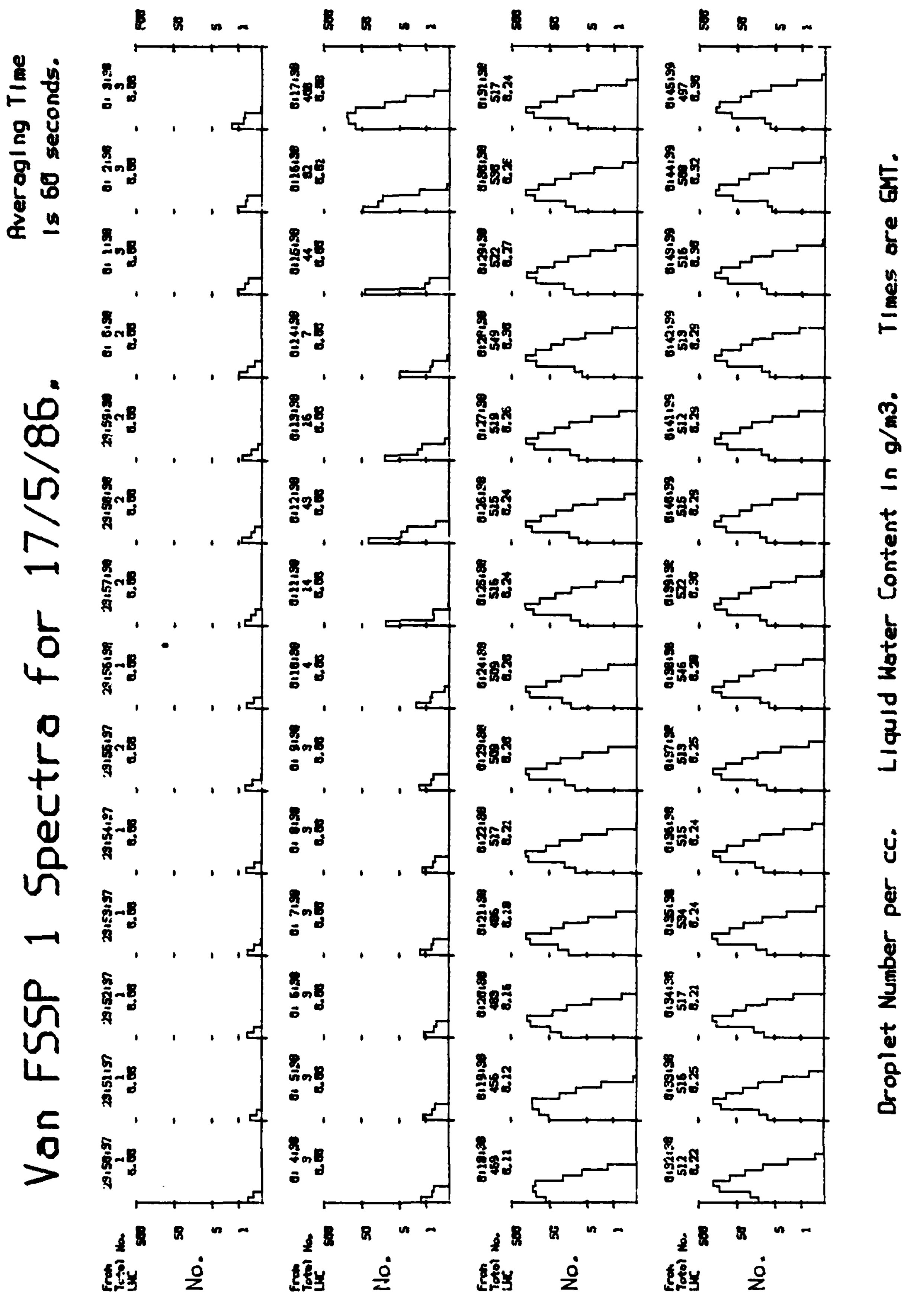

Van FSSP 1 Spectra for 17/5/86.
Averaging Time is 60 seconds.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.

Figure 10.

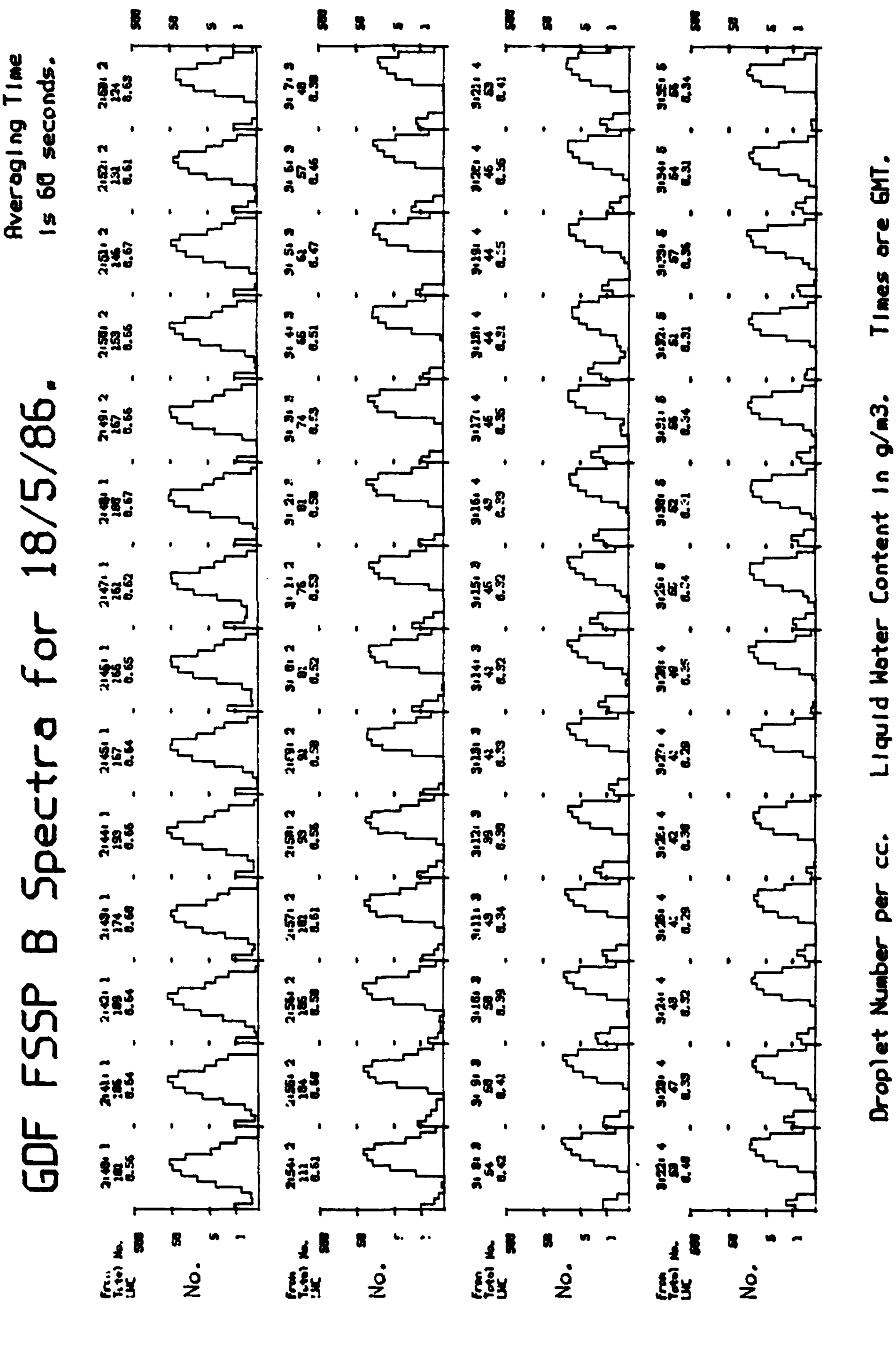
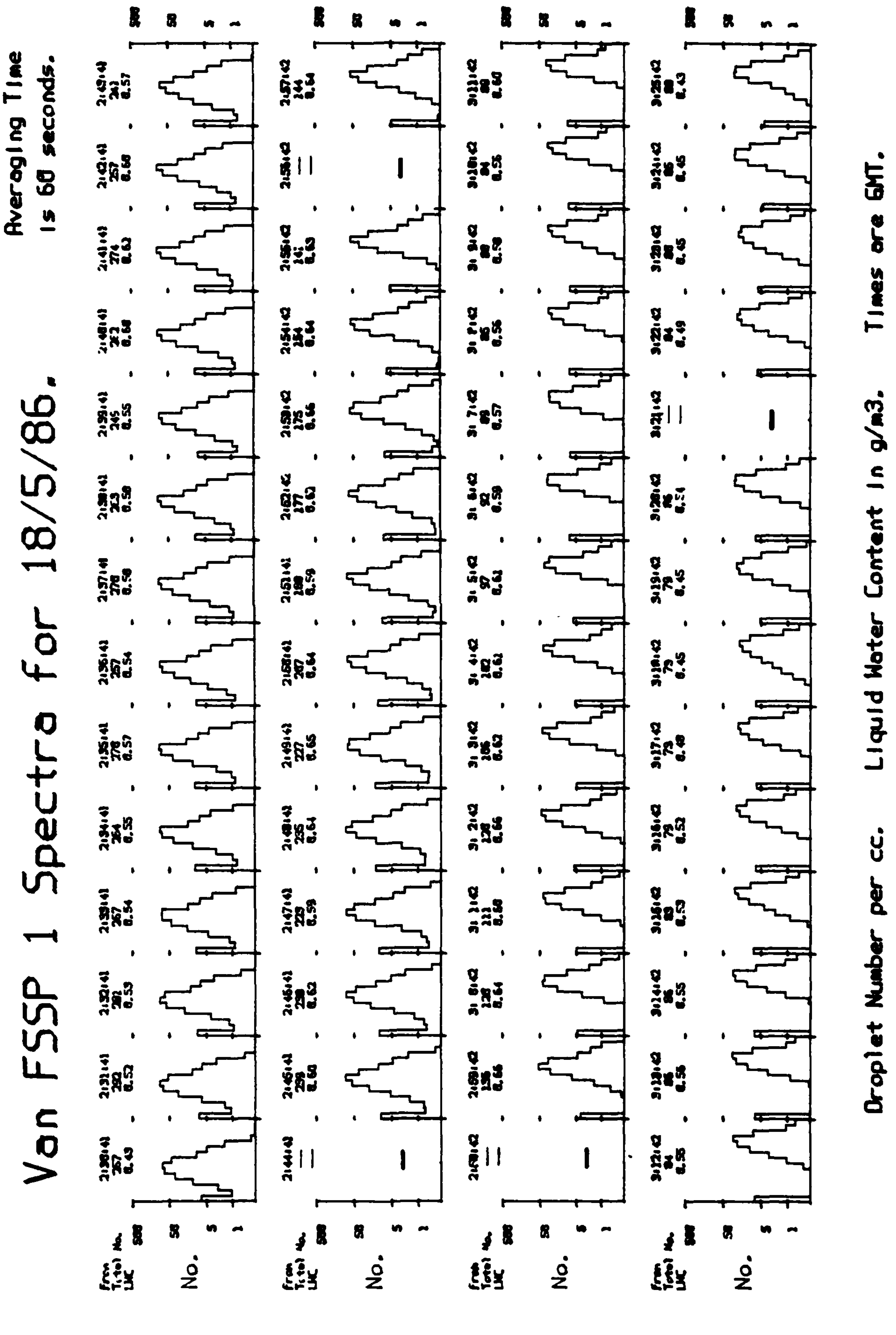

GDF FSSP B Spectra for 18/5/86.
Averaging Time
Is 60 seconds.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.
No.
No.
No.
No.

Figure 11.


Van FSSP 1 Spectra for 18/5/86.
Averaging Time
Is 60 seconds.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.

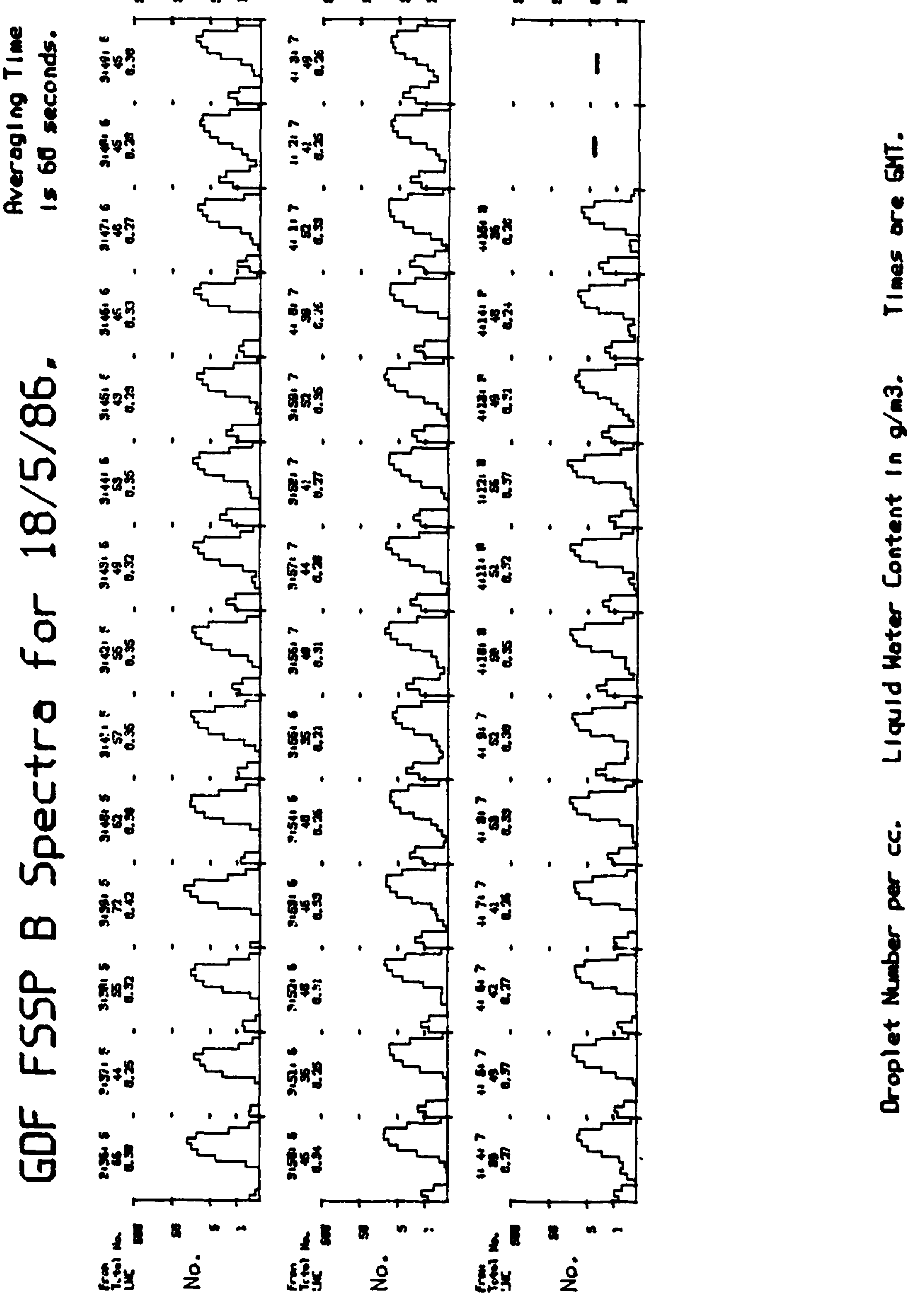
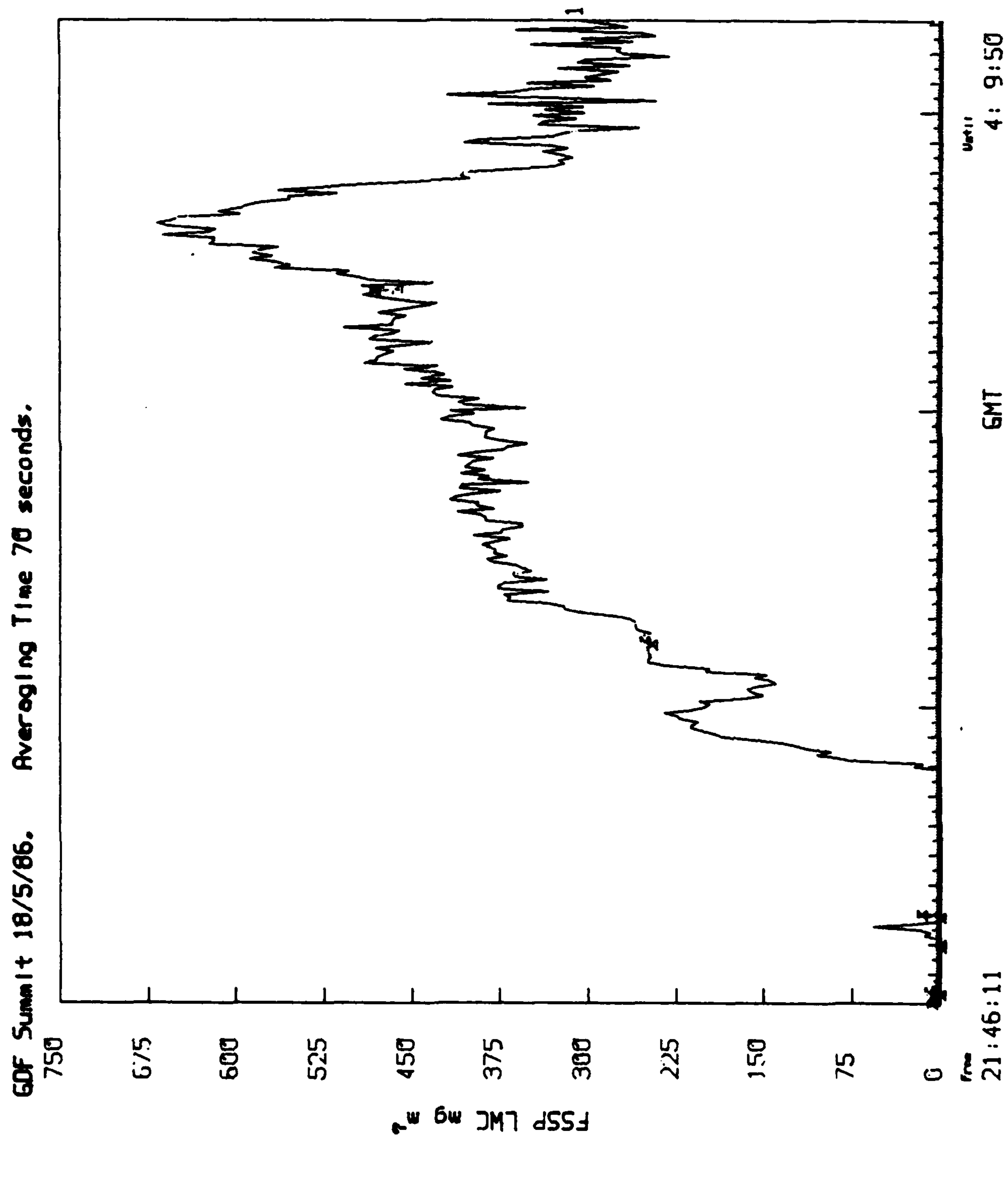

GDF FSSP B Spectra for 18/5/86.
Averaging Time is 60 seconds.
No.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.

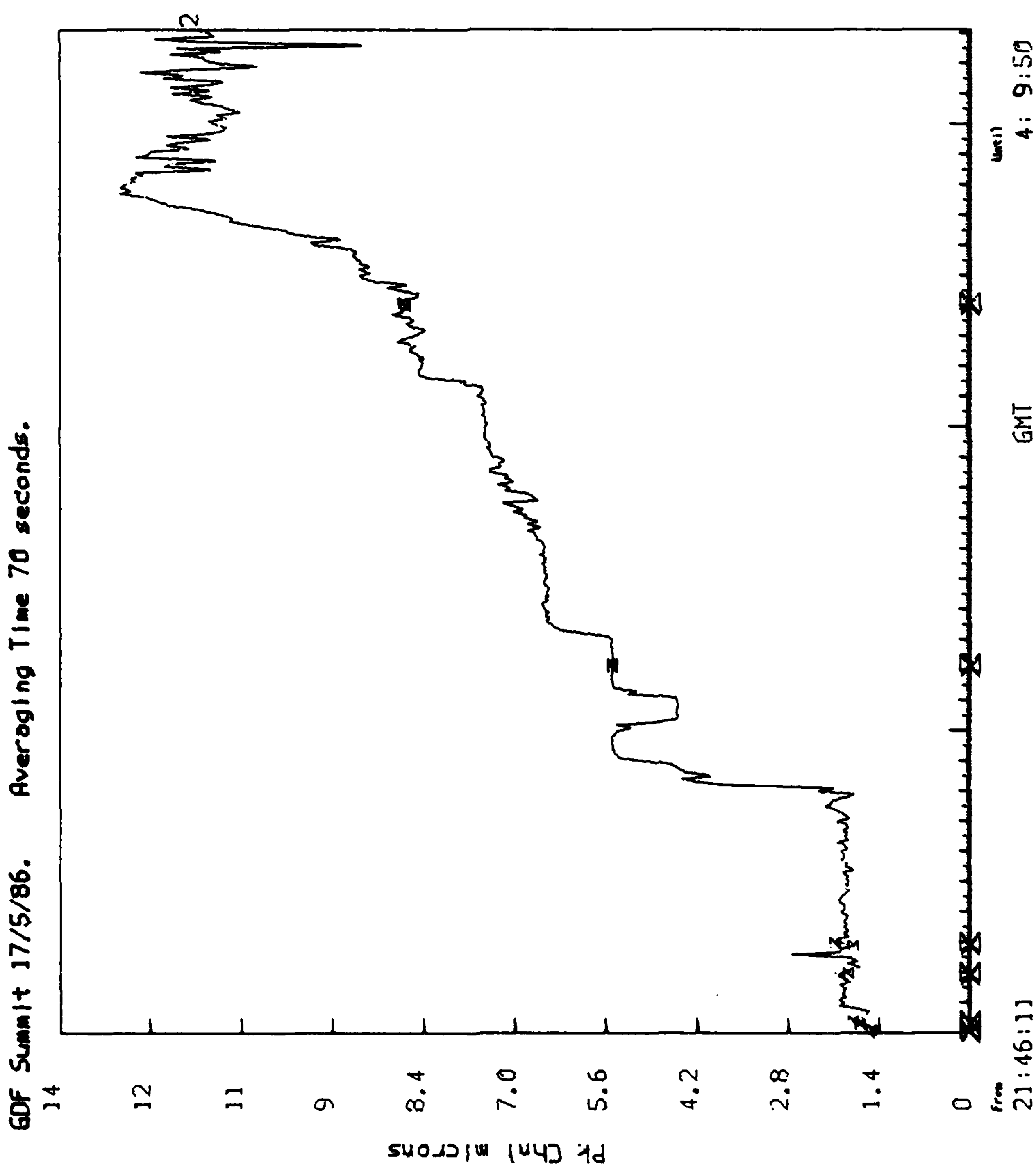
Figure 12.

Figure 13.



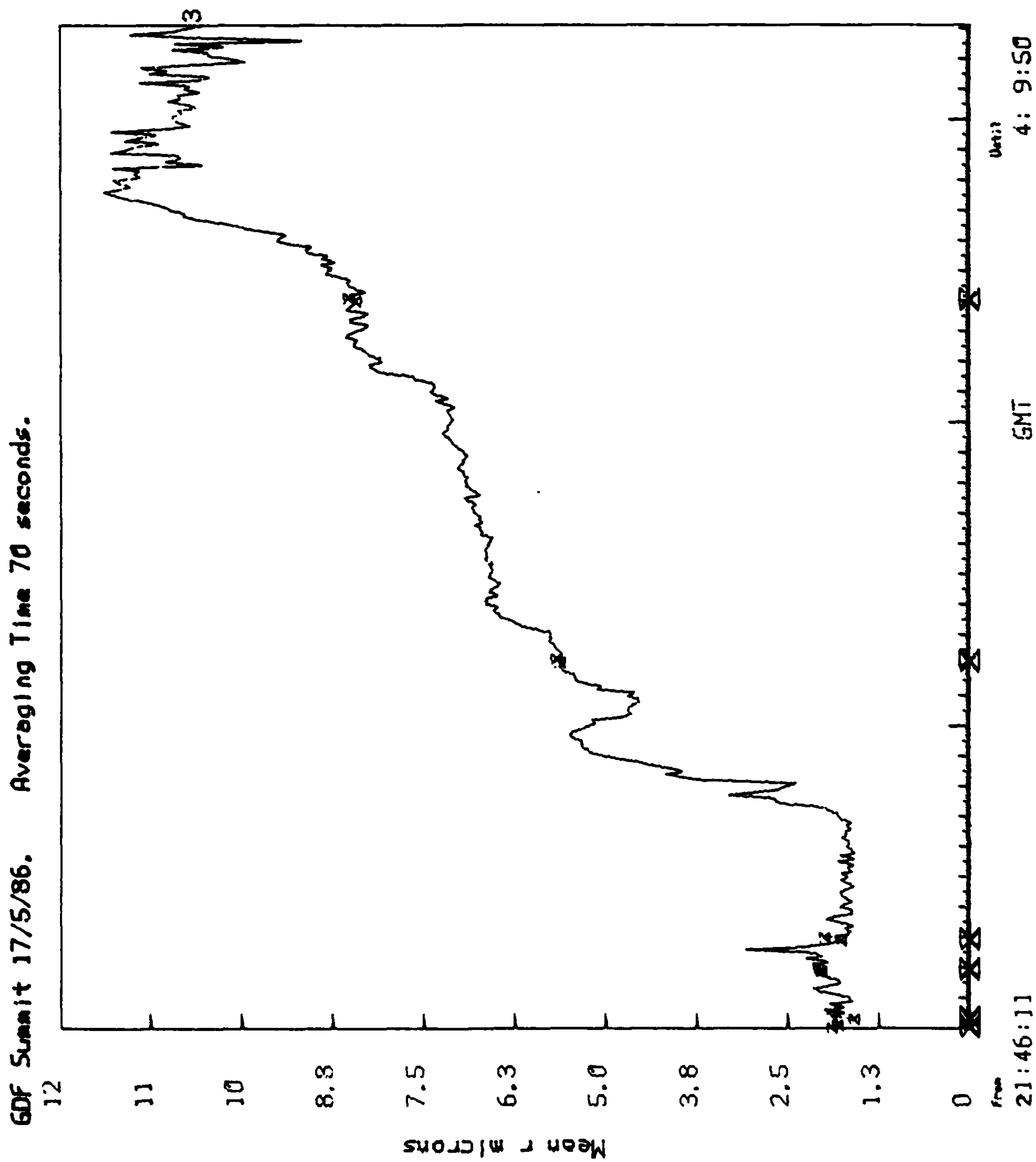
GDF Summit 18/5/86. Averaging Time 70 seconds.
FSSP LWC mg m⁻³
750
675
600
525
450
375
300
225
150
75
0
21:46:11
GMT
4: 9:50

Figure 14.



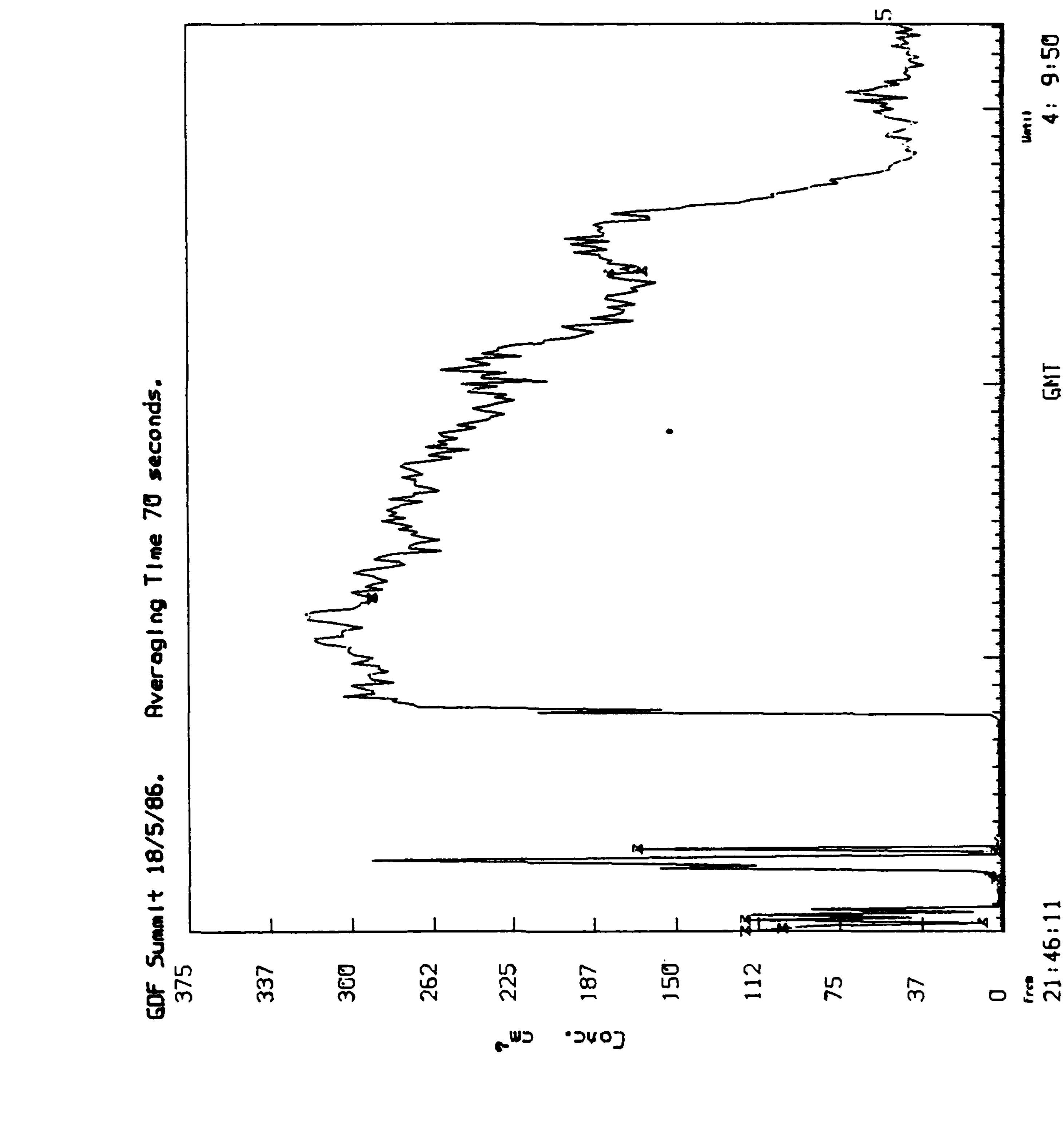
GDF Summit 17/5/86. Averaging Time 70 seconds.
Pk Chnl microns
14
12
11
9
8.4
7.0
5.6
4.2
2.8
1.4
0
from 21:46:11
GMT
until 4: 9:50

Figure 15.



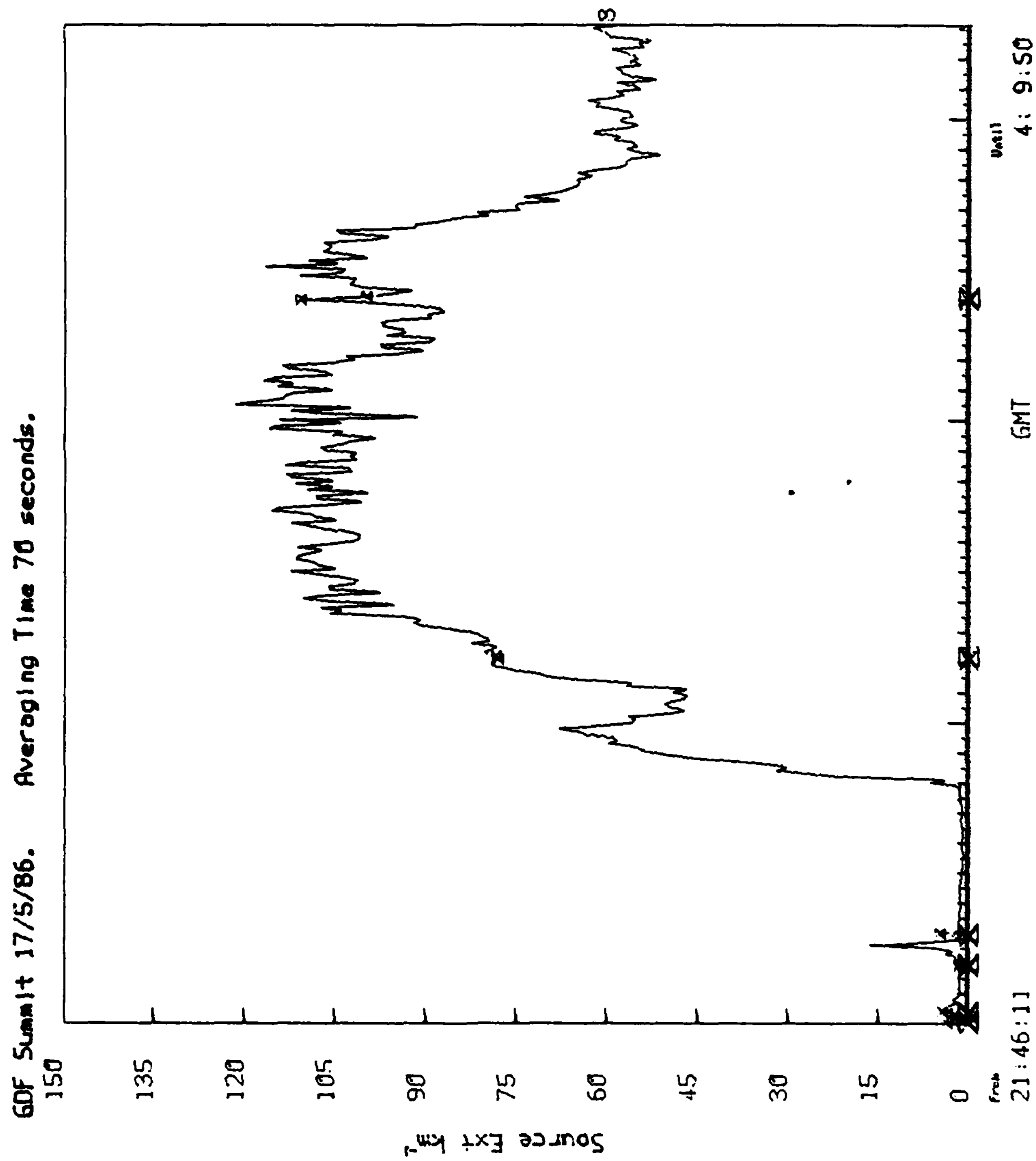
GDF Summit 17/5/86. Averaging Time 70 seconds.
Mean r microns
12
11
10
8.8
7.5
6.3
5.0
3.8
2.5
1.3
0
from
21:46:11
GMT
Until
4: 9:50

Figure 16.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
375
337
300
262
225
187
150
112
75
37
0
Conc. cm-3
from
21:46:11
GMT
until
4: 9:50

Figure 17.



GDF Summit 17/5/86.
Averaging Time 70 seconds.
150
135
120
105
90
75
60
45
30
15
0
Source Ext km⁻¹
From
21:46:11
GMT
Until
4: 9:50

Figure 18.

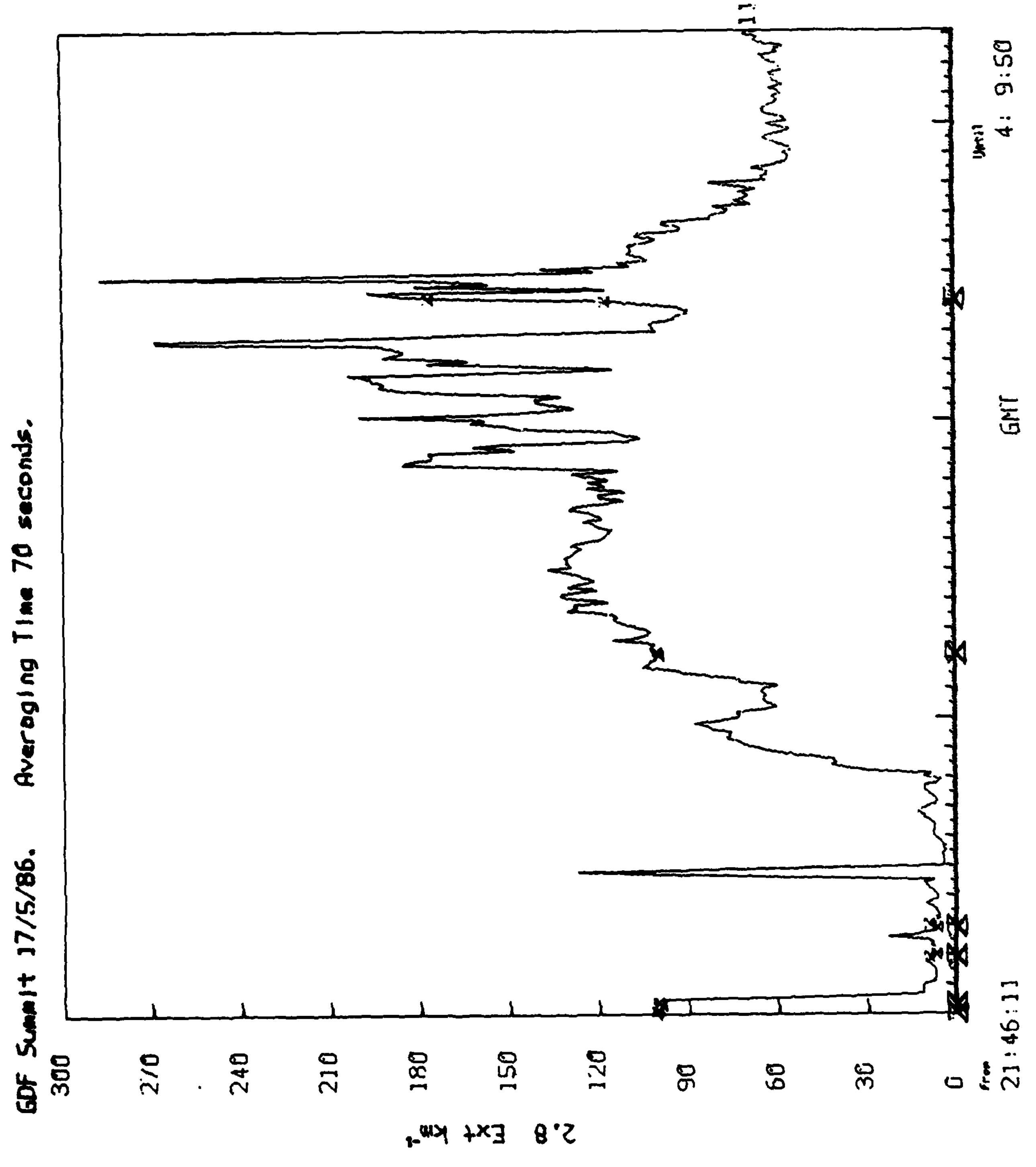

GDF Summit 17/5/86. Averaging Time 70 seconds.
300
270
240
210
180
150
120
90
60
30
0
2.8 Ext km-1
from
21:46:11
GMT
Until
4: 9:50

Figure 19.

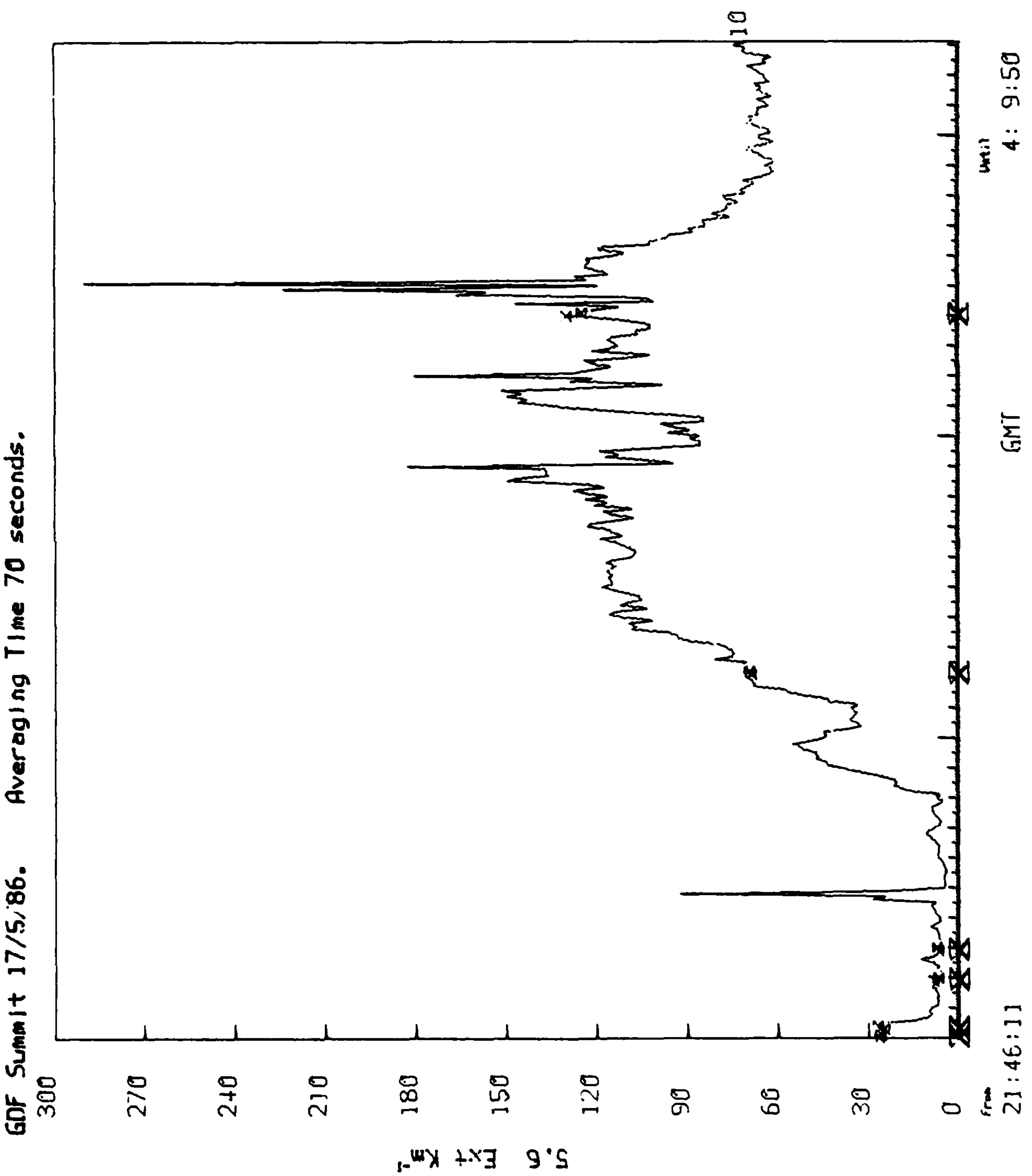

GDF Summit 17/5/86. Averaging Time 70 seconds.
5.6 Ext Km⁻¹
300
270
240
210
180
150
120
90
60
30
0
from
21:46:11
GMT
until
4: 9:50
10

Figure 20.

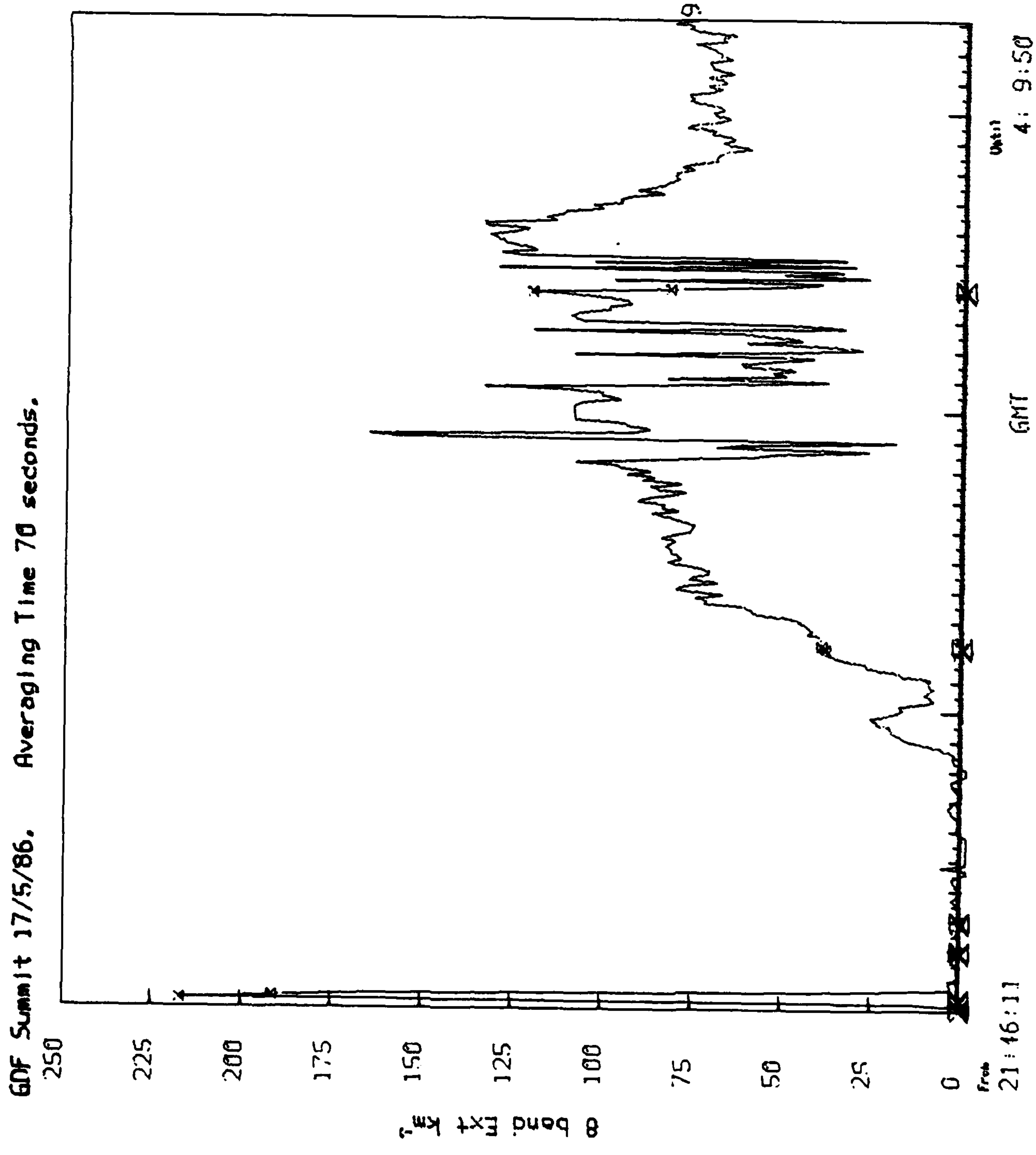

GDF Summit 17/5/86.
Averaging Time 70 seconds.
8 band Ext km^-1
250
225
200
175
150
125
100
75
50
25
0
From 21:46:11
GMT
Until 4: 9:50

Figure 21.

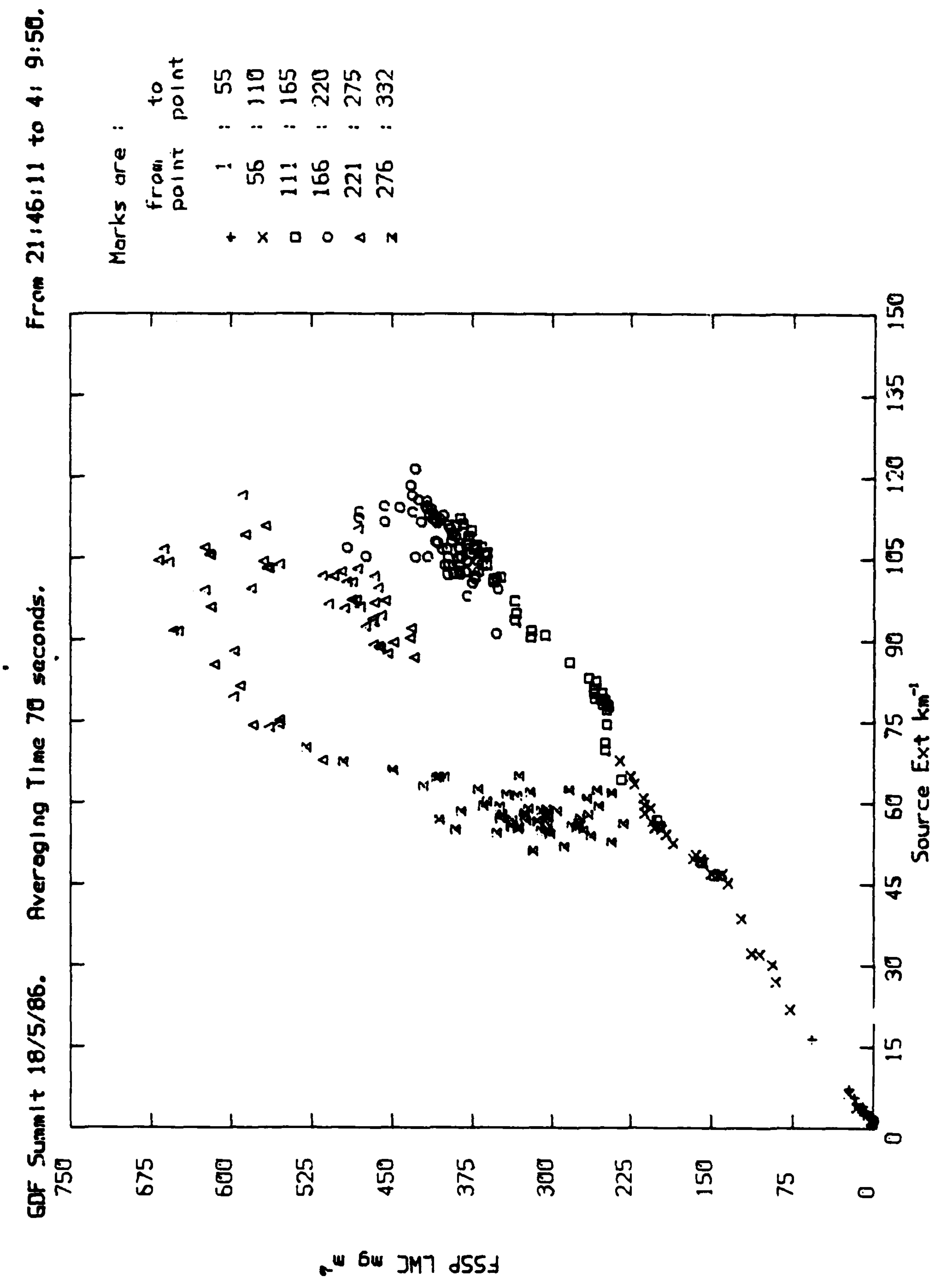

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 21:46:11 to 4: 9:50.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
z 276 : 332
FSSP LWC mg m-3
750
675
600
525
450
375
300
225
150
75
0
Source Ext km-1
0
15
30
45
60
75
90
105
120
135
150

Figure 22.

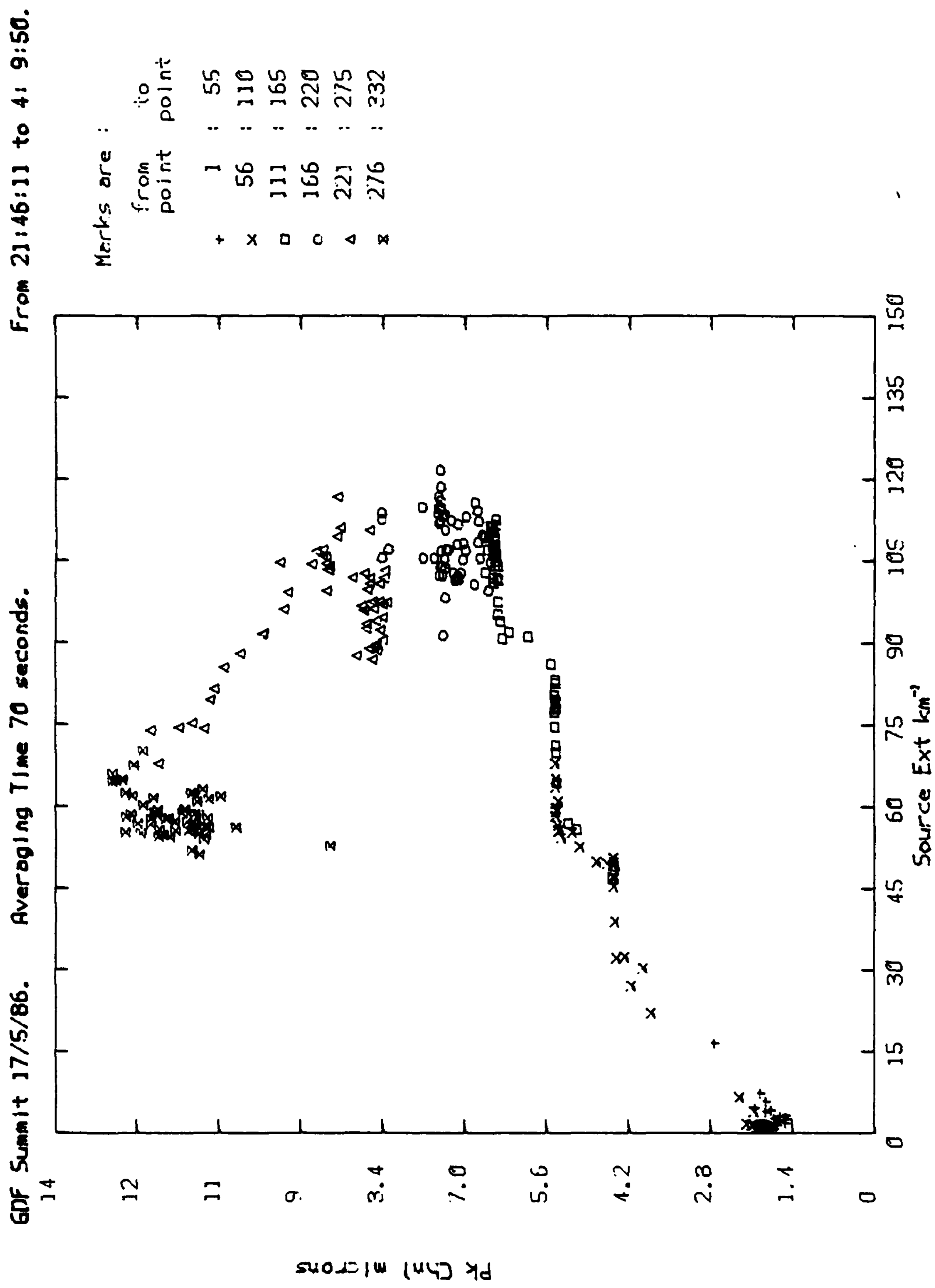
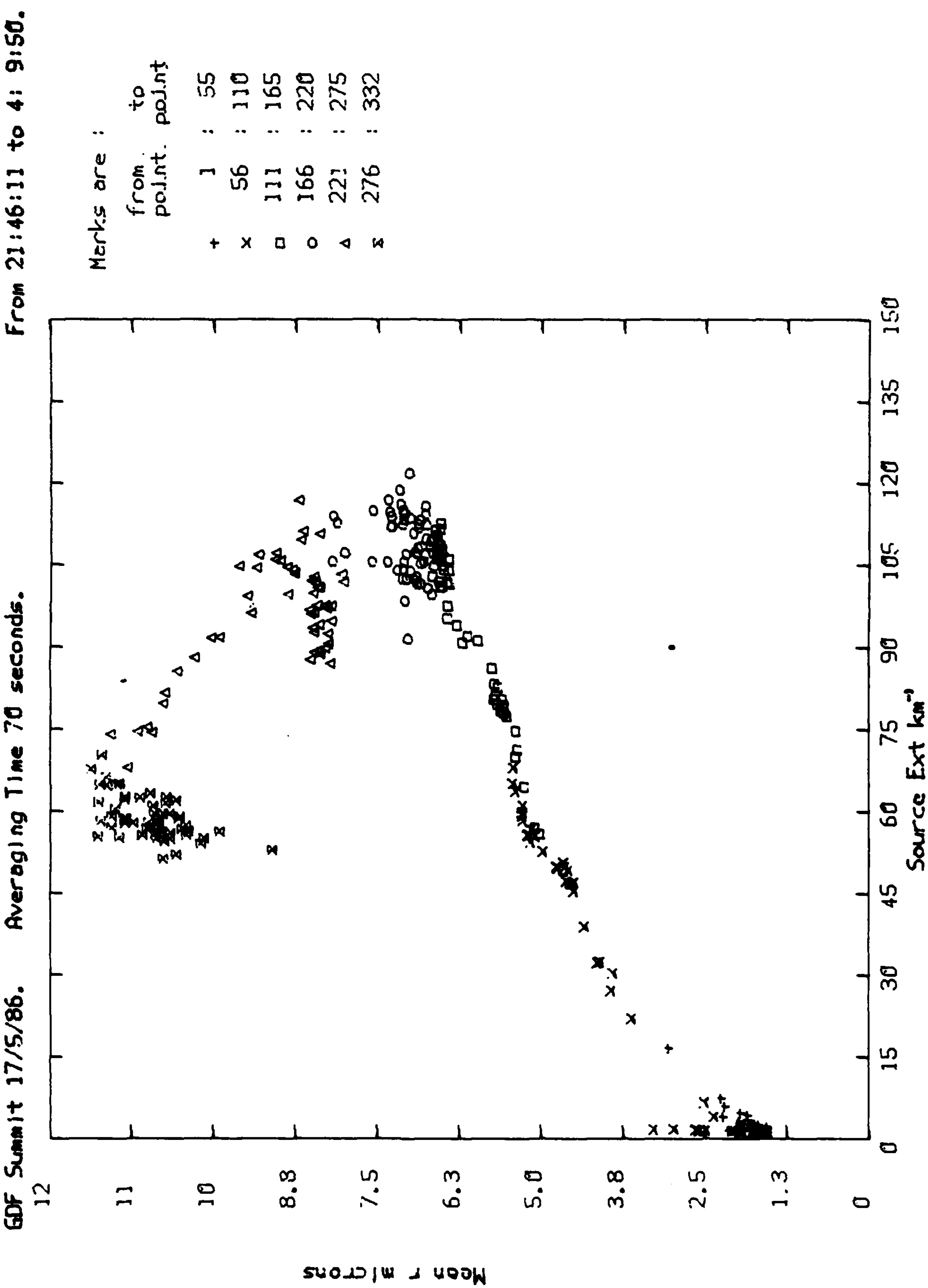
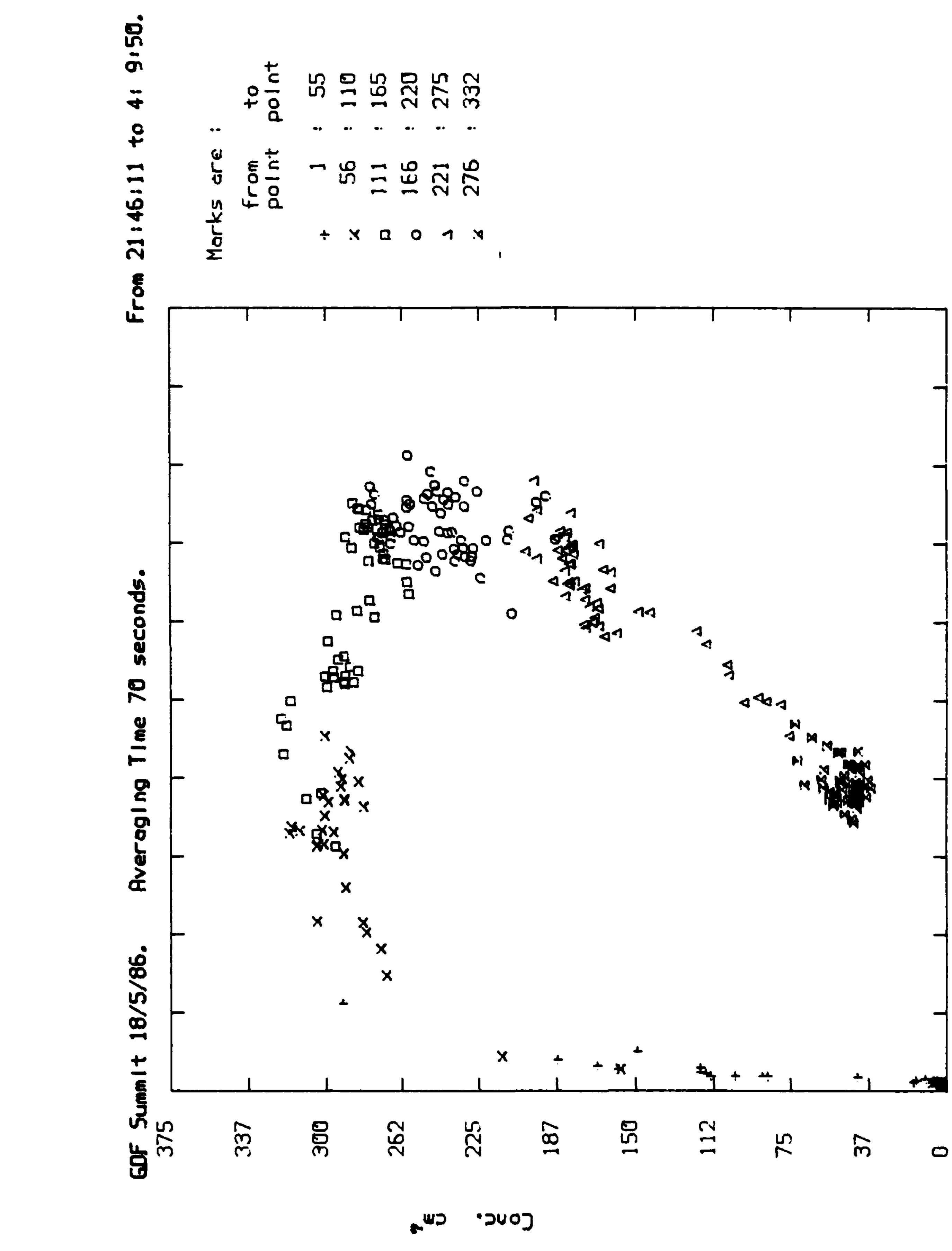

GDF Summit 17/5/86.
Averaging Time 70 seconds.
From 21:46:11 to 4: 9:50.
Marks are :
from point : to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
⧖ 276 : 332
Source Ext km⁻¹
0
15
30
45
60
75
90
105
120
135
150
14
12
11
7.0
5.6
4.2
2.8
1.4
0

Figure 23.



GDF Summit 17/5/86.
Averaging Time 70 seconds.
From 21:46:11 to 4: 9:50.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
⊠ 276 : 332
12
11
10
8.8
7.5
6.3
5.0
3.8
2.5
1.3
0
0
15
30
45
60
75
90
105
120
135
150
Mean r microns
Source Ext km-1

Figure 24.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 21:46:11 to 4: 9:50.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
x 276 : 332
Conc. cm
375
337
300
262
225
187
150
112
75
37
0
0
15
30
45
60
75
90
105
120
135
150
Source Ext km-1

Figure 25.

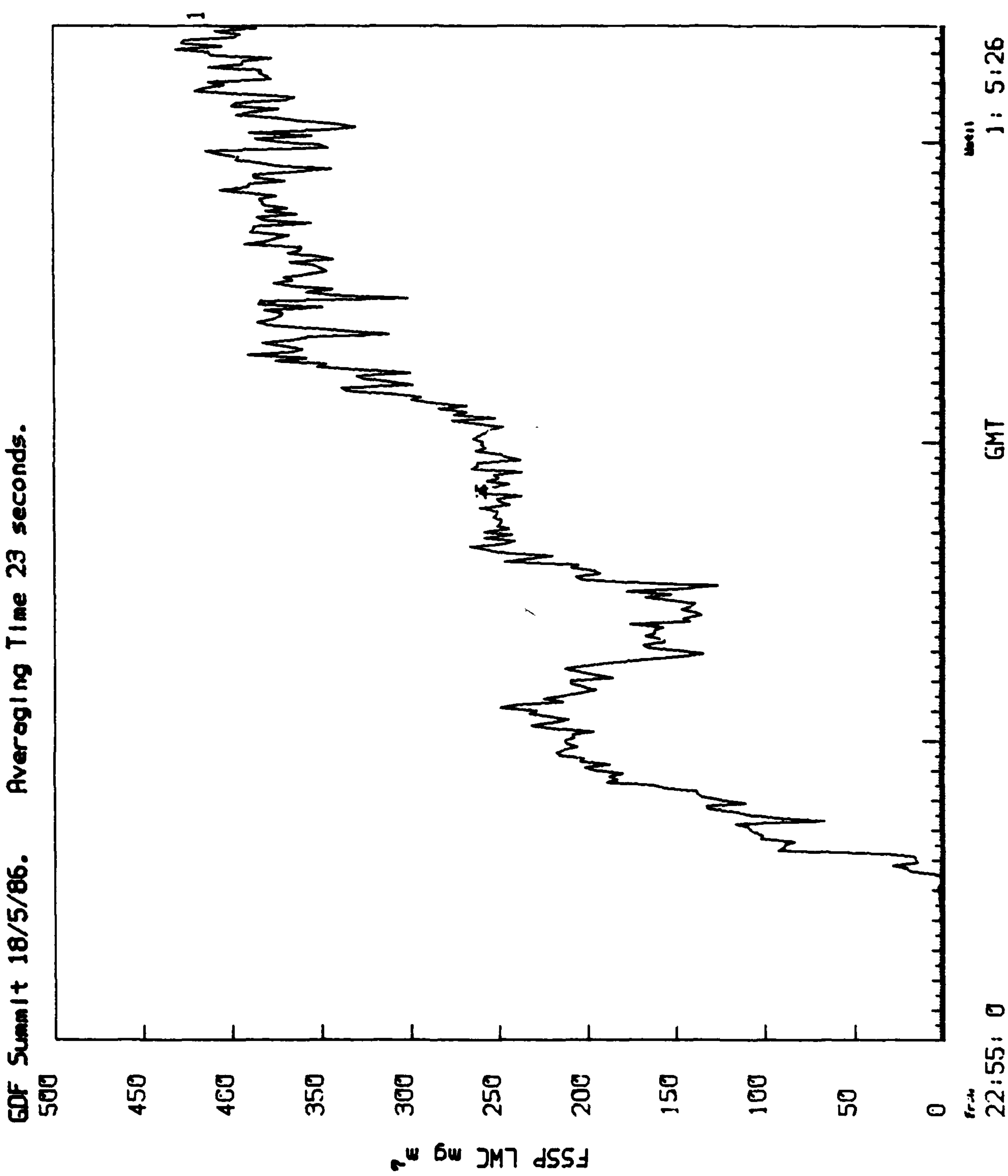

GDF Summit 18/5/86.   Averaging Time 23 seconds.
500
450
400
350
300
250
200
150
100
50
0
FSSP LWC mg m-3
22:55: 0
GMT
1: 5:26

Figure 26.

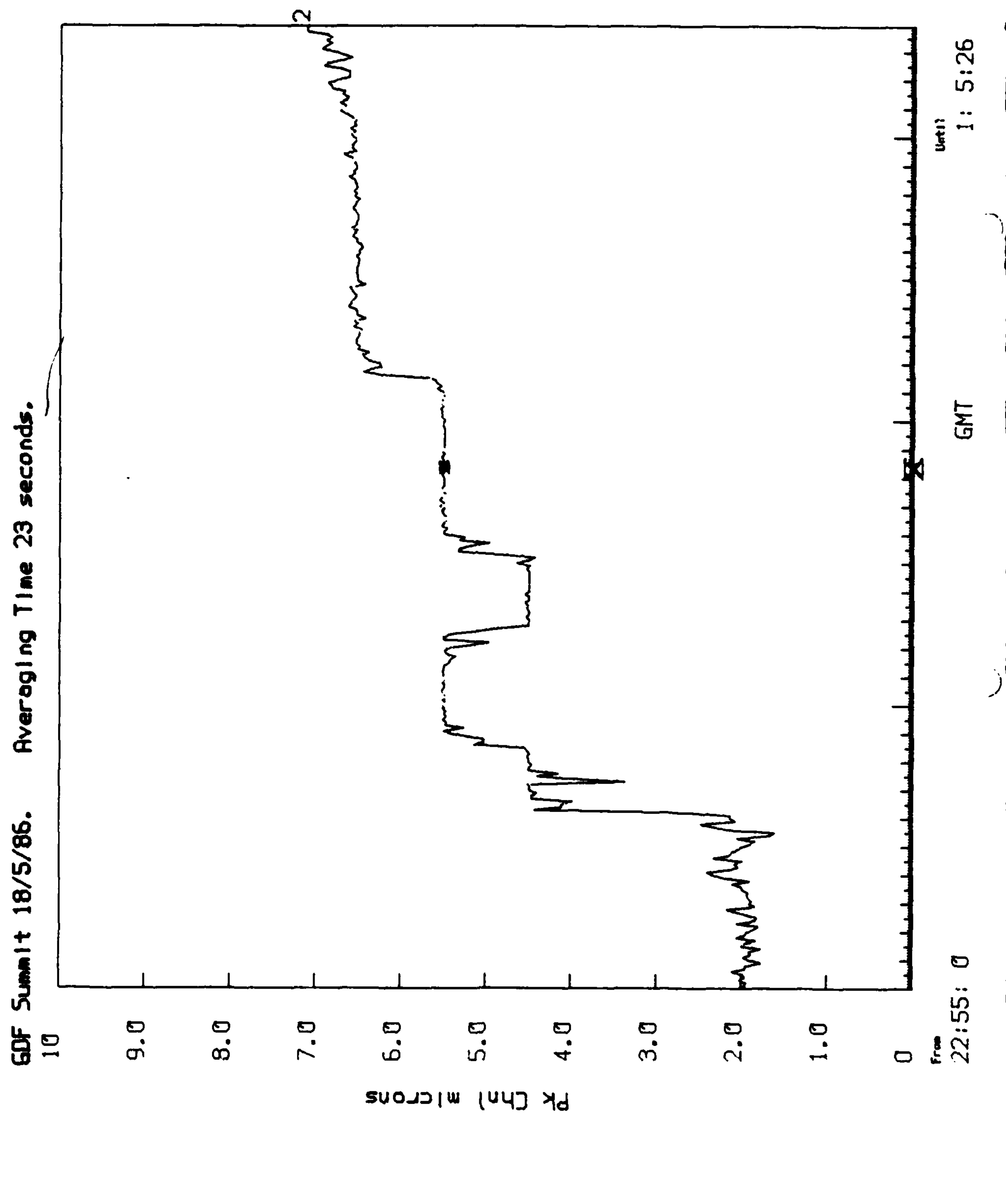

GDF Summit 18/5/86.
Averaging Time 23 seconds.
Pk Chnl microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
From
22:55: 0
GMT
Until
1: 5:26
2

Figure 27.

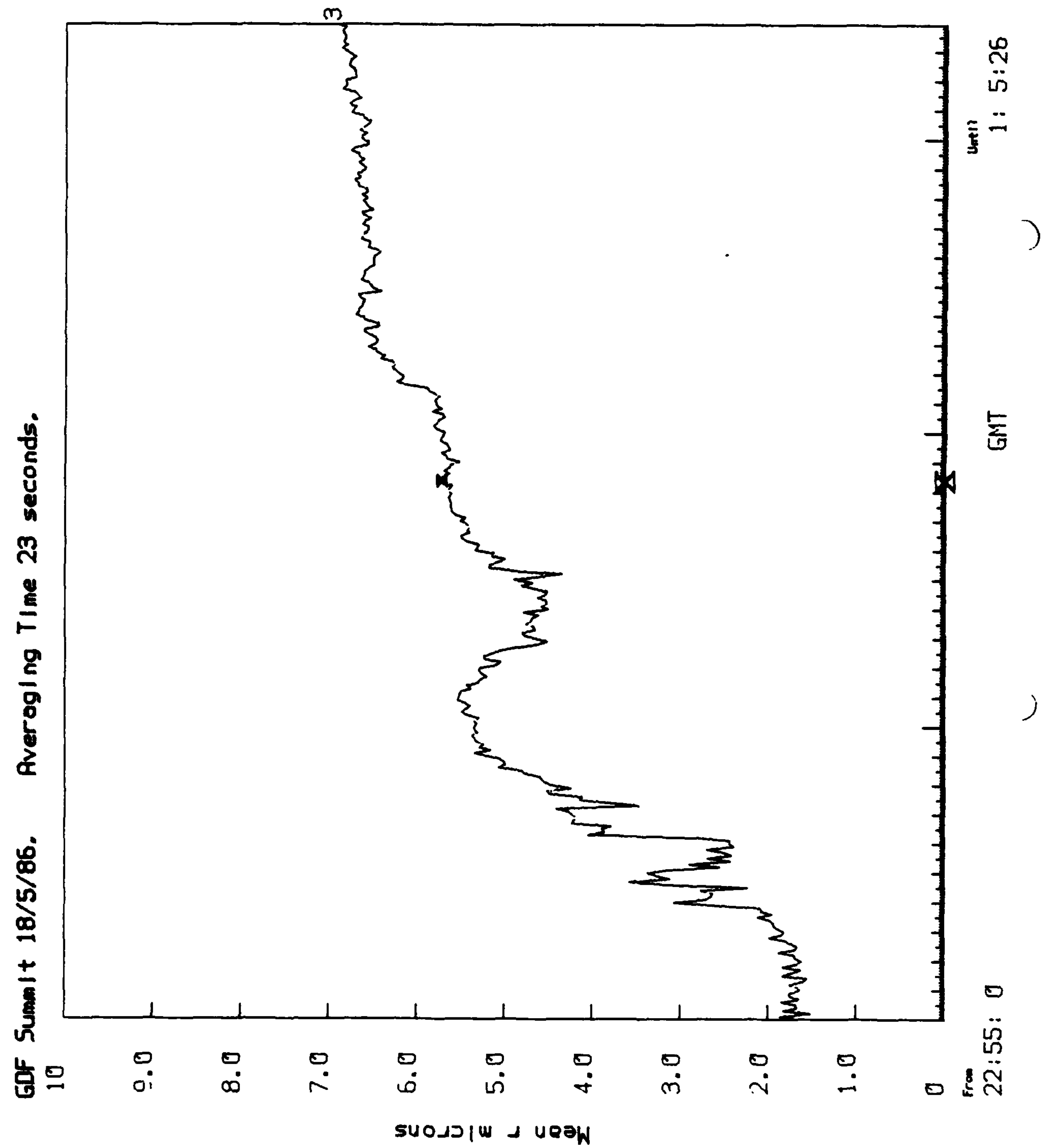

GDF Summit 18/5/86. Averaging Time 23 seconds.
Mean r microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
From 22:55: 0
GMT
Until 1: 5:26
3

Figure 28.

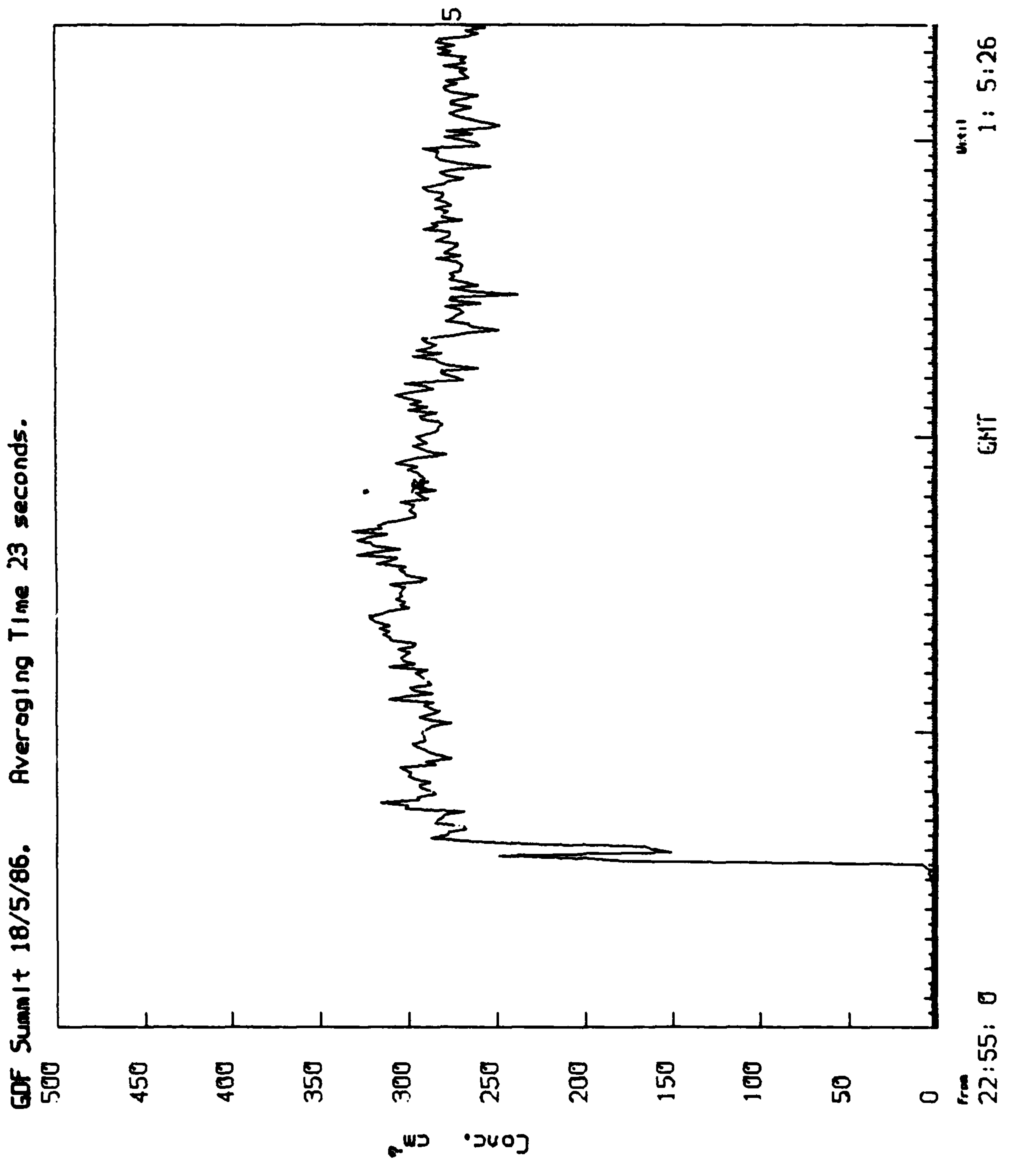

GDF Summit 18/5/86. Averaging Time 23 seconds.
500
450
400
350
300
250
200
150
100
50
0
Conc, cm
from
22:55: 0
GMT
until
1: 5:26
5

Figure 29.

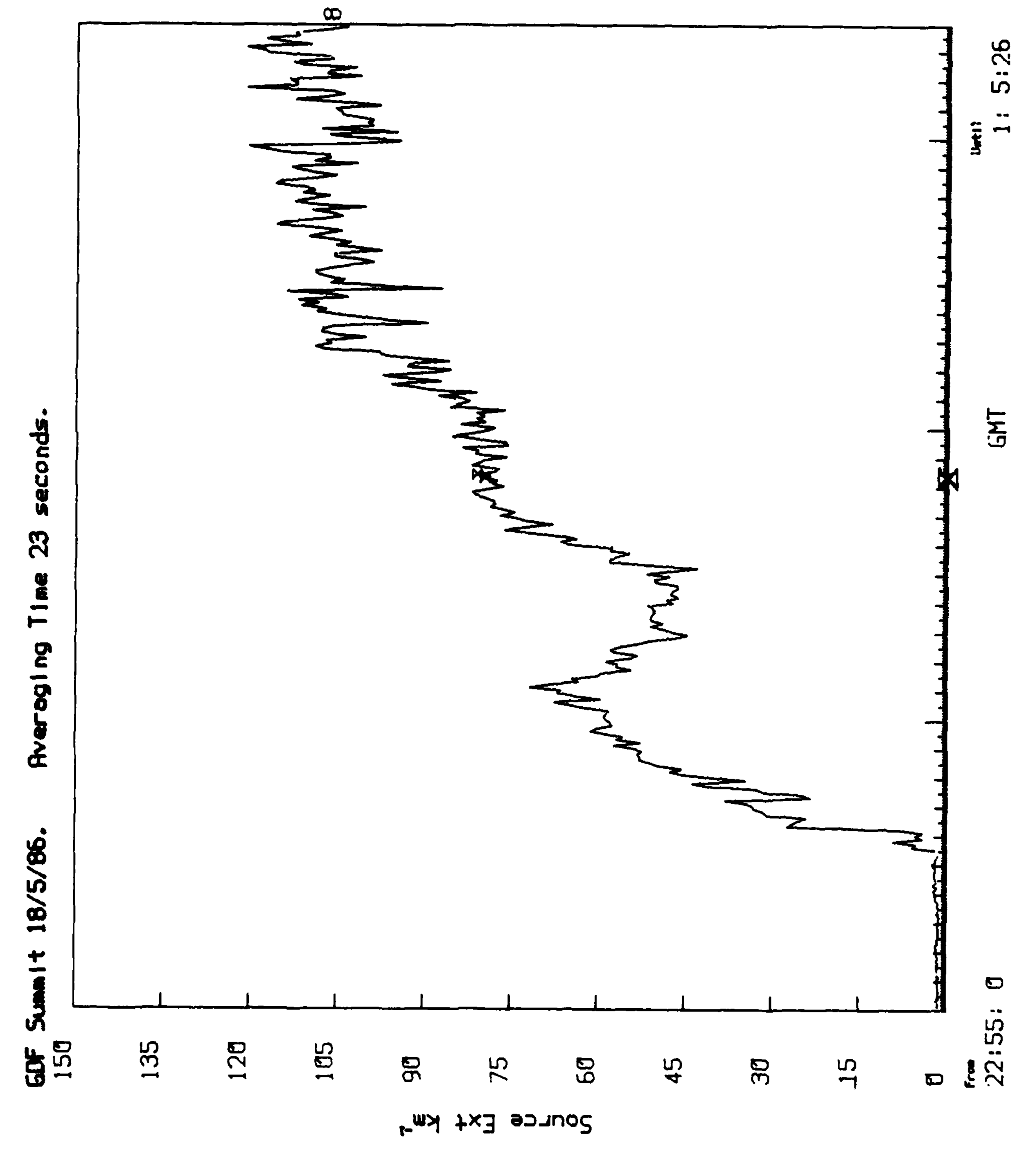
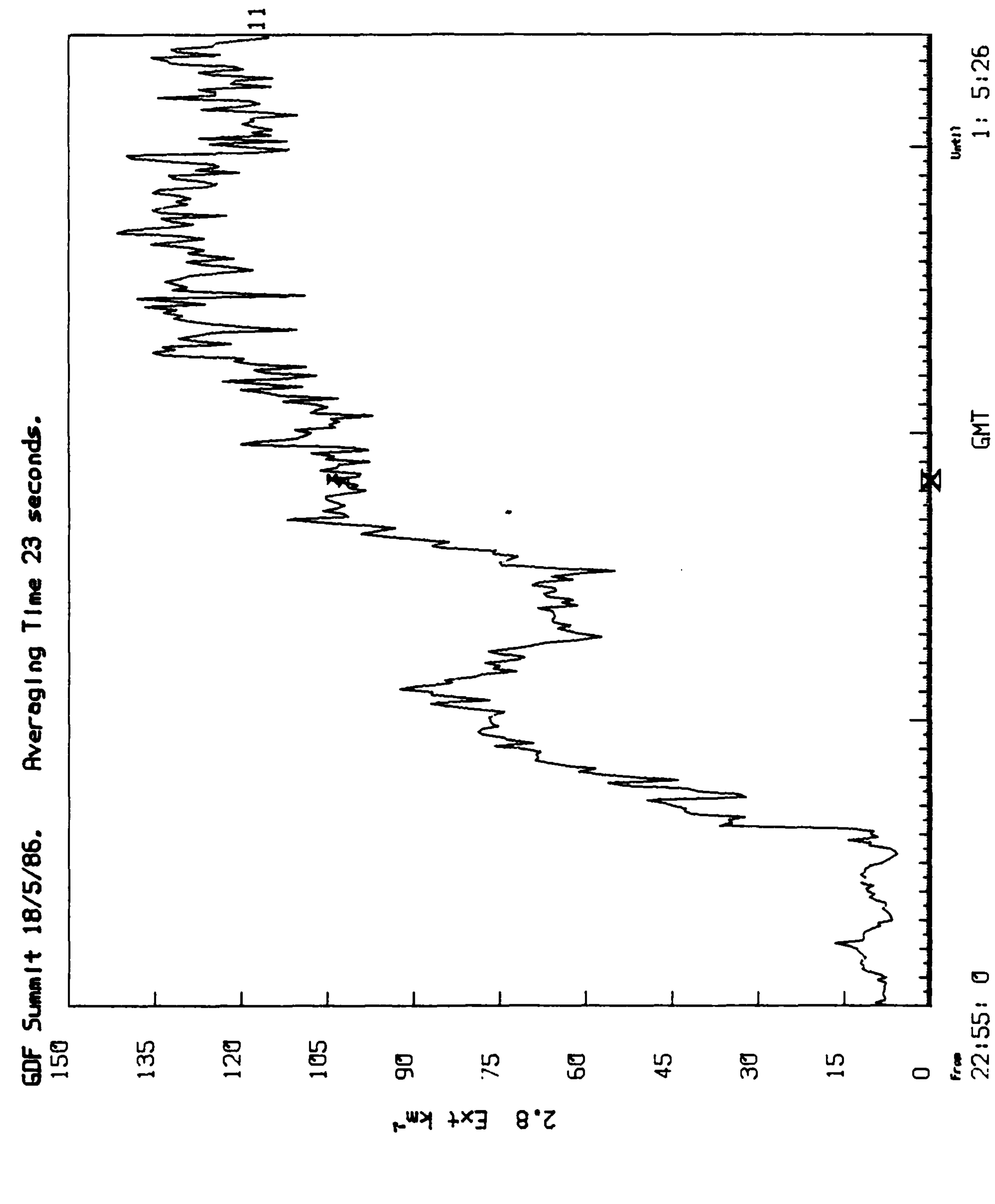
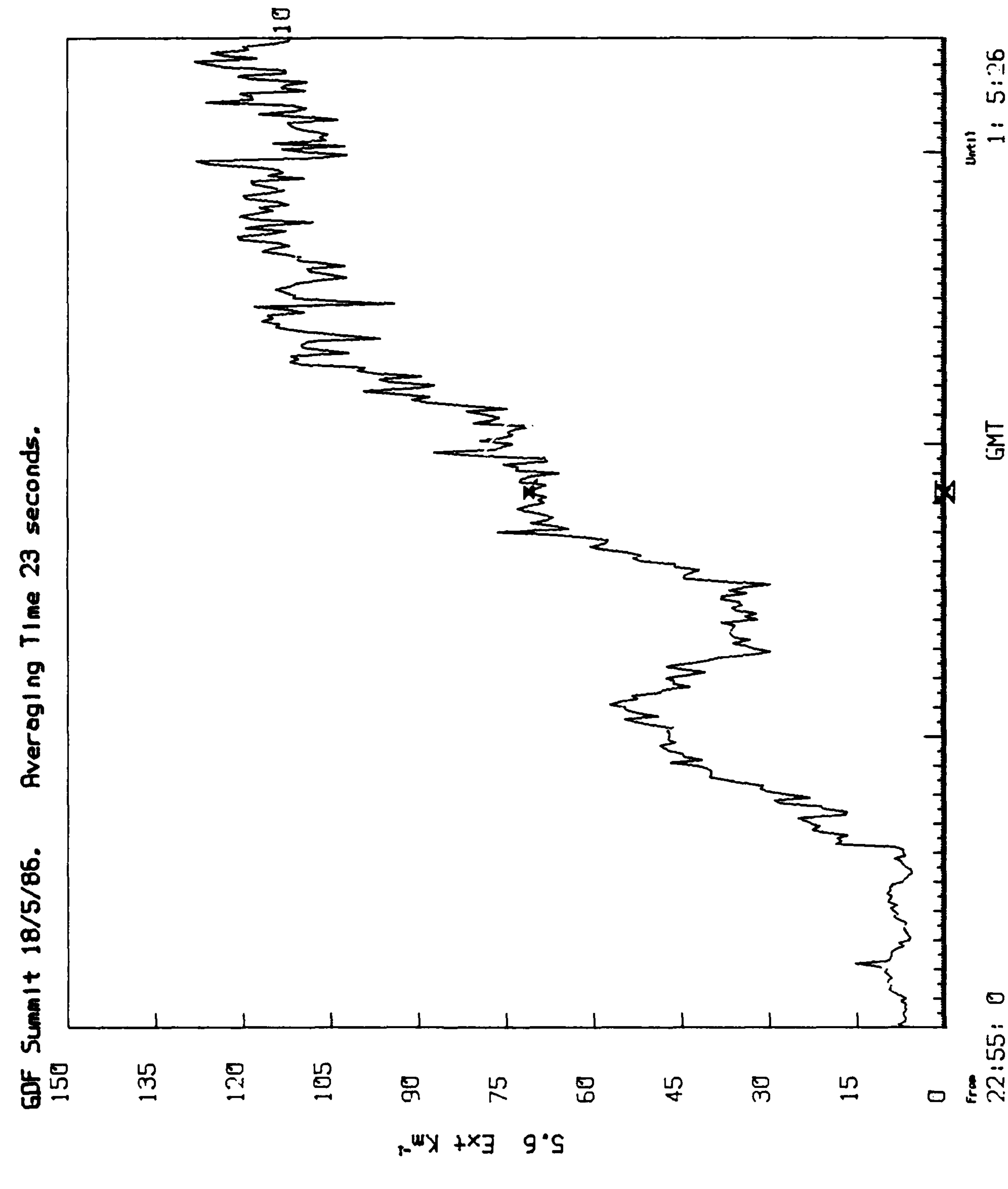

GDF Summit 18/5/86.
Averaging Time 23 seconds.
Source Ext km-1
150
135
120
105
90
75
60
45
30
15
0
From
22:55: 0
GMT
Until
1: 5:26

Figure 30.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
150
135
120
105
90
75
60
45
30
15
0
2.8 Ext km-1
From
22:55: 0
Until
1: 5:26
GMT
11

Figure 31.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
5.6 Ext Km-1
150
135
120
105
90
75
60
45
30
15
0
10
From
22:55: 0
GMT
Until
1: 5:26

Figure 32.

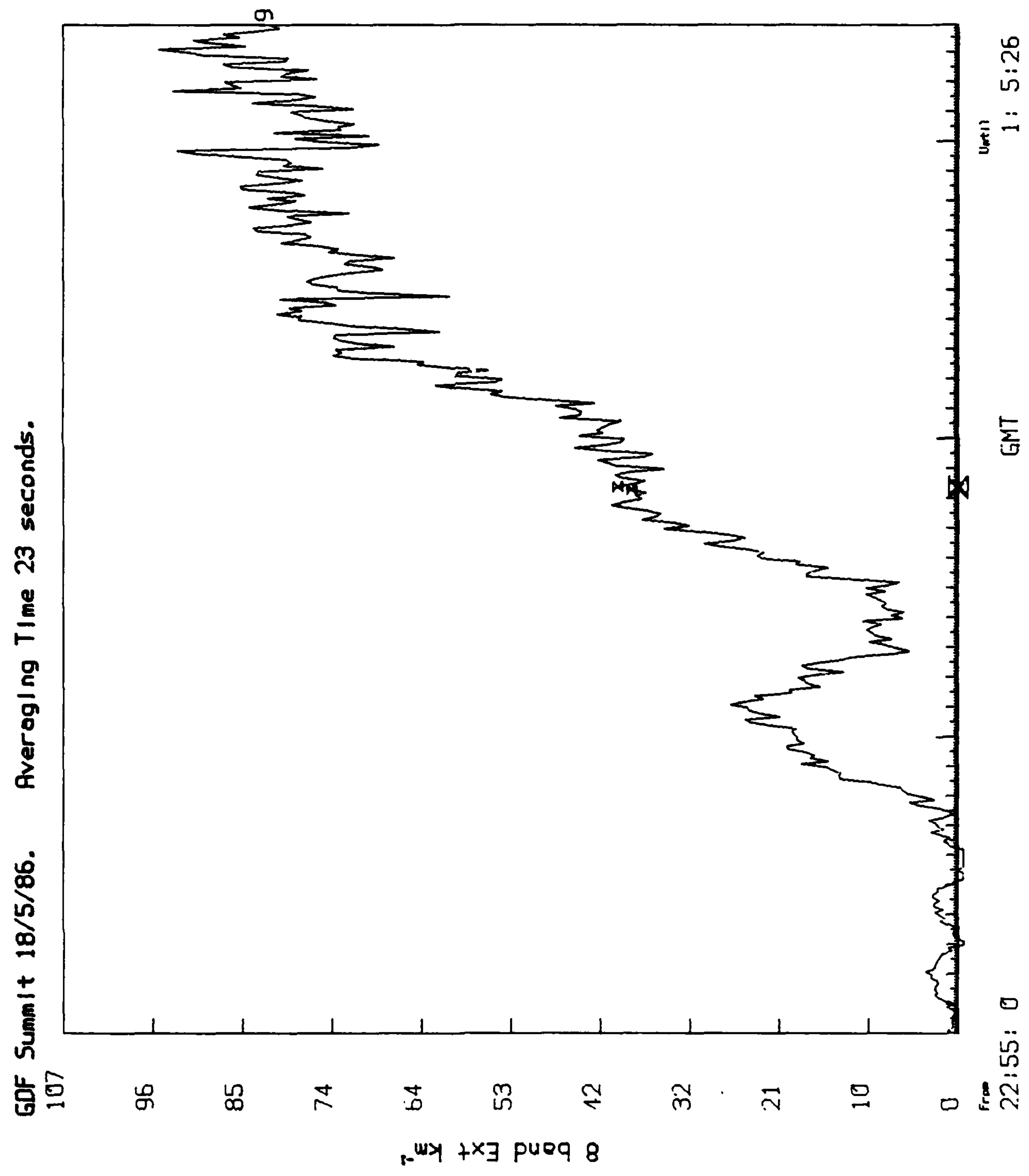

GDF Summit 18/5/86.
Averaging Time 23 seconds.
8 band Ext km-1
107
96
85
74
64
53
42
32
21
10
0
From
22:55: 0
GMT
Until
1: 5:26

Figure 33.

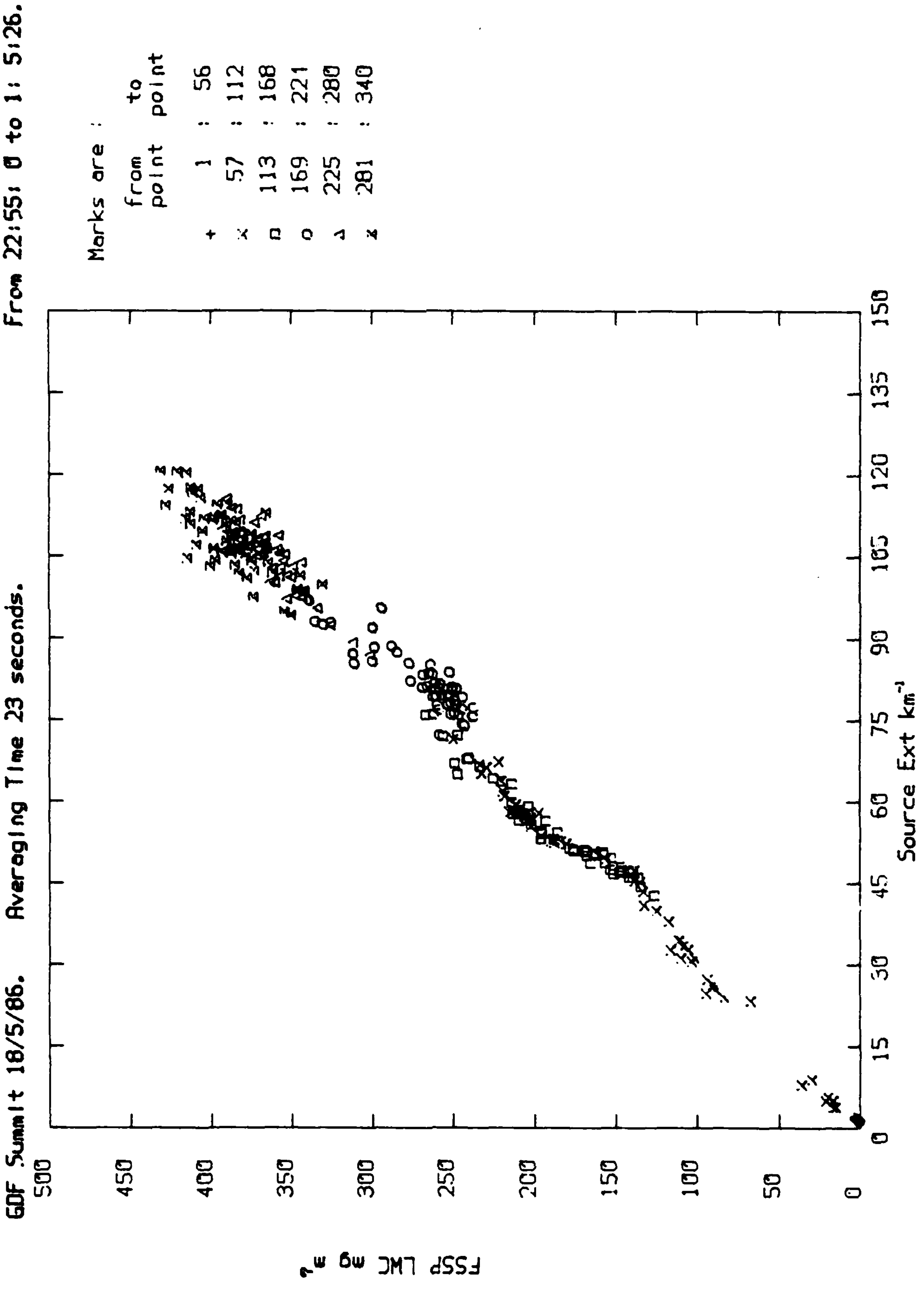
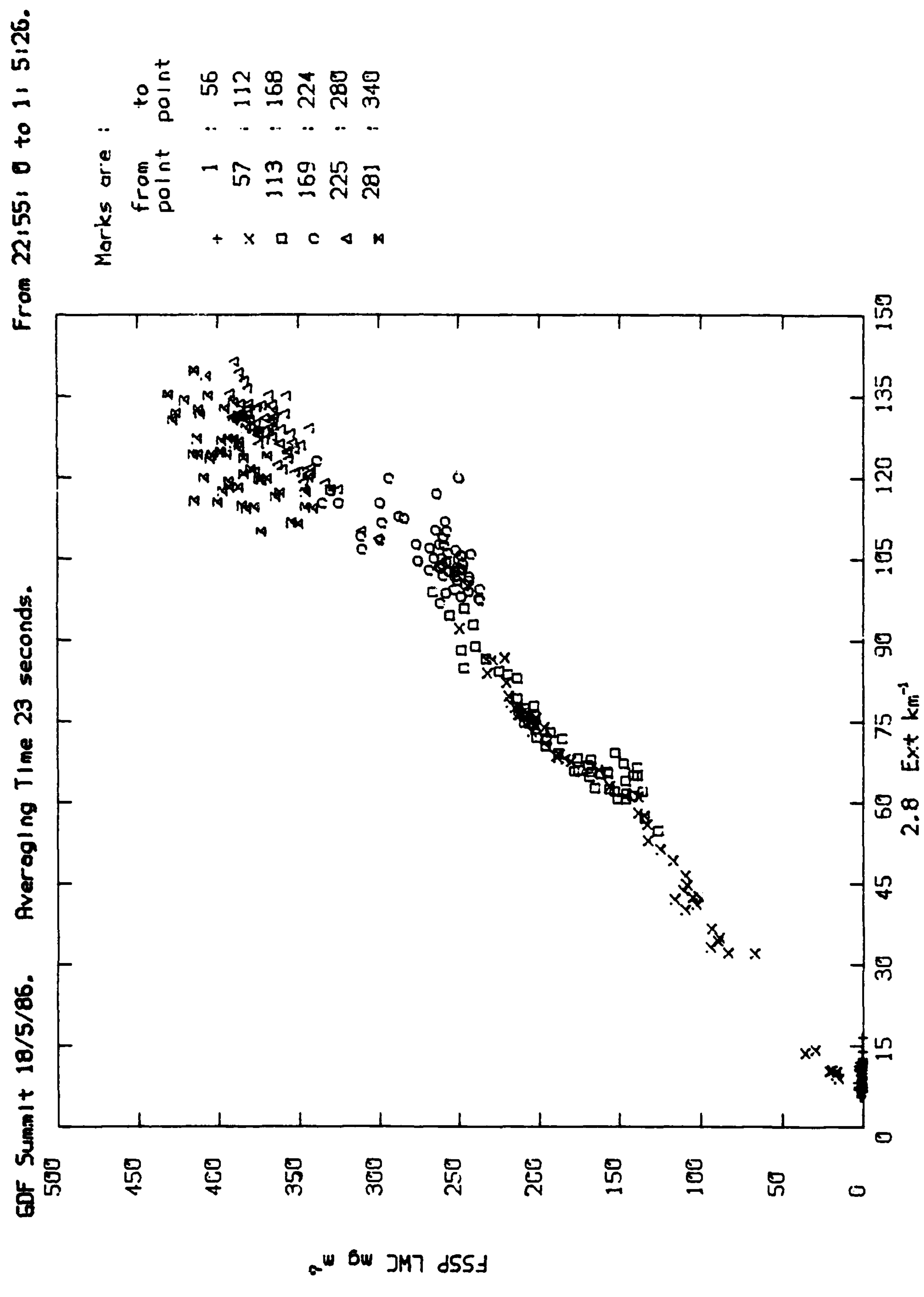

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 221
Δ 225 : 280
x 281 : 340
FSSP LWC mg m-3
Source Ext km-1
0
50
100
150
200
250
300
350
400
450
500
0
15
30
45
60
75
90
105
120
135
150

Figure 34.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
⌧ 281 : 340
FSSP LWC mg m-3
2.8 Ext km-1
0
50
100
150
200
250
300
350
400
450
500
0
15
30
45
60
75
90
105
120
135
150

Figure 35.

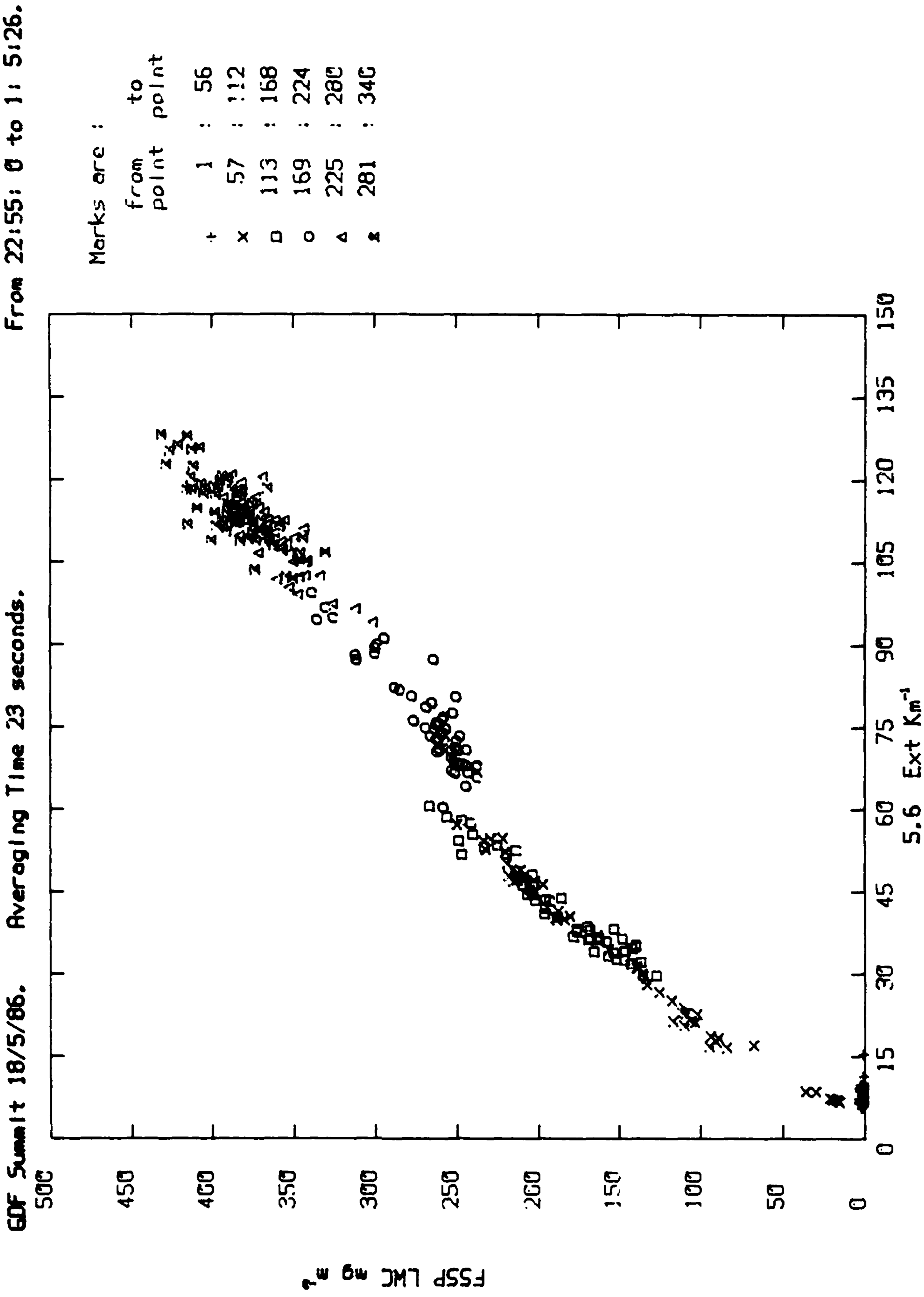

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
281 : 340
0 15 30 45 60 75 90 105 120 135 150
5.6 Ext Km-1
0 50 100 150 200 250 300 350 400 450 500
FSSP LWC mg m-3

Figure 36.

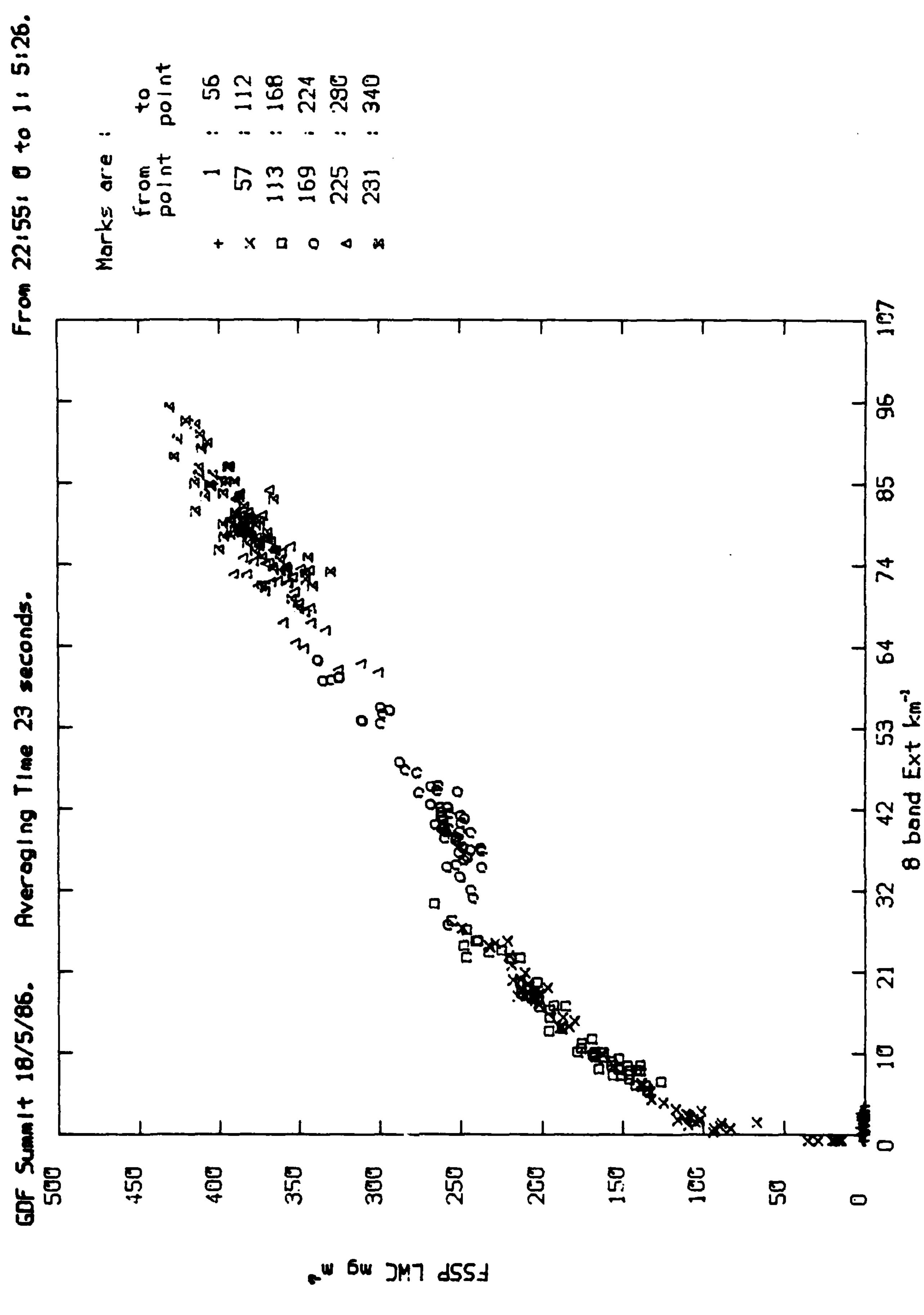

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
○ 169 : 224
△ 225 : 230
⌘ 231 : 340
FSSP LWC mg m-3
8 band Ext km-1
0
50
100
150
200
250
300
350
400
450
500
0
10
21
32
42
53
64
74
85
96
107

Figure 37.

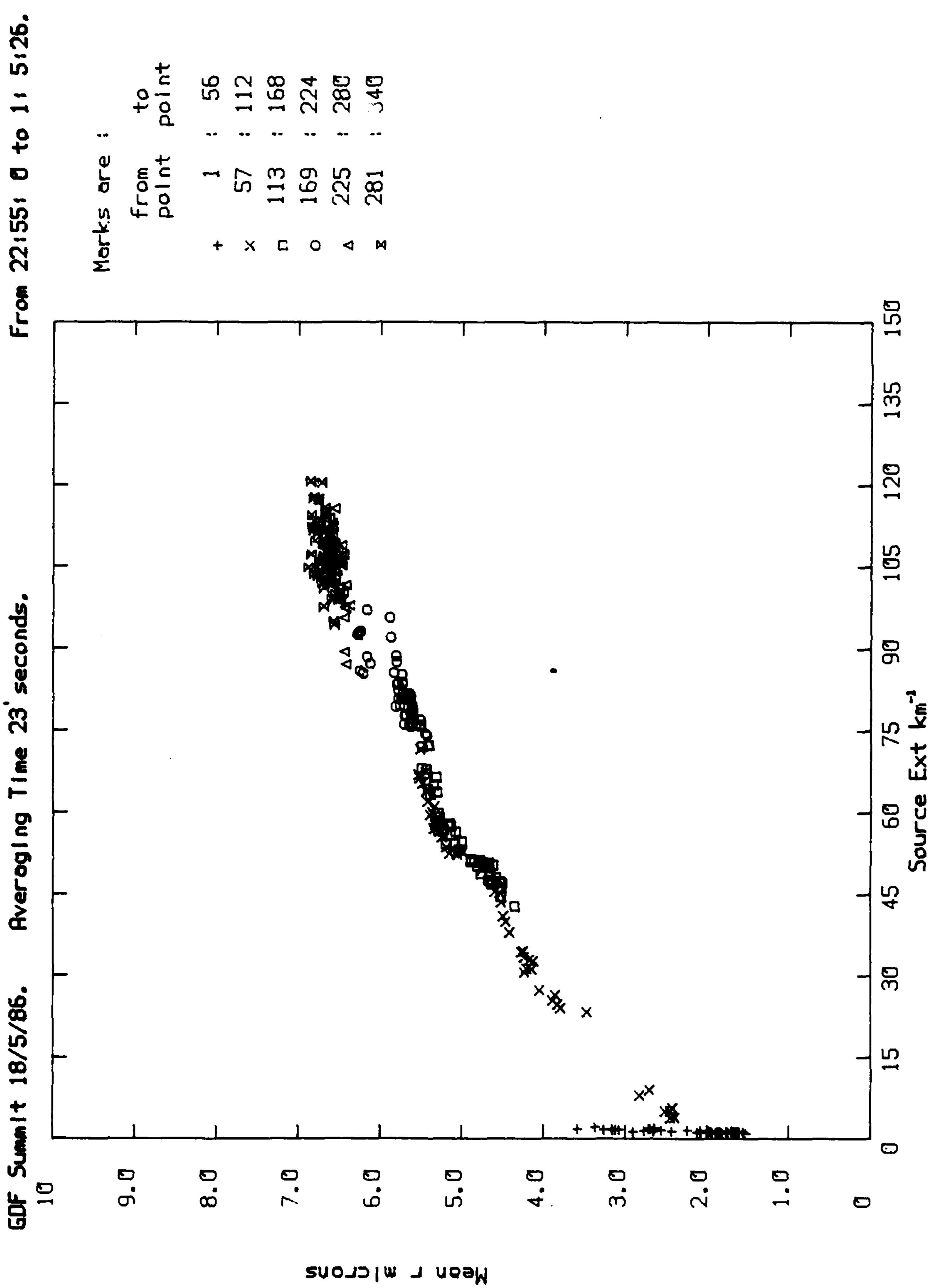
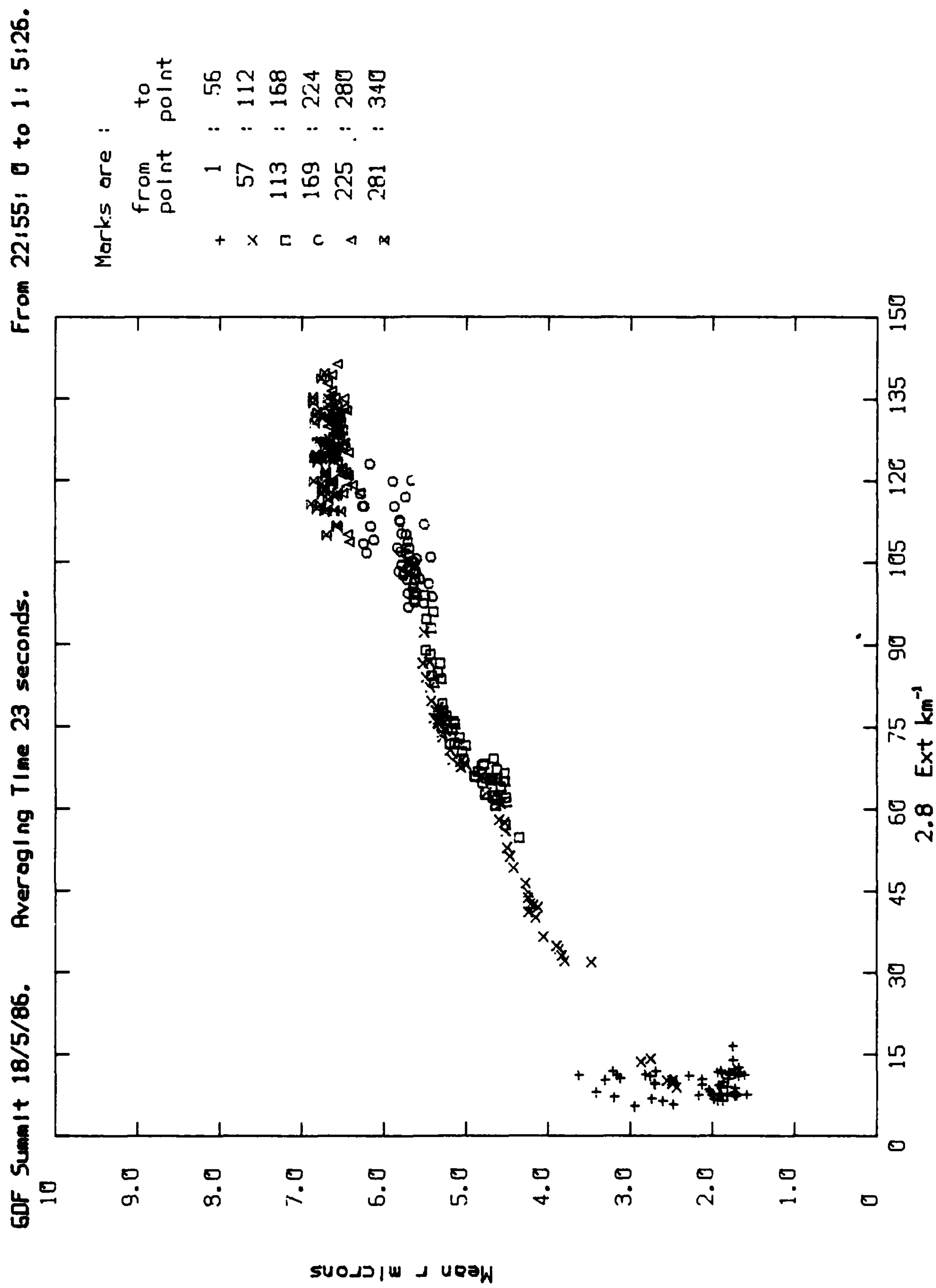
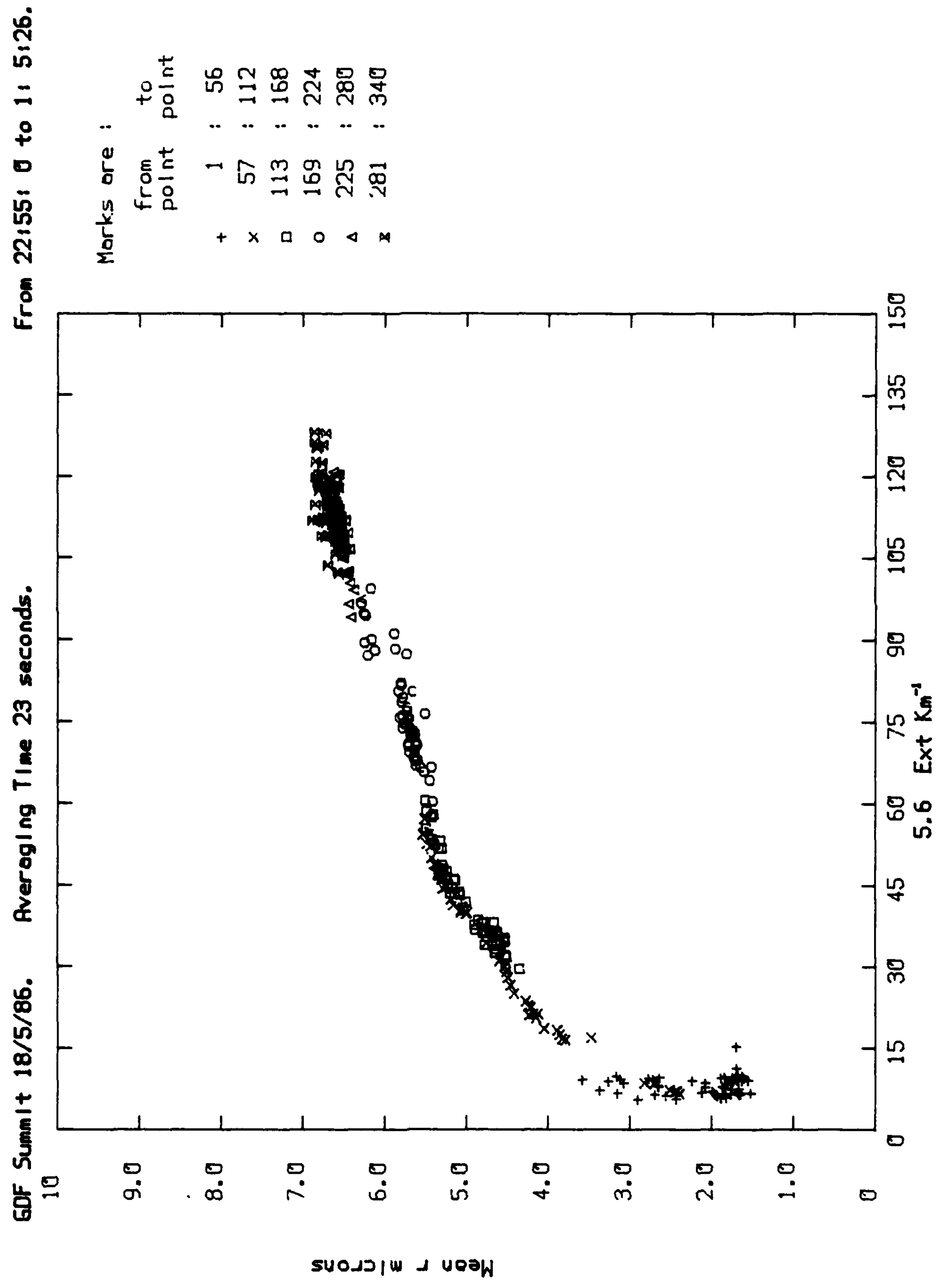

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
⧗ 281 : 340
0
15
30
45
60
75
90
105
120
135
150
Source Ext km^{-1}
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
Mean r microns

Figure 38.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
○ 169 : 224
△ 225 : 280
⧗ 281 : 340
Mean r microns
0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10
0 15 30 45 60 75 90 105 120 135 150
2.8 Ext km⁻¹

Figure 39.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
x 281 : 340
Mean r microns
5.6 Ext Km⁻¹
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
0
15
30
45
60
75
90
105
120
135
150

Figure 40.

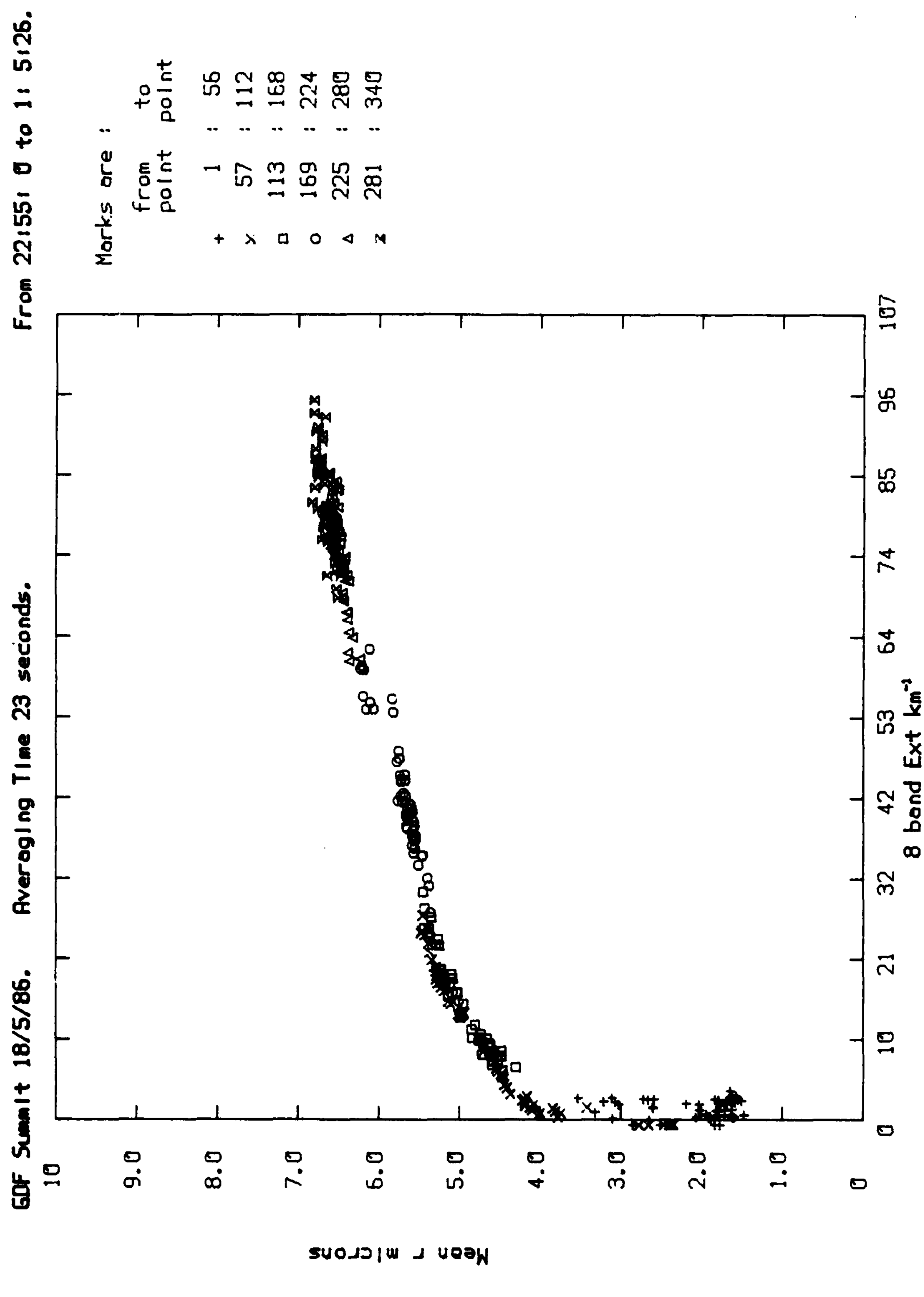

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
z 281 : 340
Mean r microns
8 band Ext km-1
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
10
21
32
42
53
64
74
85
96
107

Figure 41.

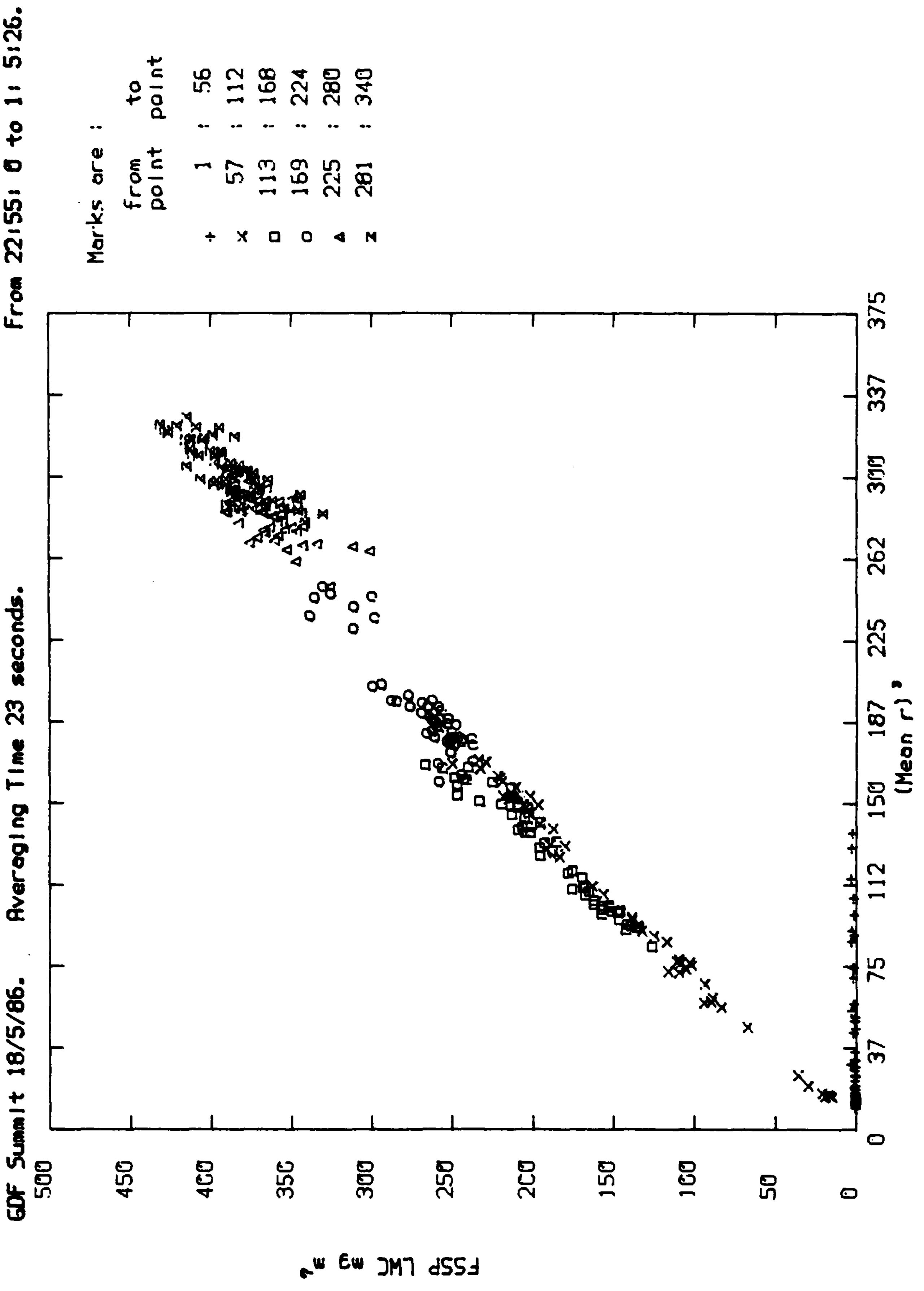
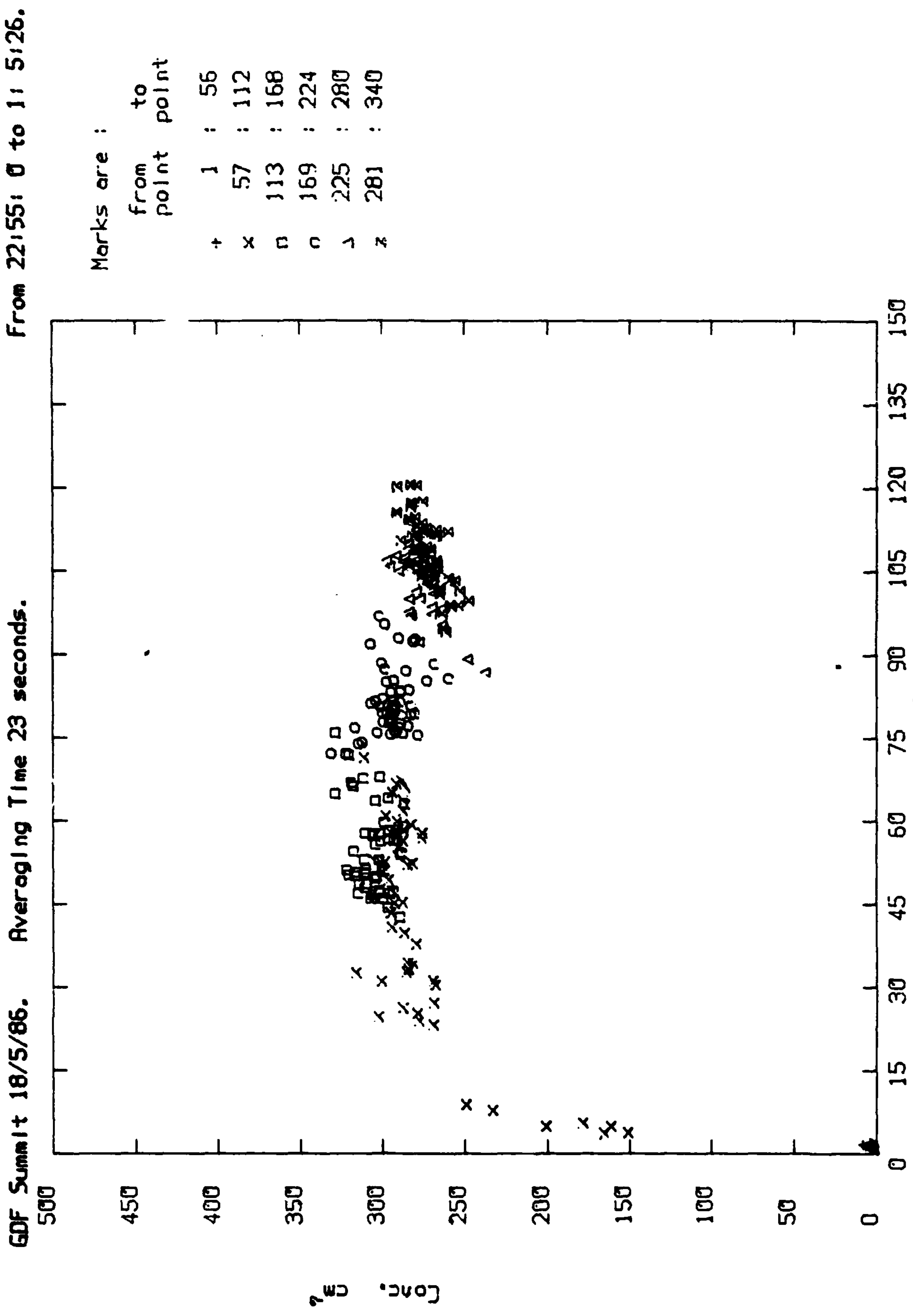
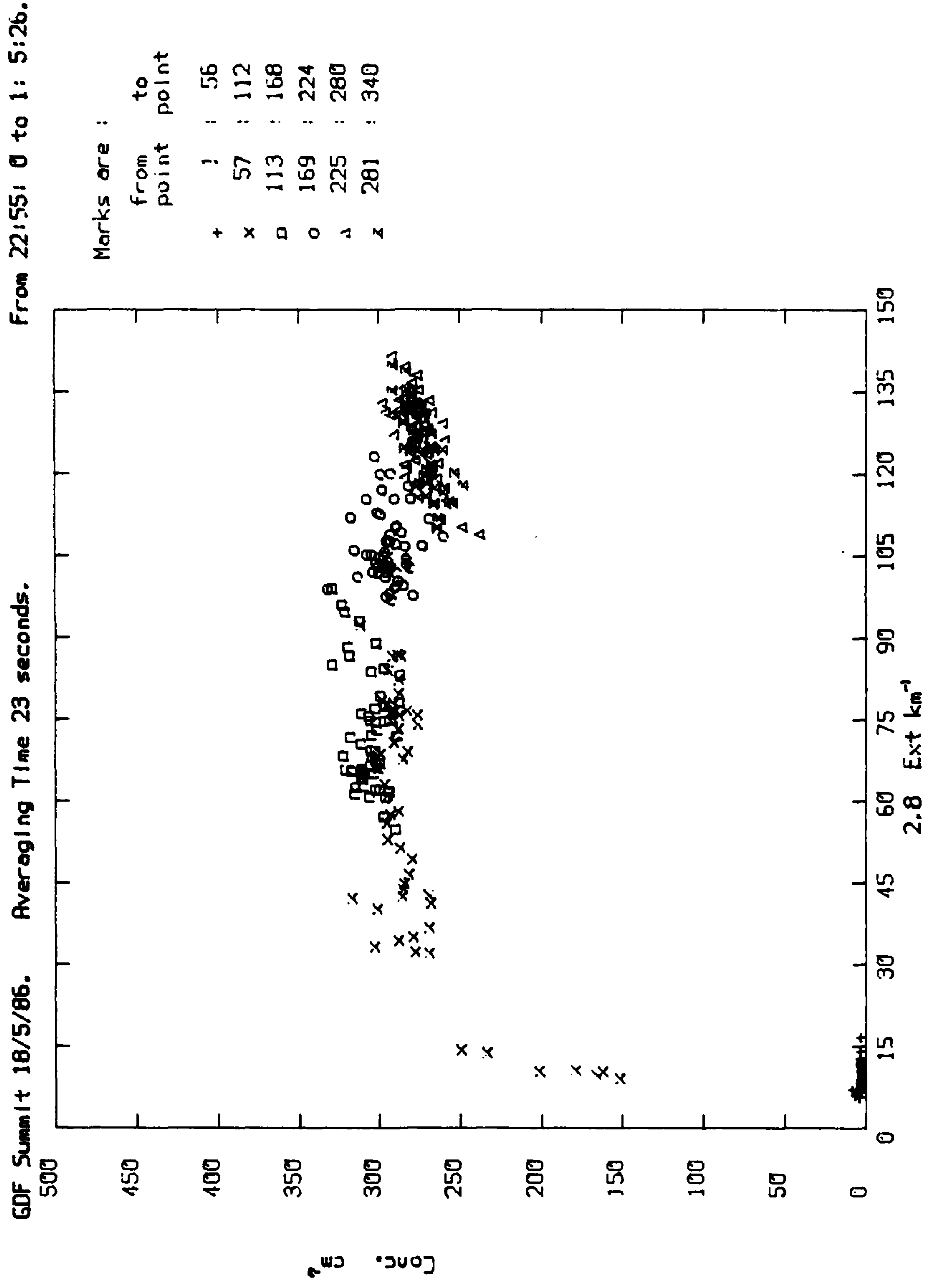

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
▲ 225 : 280
z 281 : 340
FSSP LWC mg m-3
(Mean r)3
0 50 100 150 200 250 300 350 400 450 500
0 37 75 112 150 187 225 262 300 337 375

Figure 42.



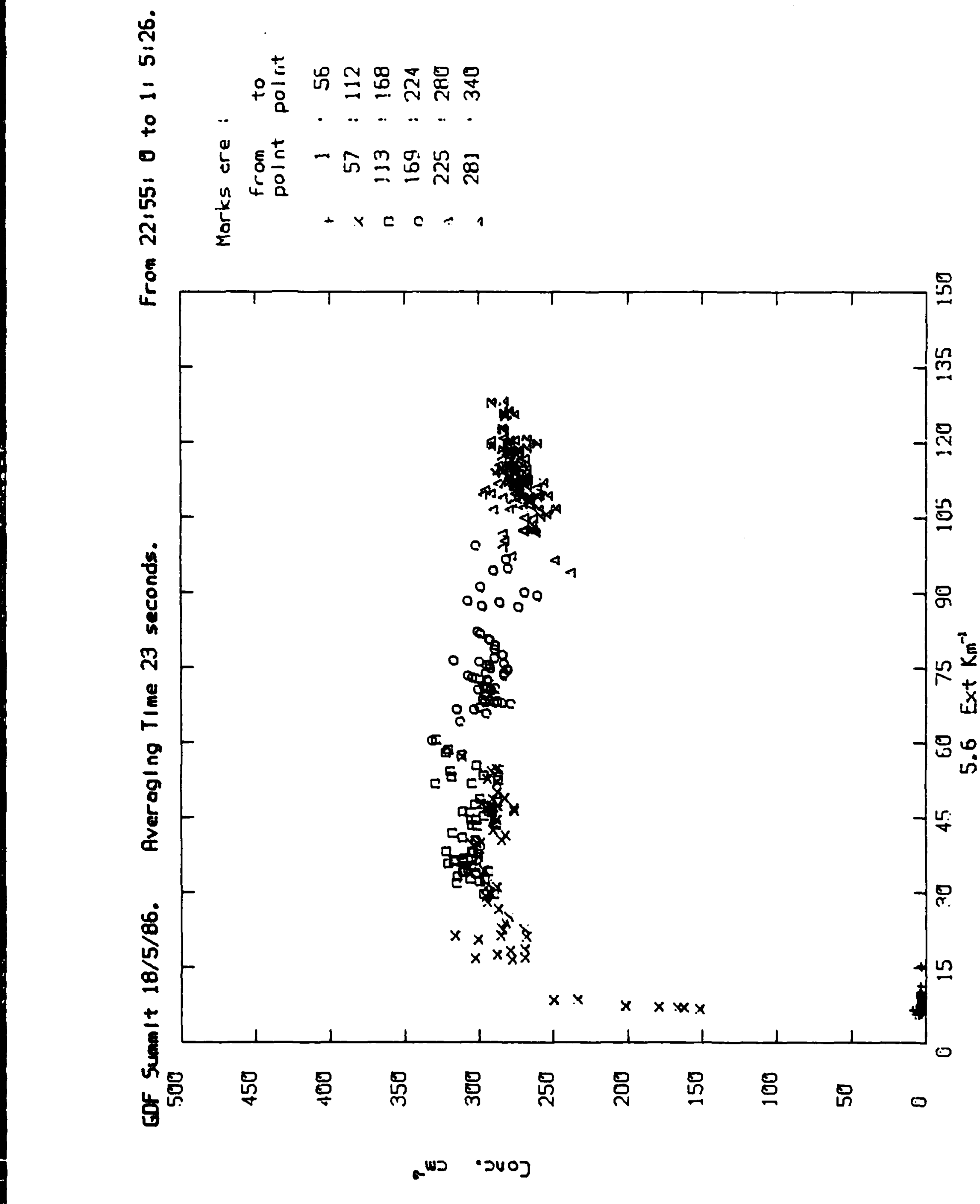
GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 340
0 50 100 150 200 250 300 350 400 450 500
0 15 30 45 60 75 90 105 120 135 150
Source Ext km-1
Conc, cm

Figure 43.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
○ 169 : 224
Δ 225 : 280
z 281 : 340
Conc. cm⁻³
2.8 Ext km⁻¹
0
50
100
150
200
250
300
350
400
450
500
15
30
45
60
75
90
105
120
135
150

Figure 44.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
1 : 56
57 : 112
113 : 168
169 : 224
225 : 280
281 : 340
Conc. cm^-3
5.6 Ext Km^-1
0
15
30
45
60
75
90
105
120
135
150
50
100
150
200
250
300
350
400
450
500

Figure 45.

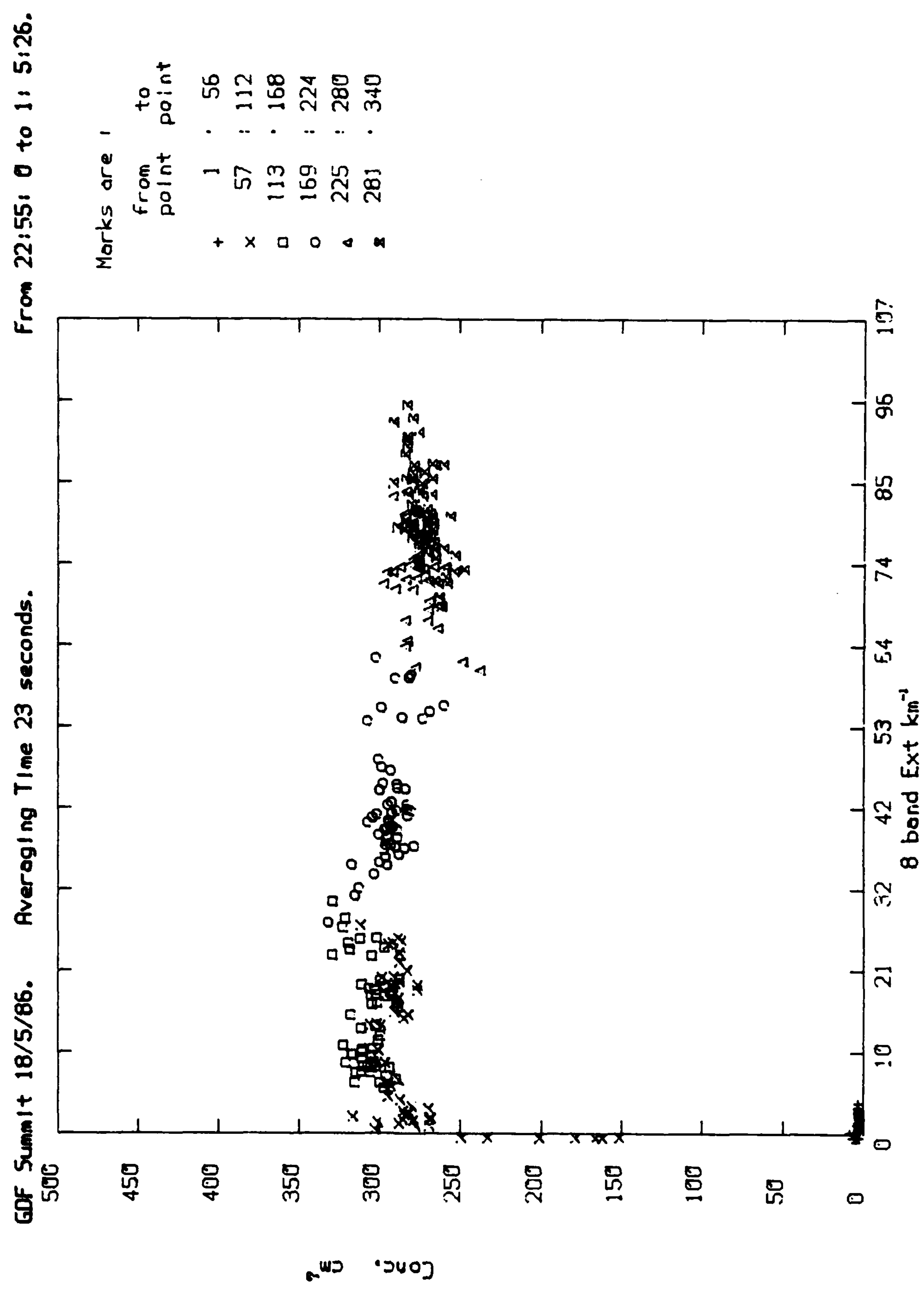
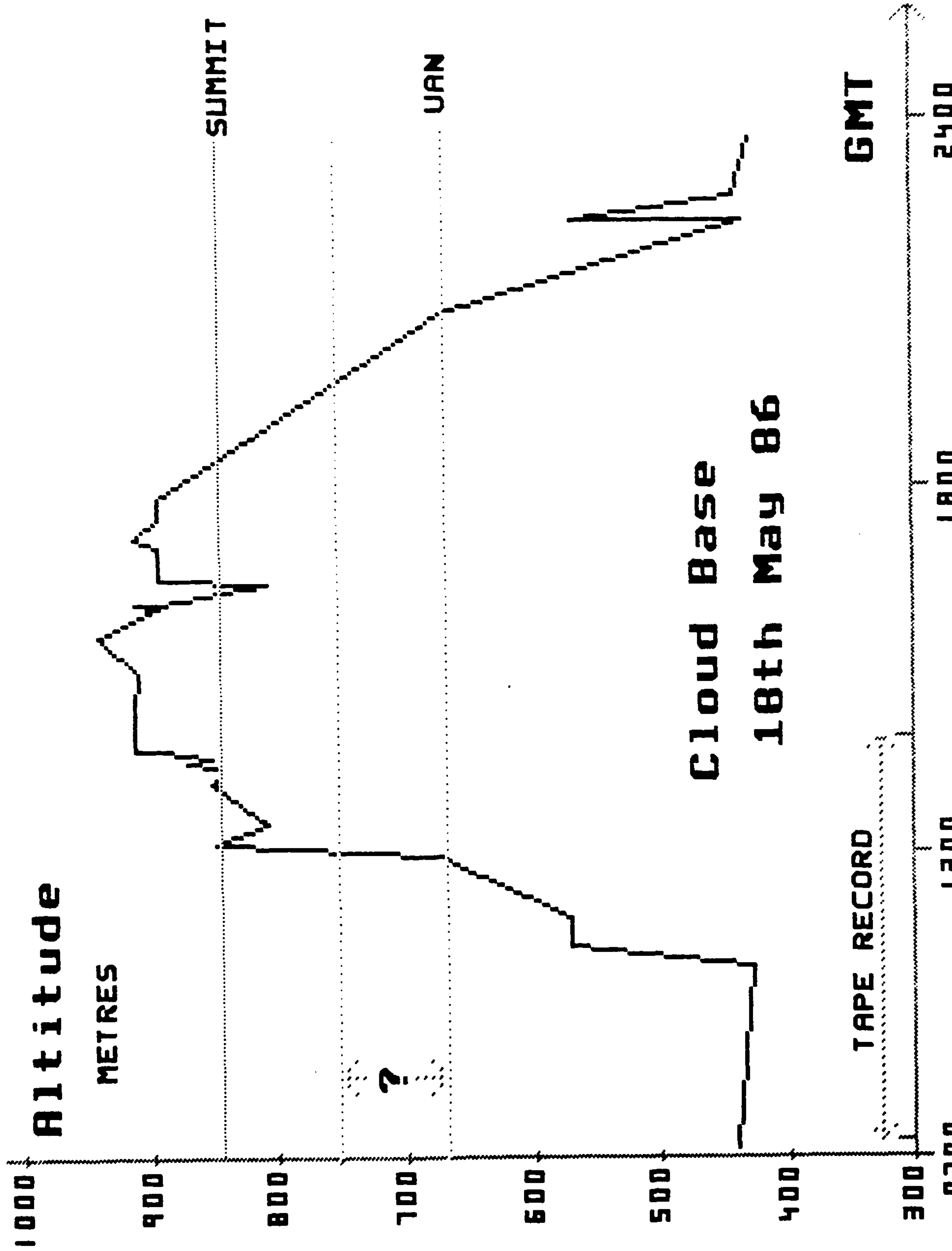

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
▲ 225 : 280
✱ 281 : 340
500
450
400
350
300
250
200
150
100
50
0
Conc, cm
0
10
21
32
42
53
64
74
85
96
107
8 band Ext km⁻¹

Figure 46.



Altitude
METRES
SUMMIT
VAN
?
Cloud Base
18th May 86
TAPE RECORD
GMT
1000
900
800
700
600
500
400
300
0700
1200
1800
2400

Figure 47.

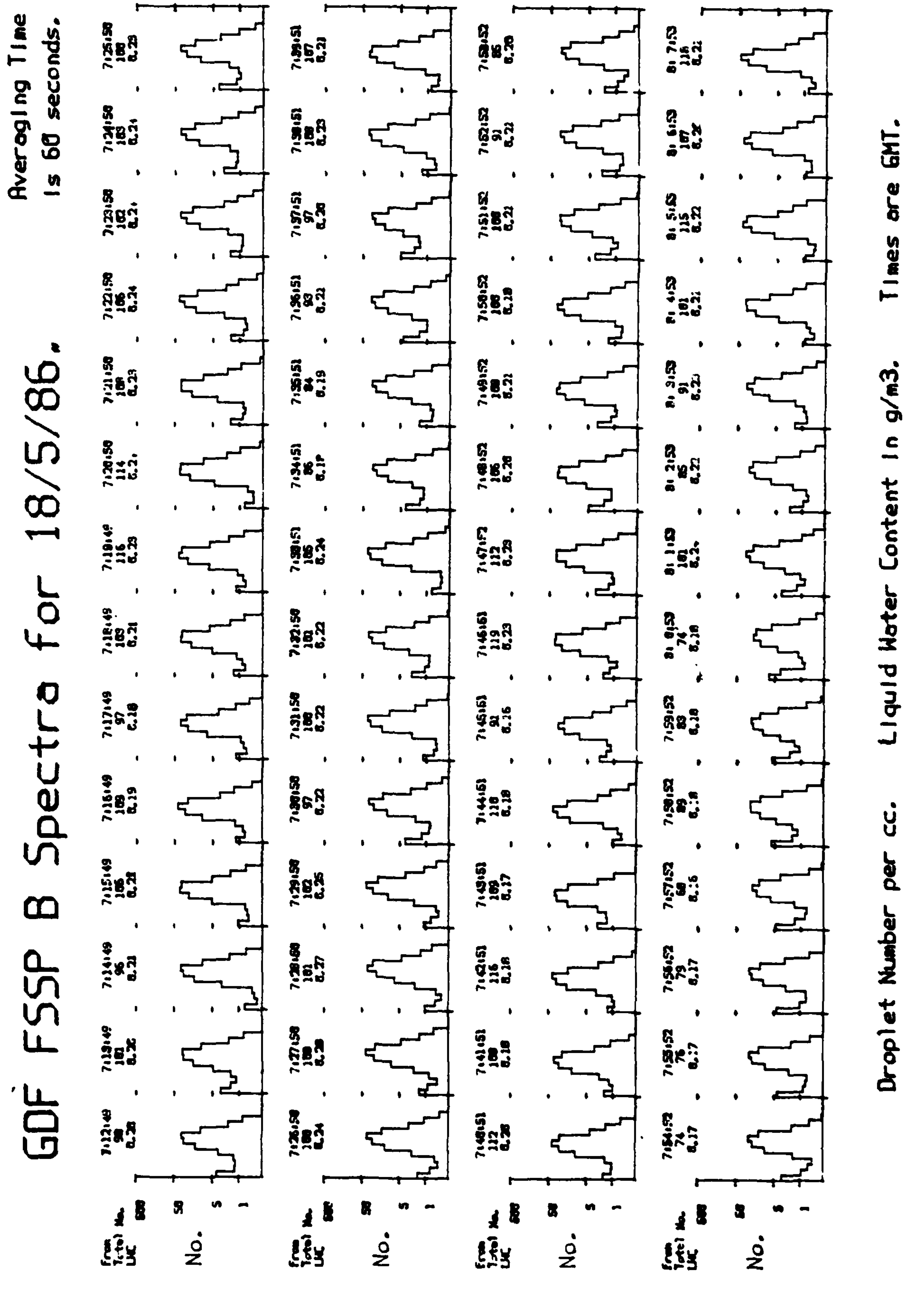

GDF FSSP B Spectra for 18/5/86.
Averaging Time is 60 seconds.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.
No.
500
50
5
1

Figure 48.

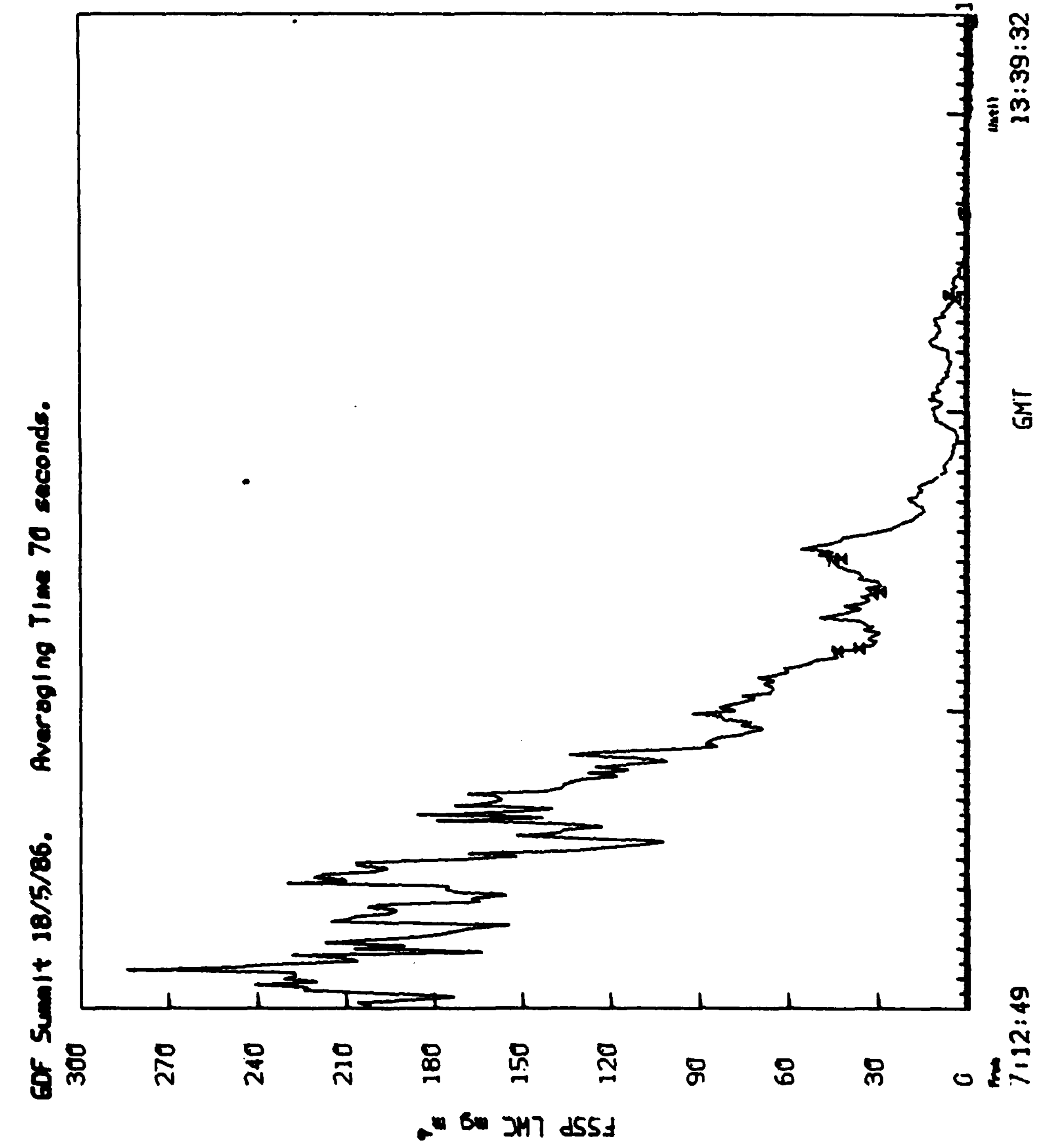
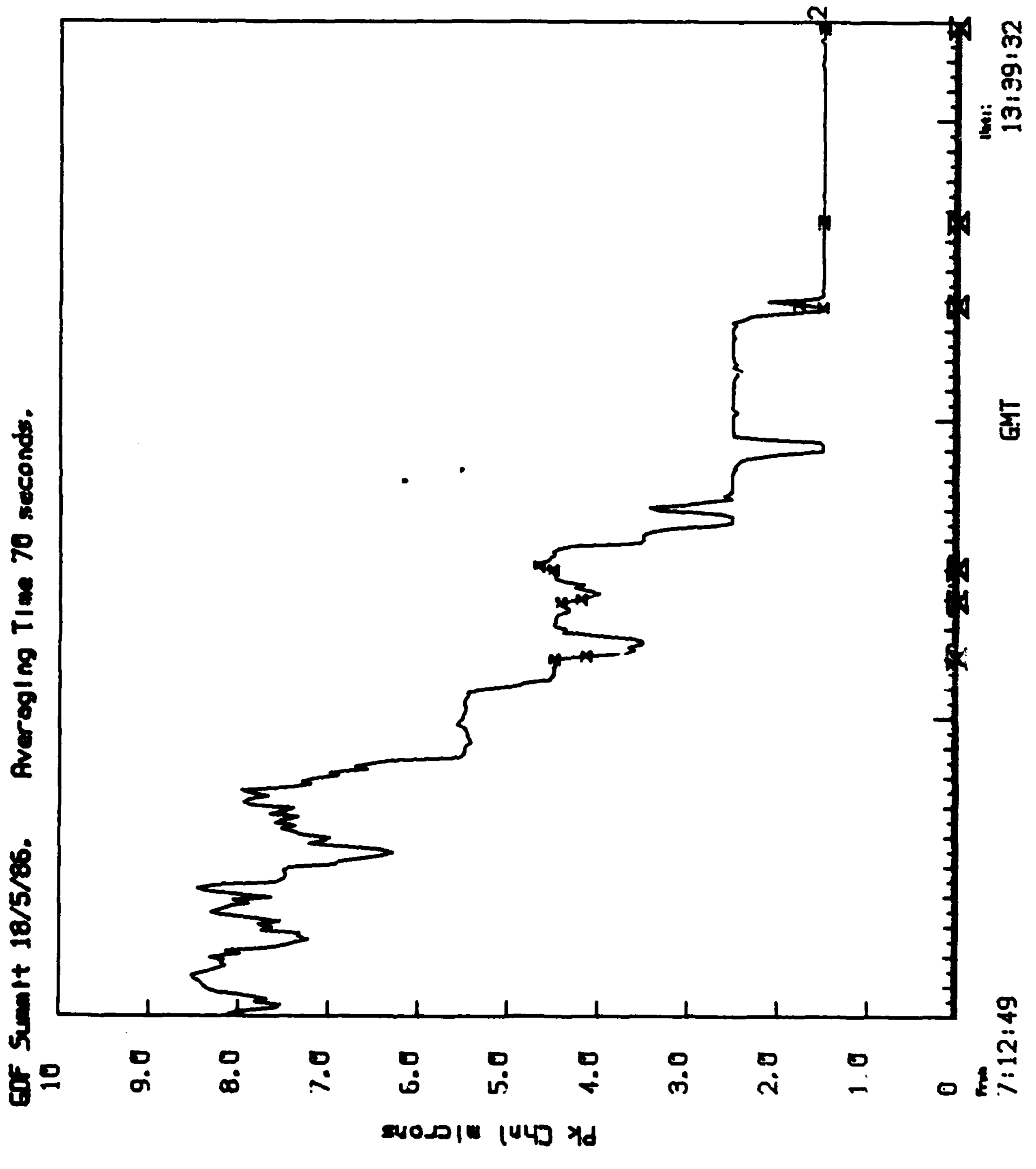

GDF Summit 18/5/86.   Averaging Time 70 seconds.
FSSP LWC mg m-3
300
270
240
210
180
150
120
90
60
30
0
from
7:12:49
GMT
until
13:39:32

Figure 49.



EDF Summit 18/5/86.
Averaging Time 70 seconds.
Pk Chl microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
7:12:49
GMT
13:39:32

Figure 50.

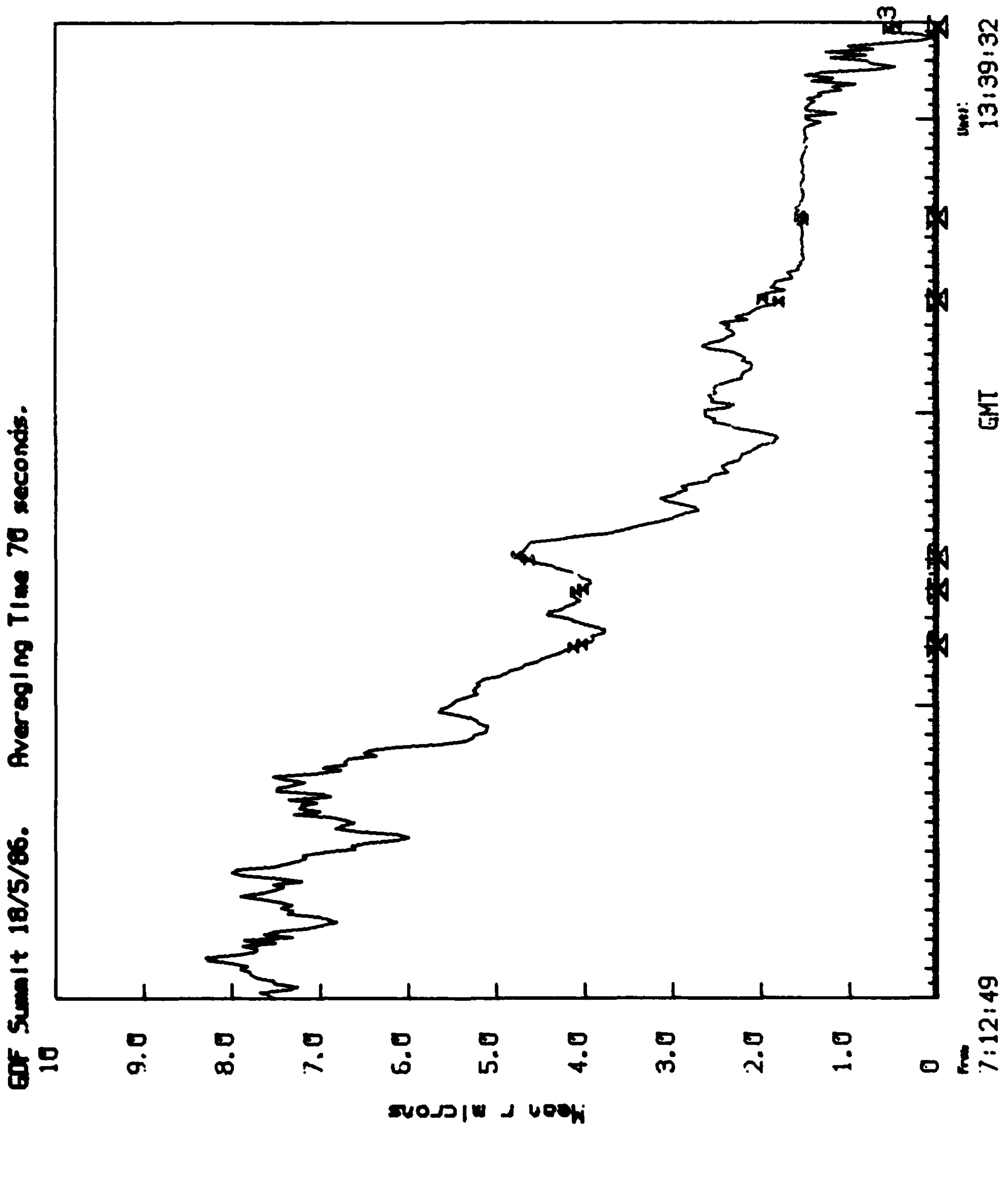
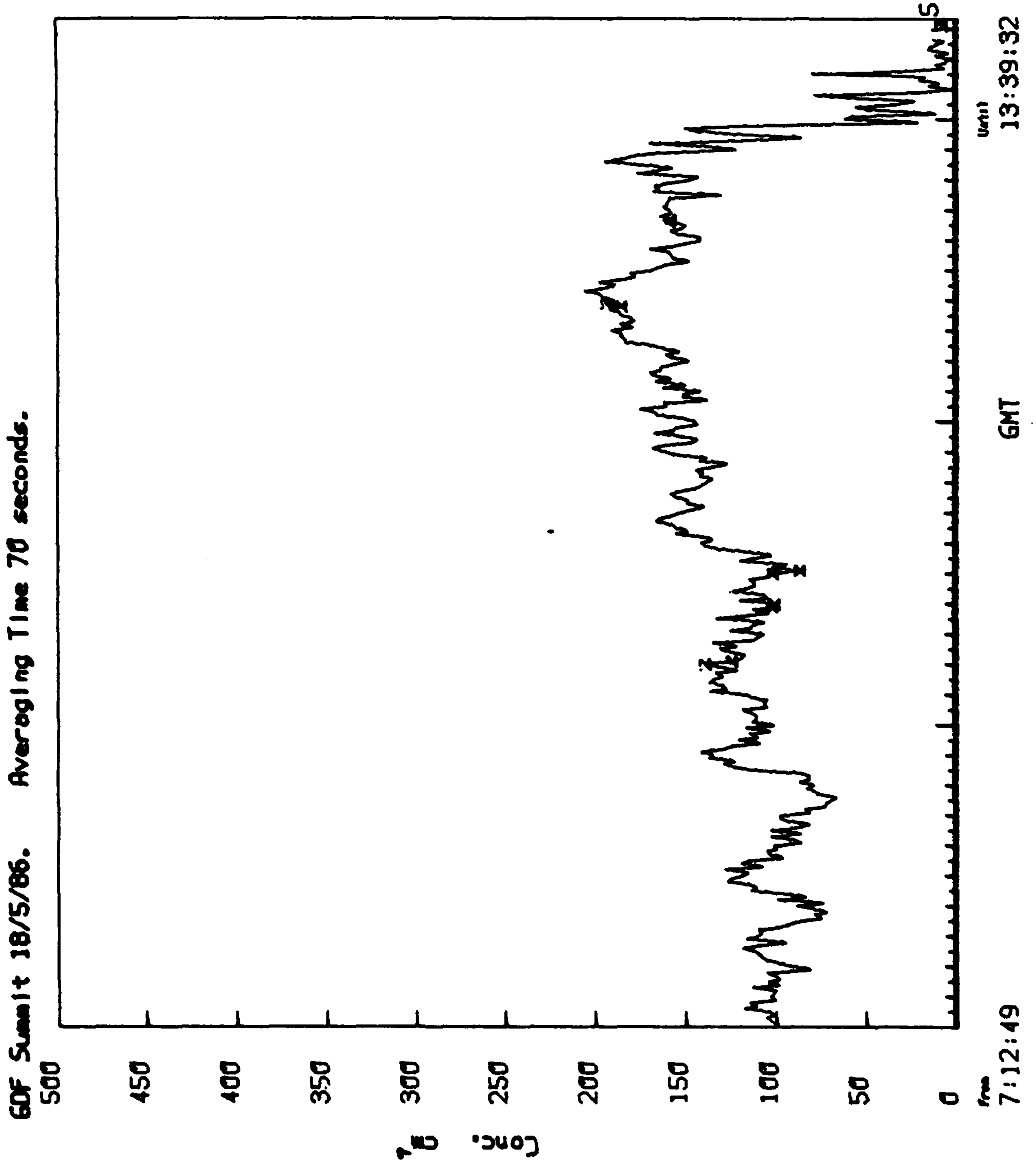
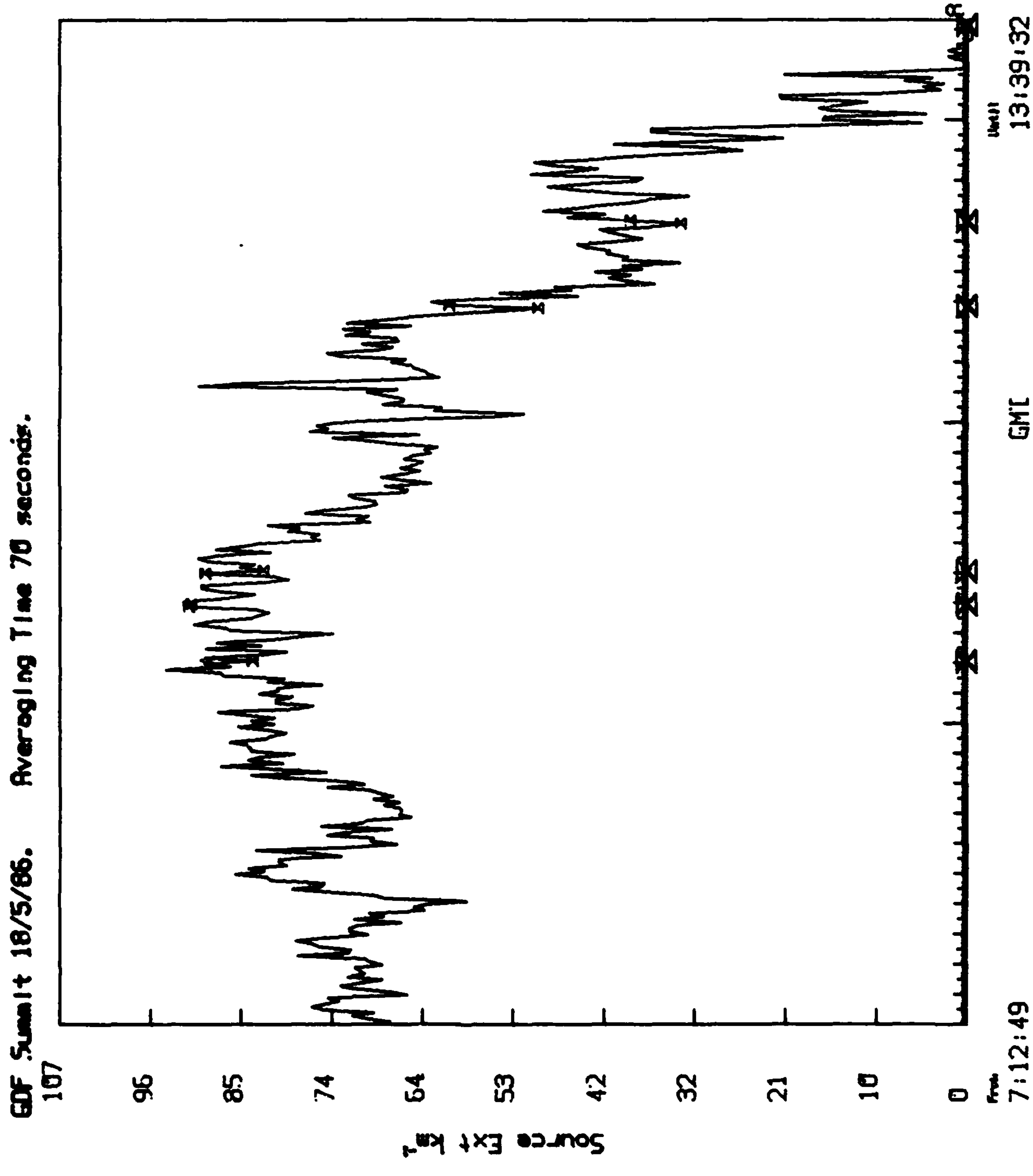

GDF Summit 18/5/86. Averaging Time 70 seconds.
Mean r microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
From:
7:12:49
GMT
Until:
13:39:32

Figure 51.



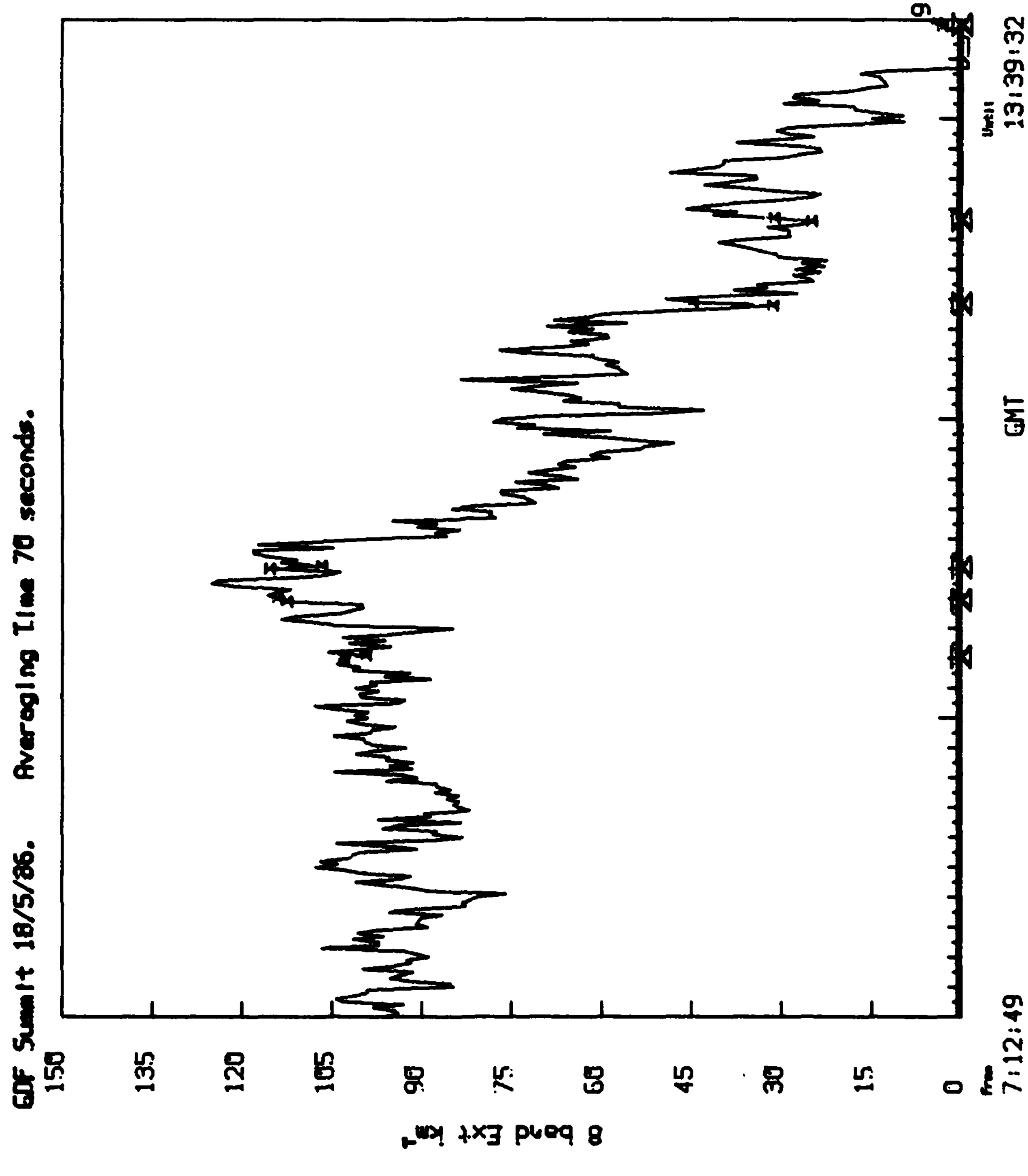
GDF Summit 18/5/86.
Averaging Time 70 seconds.
Conc. cm
500
450
400
350
300
250
200
150
100
50
0
from
7:12:49
GMT
Until
13:39:32
S

Figure 52.



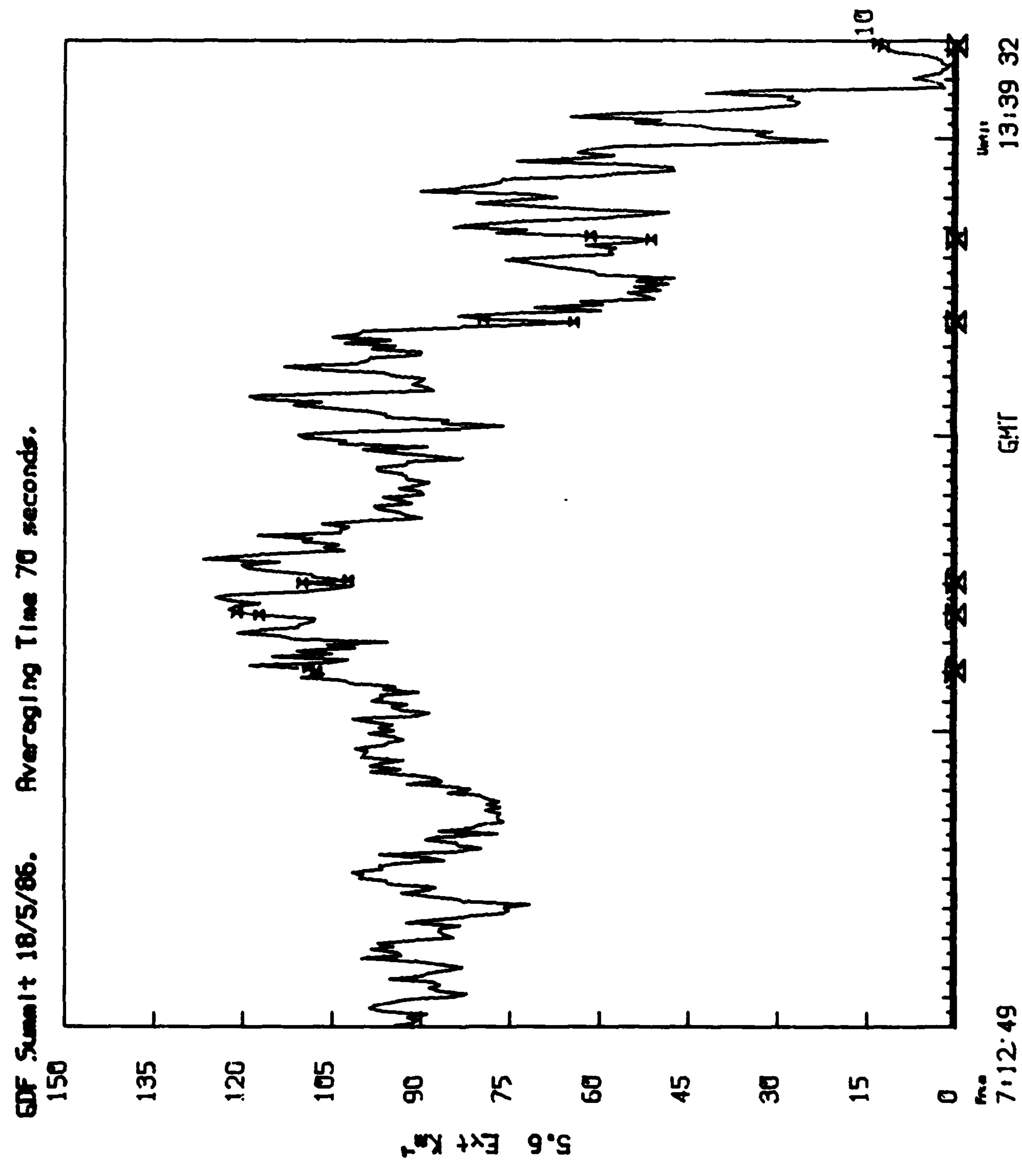
GDF Summit 18/5/86.
Averaging Time 70 seconds.
107
96
85
74
64
53
42
32
21
10
0
Source Ext km-1
From
7:12:49
GMT
Until
13:39:32

Figure 53.



GDF Summit 18/5/86. Averaging Time 70 seconds.
B band Ext km-1
150
135
120
105
90
75
60
45
30
15
0
From
7:12:49
GMT
Until
13:39:32
9

Figure 54.



SDF Summit 18/5/86. Averaging Time 70 seconds.
5.6 Ext Km-1
150
135
120
105
90
75
60
45
30
15
0
7:12:49
GMT
13:39 32
10

Figure 55.

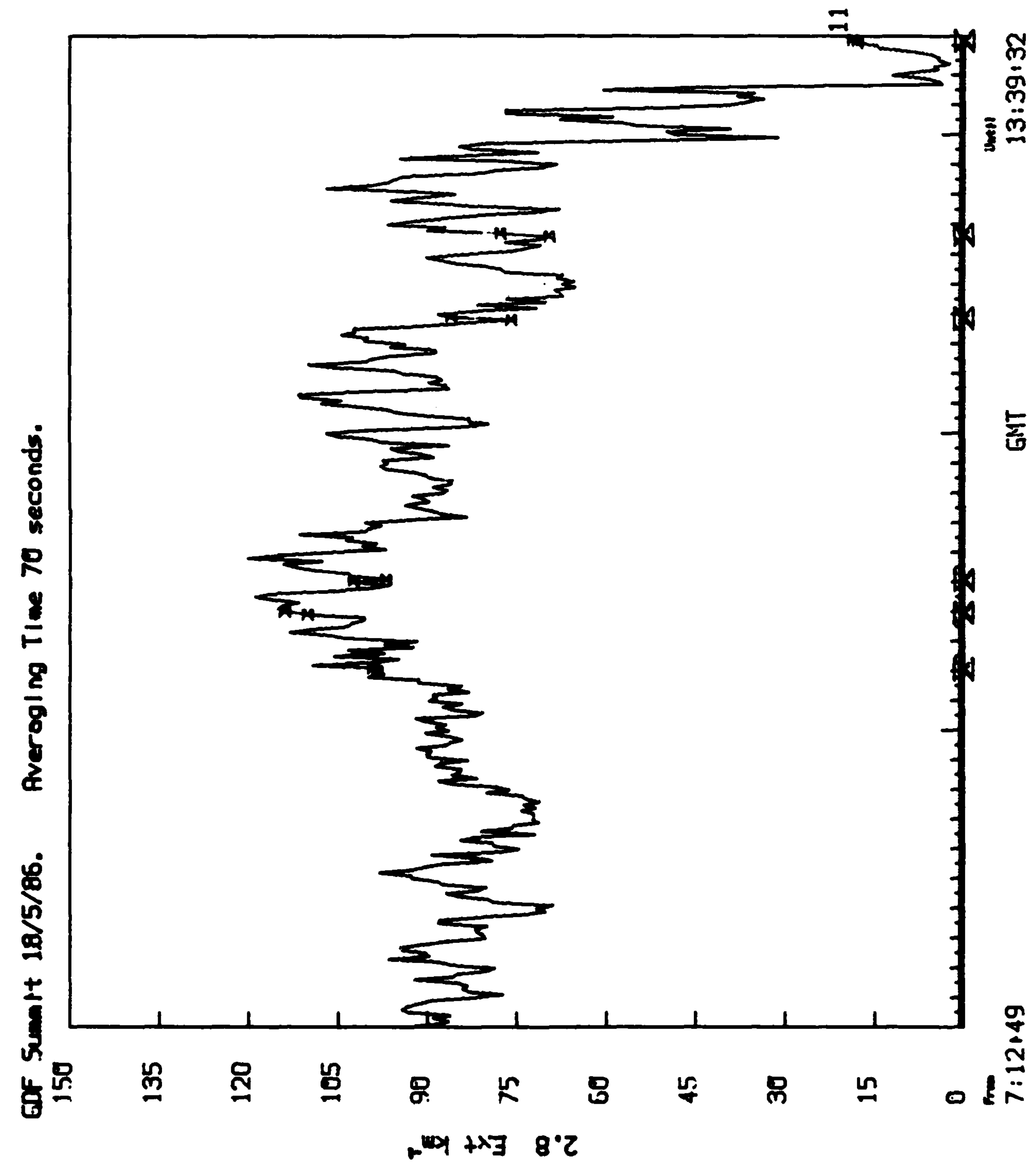

GDF Summit 18/5/86.
Averaging Time 70 seconds.
2.8 Ext km-1
150
135
120
105
90
75
60
45
30
15
0
From
7:12:49
GMT
Until
13:39:32
11

Figure 56.

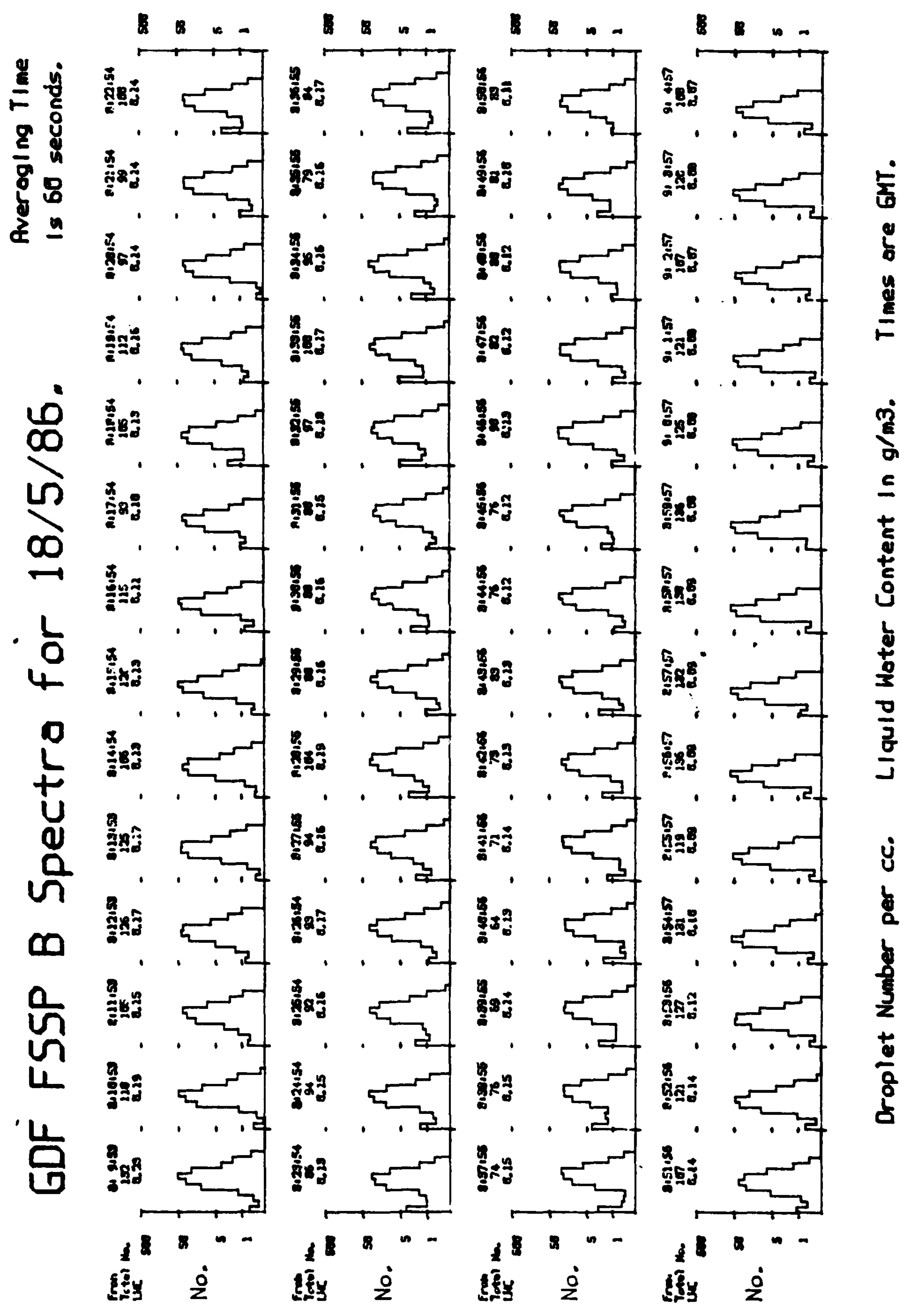
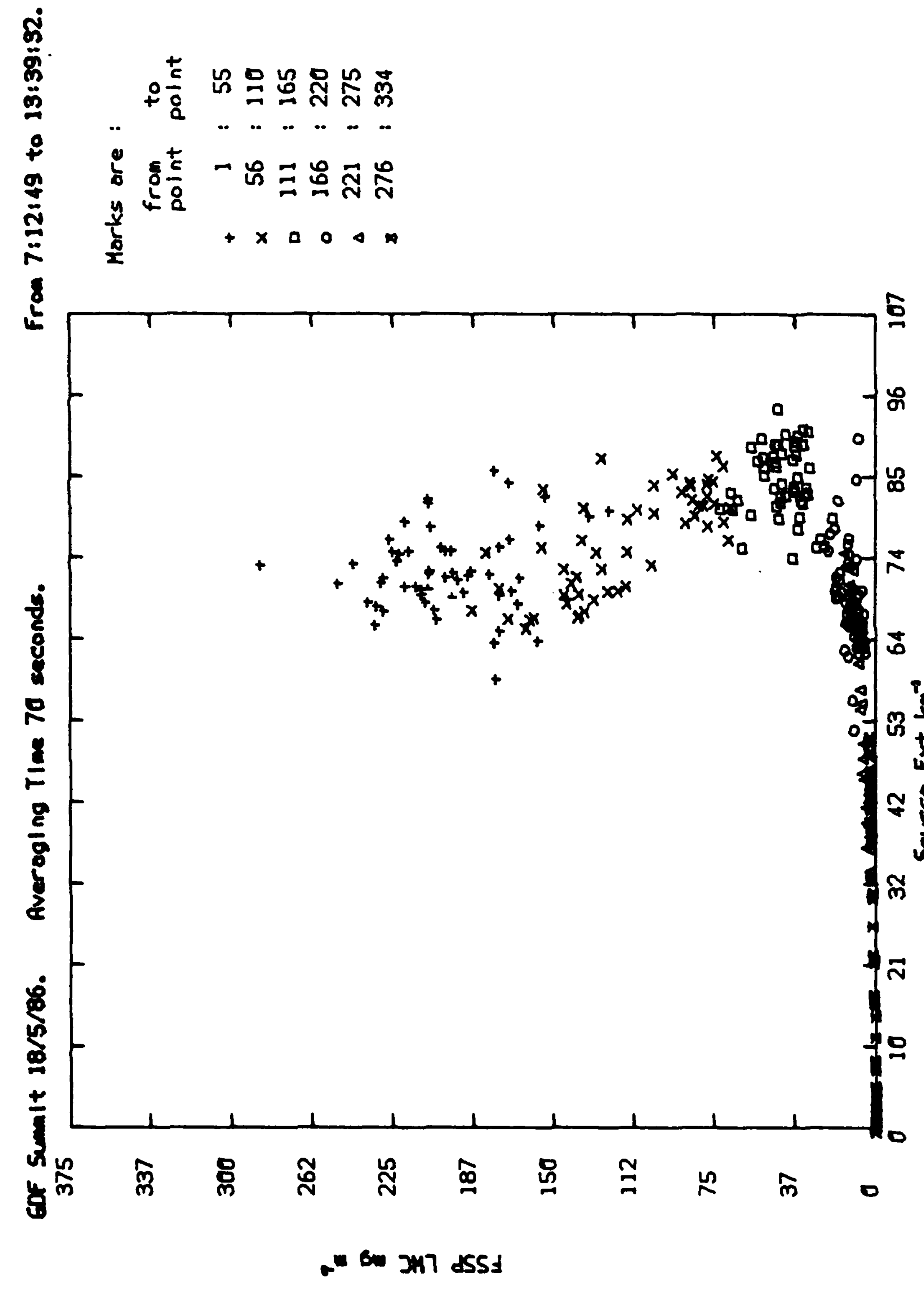

GDF FSSP B Spectra for 18/5/86.
Averaging Time is 60 seconds.
Droplet Number per cc.
Liquid Water Content in g/m3.
Times are GMT.
No.

Figure 57.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
⌧ 276 : 334
FSSP LWC mg m⁻³
375
337
300
262
225
187
150
112
75
37
0
Source Ext km⁻¹
0
10
21
32
42
53
64
74
85
96
107

Figure 58.

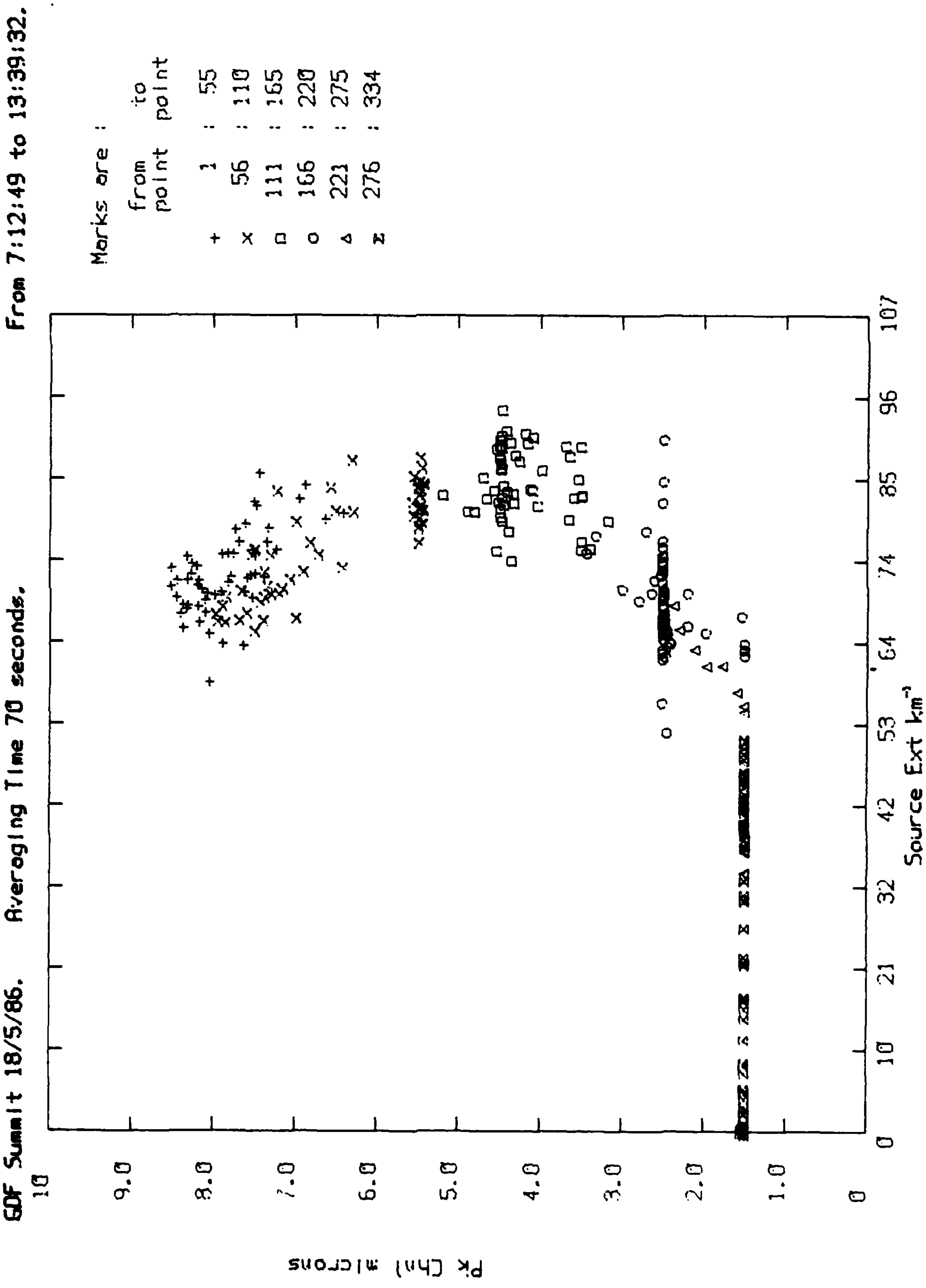

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
z 276 : 334
Pk Chl microns
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
Source Ext km-1
0
10
21
32
42
53
64
74
85
96
107

Figure 59.

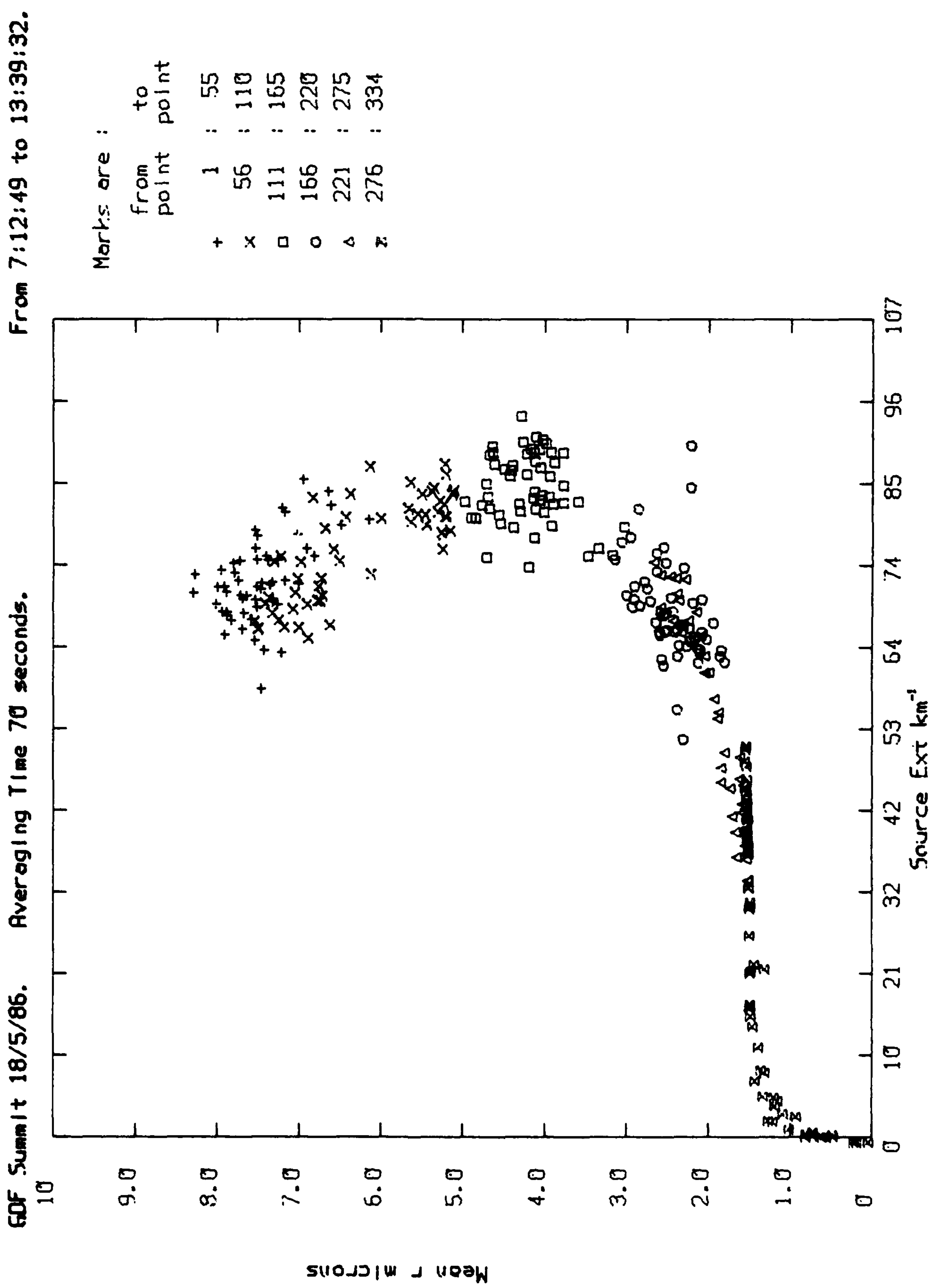
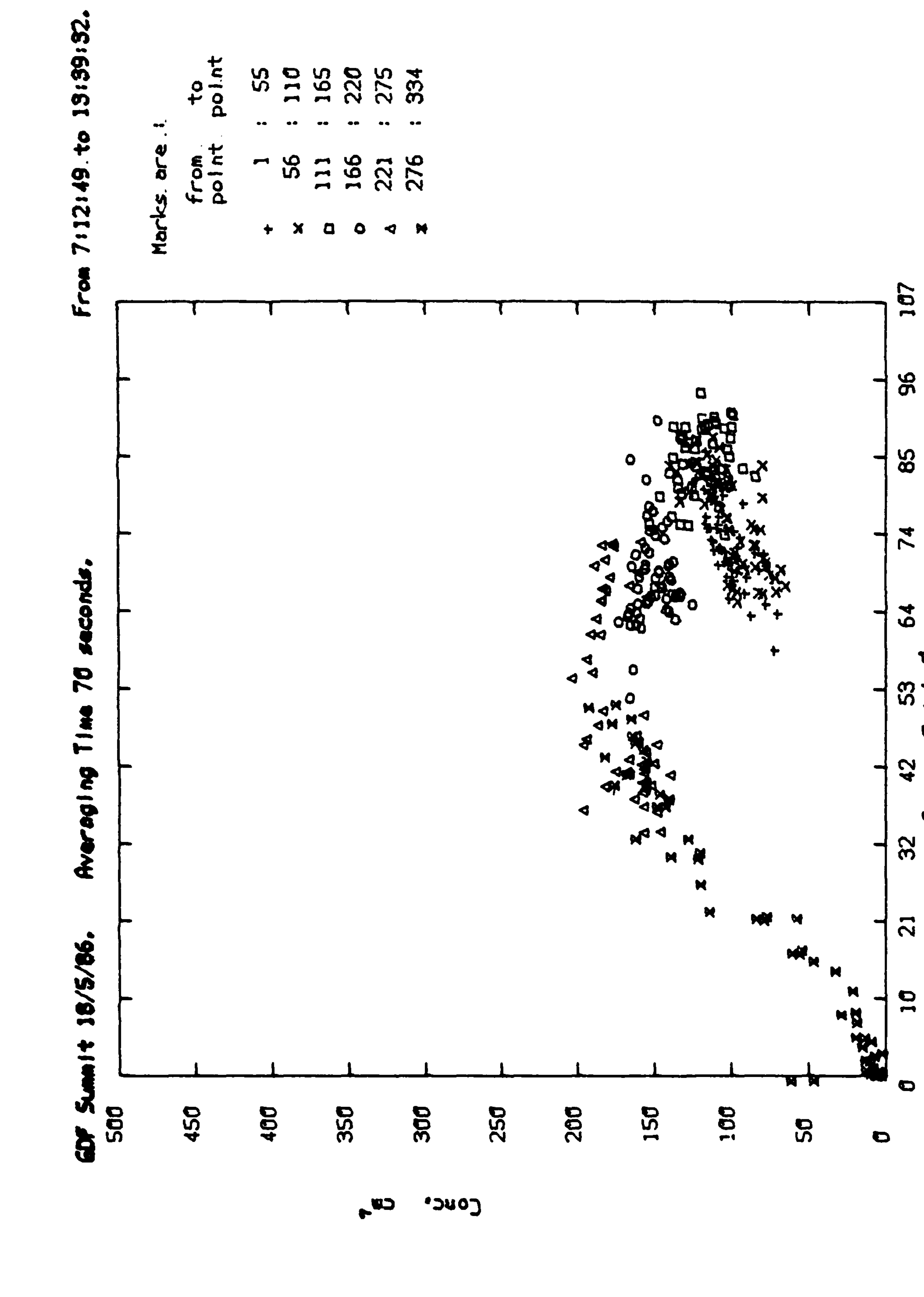

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
z 276 : 334
Mean r microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
Source Ext km-1
0
10
21
32
42
53
64
74
85
96
107

Figure 60.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
x 276 : 334
Conc, cm⁻³
Source Ext km⁻¹
0
50
100
150
200
250
300
350
400
450
500
0
10
21
32
42
53
64
74
85
96
107

Figure 61.

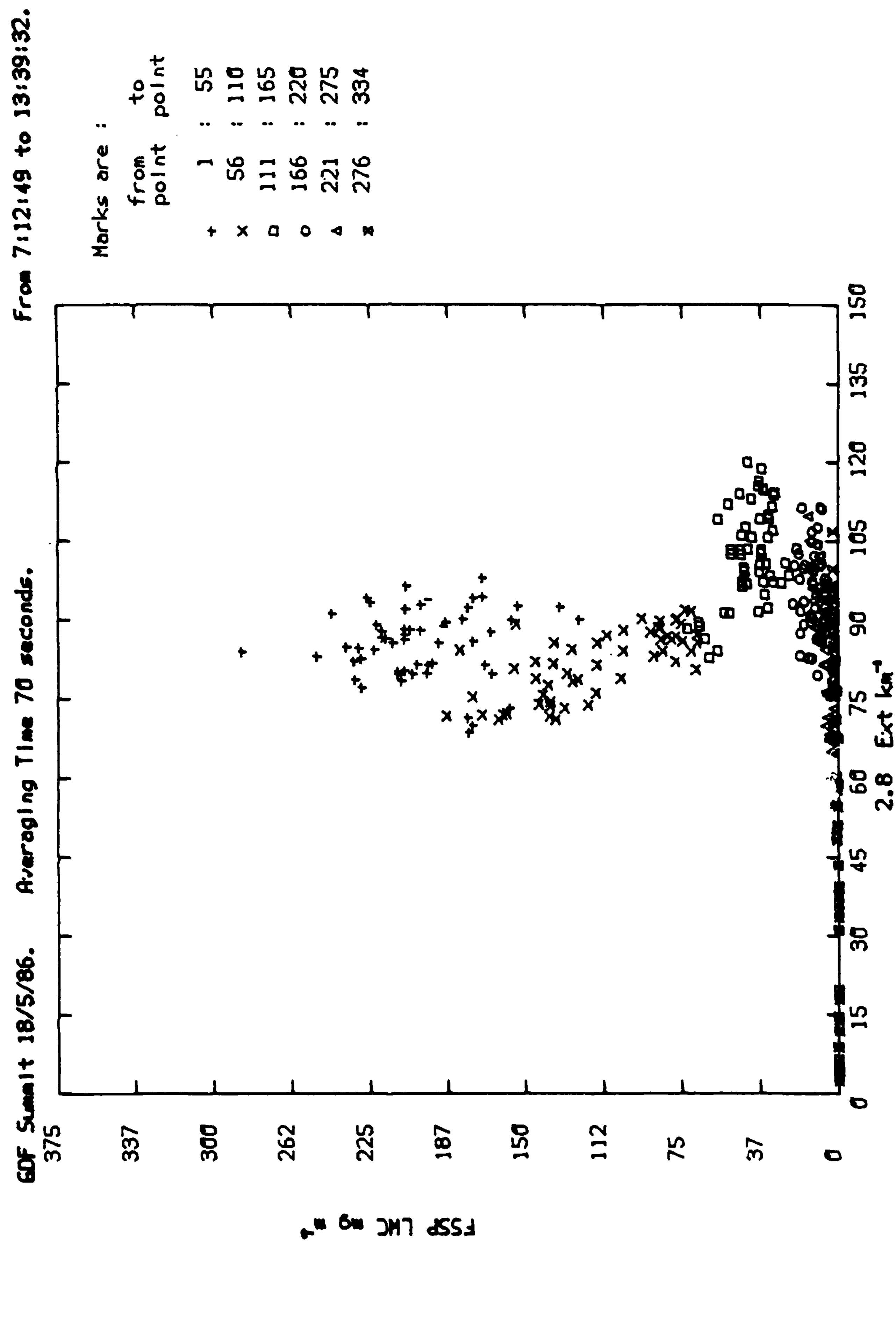
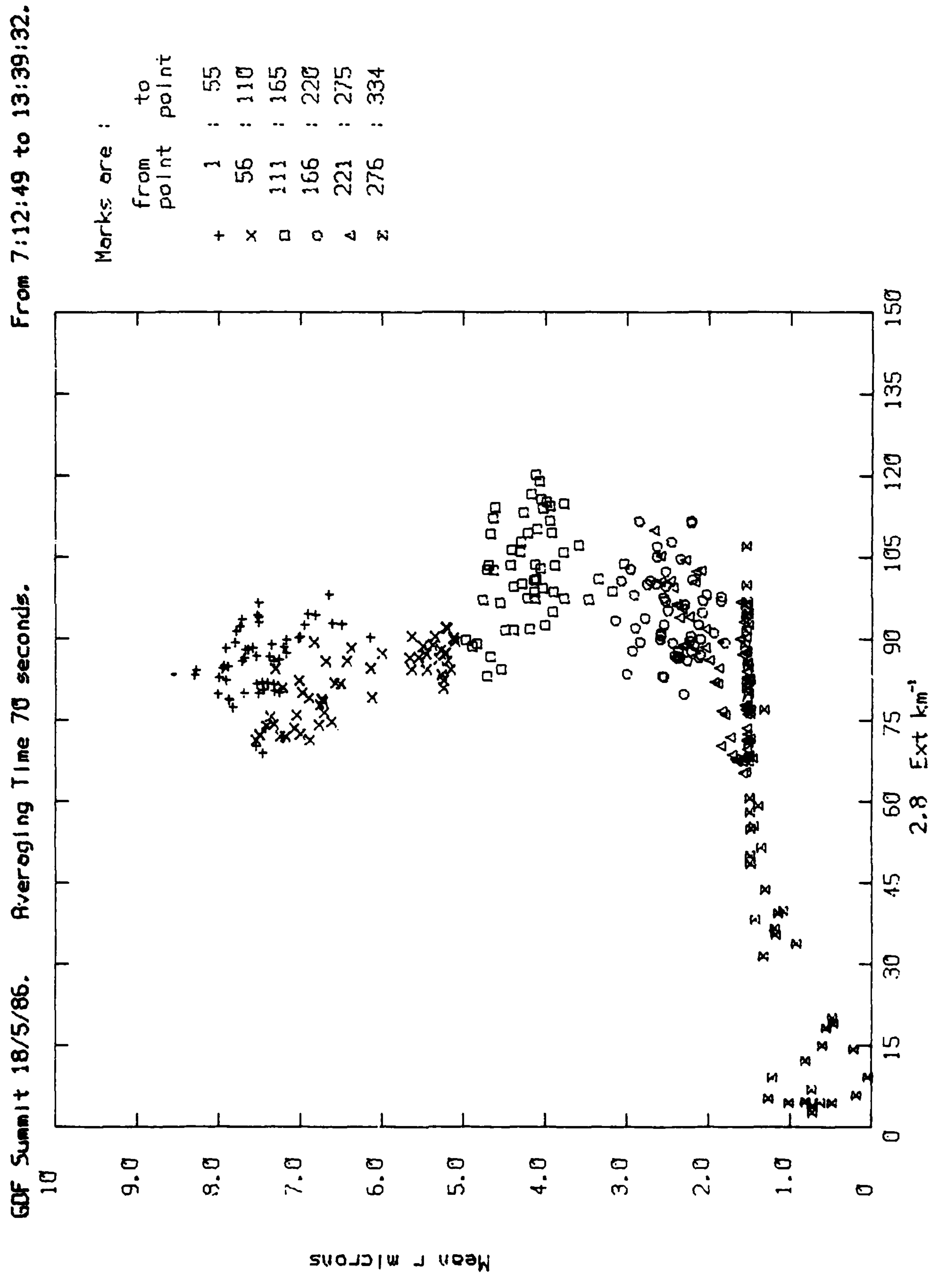
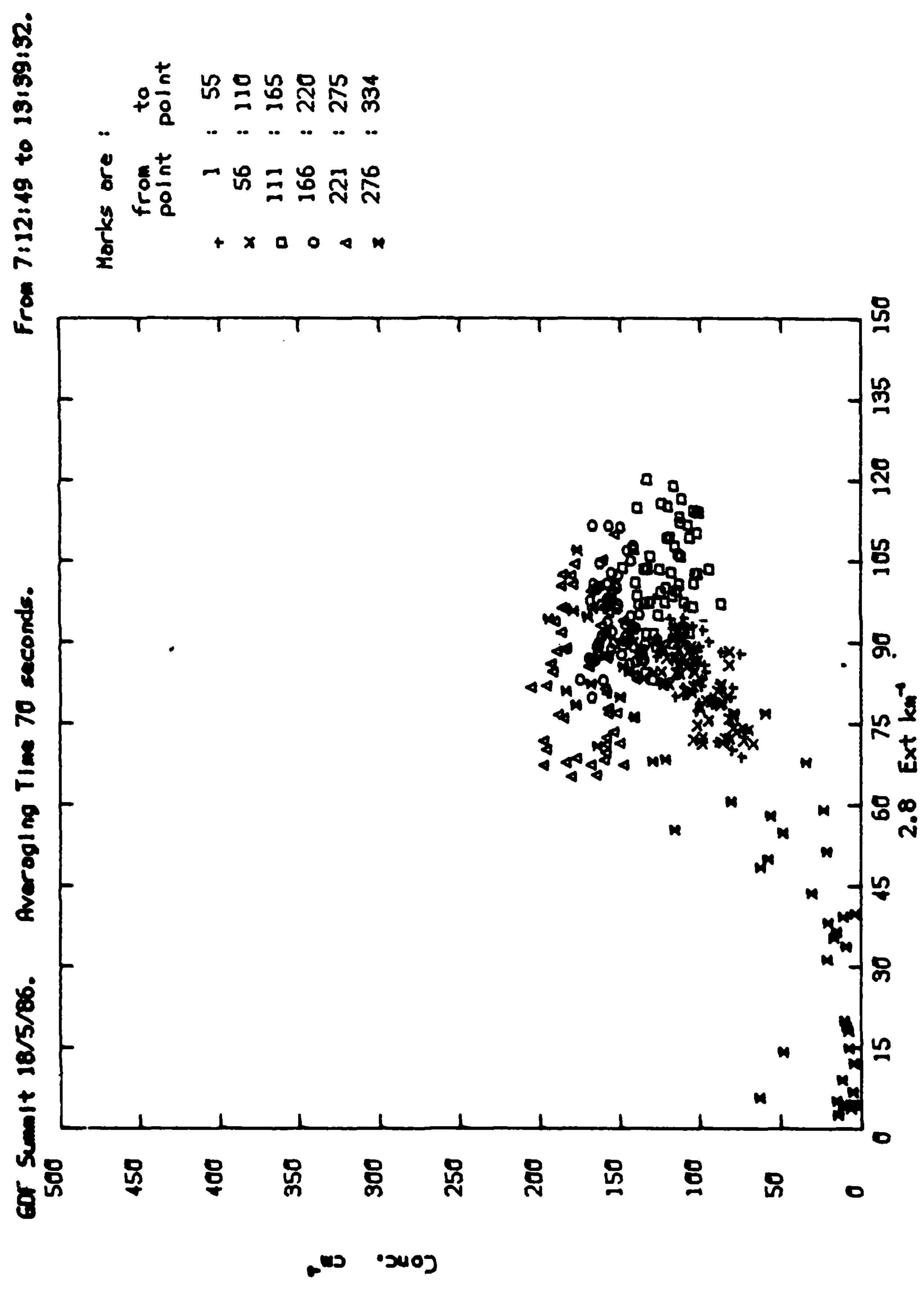

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
* 276 : 334
FSSP LWC mg m-3
0 37 75 112 150 187 225 262 300 337 375
0 15 30 45 60 75 90 105 120 135 150
2.8 Ext km-1

Figure 62.



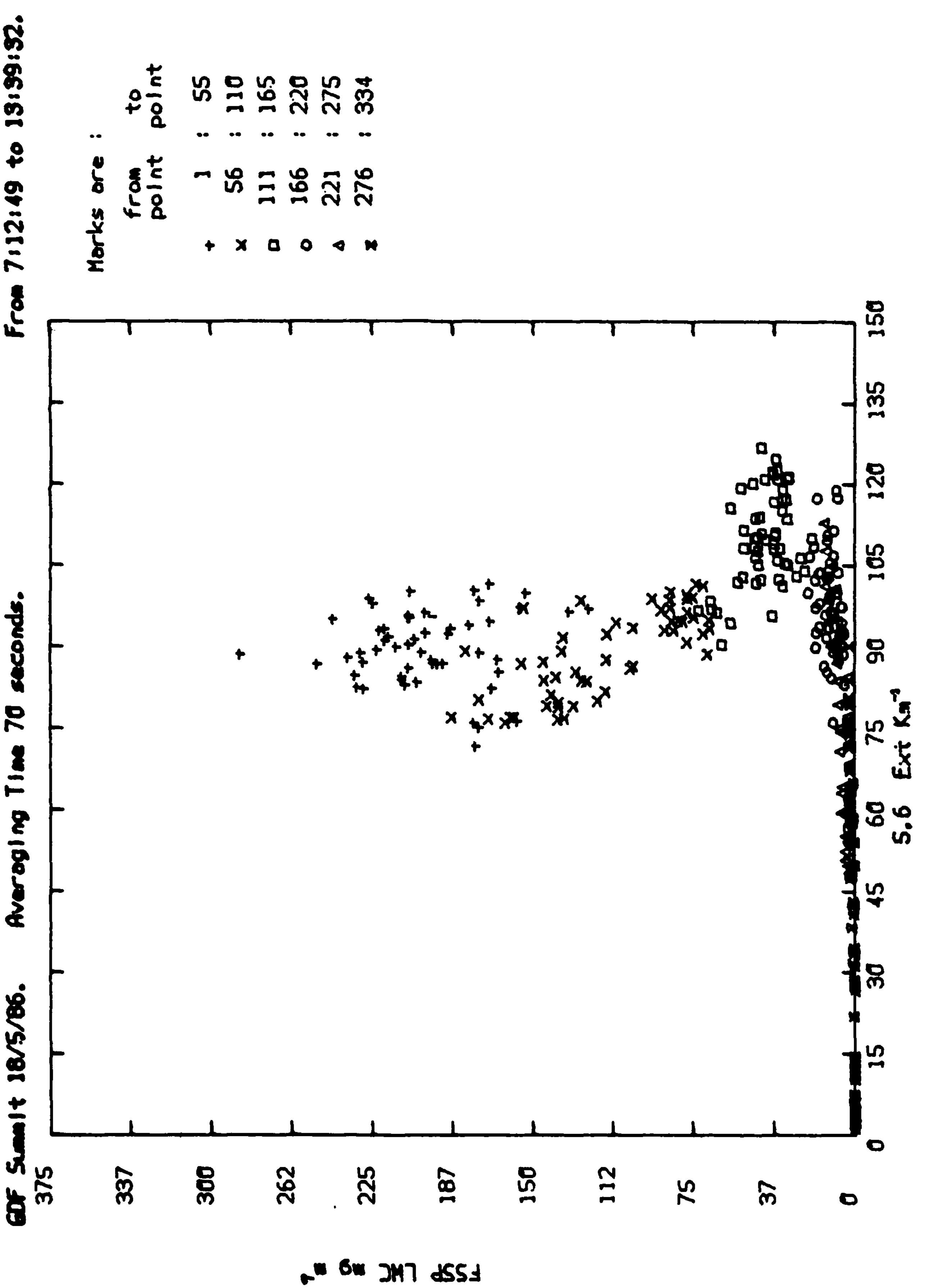
GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
z 276 : 334
Mean r microns
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
0
15
30
45
60
75
90
105
120
135
150
2.8 Ext km⁻¹

Figure 63.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
ж 276 : 334
0 15 30 45 60 75 90 105 120 135 150
2.8 Ext km⁻¹
0 50 100 150 200 250 300 350 400 450 500
Conc. cm⁻³

Figure 64.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
* 276 : 334
FSSP LWC mg m⁻³
S.6 Ext Km⁻¹
0
37
75
112
150
187
225
262
300
337
375
0
15
30
45
60
75
90
105
120
135
150

Figure 65.

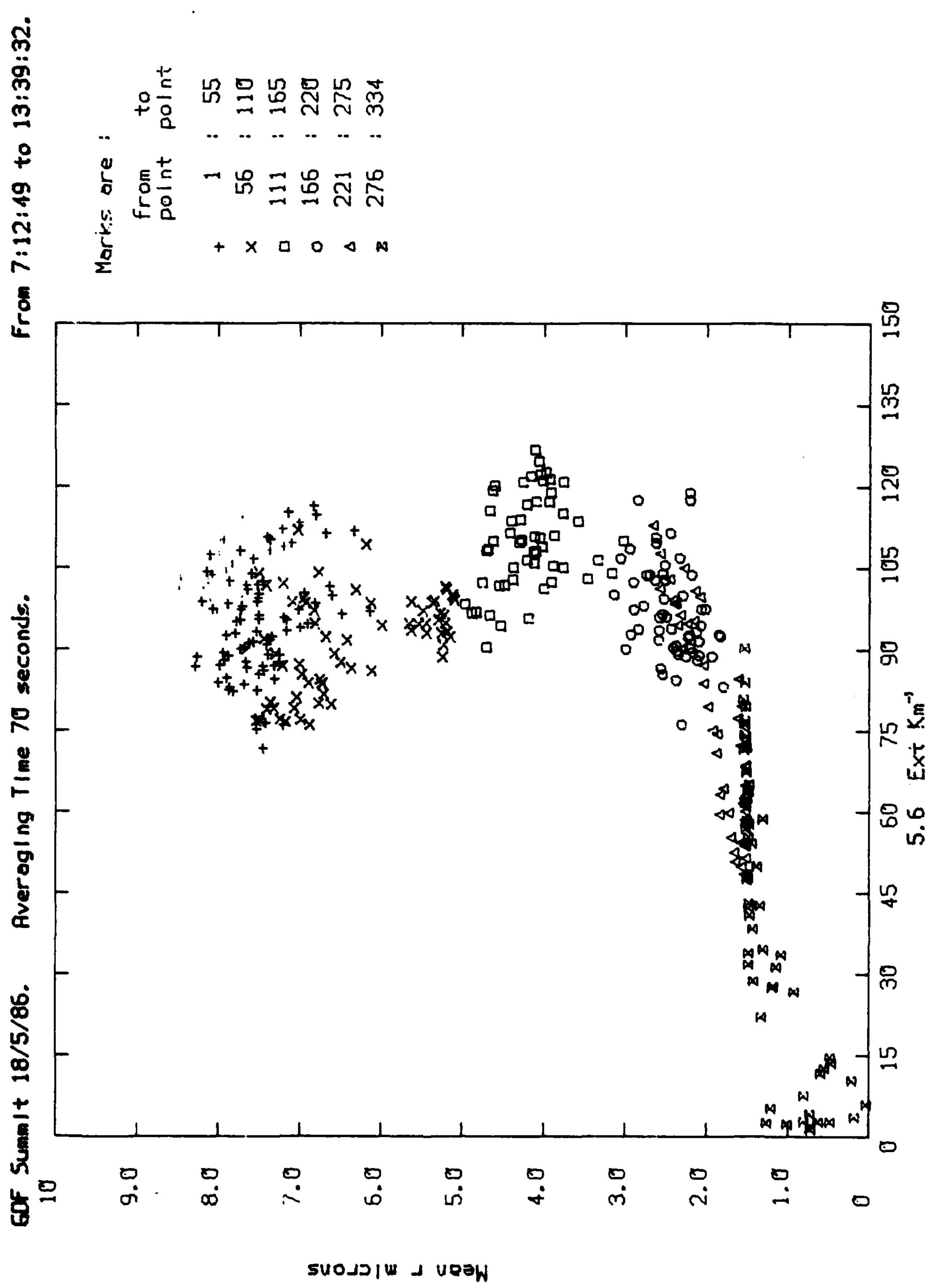
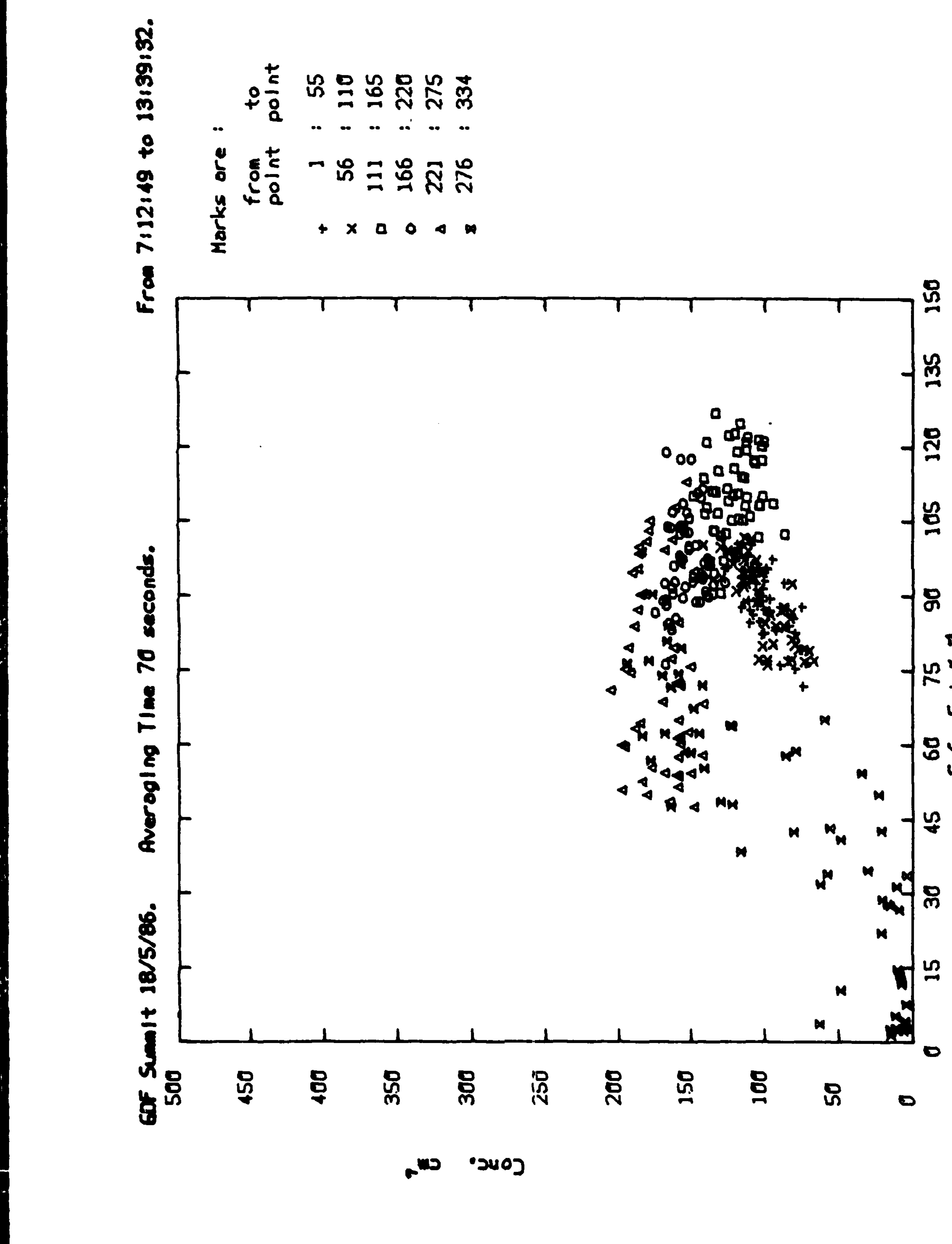

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
z 276 : 334
Mean r microns
5.6 Ext Km⁻¹
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10
15
30
45
60
75
90
105
120
135
150

Figure 66.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
¤ 276 : 334
Conc, cm⁻³
500
450
400
350
300
250
200
150
100
50
0
0
15
30
45
60
75
90
105
120
135
150
5.6 Ext Km⁻¹

Figure 67.

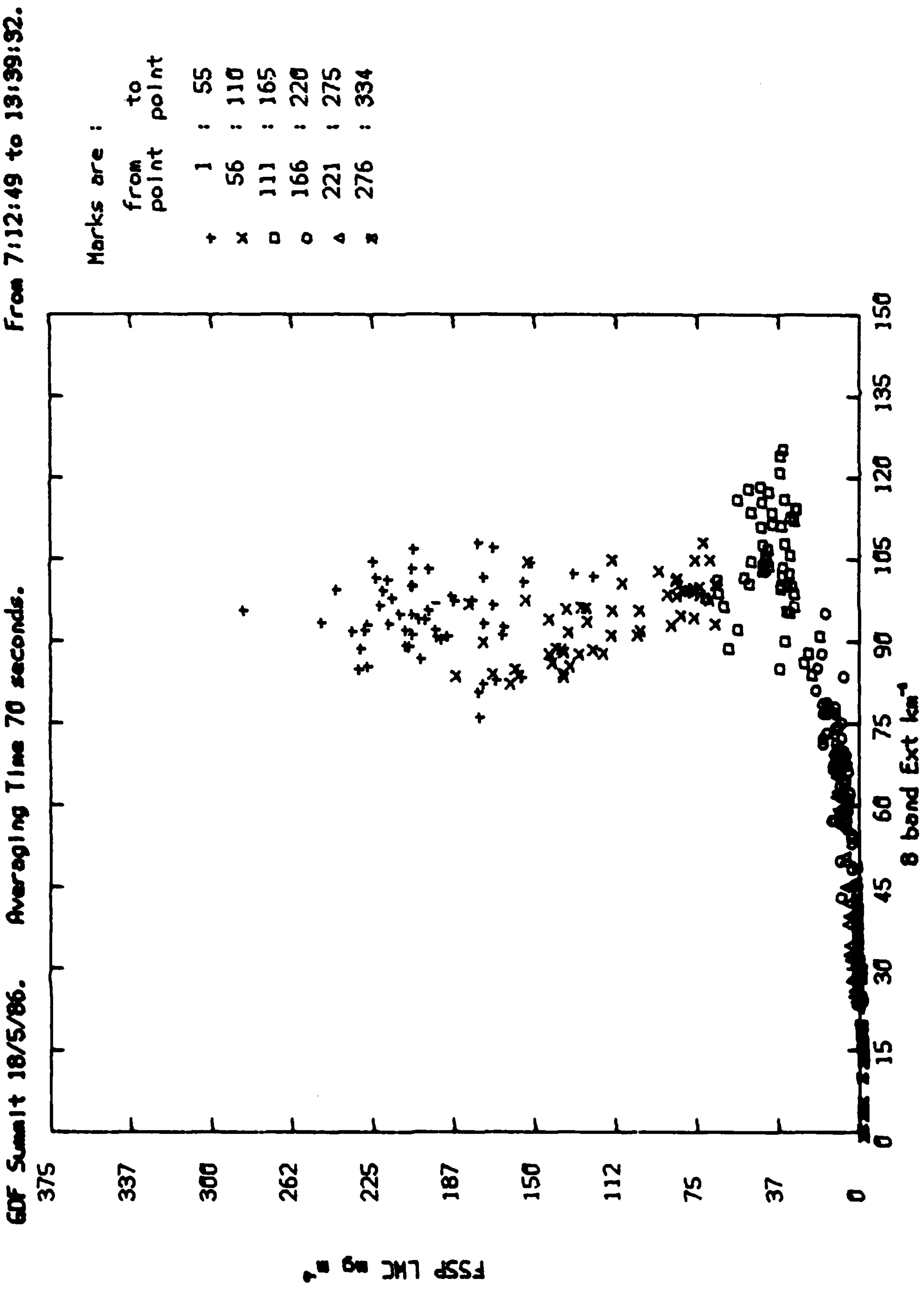
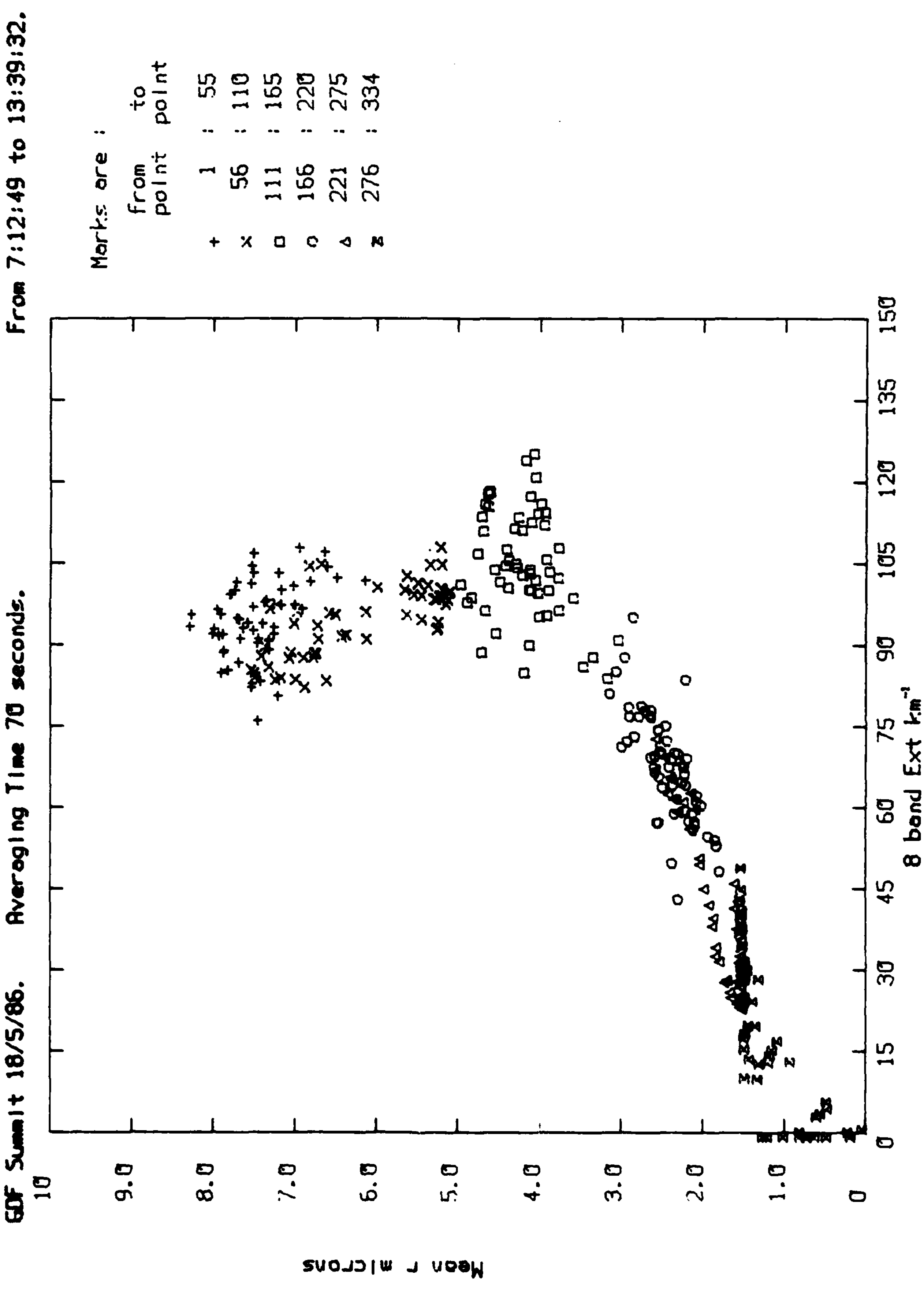

GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point | to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
Δ 221 : 275
* 276 : 334
375
337
300
262
225
187
150
112
75
37
0
0
15
30
45
60
75
90
105
120
135
150
B band Ext km⁻¹
FSSP LWC mg m⁻³

Figure 68.



GDF Summit 18/5/86.
Averaging Time 70 seconds.
From 7:12:49 to 13:39:32.
Marks are :
from point
to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
z 276 : 334
10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
Mean r microns
0
15
30
45
60
75
90
105
120
135
150
8 band Ext km-1

Figure 69.

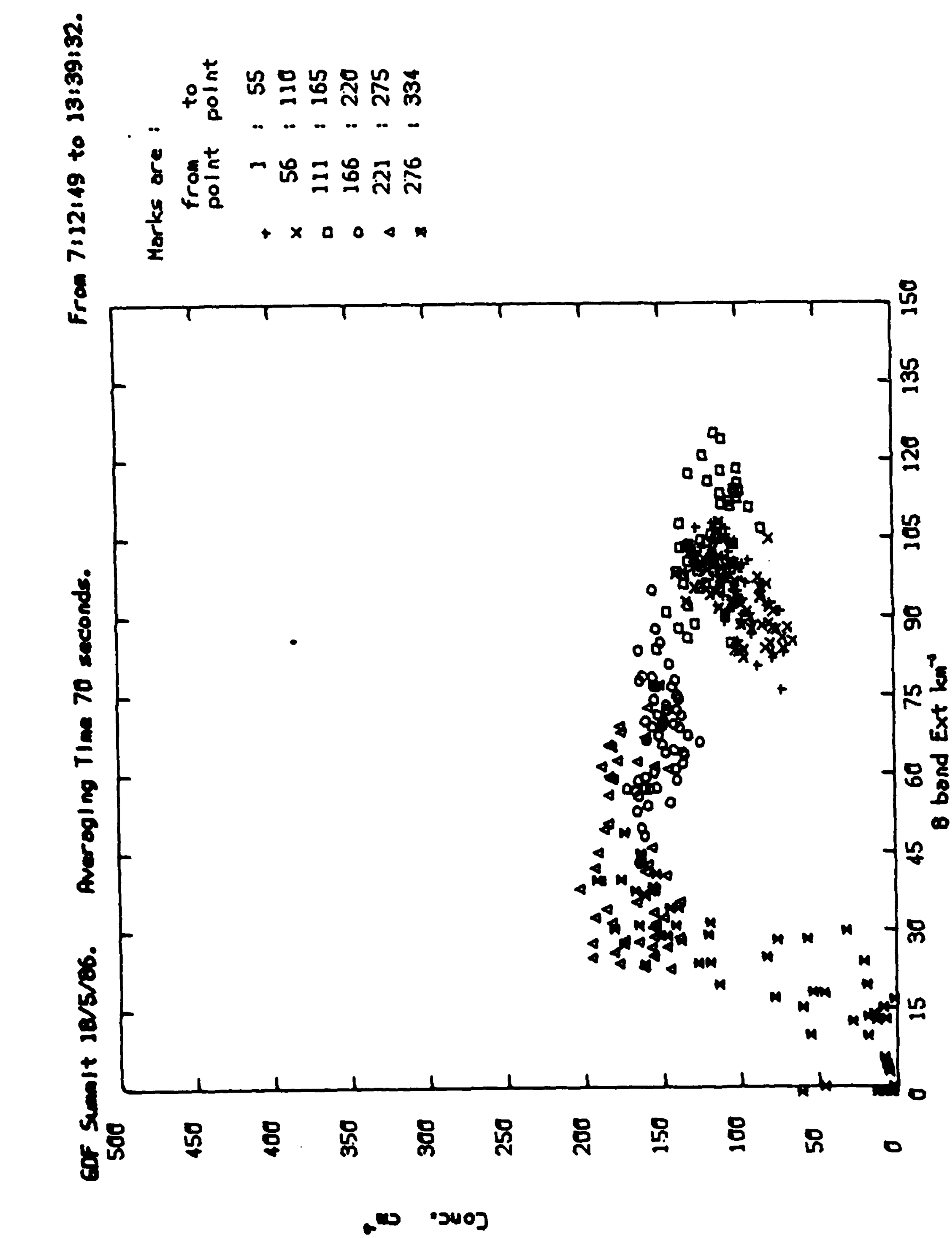

GDF Summit 18/5/86. Averaging Time 70 seconds. From 7:12:49 to 13:39:32.
Marks are :
from point to point
+ 1 : 55
x 56 : 110
□ 111 : 165
o 166 : 220
△ 221 : 275
⌘ 276 : 334
Conc. cm⁻³
0 50 100 150 200 250 300 350 400 450 500
0 15 30 45 60 75 90 105 120 135 150
B band Ext km⁻¹

Figure 70.

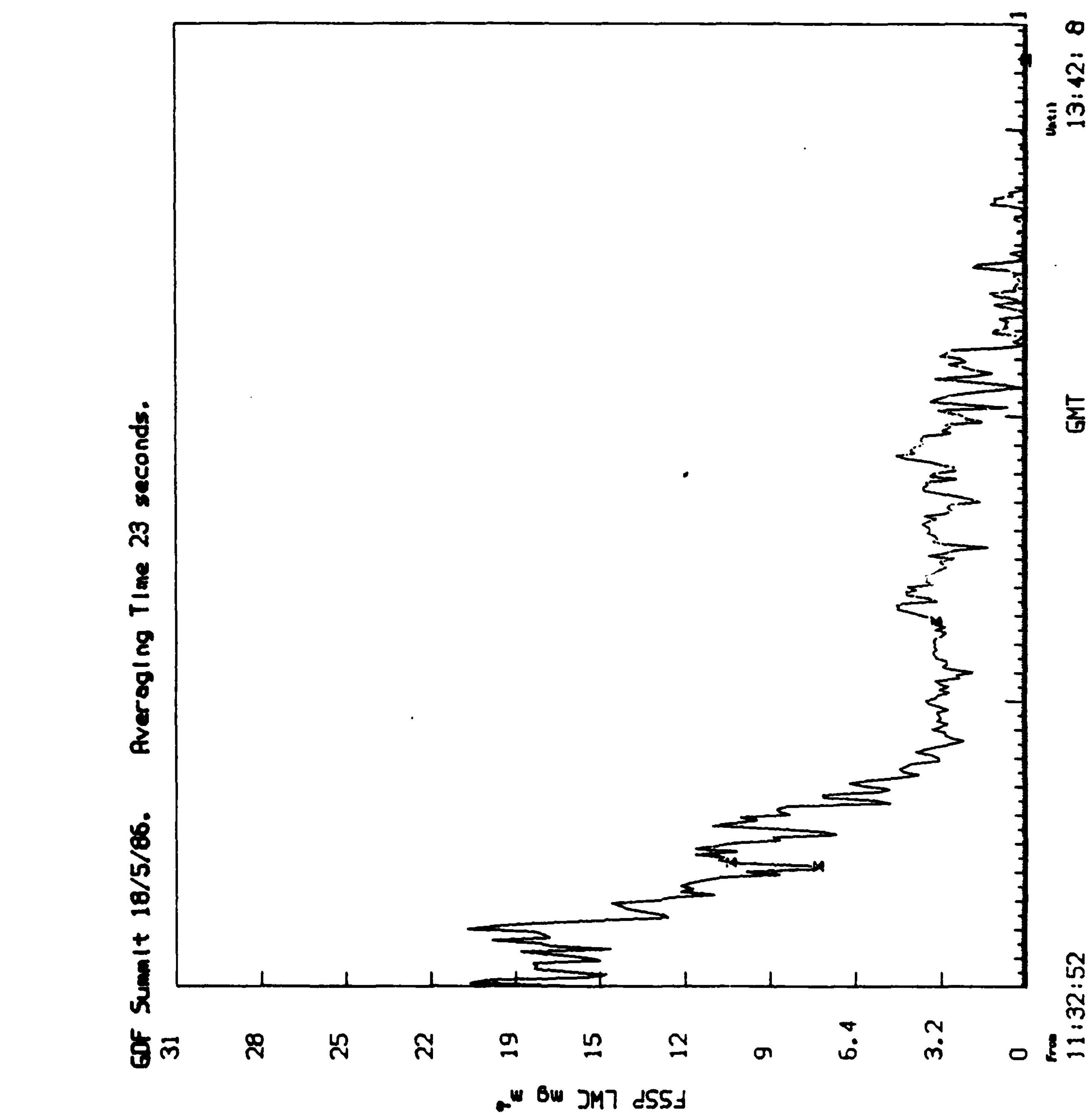

GDF Summit 18/5/86.
Averaging Time 23 seconds.
31
28
25
22
19
15
12
9
6.4
3.2
0
FSSP LWC mg m-3
From
11:32:52
GMT
Until
13:42: 8

Figure 71.

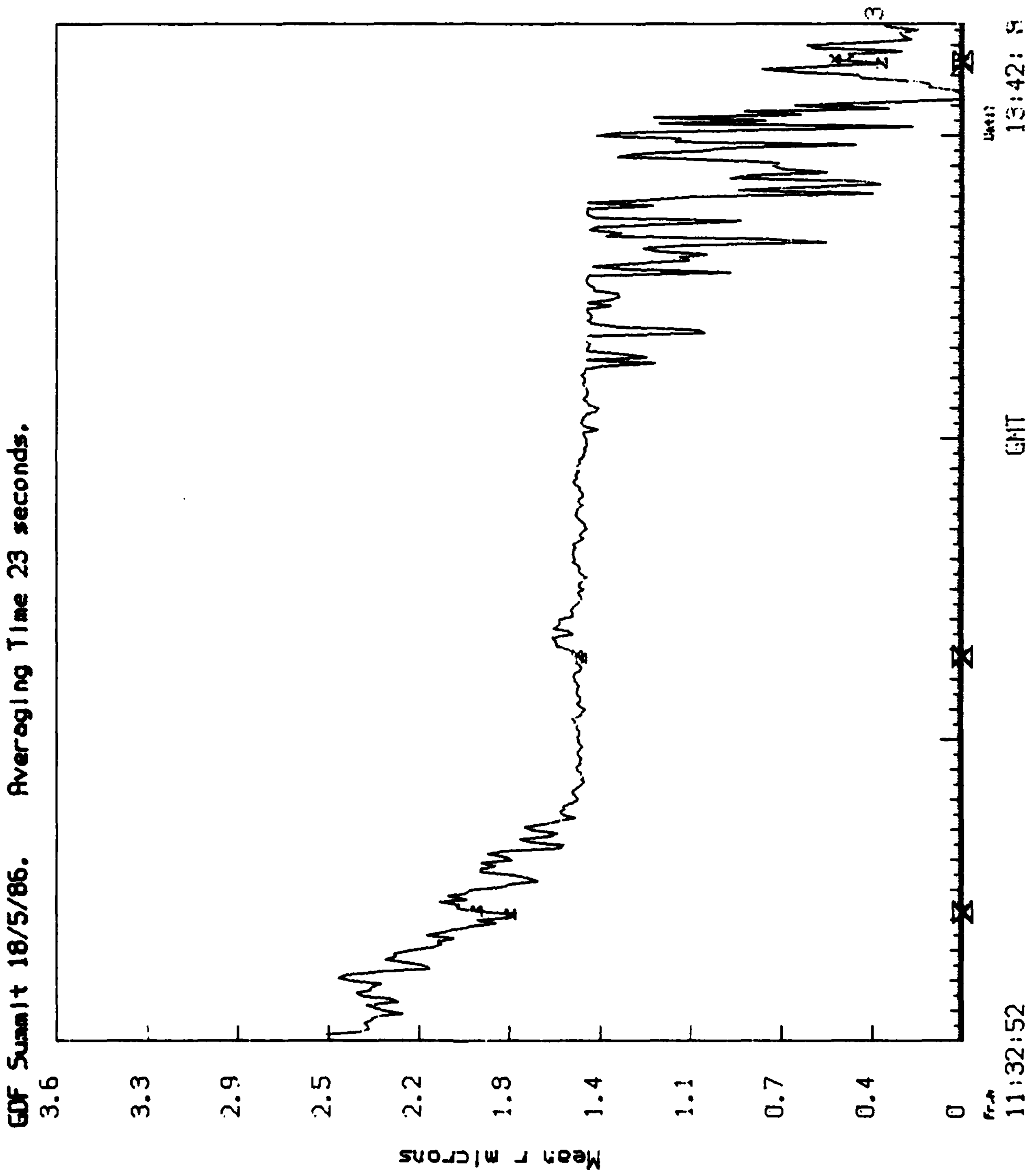

GDF Summit 18/5/86.
Averaging Time 23 seconds.
Mean r microns
3.6
3.3
2.9
2.5
2.2
1.8
1.4
1.1
0.7
0.4
0
11:32:52
GMT
13:42:

Figure 72.

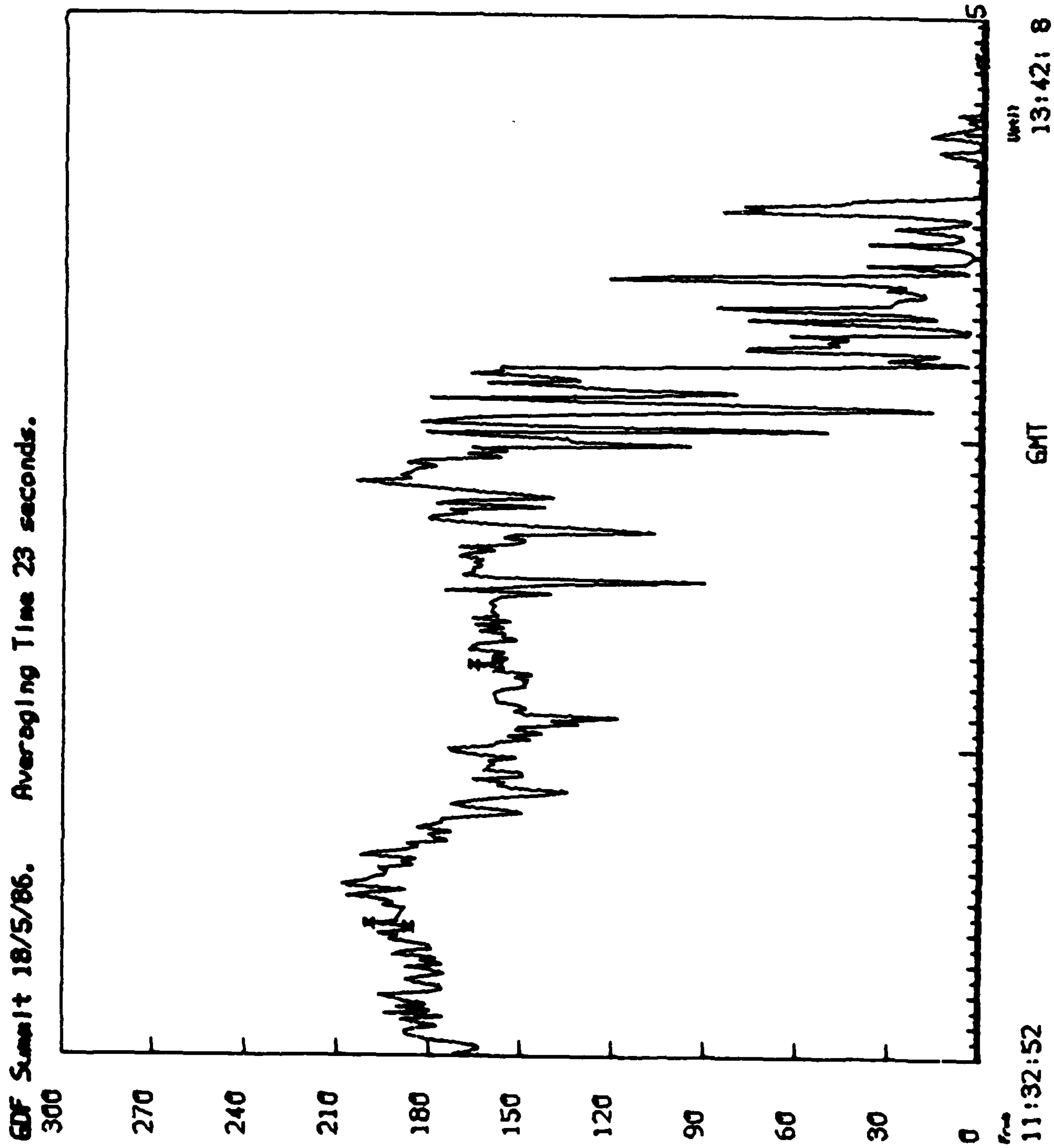

GDF Summit 18/5/86.
Averaging Time 23 seconds.
300
270
240
210
180
150
120
90
60
30
0
Conc.
11:32:52
13:42: 8
GMT

Figure 73.

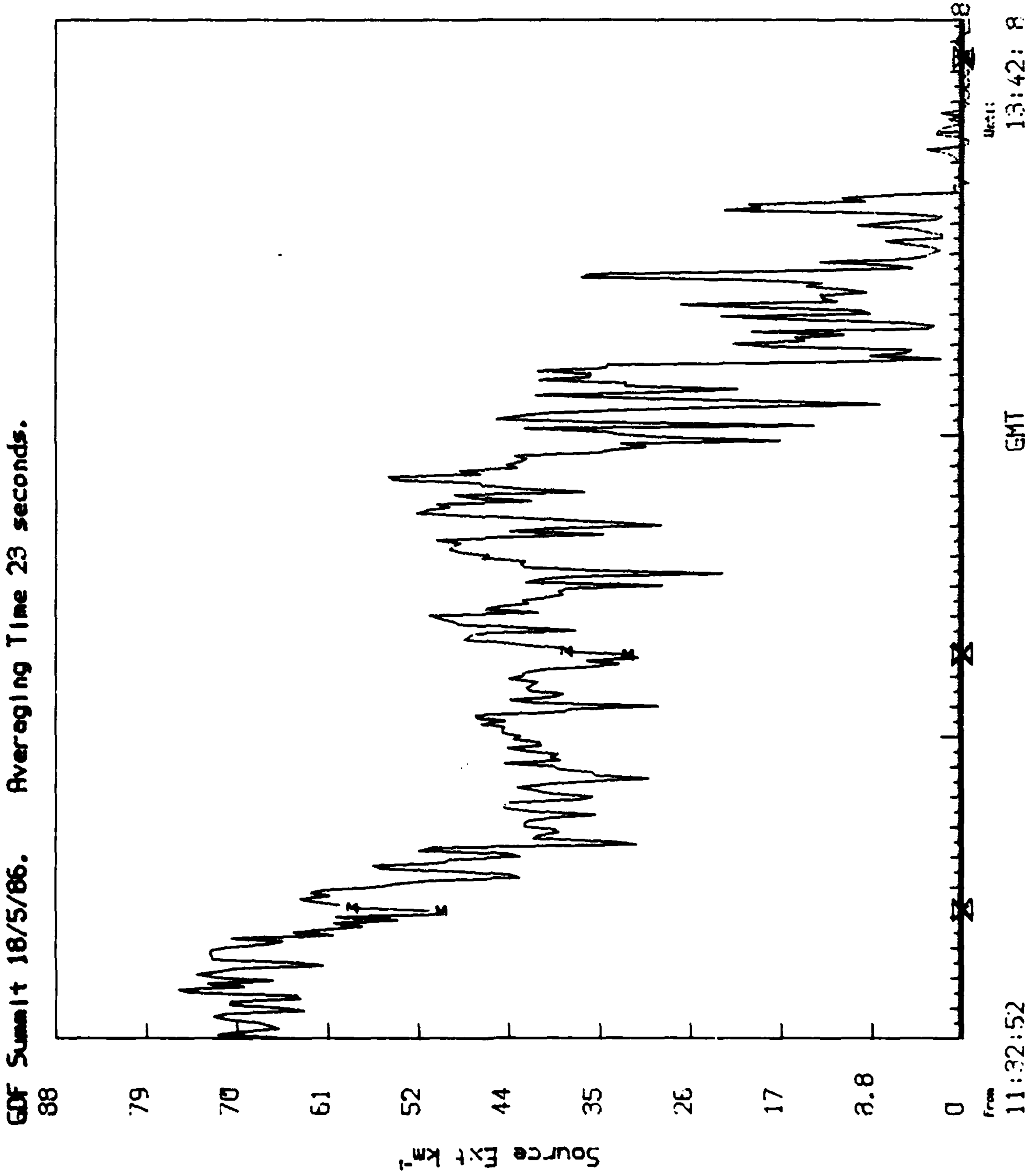

GDF Summit 18/5/86.
Averaging Time 23 seconds.
Source Ext km⁻¹
88
79
70
61
52
44
35
26
17
8.8
0
GMT
From
11:32:52
Until
13:42: 8

Figure 74.

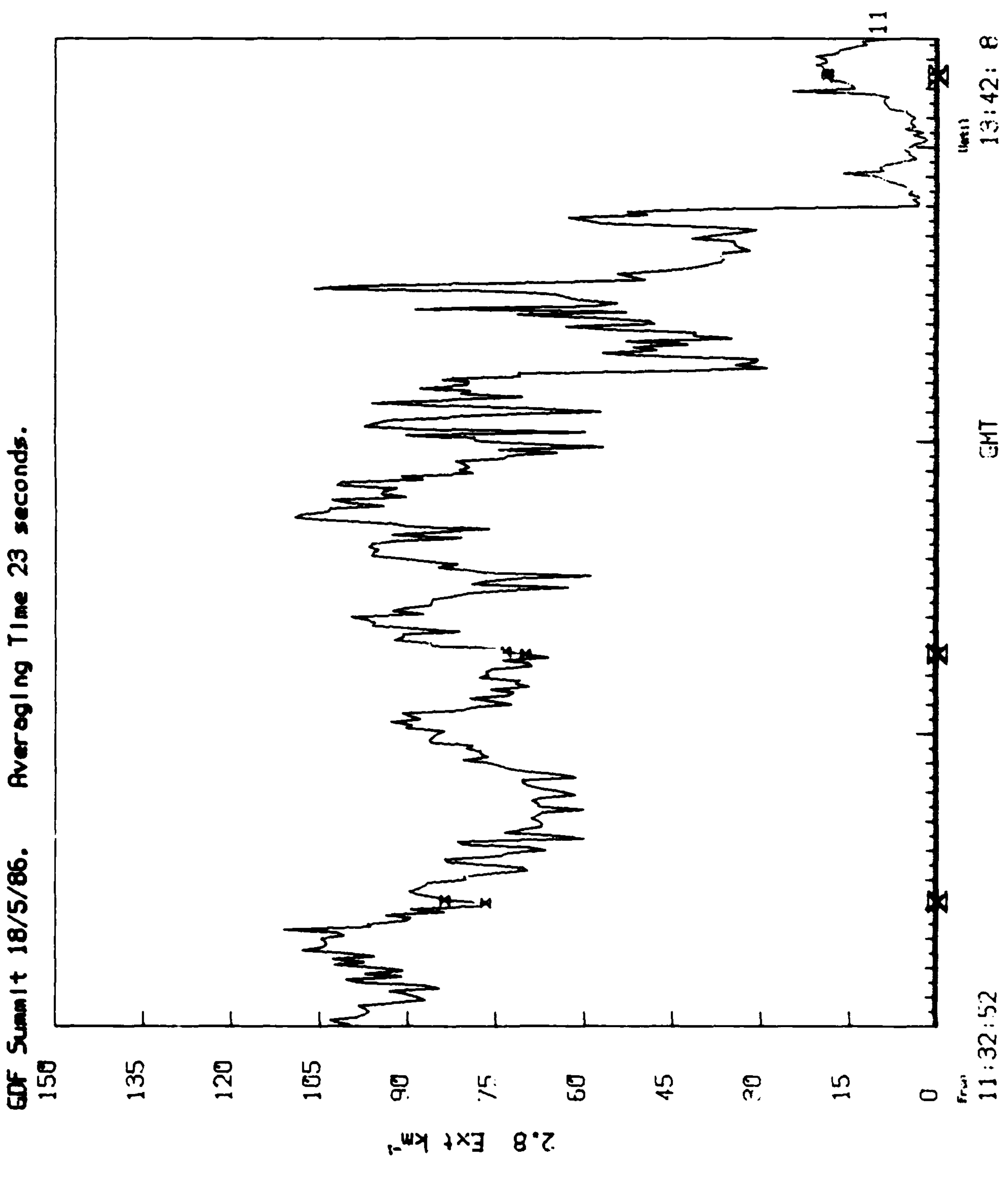
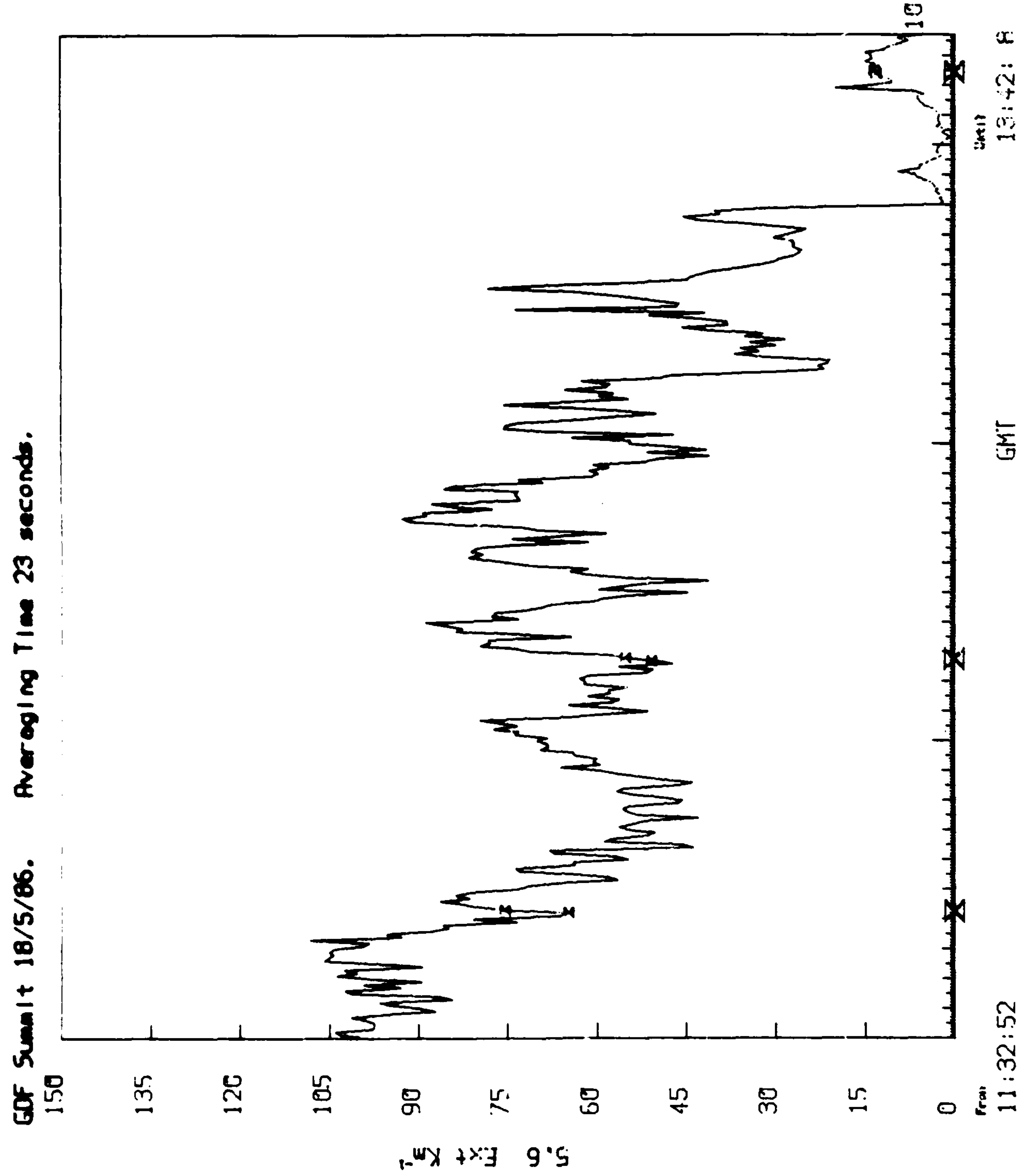

GDF Summit 18/5/86.   Averaging Time 23 seconds.
2.8 Ext km⁻¹
150
135
120
105
90
75
60
45
30
15
0
11:32:52
GMT
13:42: 8
11

Figure 75.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
150
135
120
105
90
75
60
45
30
15
0
5.6 Ext Km-1
From
11:32:52
GMT
Until
13:42: A

AD-A181 570 STUDIES OF ELECTRO-OPTICAL ATTENUATION IN THE VICINITY OF CLOUD BASE(U) UNIVERSITY OF MANCHESTER INST OF SCIENCE AND TECHNOLOGY (ENGL J LATHAM FEB 87 2/2

UNCLASSIFIED EOARD-TR-87-4 AFOSR-85-0229 F/G 20/6 NL

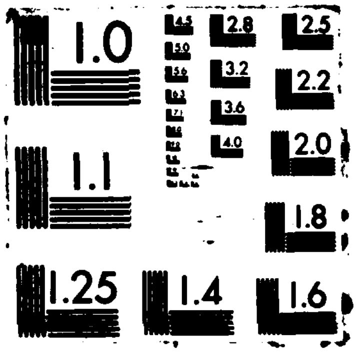
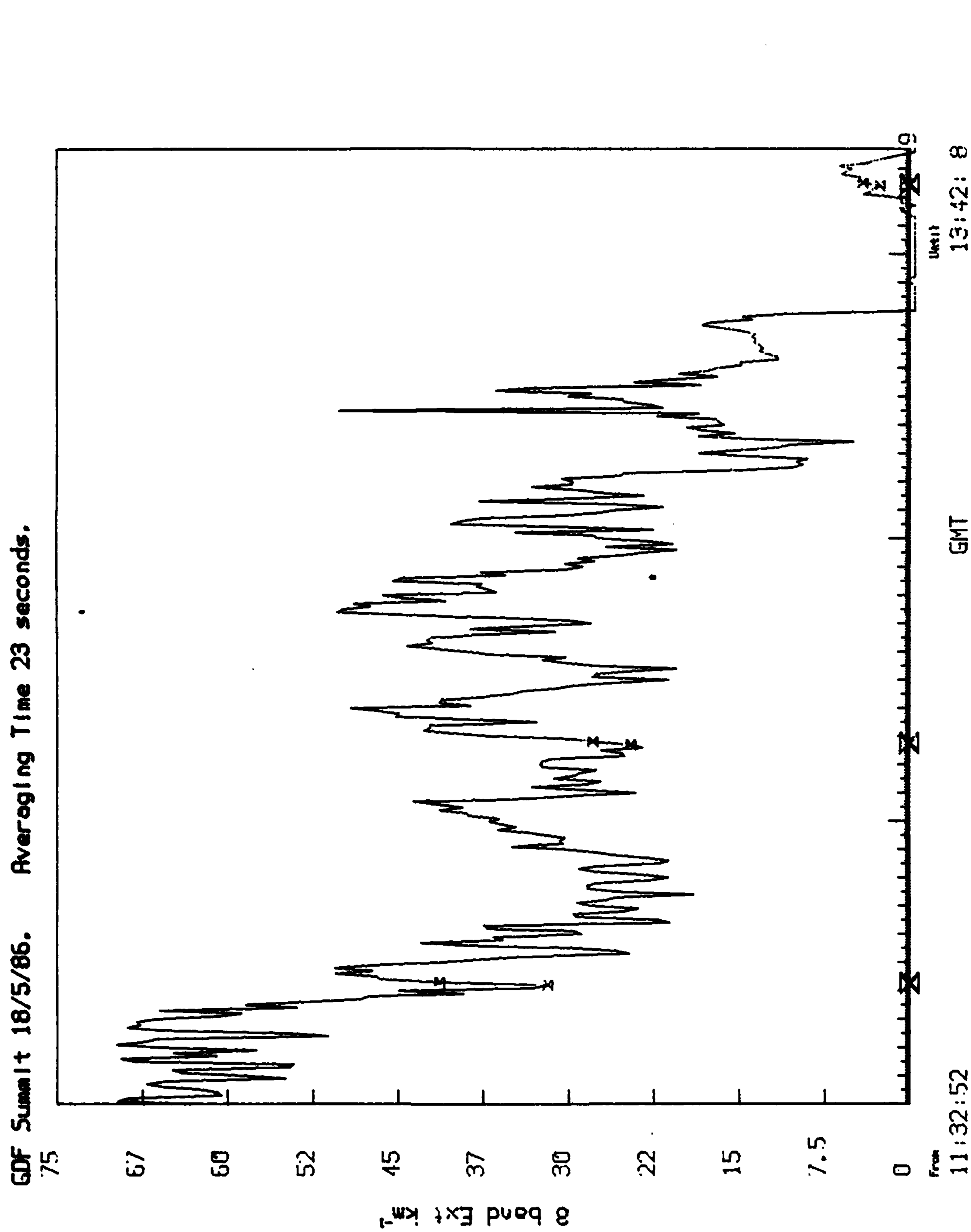
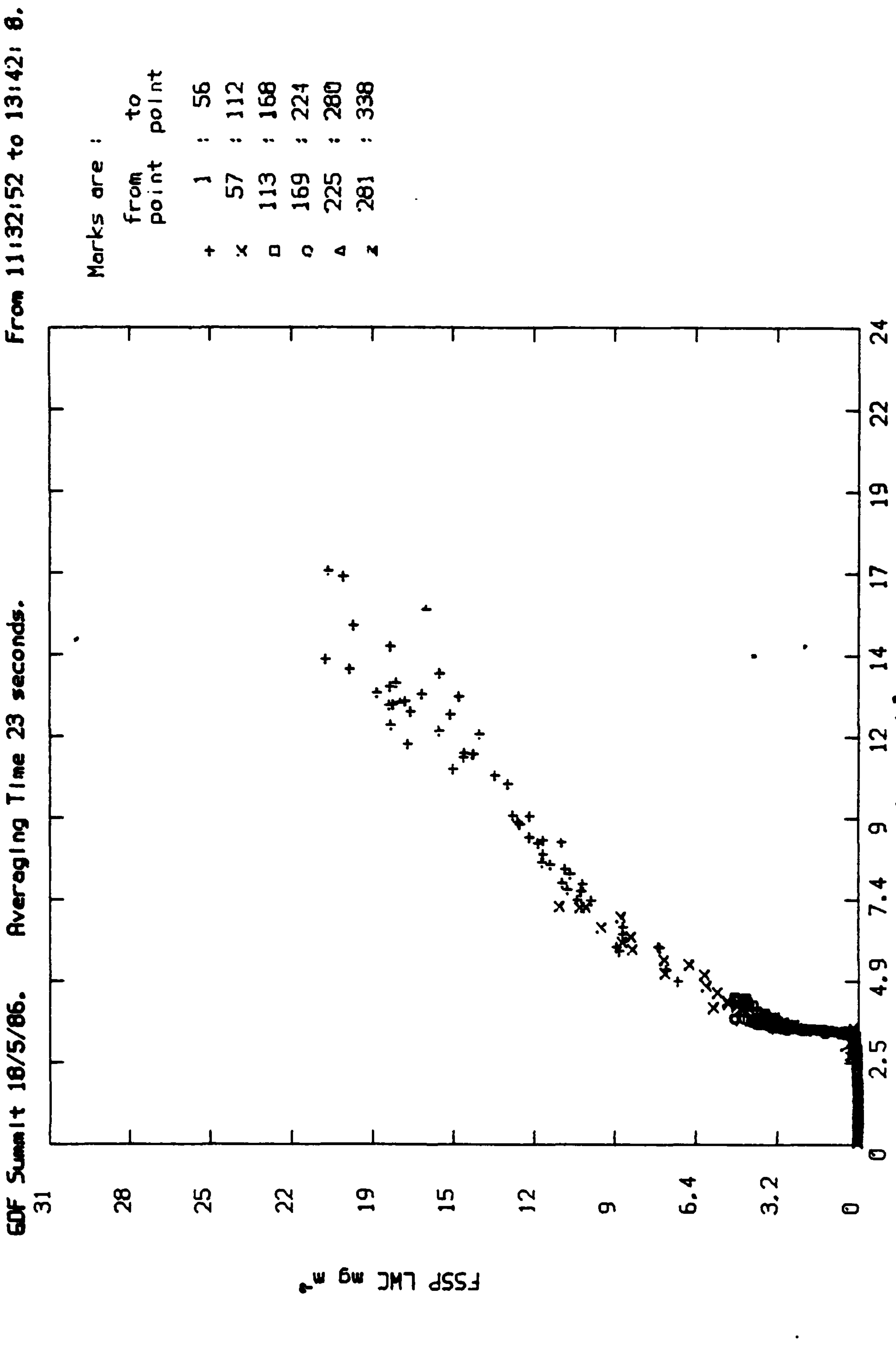

1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6

Figure 76.



GDF Summit 18/5/86. Averaging Time 23 seconds.
a band Ext km-1
75
67
60
52
45
37
30
22
15
7.5
0
From
11:32:52
GMT
Until
13:42: 8

Figure 77.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
31
28
25
22
19
15
12
9
6.4
3.2
0
FSSP LWC mg m^{-3}
0
2.5
4.9
7.4
9
12
14
17
19
22
24
$(Mean\ r)^3$

Figure 78.

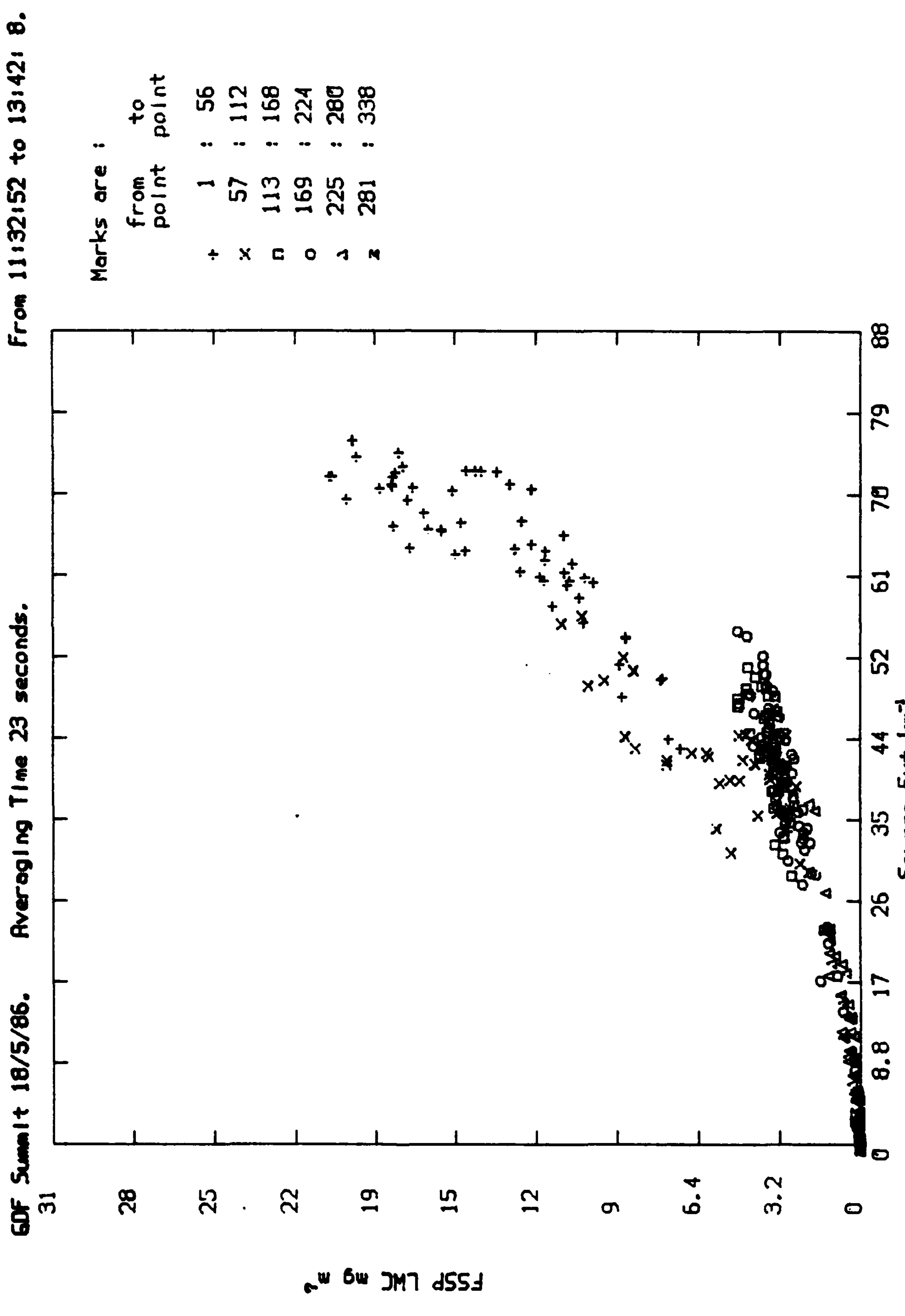

GDF Summit 18/5/86.   Averaging Time 23 seconds.   From 11:32:52 to 13:42: 8.
Marks are :
from point : to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
FSSP LWC mg m⁻³
0 3.2 6.4 9 12 15 19 22 25 28 31
Source Ext km⁻¹
0 8.8 17 26 35 44 52 61 70 79 88

Figure 79.

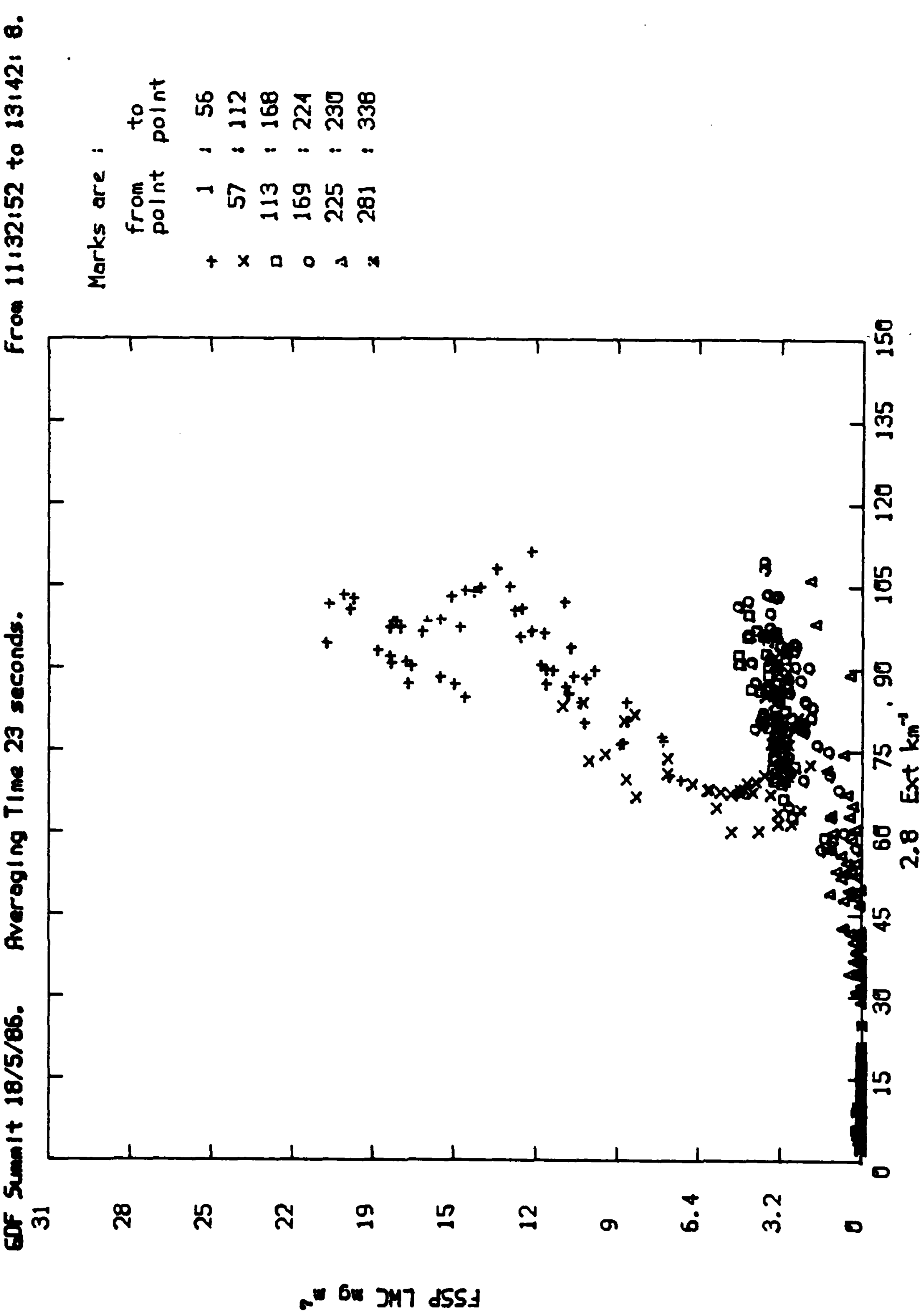
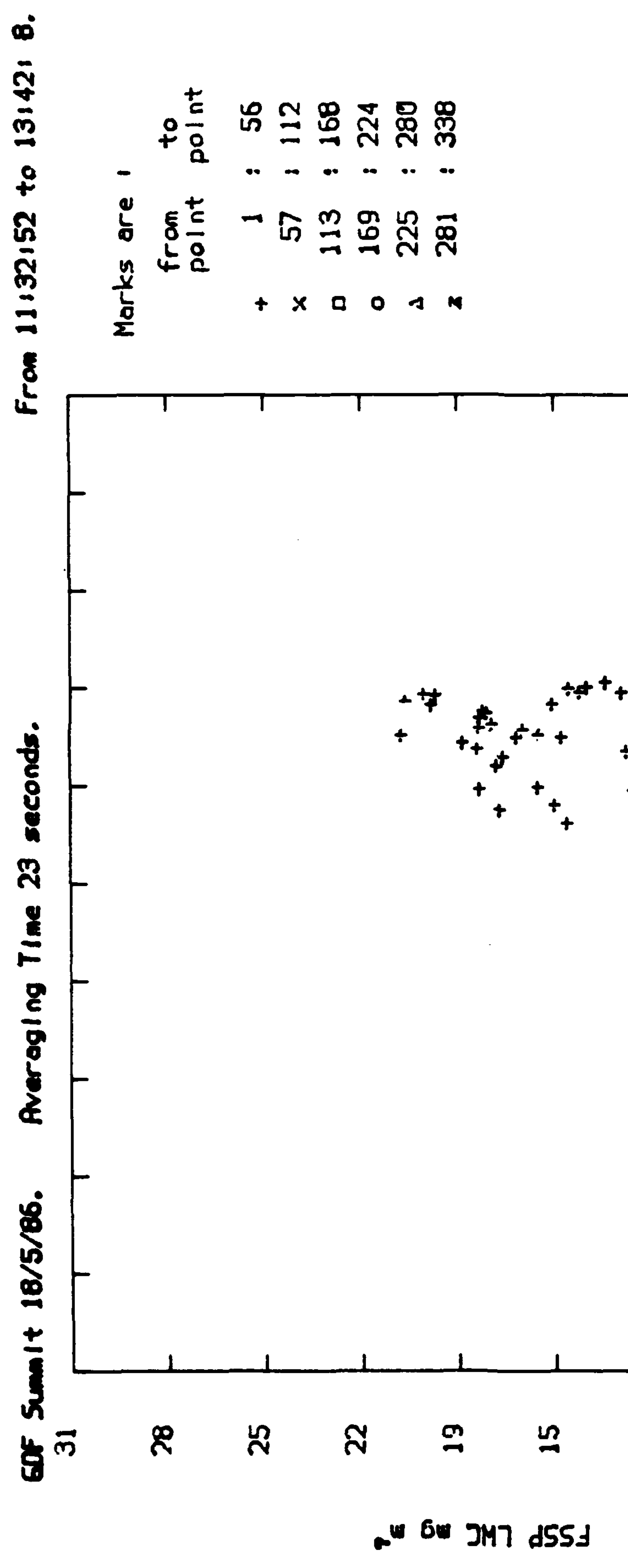

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 230
ж 281 : 338
FSSP LWC mg m^{-3}
0
3.2
6.4
9
12
15
19
22
25
28
31
0
15
30
45
60
75
90
105
120
135
150
2.8
Ext km^{-1}

Figure 8



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
0
3.2
6.4
9
12
15
19
22
25
28
31
FSSP LWC mg m⁻³
0
15
30
45
60
75
90
105
120
135
150
5.6 Ext Km⁻¹

Figure 81.

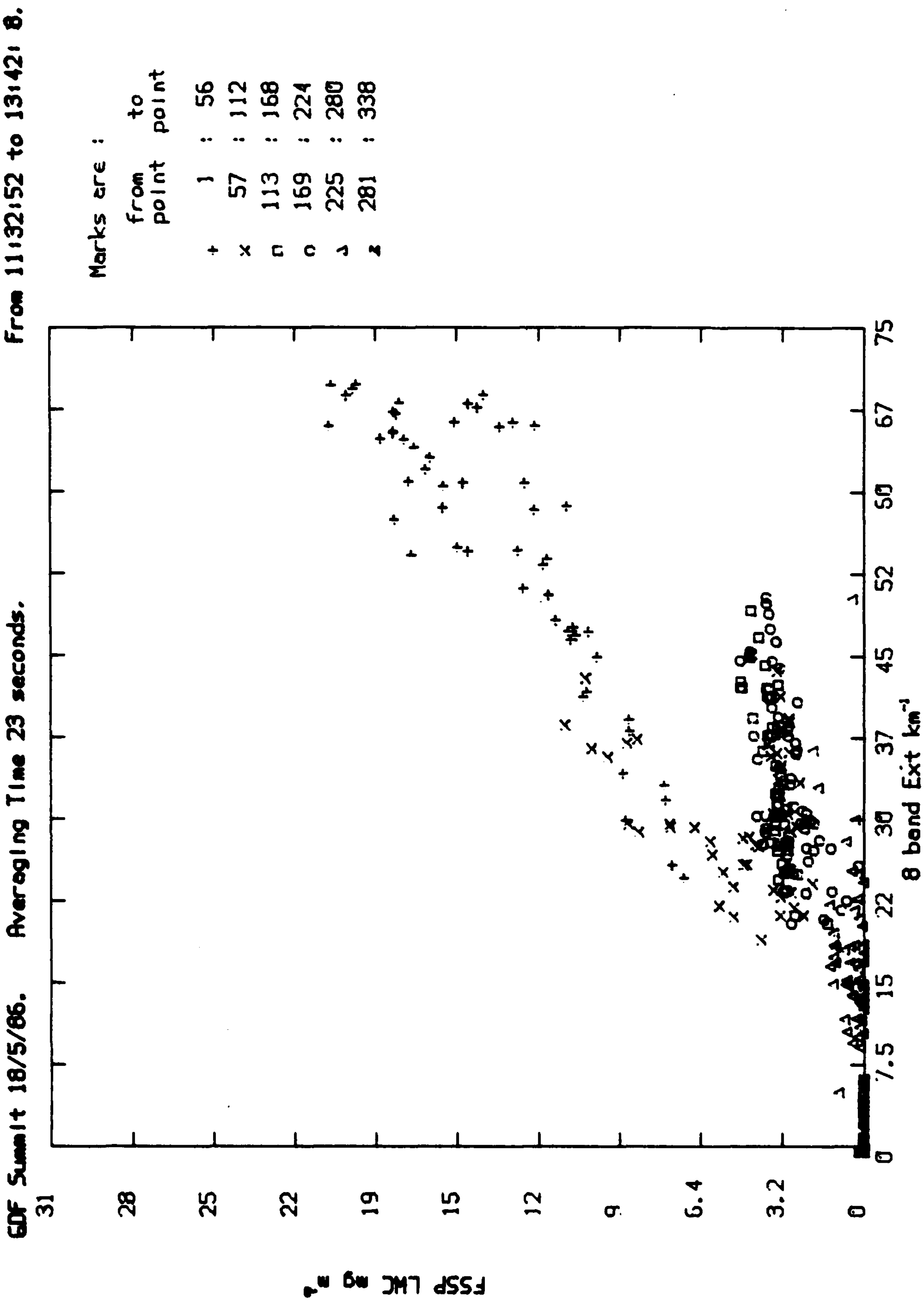
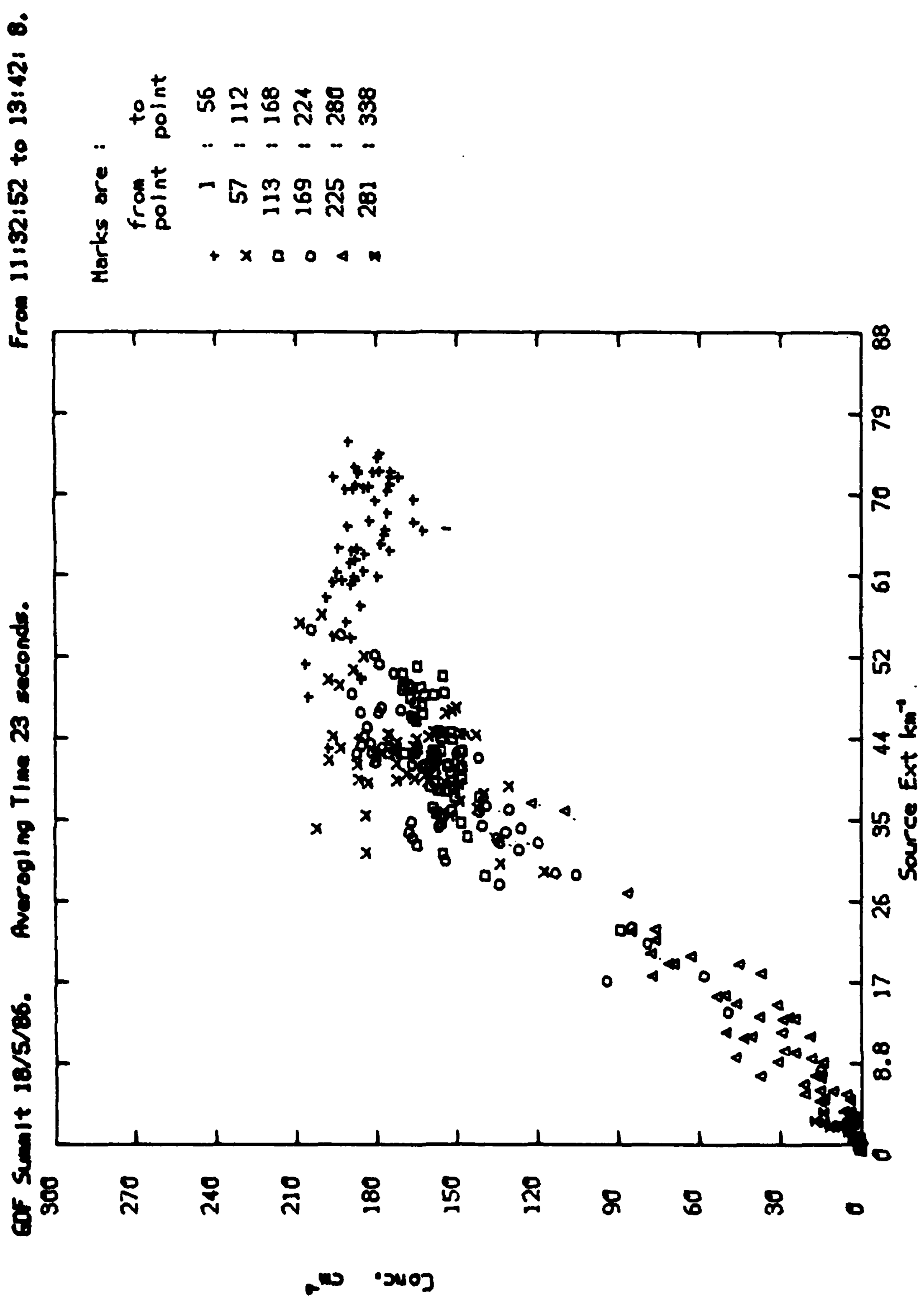
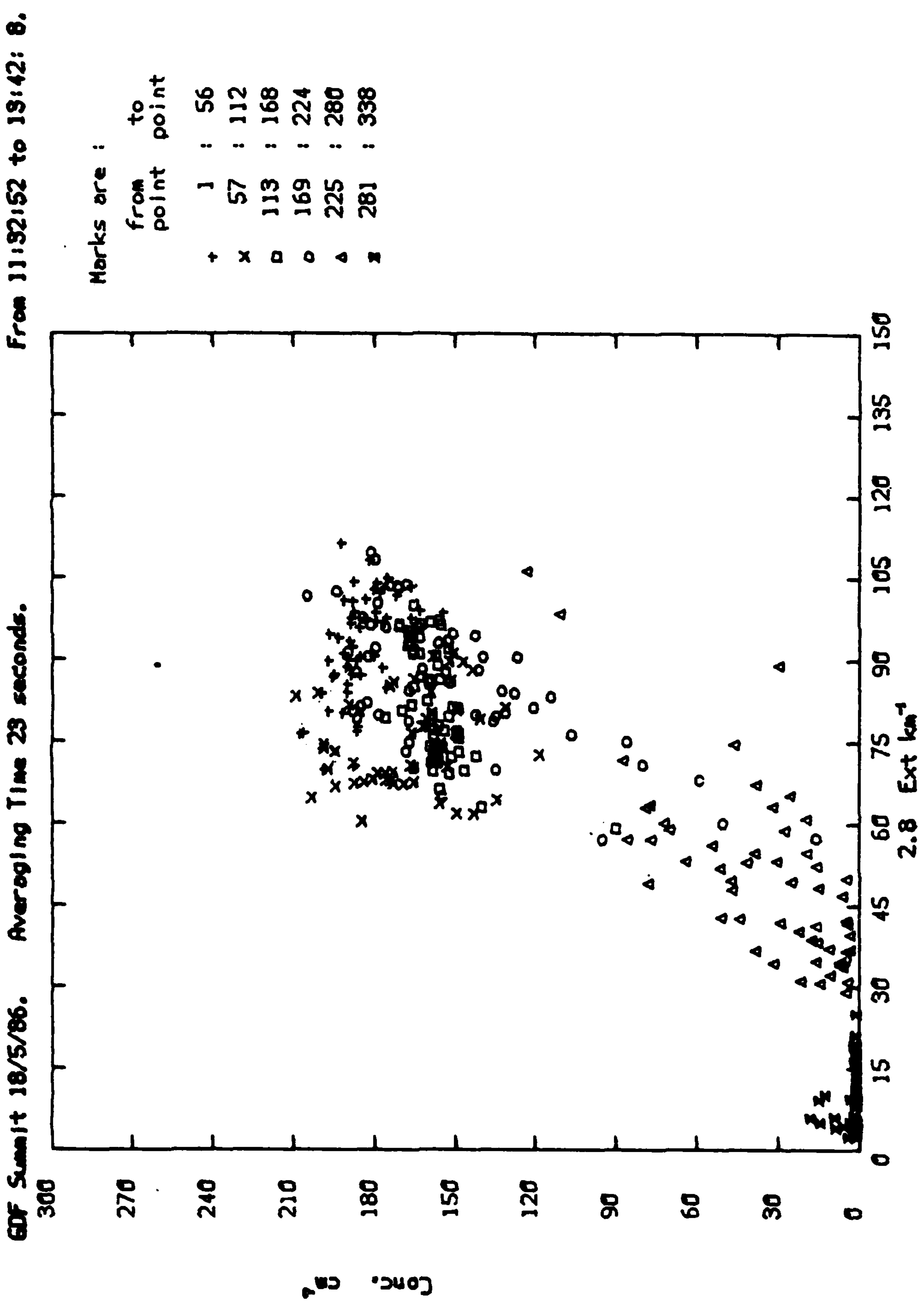

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
FSSP LWC mg m⁻³
0
3.2
6.4
9
12
15
19
22
25
28
31
0
7.5
15
22
30
37
45
52
60
67
75
B band Ext km⁻¹

Figure 82.



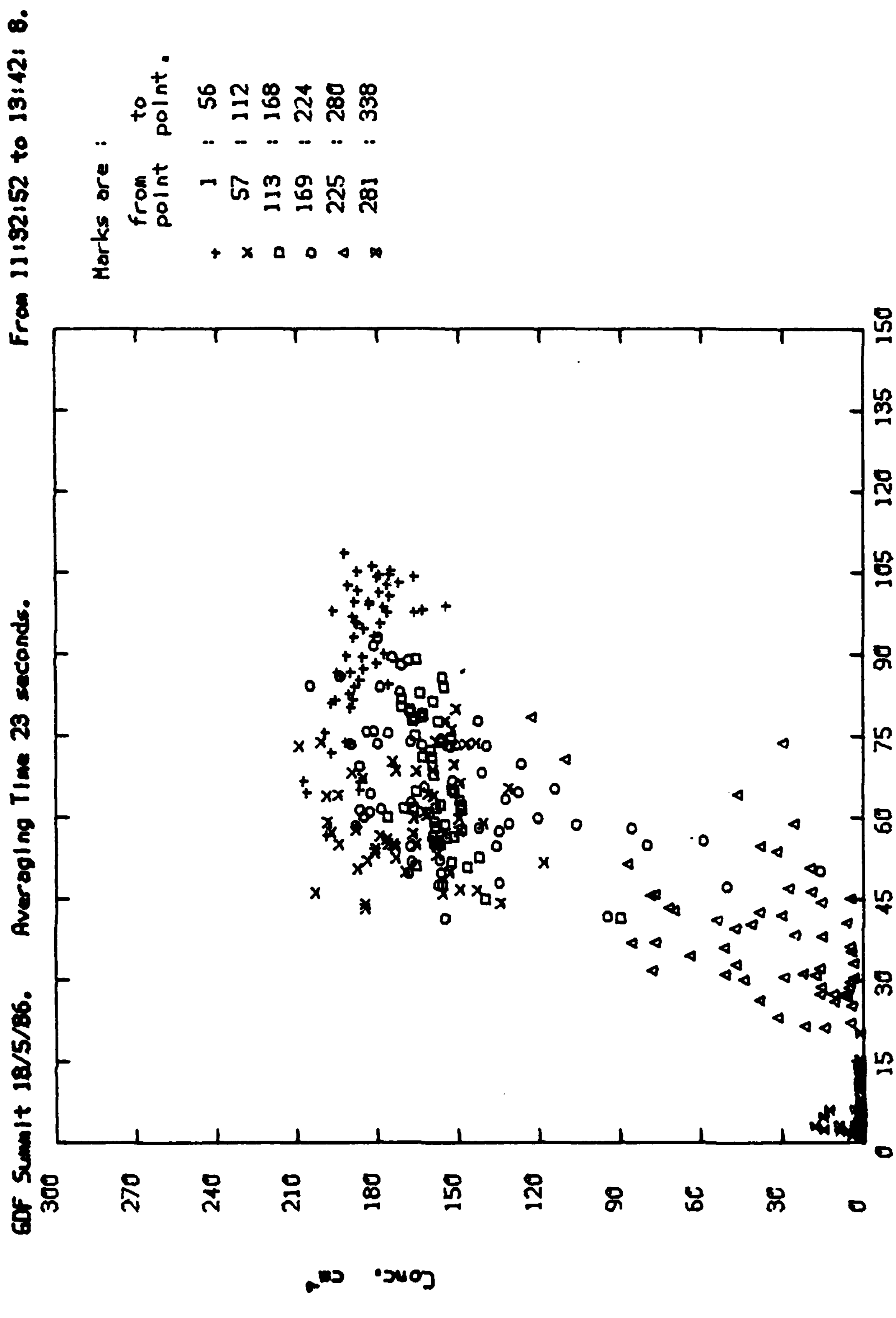
GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
⧖ 281 : 338
Conc. cm⁻³
0
30
60
90
120
150
180
210
240
270
300
Source Ext km⁻¹
0
8.8
17
26
35
44
52
61
70
79
88

Figure 83.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
281 : 338
Conc. cm-3
2.8 Ext km-1
0
30
60
90
120
150
180
210
240
270
300
0
15
30
45
60
75
90
105
120
135
150

Figure 84.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point.
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
✱ 281 : 338
Conc. cm-3
5.6 Ext Km-1
0
15
30
45
60
75
90
105
120
135
150
0
30
60
90
120
150
180
210
240
270
300

Figure 85.

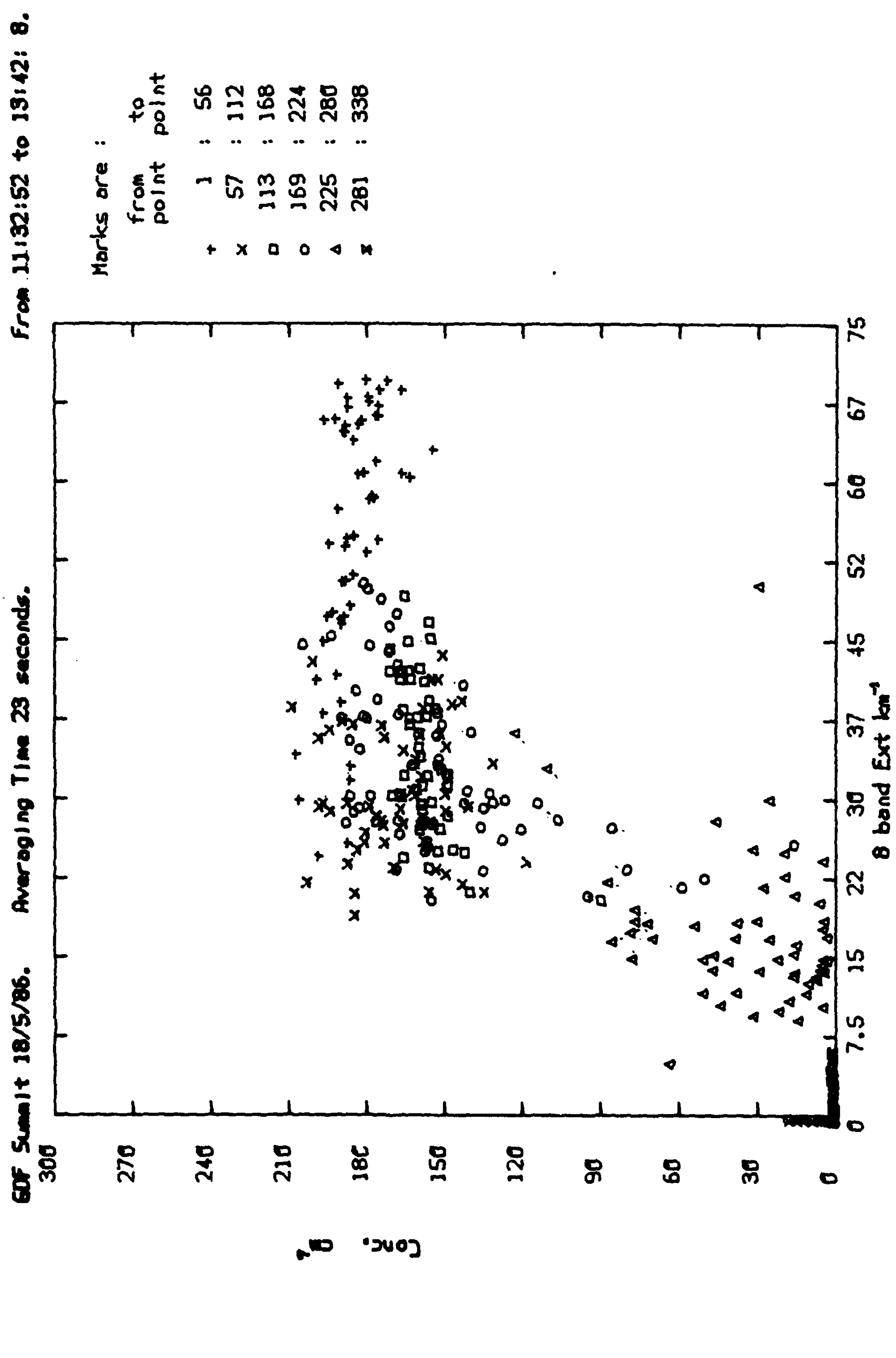
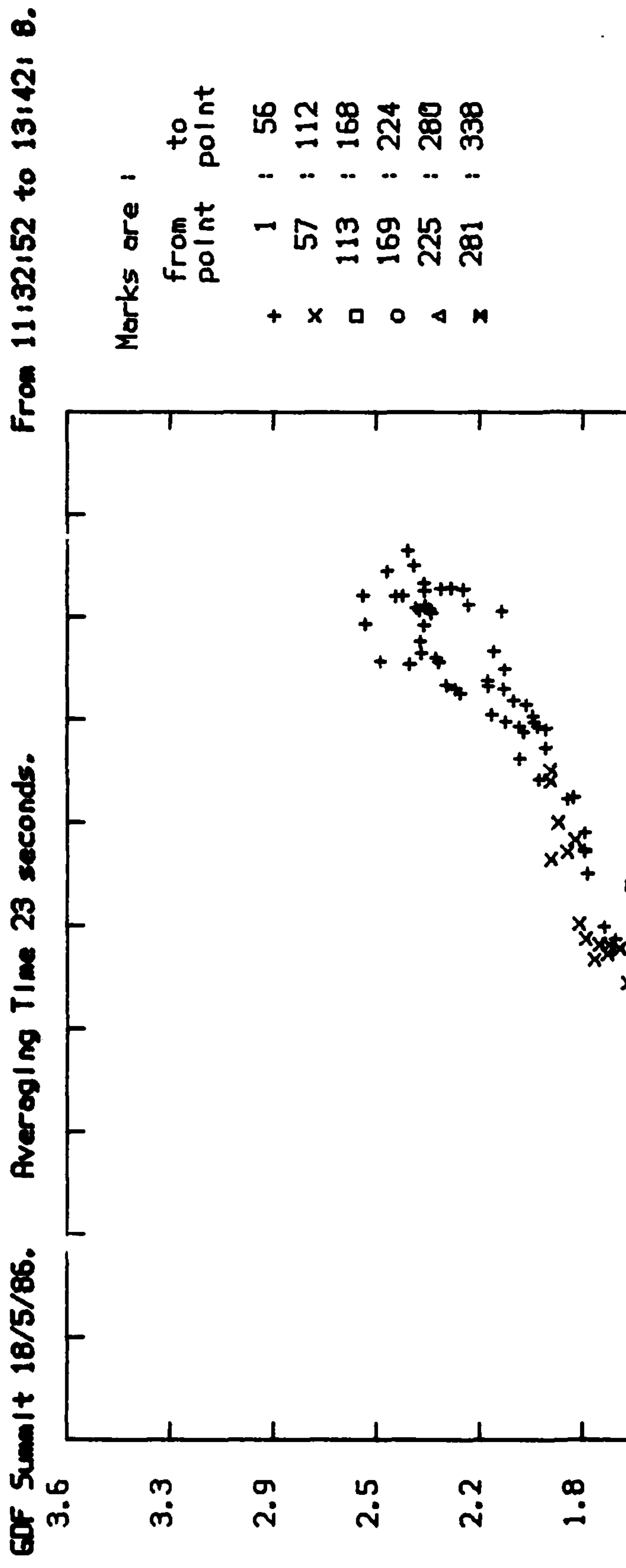
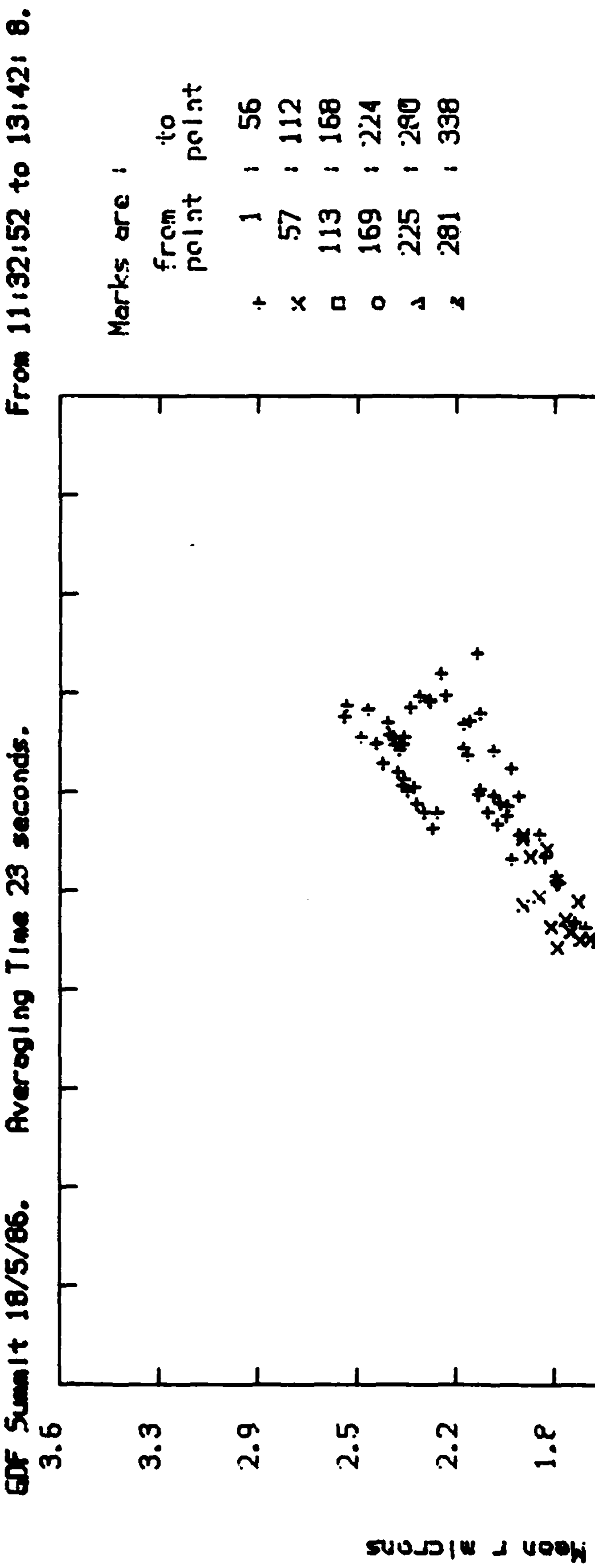

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point : to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
* 281 : 338
Conc, g/m³
8 band Ext km⁻¹
300
270
240
210
180
150
120
90
60
30
0
0
7.5
15
22
30
37
45
52
60
67
75

Figure 86.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
x 281 : 338
Mean r microns
3.6
3.3
2.9
2.5
2.2
1.8
1.4
1.1
0.7
0.4
0
Source Ext km⁻¹
0
8.8
17
26
35
44
52
61
70
79
88

Figure 87.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
Mean r microns
3.6
3.3
2.9
2.5
2.2
1.8
1.4
1.1
0.7
0.4
0
2.8 Ext km⁻¹
0
15
30
45
60
75
90
105
120
135
150

Figure 88.

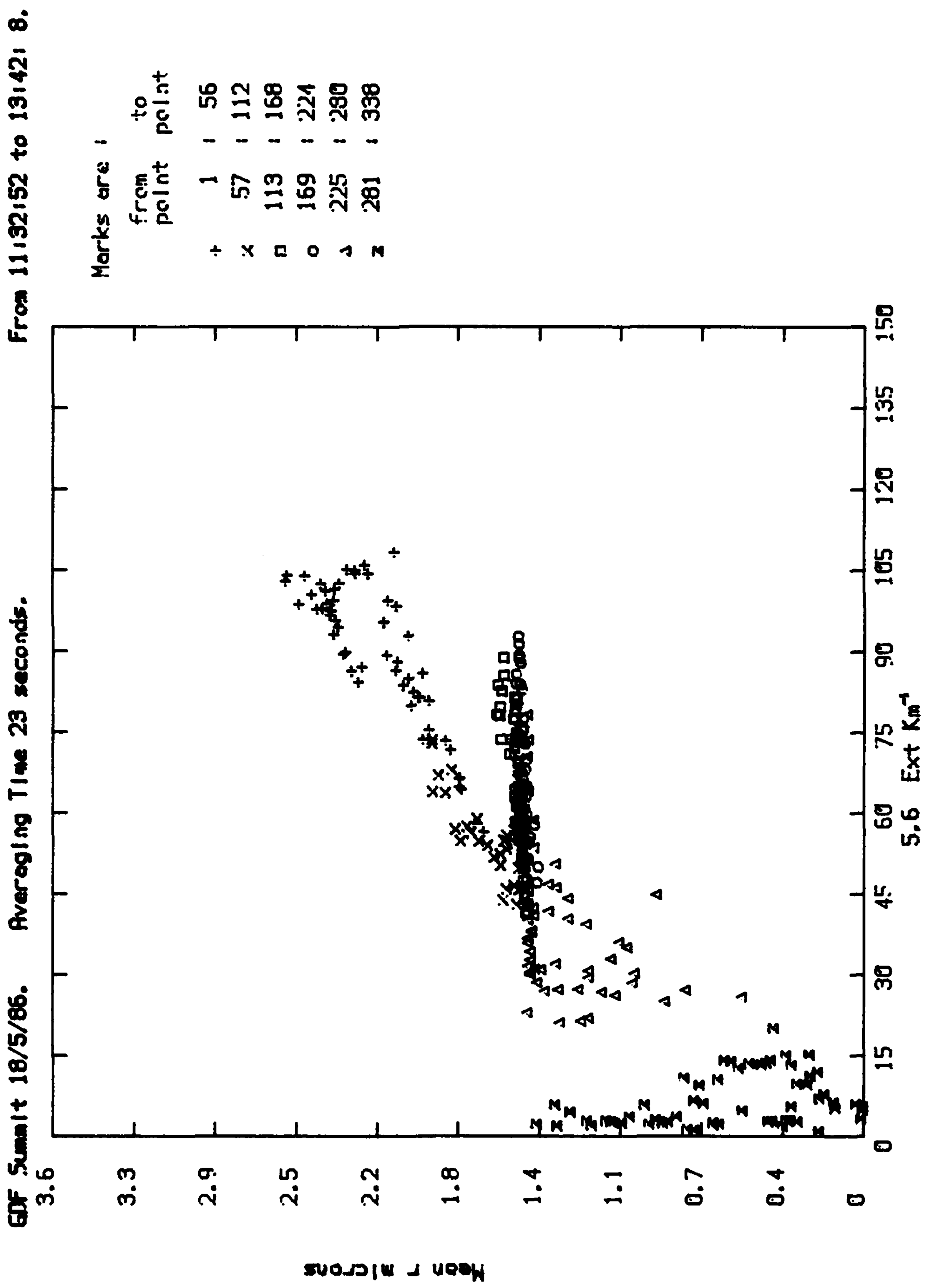
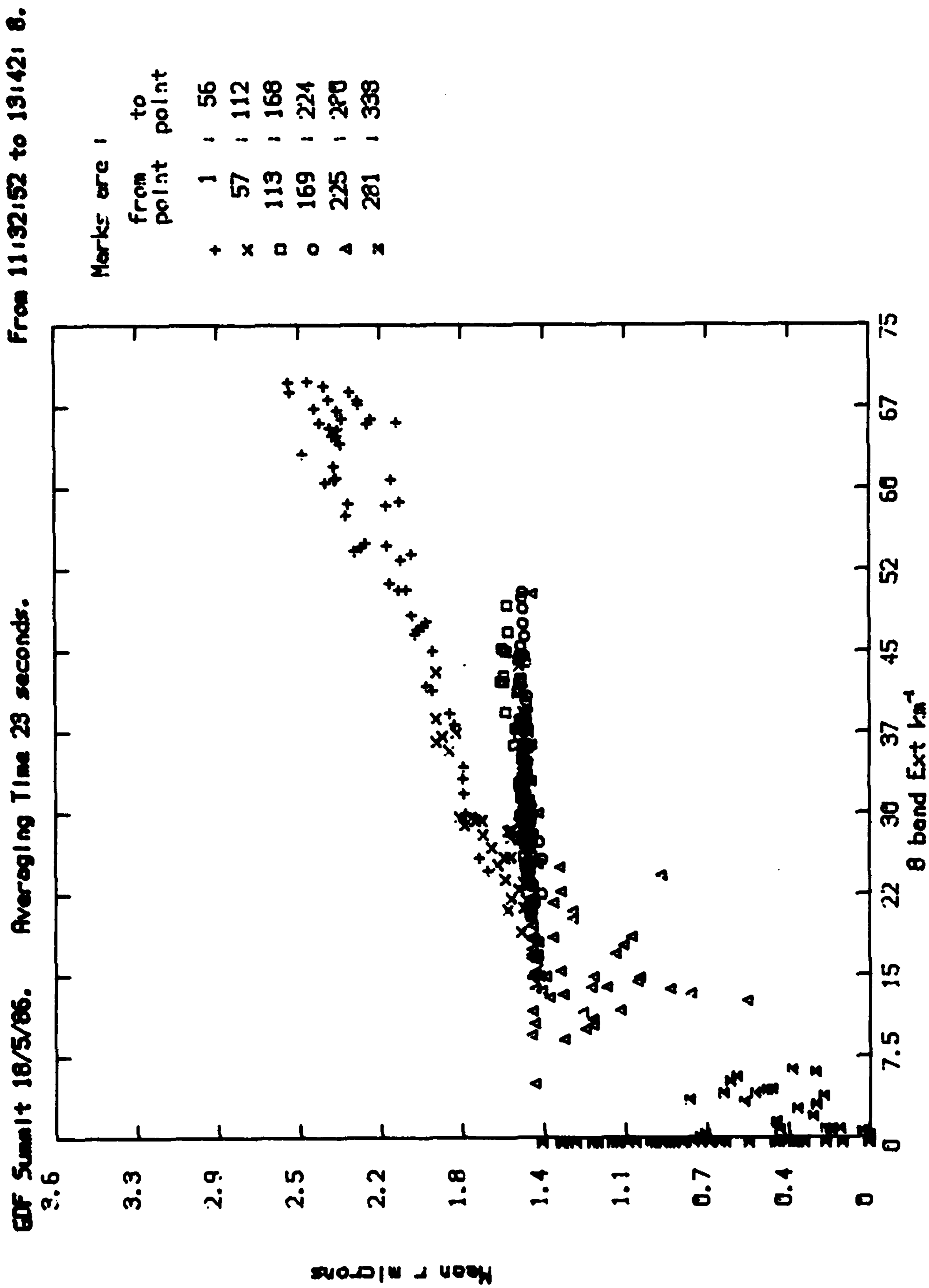
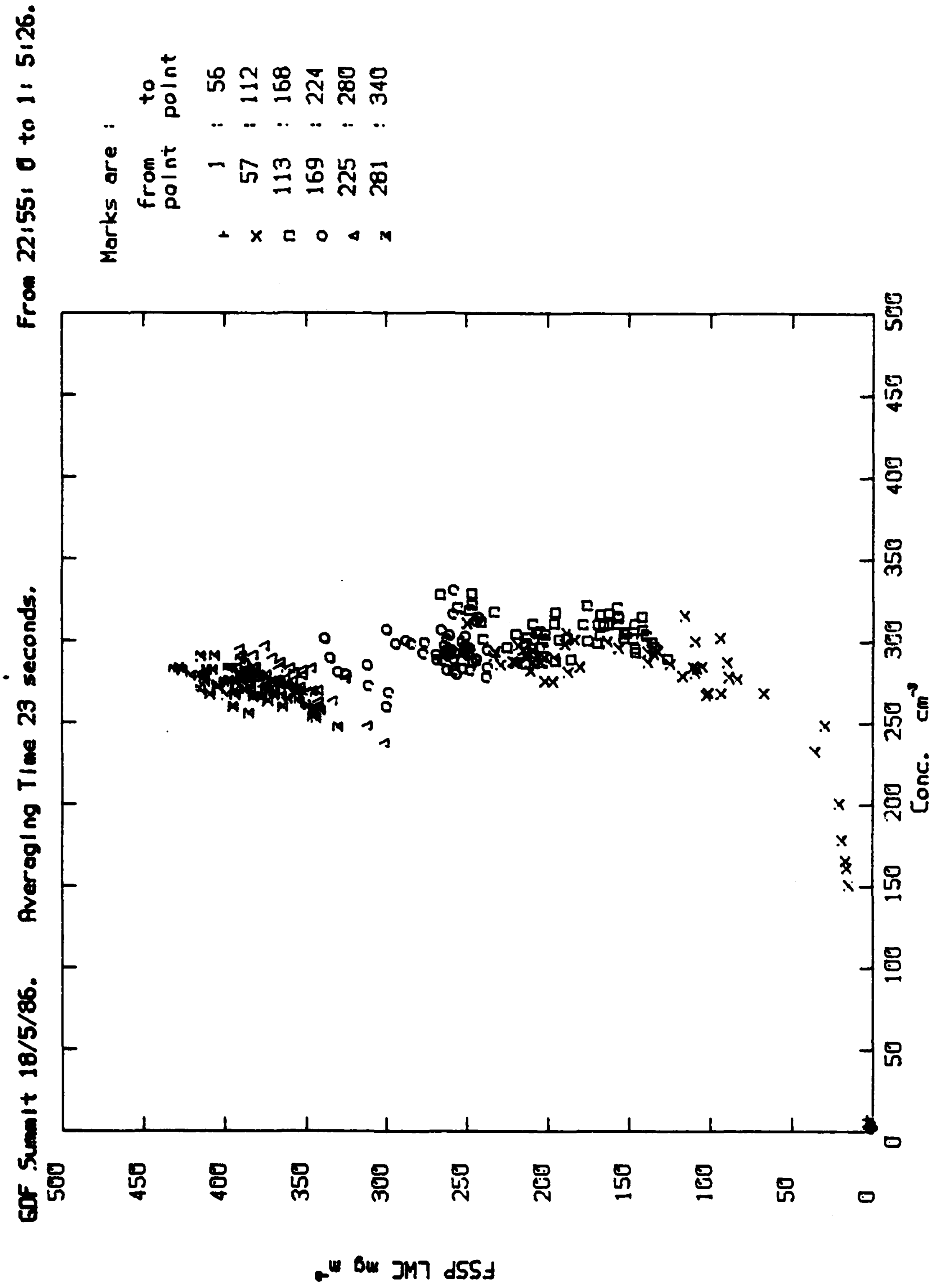

GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
Mean r microns
5.6 Ext Km-1
0
0.4
0.7
1.1
1.4
1.8
2.2
2.5
2.9
3.3
3.6
15
30
45
60
75
90
105
120
135
150

Figure 89.



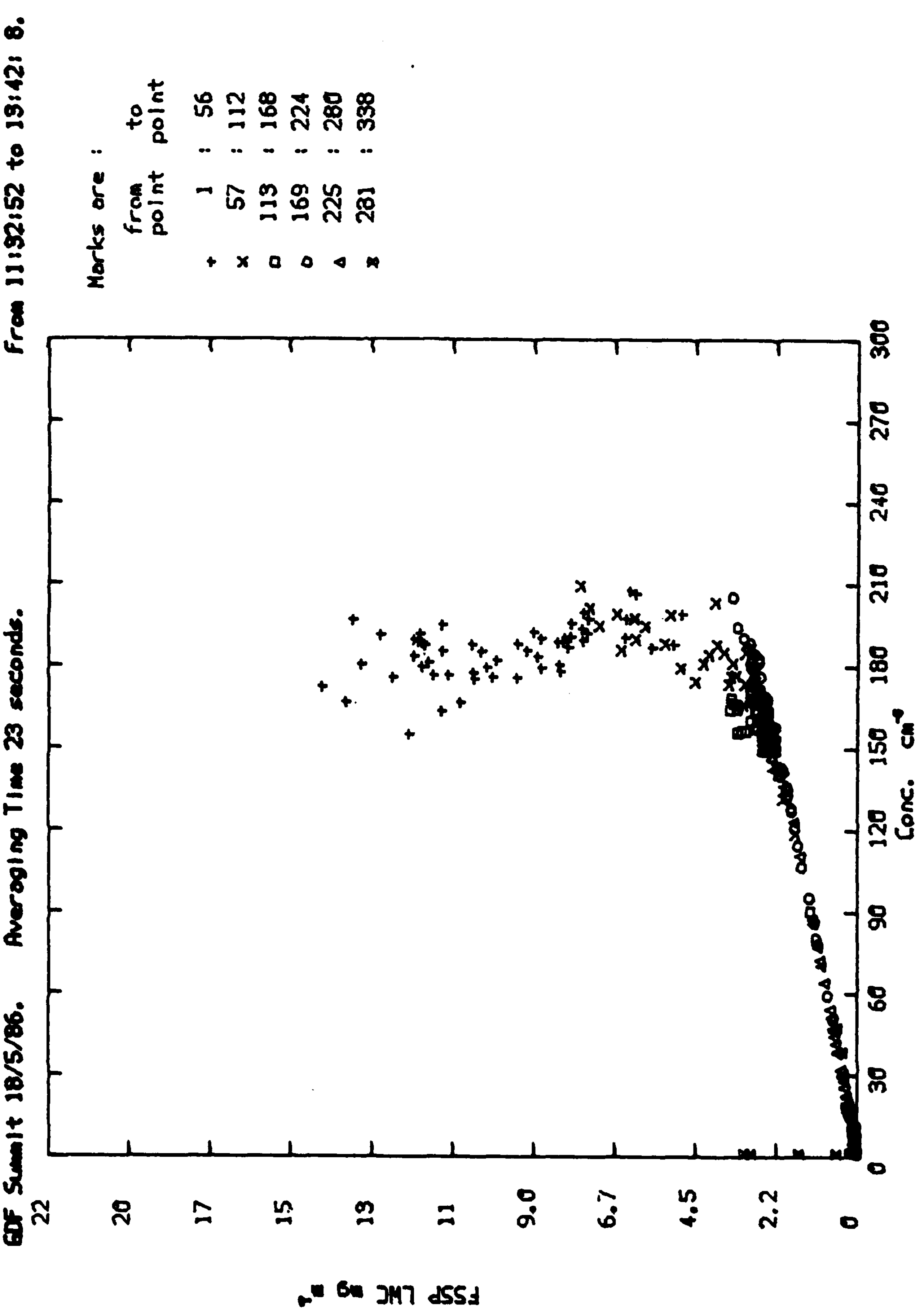
EDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
Δ 225 : 280
z 281 : 338
Mean r microns
B band Ext km⁻¹
0 7.5 15 22 30 37 45 52 60 67 75
0 0.4 0.7 1.1 1.4 1.8 2.2 2.5 2.9 3.3 3.6

Figure 90.



GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 22:55: 0 to 1: 5:26.
Marks are :
from point
to point
+ 1 : 56
x 57 : 112
□ 113 : 168
o 169 : 224
△ 225 : 280
z 281 : 340
FSSP LWC mg m-3
Conc. cm-3
0
50
100
150
200
250
300
350
400
450
500

Figure 91.


GDF Summit 18/5/86.
Averaging Time 23 seconds.
From 11:32:52 to 13:42: 8.
Marks are :
from point to point
1 : 56
57 : 112
113 : 168
169 : 224
225 : 280
281 : 338
22
20
17
15
13
11
9.0
6.7
4.5
2.2
0
FSSP LWC mg m-3
0
30
60
90
120
150
180
210
240
270
300
Conc. cm-3

END
7-87
DTIC