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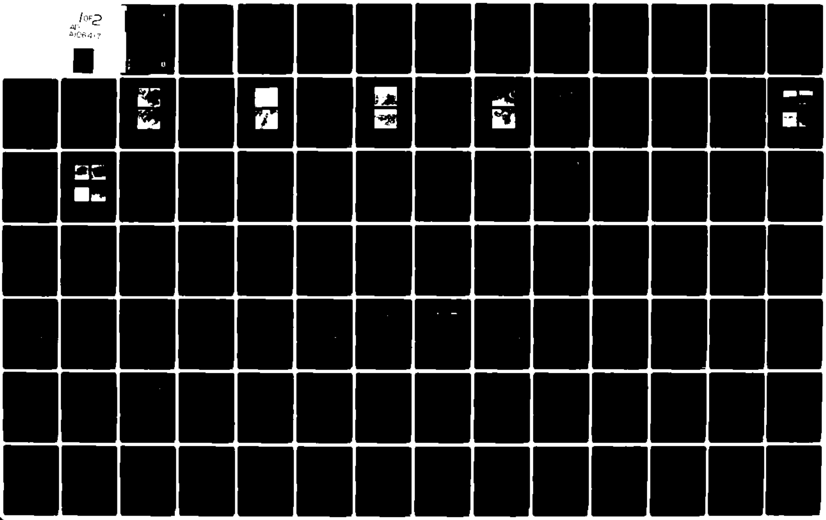

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AFGL-TR-81-0127
ENVIRONMENTAL RESEARCH PAPERS, NO. 739

Development of a Large Scale Cloud System, 23—27 March 1978

IAN D. COHEN, Capt, USAF

4 May 1981

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METEOROLOGY DIVISION PROJECT 2310
AIR FORCE GEOPHYSICS LABORATORY
HANSCOM AFB, MASSACHUSETTS 01731

AIR FORCE SYSTEMS COMMAND, USAF

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

John Howard

Chief Scientist

Unclassified AFGL-ERP-739

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AFGL-TR-81-0127	2. GOVT ACCESSION NO. AD-A106417	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) DEVELOPMENT OF A LARGE SCALE CLOUD SYSTEM, 23-27 MARCH 1978		5. TYPE OF REPORT & PERIOD COVERED Scientific. Interim.
		6. PERFORMING ORG. REPORT NUMBER ERP No. 739
7. AUTHOR(s) Ian D. Cohen, Capt, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Geophysics Laboratory (LYC) Hanscom AFB Massachusetts 01731		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61102F 2310G501
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory (LYC) Hanscom AFB Massachusetts 01731		12. REPORT DATE 4 May 1981
		13. NUMBER OF PAGES 112
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Cloud microphysics
Cloud particle spectra
Convective cloud structure
Stratiform cloud structure
Liquid water content
Storm development
Ice water content

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The visual and microphysical properties of a large scale cloud system are described as that system developed from an open wave in Oklahoma to a deep occlusion covering most of the east coast of the United States. Microphysical properties examined include particle size, liquid water content, particle density, crystal type, and Form Factor (a measure of uniformity of particle size within a sample). Visual and microphysical observations were made at four levels, approximately at the 400, 400, 700, and 850-mb surfaces, on four consecutive days. On each day the MC-130E aircraft instrumented for cloud

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physics research by AFGL flew at each level for approximately 30 minutes. In addition to examination of the continuous data provided by the aircraft, a detailed examination of 32 samples of 2 min each was undertaken.

Sampling was conducted in the northeast quadrant of the storm. During the first day, the storm was mainly convective in nature, and as a result, had high liquid water content and particle distributions which were uniform along the vertical axis. As the storm moved eastward, it became more stratified. As it did, the observed particle size and types showed greater variations. The upper levels were affected less than the lower levels, thus reducing the uniformity along the vertical axis. As the system occluded, it lost moisture, producing smaller hydrometeors, lower liquid water content, and lighter precipitation at the surface. Later, an influx of warm air increased the liquid water content and the intensity of the precipitation.

The 2-min samples showed that the Form Factor tended to be highest at the higher levels, often as high as 0.60, while it varied from 0.00 to 0.25 at lower levels. This showed a consistency of particle size and type in time and space in the upper levels while wide variations in particle size and type were occurring at lower levels.

Preface

The development and complete life cycle of large scale storms has long been of interest to meteorologists. The use of an aircraft with PMS probes and other cloud physics equipment has enabled us to look at both the visual and microphysical development of a large scale storm.

In order to gather the necessary aircraft data, the aircrew made four flights totalling approximately 21 hours in four days. Most of this time was spent in weather which aircrews prefer to avoid. Thus I extend my deepest appreciation for the efforts of the 4950th Test Wing and to the aircrew and maintenance personnel who participated on these missions.

The AFGL project crew, consisting of Capt (now Major) Donald Cameron, MSgt James Bush, TSgt Marshall Wright, and SSgt Dennis LaGross, did an outstanding job in maintaining and operating the project equipment and providing the visual and microphysical data upon which this report is based. Guidance in locating the optimum sampling areas was provided by Dr. Arnold A. Barnes, Jr., Mr. Robert Myers, and Capt (now Major) Leandro Delgago of AFGL, and Mr. John Powers of Systems and Applied Sciences Corp. using the AFGL Man-computer Interactive Data Access System (McIDAS).

Special thanks go to Lt Col Donald Varley and Dr. Arnold A. Barnes, Jr. for suggestions and assistance in the preparation of this report, to Mrs. Pat Sheehy for typing the manuscript, to Ms. Barbara Main for preparing the illustrations, and to Mr. James Lally of Digital Programming Services, Inc. for providing computer printouts and plots.

Contents

Contents

Illustrations

Illustrations

Tables

Development of a Large Scale Cloud System 23–27 March 1978

1. INTRODUCTION

During March 1978, the MC-130E of the 4950th Test Wing with AFGL Cloud Physics instrumentation gathered data on several storm systems in the eastern and central United States as a part of the AFGL Large Scale Cloud Systems (LSCS) project. The LSCS Project investigated changes in the microphysics of cyclonic storms as they developed and crossed the United States. This report will examine data obtained in one such storm system.

The MC-130E sampled a storm system from 23 to 26 March. On each of these days, the aircraft made a flight into the storm area and investigated the northeast quadrant of the storm. A single quadrant was chosen to provide a consistent view of the variations of meteorological conditions as the storm progressed through its life cycle. In this case, the northeast quadrant was chosen because of the large extent of clouds and precipitation which permitted long sampling paths in uniform stratiform clouds. The clouds in this quadrant were thick, which permitted productive sampling passes at 400, 500, 700, and 850 mb on each flight.

Areas of convective activity were generally avoided, as were those frontal surfaces which had strong wind gradients.

(Received for publication 30 April 1978)

Instrumentation on the aircraft is adequately described by Varley,[1] Knollenberg[2,3,4] and others, and so will not be discussed in detail here. The standard configuration of probes was used on this series of flights. PMS 1-D and 2-D probes were located in the positions shown on Figure 1. The EWER probe (item 7 on Figure 1) is a new instrument designed to measure the total liquid water content of a sample of air. Data from the EWER probe were taken but were not used in the preparation of this report since the EWER was not considered reliable when these flights were made.

On 23 March the aircraft made three data passes in the Texas Panhandle and then flew four data passes in northeastern Oklahoma. On subsequent days, four passes were flown on each flight. Table 1 shows the times of the flights on each of the four days.

A recent report by Varley[5] examined the large scale cloud system of 1 to 3 March 1978. His report contains a survey of work done in this field.

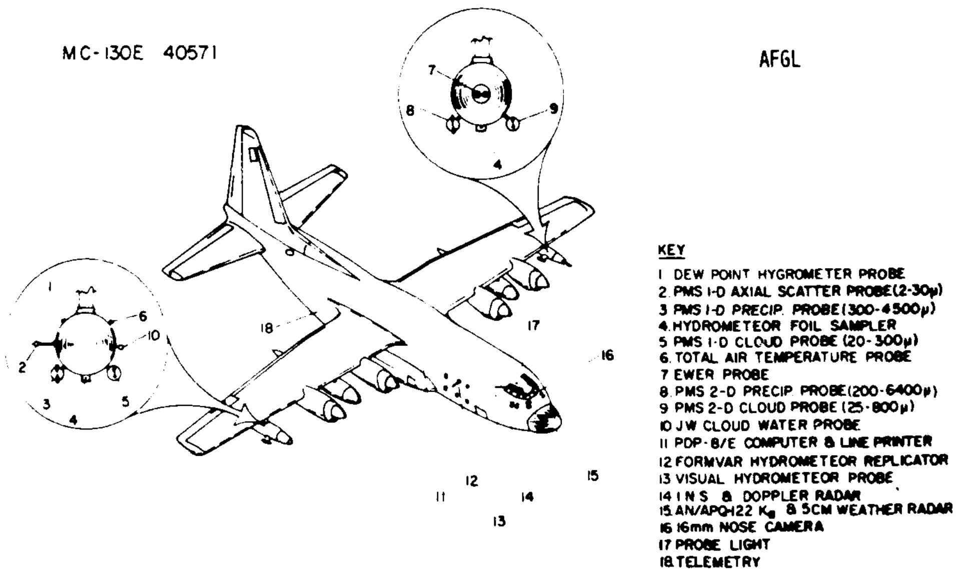


Figure 1. Cloud Physics Equipment on MC-130E 40571

(Due to the large number of references cited above, they will not be listed here. See References, page 77.)

Table 1. Flights of MC-130E, #640571 on 23 to 27 March 1978

2. SYNOPTIC SITUATION

A synoptic analysis of this system was made by Chin and Hamilton.[6] Selected data and maps from their report have been included in this report.

On 23 March, a small low pressure area formed on a quasi-stationary front in Oklahoma. By 0000Z on 24 March (the approximate time of Flight 78-10, the first of the four flights) the low had become an open wave, as shown in Figure 2. Southerly winds at 850 mb brought warm, moist air into the system, while a 500 mb trough over west Texas helped the system intensify. The GOES satellite photos in *Figure* 3 show the extensive cloudiness ahead of the system and considerable convective activity associated with the storm at this stage of development. This convective activity was evident during Flight 78-10. Twenty-four hours later, the low had moved to Missouri, as seen in Figure 4. The deep 850-mb low continued to bring warm, moist air into the system resulting in a large area of cloudiness north of the warm front. The satellite photos in Figure 5 reveal the extent and depth of this cloudiness. Flight 78-11 obtained data in this cloud shield north of the front. The cloudiness was the result of the warm air overrunning the stationary front along the Kentucky-Tennessee border.

The system continued to deepen and by the afternoon of 25 March an occluded front connected the main low in Illinois to a secondary low in Georgia. Figure 6 shows this as well as the nearly vertical structure of the upper air low system. This is typical of a deep occlusion, as are the extensive areas of cloudiness seen in Figure 7. As the infrared photo shows, most of the higher clouds were ahead of the system. Flight 78-12 sampled clouds in the trailing edge of the more intense activity. By this time much of the convective character of the

6. Chin, D., and Hamilton, H.D. (1979) Synoptic Analysis Case 2, 23 March 1978, AFGL-TR-79-0007, AD A065555.

storm was gone. It was replaced by more extensive stratiform clouds and less intense but more widespread precipitation.

While the original low continued to drift eastward, it was the secondary low (formed in Georgia on 25 March) that dominated the weather in the eastern United States on 26 March. As Figure 8 shows, this low combined with the nearly vertical cyclonic system in Ohio to create strong southerly winds along the Atlantic coast which brought considerable moisture to eastern Pennsylvania and New York. Many stations from Virginia to New York reported moderate rain for much of the day. The satellite photos in Figure 9 show the extent of the cloud shield. The thickest clouds were associated with the warm front which extended from the low in Georgia to Long Island. Flight 78-13 occurred in the northern portion of this area. At 5,000 ft (1.5 km) the aircraft was often in rain, but not in clouds. The cloud shield consisted mainly of widespread stratiform clouds, much as it had been the day before. Convective activity was limited to an area in eastern North Carolina and over the ocean northeast of the secondary low, well away from the sampling aircraft.

A summary of the track of this storm and the sampling areas used on the four flights described in this report appear in Figure 10. Portions of the fronts which did not influence the flights have been omitted to avoid confusion.

During the four days the MC-130 investigated it, the system changed from a small, fast moving wave with considerable convective activity to a deep occlusion which spread uniform stratocumulus and nimbostratus overcasts over the entire eastern half of the United States. It brought widespread rain, freezing rain, and snow to much of the northeastern United States. This report will explore the changes in clouds and cloud structure during the period.

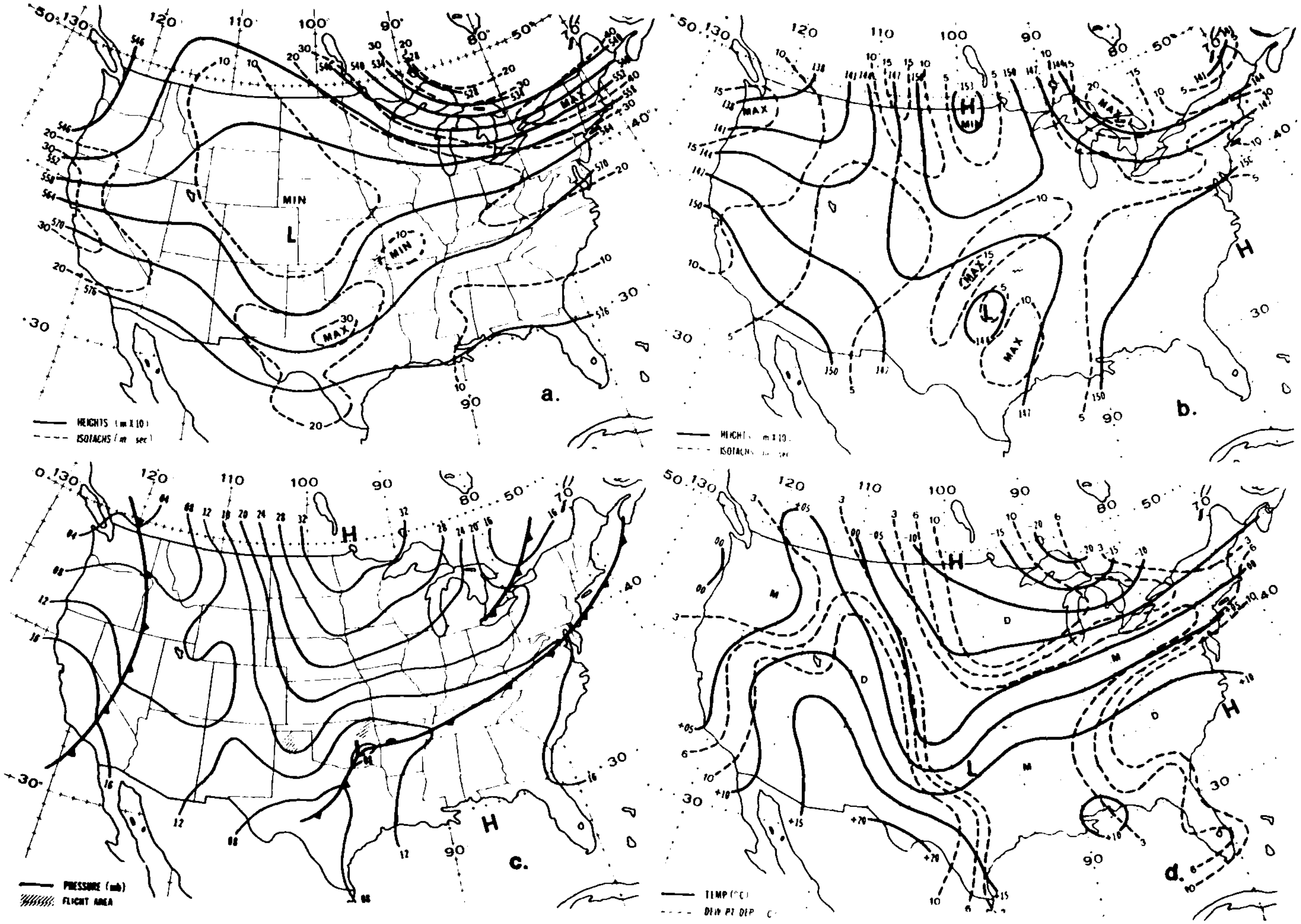


Figure 2. Synoptic Maps for 24 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.

b.

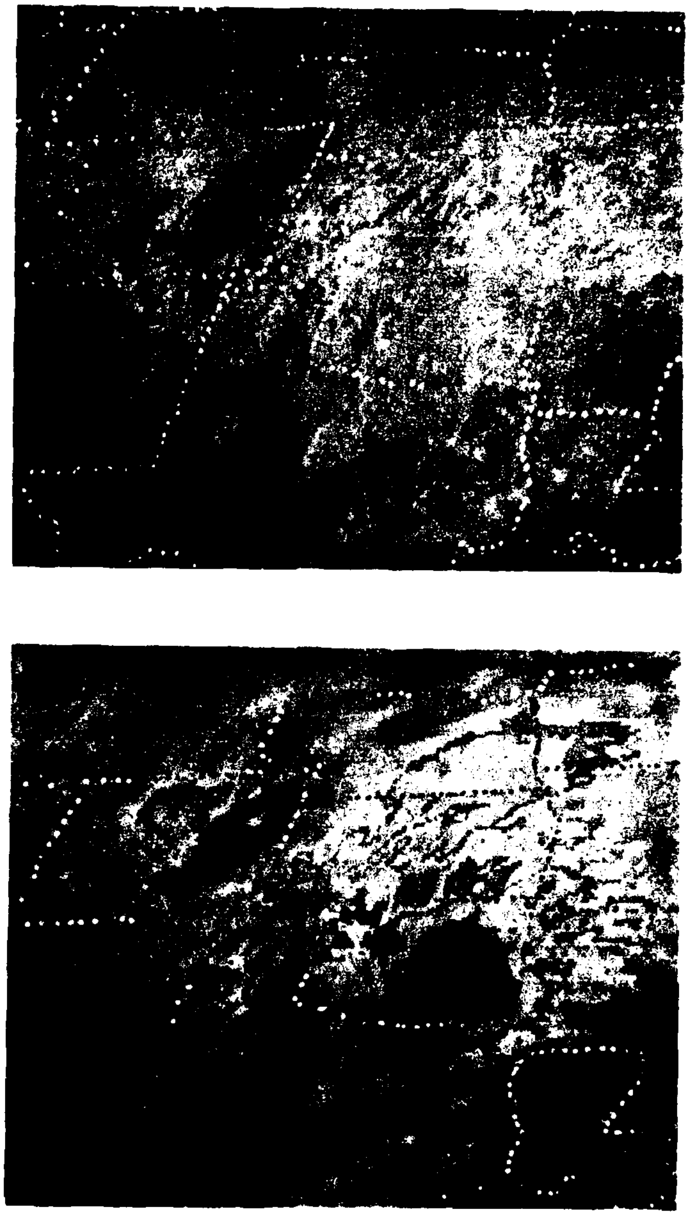


Figure 3. GOES East Satellite Photographs for 23 March. (a) visible at 2300Z, (b) infrared at 2230Z

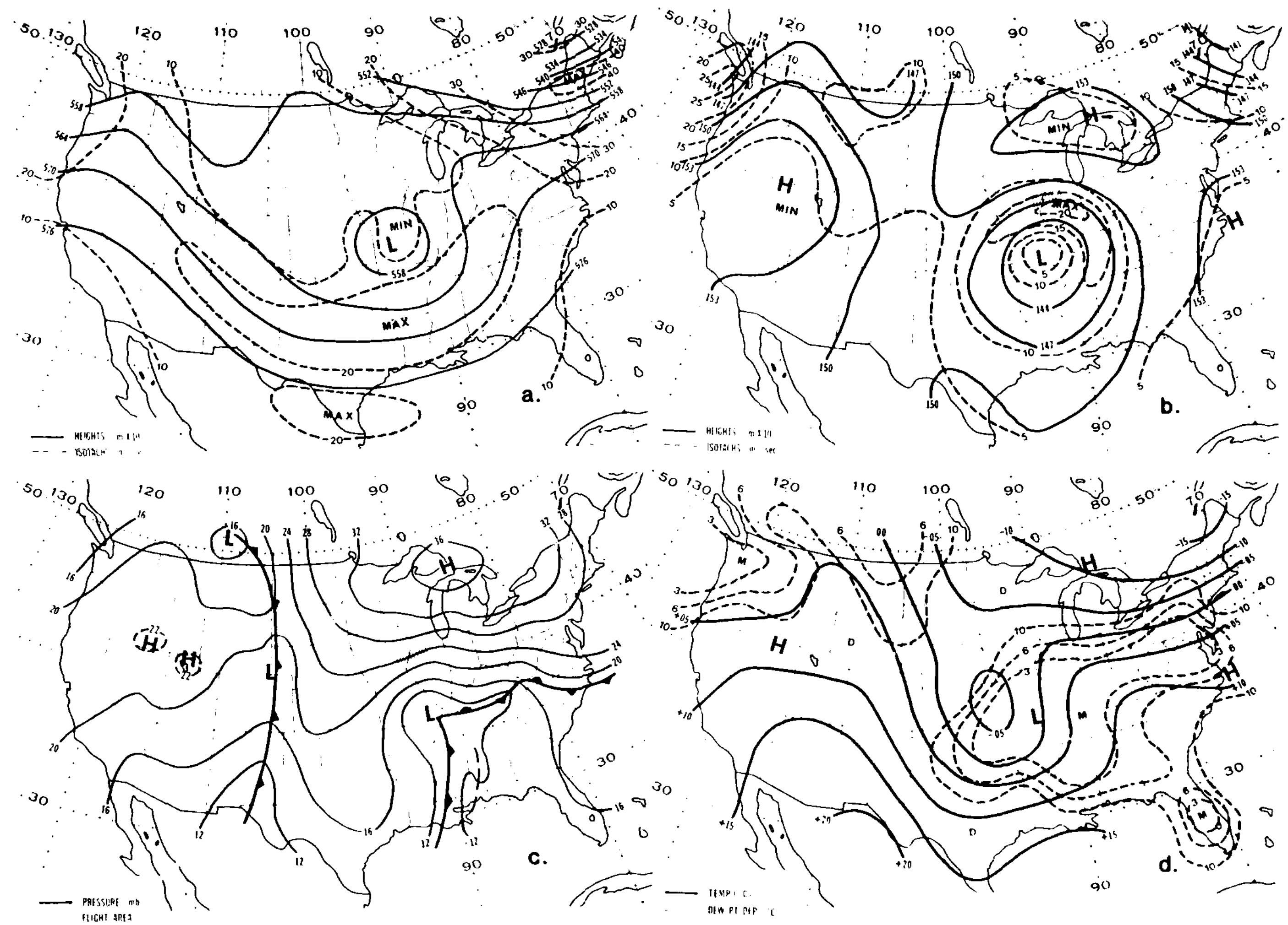


Figure 4. Synoptic Maps for 25 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.

b.

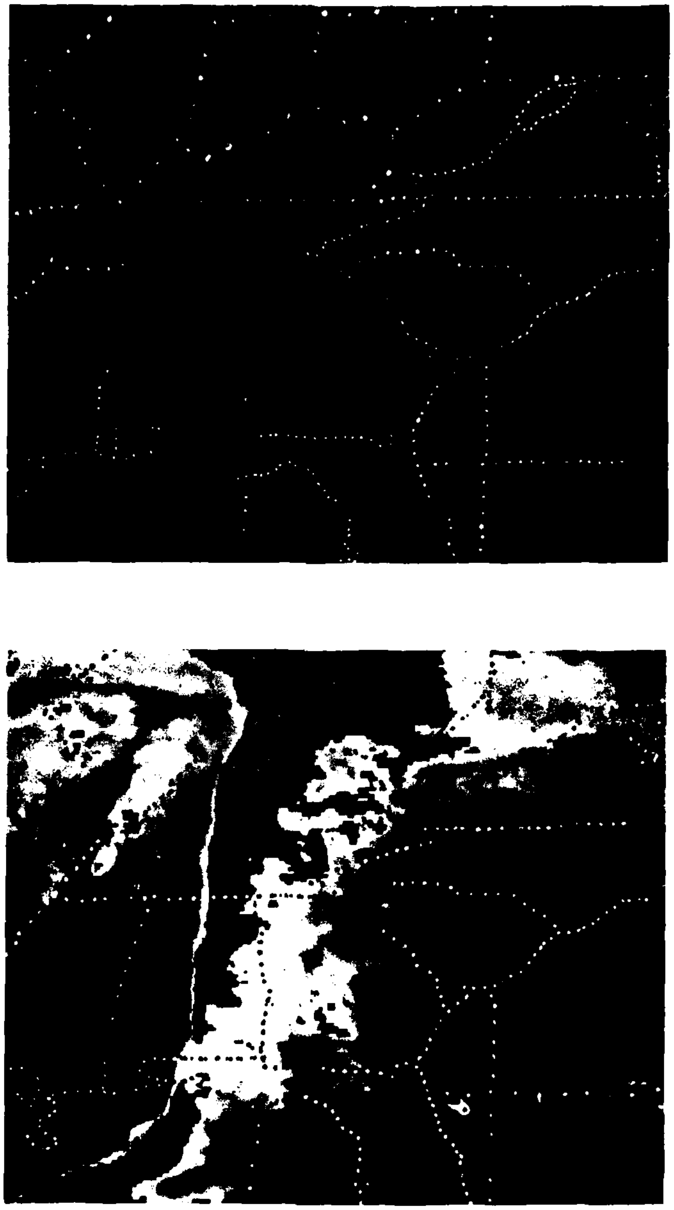


Figure 5. GOES East Satellite Photographs for 24 March, (a) visible at 2230Z, (b) infrared at 2200Z

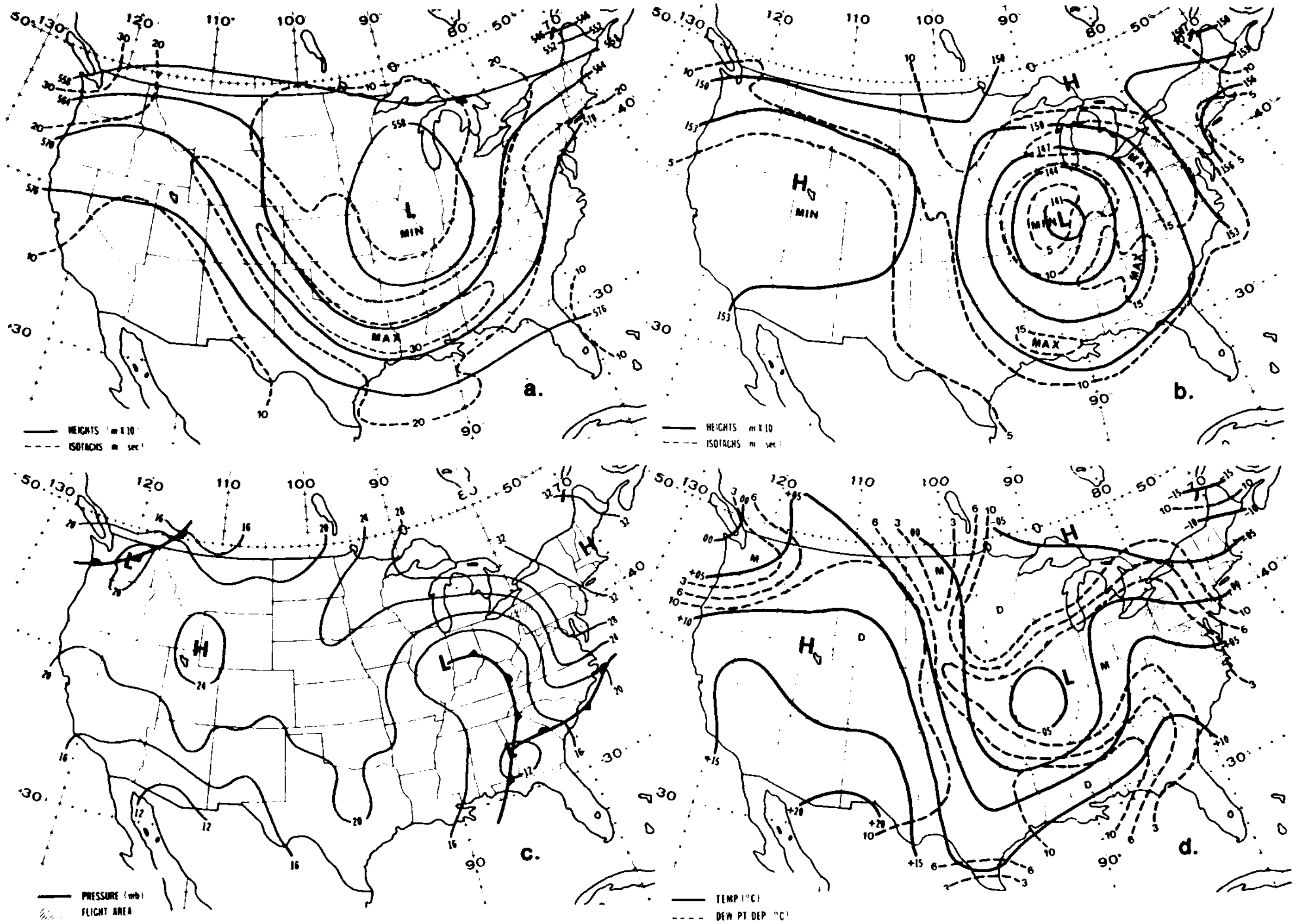


Figure 6. Synoptic Maps for 26 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.

b.

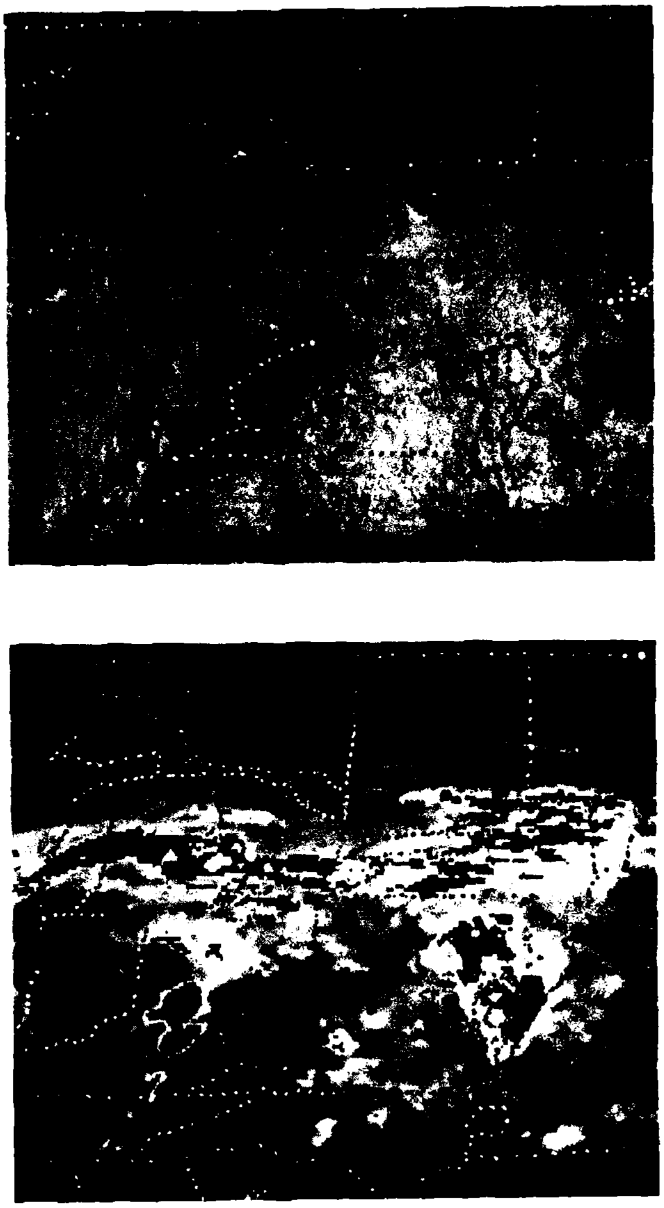


Figure 7. GOES East Satellite Photographs for 25 March. (a) visible at 2030Z, (b) infrared at 2000Z.

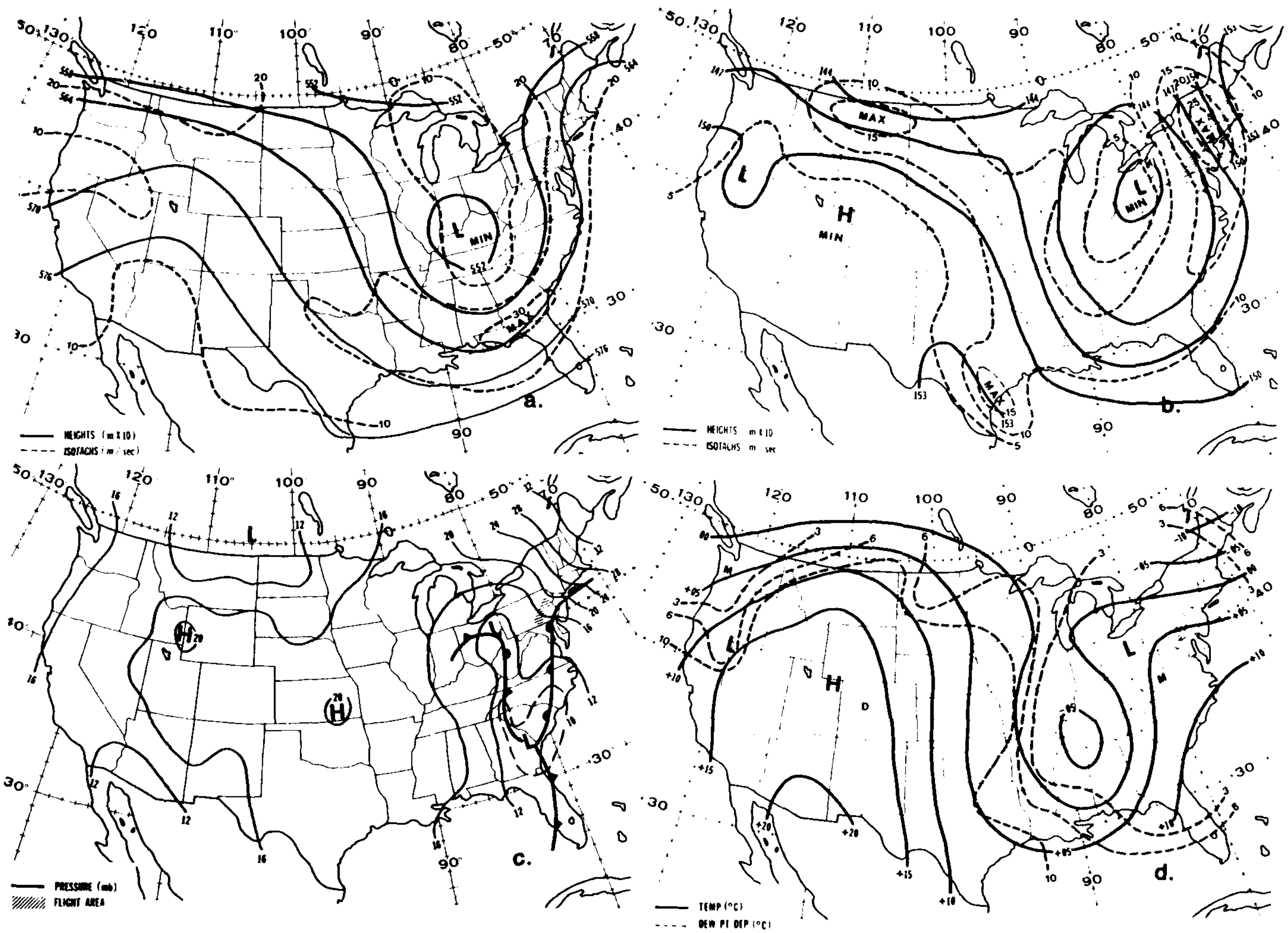


Figure 8. Synoptic Maps for 27 March 1978 at 0000Z. Charts show: (a) 500-mb heights and isotachs, (b) 850-mb heights and isotachs, (c) surface fronts and pressure patterns, (d) 850-mb temperature and moisture

a.

b.

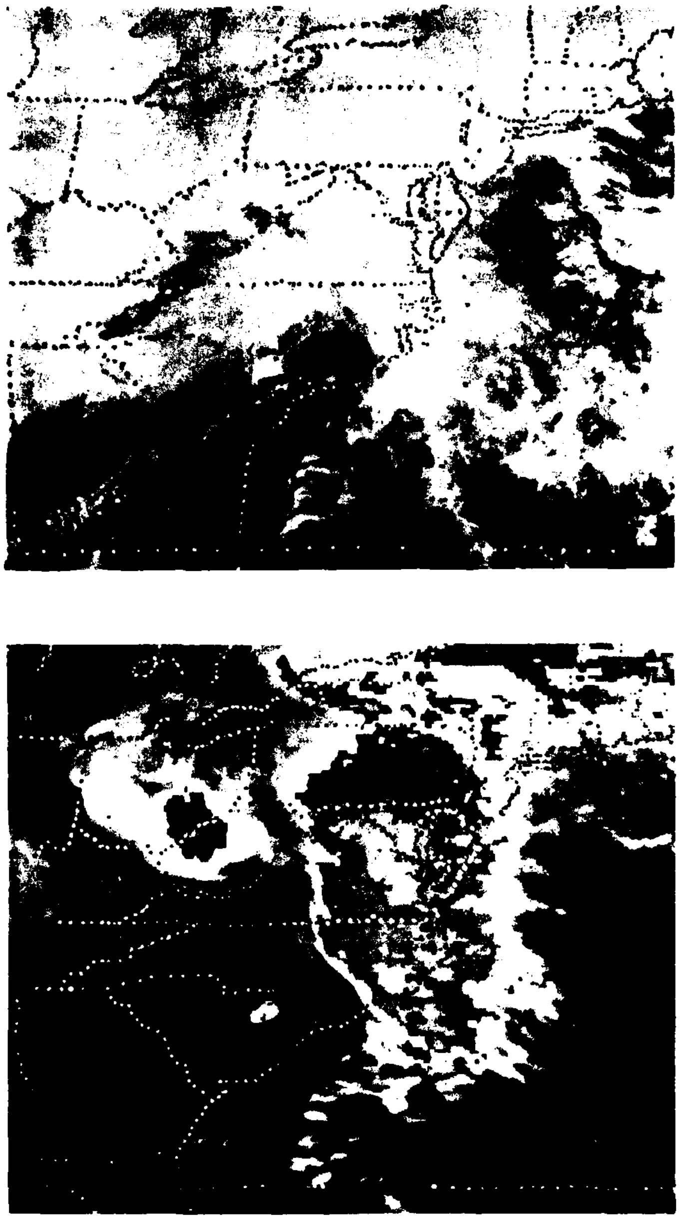


Figure 9. GOES East Satellite Photographs for 26 March. (a) visible at 1930Z, (b) infrared at 1900Z

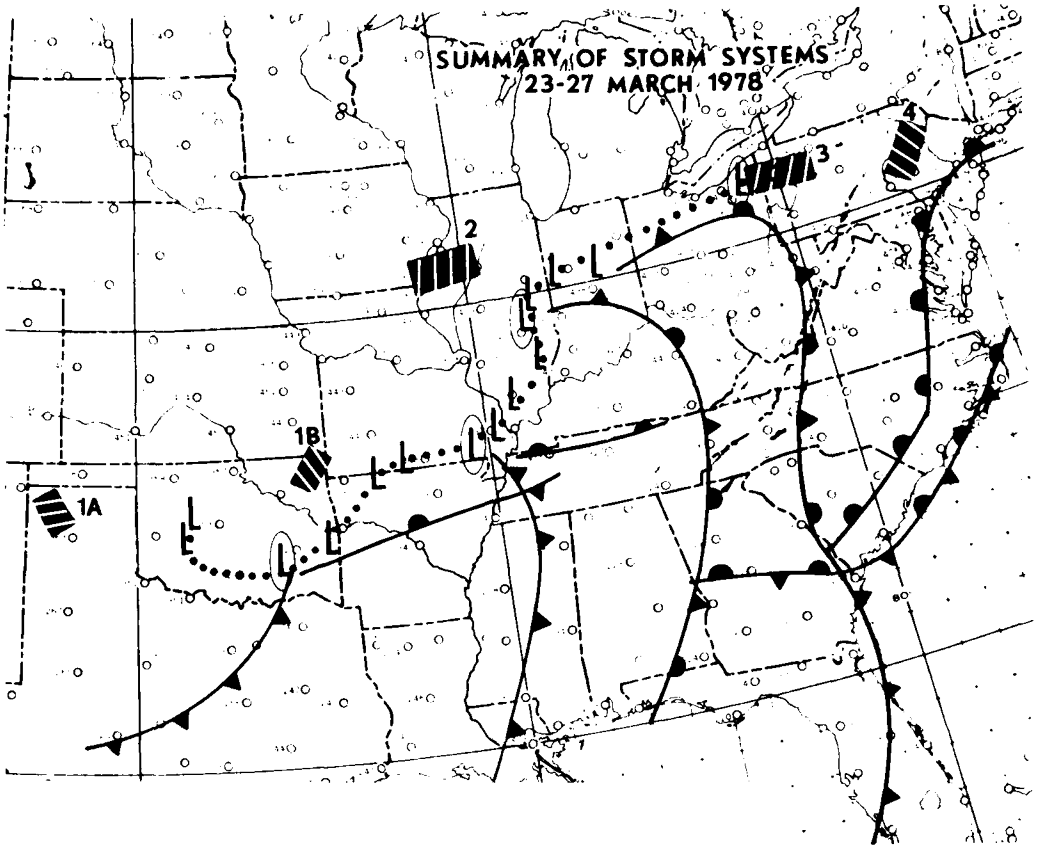


Figure 10. Track of the Main Low Pressure Area and Frontal Systems From 23 to 27 March. Frontal positions are those at 00Z on 24, 25, 26, and 27 March. The full extent of the fronts can be found on Figures 2, 4, 6, and 8. The position of the low center is shown for 6-hr intervals beginning at 12Z on 23 March. Positions of the low center which correspond to those of the frontal systems are circled. The dotted line show the track of the low. Shaded areas indicate the sampling locations

3. THE FLIGHTS

On each of the four days, the MC-130E departed during the morning. It flew to a predetermined area north of the storm system and obtained data first at approximately 23,000 ft (7.0 km-the 400-mb surface) than at 18,000 ft (5.5 km), 10,000 ft (3.0 km), and 4,700 ft (1.5 km); the 500-, 700-, and 850-mb surfaces. Figure 10 shows these areas and the track of the main low center. On 23 March, passes at the first three levels were flown in north Texas (in the northwestern sector of the storm) before the complete pattern was flown in northeastern Oklahoma (in the northeastern sector of the storm). The aircraft landed late in the afternoon of each day thus providing data during the period of maximum solar heating. Thus the four flights provide us with a profile of the storm from its development through its dissipation. A flight was planned for 27 March but by that time the storm had dissipated to such an extent that a flight would not have provided a significant increase in data. Table 1 provides information on the time and location of each flight.

3.1 Flight 78-10

On 23 March, the storm system consisted of a small low center in Oklahoma. The MC-130E departed from Kirtland AFB, Albuquerque, New Mexico. It first flew passes at 400, 500, and 700 mb in northern Texas. These passes were flown northwest of the center of the storm, since evidence from McIDAS showed extensive and deep cloudiness in this quadrant of the storm and the opportunity to sample two quadrants of the storm on the same day. In the northwest quadrant, the activity was mostly of a convective nature and as a result liquid water content varied drastically within each of the three passes. 2-D data showed an unusually high number of large particles, especially at 500 millibars. After completing these passes, the aircraft flew (at 23,000 ft/7.0 km) to northeastern Oklahoma, where four passes were flown, one each at 400, 500, 700, and 850 millibars. This area was in the northeast quadrant of the developing storm.

During the trip from northwest Texas to northeastern Oklahoma, the aircraft passed through some clouds but remained above most of the activity. Upon arriving at the sampling area, however, the aircraft was in uniformly gray clouds from 23,000 ft to 5000 ft (7.0 to 1.5 km). As a result, the liquid water recorded was generally high at all levels. After completing these passes, the airplane landed at Little Rock AFB, Arkansas.

3.2 Flight 78-11

By 1800Z on 24 March, with the low pressure center in northern Arkansas and a deepening open wave, the MC-130E departed from Little Rock AFB at 1746Z and proceeded to an area in eastern Iowa and northern Illinois about 200 nm north of the center. The strong low pressure areas at the surface and 850-mb levels drew considerable moisture into the system. The result was extensive cloudiness. Enroute to the sampling area, the aircraft, flying at 23,000 ft (7.0 km), was above a solid undercast which frequently reached the aircraft's altitude. Four passes were completed, one each at 400, 500, 700, and 850 millibars. Except for a few brief breaks, the aircraft was in cloudiness throughout this period. Liquid water content values were very high. The Mission Director frequently reported large, wet snowflakes. At 700 and 850 mb rain was often mixed with the snow. Conglomorate snowflakes as large as 5000 μ were observed at these levels. *During this period,* heavy snow forecasts were issued for much of Illinois and Indiana. The MC-130E flew from its sampling area to Wright-Patterson AFB, Ohio. Enroute, it was above a continuous overcast. It landed at Wright-Patterson AFB at 2340Z.

3.3 Flight 78-12

On 25 March, the low pressure center had moved to southern Illinois with an occluded front extending to eastern Tennessee. The MC-130E flew to an area in eastern Ohio and western Pennsylvania, about 350 nm northeast of the low. By this time, extensive low stratiform cloudiness covered all of the northeast except eastern New England. The MC-130E left Wright Patterson AFB, Ohio at 1705Z. It crossed central Ohio at 23,000 ft (7.0 km). At this altitude, it was between an altostratus layer (with tops estimated at 14,000 ft/4.3 km) and a cirrus layer (with bases estimated at 30,000 ft/9.1 km). The liquid water content observed at 400 and 500 mb was generally less than that observed during the previous day, indicating that while the system had become more widespread, it was not as intense. There was more moisture at 700 and 850 mb than there was on 24 March but not as much as had been observed on 23 March. The temperature in the lower 10,000 ft (3.0 km) changed little with altitude. Since the lower 3 km were generally near 0°C, the aircraft experienced considerable icing both at 700 mb and 850 mb. Most of the precipitation observed at these levels was either rain or snow mixed with rain. In general, precipitation intensity was much less than had been observed on earlier flights. The aircraft returned to Wright-Patterson AFB, and encountered the same type of enroute weather as it had while flying to the sampling area. The airplane landed at Wright-Patterson AFB at 2102Z.

3.4 Flight 78-13

On 26 March, secondary cyclogenesis pushed the warm air northward along the coast. The MC-130E left Wright-Patterson AFB at 1444Z and flew above the occlusion (which now ran from a low in Indiana through Ohio and south to a secondary low in Georgia; see Figures 6 and 8) to eastern Pennsylvania where the warm front from the secondary low was moving westward due to the circulation around the complex low system. The result was a uniform mass of stratiform clouds. Liquid water content was high throughout all of the sampling passes. During both the flight to the sampling area and the return, the airplane was at 23,000 ft (7.0 km). This put it above the lower clouds and most of the middle clouds. Cirrus clouds were above the airplane, however, during most of the deployment and return, the aircraft was not in visible clouds. The majority of the cloudiness was at 15,000 ft (4.6 km) and below. There was little vertical development—but stratus and stratocumulus clouds covered all of the eastern United States north of Florida. Bases of the clouds in the sampling area were generally above the 850-mb level, although lower stratus clouds were observed while the aircraft was at the 850-mb level. The MC-130E returned to Wright-Patterson AFB and landed there at 1923Z. The storm system weakened after 0000Z on 27 March and no further flights were made.

4. VISUAL OBSERVATIONS OF THE CLOUDS

In addition to providing microphysical observations of this storm system, the inflight meteorologist (Mission Director) provided a visual account of the changes in the cloud structure as the storm progressed. The photographs used to illustrate this section of the report were taken by the Mission Director during the sampling flight.

4.1 Upper Levels

Figures 11, 12, 13, and 14 illustrate the changes in cloud appearance at 23,000 ft (7.0 km). All pictures were taken at that altitude, either while enroute to the storm area or during the first data pass in the area. As Figure 11 shows, there was considerable convective activity on 23 March. By 24 March (Figure 12) the number of convective cells was no longer as great, but the undercast had a wavelike appearance which strongly suggested convective cells completely embedded in the clouds below. During the next two days, the clouds became more uniform and convective activity became weaker and less organized. As Figure 13 shows, the structure had weakened, and by 26 March (Figure 14) there was little structure remaining. The amount of cloud at 23,000 ft (7.0 km), however, had increased but instead of the wavelike clouds shown in Figure 12 they were uniform gray in appearance.

Figure 11. Clouds From 23,000 ft (7.1 km) on 23 March 1978. Distinct convective activity can be seen in the center of the picture

Figure 12. Clouds From 23,000 ft (7.1 km) on 24 March 1978. While some convective activity was present, there were no distinct cells

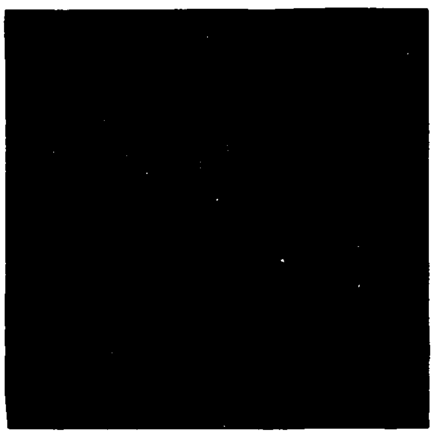


Figure 13. Clouds From 23,000 ft (7.1 km) on 25 March 1978. The system was occluded and stratified clouds prevailed

Figure 14. Clouds From 23,000 ft (7.1 km) on 26 March 1978. Almost no convective activity was found in this part of the system

4.2 Lower Levels

Figures 15, 16, 17, and 18 show how the cloud structure at lower levels appeared. Figure 15 was taken at 10,000 ft during the third data pass on 23 March. At this time, the aircraft was flying through small snow crystals which had fallen from the cloud deck above. No pictures were taken at 5000 ft (1.5 km) since the aircraft was continuously in clouds. On 24 March, the aircraft was continuously in clouds while sampling at 10,000 and 5000 ft (3.0 and 1.5 km). As Figure 16 shows, there was considerable rime icing at 10,000 ft (3.0 km). The outside air temperature was near 0°C and precipitation frequently changed from snow to rain. The same conditions were reported during the aircraft's 5000-ft (1.5 km) sampling pass. On 25 March, conditions at 10,000 ft (3.0 km) were similar, but at 5000 ft (1.5 km), there was much less cloudiness. As Figure 17 shows, the ground was visible from 5000 ft (1.5 km). On 26 March, there was an increase in cloudiness and precipitation at 5000 ft (1.5 km), but as Figure 18 shows, the ground was still visible through breaks in the clouds. The system had more moisture, but most of the additional moisture was reflected in the increase of upper and middle level clouds.,

5. DATA PROFILES FOR EACH FLIGHT

5.1 23 March 1978

Figure 19 shows the altitude, temperature, liquid water content (LWC), medium volume diameter (DO), reflectivity (Z), number density (NT), and Form Factor (FF) as functions of time for the flight of 23 March 1978. The Form Factor is a method of characterizing distributions. It is more fully described by Varley[5] and in Section 6.3 of this report. The heavy solid lines in Figure 19 indicate data passes. During the first three passes, with the airplane in a convective area, all of these quantities fluctuated quite rapidly. During the later passes taken in the northeast quadrant of the storm, LWC, DO, and Z all increased in magnitude; all reaching unusually high levels. The number density, however, tended to decrease as the aircraft descended. This we attribute to aggregation as the particles combined to form larger particles. The contrast in the Form Factor was most dramatic. During the first series of passes, it fluctuated rapidly from 0 to 1 while during the later passes it was more consistent; generally showing values of 0.20 to 0.30. Further discussion of the variations in the Form Factor and liquid water content will be found in Section 6 of this report.

Figure 15. Clouds From 10,000 ft (3.0 km) on 23 March 1978. Low level clouds presented a uniform gray appearance

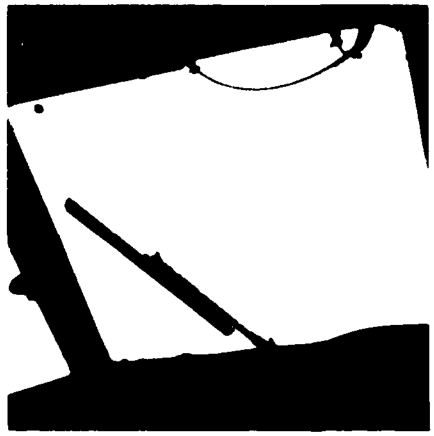


Figure 16. Clouds From 10,000 ft (3.0 km) on 24 March 1978. No structure was visible at this level. Note the icing on the wiper

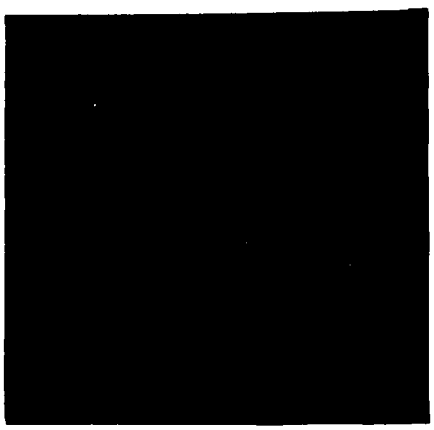


Figure 17. Clouds From 5000 ft (1.5 km) on 25 March 1978. The ground can be seen through low clouds

Figure 18. Clouds From 5000 ft (1.5 km) on 26 March 1978. During most of this pass the airplane was in rain. The ground could usually be seen below the fractocumulus layer

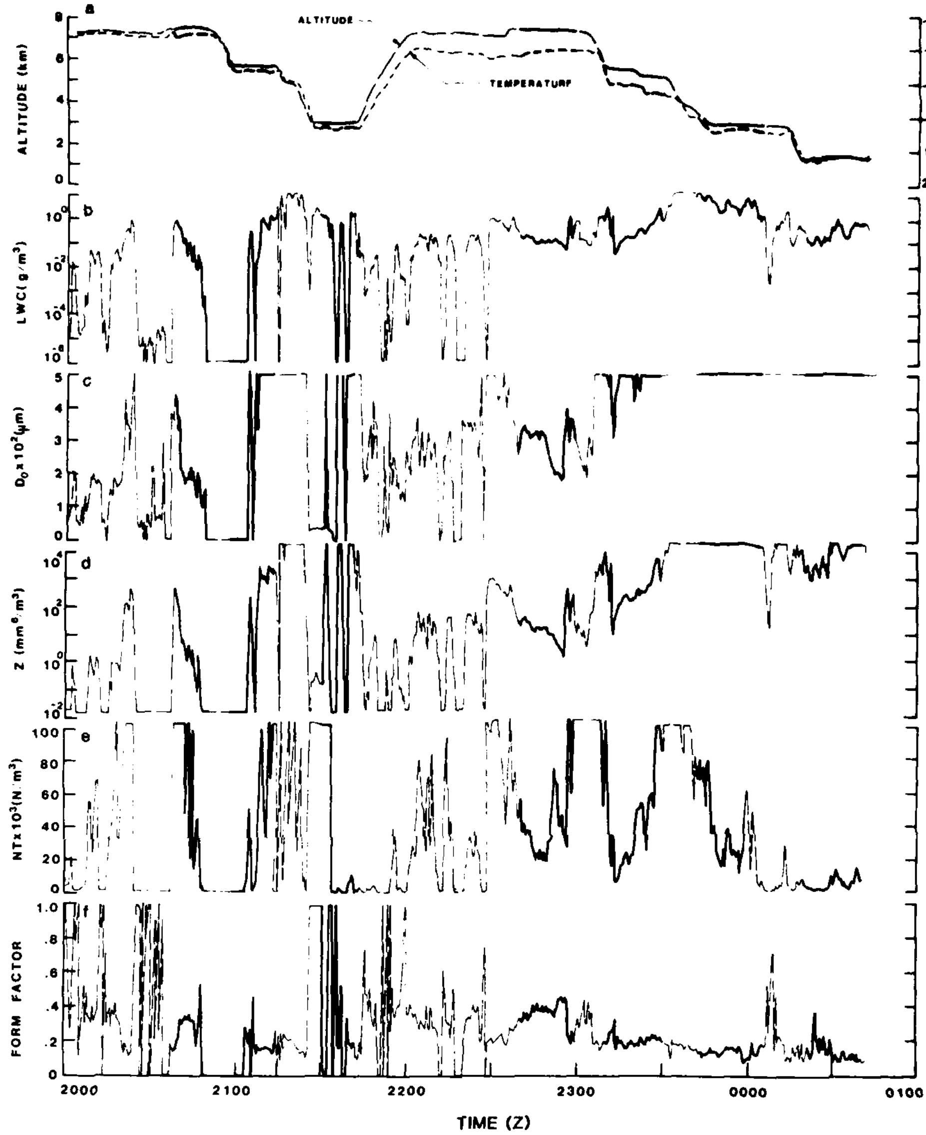


Figure 19. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 23 March. Solid lines show when the aircraft was in a data pass

5.2 24 March 1978

Figure 20 shows the altitude, temperature, LWC, DO, Z, NT, and FF vs time for the 24 March flight. LWC values of 10^{-2} to 10^{-1} g/m^{-3} predominated. The reflectivity, however, did show a sharp increase in the lower levels. The high LWC values were reflected in high DO values but low NT values, thus a comparatively small number of larger particles were producing the high LWC values. The Form Factor showed a decrease at the lower altitudes. There was a decrease in the variation of FF with time during the passes at lower altitudes but it was not as pronounced as it was during the flight of 23 March.

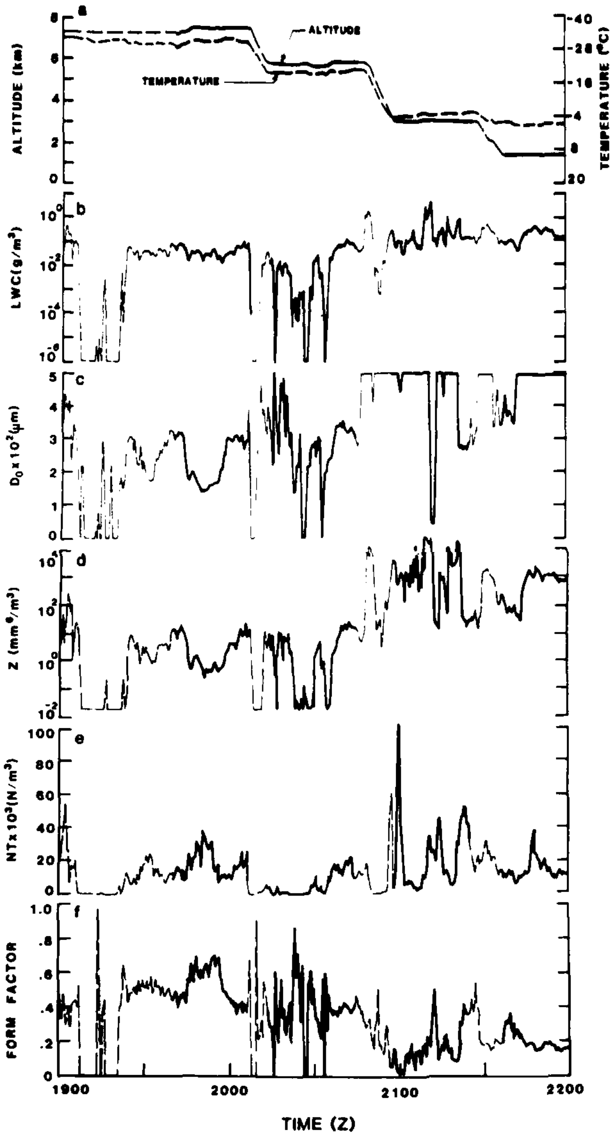


Figure 20. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 24 March. Solid lines show when the aircraft was in a data pass

5.3 25 March 1978

Figure 21 shows the same variables as Figures 19 and 20 for the flight of 25 March. The storm was weaker at this time, and in general the LWC was lower. Both Z and NT values were smaller, especially at the higher levels. As was mentioned in Section 4, the amount of cloudiness was smaller and the system was less well organized on 25 March. The medium volume diameter (DO) remained high, especially at lower levels, while the particle density was generally lower. Thus the decrease in LWC was more closely related to the smaller number of particles than to their smaller size. This was reflected in the lighter intensity of the precipitation reported by surface weather stations, as noted in Section 3. The Form Factor was more erratic, being generally higher at 400, 500, and 850 mb and lower at 700 millibars. The low Form Factor may have been the result of a frontal inversion at that level. The higher Form Factors at the higher levels may have indicated that there was less upward vertical motion that kept larger particles and the moisture needed to allow smaller particles to grow at lower levels. The 850-mb pass was in the melting layer, and as a result, a larger variety of particle sizes pushed up the Form Factor.

5.4 26 March 1978

Figure 22 shows these variables for the 26 March flight. The influx of warm air was reflected both by the warmer temperatures at 850 mb and the increase in LWC as compared to the data obtained on the previous day. The increase in LWC was a result of particle size as opposed to the number of particles. The values of DO were high throughout the flight. The high LWC, especially at lower levels, led to high values of reflectivity. The influx of warm moist air caused by the secondary low, which had formed in Georgia, led to an increase of large snowflakes and raindrops. The low values of the Form Factor at lower levels indicate a large variety of sizes, resulting partially from the influx of warm, moist air, and partially from aggregation. The amount of cloudiness increased and the intensity of the precipitation produced by the storm also increased. This occurred despite the fact that the main low itself was weakening.

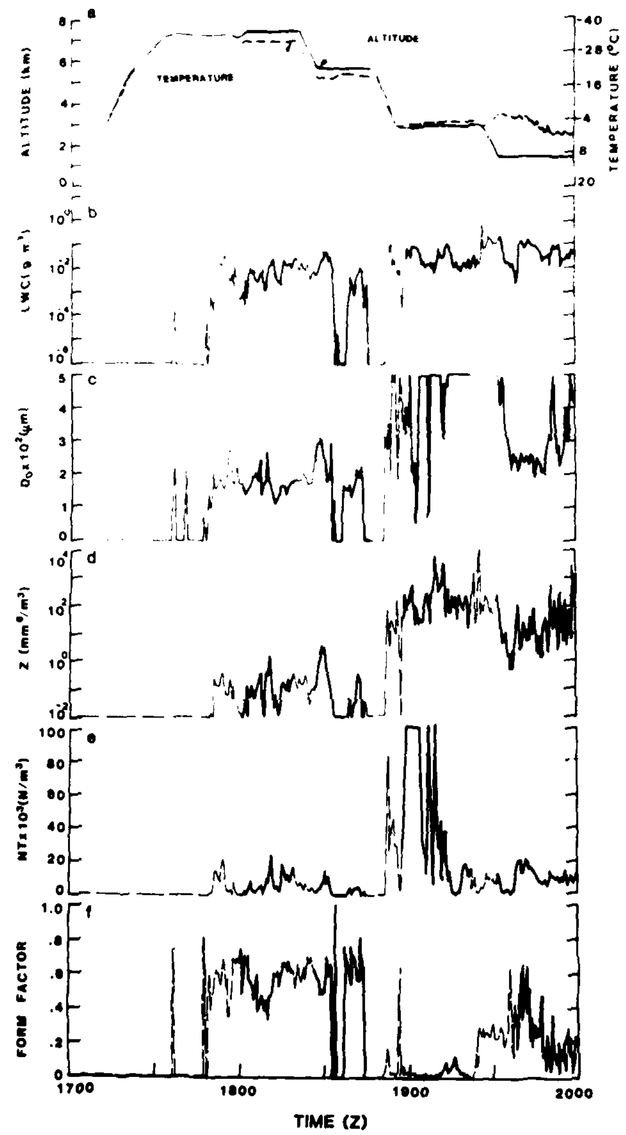


Figure 21. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 25 March. Solid lines show when the aircraft was in a data pass

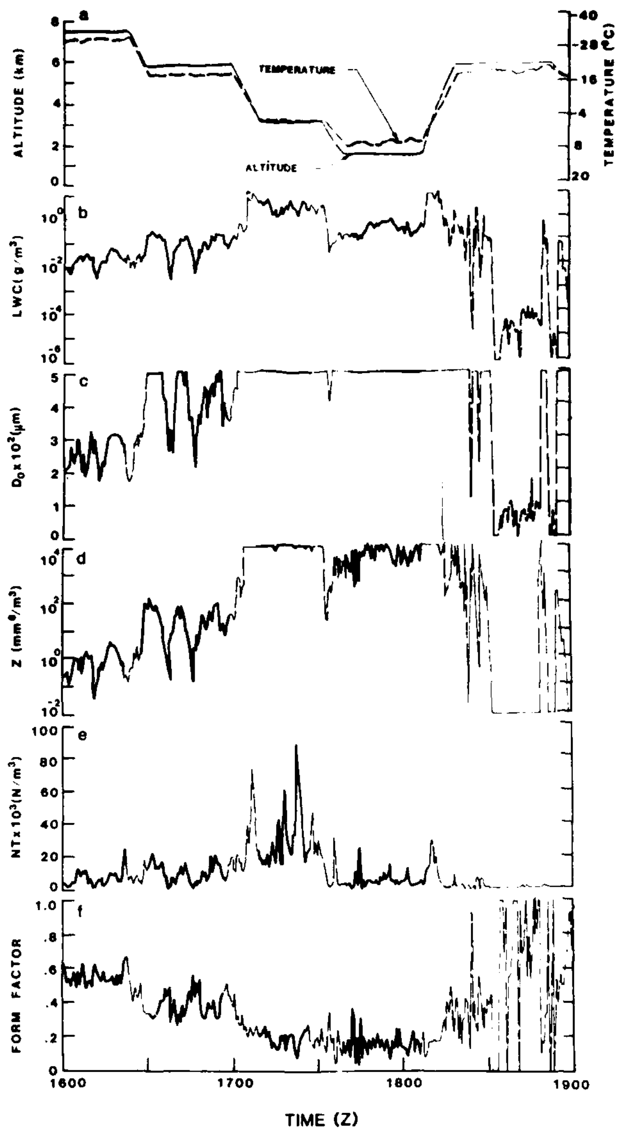


Figure 22. Profiles of (a) Altitude and Temperature, (b) Liquid Water Content, (c) Medium Volume Diameter, (d) Reflectivity, (e) Density, and (f) Form Factor With Time for the Flight of 26 March. Solid lines show when the aircraft was in a data pass

6. DISCUSSION OF DATA

The previous section looked at the measurements obtained by each flight as a separate though related unit. This Section will concern itself with an examination of how various data changed at each of the four levels investigated.

6.1 Crystal Types Encountered

The Mission Director made in-flight observations of the predominating crystal habit. His comments are included in the transcripts in Appendix A. These observations provided input to the real-time 1-D data reduction programs, which provide LWC and Z values, and for post flight backup in case of the loss of 2-D data. The snow stick, the 2-D display, and visual observations of hydrometeors passing by and hitting the aircraft helped him determine the crystal habit.
The PMS 2-D system was operational on all data passes. Table 2 shows the predominant crystal types recorded by the 2-D system. At the 400-mb level, the predominant crystal type was small snow, although at times bullet rosettes were common. At 500 mb, large snow occurred when the system was more active. During less active periods, small snow predominated. At the lower levels, rain, needles, wet snow, and large snow occurred, as the temperature was generally near freezing.

The crystal types, as indicated in Table 2, were used to prepare 1-D PMS data for this report.

Table 2. Particle Types Encountered During Different Passes on the Flights of 23 to 27 March 1978

Altitude	23 March (Texas)	23 March (Oklahoma)	24 March (Iowa, Illinois)	25 March (Ohio Pennsylvania)	26 March (Pennsylvania)
23,000 ft	Small Snow Bullet Rosettes	Small Snow	Small Snow	Small Snow	Small Snow
18,000 ft	Large Snow	Large Snow	Large Snow Small Snow	Small Snow Bullet Rosettes	Large Snow Small Snow
10,000 ft	Wet Snow	Wet Snow Rain	Rain, Wet Snow Needles Large Snow	Rain	Wet Snow
5,000 ft		Rain	Large Snow Needles	Large Snow	Rain

Figure 23 shows some typical 2-D shadowgraphs observed during each of the nineteen data passes taken during these missions. In most cases data from both the cloud probe and precip probe are included. Data from the precip probe are indicated by the letter "P". The height of the vertical lines on these samples represents a distance of 6400 μm. Data from the cloud probe are indicated by the letter "C". On these samples, the vertical lines represent 800 μm. The samples have been assembled to show the changes with height and time of the crystals and droplets contained in the clouds.

Precipitation probe data from Pass I on 25 March are excluded due to the lack of larger crystals during this pass. During Pass III on that same day, water lodged in the precip probe obscured most of the precip probe data. Therefore precip probe data from Passes I and III are excluded.

Additional 2-D shadowgraphs are presented later in this report.

The snow stick can provide detailed observations of snow and ice crystals. A 1-cm square area marked on a black background with millimeter graduations is mounted on an aluminum rod. This rod is passed through a hole in the aircraft skin so that the exposed surface is parallel to the airflow. The Mission Director observes the particles from the flight deck window at a distance of about 3 feet. Since there are four graduated surfaces, a fresh surface may be obtained by rotating the snow stick.

Postflight crystal habit determinations using 2-D data were used for the flights since they provide a continuous objective source. Snow stick observations augmented the 2-D data. Other Mission Director comments and data from the Johnson-Williams instrument were used to help detect supercooled water and the presence of rain in snow.

6.2 Particle Size Distributions

Marshall and Palmer[7] observe that raindrop size distributions approximate an exponential curve. Most observations of snowflake sizes also approximate an exponential curve. The distributions observed at various altitudes for the four flights being considered are presented in Figure 24. Houze et al[8] have considered departures from this exponential curve and describe an enhanced distribution as having an increase of smaller particles (30 to 500 μm) above an exponential curve, while a suppressed distribution has a decrease below the curve. Houze's study disregarded

7. Marshall, J.S., and Palmer, W. Mck (1948) The distribution of raindrops with size, J. Meteor. 5:165-166.

8. Houze, R.A., Hobbs, P.V., Herzegh, P.H., and Parsons, D.B. (1978) Airborne measurements of the size distributions of precipitation particles in frontal clouds, Preprints of Conf. on Cld. Physics and Atmos. Elect., American Meteorological Society, Issaquch, WA, pp 168-172.

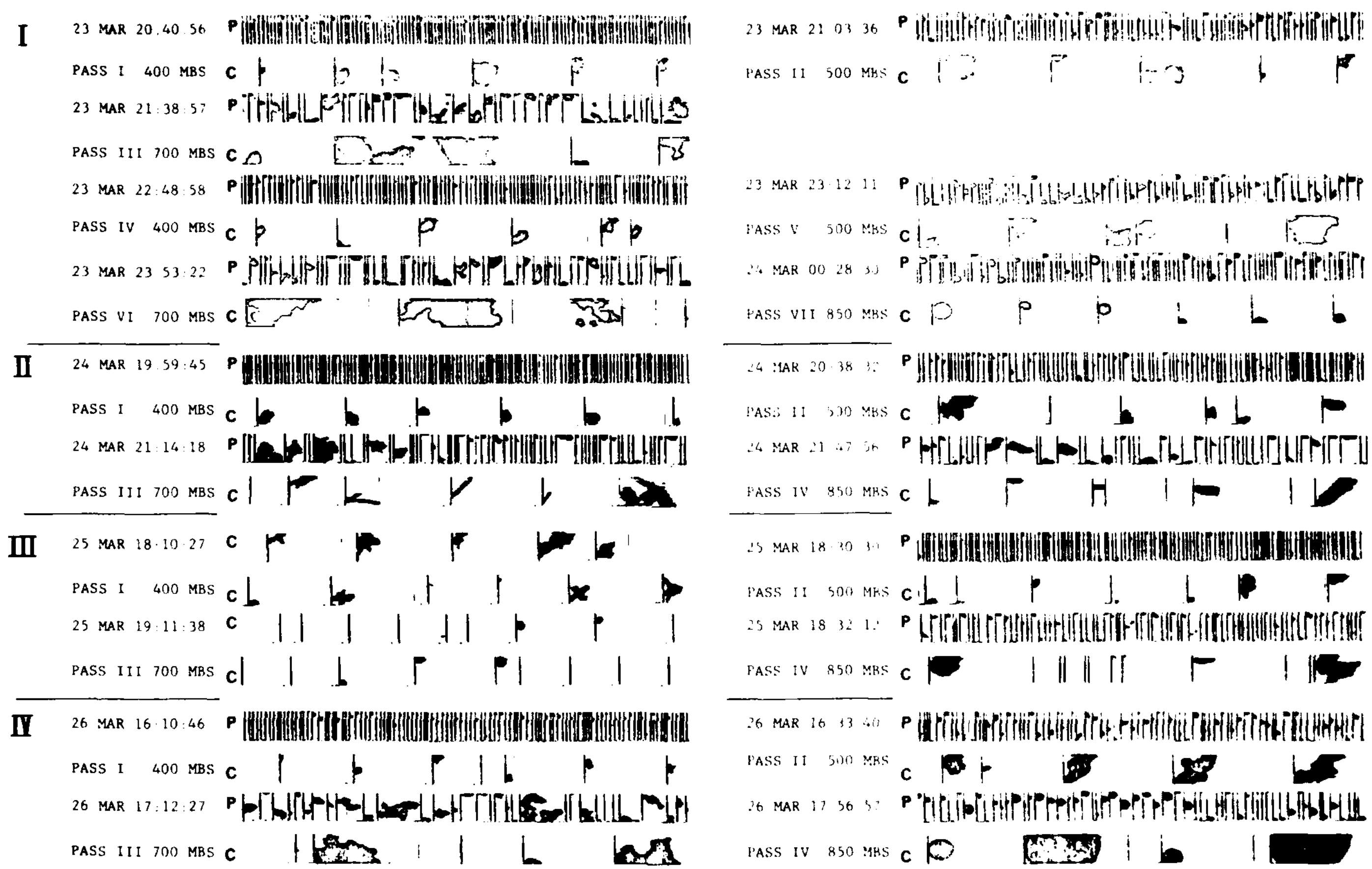


Figure 23. Typical 2-D Shadowgraph. Data from the Knollenberg 2-D system are presented for each pass. A letter "C" indicates a line of cloud probe data. Thus, the height of each line is 800 μm. A letter "P" indicates precip probe data, with the height of each line representing 6400 μm

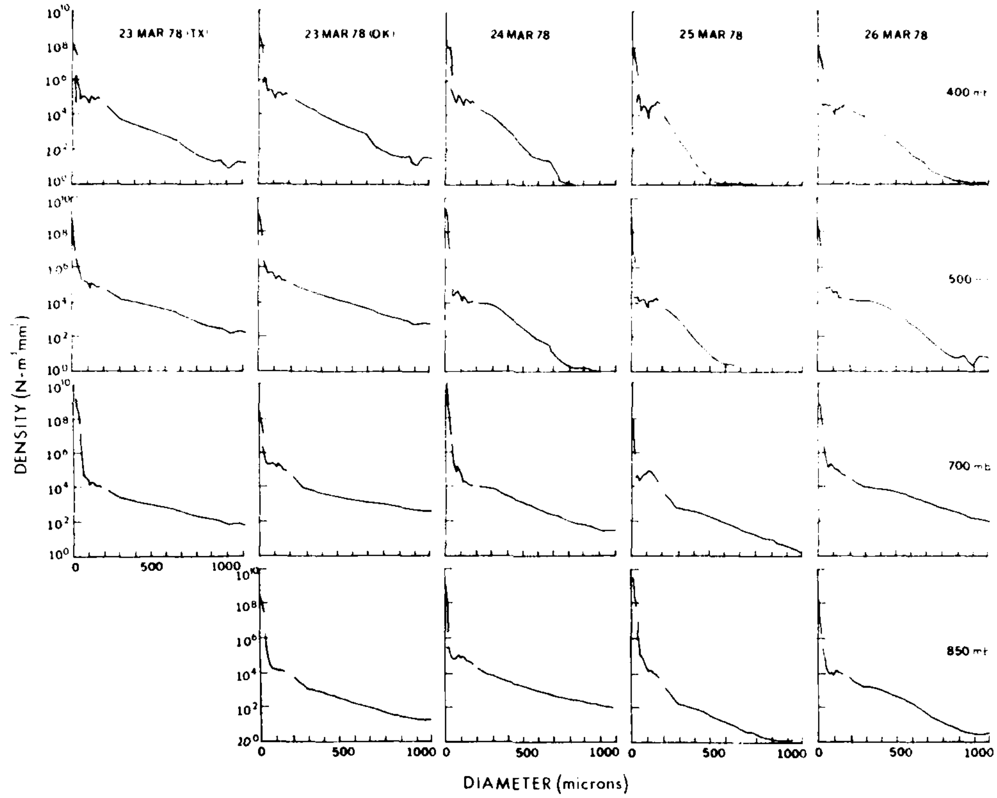


Figure 24. Distributions of Particle Density vs Particle Size (equivalent melted diameter) for Each Pass During the Sampling Flights

data from the ASSP (below 30 μm), probably because the ASSP tends to count all particles and thus overestimates the number of small particles whenever a large number of particles above 30 μm are present. Figure 24 shows the particle density vs diameter for each data pass observed during the four days. To insure uniformity, equivalent melted diameter was used as a measure of particle size. Although ASSP data are included in Figure 24, they should not be used when making comparisons to Houze's work. As Figure 24 shows, the storm had suppressed distributions at the higher levels, but had enhanced distributions at lower levels. Since Figure 24 used melted diameter rather than the measured diameter for particle size, departures from the exponential curve are most evident at a size range of 15 to 300 μm. Furthermore, the type of distribution varied more with altitude than it did with time. At lower levels, the enhanced distributions probably were the result of an increase in the number of large particles. The number of particles in the 15 to 300 μm range showed little change. As Table 2 showed, rain and wet snow predominate there. The larger number of large particles gave the exponential curve a smaller slope. Thus, the same density of smaller particles that appeared as an enhanced distribution at low levels was part of a suppressed distribution at higher levels.

A few words of caution about the use of exponential curves as fits to these size distributions are in order. First, the fit is only for a limited region of the size distribution and has usually been applied to cases of moderate to heavy precipitation rates where the particles are fairly large, that is, in the hundreds of microns range. Second, the upper limit of the useable spectra (about 6 mm for rain and for snow) have been empirically determined by Plank, Berthel and Barnes[9] and Berthel[10] to be inversely related to the slope of the exponential. Third, a peak in the distribution in the 0.1 to 10 μm range is suspected due to the rapid growth of water molecule clusters below this size range. Fourth, in general, the longer the period of sampling and the larger the number of particles sampled, the closer the fit will be to an exponential curve. This is due to the small sampling volumes of the instruments and the separation of sizes by natural processes.

6.3 Form Factor

Plank[11] describes the Form Factor as a method of characterizing various types of particle distributions. The Form Factor is a measure of the uniformity of distribution of different sized particles. A Form Factor of 1.0 (the maximum) indicates that all particles in a given distribution fall in the same size range. This would represent a monodispurse distribution. Generally, the broader the spectrum of particle size, the lower the form factor will be. Figure 25 shows how the Form Factor at 400 mb changed with time. As the storm moved eastward, the cloud was more often a result of overrunning, thus producing a more homogeneous cloud. The top line of Figure 24 shows that the number of larger particles decreased from the 23rd to the 25th as the storm moved north and east. This led to a higher average Form Factor on the 24th and 25th as seen in Figure 25. This Form Factor at 500 mb (Figure 26) tends to be lower.

9. Plank, V.G., Berthel, R.O., and Barnes, A.A. (1980) An improved method for obtaining water content values of ice hydrometeors from aircraft and radar data, J. Appl. Meteorology, 19:1293-1299.

10. Berthel, R.O. (1980) A Method to Predict the Parameters of a Full Spectral Distribution From Instrumentally Truncated Data, ERP No. 689, AFGL-TR-80-0001, AD A085950.

11. Plank, V.G. (1977) Hydrometeor Data and Analytical-Theoretical Investigations Pertaining to the SAMS Rain Erosion Program of the 1972-1973 Season at Wallops Island, Virginia. AFGL/SAMS Report No. 5, ERP No. 603, AFGL-TR-77-0149, AD A051193.

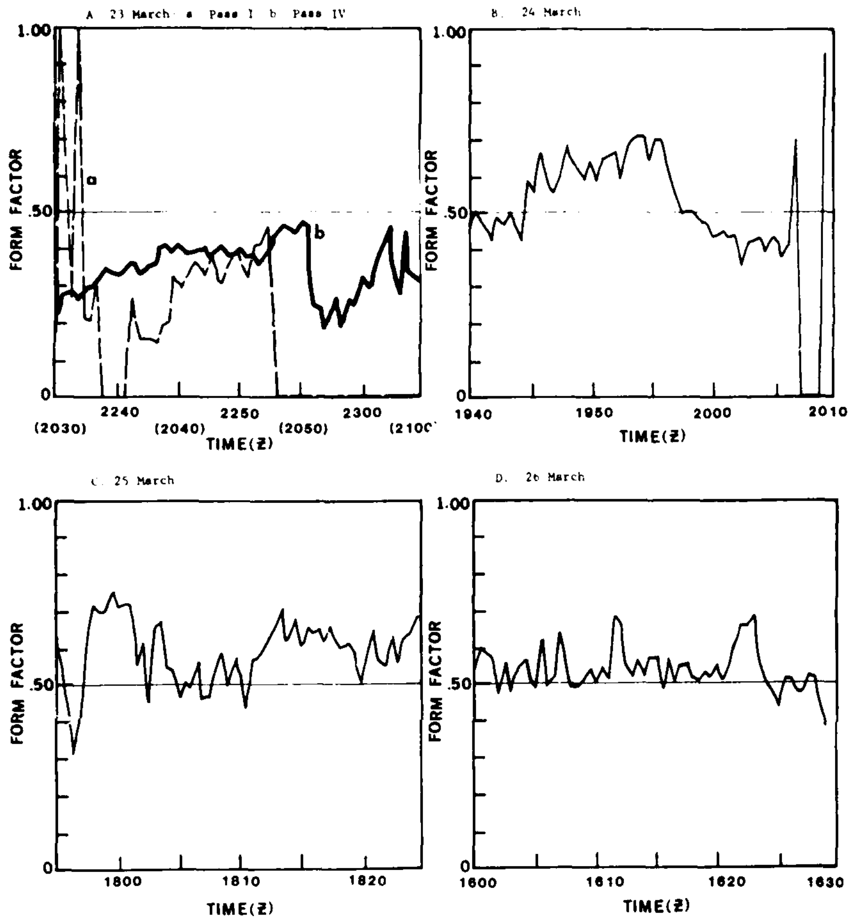


Figure 25. Form Factor at 400 mb for Each of the Four Days. Dotted line shows data from the first pass on 23 March. Times in parenthesis refer to that pass.

The predominance of larger particles (large snow as opposed to the small snow at 400 mb) and a flatter distribution leads to the lower Form Factors. At the lower levels, the Form Factor varies at a more rapid rate. Thus in this case, the particles at 400 mb tended to be more uniform in size than those at lower levels. The 700-mb data (Figure 27) are quite irregular as the changing conditions at that level caused a variety of particle types. This level was frequently near the freezing level. The 850-mb data (Figure 28) shows a high degree of variability. This can be attributed to the presence or lack of clouds and/or precipitation at that level. The difference between the third flight (during which the aircraft was in almost continouns cloud at 850 mb) and the fourth (in which the aircraft was constantly going into and out of clouds and precipitation) is most striking.

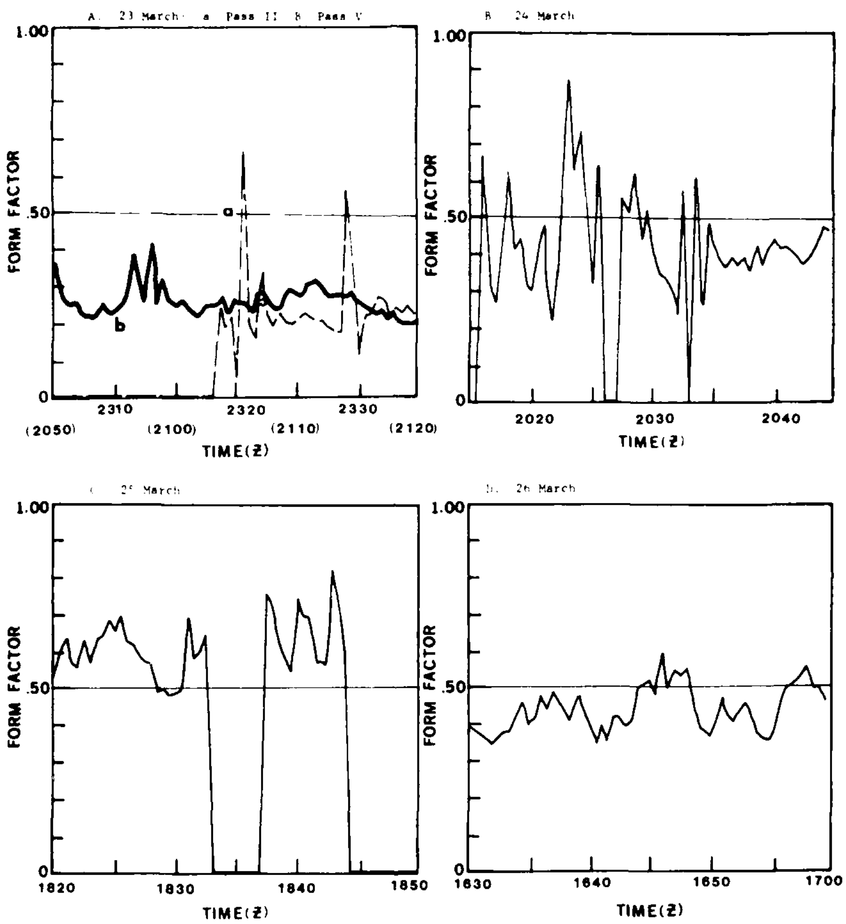


Figure 26. Form Factor at 500 mb for Each of the Four Days. Dotted line shows data from the second pass on 23 March

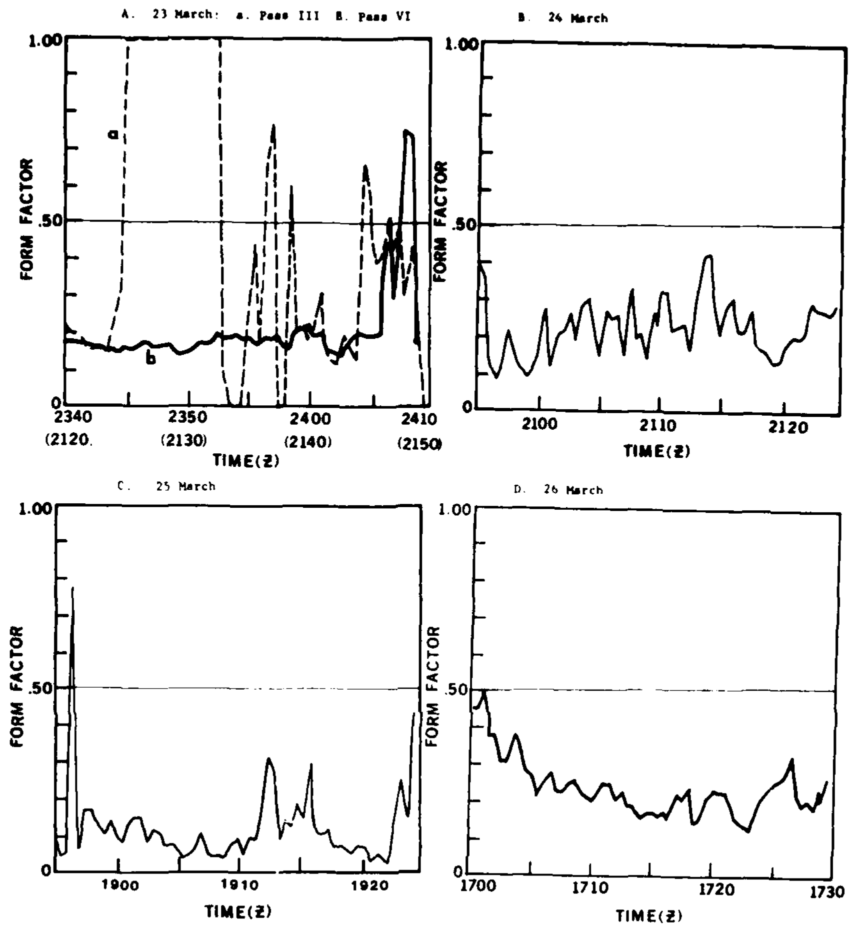


Figure 27. Form Factor at 700 mb for Each of the Four Days. Dotted line shows data from the third pass on 23 March

6.4 Liquid Water Content

As a general rule, liquid water content values (LWC) throughout these four flights were higher than those found in the 1 to 3 March 1978 flights (see Varley[5]). At 400 mb, values of LWC of 10^{-1} g/m^3 were common, and as Figure 29 shows, a value of 1 g/m^3 was recorded during the first flight. Highest values of LWC at 400 mb were recorded during the first two days while the storm was feeding on warm, tropical air. Later, as the storm moved farther north, there was a decrease in the liquid water content at this level. A similar though less emphatic pattern emerged at 500 mb, as shown in Figure 30. Again, values as large as

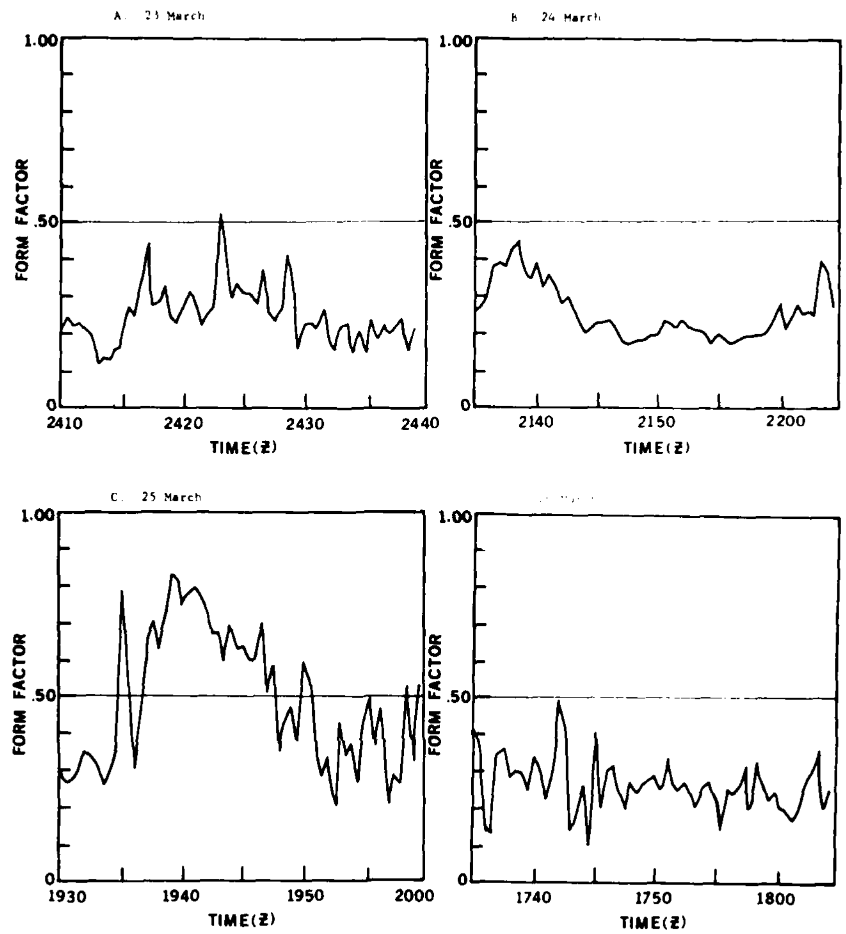


Figure 28. Form Factor at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

1 g/m^3 were reported on the first flight, with values as high as 10^{-1} g/m^3 reported on other flights. The increase in 500-mb LWC on the final day may have been due to either a reintensification of vertical motion in the storm or the proximity of the ocean. There was a similar increase in LWC at 400 mb, but it was much smaller than the increase at 500 millibars. Generally, the 500-mb LWC seemed less strongly affected by latitude and more strongly related to the strength of the storm and the proximity of a large boty of water. The LWC at 700 mb seemed to follow this latter trend to an even greater extent. As Figure 31 shows, at this level the flight had high but irregular values of LWC. The next highest values were recorded

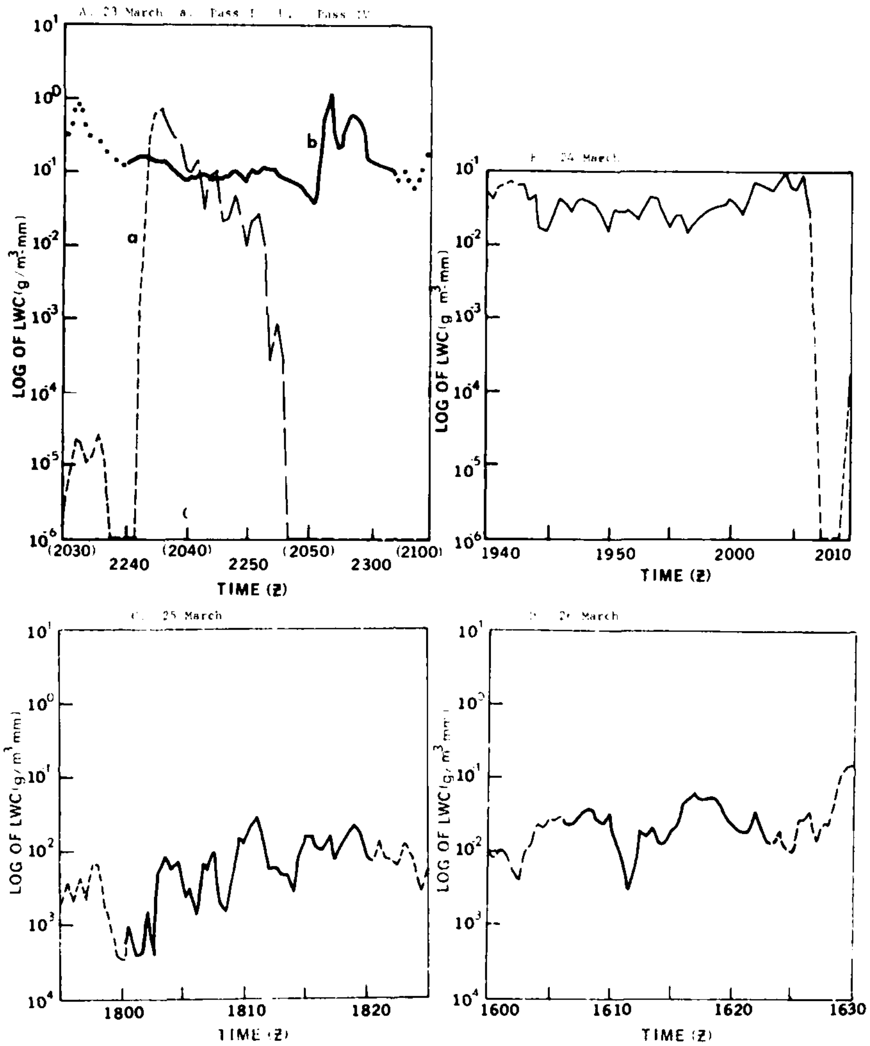


Figure 29. Liquid Water Content at 400 mb for Each of the Four Days. Dotted line shows data from the first pass on 23 March

on the final flight, where LWC values were generally greater than 10^{-1} g/m^3. Values this high were rare at this level on the second day and almost nonexistant on the third. The 850-mb LWC data, seen in Figure 32, shows the least variability, in contrast to the Form Factor at the same level (see Figure 28). Both within the flights and from flight to flight, the LWC values here are the most consistent. Generally at this level the airplane was in rain or water-droplet clouds. Thus, while the particle distributions may have varied, the actual amount of water present in the atmosphere at the 850-mb level seemed less affected either by the geographic location of the storm or its state of development.

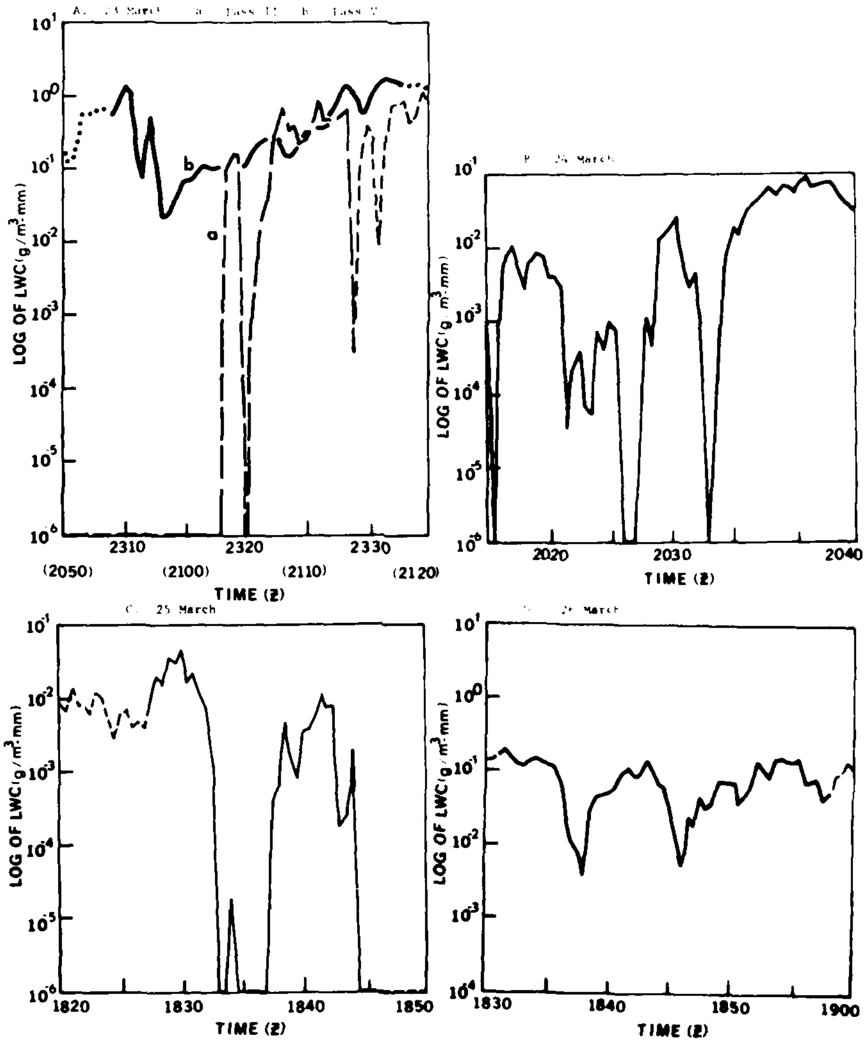


Figure 30. Liquid Water Content at 500 mb for Each of the Four Days. Dotted line shows data from the second pass on 23 March

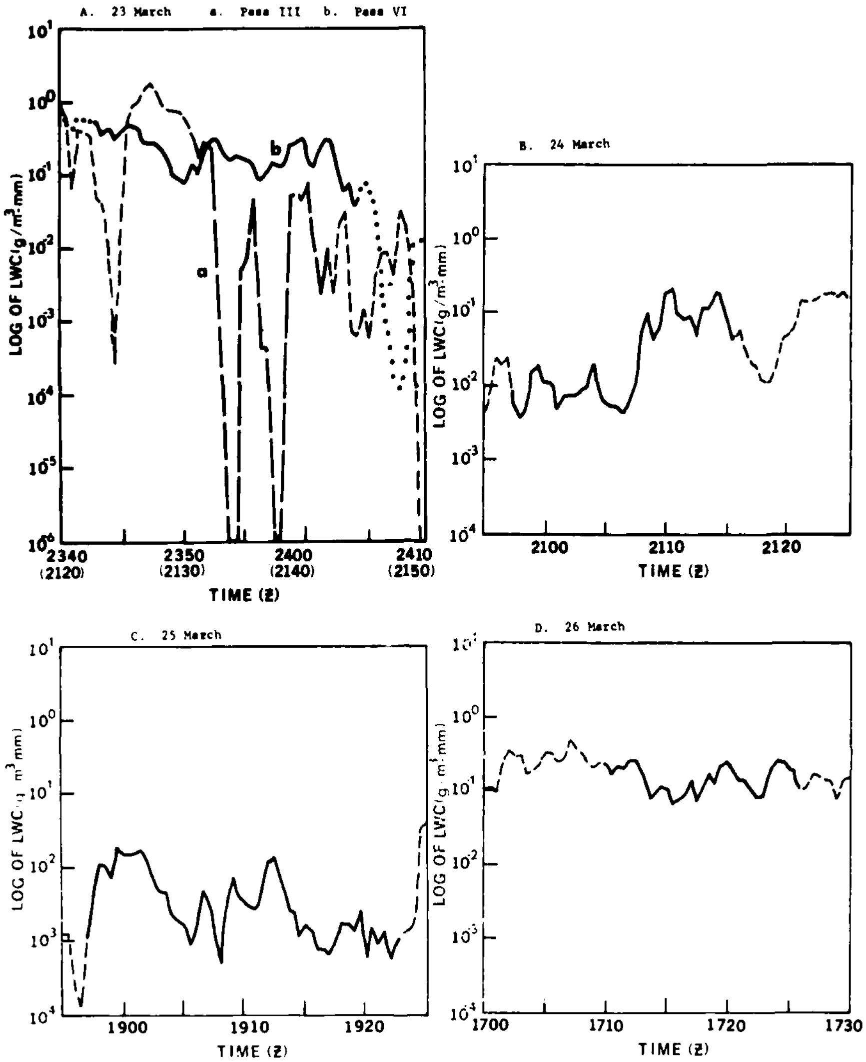


Figure 31. Liquid Water Content at 700 mb for Each of the Four Days. Dotted line shows data from the third pass on 23 March

6.5 Particle Counts

The Particle Count (NT) is a limited measure of the number of ice or water particles per unit volume.

NT is calculated from data provided by the ASSP, the 1-D cloud probe, and the 1-D precip probe that adjust for the overlap of their measuring ranges. Particles larger than 6.4 mm and smaller than 2 μm are excluded since they are outside the range of the instruments. The range of measurements is the same for most of our flights, including all of those described herein. Values of NT reported by different investigators may vary due to the specific instrumentation used. As seen in Figure 24 and commonly observed on most of our flights, NT is dominated by the number of small particles. Thus NT is very sensitive to the minimum size required for a particle to be sensed.

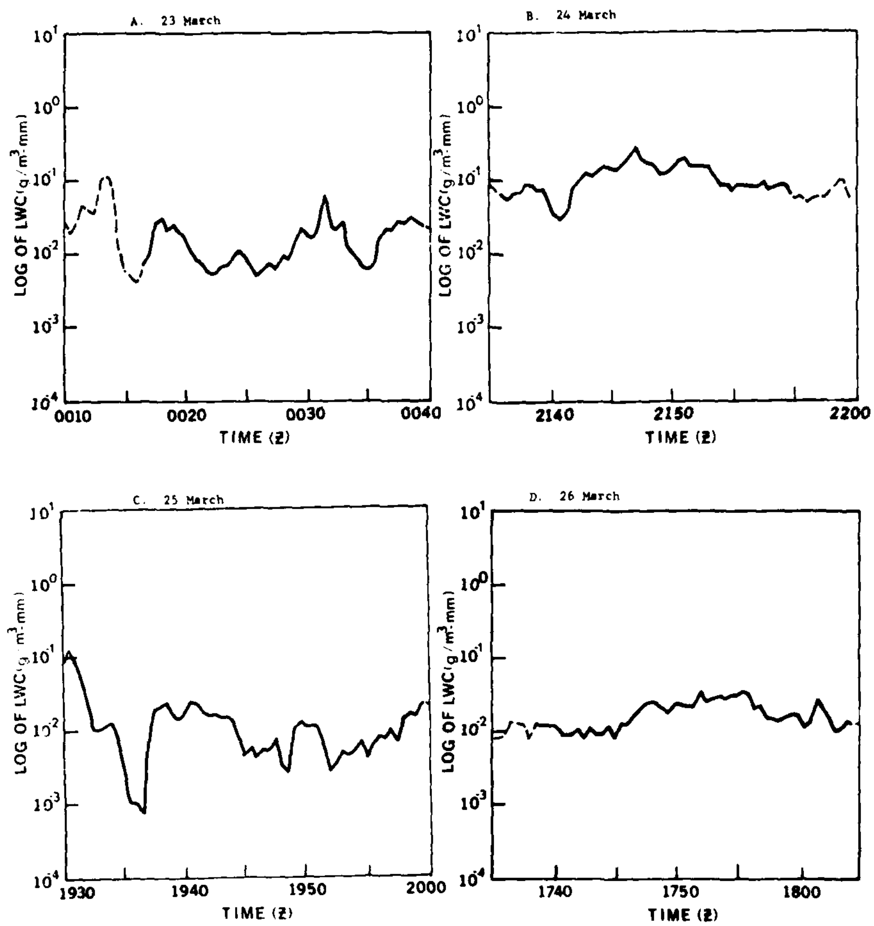


Figure 32. Liquid Water Content at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

Byers[12] indicates that cumulus (convective) clouds will have a different particle size distribution from stratus clouds. Generally, the convective clouds will have large particles and a less consistent distribution of particles vs size. As a rule, observations on this flight showed that in convective clouds there were more particles at higher levels, while particle counts at lower levels were influenced less by the type of cloud.

Figure 33 shows NT for particles in the 2- to 6400-μm size range vs time for the passes at 400 millibars. The convective clouds on 23 March gave high but erratic values of NT. By 24 March, there were considerably fewer particles at this level. On the last two days, particle counts were considerably lower, since not only was the storm mostly stratiform, but there was less moisture at 23,000 feet.

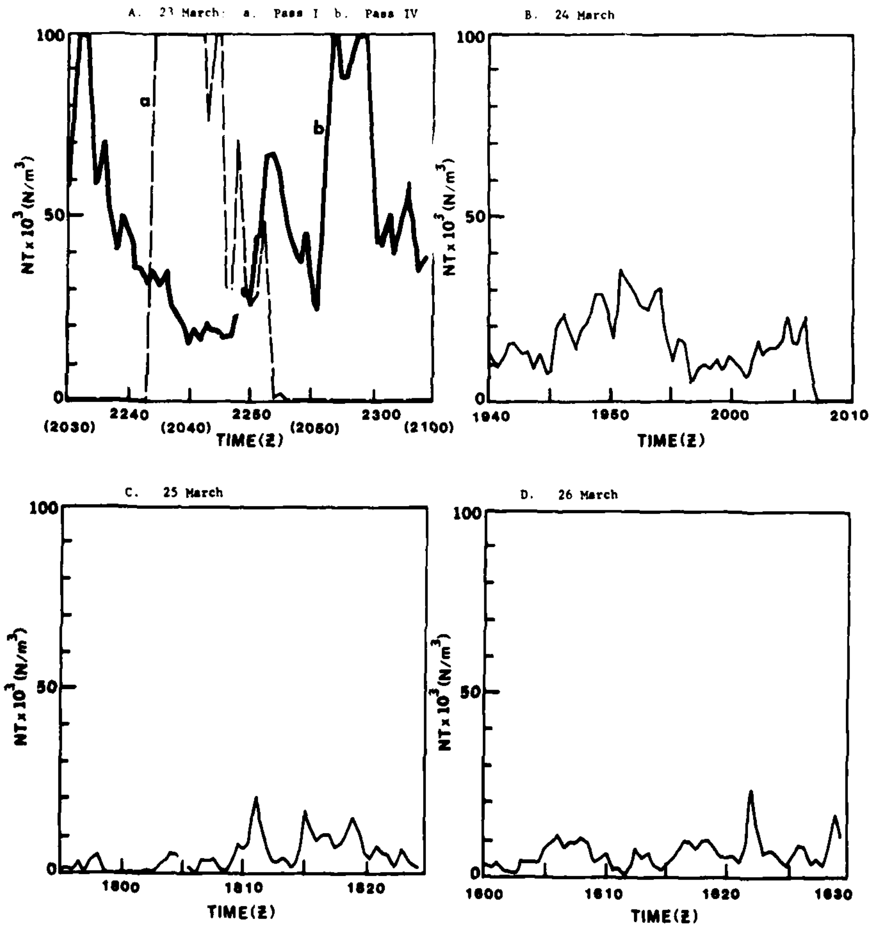


Figure 33. Particle Density (number of particles per cubic meter) at 400 mb for Each of the Four Days. Dotted line shows data from the first pass on 23 March

12. Byers, H. R. (1965) Elements of Cloud Physics, University of Chicago Press.

A similar trend appears at 500 mb as seen in Figure 34. As the system became more stratified, the values of NT decreased, although unlike the case at 400 mb the aircraft was in heavy cloudiness at 400 mb on all four days.

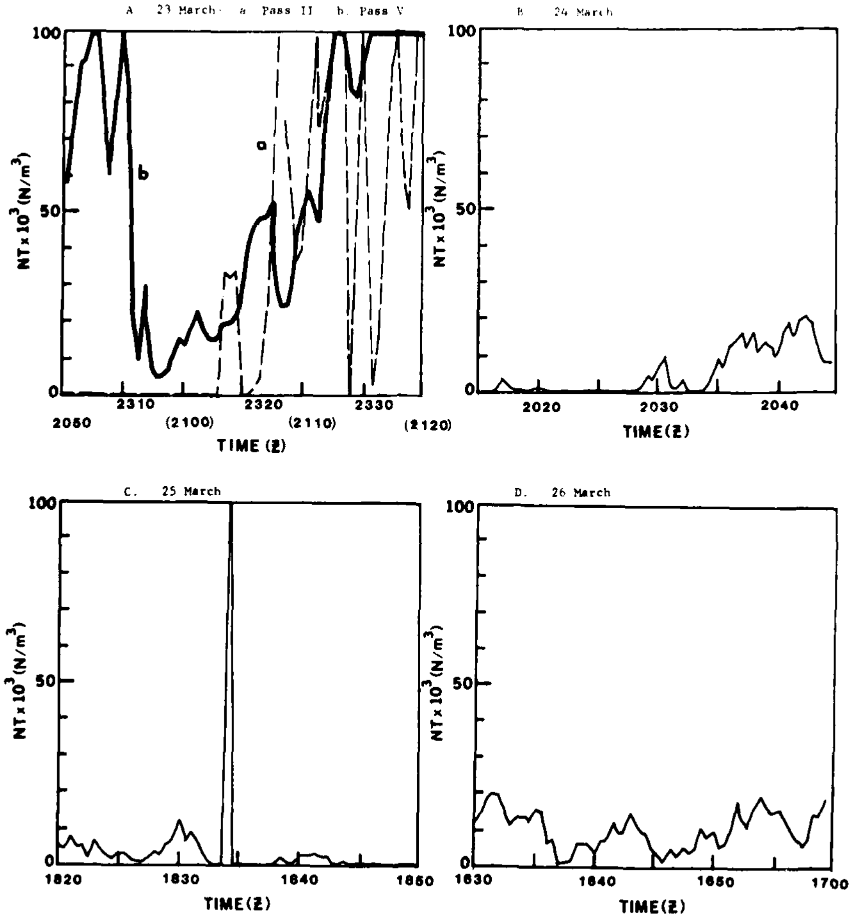


Figure 34. Particle Density (number of particles per cubic meter) at 500 mb for Each of the Four Days. Dotted line shows data from the second pass on 23 March

The particle counts at 700 mb showed a smaller change overall, although as Figure 35 shows, the values were more erratic on the first day. Despite the more stratified nature of the clouds on days 3 and 4, there were still some high values of NT, several times reaching $5 \times 10^5/m^3$, a value never approached during the passes at higher altitudes.

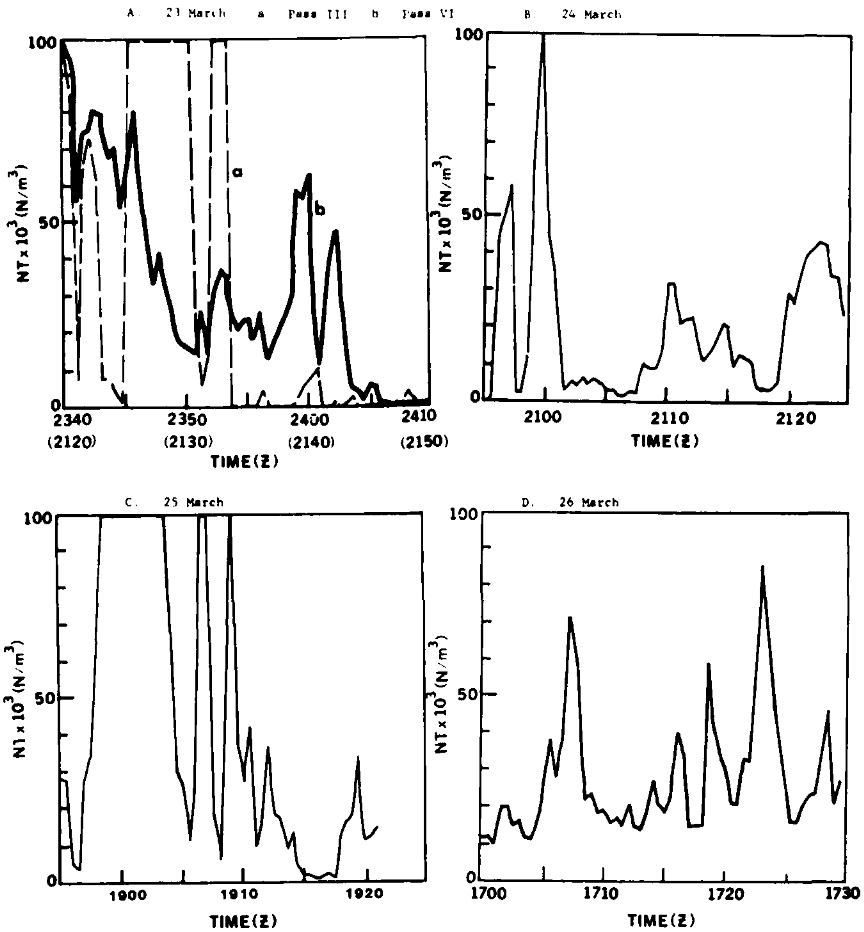


Figure 35. Particle Density (number of particles per cubic meter) at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

In general, NT values were smallest at 850 millibars. This can probably be attributed to smaller particles combining into larger particles (aggregation) between the 700-mb and 850-mb level. As Figure 36 shows, the particle distributions varied more within a given pass than thev did from pass to pass. This is an indication of the variability of aggregation.

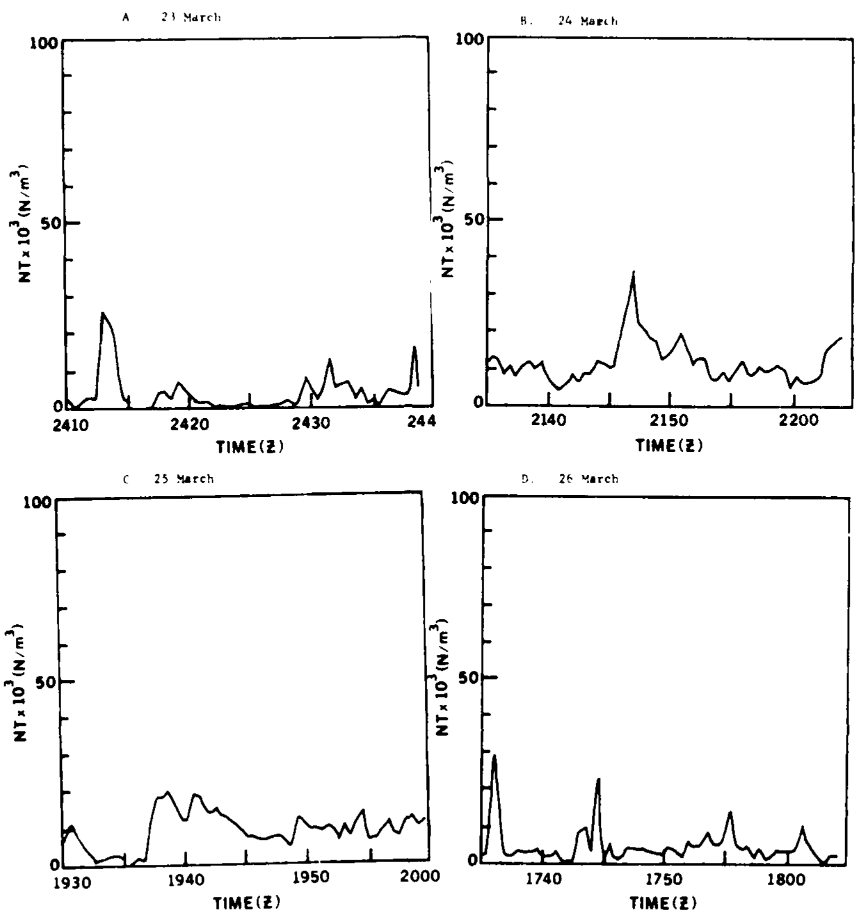


Figure 36. Particle Density (number of particles per cubic meter) at 850 mb for Each of the Four Days. Dotted line shows data from the fourth pass on 23 March

6.6 Other Data

Reflectivity (Z) and medium particle diameter (DO) can also be examined in this manner. As a rule the reflectivity seemed to follow the liquid water content. As can be seen in Figures 19 to 22, high values of Z usually correspond to high values of LWC. Dyer, Berthel, and Izumi[13] have examined the relationship of Z to the

13. Dyer, R.M., Berthel, R.O., and Izumi, Y. (1981) Techniques for Measuring Liquid Water Content Along a Trajectory, ERP No. 233, AFGL-TR-81-0082, (in press).

mass of a particle. Their work used data taken at Wallops Island, Virginia and Kwajalein Atoll in the Marshall Islands.

The medium volume diameter tended to increase at lower altitudes. It followed similar patterns on all flights, with 700- and 850-mb values being higher than 400 and 500 millibars. This may be due to a reduced number of smaller drops resulting from either sublimation of these small drops or the coalescence of smaller drops into bigger ones. This agrees with the observation that NT is smaller at lower levels. Regardless of the type of cloud, there are fewer, but larger particles at the lower levels; another sign of aggregation.

7. OBSERVED TWO-MINUTE PARTICLE DISTRIBUTIONS

We can take a closer look at the LWC and particle size distributions by examining averages over 2-min periods. Two such periods have been selected for each altitude and each flight and are presented here with corresponding PMS 2-D data.

In addition to the PMS 2-D data and particle size distributions, the mean and standard deviations of 30-sec averages of temperature, altitude, liquid water content (LWC), reflectivity (Z), medium volume diameter (DO), number density (NT), and Form Factor (FF) are provided. The data for each 30-sec period are found in Appendix B, therefore, only the mean and standard deviations of the four 30-sec periods within each 2-min period are included here.

Periods were selected at times of consistent LWC and are intended to represent periods of high particle concentration during the respective pass.

7.1 Samples From 23 March 1978

Eight 2-min samples were selected from the 23 March flight. Two samples were selected from each of the four levels. Since there were two passes at 400, 500 and 700 mb, one sample was taken from each of the first six passes. The 850-mb samples came from the last pass.

Data from the two 400-mb samples are shown in Figure 37. Although separated by 2 hours and 400 miles, the profiles are quite similar. As can be seen from the 2-D shadowgraphs, small snow predominated during both sampling periods. In both cases the largest particles were between 2 and 3 mm in diameter. The only substantial difference was in values of NT, where the earlier sample had much higher numbers of particles. Since LWC values were similar, there evidently were more small particles in this sampl ·, and the particle distributions support this assumption. In both cases, convective clouds predominated, but the convective activity was stronger during the second sampling period.

Data from the two 500-mb samples are shown in Figure 38. At this level in both cases, there were more large particles and the maximum particle size was greater than 5 millimeters. The Form Factors were smaller, thus indicating a wider distribution of particle sizes. The LWC increased substantially over that observed at 500 mb, as did the average particle size. As was true at 400 mb, the values of NT show the greatest difference between the two passes. Again the standard deviation among the four 30-sec averages was quite large; in the earlier sample, it was one-third of the mean value. As was frequently the case, the Form Factor was the most consistent variable.

Data from the 700-mb samples appear in Figure 39. This level was close to the freezing level, and as a result, wet snow predominated. The second pass in the more uniform convective activity, yielded some of the highest values of the LWC observed on any MC-130E flights over the continental United States. The total number of particles also changed between the earlier and the later sampling period. The more intense convective activity produced both a greater number of particles and a larger liquid water content. Even the Form Factor showed a difference; the larger value observed during the first sampling period also had a large standard deviation. In the first case, therefore, the particle sizes and their distributions were consistent both with time and at a given moment.

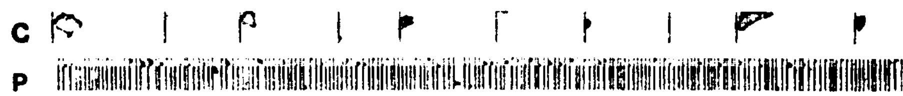
Comparing the two quadrants shows that convective activity prevailed throughout the storm at this time. In both quadrants, the cloud cover was sporadic and conditions changed rapidly, both in time and space. The northeast quadrant, however, was becoming the more intense. Cloud cover there was more extensive, and the warm, moist flow from the Gulf of Mexico was causing the storm to intensify and become better organized.

In the three preceding instances, the two sampling periods represented different sampling passes. In the remaining cases, both sampling periods were extracted from the same pass.

In the case of the 850-mb data shown in Figure 40, both samples were taken from Pass VII, which was part of the series which contained the later samples at higher levels. At this level, the temperature was well above the freezing point, and thus almost all of the precipitation observed was in liquid form as can be seen by the predominance of round particles on the 2-D shadowgraphs. Particle size and LWC have decreased from the 700-mb values. The low numbers of particles, low LWC and low Form Factor indicate that drops and droplets of a variety of sizes existed at this level, but that heaviest concentration of water was near the freezing level.

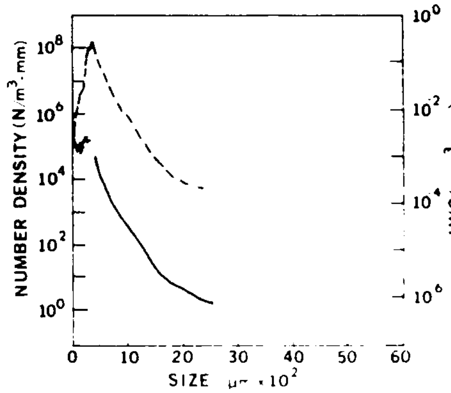
The four levels sampled on this first day provided a vertical cross section of this young, convective system. Perhaps the most consistent variable was the Form Factor. The range of values of the Form Factor on this flight was the smallest of any of the flights in this series. Thus, while the particle size type, density, and LWC changed, the type of size distribution remained relatively consistent with altitude. As the system became more stratified, this consistency diminished, and Form Factors at higher levels became larger, while those at lower levels varied widely.

TIME: 2040-2042Z		TEMP	ALT	LWC	Z	DO	NT	FF
PARTICLE TYPE: Small Snow		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
	MEAN	-34.2	7.3	.0980	2.2E+00	184	152224	.33
	STANDARD DEVIATION	.2	.0	.0436	1.0E+00	9	83413	.01

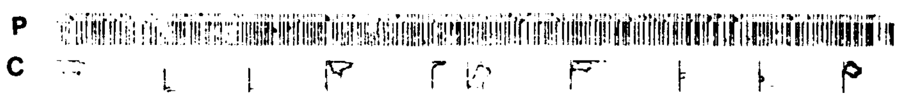


PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	5.60E+08	27	3.59E+05	466	3.64E+04
4	6.04E+08	50	4.59E+06	744	2.19E+03
6	5.32E+08	73	7.61E+04	1089	2.90E+02
8	3.86E+08	96	1.46E+05	1434	3.49E+01
10	2.60E+08	119	1.61E+05	1779	7.01E+00
12	1.88E+08	142	1.17E+05	2124	2.90E+00
14	1.20E+08	165	1.09E+05	2469	1.88E+00
16	1.27E+08	188	5.81E+04	2814	0.
18	9.63E+07	211	1.85E+05	3159	0.
20	6.24E+07	234	1.73E+05	3504	0.
22	4.69E+07	257	1.57E+05	3849	0.
24	4.62E+07	280	1.17E+05	4194	0.
26	4.54E+07	303	1.34E+05	4539	0.
28	4.01E+07	326	1.54E+05	4884	0.
30	3.29E+07	349	1.21E+05	5229	0.
LWC	7.02E-03		4.75E-02		5.05E-02



TIME: 2244-2246Z		TEMP	ALT	LWC	Z	DO	NT	FF
PARTICLE TYPE: Small Snow		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
	MEAN	-29.3	7.3	.0810	7.0E+00	314	21259	.40
	STANDARD DEVIATION	.1	.0	.0080	7.3E-01	5	2842	.01



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	5.14E+08	27	2.23E+05	466	9.11E+03
4	6.05E+08	50	2.54E+05	744	8.16E+03
6	4.47E+08	73	7.04E+04	1089	1.39E+03
8	3.16E+08	96	8.29E+04	1434	2.82E+02
10	2.00E+08	119	7.87E+04	1779	6.32E+01
12	1.35E+08	142	6.32E+04	2124	2.97E+01
14	9.17E+07	165	3.86E+04	2469	1.87E+01
16	8.97E+07	188	1.40E+04	2814	1.14E+00
18	6.31E+07	211	3.11E+04	3159	0.
20	3.73E+07	234	1.32E+04	3504	0.
22	2.91E+07	257	9.78E+03	3849	0.
24	2.45E+07	280	4.04E+03	4194	0.
26	2.03E+07	303	5.33E+03	4539	0.
28	2.24E+07	326	9.87E+03	4884	0.
30	2.07E+07	349	9.73E+03	5229	0.
LWC	4.37E-03		5.00E-03		7.60E-02

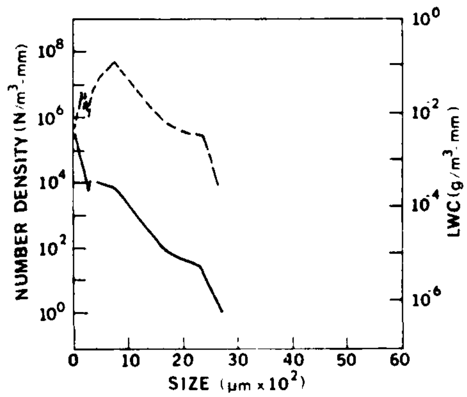
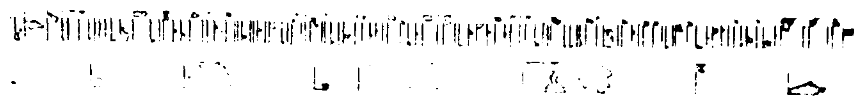


Figure 37. Sample Data From 400 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: [illegible]
PARTICLE TYPE: Large Snow

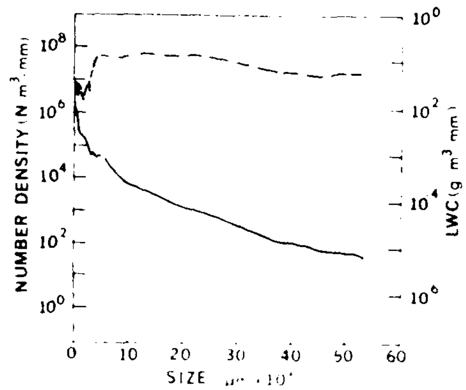
	TEMP C	ALT KM	LWC G M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-20.9	5.6	.6339	8.5E+02	694	69211	.17
STANDARD DEVIATION	.1	.0	.2858	5.9E+02	100	23421	.01

P
C



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.51E+08	27	7.77E+05	466	3.02E+04
4	5.52E+08	50	1.14E+06	744	8.90E+03
6	8.30E+08	73	2.87E+05	1089	4.36E+03
8	8.19E+08	96	2.19E+05	1434	2.34E+03
10	6.60E+08	119	1.99E+05	1779	1.30E+03
12	4.92E+08	142	1.31E+05	2124	8.83E+02
14	3.49E+08	165	9.86E+04	2469	5.98E+02
16	3.28E+08	188	4.55E+04	2814	3.38E+02
18	2.25E+08	211	7.64E+04	3159	2.22E+02
20	1.29E+08	234	6.13E+04	3504	1.42E+02
22	1.04E+08	257	5.58E+04	3849	8.70E+01
24	8.04E+07	280	4.22E+04	4194	7.27E+01
26	7.67E+07	303	4.83E+04	4539	4.81E+01
28	6.20E+07	326	5.60E+04	4884	4.81E+01
30	7.09E+07	349	5.06E+04	5229	4.19E+01
LWC	1.46E-02		2.09E-02		6.13E-01



TIME: [illegible]
PARTICLE TYPE: Large Snow

	TEMP	ALT	LWC	Z	DO	NT	FF
MEAN	-17.0	5.6	.1434	1.0E+02	541	19946	.20
STANDARD DEVIATION	.2	.0	.0048	1.3E+01	20	2605	.01

C
P

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	4.39E+08	27	1.89E+05	466	1.36E+04
4	4.03E+08	50	1.04E+05	744	2.89E+03
6	4.37E+08	73	6.03E+04	1089	1.30E+03
8	3.59E+08	96	8.39E+04	1434	6.56E+02
10	2.70E+08	119	7.84E+04	1779	3.54E+02
12	2.01E+08	142	5.63E+04	2124	2.01E+02
14	1.40E+08	165	4.30E+04	2469	1.12E+02
16	1.52E+08	188	1.81E+04	2814	5.60E+01
18	1.10E+08	211	4.31E+04	3159	2.72E+01
20	7.10E+07	234	3.70E+04	3504	1.58E+01
22	6.17E+07	257	3.38E+04	3849	1.08E+01
24	5.14E+07	[illegible]	7.23E+04	4194	7.15E+00
26	5.31E+07	303	[illegible]	4539	3.90E+00
28	4.93E+07	326	3.60E+04	4884	3.63E+00
30	6.10E+07	349	2.64E+04	5229	1.12E+00
LWC	8.72E-03		1.04E-02		1.33E-01

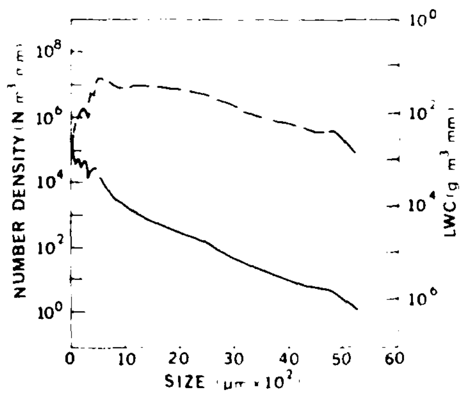


Figure 38. Sample Data From 500 mb 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min periods

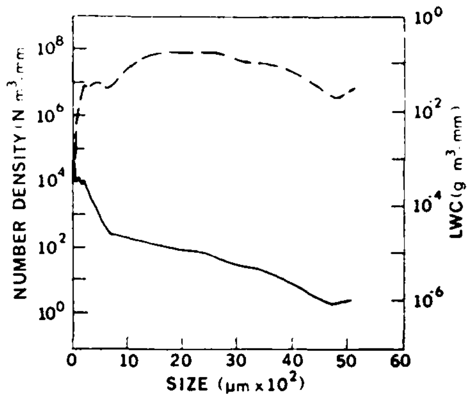
		TEMP	ALT	LWC	Z	DO	NT	FF
TIME: 2140-2142Z		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
PARTICLE TYPE: Wet Snow	MEAN	-1.3	3.0	.6212	7.8E+03	1679	5295	.20
	STANDARD DEVIATION	.2	.0	.5836	7.4E+03	38	4793	.04

P

C

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	5.36E+07	23	2.73E+05	412	1.81E+03
4	2.62E+07	43	5.52E+04	648	3.25E+02
6	3.59E+07	73	1.50E+04	1089	2.43E+02
8	4.54E+07	96	1.81E+04	1434	1.97E+02
10	4.04E+07	119	2.14E+04	1779	1.29E+02
12	4.24E+07	142	1.70E+04	2124	9.27E+01
14	3.43E+07	165	1.28E+04	2469	7.35E+01
16	2.80E+07	188	1.13E+04	2814	4.06E+01
18	2.46E+07	211	1.53E+04	3159	2.47E+01
20	1.55E+07	234	7.87E+03	3504	2.10E+01
22	1.31E+07	257	7.68E+03	3849	1.40E+01
24	7.30E+06	280	4.81E+03	4194	7.78E+00
26	1.02E+07	303	4.09E+03	4539	3.42E+00
28	6.27E+06	326	3.70E+03	4884	1.52E+00
30	8.62E+06	349	3.03E+03	5229	2.13E+00
LWC	1.50E-03		1.32E-02		6.08E-01



		TEMP	ALT	LWC	Z	DO	NT	FF
TIME: 2354-2356Z		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
PARTICLE TYPE: Wet Snow	MEAN	-1.3	3.0	2.5891	4.2E+04	1844	20767	.17
	STANDARD DEVIATION	.1	.0	.1974	3.2E+03	49	1994	.01

P

C

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU).	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.82E+09	23	7.66E+05	412	1.20E+04
4	2.11E+09	43	1.21E+05	648	2.71E+03
6	2.35E+08	73	5.58E+04	1089	1.03E+03
8	1.52E+08	96	6.29E+04	1434	5.93E+02
10	1.12E+08	119	5.87E+04	1779	3.79E+02
12	8.76E+07	142	8.77E+04	2124	2.54E+02
14	5.95E+07	165	7.08E+04	2469	2.02E+02
16	5.35E+07	188	4.45E+04	2814	1.35E+02
18	3.91E+07	211	7.06E+04	3159	9.82E+01
20	2.44E+07	234	4.50E+04	3504	8.23E+01
22	2.20E+07	257	3.65E+04	3849	6.38E+01
24	1.91E+07	280	1.86E+04	4194	5.04E+01
26	1.69E+07	303	1.96E+04	4539	3.96E+01
28	1.43E+07	326	2.08E+04	4884	3.47E+01
30	1.29E+07	349	1.80E+04	5229	2.59E+01
LWC	3.06E-03		6.47E-02		2.52E+00

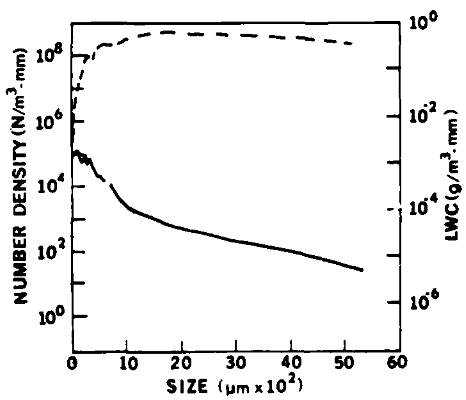


Figure 39. Sample Data From 700 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

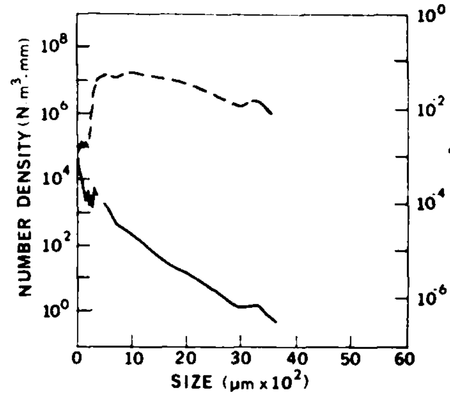
TIME: 0020-0022Z
PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	9.6	1.5	.1669	2.2E+03	1320	2037	.13
STANDARD DEVIATION	.3	.0	.0636	1.1E+03	127	470	.03

P
C

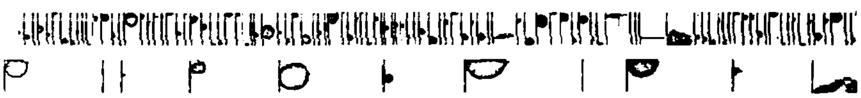

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.98E+08	23	2.12E+05	405	2.18E+03
4	1.04E+08	43	4.10E+04	648	4.55E+02
6	6.36E+07	63	1.92E+04	945	1.98E+02
8	3.04E+07	83	3.15E+03	1242	7.77E+01
10	1.64E+07	103	4.96E+03	1539	3.20E+01
12	8.62E+06	122	2.59E+03	1836	1.75E+01
14	6.40E+06	142	5.78E+03	2133	9.27E+00
16	3.02E+06	162	1.69E+03	2430	4.20E+00
18	3.26E+06	182	3.65E+03	2727	1.95E+00
20	1.16E+06	202	2.38E+03	3024	1.04E+00
22	1.86E+06	221	5.68E+03	3321	1.13E+00
24	3.48E+05	241	5.82E+03	3618	4.22E-01
26	6.98E+05	261	5.19E+03	3915	0.
28	4.63E+05	281	5.07E+03	4212	0.
30	1.04E+06	301	4.42E+03	4509	0.
LWC	2.22E-04		5.76E-03		1.61E-01



TIME: 0034-0036Z
PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	8.5	1.5	.1612	3.6E+03	1903	2602	.12
STANDARD DEVIATION	.3	.0	.0118	1.0E+03	191	2012	.02

P
C


PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	2.60E+09	23	1.69E+05	405	5.46E+02
4	8.89E+09	43	7.45E+04	648	1.11E+02
6	3.57E+09	63	3.47E+03	945	9.49E+01
8	1.08E+09	83	1.04E+04	1242	6.55E+01
10	1.52E+08	103	9.18E+03	1539	4.44E+01
12	1.52E+07	122	3.15E+03	1836	2.21E+01
14	2.92E+07	142	3.28E+03	2133	1.47E+01
16	3.38E+06	162	2.04E+03	2430	7.52E+00
18	3.51E+06	182	2.57E+03	2727	2.91E+00
20	1.52E+06	202	1.60E+03	3024	2.08E+00
22	2.45E+06	221	3.97E+03	3321	1.13E+00
24	1.87E+06	241	2.45E+03	3618	0.
26	7.03E+05	261	1.60E+03	3915	9.13E-01
28	1.29E+06	281	1.34E+03	4212	0.
30	1.40E+06	301	1.15E+03	4509	0.
LWC	2.81E-03		2.53E-03		1.59E-01

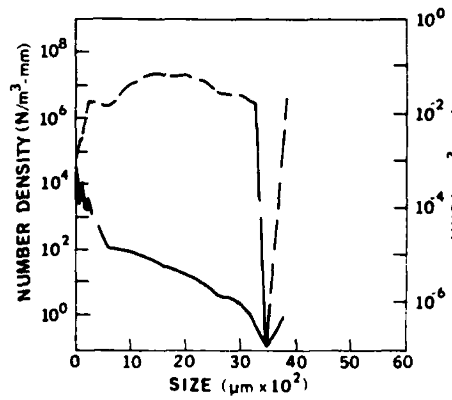


Figure 40. Sample Data From 850 mb - 23 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

7.2 Samples From 24 March 1978

Two samples were taken from each of the four passes completed on 24 March. Each sample was 2 min in length. By this time, the storm system was a mature open wave.

The samples taken at 400 mb are shown in Figure 41. As had been the case on 23 March, both show maximum particle sizes of approximately 2.5 millimeters. The Form Factors are quite high and also quite consistent; those of the first sample averaging 0.60. This and the relatively low liquid water content indicate a predominance of small particles of uniform size as can be seen in the plots. The medium volume diameters were similar to those observed at 400 mb on the previous day. In general, the change in cloud structure at 400 mb was smaller than at the lower levels.

The samples taken at 500 mb appear in Figure 42. The maximum particle size and medium volume diameter increased substantially when going from 400 to 500 mb, but not as much as on the previous day. Liquid water content, however, was low, especially during the first sampling period, where the mean value was only 9×10^{-3} g/m^3. The Form Factor remained high, and showed less consistency than usual. Thus there was a greater variety of distributions of particles at this level. The weather was caused mainly by the warm air overrunning the colder air north of the front. The warm air was relatively stable, keeping most of the moisture at lower levels. The variance of the Form Factor may be due to the isolated convective activity still present at this time.

The 700-mb level also showed some interesting contrasts. As was noted earlier (see Table 2), a variety of crystal types was present at this level. Data from this level are displayed in Figure 43. Although both samples show many large particles, the number, liquid water content, and Form Factor vary greatly from the first sample to the second. They were taken 14 min apart and in both cases the airplane was in thick clouds. While on 23 March the 700-mb surface was close to the freezing level, on 24 March temperatures were still well below freezing. Needles, large snow, wet snow, and supercooled rain were all present. The aircraft did experience some icing. Small particles were comparatively rare, especially during the second sample. The 2-D cloud probe recorded an unusually small quantity of data. Several channels of the scatter probe failed to record any particles; a highly unusual situation in this type of cloudiness. Thus, despite the uniform appearance, there was still a variety of particle distributions at this level.

The situation was similar at 850 mb, as seen in Figure 44. Again, there was wide divergence in liquid water content and Form Factor. Again, there were a variety of particles recorded by the 2-D system. Here the aircraft was closer to the freezing level and rain was more plentiful. The Mission Director reported rain, generally mixed with snow, several times during the pass (see Appendix A). There were comparatively few smaller particles especially during the earlier period. This may be a result either of accretion that occurred at higher levels or of sublimation of the smaller particles.

The 24 March flight took place when the storm system was changing in character. It was much more widespread than it had been the previous day and it provided precipitation to much of the central United States. The clouds, however, were far from uniform. At times they had very large liquid water contents values, but at other times, they had little moisture. The low pressure area was deepening and soon the fronts would begin to occlude.

7.3 Samples From 25 March 1978

On 25 March, the fronts had occluded, and the system contained a large amount of cloud. Although they covered a large area, the clouds sampled did not contain as much liquid water as they had the previous day. As a result, while precipitation was more widespread, it was generally less intense.

The sampling procedure was the same as the previous day. Samples, each 2 min long, were selected from each of the four passes for study.

Figure 45 shows the resultant data from 400 millibars. Unlike previous days, at this time clouds were not continuous at 400 millibars. The liquid water content was low. This was the result of a lack of large particles, as the 2-D data show clearly. The Form Factor in both samples was high. Values were generally 0.50 or higher. Unlike the 24 March case, this time the Form Factor was quite consistent indicating a uniformity to the particle size distributions in the high clouds which had not been there the day before.

Figure 46 shows that the same uniformity was present at 500 millibars. Again, there were few large particles and low liquid water content values observed during both sampling periods. This was the only case in the four flights during which the Form Factor did not decrease when going from 400 to 500 millibars. The moisture in the system was spread over a larger geographical area and the moisture at a given location was less. The number of particles had only decreased slightly, but the medium volume diameter and maximum size had both become much smaller. In addition, most of the clouds were confined to lower levels. Occasionally while at 500 mb the aircraft was in clear air with blue sky above. This was in contrast to the solid overcasts observed at 500 mb on previous days.

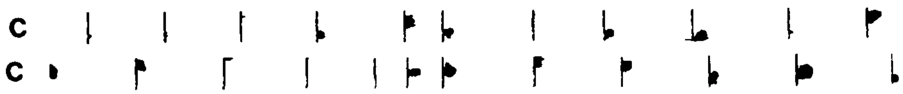
The 700-mb data are shown in Figure 47. Although the first sample had the highest average particle count of any sample period, the liquid water content was low. Small particles predominated. The Form Factor was unusually low since there was a fairly uniform distribution of particles throughout the range of the scatter probe. The low Form Factor and low liquid water content were also seen in the second sample, however, the particle count had dropped from 1.6×10^6 to a more normal 2.1×10^5 particles per cubic meter. The medium volume diameter had increased, as had the maximum particle size. Although the temperature was still -4°C, most of the particles were in the form of small water droplets. The aircraft experienced considerable icing during this pass. The 2-D probes rarely gave representative shadowgraphs since water and ice caught on the optical sensors and produced long, meaningless "streaks". This phenomena, called "streaking" is frequently observed in liquid precipitation. During this time, some surface stations nearby were reporting freezing rain.

Data from the 850-mb samples are shown in Figure 48. The temperature reported by the aircraft varied drastically during this pass and as a result the first sample occurred at a temperature well below freezing while the second occurred while the temperature was above freezing. Precipitation varied from snow to freezing rain to rain. In both cases, the liquid water content was small. Average Form Factors were both near 0.20 which is a moderate value for this variable at this level. The maximum particle size was quite large (over 400 μm) during the first sample in large snow, while it was somewhat smaller (less than 2500 μm) in the rain.

The 25 March flights explored a deep low pressure area with an occluded front extending well to the south. Thus most of the moisture in the system remained well to the south of the sampling aircraft. As a result, the clouds while wide spread, contained relatively little moisture. At the time, the system appeared to be weakening, but during the next 24 hours an influx of moisture from the Atlantic Ocean caused the system to reintensify.

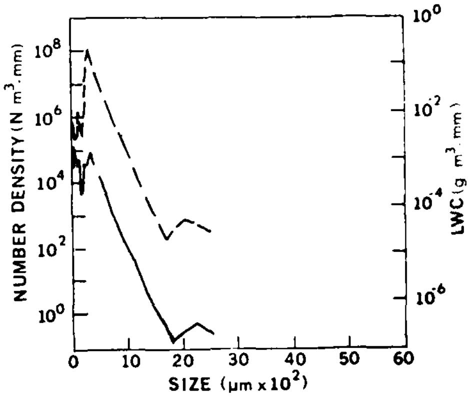
TIME: 1946-1948Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-32.0	7.3	.0370	7.0E-01	190	19911	.60
STANDARD DEVIATION	.2	.0	.0054	9.9E-02	9	3304	.04



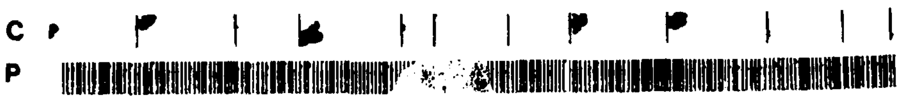
PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	9.29E+08	27	1.25E+05	466	1.71E+04
4	2.00E+08	50	1.81E+05	744	7.03E+02
6	1.69E+08	73	4.19E+04	1089	3.80E+01
8	1.29E+08	96	5.19E+04	1434	1.69E+00
10	9.36E+07	119	6.88E+04	1779	1.52E-01
12	7.62E+07	142	2.72E+04	2124	3.13E-01
14	4.57E+07	165	1.72E+04	2469	1.66E-01
16	5.76E+07	188	5.06E+03	2814	0.
18	3.94E+07	211	1.65E+04	3159	0.
20	2.34E+07	234	1.77E+04	3504	0.
22	1.96E+07	257	4.32E+04	3849	0.
24	1.46E+07	280	3.98E+04	4194	0.
26	1.71E+07	303	5.91E+04	4539	0.
28	1.45E+07	326	8.96E+04	4884	0.
30	1.32E+07	349	6.81E+04	5229	0.
LWC	2.69E-03		1.60E-02		2.02E-02



TIME: 2000-2002Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-32.6	7.3	.0354	2.2E+00	295	10717	.44
STANDARD DEVIATION	.2	.0	.0067	6.1E-01	6	1538	.01



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	8.40E+08	27	3.73E+05	466	4.47E+03
4	3.09E+08	50	6.26E+04	744	4.28E+03
6	1.85E+08	73	3.66E+04	1089	3.56E+02
8	1.42E+08	96	3.98E+04	1434	4.98E+01
10	1.04E+08	119	9.30E+04	1779	5.26E+00
12	7.73E+07	142	3.93E+04	2124	6.21E+00
14	5.02E+07	165	2.54E+04	2469	4.58E+00
16	6.47E+07	188	8.55E+03	2814	0.
18	3.96E+07	211	1.70E+04	3159	0.
20	2.45E+07	234	9.82E+03	3504	0.
22	1.97E+07	257	4.76E+03	3849	0.
24	1.64E+07	280	2.65E+03	4194	0.
26	1.43E+07	303	3.47E+03	4539	0.
28	1.22E+07	326	5.00E+03	4884	0.
30	1.12E+07	349	4.94E+03	5229	0.
LWC	2.64E-03		3.10E-03		3.23E-02

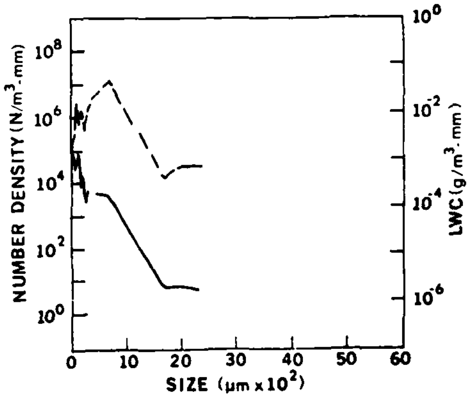
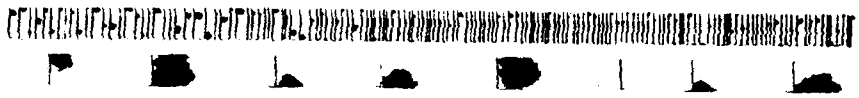


Figure 41. Sample Data From 400 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 2018-2020Z							
PARTICLE TYPE: Large Snow — MEAN	-20.4	5.6	.0090	2.7E+00	434	931	.41
STANDARD DEVIATION	.2	.0	.0030	1.5E+00	43	397	.12

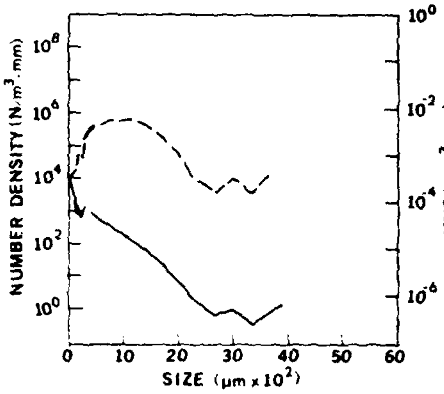
P

C



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

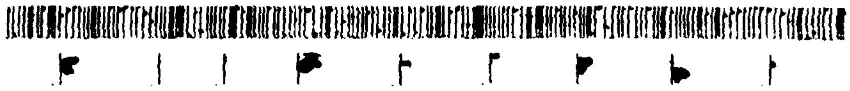
SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.25E+09	27	0.	466	7.56E+02
4	3.06E+09	50	7.53E+03	744	3.26E+02
6	7.06E+09	73	4.74E+03	1089	1.59E+02
8	5.97E+09	96	2.81E+03	1434	6.96E+01
10	4.00E+09	119	1.91E+03	1779	2.37E+01
12	2.72E+09	142	1.06E+03	2124	5.57E+00
14	1.35E+09	165	1.39E+03	2469	1.14E+00
16	1.44E+09	188	6.87E+02	2814	4.09E-01
18	4.80E+08	211	1.24E+03	3159	6.55E-01
20	7.49E+07	234	0.	3504	2.35E-01
22	1.97E+07	257	5.96E+02	3849	5.09E-01
24	7.26E+06	280	0.	4194	0.
26	9.00E+06	303	6.24E+02	4539	0.
28	1.52E+07	326	1.25E+03	4884	0.
30	1.77E+07	349	1.15E+03	5229	0.
LWC	3.07E-02		2.02E-04		8.77E-03



	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 2038-2040Z							
PARTICLE TYPE: Small Snow — MEAN	-20.4	5.7	.0669	7.6E+00	334	14111	.40
STANDARD DEVIATION	.1	.6	.0044	1.4E+00	4	2084	.03

P

C



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	6.91E+08	27	9.77E+04	466	4.61E+03
4	4.10E+08	50	1.73E+05	744	5.80E+03
6	3.09E+08	73	3.38E+04	1089	1.55E+03
8	2.58E+08	96	4.53E+04	1434	3.35E+02
10	1.80E+08	119	5.29E+04	1779	9.63E+01
12	1.55E+08	142	4.97E+04	2124	3.13E+01
14	1.07E+08	165	3.00E+04	2469	1.70E+01
16	1.20E+08	188	1.08E+04	2814	1.04E+00
18	8.74E+07	211	2.85E+04	3159	2.27E-01
20	5.24E+07	234	1.14E+04	3504	0.
22	4.32E+07	257	1.04E+04	3849	2.59E-01
24	3.53E+07	280	3.73E+03	4194	2.81E-01
26	3.47E+07	303	3.61E+03	4539	0.
28	2.85E+07	326	4.31E+03	4884	3.44E-01
30	2.67E+07	349	4.35E+03	5229	3.87E-01
LWC	5.67E-03		3.45E-03		6.35E-02

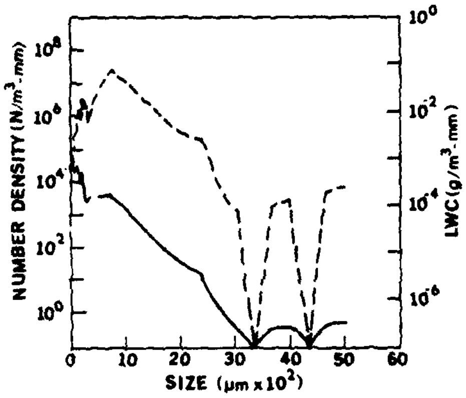
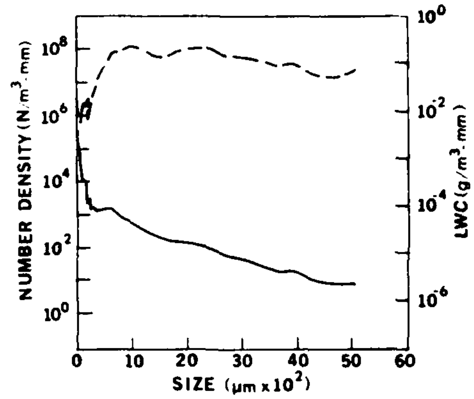


Figure 42. Sample Data From 500 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

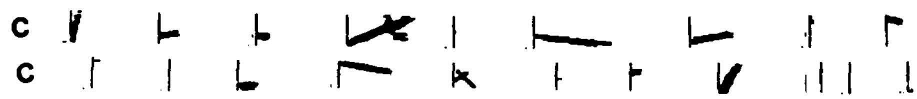
		TEMP	ALT	LWC	Z	DO	NT	FF
		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
TIME: 2108-2110Z	MEAN	-5.2	3.0	1.1578	1.5E+04	1710	11597	,18
PARTICLE TYPE: Wet Snow	STANDARD DEVIATION	.1	.0	.4699	1.1E+04	331	2260	.04

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	2.86E+08	23	1.97E+07	412	1.75E+03
4	5.82E+08	43	2.86E+05	648	1.94E+03
6	4.89E+08	73	4.96E+04	1089	6.46E+02
8	3.52E+08	96	1.37E+04	1434	2.47E+02
10	2.66E+08	119	1.81E+04	1779	1.72E+02
12	1.91E+08	142	1.58E+04	2124	1.61E+02
14	1.44E+08	165	1.02E+04	2469	1.17E+02
16	1.23E+08	188	2.62E+03	2814	6.90E+01
18	9.06E+07	211	3.39E+03	3159	4.51E+01
20	7.19E+07	234	4.02E+03	3504	3.23E+01
22	5.65E+07	257	1.69E+03	3849	2.00E+01
24	4.59E+07	280	2.26E+03	4194	1.80E+01
26	3.93E+07	303	2.06E+03	4539	9.71E+00
28	3.15E+07	326	1.91E+03	4884	7.33E+00
30	3.15E+07	349	1.86E+03	5229	7.81E+00
LWC	6.83E-03		9.35E-03		1.15E+00



		TEMP	ALT	LWC	Z	DO	NT	FF
		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
TIME: 2122-2124Z	MEAN	-5.6	3.0	.1387	1.2E+01	275	46788	.37
PARTICLE TYPE: Needles	STANDARD DEVIATION	.1	.0	.0128	2.0E+00	7	4928	.04



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.08E+08	65	2.63E+07	692	1.47E+04
4	3.29E+07	73	6.45E+04	1092	1.38E+04
6	1.49E+07	98	3.08E+05	1476	2.66E+03
8	5.61E+06	124	1.34E+05	1860	1.00E+03
10	2.15E+06	150	3.86E+05	2244	4.14E+02
12	9.68E+05	175	1.49E+05	2628	2.34E+02
14	1.08E+06	201	9.14E+04	3012	1.33E+02
16	2.17E+05	226	3.47E+04	3396	4.35E+01
18	1.05E+05	252	3.46E+04	3780	2.32E+01
20	1.07E+05	278	3.18E+04	4164	1.21E+01
22	0.	303	3.22E+04	4548	5.12E+00
24	0.	329	1.98E+04	4932	4.69E+00
26	1.09E+05	354	1.74E+04	5316	2.26E+00
28	0.	380	1.55E+04	5700	5.38E+00
30	0.	406	1.54E+04	6084	2.42E+00
LWC	2.60E-05		1.65E-02		1.22E-01

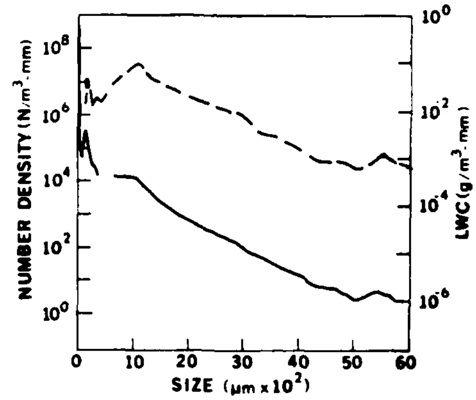


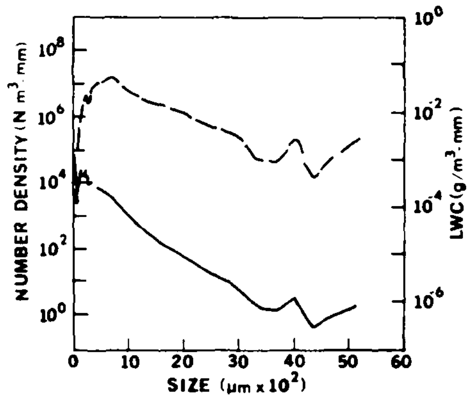
Figure 43. Sample Data From 700 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 2136-2138Z
PARTICLE TYPE: Large Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT #/M**3	FF
MEAN	-2.4	1.4	.0795	3.1E+01	370	10863	.28
STANDARD DEVIATION	.1	.0	.0086	1.0E+01	37	1661	.08

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	4.86E+08	27	9.83E+04	466	9.70E+03
4	1.82E+07	50	2.59E+04	744	4.35E+03
6	7.00E+06	73	3.04E+03	1089	8.77E+02
8	2.49E+06	96	2,54E+04	1434	2.88E+02
10	2.13E+06	119	2.40E+04	1779	1.15E+02
12	2.35E+05	142	3.37E+04	2124	6.01E+01
14	1.07E+06	165	2.84E+04	2469	2.54E+01
16	2.39E+05	188	2.12E+04	2814	1.29E+01
18	2.36E+05	211	2.77E+04	3159	6.72E+00
20	0.	234	2.16E+04	3504	1.80E+00
22	1.20E+05	257	2.26E+04	3849	1.30E+00
24	0.	280	1.15E+04	4194	3.19E+00
26	0.	303	1.30E+04	4539	3.87E-01
28	0.	326	1.49E+04	4884	8.74E-01
30	0.	349	1.38E+04	5229	1.45E+00
LWC	2.11E-05		5.73E-03		7.38E-02



TIME: 2150-2152Z
PARTICLE TYPE: Large Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT #/M**3	FF
MEAN	-1.8	1.5	.2030	4.9E+02	848	17043	.19
STANDARD DEVIATION	.1	.0	.0336	2.2E+01	47	1904	.01

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.32E+08	27	3.13E+05	466	8.05E+03
4	3.83E+07	50	6.96E+04	744	1.30E+03
6	1.85E+07	73	4.90E+04	1089	1.08E+03
8	7.62E+06	96	5.39E+04	1434	7.57E+02
10	3.58E+06	119	5.53E+04	1779	5.43E+02
12	2.19E+06	142	5.56E+04	2124	4.07E+02
14	1.85E+06	165	7.29E+04	2469	2.83E+02
16	1.50E+06	188	3.99E+04	2814	1.94E+02
18	5.79E+05	211	5.37E+04	3159	1.46E+02
20	6.93E+05	234	3.67E+04	3504	1.01E+02
22	8.10E+05	257	3.71E+04	3849	6.24E+01
24	3.40E+05	280	1.66E+04	4194	5.00E+01
26	1.15E+05	303	1.83E+04	4539	3.13E+01
28	2.31E+05	326	2.02E+04	4884	2.61E+01
30	1.15E+05	349	1.73E+04	5229	2.11E+01
LWC	7.15E-05		9.40E-03		2.74E-01

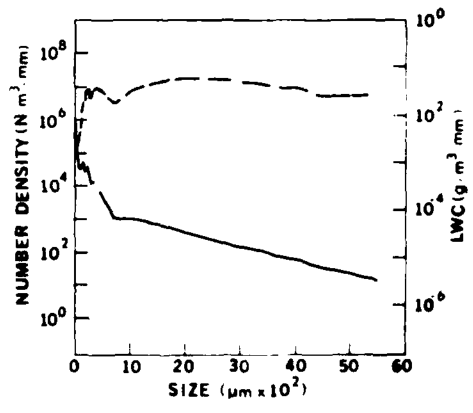


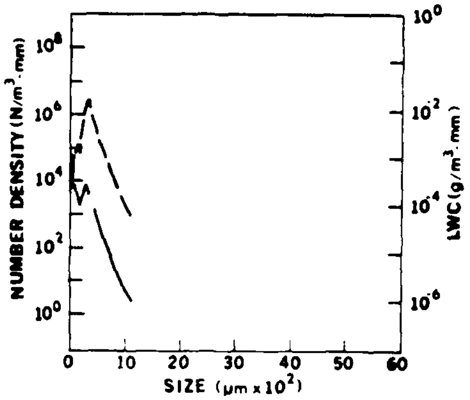
Figure 44. Sample Data From 850 mb - 24 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

TIME: 1804-1806Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-32.7	7.3	.0040	6.2E-02	182	3464	.82
STANDARD DEVIATION	.1	.0	.0024	2.4E-02	7	2418	.04

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.20E+09	27	3.46E+04	464	1.54E+03
4	9.83E+07	50	5.24E+04	744	5.63E+01
6	3.81E+07	73	7.49E+03	1089	2.34E+00
8	3.32E+07	96	1.21E+04	1434	0.
10	2.49E+07	119	7.33E+03	1779	0.
12	1.80E+07	142	7.37E+03	2124	0.
14	1.16E+07	165	4.03E+03	2469	0.
16	1.13E+07	188	2.29E+03	2814	0.
18	6.49E+06	211	3.59E+03	3159	0.
20	5.16E+06	234	4.89E+03	3504	0.
22	3.99E+06	257	6.20E+03	3849	0.
24	3.65E+06	280	6.30E+03	4194	0.
26	3.24E+06	303	7.74E+03	4539	0.
28	2.66E+06	326	9.67E+03	4884	0.
30	2.66E+06	349	7.09E+03	5229	0.
LWC	6.05E-04		2.24E-03		1.74E-03



TIME: 1818-1820Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-33.0	7.3	.0167	2.3E-01	174	12277	.60
STANDARD DEVIATION	.1	.0	.0040	5.0E-02	5	2982	.03

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.77E+09	27	5.96E+04	464	4.67E+03
4	1.79E+08	50	1.75E+05	744	1.24E+02
6	8.74E+07	73	1.58E+04	1089	1.64E+00
8	6.09E+07	96	2.02E+04	1434	0.
10	4.72E+07	119	2.47E+04	1779	0.
12	4.21E+07	142	1.96E+04	2124	0.
14	2.30E+07	165	1.22E+04	2469	0.
16	3.05E+07	188	3.40E+03	2814	0.
18	2.06E+07	211	1.28E+04	3159	0.
20	1.15E+07	234	2.22E+04	3504	0.
22	9.09E+06	257	2.04E+04	3849	0.
24	8.44E+06	280	2.00E+04	4194	0.
26	8.04E+06	303	3.24E+04	4539	0.
28	8.05E+06	326	5.32E+04	4884	0.
30	6.39E+06	349	3.77E+04	5229	0.
LWC	1.43E-03		9.97E-03		6.68E-03

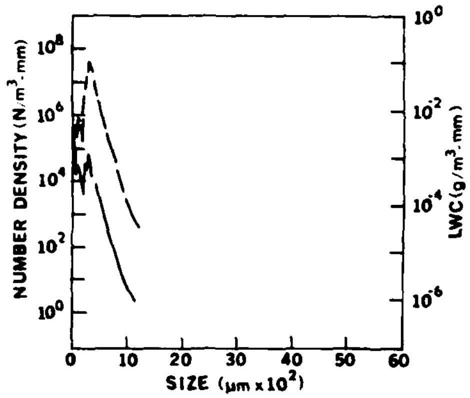
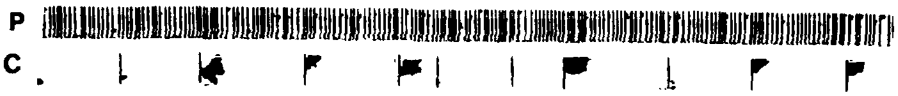


Figure 45. Sample Data From 400 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

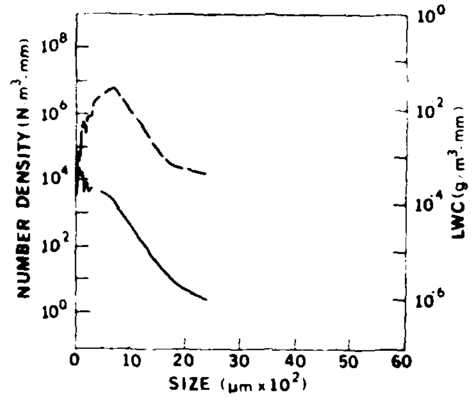
TIME: 1828-1830Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-19.9	5.6	.0286	1.8E+00	294	6668	.50
STANDARD DEVIATION	.1	.0	.0128	8.7E-01	8	3376	.02



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.73E+09	27	2.77E+04	466	5.21E+03
4	1.01E+08	50	3.21E+04	744	2.94E+03
6	1.12E+08	73	1.39E+04	1089	3.41E+02
8	8.38E+07	96	3.52E+04	1434	5.13E+01
10	6.27E+07	119	1.97E+04	1779	1.07E+01
12	5.00E+07	142	2.16E+04	2124	5.40E+00
14	3.29E+07	165	1.42E+04	2469	3.39E+00
16	4.16E+07	188	5.88E+03	2814	0.
18	2.98E+07	211	9.02E+03	3159	0.
20	1.62E+07	234	8.77E+03	3504	0.
22	1.55E+07	257	7.31E+03	3849	0.
24	1.22E+07	280	5.34E+03	4194	0.
26	1.04E+07	303	6.25E+03	4539	0.
28	1.13E+07	326	7.12E+03	4884	0.
30	7.84E+06	349	6.76E+03	5229	0.
LWC	1.91E-03		2.65E-03		2.60E-02



TIME: 184 -184
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-21.1	5.6	.0062	1.2E-01	170	3694	.66
STANDARD DEVIATION	.1	.0	.0024	9.5E-02	28	714	.09

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.20E+09	27	0.	466	1.95E+03
4	6.87E+07	50	7.34E+03	744	1.19E+02
6	2.97E+07	73	5.74E+03	1089	1.56E+01
8	2.32E+07	96	9.57E+03	1434	2.03E+00
10	1.80E+07	119	8.82E+03	1779	4.96E-01
12	1.34E+07	142	9.29E+03	2124	0.
14	8.75E+06	165	1.19E+04	2469	0.
16	1.00E+07	188	6.46E+03	2814	0.
18	8.58E+06	211	1.40E+04	3159	0.
20	4.73E+06	234	1.66E+04	3504	0.
22	3.75E+06	257	1.42E+04	3849	0.
24	2.59E+06	280	1.16E+04	4194	0.
26	3.66E+06	303	1.08E+04	4539	0.
28	3.57E+06	326	1.02E+04	4884	0.
30	2.50E+06	349	7.63E+03	5229	0.
LWC	5.79E-04		3.53E-03		2.67E-03

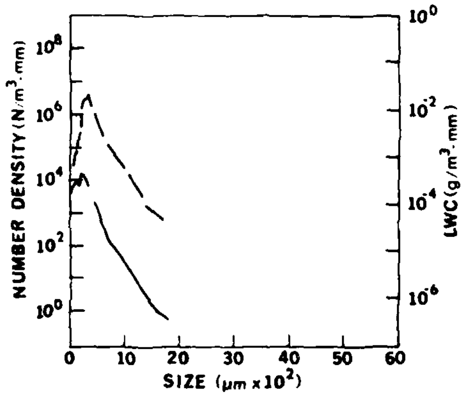
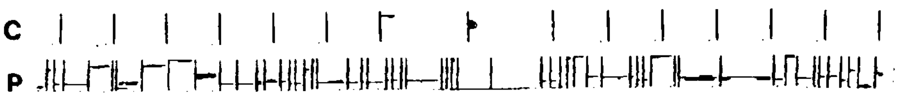


Figure 46. Sample Data From 500 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

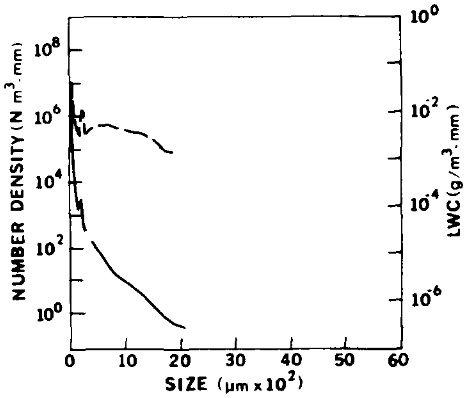
TIME: 1902-1904Z
PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-3.7	2.9	.0160	2.9E+01	230	155265	.02
STANDARD DEVIATION	.0	.0	.0063	1.6E+01	131	63339	.00



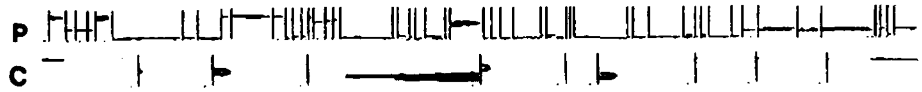
PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.07E+09	23	1.17E+05	405	1.61E+02
4	5.59E+09	43	7.62E+06	648	4.70E+01
6	1.36E+10	63	1.09E+05	945	1.18E+01
8	1.44E+10	83	7.19E+04	1242	4.82E+00
10	1.04E+10	103	1.56E+04	1539	1.85E+00
12	7.33E+09	122	5.31E+03	1836	4.85E-01
14	4.86E+09	142	3.39E+03	2133	2.61E-01
16	4.24E+09	162	1.87E+03	2430	0.
18	2.88E+09	182	2.68E+03	2727	0.
20	1.40E+09	202	3.32E+03	3024	0.
22	1.04E+09	221	2.43E+03	3321	0.
24	6.29E+08	241	1.81E+03	3618	0.
26	4.05E+08	261	6.94E+02	3915	0.
28	2.90E+08	281	3.61E+02	4212	0.
30	2.88E+08	301	3.13E+02	4509	0.
LWC	1.46E-01		8.84E-03		7.95E-03



TIME: 1918-1920Z
PARTICLE TYPE: Rain

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-4.3	2.9	.0131	9.6E+01	1092	20728	.02
STANDARD DEVIATION	.1	.0	.0014	5.0E+01	181	6657	.01



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.24E+08	23	2.75E+04	405	2.84E+02
4	4.24E+07	43	1.03E+06	648	2.80E+01
6	1.12E+07	63	0.	945	1.09E+01
8	3.59E+06	83	0.	1242	5.26E+00
10	1.69E+06	103	1.37E+03	1539	1.20E+00
12	7.84E+05	122	4.99E+02	1836	2.56E+00
14	6.79E+05	142	1.20E+03	2133	5.39E-01
16	3.39E+05	162	9.90E+02	2430	0.
18	1.12E+05	182	2.10E+03	2727	3.15E-01
20	2.26E+05	202	1.13E+03	3024	0.
22	2.24E+05	221	2.53E+03	3321	0.
24	1.14E+05	241	4.72E+02	3618	0.
26	1.12E+05	261	7.40E+02	3915	0.
28	1.11E+05	281	1.03E+03	4212	0.
30	2.24E+05	301	8.34E+02	4509	0.
LWC	3.40E-05		2.16E-03		1.10E-02

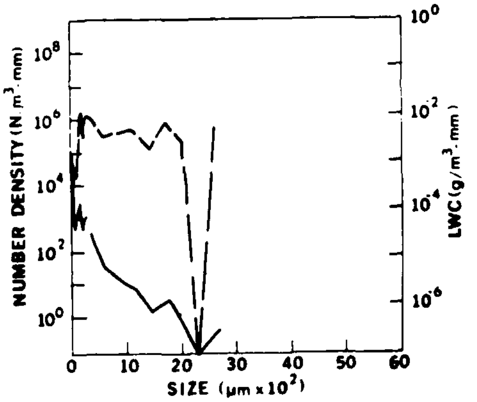
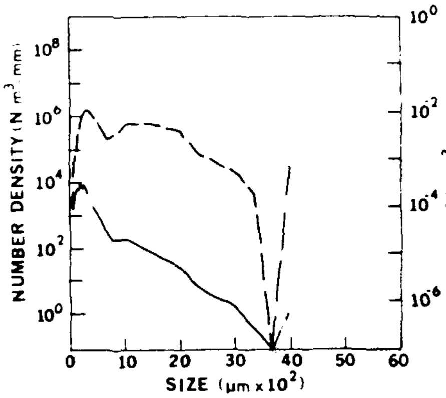


Figure 47. Sample Data From 700 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

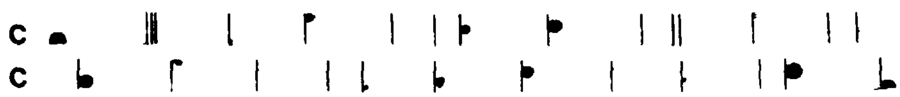
			TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 1932-1934Z									
PARTICLE TYPE: Large Snow	MEAN		-6.5	1.4	.0154	5.7E+00	461	2492	.25
	STANDARD DEVIATION		.1	.0	.0043	2.2E+00	32	298	.04

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.44E+08	27	1.31E+04	466	1.78E+03
4	1.29E+07	50	3.39E+03	744	1.88E+02
6	6.01E+06	73	1.62E+03	1089	1.84E+02
8	2.75E+06	96	0.	1434	9.39E+01
10	1.62E+06	119	5.22E+03	1779	4.49E+01
12	5.03E+05	142	6.24E+03	2124	2.31E+01
14	3.75E+05	165	7.23E+03	2469	5.48E+00
16	7.53E+05	188	6.60E+03	2814	2.47E+00
18	1.28E+05	211	1.05E+04	3159	1.20E+00
20	1.28E+05	234	7.77E+03	3504	3.17E-01
22	3.80E+05	257	8.56E+03	3849	0.
24	0.	280	9.04E+03	4194	7.62E-01
26	0.	303	7.42E+03	4539	0.
28	2.55E+05	326	6.42E+03	4884	0.
30	0.	349	5.16E+03	5229	0.
LWC	2.34E-05		2.32E-03		1.31E-02



			TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 1954-1956Z									
PARTICLE TYPE: Rain	MEAN		1.0	1.4	.0320	3.7E+01	305	9465	.18
	STANDARD DEVIATION		.3	.0	.0075	3.2E+01	58	3561	.13



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.06E+09	23	0.	405	1.31E+03
4	6.01E+09	43	9.27E+04	648	1.07E+02
6	3.17E+09	63	3.42E+04	945	1.31E+01
8	1.20E+09	83	5.26E+04	1242	1.95E+00
10	4.32E+08	103	5.32E+04	1539	2.60E-01
12	1.69E+08	122	6.22E+04	1836	0.
14	8.12E+07	142	4.63E+04	2133	2.93E-01
16	3.04E+07	162	3.29E+04	2430	3.13E-01
18	1.78E+07	182	2.98E+04	2727	0.
20	9.67E+06	202	2.10E+04	3024	0.
22	6.41E+06	221	1.22E+04	3321	0.
24	6.41E+06	241	1.06E+04	3618	0.
26	5.00E+06	261	6.93E+03	3915	0.
28	3.37E+06	281	5.20E+03	4212	0.
30	3.05E+06	301	4.15E+03	4509	0.
LWC	3.96E-03		1.53E-02		1.67E-02

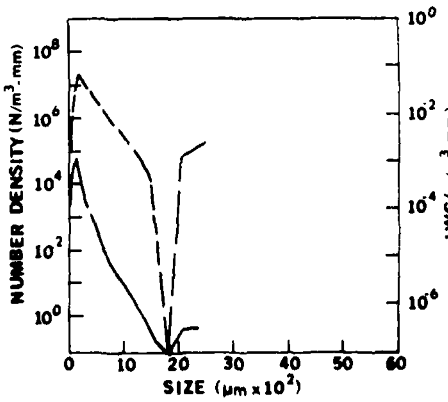


Figure 48. Sample Data From 850 mb - 25 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

7.4 Samples From 26 March 1978

By 26 March, the secondary low in Georgia had brought additional moisture to the lower levels of the storm system. The main system now had reached the east coast and the Atlantic Ocean provided additional moisture. The intensity of precipitation from the system increased as the liquid water content of the clouds increased.

Data from the 400-mb level on 26 March are presented in Figure 49. Liquid water content increased as the number of large particles increased. The Form Factor remained high, which indicated that the particles at this level were still of uniform size. The distribution does show a similarity to the distributions found at this level on 23 and 24 March. All had relatively high Form Factors and low values of liquid water content. The crystal types generally were small snow with some bullet rosettes despite the different synoptic situations.

Data from the 500-mb level on 26 March are shown Figure 50. The difference between the system on 25 and 26 March is more evident at this level. Large snow was present and, as both the 2-D data and particle size distributions show, there were many larger particles at this level on 26 March. The large particles caused a decrease in the Form Factor both from the 400-mb level on both days and the 500-mb level on 25 March. Although the increase in moisture at this level was substantial, the 500-mb data from 23 March show that in a more convective system even more moisture can be found at this level. The 500-mb data showed the greatest variation in Form Factor, maximum particle size, and particle size distribution of any level examined in this report.

The 700-mb level showed the influx of moisture clearly. As Figure 51 shows, the liquid water content at this level was among the highest observed during the series of flights. A large number of particles, combined with the frequent occurrence of large and wet snow, provided an ample amount of moisture that led to the moderate rain observed at the surface. The temperature was about -3°C, thus, the freezing level was still below the aircraft. Unlike the 500-mb level, at this level the liquid water content was greater in the stratified situation on 26 March then in the more convective situation on 23 March.

At the 850-mb level, the aircraft was no longer in solid clouds. Figure 52 shows that rain and water droplets predominated. The influx of warm air led to relatively warm temperatures as compared to those observed on 24 and 25 March at this level. As was the case on previous days, the Form Factor was low at 850 mb indicating a broad range of particle sizes. Secondary peaks, above 3000 μm, helped decrease the value of the Form Factor. The total number of particles had decreased from 700 mb; possibly due to the difference in sampling time and location or to the particles combining into larger drops before reaching this altitude.

This final sampling of the storm system showed the effect of the development of a secondary center and/or the proximity of the ocean. This was most evident at the 700-mb level where the number of particles, particle size, and particle type combined to produce a dramatic increase in liquid water content. Although the storm had reintensified, it had not regained the convective character it had displayed earlier and as a result the 500-mb level was not as strongly affected by the influx of moisture. Although there was an increase in moisture at 500 mb, the increase was much smaller than that observed at 700 millibars.

8. OVERALL DISCUSSION

The four flights made on 23 to 27 March 1978 provided a cross section of the development with time of a large scale system. The flight pattern provided a vertical cross section of the storm. The sampling area for each flight was selected to be north of the main low pressure and with the exception of the first three passes on 23 March, all data were gathered in the northeast quadrant of the system.

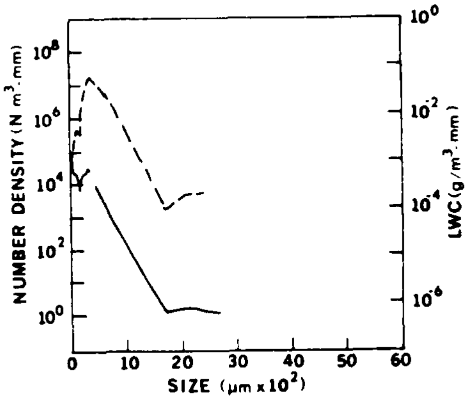
During the early stages, the storm consisted mainly of convective activity. This resulted in high liquid water contents in the 500-, 700-, and 850-mb levels. As the storm moved eastward, it became more stratified. The 500-mb level became drier, while moisture, when available, remained at the lower levels where the moisture was entering the storm system. Although some changes were seen at the 500-mb level, there was less change in liquid water content, Form Factor, and particle type there than in any of the lower levels.

TIME: 1606-1608Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DC MU	NT N/M**3	FF
MEAN	-32.2	7.3	.0274	9.3E-01	228	97[illegible]	.5[illegible]
STANDARD DEVIATION	.1	.0	.0056	3.7E-01	24	1056	.0[illegible]

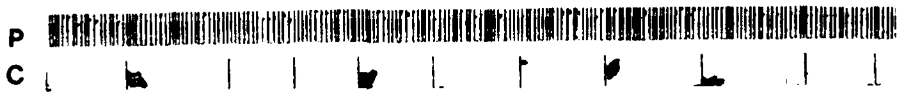
PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.63E+09	27	1.69E+04	466	1.07E+04
4	1.87E+08	50	5.77E+04	744	1.48E+03
6	1.03E+08	73	2.09E+04	1089	1.18E+02
8	7.94E+07	96	2.30E+04	1434	1.25E+01
10	5.95E+07	119	2.29E+04	1779	1.05E+00
12	4.42E+07	142	1.35E+04	2124	1.43E+00
14	2.72E+07	165	9.88E+03	2469	1.10E+00
16	3.49E+07	188	5.72E+03	2814	0.
18	2.12E+07	211	1.32E+04	3159	0.
20	1.30E+07	234	2.14E+04	3504	0.
22	1.10E+07	257	2.14E+04	3849	0.
24	7.73E+06	280	2.12E+04	4194	0.
26	9.13E+06	303	2.53E+04	4539	0.
28	9.03E+06	326	3.17E+04	4884	0.
30	6.84E+06	349	2.64E+04	5229	0.
LWC	1.54E-03		7.48E-03		1.99E-02



TIME: 1616-1618Z
PARTICLE TYPE: Small Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-32.1	7.3	.0547	3.9E+00	307	9664	.54
STANDARD DEVIATION	.1	.0	.0037	3.3E-01	1	623	.01



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	7.93E+08	27	4.38E+04	466	4.92E+03
4	2.71E+08	50	5.77E+04	744	7.07E+03
6	1.75E+08	73	2.49E+04	1089	6.97E+02
8	1.41E+08	96	3.93E+04	1434	1.07E+02
10	9.65E+07	119	3.46E+04	1779	1.57E+01
12	7.72E+07	142	2.47E+04	2124	1.09E+01
14	4.50E+07	165	2.45E+04	2469	6.83E+00
16	5.82E+07	188	7.17E+03	2814	0.
18	3.51E+07	211	1.55E+04	3159	0.
20	1.85E+07	234	5.72E+03	3504	0.
22	1.54E+07	257	4.10E+03	3849	0.
24	1.43E+07	280	4.85E+03	4194	0.
26	1.27E+07	303	4.35E+03	4539	0.
28	1.05E+07	326	4.13E+03	4884	0.
30	9.11E+06	349	4.25E+03	5229	0.
LWC	2.29E-03		2.45E-03		5.22E-02

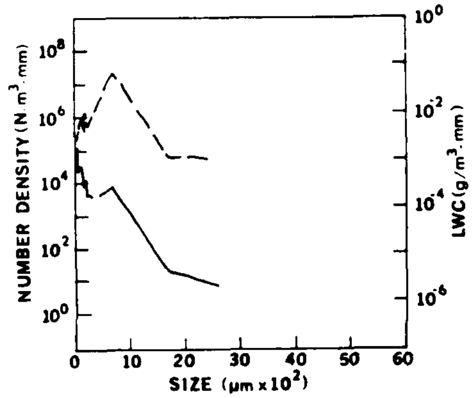
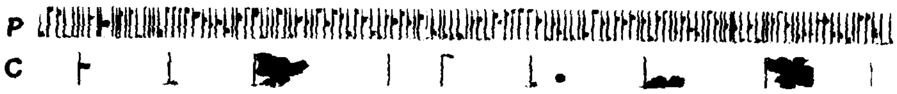


Figure 49. Sample Data From 400 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

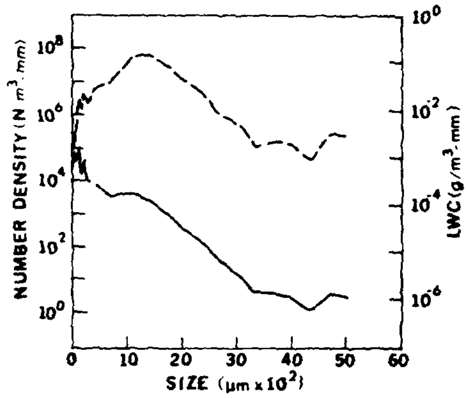
TIME: 1632-1634Z
PARTICLE TYPE: Large Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-19.7	5.6	.1910	8.1E+01	326	15318	.[illegible]
STANDARD DEVIATION	.1	.0	.0193	6.0E+00	8	1060	.[illegible]



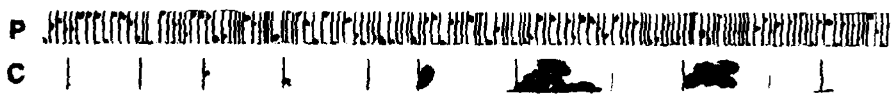
PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	6.22E+08	27	7.62E+04	466	5.40E+03
4	3.24E+08	50	1.37E+05	744	2.45E+03
6	2.13E+08	73	3.29E+04	1089	3.17E+03
8	1.63E+08	96	5.21E+04	1434	2.07E+03
10	1.22E+08	119	6.69E+04	1779	7.69E+02
12	9.51E+07	142	5.13E+04	2124	2.24E+02
14	6.96E+07	165	3.72E+04	2469	8.37E+01
16	7.57E+07	188	1.39E+04	2814	1.90E+01
18	5.22E+07	211	2.81E+04	3159	9.10E+00
20	3.10E+07	234	1.61E+04	3504	2.33E+00
22	2.40E+07	257	1.27E+04	3849	2.53E+00
24	2.19E+07	280	7.85E+03	4194	1.66E+00
26	2.15E+07	303	7.95E+03	4539	6.07E-01
28	1.89E+07	326	8.26E+03	4884	2.02E+00
30	1.91E+07	349	7.72E+03	5229	1.52E+00
LWC	3.60E-03		4.71E-03		1.86E-01



TIME: 1654-1656Z
PARTICLE TYPE: Large Snow

	TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
MEAN	-19.6	5.7	.2082	9.6E+01	496	17163	.31
STANDARD DEVIATION	.0	.0	.0030	1.1E+01	31	1729	.07



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.02E+09	27	1.60E+05	466	5.00E+03
4	2.00E+08	50	9.40E+04	744	4.34E+03
6	2.11E+08	73	5.57E+04	1089	4.05E+03
8	1.67E+08	96	6.71E+04	1434	2.00E+03
10	1.23E+08	119	6.49E+04	1779	6.45E+02
12	9.20E+07	142	5.99E+04	2124	1.00E+02
14	6.69E+07	165	4.92E+04	2469	7.78E+01
16	7.07E+07	188	2.40E+04	2814	1.76E+01
18	5.05E+07	211	3.69E+04	3159	6.67E+00
20	2.90E+07	234	2.00E+04	3504	2.08E+00
22	2.59E+07	257	1.99E+04	3849	7.53E-01
24	2.21E+07	280	9.43E+03	4194	4.91E+00
26	1.90E+07	303	9.03E+03	4539	3.00E-01
28	1.76E+07	326	7.02E+03	4884	5.34E+00
30	1.40E+07	349	6.79E+03	5229	4.13E+00
LWC	3.37E-03		5.57E-03		2.03E-01

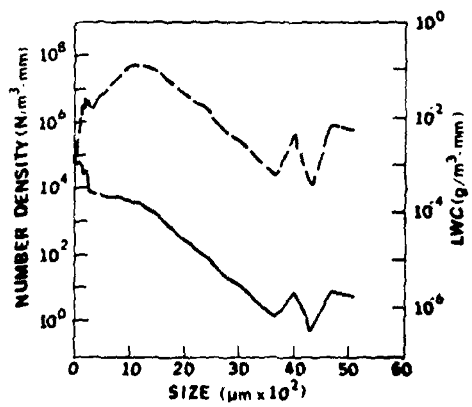
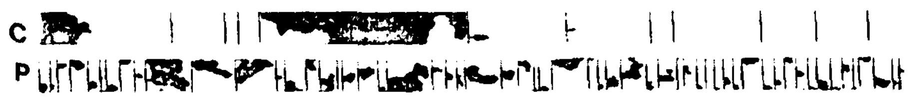


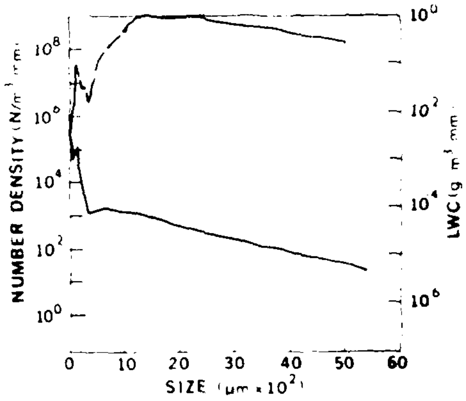
Figure 50. Sample Data From 500 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

		TEMP	ALT	LWC	Z	DO	NT	FF
		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
TIME: 1710-1712Z	MEAN	-2.7	3.0	3.0141	6.2E+04	1851	17266	.22
PARTICLE TYPE: Wet Snow	STANDARD DEVIATION	.1	.0	.3262	1.1E+04	112	2284	.01

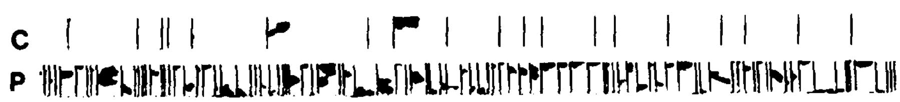


PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	6.14E+08	23	1.30E+07	412	1.52E+03
4	2.97E+09	43	1.77E+05	648	1.87E+03
6	1.35E+09	73	7.08E+04	1089	1.44E+03
8	3.63E+08	96	9.06E+04	1434	1.07E+03
10	1.34E+08	119	1.53E+05	1779	6.88E+02
12	9.10E+07	142	4.85E+04	2124	4.73E+02
14	6.83E+07	165	3.78E+04	2469	3.35E+02
16	7.24E+07	188	1.41E+04	2814	2.34E+02
18	5.00E+07	211	7.39E+03	3159	1.73E+02
20	3.52E+07	234	6.18E+03	3504	1.17E+02
22	3.47E+07	257	4.05E+03	3849	1.04E+02
24	2.74E+07	280	2.46E+03	4194	6.69E+01
26	2.55E+07	303	1.33E+03	4539	4.97E+01
28	2.15E+07	326	1.28E+03	4884	4.26E+01
30	2.47E+07	349	1.29E+03	5229	3.31E+01
LWC	4.77E-03		1.61E-02		3.00E+00



		TEMP	ALT	LWC	Z	DO	NT	FF
		C	KM	G/M**3	MM**6/M**3	MU	N/M**3	
TIME: 1722-1724Z	MEAN	-2.5	3.0	1.9082	1.8E+04	1427	39315	.12
PARTICLE TYPE: Wet Snow	STANDARD DEVIATION	.1	.0	.9784	1.1E+04	158	20974	.03



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	8.00E+07	23	2.50E+05	412	2.12E+04
4	1.09E+09	43	1.20E+06	648	2.02E+03
6	2.50E+09	73	9.03E+04	1089	9.57E+02
8	2.45E+09	96	1.00E+05	1434	6.84E+02
10	1.71E+09	119	8.15E+04	1779	4.24E+02
12	1.19E+09	142	1.13E+05	2124	2.40E+02
14	6.72E+08	165	1.08E+05	2469	1.49E+02
16	5.86E+08	188	9.41E+04	2814	8.55E+01
18	2.98E+08	211	1.06E+05	3159	6.02E+01
20	1.38E+08	234	9.29E+04	3504	3.34E+01
22	9.74E+07	257	9.62E+04	3849	2.44E+01
24	6.55E+07	280	6.86E+04	4194	1.34E+01
26	5.20E+07	303	5.09E+04	4539	9.00E+00
28	3.37E+07	326	5.15E+04	4884	7.25E+00
30	3.13E+07	349	4.05E+04	5229	5.45E+00
LWC	1.86E-02		1.47E-01		1.76E+00

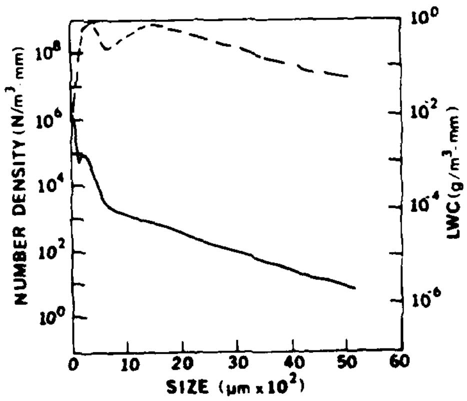
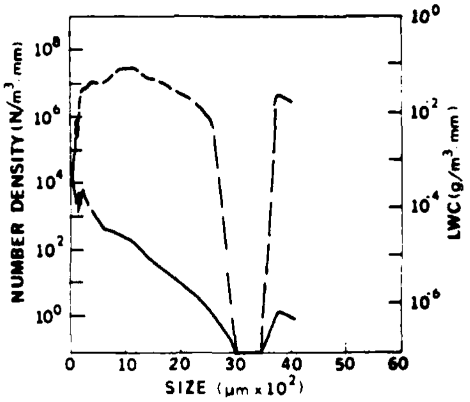


Figure 51. Sample Data From 700 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

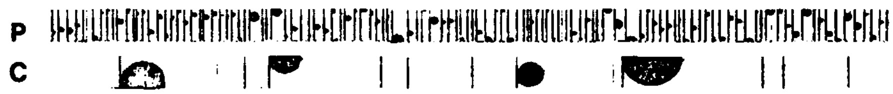
		TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 1740-1742Z	MEAN	6.0	1.4	.1622	2.7E+03	1289	2297	.18
PARTICLE TYPE: Rain	STANDARD DEVIATION	.2	.0	.0192	1.2E+03	149	634	.08

PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	3.89E+08	23	4.32E+04	405	1.52E+03
4	2.06E+09	43	3.44E+04	648	3.07E+02
6	1.44E+09	63	7.16E+03	945	2.41E+02
8	3.74E+08	83	5.34E+03	1242	1.16E+02
10	9.33E+07	103	2.16E+03	1539	3.34E+01
12	3.32E+07	122	4.30E+03	1836	1.60E+01
14	2.16E+07	142	5.92E+03	2133	5.78E+00
16	1.10E+07	162	1.39E+03	2430	2.47E+00
18	7.43E+06	182	5.26E+03	2727	6.53E-01
20	4.31E+06	202	2.05E+03	3024	0.
22	3.12E+06	221	6.77E+03	3321	0.
24	1.79E+06	241	4.99E+03	3618	0.
26	1.08E+06	261	3.78E+03	3915	9.19E-01
28	1.44E+06	281	3.18E+03	4212	5.19E-01
30	1.56E+06	301	2.82E+03	4509	0.
LWC	1.36E-03		4.64E-03		1.58E-01



		TEMP C	ALT KM	LWC G/M**3	Z MM**6/M**3	DO MU	NT N/M**3	FF
TIME: 1758-1800Z	MEAN	5.6	1.5	.2711	3.6E+03	1469	3461	.16
PARTICLE TYPE: Rain	STANDARD DEVIATION	.3	.0	.0344	1.3E+03	79	847	.03



PARTICLE SIZE DISTRIBUTION (N/M**3-MM)

SIZE (MU)	SCATTER PROBE	SIZE (MU)	CLOUD PROBE	SIZE (MU)	PRECIP PROBE
2	1.20E+08	23	1.16E+05	405	1.61E+03
4	1.58E+09	43	7.59E+04	648	4.60E+02
6	1.98E+09	63	1.61E+04	945	2.07E+02
8	1.25E+09	83	9.61E+03	1242	1.70E+02
10	6.57E+08	103	3.62E+03	1539	8.00E+01
12	3.25E+08	122	3.25E+03	1836	3.95E+01
14	1.45E+08	142	5.06E+03	2133	1.80E+01
16	7.43E+07	162	2.78E+03	2430	4.95E+00
18	2.60E+07	182	4.88E+03	2727	2.32E+00
20	1.01E+07	202	3.67E+03	3024	7.12E-01
22	7.45E+06	221	4.48E+03	3321	1.96E+00
24	3.01E+06	241	4.52E+03	3618	0.
26	5.17E+06	261	3.55E+03	3915	4.65E-01
28	3.48E+06	281	3.10E+03	4212	0.
30	4.80E+06	301	2.79E+03	4509	0.
LWC	4.10E-03		4.40E-03		2.67E-01

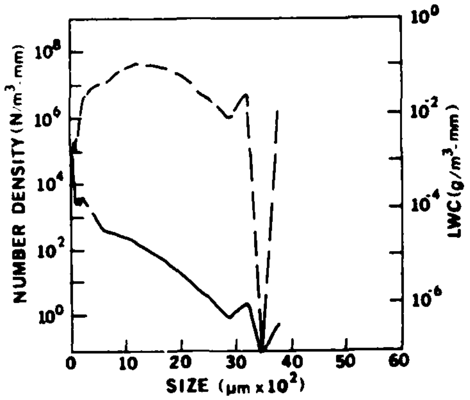


Figure 52. Sample Data From 850 mb - 26 March 1978. The particle distributions are averages for 2-min periods. The 2-D shadowgraphs were selected from the 2-D data collected during the 2-min period

Although its derivation seems arbitrary (see Varley[5]) the Form Factor did provide a way of characterizing particle distributions. Figure 53 shows the average of the Form Factors of the two 2-min samples taken at each level on each flight. The convective clouds increased vertical mixing and as a result the first case (23 March) showed the most uniform distribution of Form Factor with altitude. On 24 March, the storm retained convective characteristics and also had the second most uniform distribution of Form Factor. The weak stratiform case on 25 March shows the widest variation. In all cases, the Form Factor decreased between 400 and 700 mb and between 500 and 850 millibars. In general, the Form Factor at higher levels (between 400 and 500 mb) increased with time indicating that the more stratified clouds had a concentration of similar-sized particles. The Form Factor at lower levels (700 and 850 mb) showed no definitive pattern which showed that changes there were more random.

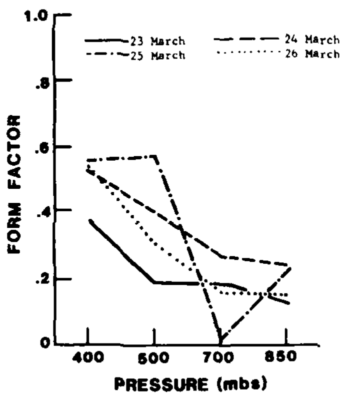


Figure 53. Average Form Factor of 2-min Samples vs Altitude for Each of the Four Sampling flights

In Figure 54, the same method has been used to compare mean particle diameters. In all four cases, the largest particles occurred at the 700-mb level. This was usually the level closest to the melting layer. In all cases, the particle size at 400 mb was small. The mean size was also consistent from sample to sample. This was not the case at 700 or 850 mb as can be seen by examining Figures 37 to 52. As a general rule, the larger the particle diameters, the larger the variability. The larger particles found in the lower levels of the 23 and 26 March cases may be due to the warmer temperatures since warmer air can hold more water vapor. On both of these days, the 850-mb temperatures were 5°C or warmer, while on the other days, 850-mb temperatures were generally below 0°C.

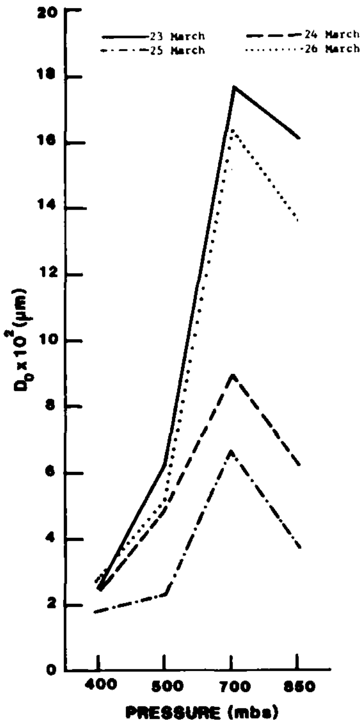


Figure 54. Average Particle Size During 2-min Samples vs Altitude for Each of the Four Sampling Flights

These two quantities illustrate the general tendency of a more consistent cloud above 20,000 ft during the life of the storm, while larger changes in crystal type, density, size, and structure occurred at lower levels. Additionally, the higher level clouds tended toward enhanced particle distributions (see Houze et al[8]), while suppressed distributions were more common at lower levels. Sublimation at higher levels and aggregation at lower levels could give rise to this result.

In effect, there was a tendency toward a uniform type of particle distribution along the vertical axis in the case of a convective storm. The stronger vertical currents caused a more even distribution of particles with altitude. Form Factor and liquid water content varied less from level to level on 23 March than on 25 or 26 March.

9. CONCLUDING COMMENTS

The storm of 23 to 27 March 1978 provided an excellent example of a developing mid-latitude cyclone. The data provided by the MC-130E provide an in depth, detailed look at the development of the storm; the microphysical development of the clouds in the system.

This was a good example of a fairly intense large scale storm. Although the data presented represent only a small sample of the clouds associated with the storm, some essential features of the storm system were sampled, described, and characterized. The fine scale, microphysical data delineate regions dominated by sublimation or aggregation. Future studies of the onset of aggregation and its causes could reveal the potential for advancing or delaying aggregation. Any control in the onset of aggregation would modify the ground precipitation patterns.

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AFB	Air Force Base
AFGL	Air Force Geophysics Laboratory
Ci	Cirrus
Cu	Cumulus
DO	Medium Volume Diameter
EWER	Evaporate the Water that aggravates Erosion on Reentry
FF	Form Factor
GOES	Geostationary Environmental Satellite
Hdg	Aircraft Heading
IAS	Indicated Airspeed (knots)
INS	Inertial Navigation System
km	Kilometer
LWC	Liquid Water Content
m	Meter
mb	Millibar
McIDAS	Man-Computer Interactive Data Access System
mi	Miles
mm	Millimeter (= 10^{-3} meters)
nm	Nautical Miles
NT	Number Density; Total Number of Particles per Cubic Meter
OAT	Aircraft Outside Air Temperature (degrees, Celsius)
PMS	Particle Measuring Systems, Incorporated

Sc	Stratocumulus
St	Stratus
TAS	True Airspeed (knots)
TT	Rosemount Total Temperature
Vis	Visibility
Z	Reflectivity or Greenwich (Universal) Mean Time
μm	microns (= 10^{-6} meters)
1-D	One Dimensional PMS Probe
2-D	Two Dimensional PMS Probe

Appendix A

Mission Director's Comments

Excerpts from the written notes and those recorded on the voice tape by the Mission Director, Capt Donald Cameron, are presented here. Remarks in parentheses are additions by the author based on the voice tapes, nose camera film, and photographs taken by the Mission Director.

All temperatures are those read from the aircraft outside air temperature indicator. These are generally warmer than the actual air temperature. The Rosemount Total Temperature readings are included in the listings found in Appendix B.

Aircraft position is reported as "Latitude/Longitude" and is given in degrees and minutes.

Winds are reported as "Direction in degrees/speed in knots".

Flight Notes From 23 March 1978 - Mission 78-10

TIME (Z)	COMMENTS
19:10:00	(Rain reported by crew while preparing for takeoff from Kirtland AFB.)
19:11:51	(Thunderstorm with hail observed by aircrew.)
19:25:53	Takeoff from Kirtland AFB, New Mexico.
20:24:17	12 mi West of Amarillo.
20:28:00	Most clouds in the area look solid with good vertical development.
20:29:00	Setting up a leg between Dalhart and Texico.
20:31:05	Ran out of clouds, about to go back into them.
20:32:47	Clouds now very thick; at Amarillo, there weren't any clouds.
20:34:14	Altitude: 23,600 ft; Heading: 286; Winds: 035/21; TAS: 248; IAS: 170.
20:36:35	Going into clouds soon. Coming to tail clouds 8-9,000 ft above us. Moderate snow, occasional light turbulence.
20:39:00	BEGIN PASS 1: Alt: 23,700 ft; 40 NM east of Dalhart. Heading 272 and turning. INS Winds: 183/28 - 0.3 to 0.3 mm particles Max = 0.6 mm.
20:40:37	Gray outside from top to bottom. TAS 219.
20:41:14	116 deg/33 nm from Dalhart.
20:41:43	0.3 mm particles - IAS 150, TAS 220, sky still gray. Horizontal visibility 1 nm. Occasional light turbulence.
20:43:07	Passed a brief break in the clouds. Particle sizes 0.2 to 0.4 mm; sizes gradually increasing. Plates are common.
20:45:07	Can see a layer below. Still light updates. Ci has thinned out; Filaments are going by.
20:47:18	Sc undercast with towering Cu coming through it.
20:50:00	END PASS 1. Beginning a spiral descent, undercast Sc, Cu popping through. Clear above.
20:55:54	Coming under a cloud deck.
20:56:58	Position: 35.57/102.26. Under cloud band.
20:58:00	BEGIN PASS 2. Position: 35.54/102.22, Wind 243/22; 15 nm from Dalhart.
21:00:35	Solid undercast. Fairly solid overcast with CU activity.
21:01:52	Nothing on snowstick. Gray all over.
21:04:46	Broke out of clouds. Solid undercast. Sc and Cu.
21:06:37	Back into clouds Spotty snow, many sizes—from 0.2 to 2.0 mm on snowstick.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

TIME	COMMENTS
21:08:13	18 nm from Amarillo. Larger snowstick activity, about 3 mm.
21:09:52	Good 2.0 mm updates. It is gray out; can not see up or down. Can locate the sun only by its brightness.
21:11:04	Moderate snow. Light turbulence. Sizes 0.6 - 0.7 mm to 2.0 mm.
21:12:06	Hdg 130; six miles from Amarillo.
21:14:00	END PASS 2. Large snow - moderate. Particles as big as 3.0 to 4.0 mm.
21:26:00	In clear air.
21:26:26	Weather has changed rapidly. Since arriving in the area, the system has moved from west of Amarillo to Amarillo to east of Amarillo.
21:28:10	Clouds are now past Amarillo; nothing to the west.
21:30:00	BEGIN PASS 3. 9,880 ft. Wind 262/14. Between layers; Ci and middle cloud above. Undercast below, position 35.40/105.57.
21:31:43	Still between layers. Horizontal bands to the side.
21:33:00	Between layers. 1500 feet above the lowest layer. Not getting any droplets. 2 to 3 thousand feet below bases of upper layer.
21:34:22	Getting into haze. Sun not visible. Nothing on probes or snowstick.
21:35:37	Position: 35.42/101.37. Getting some fallout from cloud above. Can see virga.
21:38:42	Horizontal visibility is now 15 miles. Decreasing as we go into underhang from clouds. Wet snow - particle sizes 2 to 3 mm - on snowstick.
21:39:42	Completely in cloud. OAT = +4. In a turn. TAS - 180.
21:40:27	Snow grains - 2 to 3 mm. Some melt, others do not.
21:41:15	Breaking into a clear area. Position: 35.40/101.14
21:42:00	END PASS 3.
21:42:28	Enroute to NE Oklahoma. (Enroute to the next area aircraft climbed to 23,000 ft. At that altitude, it was in the clear until 2200Z.)
22:00:00	(From here until arrival at the next area, aircraft was in and out of clouds.)
22:40:40	BEGIN PASS 4. 23,000 ft. OAT - 20 IAS 148 in cloud - have been for a while A little icing on wingtips.
22:41:22	Heavy particles 0.4 to 0.8 mm on snowstick.
22:43:20	Crystals appear to melt. Maximum size 1 mm - getting into heavier precipitation.
22:44:37	Hdg 200. Pos. 35.53/95.47. Wind 233/34 strictly in cloud.
22:45:38	Little icing on the wing. Can not see filaments - only gray.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

TIME	COMMENTS
22:46:22	Consistent cloud. Size of particles 2 mm, 0.5 mm width. Clouds are black to gray.
22:48:37	Still in cloud. Most particles are 0.3 to 0.8 mm. Maximum particle size is 1 mm.
22:49:08	Possibly a little lighter out. Still gray. Hdg 005. Pos 36.13/95.39. Wind 231/39 TAS 224, IAS 151. Small counts on Precip probe.
22:50:46	In cloud. Particles a bit smaller - 0.3 to 0.5 mm. Wing visible. Horizontal Vis 1/2 mi. No ice on windsheild. Alt 23.6 m Had 002.
22:52:37	Stick not icing as before. Particle distribution is bimodal. Peaks at 0.2 and 0.8 mm.
22:54:25	Sun very dimly visible through clouds above. Ice on edge of wing.
22:56:23	A little turbulence. Particles going to 2.0 mm.
22:58:49	Turbulence decreasing. Particles 0.3 to 2.0 mm. Still in gray clouds.
23:00:25	Particle size getting a bit smaller.
23:02:00	END PASS 4. Will descend to 18,000 ft, then turn around to start pass.
23:06:26	(Navigator notes storms about 20 NM out.)
23:09:47	In cloud. 18,300 ft alt. Deviating to avoid thunderstorms.
23:11:07	Snow - up to 3 mm. Snowstick quickly covered with snow.
23:12:50	Position 36.43/95.29.
23:13:30	Particles now smaller - about 0.3 mm.
23:15:22	Back to larger snow, almost wet. About 0.8 mm. 6-sided crystals.
23:16:23	Position 36.34/96.25. Wind 238/24.
23:19:07	Still gray. Hdg 200. Wind 242/27. 47 nm from Okmulgee, Oklahoma.
23:19:54	Snowstick range 0.4 to 1.0 mm.
23:20:32	Patches of small snow alternate with large ones.
23:22:05	Altitude change to 17,100 ft beginning at 2323Z. Position 36.15/95.35. Wind 240/23 - have picked up.
23:24:23	Sizes of particles are larger. More at 1-2 mm. 60% still 0.3 to 0.4 mm.
23:25:25	Max particle size 1.5 mm Min size 0.4 mm.
23:26:17	Some particles are 3.0 mm. No turbulence. Alt 17,200 ft. 25 mi from Okmulgee. Position 36.05/95.40, Wind 220/24.
23:28:35	Snowflakes visible. Max size 2 mm. Occasional light turbulence.
23:29:16	Size dropping off to 0.9 mm.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

TIME	COMMENTS
23:32:47	Big particles on 2D, but the recorder had stopped.
23:33:00	END PASS 5.
23:36:00	Lightning just ahead. Position 35.41/95.51. Winds 218/22.
23:43:00	BEGIN PASS 6.
23:43:35	Getting large wet snow. 3 to 4 mm sizes. Occasional light turbulence.
23:45:07	Altitude 9,900 ft. Wet snow. Particles as large as 5.0 mm.
23:46:28	Position: 36.08/95.40. Wind 220/15.
23:47:10	No definitions of clouds just uniform gray up and down. OAT +4, TAS 174, Hdg 008. Pos. 36.13/95.38. Wind 213/27.
23:48:10	Still wet snow, 2 to 3 mm. Melting as it hits the stick. Intensity: light.
23:50:03	Gray, wet snow. Sizes a bit smaller. 3 mm max. TAS 187 Hdg 012.
23:51:20	Particles a bit bigger—to 4.0 mm.
23:53:52	Wet snow melts when hitting the stick. Diameters to 6 mm.
23:55:45	TAS 184. Position: 36.37/95.26.
23:56:30	Data still verv consistent.
23:57:07	(More lightning observed by crew)
23:57:37	More intense 2 to 3 mm wet snow. IAS 150.
23:58:55	Moderate rain, occasional snow. Light turbulence. Position: 36.48/95.16. Wind 300/09.
00:00:38	Wet snow then rain, lightning to the right.
00:02:30	Occasional light turbulence. Wet snow. 2 to 3 mm occasionally heavier.
00:02:45	Gray outside. Consistent at all levels.
00:03:20	Clouds have appeared below. CU type. The first time in awhile that structure is visible.
00:05:00	END PASS 6. Wet snow; uniform gray.
00:18:23	In rain. Good streaks. Alt 5,000 ft.
00:19:30	BEGIN PASS 7. Alt 4.9 m. Hdg 212. Light rain.
00:20:08	Position 36.44/95.21. Wind 161/04. Small clouds to the side. Clouds above a little lighter than before.
00:20:41	Lower layer tops 3000 ft, solid undercast. Also solid overcast. Tops are 6000 ft to the west. Rain intensity has decreased.
00:22:57	In light rain between layers. Sc, St below; some Sc at 5 to 6 thousand feet.
00:23:38	Getting rain from the layer above.

Flight Notes From 23 March 1978 - Mission 78-10 (Cont)

TIME	COMMENTS
00:24:55	Visibility decreasing. Still in light rain. TAS 165.
00:27:30	Still in light rain. Going through the base of a cloud.
00:30:35	Cu clouds; ground visible. Low broken St 700 ft above the ground. Broken layer 4 to 7 thousand feet. Still in continuous light rain.
00:32:36	Hdg 200. Alt 4,800 ft. TAS 164 Position: 6.14/95.39. Wind 160/04. Starting to see clouds and particles going by.
00:33:23	Light to moderate rain. In and out of cloud. Tops 6M.
00:34:00	Back into cloud. Occasional light turbulence.
00:36:57	Rain is a bit lighter. Ground visible. Out of clouds. Broken St below at an altitude of 2500 to 3500 ft.
00:37:40	Still getting light rain. Horizontal visibility 4 nm. Alt 4700 ft.
00:40:00	END PASS 7. TAS 160; IAS 149.
00:43:32	Climbing to 19,000 feet.
01:36:00	Land at Little Rock AFB, AR.

Flight Notes From 24 March 1978 - Mission 78-11

TIME	COMMENTS
17:46:20	Takeoff from Little Rock AFB, AR.
17:49:00	(Aircraft is climbing through low cloud layer.)
19:43:00	BEGIN PASS 1. In cloud. Heading 246. Position 41.10/89.40. True Airspeed 220. Indicated Airspeed 150 knots.
19:43:55	Sun a little brighter now. Light but increasing activity on the snowstick. 0.8 mm average.
19:44:41	Altitude, 23,400 ft. IAS 145, TAS 213, Outside air temp -19.
19:45:35	Position 41.07/89.49. Wind 166/24.
19:46:35	Snowstick particles are smaller - 0.2 to 0.3 mm. Intensity is light.
19:48:37	Snowstick particles are now round. Cloud has filaments. A bit of blue is visible. Tops appear 3,000 ft up. Horizontal visibility 2 miles. Gray below.
19:49:21	Very little evidence of icing.
19:50:29	Sky almost blue, but in a wall of clouds. Clouds still extend 2 to 3,000 feet up.
19:52:11	Clouds are a bit lighter than yesterday.
19:54:42	Looks like it is getting thinner above.
19:55:50	Jet passed; no contrails. Grayish above. No distinction of cloud below.
19:58:46	Particle size increasing. Intensity moderate. Stick fills up in 5 to 6 seconds. Size 0.4 to 0.5 mm. Max 1.0 mm.
20:00:17	Intensity now light to moderate. 40.56/91.02. Wind 129/15. TAS 223 OAT -20 to -21.
20:01:10	Size more consistent. Intensity is heavier.
20:13:25	Position 40.34/96.19. Wind 120/31. Probably going through the tops of Cu. Nothing on radar.
20:04:21	Snowstick particles a bit larger - average size 0.8 mm.
20:04:39	Particles now a bit smaller - roundish - 0.9 mm max; width 0.4 mm.
20:05:35	Starting to break out. Patch ahead.
20:07:00	END PASS 1. Clouds to the right; open to the left. Position 40.51/91.39 - is 10 nm after leaving clouds.
20:11:22	Level and in clouds at 40.50/91.57.
20:15:00	BEGIN PASS 2.
20:15:21	40.54/91.57. Between layers. Hdg 080. Wind 134/13.
20:16:52	Bright above. Ci well above.
20:17:52	Alt. 18,300. Still between layers.
20:19:27	Round snow - may be icing up. Flakes are 1 to 2 mm.

Flight Notes From 24 March 1978 - Mission 78-11 (Cont)

TIME	COMMENTS
20:20:32	Completely overcast. Now in clouds. Alt 18,300.
20:22:37	Sun briefly visible. 0.3 mm particles are probably fallout from Ci.
20:23:47	41.00/91.22. Wind 156/18. Very light snow. Can see clouds passing.
20:28:22	In and out of Cu. Light Chop. Sun visible. Thin Ci overcast above. Light snowstick activity.
20:29:21	At 18,000 ft. Horizon has disappeared.
20:30:12	Light Chop. Particles are a bit larger — to 0.6 mm.
20:31:00	Horizon visible to left; not to right. Snowstick icing up.
20:32:12	Back in clouds. Light snowstick activity. Sizes 0.6 to 0.7 mm.
20:33:57	Between layers.
20:35:40	In clouds. Looks like large snow. 1 to 2 mm.
20:36:47	Position: 41.06/90.26. Wind 185/32.
20:39:47	Can see horizon. Can see sun. Snowstick particles 1 to 2 mm. Occasionally 3 mm.
20:42:36	Smaller, elongated particles on snowstick. 1 mm long; 0.4 mm wide.
20:44:00	Particles more elongated. Narrow, bunched up snow, some ice on probes.
20:45:10	18,600 ft. 2.0 mm particles on snowstick. Sun appears as a bright spot. Overcast above and below. Wind 201/18.
20:46:00	END PASS 2. Position 41.10/89.43.
20.56:35	(Winter storm advisories are up for IN, IL, OH).
20:57:30	BEGIN PASS 3. 9,600 ft. Gray outside. Winds 133/29. Pos. 41.07/90.10 OAT +1. Dew Pt. -3. Snowstick iced up.
20:58:37	Wet, melting snow.
20:59:30	Rain and snow mixed. Particles to 3 mm. Alt 9700 ft. Hdg 248.
21:00:07	33 nm from Bradford. Most particles are droplet size.
21:00:48	Rime type icing. Easy to remove. Snow occasionally visible.
21:01:27	41.04/90.23. OAT = -1. Dew Pt -2.7 Occasional snow, but mostly water. Size 0.8 mm. Stick freezes.
21:03:20	Rime icing on windshield.
21:05:03	Little snow now - mostly rain.
21:06:33	41.02/90.44. Wind 118/31. TAS 174. IAS 150; bottom windows are covered with ice.
21:11:01	More rain and rime icing. Flakes to almost 4.0 mm; large snow.
21:12:30	Solid looking 3 mm globs. Also wet snow. IAS 150. TAS 172. Alt. 9,700.

Flight Notes From 24 March 1978 - Mission 78-11 (Cont)

TIME	COMMENTS
21:15:46	Well formed 2 to 3 mm snowflakes.
21:17:00	OAT is just above 0.
21:18:10	Alternating between wet and large snow.
21:19:57	More icing, wet snow 2-3 mm max. Most flakes about 1 mm.
21:21:41	Hdg 250. Dew Pt -4.0.
21:25:00	END PASS 3.
21:29:58	Alt 7,200, observing big, wet snow.
21:30:59	Flight has been smooth.
21:32:57	Still getting wet snow. Icing on probes.
21:36:00	BEGIN PASS 4. In wet snow at 5,000 ft.
21:37:18	Sizes 2 to mm. Alt 4,700 ft. TAS 159, OAT = +2, IAS 150.
21:40:25	Often in precipitation.
21:41:55	Dew Pt 0, OAT +2. Occasional snowflakes, but mostly rain.
21:43:30	Rain and snow mixed.
21:44:38	TAS 159. Alt 4,700. Hdg 078. 40.56/91.26. OAT +3.
21:46:22	More wet snow. Sizes range from 1 to 2 mm.
21:48:00	Sizes of flakes are increasing. One was 5.0 mm.
21:49:11	Rain and snow mixed.
21:54:40	Alt 4,700 ft. TAS 159. OAT = +3. Position: 40.69/91.01. Wind 092/38. Wet snow. A trace of icing. Snow diameters 0.3 to 3.0 mm.
21:57:55	Snow shapes are irregular. OAT +3.
22:00:00	41.01/90.48. Dew Pt = -0.7. TT +3. END PASS 4.
22:05:27	Climbing to 17,000 ft for the flight back to Wright-Patterson AFB.
23:02:40	Ice forming on the leading edge of the wing.
23:03:30	(Crew can see the ground.)
23:40:00	Land at Wright-Patterson AFB, OH.

Flight Notes From 25 March 1978 - Mission 78-12

TIME (Z)	COMMENTS
16:56:00	(Pilot notes low ceilings at Wright-Patterson AFB.)
17:05:25	Takeoff from Wright-Patterson AFB, OH.
17:34:00	(Ci; changes from overcast to scattered.)
18:00:00	BEGIN PASS 1. Between layers. Ci and halo above. Ci about 4 to 5,000 ft up.
18:00:41	On snowstick, light activity. Looks like small snow.
18:01:12	TAS 219. Hdg 109. 75 mi from Bradford, PA.
18:02:00	Position 41.44/80.15. OAT -20. Wind 238/34. Vis 3 mi in cloud and haze. Top of lower cloud layer visible.
18:03:48	Altitude: 25,000 ft.
18:04:00	Totally gray ahead, but currently in an open area.
18:05:30	Clouds at flight level. Small snow on the stick - 0.4 to 0.5 mm. 2-D shows elongated particles.
18:07:42	Halo still visible. Hard to see lower clouds. Snowstick activity has decreased. Visibility has improved.
18:16:23	Alt 23,600. IAS 150. TAS 219. OAT -21. 44.78/78.56. Wind 234/39. Snowstick -0.2 mm. Activity is light.
18:18:57	41.44/78.44, IAS 150. Can see texture of clouds above. Snowstick 0.2, occasionally 0.5 mm.
18:20:30	END PASS 1. Clouds today are thinner and more stratified than in previous days.
18:27:00	Level. BEGIN PASS 2. Alt 18,300 ft. TAS 206. Position: 41.46/78.58.
18:28:30	Wind 218/34. Snowstick particles up to 2 mm. Average 0.8 mm.
18:29:19	Uniformly gray.
18:30:37	41.46/79.10. 0.8 - 0.9 mm. Occasionally 1.5 mm. Intensity back to light. Most flakes are round. A few are elongated.
18:31:34	Halo above.
18:32:38	Lower tops 9 to 10,000 ft. Blue patch above.
18:33:33	Little on snowstick.
18:34:33	Overcast 3,000 ft above.
18:39:17	A little bounce. Can see clouds below. Contrails overhead. Can see through Ci. Looks grayer ahead.
18:40:20	Entering clouds. Snow stick has 0.4 to 0.5 mm particles. Alt 18,300 ft. More clouds ahead.
18:40:52	41.46/79.50. Wind 224/28. Snowstick 0.2 - 0.3 mm.

Flight Notes From 25 March 1978 - Mission 78-12 (Cont)

TIME	COMMENTS
18:42:14	Stratified clouds to the right. 3 layers of Ac and As.
18:43:12	2000 ft below solid Ci. Clouds lower to the left. Few clouds to the south.
18:44:20	Will terminate pass early due to lack of clouds at 18,000 ft.
18:46:00	END PASS 2. 41.47/80.09. Wind 224/28.
18:47:12	Clouds are light-between layers. Undercast left. 3000 ft below.
18:48:45	Open sky south. Alt 15,700. Undercast 2000 ft down.
18:51:00	Entering cloud tops at 13,500 ft. OAT -2.
18:52:02	Snowstick is freezing up. Mostly rain.
18:53:26	In freezing rain.
18:57:00	BEGIN PASS 3. Much cloudiness at 10,000 ft. Dew Point +1.9. Mostly rain. Occasional snowflakes. Alt 9,600.
18:59:37	Water streaming off the window.
19:03:00	Freezing rain reported in Maryland.
19:03:42	OAT +2. TAS 173. Position: 41.47/80.12. Wind 230/24. Can not see texture of clouds. Visibility 1/2 mi. Rime icing on wing.
19:09:10	Icing, but few particles on the snowstick.
19:10:50	Altitude 9,600 ft. Ice on intakes.
19:11:34	In rain. Icing coming from precipitation. More icing than yesterday.
19:13:26	TAS 171. OAT 0. 41.48/79.33 241/21. Icing: poor visibility, definitely in cloud. No flakes hit the snowstick.
19:19:20	Ice readily forms; is easy to knock off. Still raining. Occasional flakes. Alt. 9,550 ft. Hdg 098.
19:23:00	END PASS 3. Terminated early due to aircraft icing problems.
19:28:27	Ground visible. Snow still there.
19:31:00	BEGIN PASS 4. 4,700 ft. Back in large snow.
19:32:05	Snow 2 to 3 mm. down to 0.8 mm. Ground with snow visible. OAT -2. TAS 154. 4,600 ft. Hdg 270.
19:32:44	Position: 41.44/78.05 Wind 130/47. TT -5. Light snowstick activity - elongated Max 2.0 mm.
19:33:34	Fracto Cu below. Bases less than 1000 ft above the ground.
19:38:20	Ground visible. Supercooled water. More clouds below.
19:39:11	Visibility 1/4 mi. Continuous clouds above.
19:43:33	Light turbulence.
19:44:30	Now getting pure rain. In cloud, ground not visible.
19:45:37	Still getting icing on props and probes.
19:46:35	In and out of clouds. Overcast solid above. Only rain on snowstick.

Flight Notes From 25 March 1978 - Mission 78-12 (Cont)

TIME	COMMENTS
19:47:47	Winds dropped to 34 kts.
19:55:00	Light rain. TAS 157. Alt. 4,700. Hdg 275. OAT +4.5.
19:55:49	42.00/78.18. Wind 157/17.
19:57:50	Still looks like rain - light streaking. IAS 150. TAS 160. PAT +4. Pos. 41.43/80.23. Wind 156/17.
19:59:33	Ground and low clouds below. Rain at Acft level. 41.43/80.33.
20:00:00	END PASS 4.
20:40:00	(Between layers.)
20:48:06	(Crew observes rain.)
20:55:30	Final comments. Not as much cloudiness as on previous flights. Much icing at the lower levels. Temperature was constant with altitude at +2 to +4. Rain and snow were mixed at lower levels.
21:02:25	Land at Wright-Patterson AFB, OH.

Flight Notes From 26 March 1978 - Mission 78-13

TIME (Z)	COMMENTS
14:44:40	Takeoff from Wright-Patterson AFB (Into Ragged Sky).
14:47:46	(On top of Sc deck.)
15:24:00	(Aircraft moves below Ci shield.)
15:35:38	(Aircraft goes into cloud.)
16:01:00	Nice Halo. Contrail through Ci. Nothing below. Layer above. Gray on both sides.
16:06:00	BEGIN PASS 1. 23,600 ft. Outside Air Temp = -20. Dew Pt = -30.
16:07:45	Position 40.29/76.40
16:08:46	Can barely see a halo. Winds 260/73. Sun is bright. In light precipitation. No definition of cloud. Particle length 1 mm. Width 0.4 mm.
16:09:36	Intensity is increasing. OAT -20.
16:11:00	Intensity still light. Max Particle 1.5 mm; most are smaller. -0.2 mm.
16:12:51	OAT -20. TAS 222. Particle sizes 1.0 to 0.4 mm. Sun is bright - with halo. Below - solid clouds. IAS 150.
16:13:37	Position: 40.48/76.15. Wind 199/70.
16:14:33	Particle distribution on snowstick is bimodal. Peaks at 0.4 mm and 1.0 mm.
16:16:38	Position: 41.01/76.00. Wind 204/74. Larger particles are round; 1 mm in diameter.
16:17:40	Now particles are smaller. Avg. 0.7 mm.
16:20:52	Nice halo. Sun too bright to look at.
16:22:40	Flakes smaller. Winds 210/65.
16:23:00	END PASS 1.
16:24:30	Descending to 18,300 ft.
16:31:00	BEGIN PASS 2. Alt 18,300. IAS 150 kts.
16:31:40	TAS 202. OAT -10. Snowflakes 2. to 3. mm. Same on precip. Intensity light to mod.
16:32:30	Some particles 0.8 mm. Pos. 41.12/75.49. Winds 202/36.
16:33:27	Wind 213/28. Snowstick - 2 mm avg. Some about 1 mm.
16:35:50	1.0 to 2.5 mm on stick. Light snow. Some elongated.
16:37:16	Breaks in clouds; snow becoming less intense.
16:39:00	Position: 40.48/76.08. Wind 248/14, speed diminishing. Snowflakes light - 1 to 2 mm sizes, some smaller.
16:44:06	Light-Mod. precip. 2 to 3 mm, or smaller. Sometimes they melt on stick.

Flight Notes From 26 March 1978 - Missi ~8-13 (Cont)

TIME	COMMENTS
16:45:10	Clouds consistent; grayer toward the front. Can almost see the sun.
16:46:00	Halo still visible. Clouds are stratified, tops are at 15,000 ft. Few breaks in Ci. Smaller flakes, afg 0.7 mm; Dew Pt -16.8.
16:48:33	Good sized snowflakes. Clouds uniformly gray.
16:50:02	Larger particles now fill stick quickly. Max 3.0 mm. Small ones 0.5 mm.
16:51:27	Alt 18,400. Hdg 226. OAT -10. 40.28/76.41. Wind 186/40.
16:53:00	1 to 3 mm flakes. Look like nice snowflakes.
16:54.00	Larger flakes 2 to 3 mm. Alt 18,400. TAS 205 kts.
16:54:50	Big flakes - look like 5-sided starts.
16:55:25	Position: 40.22/76.51. Winds 187/45. Snowstick bimodal; max 2 mm. Most 0.7 mm. A bit brighter.
16:58:00	END PASS 2. 40.17/76.58. Starting descent to 10,000 ft.
17:03:48	At 15,000 ft and descending.
17:10:00	BEGIN PASS 3. Alt. 9,800 ft. in cloud.
17:11:20	Position: 40.39/76.27. Wind 201/44. Particles melt on snowstick.
17:12:27	In clouds-gray again. Light intensity. Large conglamerations of flakes 2 to 3 mm in diameter.
17:13:42	Dew Pt varying from -1 to +1. Flakes still 2 to 3 mm. Intensity still light.
17:16:02	Little light turbulence. In liquid precipitation.
17:17:24	Into snow. Some round (rain) particles.
17:22:10	12 miles south of Wilkes-Barre, PA. Rain now predominant. Less icing than yesterday.
17:25:00	Dew Pt -0.9. Position: 41.14/75.38. Still in wet snow.
17:26:00	END PASS 3.
17:36:00	Still descending.
17:38:00	(Begin to see the bottom of the cloud.)
17:39:00	Level at 5,000 ft.
17:39:30	BEGIN PASS 4. Scattered stratus 400 to 1000 ft above ground.
17:40:07	Ground visible. In rain below the bases of the overcast. Aircraft is 3000 feet above the ground.
17:41:40	Position: 40.51/76.06. Wind 163/41. Altitude 4500 ft. Light rain. Ground not visible. Light turbulence.
17:45:30	Wind 160/40. In continuous rain.
17:47:00	Breaking into an open area. Ground visible. Clouds at 500 ft and 1000 ft above aircraft. Light turbulence.

Flight Notes From 26 March 1978 - Mission 78-13 (Cont)

TIME	COMMENTS
17:49:27	Ground below is snow covered. We are in rain. Overcast is at 5500 ft.
17:53:48	Position: 40.31/76.31. Wind 157/35. Nothing on snowstick. Rain. Visibility 1/4 mile. Cloud filaments at flight level. Continuous light turbulence.
17:55:12	Cloud tops at flight level—stratified.
17:57:30	Between layers. About one mile visibility. Ground visible through broken Cu below. Moving into heavier rain, obscuring cloud and ground.
18:00:14	Few layered clouds outside.
18:01:50	Light Turbulence.
18:03:45	10 mi from Harrisburg, PA. Visibility 4 mi in light rain. Clouds visible to the side. Clouds appear 1300 ft below.
18:04:24	Going back into cloud. More rain on left side of aircraft.
18:04:57	Visibility decreasing. Dark streak to the right.
18:05:24	Alt 4,700. OAT +7. Pos 40.15/76.55. Wind 166/33.
18:06:30	END PASS 4.
18:08:00	(Climbing-went into cloud deck.)
18:19:00	(Near top of clouds.)
18:23:00	(In Clear between layers.)
18:31:00	(In clear-broken Ci above. Broken Sc below.)
18:49:40	Pos 42.14/80.50. In cloud.
19:15:00	Final comments. Constant clouds and precipitation. Some turbulence.
19:22:45	Land at Wright-Patterson AFB, OH

Appendix B

30-Second Data Averages

Data from the four flights are included in this Appendix. Passes are indicated by brackets, "┌" indicating the beginning and "└" at the end of a pass. Those averages used in the samples discussed in Section 7 are indicated with an asterisk (*).

The following information is included:

START TIME	Time the 30-sec average started,
ALT KM	Average pressure altitude in kilometers,
TEMP C	Average temperature in degrees Celsius,
LWC-SC G/m**3	The Liquid Water Content recorded by the Axial Scattering Spectrometer Probe (ASSP) in grams per cubic meter,
LWC-TOT G/m**3	The Liquid Water Content recorded by the cloud and precip probes in grams per cubic meter.
LWC % CLD	Percent of LWC-TOT recorded by the cloud probe,
DO UM	Medium Volume Diameter in microns,
NT N/M**3	The average number of particles per cubic meter observed during the 30-sec period,
L MAX UM	The diameter (in microns) of the largest particle observed during the period by the 1-D system,
FF	The average Form Factor.

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NOTE: Start times greater than 23:59:59 indicate a time in the next day (GMT), (for example, 24:14:32 on 23 March (Flight 78-10) refers to 00:14:32Z on 24 March.

Although Flight 73-10 did extend into a new "day" in "Z" time, it was completed on 23 March, local time, since there is a 6-hr difference between "Z" time and Central Standard Time.

23 MAR 78 — 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
20:30:08	7.1	-33.4	.0025	.0000	0	217	1	465	1.00
20:30:38	7.1	-33.5	.0027	.0000	81	57	288	465	.26
20:31:08	7.1	-33.3	.0027	.0000	77	68	200	465	.35
20:31:38	7.1	-33.3	.0024	.0000	71	66	46	743	.22
20:32:08	7.1	-33.4	.0028	.0000	71	76	32	465	.55
20:32:38	7.1	-33.1	.0034	.0000	92	60	382	743	.27
20:33:08	7.1	-33.0	.0023	.0000	61	89	24	743	.40
20:33:38	7.1	-33.2	.0016	.0000	0	294	0	743	.93
20:34:08	7.1	-33.4	.0017	0.0000	0	0	0	30	0.00
20:34:38	7.2	-34.1	.0034	0.0000	0	0	0	30	0.00
20:35:08	7.3	-34.7	.0025	0.0000	0	0	0	30	0.00
20:35:38	7.3	-34.6	.0012	0.0000	0	0	0	30	0.00
20:36:08	7.3	-34.3	.0008	0.0000	0	0	0	30	0.00
20:36:38	7.3	-33.9	.0020	.0419	14	375	22554	3503	.19
20:37:08	7.3	-33.3	.0204	.4480	17	359	283732	5228	.16
20:37:38	7.2	-33.0	.0277	.7354	13	428	379441	5228	.14
20:38:08	7.3	-33.7	.0272	.7619	12	420	339619	5228	.16
20:38:38	7.3	-33.7	.0153	.3537	19	333	252621	5228	.16
20:39:08	7.3	-33.8	.0146	.3491	12	360	147614	5228	.21
20:39:38	7.3	-33.9	.0111	.2348	23	252	183929	3848	.22
* 20:40:08	7.3	-34.1	.0064	.0955	39	199	112152	2468	.34
* 20:40:38	7.3	-34.0	.0090	.1271	44	191	181485	2468	.31
* 20:41:08	7.3	-34.2	.0104	.1412	57	172	270127	2468	.33
* 20:41:38	7.3	-34.5	.0024	.0282	47	184	45135	1433	.33
20:42:08	7.3	-34.4	.0069	.0911	47	185	127194	2468	.36
20:42:38	7.3	-34.5	.0064	.0966	37	203	113304	2468	.34
20:43:08	7.3	-34.7	.0024	.0268	49	181	38699	2468	.36
20:43:38	7.3	-34.8	.0028	.0162	34	209	19559	2468	.33
20:44:08	7.3	-34.7	.0046	.0659	48	183	95628	2468	.33
20:45:01	7.3	-34.5	.0014	.0060	65	127	28282	1011	.33
20:45:31	7.3	-34.3	.0024	.0198	25	194	32714	1622	.26
20:46:01	7.3	-34.4	.0026	.0189	34	178	48135	1927	.20
20:46:31	7.3	-34.5	.0013	.0045	73	113	26175	1011	.32
20:47:01	7.3	-34.3	.0003	.0001	99	98	1668	437	.46
20:47:31	7.3	-34.1	.0003	.0005	70	110	2557	706	.33
20:48:01	7.3	-34.0	.0002	.0002	45	151	1082	706	.24
20:48:31	7.3	-34.0	.0003	0.0000	0	0	0	28	0.00
20:49:01	7.3	-34.0	.0003	0.0000	0	0	0	26	0.00
20:49:31	7.3	-34.0	.0004	0.0000	0	0	0	30	0.00
20:50:01	7.3	-33.9	.0004	0.0000	0	0	0	28	0.00
20:50:31	7.3	-33.9	.0004	0.0000	0	0	0	28	0.00
20:51:01	7.3	-33.9	.0005	0.0000	0	0	0	28	0.00
20:51:31	7.3	-33.6	.0002	0.0000	0	0	0	30	0.00
20:52:01	7.2	-32.8	.0003	0.0000	0	0	0	24	0.00
20:52:31	7.1	-32.1	.0002	0.0000	0	0	0	18	0.00
20:53:01	7.0	-31.2	.0003	0.0000	0	0	0	26	0.00
20:53:31	6.9	-31.0	.0008	0.0000	0	0	0	28	0.00
20:54:01	6.8	-31.1	.0007	0.0000	0	0	0	30	0.00
20:54:31	6.6	-29.8	.0011	0.0000	0	0	0	30	0.00
20:55:01	6.5	-28.6	.0008	0.0000	0	0	0	30	0.00
20:55:31	6.3	-27.3	.0008	0.0000	0	0	0	30	0.00
20:56:01	6.1	-25.1	.0007	0.0000	0	0	0	28	0.00
20:56:31	5.9	-23.3	.0009	0.0000	0	0	0	30	0.00
20:57:01	5.7	-21.6	.0003	0.0000	0	0	0	22	0.00
20:57:31	5.6	-20.9	.0001	0.0000	0	0	0	26	0.00
20:58:01	5.6	-20.8	.0001	0.0000	0	0	0	14	0.00

23 MAR 78 — 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
20:58:31	5.7	-21.0	.0001	0.0000	0	0	0	16	0.00
20:59:01	5.6	-20.9	.0001	0.0000	0	0	0	16	0.00
20:59:31	5.6	-20.9	.0001	0.0000	0	0	0	12	0.00
21:00:01	5.6	-20.7	.0001	0.0000	0	0	0	14	0.00
21:00:31	5.6	-21.0	.0001	0.0000	0	0	0	8	0.00
21:01:01	5.6	-20.9	.0001	0.0000	0	0	0	10	0.00
21:01:31	5.6	-21.0	.0001	0.0000	0	0	0	10	0.00
21:02:01	5.6	-21.2	.0001	0.0000	0	0	0	10	0.00
21:02:31	5.6	-21.0	.0001	0.0000	0	0	0	12	0.00
21:03:01	5.6	-21.2	.0001	0.0000	0	0	0	10	0.00
21:03:31	5.6	-21.3	.0047	.1056	12	367	34963	5228	.24
21:04:01	5.7	-21.5	.0068	.1699	7	502	35730	5228	.19
21:04:31	5.7	-21.6	.0067	.1518	6	442	33169	5228	.22
21:05:01	5.6	-21.5	.0000	0.0000	0	0	0	12	0.00
21:05:31	5.6	-20.9	.0001	.0003	97	123	740	465	.66
21:06:01	5.6	-20.9	.0004	.0071	14	361	2772	4193	.20
21:06:31	5.6	-21.2	.0009	.0248	10	562	5560	5228	.16
21:07:01	5.6	-21.2	.0025	.0662	11	327	18057	3848	.26
21:07:31	5.7	-21.0	.0122	.5413	3	646	63396	5228	.17
* 21:08:01	5.6	-20.9	.0238	1.1082	2	806	101210	5228	.15
* 21:08:31	5.6	-21.1	.0127	.4894	5	531	77394	5228	.18
* 21:09:01	5.6	-20.8	.0133	.5841	3	717	61287	5228	.16
* 21:09:31	5.6	-20.7	.0085	.3539	3	724	36954	5228	.16
21:10:01	5.6	-20.8	.0088	.3803	3	682	40642	5228	.17
21:10:31	5.6	-20.4	.0153	.7277	3	671	72972	5228	.18
21:11:01	5.6	-20.6	.0311	1.2498	4	659	144460	5228	.17
21:11:31	5.7	-21.2	.0185	.7417	3	717	74265	5228	.17
21:12:01	5.6	-21.0	.0201	.7504	5	683	87015	5228	.16
21:12:31	5.7	-21.0	.0345	.7504	7	609	135304	5228	.14
21:13:01	5.7	-21.3	.0446	.9023	3	763	111622	5228	.14
21:13:31	5.7	-21.5	.0358	.9581	9	572	217570	5228	.13
21:14:01	5.6	-21.0	.0001	.0016	0	1183	4	1778	.66
21:14:31	5.5	-19.6	.0099	1.8303	3	1199	18330	5228	.26
21:15:01	5.3	-18.5	.0256	6.0611	2	1521	281201	5228	.09
21:15:31	5.2	-17.4	.0117	3.8838	2	1371	36165	5228	.22
21:16:01	5.2	-18.2	.0029	.1343	7	1315	3664	3503	.15
21:16:31	5.3	-18.1	.0108	3.4719	0	1519	18895	5228	.26
21:17:01	5.3	-18.1	.0303	13.8745	0	1637	62773	5228	.25
21:17:31	5.3	-17.9	.0307	13.4088	1	1647	89072	5228	.21
21:18:01	5.3	-18.1	.0344	14.9698	1	1575	98605	5228	.22
21:18:31	5.2	-17.6	.0153	7.5540	1	1572	57446	5228	.20
21:19:01	5.2	-17.3	.0213	10.2209	0	1657	52403	5228	.23
21:19:31	5.2	-17.9	.0370	19.4423	1	1761	102793	5228	.21
21:20:01	5.2	-18.0	.0356	16.8798	1	1621	115905	5228	.20
21:20:31	5.1	-16.8	.0225	11.1850	1	1738	80490	5228	.19
21:21:01	4.8	-14.4	.0031	1.3727	1	1943	8864	5228	.18
21:21:31	4.6	-13.2	.0172	8.1493	1	1950	58612	5228	.17
21:22:01	4.4	-11.9	.0186	7.7433	1	2010	76064	5228	.14
21:22:31	4.2	-10.8	.0140	6.367	1	2040	56250	5228	.15
21:23:01	4.0	-9.2	.0030	.9442	1	2040	7597	5228	.15
21:23:31	3.8	-7.7	.0020	.7370	1	1827	8360	5228	.14
21:24:01	3.6	-6.3	.0005	.1742	2	1277	3586	3848	.17
21:24:31	3.5	-4.8	.0001	.0006	71	200	1859	647	.09
21:25:01	3.3	-3.3	.0000	.0210	99	28	147544	411	2.10
21:25:31	3.1	-1.4	.0001	.6225	100	34	8252614	72	1.65
21:26:01	3.0	-1.2	.0000	1.2185	100	34	16722607	72	1.60

START TIME	ALT KM	23 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
21:26:31	3.0	-1.4	.0000	1.3794	100	34	18532137	72	1.61
21:27:01	3.0	-1.1	.0000	2.1417	100	34	28554991	164	1.57
21:27:31	3.0	-.5	.0000	2.3939	100	36	34957030	141	1.46
21:28:01	3.0	-1.2	.0000	1.8892	100	34	25296261	141	1.60
21:28:31	3.0	-1.4	.0000	1.1718	100	33	14653323	141	1.68
21:29:01	3.0	-1.7	.0000	1.0542	100	33	13544108	95	1.65
21:29:31	3.0	-.9	.0000	.9781	100	31	11576466	95	1.77
21:30:01	3.0	-.8	.0000	.9823	99	34	12710124	647	1.12
21:30:31	3.0	-1.0	.0004	.8550	83	35	7756472	3848	.02
21:31:01	3.0	-1.0	.0008	1.0248	35	1322	4102845	5228	.01
21:31:31	3.0	-1.0	.0001	.2811	76	36	1974446	5228	.01
21:32:01	3.0	-.7	.0000	.3589	100	28	2445766	72	2.68
21:32:31	3.0	-.6	.0000	.2941	100	28	2115870	72	2.65
21:33:01	3.0	-.6	.0000	.0029	100	25	9057	43	5.29
21:33:31	3.0	-.4	.0000	0.0000	0	0	0	2	0.00
21:34:01	3.0	-.9	.0000	0.0000	0	0	0	10	0.00
21:34:31	3.0	-.7	.0000	0.0000	0	0	0	4	0.00
21:35:01	3.0	-.7	.0001	.0991	0	2565	181	5228	.26
21:35:31	3.0	-1.2	.0002	.2330	0	2271	193	5228	.43
21:36:01	3.0	-1.5	.0011	.7810	1	2158	4884	5228	.16
21:36:31	3.0	-1.4	.0000	.0135	0	2011	7	4883	.52
21:37:01	3.0	-1.3	.0000	.0013	0	1963	1	2813	.75
21:37:31	3.0	-1.3	.0000	0.0000	0	0	0	4	0.00
21:38:01	3.0	-1.4	.0000	0.0000	0	0	0	2	0.00
21:38:31	3.0	-1.2	.0000	.0136	0	1937	9	4193	.58
21:39:01	3.0	-1.4	.0017	1.0350	0	2268	3982	5228	.20
21:39:31	3.0	-1.4	.0024	1.0630	1	1710	6964	5228	.21
* 21:40:01	3.0	-1.3	.0020	.8445	2	1705	8761	5228	.17
* 21:40:31	3.0	-1.5	.0036	1.4743	1	1726	11175	5228	.19
* 21:41:01	3.1	-1.0	.0003	.1338	0	1628	341	5228	.32
* 21:41:31	3.1	-1.4	.0001	.0320	8	1660	906	4193	.11
21:42:01	3.0	-1.7	.0006	.1874	1	2305	2110	5228	.12
21:42:31	3.1	-2.6	.0000	.0435	0	1857	870	4193	.11
21:43:01	3.2	-3.4	.0006	.0247	4	739	2527	5228	.19
21:43:31	3.4	-4.5	.0019	.0306	4	894	3337	5228	.16
21:44:01	3.6	-6.0	.0014	.0005	7	295	325	1088	.33
21:44:31	3.7	-6.6	.0021	.0006	59	171	339	1088	.65
21:45:01	3.9	-7.8	.0007	.0016	44	196	645	1088	.58
21:45:31	4.0	-8.8	.0047	.0006	49	181	563	1433	.39
21:46:01	4.1	-9.7	.0012	.0047	26	228	2535	1433	.42
21:46:31	4.2	-10.5	.0009	.0088	13	297	2011	1778	.48
21:47:01	4.4	-11.4	.0009	.0095	8	345	1592	2468	.43
21:47:31	4.5	-12.5	.0077	.0047	20	244	1600	1433	.49
21:48:01	4.6	-13.4	.0145	.0324	5	412	5502	5228	.31
21:48:31	4.7	-14.4	.0070	.0226	7	352	3661	2813	.44
21:49:01	4.9	-15.0	.0015	.0025	16	344	1428	2123	.25
21:49:31	5.0	-15.4	.0000	0.0000	0	0	0	2	0.00
21:50:01	5.1	-16.0	.0000	0.0000	0	0	0	2	0.00
21:50:31	5.2	-16.1	.0000	0.0000	0	0	0	2	0.00
21:51:01	5.3	-16.8	.0000	.0000	100	30	220	72	2.04
21:51:31	5.4	-17.8	.0000	.0000	100	51	326	72	1.00
21:52:01	5.5	-19.0	.0050	.0032	19	289	1523	1778	.32
21:52:31	5.7	-20.2	.0000	.0000	100	49	215	72	1.36
21:53:01	5.8	-21.1	.0000	.0000	100	23	0	26	0.00
21:53:31	5.9	-21.9	.0000	.0000	100	51	426	72	1.00
21:54:01	6.0	-22.6	.0001	.0007	12	380	1207	1778	.13

START TIME	ALT KM	23 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
21:54:31	6.1	-23.4	.0008	.0092	55	174	7014	1778	.53
21:55:01	6.1	-24.4	.0020	.0321	21	251	12618	3503	.35
21:55:31	6.2	-24.9	.0048	.0664	26	232	32834	2813	.36
21:56:01	6.3	-25.3	.0039	.0489	37	207	31122	3848	.36
21:56:31	6.5	-26.4	.0003	.0027	56	169	2372	1433	.45
21:57:01	6.6	-27.2	.0006	.0038	52	176	3692	2123	.41
21:57:31	6.6	-27.1	.0001	.0003	98	127	525	743	.65
21:58:01	6.6	-27.4	.0003	.0022	96	147	3990	465	.57
21:58:31	6.7	-28.1	.0000	.0000	97	38	26	465	.97
21:59:01	6.8	-28.8	.0000	.0000	100	115	46	210	.56
21:59:31	6.9	-28.8	.0001	.0010	40	199	1367	1088	.35
22:00:01	7.0	-29.5	.0004	.0040	13	292	2228	1778	.34
22:00:31	7.1	-29.5	.0026	.0239	25	232	15313	2468	.38
22:01:01	7.1	-30.0	.0018	.0155	37	201	13562	2468	.41
22:01:31	7.1	-30.0	.0038	.0424	17	248	19581	2468	.41
22:02:01	7.1	-30.3	.0051	.0679	9	300	25453	2468	.36
22:02:31	7.1	-30.1	.0053	.0711	8	302	26820	2468	.36
22:03:01	7.2	-30.1	.0062	.0884	4	342	19710	2813	.37
22:03:31	7.2	-30.2	.0095	.1844	4	365	34182	5228	.34
22:04:01	7.2	-30.1	.0112	.1829	15	293	79187	5228	.26
22:04:31	7.2	-30.3	.0079	.1066	26	229	71676	2468	.35
22:05:01	7.2	-30.4	.0097	.1573	15	279	63371	3158	.34
22:05:31	7.2	-30.4	.0111	.1627	12	328	57603	3848	.29
22:06:01	7.2	-30.4	.0083	.0875	24	244	54397	5228	.27
22:06:31	7.2	-30.1	.0057	.0411	27	219	28657	2468	.41
22:07:01	7.1	-29.5	.0116	.1510	15	280	52923	4883	.32
22:07:31	7.1	-29.4	.0153	.2252	13	323	72702	5228	.28
22:08:01	7.1	-29.3	.0093	.0829	15	266	33467	3848	.36
22:08:31	7.1	-29.5	.0141	.1593	21	243	79378	3158	.34
22:09:01	7.1	-29.7	.0101	.1113	18	272	46810	3158	.31
22:09:31	7.1	-29.8	.0111	.1331	16	297	51127	4883	.28
22:10:01	7.1	-29.6	.0036	.0180	24	244	12806	2813	.29
22:10:31	7.1	-29.6	.0039	.0130	37	213	12842	2468	.27
22:11:01	7.1	-29.1	.0014	.0000	100	76	31	118	1.00
22:11:31	7.1	-29.0	.0010	0.0000	0	0	0	30	0.00
22:12:01	7.1	-28.9	.0004	.0000	100	23	0	26	0.00
22:12:31	7.1	-28.8	.0003	.0000	100	23	0	26	0.00
22:13:01	7.1	-28.9	.0026	.0199	16	259	8707	2468	.42
22:13:31	7.1	-28.7	.0139	.1650	21	245	80180	4193	.34
22:14:01	7.1	-29.0	.0158	.1799	18	280	81869	5228	.30
22:14:31	7.1	-29.0	.0155	.2281	11	330	64635	5228	.33
22:15:01	7.1	-29.0	.0118	.1194	11	327	38567	5228	.24
22:15:31	7.1	-28.7	.0038	.0364	47	184	30430	2468	.47
22:16:01	7.1	-28.6	.0037	.0353	50	179	27832	2468	.50
22:16:31	7.1	-28.6	.0002	0.0000	0	0	0	30	0.00
22:17:01	7.1	-28.5	.0021	0.0000	0	0	0	30	0.00
22:17:31	7.1	-28.5	.0005	0.0000	0	0	0	30	0.00
22:18:01	7.1	-28.5	.0001	0.0000	0	0	0	28	0.00
22:18:31	7.1	-28.4	.0015	0.0000	0	0	0	30	0.00
22:19:01	7.1	-28.4	.0018	0.0000	0	0	0	30	0.00
22:19:31	7.1	-28.4	.0014	.0000	0	362	1	1088	.87
22:20:01	7.1	-28.5	.0021	.0202	11	351	6175	5228	.24
22:20:31	7.1	-28.7	.0063	.0797	4	342	16428	5228	.31
22:21:01	7.1	-28.4	.0070	.1416	4	352	26369	5228	.34
22:21:31	7.1	-28.3	.0083	.1710	4	353	31861	5228	.35
22:22:01	7.1	-28.1	.0078	.1590	5	340	35094	5228	.33

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
22:22:31	7.1	-28.3	.0079	.1615	4	351	28076	3848	.39
22:23:01	7.1	-28.3	.0057	.1137	4	336	22335	3158	.41
22:23:31	7.1	-28.3	.0047	.0939	5	324	20857	2468	.41
22:24:01	7.1	-28.1	.0073	.1851	5	353	36789	5228	.35
22:24:31	7.1	-28.1	.0055	.1179	6	324	25685	3158	.41
22:25:01	7.1	-27.7	.0042	.0699	13	289	25307	2813	.38
22:25:31	7.1	-27.6	.0035	.0506	22	244	21015	5228	.31
22:26:01	7.1	-27.6	.0003	.0110	3	774	1694	5228	.14
22:26:31	7.1	-26.9	.0002	.0022	4	628	139	4538	.30
22:27:01	7.1	-26.8	.0000	0.0000	0	0	0	10	0.00
22:27:31	7.1	-26.9	.0001	.0032	6	596	399	4538	.22
22:28:01	7.1	-27.5	.0106	.4041	6	523	79540	5228	.18
22:28:31	7.1	-27.4	.0203	.7884	5	510	137398	5228	.20
22:29:01	7.1	-27.2	.0167	.7313	3	567	97432	5228	.21
22:29:31	7.1	-27.4	.0178	.7821	3	570	99458	5228	.22
22:30:01	7.1	-27.6	.0171	.7250	3	582	100374	5228	.20
22:30:31	7.1	-27.7	.0176	.6829	4	569	104410	5228	.20
22:31:01	7.1	-27.6	.0155	.6028	4	512	101469	5228	.22
22:31:31	7.1	-27.5	.0165	.6365	4	484	107377	5228	.22
22:32:01	7.1	-27.6	.0198	.7470	5	472	132193	5228	.22
22:32:31	7.1	-27.3	.0201	.6322	6	421	123046	5228	.24
22:33:01	7.1	-27.5	.0147	.4964	5	433	91113	5228	.25
22:33:31	7.1	-27.7	.0113	.3912	6	437	76212	5228	.23
22:34:01	7.1	-27.5	.0106	.3660	8	451	79079	5228	.20
22:34:31	7.1	-27.6	.0089	.3270	10	508	69665	5228	.18
22:35:01	7.1	-27.6	.0084	.2573	6	473	44959	5228	.21
22:35:31	7.1	-27.7	.0099	.3583	4	402	61795	5228	.28
22:36:01	7.1	-27.7	.0166	.7594	3	445	108832	5228	.28
22:36:31	7.1	-27.7	.0181	.8404	3	463	108676	5228	.28
22:37:01	7.1	-27.6	.0125	.3810	5	392	78676	5228	.26
22:37:31	7.2	-28.4	.0101	.2764	5	364	60759	5228	.29
22:38:01	7.3	-29.1	.0102	.2707	6	355	71260	5228	.29
22:38:31	7.3	-29.0	.0083	.1895	6	335	52702	4193	.32
22:39:01	7.3	-28.9	.0078	.1549	8	323	43279	3848	.34
22:39:31	7.3	-28.8	.0081	.1428	20	259	53402	4883	.33
22:40:01	7.3	-28.8	.0064	.1191	16	276	45612	4538	.32
22:40:31	7.3	-28.7	.0070	.1404	6	324	38544	4883	.34
22:41:01	7.3	-28.9	.0071	.1513	6	332	38172	3848	.36
22:41:31	7.3	-29.2	.0061	.1590	5	344	34015	5228	.36
22:42:01	7.3	-29.5	.0066	.1420	5	338	37093	5228	.33
22:42:31	7.3	-29.1	.0061	.1254	7	328	33771	3158	.35
22:43:01	7.3	-29.0	.0070	.1325	7	321	37329	3848	.35
22:43:31	7.3	-29.0	.0058	.1263	6	328	28350	2813	.40
* 22:44:01	7.3	-29.2	.0046	.0889	7	306	24663	2468	.41
* 22:44:31	7.3	-29.2	.0047	.0799	6	316	22578	2813	.38
* 22:45:01	7.3	-29.4	.0040	.0685	5	316	16919	2813	.41
* 22:45:31	7.3	-29.4	.0042	.0867	5	321	20876	2813	.40
22:46:01	7.3	-29.5	.0042	.0830	4	330	19343	2813	.39
22:46:31	7.3	-29.5	.0049	.0931	6	318	22570	2813	.39
22:47:01	7.3	-29.5	.0042	.0797	8	303	20943	3158	.40
22:47:31	7.3	-29.6	.0044	.0862	4	328	20927	2813	.38
22:48:01	7.3	-29.7	.0045	.0833	4	330	18418	4193	.39
22:48:31	7.3	-29.6	.0045	.0839	6	319	20809	2813	.40
22:49:01	7.3	-29.6	.0049	.1043	6	319	26635	2813	.39
22:49:31	7.3	-29.6	.0056	.0930	12	287	32706	2468	.39
22:50:01	7.3	-29.8	.0045	.0706	14	269	27587	2813	.40

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
22:50:31	7.3	-29.6	.0069	.1027	17	260	45150	2813	.38
22:51:01	7.3	-29.6	.0065	.0925	21	240	48679	2468	.39
22:51:31	7.3	-29.4	.0065	.1129	31	221	68661	2813	.36
22:52:01	7.3	-29.3	.0062	.1026	41	198	69859	2813	.39
22:52:31	7.3	-29.4	.0056	.0993	38	204	65644	2468	.40
22:53:01	7.3	-29.6	.0049	.0780	37	203	49157	2468	.45
22:53:31	7.3	-29.7	.0049	.0756	35	207	42156	2468	.47
22:54:01	7.3	-29.8	.0041	.0644	37	203	39039	2468	.46
22:54:31	7.3	-29.5	.0037	.0556	48	183	46351	2123	.44
22:55:01	7.3	-29.7	.0030	.0517	44	191	34849	2123	.47
22:55:31	7.3	-29.6	.0027	.0329	45	188	26075	2468	.46
22:56:01	7.3	-29.7	.0059	.1272	22	267	53549	5228	.24
22:56:31	7.3	-29.8	.0230	.5820	13	342	171245	5228	.25
22:57:01	7.3	-29.8	.0392	1.0949	13	392	350672	5228	.20
22:57:31	7.3	-29.5	.0092	.2000	20	293	86001	4538	.24
22:58:01	7.3	-29.7	.0099	.2293	18	302	93748	5228	.25
22:58:31	7.3	-29.5	.0222	.5782	15	363	195992	5228	.20
22:59:01	7.3	-29.8	.0225	.6085	11	360	153776	5228	.26
22:59:31	7.3	-29.8	.0179	.4308	13	336	134650	5228	.25
23:00:01	7.3	-29.7	.0078	.1372	25	236	71463	3848	.35
23:00:31	7.3	-29.6	.0055	.1215	16	291	44616	4193	.29
23:01:01	7.3	-29.4	.0053	.1140	18	272	43555	3503	.32
23:01:31	7.3	-29.4	.0067	.1057	21	247	52013	2468	.38
23:02:01	7.3	-29.8	.0056	.1021	20	244	42547	2468	.43
23:02:31	7.3	-29.6	.0051	.0805	35	207	49162	2468	.45
23:03:01	7.2	-28.7	.0059	.0974	29	226	58387	5228	.27
23:03:31	7.2	-28.4	.0042	.0635	44	190	50932	2468	.43
23:04:01	7.2	-28.7	.0036	.0533	26	229	35501	2468	.36
23:04:31	7.2	-28.9	.0060	.1255	9	304	33891	2468	.41
23:05:01	7.1	-28.8	.0117	.2661	16	285	89494	2813	.31
23:05:31	7.0	-27.6	.0067	.1354	23	256	58050	4193	.23
23:06:01	6.9	-26.4	.0089	.2279	15	340	72476	5228	.19
23:06:31	6.7	-25.0	.0201	.9063	3	599	93911	5228	.19
23:07:01	6.5	-23.6	.0193	.8307	3	564	93488	5228	.20
23:07:31	6.3	-22.4	.0200	.8710	4	633	102475	5228	.17
23:08:01	6.1	-20.9	.0214	1.1552	3	691	109538	5228	.17
23:08:31	5.9	-19.4	.0159	.9720	3	729	80158	5228	.18
23:09:01	5.7	-18.2	.0135	.7716	2	672	59628	5228	.20
23:09:31	5.6	-17.5	.0163	1.2158	2	767	78674	5228	.19
* 23:10:01	5.6	-17.3	.0251	2.1669	1	823	118997	5228	.19
* 23:10:31	5.6	-17.2	.0189	1.7062	1	821	81068	5228	.21
* 23:11:01	5.6	-17.5	.0074	.3755	1	678	22742	5228	.22
* 23:11:31	5.6	-17.5	.0028	.1179	3	462	11263	4193	.31
23:12:01	5.6	-17.3	.0127	.9569	0	783	31879	5228	.26
23:12:31	5.6	-17.4	.0022	.1271	2	699	7934	5228	.20
23:13:01	5.6	-17.6	.0010	.0264	14	305	4930	3503	.32
23:13:31	5.6	-17.4	.0014	.0316	14	359	6682	5228	.18
23:14:01	5.6	-17.0	.0015	.0439	10	436	7634	4538	.23
23:14:31	5.6	-16.9	.0024	.0747	11	451	12270	5228	.20
23:15:01	5.6	-17.0	.0031	.0946	8	499	15834	4883	.19
23:15:31	5.6	-17.0	.0034	.0990	6	515	14475	4193	.21
23:16:01	5.6	-16.9	.0042	.1318	6	544	18168	5228	.19
23:16:31	5.6	-17.2	.0058	.1496	8	551	22916	5228	.17
23:17:01	5.6	-17.3	.0055	.1419	6	598	19650	5228	.16
23:17:31	5.6	-17.4	.0063	.1573	4	633	15863	5228	.20
23:18:01	5.6	-17.3	.0079	.1444	5	569	15892	5228	.20

START TIME	ALT KM	23 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
23:18:31	5.6	-17.0	.0081	.1352	7	511	20684	4883	.19
23:19:01	5.6	-16.8	.0092	.1477	7	541	20078	4883	.21
23:19:31	5.6	-16.8	.0096	.1461	8	546	23132	5228	.18
23:20:01	5.6	-16.8	.0059	.1518	10	485	25135	5228	.20
23:20:31	5.6	-16.8	.0072	.2013	13	417	44064	5228	.19
23:21:01	5.5	-16.1	.0088	.2766	10	494	47717	5228	.19
23:21:31	5.4	-15.6	.0100	.3416	7	543	49837	5228	.18
23:22:01	5.3	-15.2	.0125	.3441	7	459	51219	5228	.23
23:22:31	5.3	-14.4	.0124	.3443	6	450	53477	5228	.22
23:23:01	5.3	-14.3	.0112	.2378	6	528	31657	5228	.19
23:23:31	5.3	-14.3	.0088	.2024	5	562	25500	5228	.19
23:24:01	5.3	-14.2	.0068	.2359	4	538	26416	5228	.21
23:24:31	5.3	-14.3	.0103	.3402	4	499	40416	5228	.24
23:25:01	5.3	-14.5	.0117	.4377	4	512	52584	5228	.21
23:25:31	5.3	-14.6	.0145	.5176	3	515	57825	5228	.22
23:26:01	5.3	-14.6	.0117	.4996	3	512	51482	5228	.25
23:26:31	5.3	-14.5	.0125	.5206	3	515	48412	5228	.25
23:27:01	5.3	-14.3	.0187	.9968	2	588	70613	5228	.24
23:27:31	5.2	-14.0	.0218	1.3221	2	611	99743	5228	.22
23:28:01	5.2	-14.0	.0260	2.1497	2	692	127030	5228	.22
23:28:31	5.2	-13.9	.0240	1.8951	2	691	110959	5228	.22
23:29:01	5.2	-13.9	.0184	1.4209	2	687	86182	5228	.22
23:29:31	5.2	-13.5	.0156	.7040	4	517	81734	5228	.22
23:30:01	5.2	-13.1	.0190	1.0462	3	640	90497	5228	.20
23:30:31	5.2	-13.1	.0226	1.4301	3	661	122575	5228	.19
23:31:01	5.2	-13.2	.0273	2.4517	2	813	132356	5228	.20
23:31:31	5.2	-13.4	.0293	2.7155	2	880	142166	5228	.19
23:32:01	5.0	-12.5	.0255	2.4967	1	834	129357	5228	.20
23:32:31	5.0	-12.2	.0228	2.3517	2	871	135536	5228	.18
23:33:01	4.9	-11.8	.0236	22.1390	1	1792	113713	5228	.21
23:33:31	4.9	-11.6	.0282	24.7155	1	1930	131607	5228	.19
23:34:01	4.8	-10.9	.0295	23.2478	1	1946	127148	5228	.19
23:34:31	4.7	-10.1	.0290	23.4359	1	1950	135257	5228	.19
23:35:01	4.5	-9.2	.0252	18.6839	1	1793	125037	5228	.18
23:35:31	4.4	-8.6	.0227	16.4543	1	1774	115132	5228	.18
23:36:01	4.3	-7.8	.0201	15.0164	1	1617	114048	5228	.20
23:36:31	4.2	-7.1	.0189	16.0419	1	1669	113796	5228	.20
23:37:01	4.0	-6.3	.0144	12.1359	1	1747	88893	5228	.19
23:37:31	4.0	-6.0	.0134	9.7396	1	1808	78057	5228	.17
23:38:01	4.0	-5.9	.0176	13.5623	1	1777	101399	5228	.18
23:38:31	4.0	-6.0	.0183	14.8500	1	1748	110891	5228	.18
23:39:01	4.0	-6.0	.0191	15.4984	2	1689	106733	5228	.19
23:39:31	4.0	-5.8	.0200	13.8592	2	1911	110006	5228	.16
23:40:01	4.0	-5.5	.0200	16.8913	1	2056	109021	5228	.17
23:40:31	4.0	-5.4	.0159	11.5689	2	2001	88497	5228	.16
23:41:01	3.9	-5.3	.0111	6.9054	2	1928	55126	5228	.16
23:41:31	3.8	-4.6	.0150	10.9468	1	2048	72815	5228	.16
23:42:01	3.7	-3.7	.0142	9.6842	2	2114	73349	5228	.15
23:42:31	3.6	-2.9	.0143	9.5127	2	2199	79416	5228	.14
23:43:01	3.4	-2.2	.0116	8.8190	2	2075	76645	5228	.14
23:43:31	3.3	-1.9	.0104	6.1371	3	2076	66589	5228	.13
23:44:01	3.2	-1.8	.0094	7.0197	3	2059	70031	5228	.14
23:44:31	3.1	-1.0	.0079	4.5465	4	2072	52401	5228	.13
23:45:01	3.0	-.7	.0076	6.0799	3	2068	68003	5228	.14
23:45:31	3.0	-.4	.0081	8.2122	3	2075	79773	5228	.14
23:46:01	3.0	-.1	.0077	7.7797	2	2115	63470	5228	.15

START TIME	ALT KM	23 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
23:46:31	3.0	.0	.0061	7.1035	2	2041	52982	5228	.16
23:47:01	3.0	-.0	.0041	4.1886	2	2086	31031	5228	.16
23:47:31	3.0	.1	.0047	4.5362	2	2094	40787	5228	.14
23:48:01	3.0	-.2	.0046	4.2047	3	2079	35724	5228	.15
23:48:31	3.0	-.1	.0031	3.3372	2	2084	26575	5228	.15
23:49:02	3.0	-.4	.0023	2.2402	3	2157	19394	5228	.14
23:49:32	3.0	-.5	.0018	1.5086	3	2134	19025	5228	.12
23:50:02	3.0	-.7	.0022	1.4528	3	2073	15227	5228	.13
23:50:32	3.0	-1.3	.0046	1.2952	4	2018	15655	5228	.13
23:51:02	3.0	-1.3	.0029	1.9908	4	1701	24505	5228	.14
23:51:32	3.0	-.9	.0022	1.5826	2	1878	13802	5228	.16
23:52:02	3.0	-.8	.0039	3.4734	2	1942	29192	5228	.16
23:52:32	3.0	-.9	.0048	5.2580	2	1908	36327	5228	.18
23:53:02	3.0	-.9	.0045	4.6111	2	1897	34820	5228	.17
23:53:32	3.0	-.9	.0036	3.0117	3	1875	29405	5228	.15
* 23:54:02	3.0	-1.1	.0029	2.4882	2	1777	18825	5228	.18
* 23:54:32	3.0	-1.2	.0027	2.8826	2	1818	23342	5228	.17
* 23:55:02	3.0	-1.3	.0032	2.6359	3	1887	22082	5228	.16
* 23:55:32	3.0	-1.4	.0034	2.3495	2	1898	18822	5228	.16
23:56:02	3.0	-1.5	.0037	2.1103	3	1773	24633	5228	.14
23:56:32	3.0	-1.4	.0033	1.2613	3	1725	12553	5228	.16
23:57:02	3.0	-1.4	.0040	1.5334	2	1646	17690	5228	.16
23:57:32	3.0	-1.4	.0037	2.3091	2	2066	21059	4508	.15
23:58:02	3.0	-1.3	.0080	3.3150	1	2774	26791	4508	.09
23:58:32	3.1	-1.1	.0136	2.3476	2	2178	30240	4508	.08
23:59:02	3.1	-1.6	.0082	4.8450	2	1866	61969	4508	.10
23:59:32	3.1	-1.0	.0061	5.6516	2	1971	56750	4508	.11
24:00:02	3.0	-.7	.0068	6.1304	2	1901	61436	4508	.12
24:00:32	3.0	-.7	.0030	3.7272	1	1964	23490	5228	.11
24:01:02	3.0	-.7	.0022	2.1277	2	1876	12700	5228	.19
24:01:32	3.0	-1.1	.0049	3.7588	2	2122	33169	5228	.14
24:02:02	3.0	-1.3	.0075	4.6882	3	2170	47146	5228	.13
24:02:32	3.0	-1.3	.0052	3.8269	3	2242	36990	5228	.13
24:03:02	3.0	-1.1	.0024	1.4641	3	2348	12679	5228	.13
24:03:32	3.0	-.8	.0012	.9109	1	2155	5220	5228	.17
24:04:02	3.0	-.8	.0012	1.1306	1	2257	5133	5228	.18
24:04:32	3.0	-.6	.0006	.6470	1	2215	2906	5228	.19
24:05:02	3.0	-.4	.0010	1.2633	1	2243	6153	5228	.18
24:05:32	3.0	.0	.0010	1.0560	1	2184	5052	5228	.19
24:06:02	3.0	-.3	.0006	.5215	0	2326	1912	5228	.20
24:06:32	3.1	-.2	.0000	.0275	0	1713	24	4538	.53
24:07:02	3.1	-.4	.0000	.0127	1	1562	92	2813	.28
24:07:32	3.0	.1	.0000	.0022	0	2099	2	3158	.50
24:08:02	3.0	.4	.0000	.0018	0	1365	3	1778	.73
24:08:32	3.0	.4	.0000	.0132	0	2362	4	4193	.74
24:09:02	3.0	.4	.0001	.1599	2	2079	1124	4538	.17
24:09:32	3.0	.4	.0001	.2098	0	1927	231	5228	.44
24:10:02	3.0	.1	.0004	.5185	0	2008	2444	5228	.20
24:10:32	3.0	-.0	.0002	.3266	1	2002	1183	5228	.23
24:11:02	3.0	-.2	.0004	.4691	0	2018	1927	5228	.22
24:11:32	3.0	-.1	.0005	.8071	1	2085	3055	5228	.22
24:12:02	3.0	-.3	.0005	.6912	1	2000	3497	5228	.20
24:12:32	3.0	-.8	.0009	.6114	1	2146	4183	5228	.16
24:13:02	3.0	-.7	.0039	1.6489	6	2297	26839	5228	.10
24:13:32	2.9	-.1	.0040	1.8482	4	2179	22819	5228	.12
24:14:02	2.8	1.1	.0030	1.0672	6	2197	16203	5228	.10

23 MAR 78 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
24:14:32	2.6	2.5	.0006	.1587	5	1748	3194	4211	.12
24:15:02	2.4	4.2	.0004	.0960	2	1578	2977	3023	.09
24:15:32	2.2	5.2	.0002	.0826	1	1524	962	3023	.16
24:16:02	2.1	6.3	.0002	.0707	4	1544	1267	2726	.14
24:16:32	2.0	7.2	.0002	.1168	0	1365	366	4508	.15
24:17:02	1.8	8.2	.0004	.1773	0	1195	693	3914	.19
24:17:32	1.7	9.7	.0005	.4008	1	1429	5568	3023	.18
24:18:02	[illegible]	10.6	.0005	.4908	1	1276	5220	4508	.11
24:18:32	1.5	10.2	.0004	.3250	1	1316	3746	3023	.19
24:19:02	1.5	9.6	.0005	.3911	2	1273	7737	3914	.11
24:19:32	1.5	9.1	.0005	.2810	2	1409	5372	4211	.09
* 24:20:02	1.5	9.2	.0003	.2724	2	1380	3610	3320	.14
* 24:20:32	1.5	9.6	.0003	.1618	3	1212	2462	3023	.17
* 24:21:02	1.5	9.7	.0002	.1151	4	1208	2451	3023	.13
* 24:21:32	1.5	10.0	.0001	.1184	4	1515	2827	3617	.09
24:22:02	1.5	10.2	.0001	.0866	2	1332	1046	2726	.19
24:22:32	1.5	10.1	.0001	.0669	2	1263	1239	2132	.19
24:23:02	1.5	9.8	.0001	.1022	1	1191	569	2132	.35
24:23:32	1.5	9.6	.0002	.1092	1	1199	1101	2132	.26
24:24:02	1.5	9.4	.0002	.1708	1	1420	1628	2726	.21
24:24:32	1.5	9.4	.0002	.1723	2	1337	1892	3023	.18
24:25:02	1.5	9.5	.0002	.1353	3	1599	1260	3023	.17
24:25:32	1.5	9.2	.0002	.1089	0	1437	977	2429	.22
24:26:02	1.5	9.1	.0001	.0792	2	1282	1188	2726	.17
24:26:32	1.5	9.0	.0002	.1087	1	1408	747	3023	.22
24:27:02	1.5	8.8	.0003	.1594	0	1680	1093	3914	.15
24:27:32	1.5	8.8	.0002	.1212	1	1712	1369	3023	.15
24:28:02	1.5	8.7	.0004	.1388	2	1220	2416	3320	.14
24:28:32	1.5	9.0	.0003	.1070	3	1036	1523	2132	.25
24:29:02	1.5	8.7	.0017	.2158	2	1202	2640	3617	.16
24:29:32	1.5	8.7	.0032	.4546	2	1810	8700	4508	.07
24:30:02	1.5	8.3	.0026	.2984	3	1582	5094	3617	.12
24:30:32	1.5	8.5	.0005	.3547	1	1979	3272	3914	.12
24:31:02	1.5	8.7	.0009	.5304	2	2010	4706	4508	.11
24:31:32	1.5	8.4	.0062	.8185	6	1916	13781	4508	.09
24:32:02	1.5	8.0	.0011	.4880	2	2090	5974	3914	.10
24:32:32	1.5	8.2	.0044	.4387	1	2069	6885	4211	.09
24:33:02	1.5	8.1	.0081	.5109	2	1639	7369	3023	.15
24:33:32	1.5	7.9	.0052	.2242	1	1687	2772	3320	.13
* 24:34:02	1.5	8.2	.0076	.1799	2	1671	5991	2726	.09
* 24:34:32	1.5	8.3	.0010	.1494	1	1764	1196	3914	.14
* 24:35:02	1.5	8.7	.0025	.1533	0	2045	2233	3320	.10
* 24:35:32	1.5	8.8	.0001	.1624	1	2132	989	3914	.14
24:36:02	1.5	8.8	.0004	.3078	2	1960	4304	3617	.10
24:36:32	1.5	8.7	.0006	.4271	2	1745	5643	3320	.13
24:37:02	1.5	8.8	.0006	.4459	1	1785	5449	3320	.13
24:37:32	1.5	9.0	.0008	.6274	1	1938	5429	4508	.10
24:38:02	1.5	9.0	.0005	.5219	1	1815	4677	3914	.12
24:38:32	1.5	9.1	.0031	.6111	2	1770	16998	3914	.08
24:39:02	1.5	8.9	.0011	.5591	2	1773	7555	4211	.12
24:39:32	1.5	9.8	.0004	.4904	2	2061	5201	3914	.11
24:40:02	1.5	10.0	.0005	.5296	2	2176	7245	4508	.08
24:40:32	1.5	9.7	.0007	.6143	1	2190	8309	4211	.09
24:41:02	1.5	9.0	.0005	.5249	2	1999	6243	4508	.10
24:41:32	1.6	8.8	.0004	.4444	2	2059	7030	3617	.09
24:42:02	1.6	8.6	.0004	.3021	3	1829	4596	3023	.12

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
19:30:02	7.1	-30.7	.0028	.0379	33	208	18126	2468	.53
19:30:32	7.1	-30.7	.0026	.0396	41	195	18291	2468	.57
19:31:02	7.1	-30.7	.0024	.0358	52	177	23594	2468	.53
19:31:32	7.1	-30.8	.0025	.0266	55	173	19250	1433	.55
19:32:02	7.1	-30.8	.0024	.0348	60	169	24068	1433	.60
19:32:32	7.1	-30.7	.0027	.0299	54	174	23247	2468	.50
19:33:02	7.1	-30.9	.0024	.0277	54	175	20297	2123	.53
19:33:32	7.1	-31.2	.0025	.0302	30	214	10896	2123	.58
19:34:02	7.1	-31.2	.0028	.0485	19	237	15603	2468	.52
19:34:32	7.1	-31.1	.0029	.0464	18	236	14010	2468	.54
19:35:02	7.1	-31.0	.0031	.0506	18	237	16132	2468	.54
19:35:32	7.1	-31.0	.0028	.0356	12	266	10702	2468	.48
19:36:02	7.1	-31.1	.0031	.0437	13	255	12218	2468	.53
19:36:32	7.1	-31.0	.0031	.0438	10	274	12445	2468	.50
19:37:02	7.1	-31.0	.0028	.0330	8	287	9134	2468	.47
19:37:32	7.1	-31.1	.0028	.0255	10	276	7001	2468	.50
19:38:02	7.1	-31.1	.0030	.0257	7	292	6237	2468	.53
19:38:32	7.1	-31.0	.0033	.0725	3	315	11138	2813	.53
19:39:02	7.1	-30.9	.0033	.0761	4	321	12874	2813	.48
19:39:32	7.1	-30.8	.0035	.0695	3	321	12200	2468	.47
19:40:02	7.1	-30.4	.0032	.0611	4	315	13270	2468	.45
19:40:32	7.0	-29.9	.0049	.0436	7	302	9065	2468	.51
19:41:02	7.0	-29.4	.0040	.0662	6	312	13161	2468	.48
19:41:32	7.1	-29.5	.0033	.0695	7	305	15793	2813	.47
19:42:02	7.1	-30.2	.0036	.0762	5	316	15877	4883	.43
19:42:32	7.1	-30.4	.0031	.0682	5	312	13462	2468	.49
19:43:02	7.1	-30.6	.0028	.0678	5	315	13851	2468	.47
19:43:32	7.1	-30.8	.0026	.0416	6	302	9476	2468	.50
19:44:02	7.1	-30.7	.0029	.0477	8	296	13282	2468	.46
19:44:32	7.2	-31.2	.0020	.0164	19	244	8525	2468	.44
19:45:02	7.3	-31.4	.0016	.0163	43	191	9439	1088	.58
19:45:32	7.3	-31.5	.0023	.0269	57	174	21749	1088	.56
* 19:46:02	7.3	-31.7	.0027	.0417	58	174	23920	1088	.67
* 19:46:32	7.3	-32.0	.0026	.0348	42	193	19432	1778	.57
* 19:47:02	7.3	-32.1	.0025	.0292	37	199	14895	2468	.56
* 19:47:32	7.3	-32.1	.0030	.0425	40	195	21400	1433	.60
19:48:02	7.3	-32.2	.0026	.0436	56	175	22826	1088	.69
19:48:32	7.3	-32.2	.0023	.0415	68	165	31315	1433	.64
19:49:02	7.3	-32.0	.0026	.0347	70	159	29567	1088	.61
19:49:32	7.3	-31.9	.0019	.0244	76	152	26819	1088	.59
19:50:02	7.3	-31.6	.0015	.0148	83	142	17556	1088	.62
19:50:32	7.3	-31.6	.0023	.0303	80	146	37414	1088	.59
19:51:02	7.3	-31.6	.0020	.0265	87	139	33690	743	.64
19:51:32	7.3	-31.5	.0019	.0298	84	144	31854	1088	.66
19:52:02	7.3	-31.6	.0020	.0261	83	142	27487	743	.66
19:52:32	7.3	-31.7	.0018	.0223	79	146	26643	1088	.60
19:53:02	7.3	-31.8	.0021	.0356	77	158	28067	1088	.69
19:53:32	7.3	-31.7	.0024	.0428	75	160	31324	1088	.70
19:54:02	7.3	-31.4	.0025	.0417	77	157	31079	1088	.71
19:54:32	7.3	-31.6	.0018	.0257	75	163	17955	1088	.71
19:55:02	7.3	-31.8	.0015	.0179	67	168	12690	1088	.65
19:55:32	7.3	-31.7	.0016	.0242	72	164	17064	1088	.69
19:56:02	7.3	-31.7	.0017	.0251	70	165	16513	1088	.69
19:56:32	7.3	-32.0	.0014	.0134	35	203	6363	1088	.60
19:57:02	7.3	-32.5	.0018	.0181	38	199	9469	1088	.57
19:57:32	7.3	-32.7	.0021	.0250	29	217	11469	2468	.51

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
19:58:02	7.3	-32.8	.0023	.0273	17	255	10076	1778	.50
19:58:32	7.3	-32.7	.0027	.0314	18	243	12487	2123	.50
19:59:02	7.3	-32.8	.0025	.0337	7	294	9584	2468	.48
19:59:32	7.3	-32.8	.0026	.0356	15	263	13527	2468	.47
* 20:00:02	7.3	-32.8	.0028	.0429	7	301	11968	2468	.44
* 20:00:32	7.3	-32.8	.0028	.0310	10	291	10427	2468	.44
* 20:01:02	7.3	-32.5	.0024	.0268	10	288	8320	2468	.46
* 20:01:32	7.3	-32.2	.0025	.0408	7	302	12155	2468	.43
20:02:02	7.3	-31.8	.0035	.0700	6	309	17044	2468	.44
20:02:32	7.3	-31.7	.0033	.0609	6	312	14544	5228	.37
20:03:02	7.3	-31.6	.0031	.054L	7	304	15304	2813	.43
20:03:32	7.3	-31.4	.0029	.0533	10	288	16604	2468	.43
20:04:02	7.3	-31.2	.0038	.0643	10	298	16801	2468	.44
20:04:32	7.3	-31.1	.0039	.0970	11	308	25102	3158	.39
20:05:02	7.3	-31.0	.0027	.0526	15	267	15218	2813	.44
20:05:32	7.3	-31.3	.0025	.0552	16	279	17245	2468	.42
20:06:02	7.3	-31.3	.0033	.0821	16	290	25082	3848	.38
20:06:32	7.2	-30.5	.0027	.0261	15	288	6609	3158	.43
20:07:02	7.1	-29.9	.0004	.0001	0	408	5	2123	.70
20:07:32	6.9	-29.0	.0001	0.0000	0	0	0	18	0.00
20:08:02	6.8	-28.0	.0001	0.0000	0	0	0	22	0.00
20:08:32	6.6	-26.9	.0001	0.0000	0	0	0	14	0.00
20:09:02	6.5	-26.9	.0001	0.0000	0	0	0	14	0.00
20:09:32	6.4	-26.0	.0001	.0000	86	127	50	465	.77
20:10:02	6.2	-24.8	.0137	.0002	40	261	384	1088	.23
20:10:32	6.1	-23.9	.0157	.0008	18	270	683	2123	.23
20:11:02	6.0	-23.0	.0107	.0112	4	402	1812	3503	.34
20:11:32	5.9	-21.8	.0166	.0096	3	575	1002	5228	.23
20:12:02	5.7	-20.6	.0118	.0135	5	370	1310	2468	.57
20:12:32	5.7	-20.4	.0024	.0286	3	386	2938	3158	.52
20:13:02	5.7	-20.2	.0024	.0396	4	351	6041	3503	.44
20:13:32	5.7	-20.2	.0010	.0113	11	312	2952	3158	.34
20:14:02	5.6	-20.1	.0014	.0221	7	391	4554	3503	.30
20:15:01	5.6	-20.4	.0003	.0041	13	321	1208	2813	.30
20:15:31	5.6	-20.4	.0001	.0000	0	220	0	465	1.00
20:16:01	5.6	-20.4	.0036	.0024	0	606	35	3503	.62
20:16:31	5.6	-20.5	.0016	.0107	5	486	1126	3503	.28
20:17:01	5.6	-20.5	.0006	.0139	12	374	3911	4193	.21
20:17:31	5.6	-20.6	.0004	.0069	20	258	1714	2468	.35
* 20:18:01	5.6	-20.6	.0036	.0039	2	365	311	1778	.59
* 20:18:31	5.6	-20.4	.0265	.0104	1	464	861	3848	.37
* 20:19:01	5.6	-20.3	.0346	.0112	4	429	1325	2123	.40
* 20:19:31	5.6	-20.2	.0581	.0107	2	480	1228	3848	.27
20:20:01	5.6	-20.2	.0298	.0049	12	312	1714	3158	.25
20:20:31	5.6	-20.1	.0248	.0057	2	428	680	2123	.38
20:21:01	5.6	-20.2	.0160	.0034	2	394	449	1778	.44
20:21:31	5.6	-20.5	.0003	.0000	27	283	67	743	.21
20:22:01	5.6	-20.6	.0008	.0003	12	317	106	1433	.34
20:22:31	5.6	-20.6	.0007	.0004	42	195	133	1433	.57
20:23:01	5.6	-20.5	.0003	.0001	74	137	88	465	.69
20:23:31	5.6	-20.5	.0071	.0001	58	142	30	743	.55
20:24:01	5.6	-20.4	.0122	.0008	25	220	195	1088	.72
20:24:31	5.6	-20.6	.0026	.0004	27	218	183	743	.56
20:25:01	5.6	-20.6	.0082	.0009	10	316	299	2468	.33
20:25:31	5.6	-20.6	.0056	.0008	24	224	205	1433	.64
20:26:01	5.6	-20.6	.0003	0.0000	0	0	0	16	0.00

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
20:26:31	5.6	-20.4	.0001	0.0000	0	0	0	4	0.00
20:27:01	5.6	-20.0	.0013	0.0000	0	0	0	30	0.00
20:27:31	5.6	-19.9	.0145	.0001	79	134	121	743	.55
20:28:01	5.5	-19.7	.0058	.0013	28	218	571	1088	.51
20:28:31	5.5	-19.6	.0001	.0005	33	211	167	1088	.61
20:29:01	5.5	-19.7	.0014	.0140	14	262	4946	2123	.45
20:29:31	5.5	-19.8	.0031	.0172	13	281	3823	2468	.52
20:30:01	5.5	-19.8	.0026	.0205	16	274	7257	2813	.40
20:30:31	5.5	-19.8	.0031	.0270	15	290	9418	3503	.36
20:31:01	5.5	-19.7	.0005	.0058	20	249	2486	2468	.34
20:31:31	5.5	-20.1	.0028	.0030	17	305	1608	2813	.25
20:32:01	5.5	-20.1	.0079	.0049	14	296	2912	2123	.27
20:32:31	5.5	-20.1	.0002	.0004	33	210	171	1088	.57
20:33:01	5.5	-19.7	.0001	0.0000	0	0	0	4	0.00
20:33:31	5.5	-19.7	.0001	.0001	72	149	32	1088	.54
20:34:01	5.6	-20.3	.0002	.0009	45	193	1522	1433	.28
20:34:31	5.6	-20.9	.0010	.0093	43	192	6043	1778	.49
20:35:01	5.7	-21.3	.0023	.0217	26	229	10075	2468	.41
20:35:31	5.7	-21.2	.0015	.0159	22	237	6585	2468	.41
20:36:01	5.7	-21.1	.0027	.0276	24	239	13745	2468	.37
20:36:31	5.7	-20.7	.0044	.0426	17	260	15736	2813	.40
20:37:01	5.7	-20.4	.0055	.0471	13	284	17143	2468	.38
20:37:31	5.7	-20.3	.0052	.0552	6	321	13424	2813	.39
* 20:38:01	5.7	-20.3	.0060	.0691	5	334	17214	3848	.36
* 20:38:31	5.7	-20.4	.0054	.0563	5	333	11608	2813	.42
* 20:39:01	5.7	-20.5	.0062	.0735	4	334	14678	5228	.38
* 20:39:31	5.7	-20.5	.0050	.0688	4	344	12995	2468	.43
20:40:01	5.7	-20.6	.0046	.0587	4	335	10715	2813	.44
20:40:31	5.7	-20.8	.0067	.0890	4	350	16203	2813	.42
20:41:01	5.7	-21.0	.0084	.1071	4	340	19628	3158	.43
20:41:31	5.7	-21.1	.0058	.0731	5	324	16060	2813	.42
20:42:01	5.7	-21.2	.0066	.0833	6	318	20819	2813	.40
20:42:31	5.7	-21.2	.0078	.0800	6	319	21244	2468	.38
20:43:01	5.7	-21.4	.0068	.0829	5	325	20522	2813	.40
20:43:31	5.7	-21.7	.0051	.0612	4	331	12620	3158	.42
20:44:01	5.7	-21.8	.0036	.0498	4	323	9166	2468	.48
20:44:31	5.7	-21.7	.0039	.0398	6	308	9426	2468	.46
20:45:01	5.7	-21.6	.0039	.0354	10	288	12006	2468	.41
20:45:31	5.7	-21.7	.0040	.0397	13	275	13830	2468	.42
20:46:01	5.7	-21.5	.0045	.0445	12	292	12545	4193	.38
20:46:31	5.7	-21.3	.0044	.0556	4	337	10837	3848	.39
20:47:01	5.7	-20.9	.0056	1.0845	1	1056	12579	3503	.33
20:47:31	5.6	-20.4	.0060	1.0366	2	1004	13998	2813	.33
20:48:01	5.5	-19.6	.0060	1.4541	2	1067	18080	5228	.28
20:48:31	5.4	-18.8	.0052	1.3793	1	1111	15544	4193	.32
20:49:01	5.2	-17.4	.0039	.8418	1	1085	8477	3503	.35
20:49:31	5.0	-16.3	.0021	.2574	7	916	5177	2813	.29
20:50:01	4.8	-14.9	.0006	.0502	12	923	1892	2468	.21
20:50:31	4.7	-14.1	.0001	.0029	10	943	217	1778	.15
20:51:01	4.6	-13.2	.0052	.0072	39	403	320	1778	.30
20:51:31	4.4	-12.1	.0002	.0047	1	1179	47	1778	.34
20:52:01	4.3	-11.2	.0001	.0008	0	1612	2	2123	.52
20:52:31	4.1	-10.2	.0001	.0006	13	1141	24	1433	.19
20:53:01	4.0	-9.1	.0001	.0055	3	1134	120	2468	.21
20:53:31	3.9	-8.0	.0002	.0159	9	1188	549	2468	.16
20:54:01	3.7	-7.4	.0002	.0117	13	1042	1033	2123	.13

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
20:54:31	3.6	-6.9	.0002	.0281	7	982	1243	2123	.21
20:55:01	3.4	-6.3	.0008	.0607	1	1101	743	2813	.31
20:55:31	3.3	-5.7	.0051	.1302	1	1148	1543	2813	.30
20:56:01	3.2	-5.7	.0318	.2336	6	1331	43679	3503	.06
20:56:31	3.0	-4.9	.0248	.2786	2	1343	49555	3848	.06
20:57:01	2.9	-4.2	.0279	.2123	7	1248	58599	3848	.05
20:57:31	3.0	-4.4	.0225	.0833	0	1128	2472	2468	.20
20:58:01	3.0	-4.6	.0327	.0581	1	1169	3208	2468	.13
20:58:31	3.0	-4.7	.0496	.0653	5	1282	13746	3158	.06
20:59:01	3.0	-4.7	.0629	.1204	15	1365	122161	3503	.03
20:59:31	3.0	-4.7	.0614	.0909	14	1286	64790	3158	.03
21:00:01	3.0	-4.8	.0589	.0444	29	1058	47846	2132	.03
21:00:31	3.0	-5.0	.0720	.0305	43	438	37613	1835	.04
21:01:01	3.0	-5.1	.0940	.0312	16	1479	16160	3023	.02
21:01:31	3.0	-5.0	.0941	.1073	2	1238	4490	2429	.13
21:02:01	3.0	-4.9	.1037	.0869	4	1022	6367	1835	.14
21:02:31	3.0	-4.7	.0968	.0791	4	900	5523	1835	.14
21:03:01	3.0	-4.7	.1046	.1187	3	1005	7428	2726	.08
21:03:31	3.0	-4.7	.1362	.1146	3	882	5699	2132	.18
21:04:01	3.0	-4.9	.1267	.2649	1	926	7240	3617	.14
21:04:31	3.0	-5.0	.1387	.0961	3	905	6488	2726	.11
21:05:01	3.0	-5.3	.1430	.0897	3	1202	2693	4508	.04
21:05:31	3.0	-5.4	.1327	.0547	5	927	3581	1835	.14
21:06:01	3.0	-5.4	.0990	.0678	3	1127	2773	2726	.12
21:06:31	3.0	-5.4	.0606	.0544	3	1106	2341	2132	.16
21:07:01	3.0	-5.5	.0291	.1102	1	1749	3378	3320	.07
21:07:31	3.0	-5.6	.0081	.1552	1	949	3418	3023	.18
* 21:08:01	3.0	-5.5	.0069	.9540	0	1651	11377	5228	.17
* 21:08:31	3.0	-5.2	.0128	1.9141	0	1992	10309	5228	.19
* 21:09:01	3.0	-5.2	.0047	.6397	1	2005	9385	5228	.12
* 21:09:31	3.0	-5.1	.0030	1.1235	0	1192	15318	5228	.22
21:10:01	3.0	-5.0	.0067	3.2831	0	1411	33451	5228	.20
21:10:31	3.0	-4.8	.0079	3.7986	0	1584	33382	5228	.19
21:11:01	3.0	-4.8	.0065	.0921	32	271	23301	6083	.29
21:11:31	3.0	-4.8	.0038	.0922	51	45	25186	6083	.40
21:12:01	3.0	-4.8	.0044	.1176	54	42	24055	6083	.52
21:12:31	3.0	-4.9	.0042	.0619	58	42	18899	6083	.35
21:13:01	3.0	-5.0	.0103	.2158	7	1139	33091	5228	.09
21:13:31	3.0	-5.0	.0066	.1906	9	733	41920	5228	.10
21:14:01	3.0	-4.9	.0064	.3018	5	677	41865	5228	.14
21:14:31	3.0	-5.0	.0035	.2753	4	659	29379	5228	.18
21:15:01	3.0	-5.1	.0023	.1276	6	524	20999	5228	.16
21:15:31	3.0	-5.1	.0010	.0418	5	427	10587	6083	.23
21:16:01	3.0	-5.3	.0016	.8111	1	1073	13264	4538	.23
21:16:31	3.0	-5.5	.0008	.4715	1	1104	12311	6083	.16
21:17:01	3.0	-5.3	.0002	.2357	5	946	10276	4538	.14
21:17:31	3.[illegible]	-5.5	.0001	.1815	5	778	4015	4538	.16
21:18:01	3.0	-5.7	.0001	.1278	10	1066	4285	5228	.10
21:18:31	3.0	-5.7	.0000	.1269	12	1509	3990	6083	.10
21:19:01	3.0	-5.7	.0000	.2237	10	1336	6060	5228	.10
21:19:31	3.0	-5.4	[illegible]	.5941	7	1535	20825	5228	.09
21:20:01	3.0	-5.1	.0000	.6049	10	1315	29398	5228	.09
21:20:31	3.0	-5.3	.0000	.9461	5	1155	27005	5228	.13
21:21:01	3.0	-5.5	.0000	.1261	24	275	39797	6083	.32
21:21:31	3.0	-5.6	.0000	.1151	21	271	43542	6083	.30
* 21:22:01	3.0	-5.6	.0000	.1183	18	283	46037	6083	.31

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
* 21:22:31	3.0	-5.7	.0000	.1428	12	265	51154	5315	.41
* 21:23:01	3.0	-5.6	.0000	.1536	9	272	49373	6083	.39
* 21:23:31	3.0	-5.5	.0000	.1402	7	281	40577	6083	.35
21:24:01	3.0	-5.6	.0000	.1365	8	266	41663	6083	.38
21:24:31	3.0	-5.8	.0000	.1429	4	287	30698	6083	.38
21:25:01	3.0	-6.0	.0000	.1190	3	287	21953	6083	.45
21:25:31	3.0	-6.1	.0000	.1500	2	364	19895	6083	.39
21:26:01	3.0	-6.0	.0000	.0803	4	280	16162	6083	.40
21:26:31	3.0	-5.8	.0000	.0783	2	284	13044	5699	.54
21:27:01	2.9	-5.6	.0000	.1194	3	317	19178	6083	.42
21:27:31	2.8	-4.8	.0000	.1257	3	324	21767	6083	.38
21:28:01	2.6	-4.4	.0000	.3449	2	776	17104	5228	.22
21:28:31	2.5	-4.0	.0000	.3572	2	867	18854	5228	.19
21:29:01	2.4	-3.9	.0000	.3161	2	919	17668	5228	.18
21:29:31	2.3	-3.6	.0000	.3923	2	857	21659	5228	.19
21:30:01	2.2	-2.9	.0000	.5159	3	806	30256	5228	.19
21:30:31	2.1	-2.8	.0000	.3996	3	755	26405	5228	.19
21:31:01	2.1	-3.0	.0000	.3235	4	756	22125	5228	.19
21:31:31	2.1	-3.3	.0000	.2416	6	782	24506	5228	.15
21:32:01	2.1	-3.0	.0000	.2238	6	751	18799	5228	.17
21:32:31	2.0	-2.3	.0000	.2108	7	708	20793	5228	.16
21:33:01	1.8	-2.1	.0000	.1752	10	480	21500	5228	.21
21:33:31	1.7	-2.3	.0000	.1139	14	335	20000	4883	.21
21:34:01	1.6	-2.5	.0000	.0825	11	338	13049	4883	.21
21:34:31	1.5	-2.5	.0000	.0806	9	393	11040	5228	.20
21:35:01	1.5	-2.3	.0000	.1074	6	451	12139	5228	.19
21:35:31	1.5	-2.5	.0000	.0964	7	375	13604	5228	.19
* 21:36:01	1.5	-2.[illegible]	.0000	.0796	9	340	12941	5228	.20
* 21:36:31	1.4	-2.4	.0000	.0666	8	340	9138	5228	.28
* 21:37:01	1.4	-2.2	.0000	.0812	6	369	11292	3848	.32
* 21:37:31	1.4	-2.6	.0000	.0907	4	432	8883	4883	.31
21:38:01	1.5	-2.6	.0000	.1072	5	395	11916	3503	.36
21:38:31	1.5	-2.5	.0000	.1088	5	369	13134	3158	.38
21:39:01	1.5	-2.2	.0000	.0894	6	368	10396	5228	.28
21:39:31	1.5	-1.7	.0000	.0967	6	383	12001	4883	.26
21:40:01	1.5	-1.4	.0003	.0562	8	357	8202	4538	.30
21:40:31	1.5	-1.4	.0000	.0403	8	346	5991	4883	.21
21:41:01	1.5	-1.3	.0000	.0360	7	352	5244	4193	.30
21:41:31	1.5	-1.1	.0000	.0542	6	481	6316	4538	.27
21:42:01	1.5	-1.3	.0000	.1196	4	622	9481	5228	.23
21:42:31	1.5	-1.3	.0000	.1499	2	697	7877	5228	.25
21:43:01	1.5	-1.2	.0000	.1991	2	790	9647	5228	.22
21:43:31	1.5	-1.2	.0000	.1872	2	905	9589	5228	.19
21:44:01	1.5	-1.4	.0000	.2269	3	1017	12540	5228	.17
21:44:31	1.5	-1.3	.0000	.2696	2	1028	12647	5228	.18
21:45:01	1.5	-1.3	.0000	.2425	2	932	10583	5228	.20
21:45:31	1.4	-1.5	.0000	.2231	2	842	12217	5228	.19
21:46:01	1.5	-1.7	.0000	.2750	3	736	19463	5228	.19
21:46:31	1.4	-1.6	.0000	.3506	4	786	24973	5228	.18
21:47:01	1.5	-1.6	.0000	.4636	4	920	36902	5228	.15
21:47:31	1.4	-1.6	.0001	.3422	4	1042	24315	5228	.14
21:48:01	1.4	-1.5	.0001	.2812	4	1006	20701	5228	.15
21:48:31	1.4	-1.2	.0000	.2677	3	910	20339	5228	.15
21:49:01	1.4	-1.3	.0000	.1879	5	823	17475	5228	.15
21:49:31	1.5	-1.5	.0000	.2027	4	916	13833	5228	.16

START TIME	ALT KM	24 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
* 21:50:01	1.5	-1.8	.0000	.2436	3	930	15538	5228	.16
* 21:50:31	1.5	-1.8	.0000	.2996	3	806	17654	5228	.20
* 21:51:01	1.5	-1.8	.0000	.3302	3	846	19885	5228	.20
* 21:51:31	1.5	-1.7	.0002	.2617	3	894	15097	5228	.18
21:52:01	1.5	-1.7	.0000	.2516	2	881	12718	5228	.20
21:52:31	1.5	-1.9	.0000	.2523	3	885	13947	5228	.19
21:53:01	1.5	-1.9	.0000	.2529	3	944	13642	5228	.18
21:53:31	1.5	-2.0	.0001	.1870	2	1041	8736	5228	.18
21:54:01	1.5	-1.9	.0010	.1497	3	1038	7922	5228	.17
21:54:31	1.5	-1.9	.0020	.1391	4	993	10132	5228	.14
21:55:01	1.5	-1.6	.0019	.1219	3	981	7399	5228	.16
21:55:31	1.4	-1.6	.0032	.1462	5	935	10932	5228	.15
21:56:01	1.4	-1.6	.0042	.1452	5	948	12897	5228	.14
21:56:31	1.4	-1.7	.0046	.1409	4	981	10197	5228	.15
21:57:01	1.4	-1.6	.0041	.1329	4	921	9116	5228	.16
21:57:31	1.4	-1.5	.0030	.1623	4	928	11052	5228	.16
21:58:01	1.5	-1.6	.0051	.1221	5	834	9957	5228	.16
21:58:31	1.5	-1.9	.0078	.1337	6	828	11298	5228	.16
21:59:01	1.5	-1.9	.0081	.1470	5	819	11680	5228	.17
21:59:31	1.5	-1.9	.0105	.1235	5	738	10655	5228	.19
22:00:01	1.5	-1.9	.0134	.0864	4	702	6165	5228	.23
22:00:31	1.5	-2.0	.0132	.0950	4	765	8274	5228	.18
22:01:01	1.6	-1.8	.0099	.0750	5	688	7577	4883	.20
22:01:31	1.9	-2.0	.0160	.0851	5	619	8088	4538	.23
22:02:01	2.2	-2.4	.0212	.0926	4	652	7956	5228	.21
22:02:31	2.4	-3.0	.0326	.0828	5	597	9797	5228	.22
22:03:01	2.7	-4.1	.0498	.1066	6	490	14449	4883	.20
22:03:31	2.9	-5.3	.0447	.1295	5	415	17802	3158	.34
22:04:01	3.1	-6.3	.0405	.1129	7	338	20027	4538	.27
22:04:31	3.3	-6.9	.0422	.0662	15	298	19396	5228	.17
22:05:01	3.4	-7.4	.0592	.0337	30	222	15035	3158	.21
22:05:31	3.6	-7.6	.1077	.0117	41	217	43617	4193	.04
22:06:01	3.7	-7.9	.0439	.0037	6	693	6040	3158	.06
22:06:31	3.9	-8.6	.0391	.0029	1	691	350	3848	.19
22:07:01	4.0	-9.5	.0245	.0028	0	583	171	3848	.25
22:07:31	4.2	-10.5	.0377	.0016	12	454	1860	2468	.11
22:08:01	4.3	-11.5	.0227	.0001	67	44	1661	1088	.08
22:08:31	4.5	-12.7	.0118	.0002	99	161	2745	465	.21
22:09:01	4.6	-13.7	.0000	0.0000	0	0	0	2	0.00
22:09:31	4.8	-14.5	.0000	0.0000	0	0	0	28	0.00
22:10:01	5.0	-16.1	.0000	0.0000	0	0	0	2	0.00

START TIME	ALT KM	25 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
17:50:13	7.2	-32.4	.0009	.0002	95	108	972	743	.38
17:50:43	7.2	-32.3	.0022	.0086	39	208	5905	1778	.45
17:51:13	7.2	-32.5	.0023	.0127	73	161	13378	1433	.57
17:51:43	7.2	-32.6	.0024	.0138	81	152	14213	1433	.62
17:52:13	7.2	-32.6	.0020	.0116	74	162	10519	1433	.60
17:52:43	7.2	-32.6	.0017	.0115	56	174	7725	1778	.60
17:53:13	7.2	-32.2	.0021	.0190	47	185	12880	1778	.54
17:53:43	7.2	-32.0	.0024	.0270	66	170	21606	1088	.60
17:54:13	7.2	-32.0	.0020	.0181	82	162	16445	743	.65
17:54:43	7.2	-32.2	.0014	.0070	85	157	6178	743	.69
17:55:13	7.2	-32.3	.0013	.0034	47	184	2772	1088	.51
17:55:43	7.2	-32.3	.0016	.0031	45	188	1891	1088	.57
17:56:13	7.1	-32.3	.0031	.0026	19	264	2065	1088	.35
17:56:43	7.1	-32.0	.0032	.0047	15	270	3323	1778	.34
17:57:13	7.1	-31.6	.0049	.0012	18	258	560	1088	.47
17:57:43	7.0	-31.1	.0013	.0117	74	166	8511	1088	.68
17:58:13	7.1	-31.3	.0003	.0020	72	168	1429	743	.68
17:58:43	7.1	-31.5	.0003	.0011	46	186	535	1088	.66
17:59:13	7.2	-31.8	.0002	.0005	28	217	123	1088	.69
17:59:43	7.2	-32.3	.0001	.0004	59	174	193	743	.80
18:00:13	7.3	-32.6	.0001	.0004	65	168	277	743	.66
18:00:43	7.3	-33.1	.0001	.0009	72	168	522	743	.74
18:01:13	7.3	-33.1	.0001	.0003	62	173	335	743	.47
18:01:43	7.3	-33.0	.0001	.0011	98	158	1376	465	.65
18:02:13	7.3	-32.8	.0001	.0006	84	138	538	743	.70
18:02:43	7.3	-32.7	.0001	.0007	100	151	822	348	.71
18:03:13	7.3	-32.6	.0002	.0029	98	158	2943	465	.70
18:03:43	7.3	-32.5	.0003	.0043	82	162	5384	743	.56
* 18:04:13	7.3	-32.6	.0009	.0079	65	169	7595	1088	.55
* 18:04:43	7.3	-32.8	.0006	.0036	47	184	2564	1088	.53
* 18:05:13	7.3	-32.7	.0005	.0023	44	189	2245	1088	.44
* 18:05:43	7.3	-32.8	.0004	.0021	46	187	1455	1088	.53
18:06:13	7.3	-32.9	.0005	.0038	36	200	2024	1088	.59
18:06:43	7.3	-33.0	.0008	.0044	29	178	4457	1316	.37
18:07:13	7.3	-33.1	.0012	.0060	11	237	3610	1316	.41
18:07:43	7.3	-33.2	.0010	.0058	11	235	4286	1316	.35
18:08:13	7.3	-33.1	.0003	.0006	54	137	1052	706	.49
18:08:43	7.3	-33.0	.0007	.0015	39	162	2978	1011	.35
18:09:13	7.3	-33.0	.0011	.0072	32	172	7450	1927	.36
18:09:43	7.3	-32.9	.0014	.0107	27	180	8559	1316	.47
18:10:13	7.3	-33.0	.0017	.0191	7	269	8641	1622	.36
18:10:43	7.3	-33.2	.0016	.0156	29	180	16483	1622	.37
18:11:13	7.3	-33.1	.0017	.0165	36	166	17187	1316	.48
18:11:43	7.3	-33.0	.0010	.0079	42	156	12115	1011	.42
18:12:13	7.3	-33.0	.0006	.0016	67	127	3910	706	.47
18:12:43	7.3	-33.1	.0005	.0013	97	114	3298	437	.68
18:13:13	7.3	-33.1	.0007	.0028	81	120	5646	706	.61
18:13:43	7.3	-32.9	.0005	.0020	69	127	3109	1011	.57
18:14:13	7.3	-32.9	.0007	.0028	62	135	4788	706	.54
18:14:43	7.3	-32.8	.0010	.0105	81	164	11990	743	.62
18:15:13	7.3	-32.9	.0013	.0154	82	161	14918	743	.64
18:15:43	7.3	-32.8	.0011	.0150	83	162	13874	743	.65
18:16:13	7.3	-32.8	.0010	.0121	84	163	11777	1088	.63
18:16:43	7.3	-32.9	.0008	.0074	93	140	8426	743	.71
18:17:13	7.3	-33.0	.0007	.0085	98	151	9960	465	.68
18:17:43	7.3	-33.1	.0006	.0081	80	166	7738	743	.62

START TIME	ALT KM	25 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
* 18:18:13	7.3	-33.1	.0012	.0152	70	167	12327	1088	.63
* 18:18:43	7.3	-33.0	.0016	.0171	53	178	11673	1088	.60
* 18:19:13	7.3	-33.0	.0017	.0228	62	172	16742	1088	.62
* 18:19:43	7.3	-32.9	.0012	.0116	48	182	8368	1088	.56
18:20:13	7.3	-32.0	.0008	.0078	52	178	6397	1088	.54
18:20:43	7.1	-30.5	.0010	.0111	56	175	6402	1088	.66
18:21:13	6.9	-29.4	.0010	.0095	50	179	6837	1088	.56
18:21:43	6.8	-28.7	.0010	.0088	56	175	6259	1088	.59
18:22:13	6.7	-28.1	.0012	.0060	48	182	4144	1088	.57
18:22:43	6.6	-27.1	.0010	.0100	40	196	5218	1433	.57
18:23:13	6.4	-26.3	.0013	.0112	41	193	5678	1433	.60
18:23:43	6.3	-25.7	.0009	.0074	45	188	3376	1433	.66
18:24:13	6.2	-24.6	.0008	.0041	64	168	3185	1433	.60
18:24:43	6.1	-23.5	.0006	.0025	70	164	1932	743	.66
18:25:13	5.9	-22.6	.0008	.0073	59	172	4280	1088	.67
18:25:43	5.8	-21.6	.0007	.0069	60	172	3964	1088	.68
18:26:13	5.7	-20.6	.0007	.0039	35	203	1914	1088	.59
18:26:43	5.6	-20.2	.0007	.0038	30	211	1543	1088	.61
18:27:13	5.6	-20.3	.0007	.0052	20	236	2004	1433	.54
18:27:43	5.6	-20.1	.0012	.0170	8	290	3575	1778	.58
* 18:28:13	5.6	-20.0	.0011	.0137	9	286	3550	1778	.54
* 18:28:43	5.6	-19.9	.0018	.0313	6	304	5530	2468	.51
* 18:29:13	5.6	-19.8	.0015	.0215	8	301	5227	2468	.48
* 18:29:43	5.6	-19.7	.0033	.0479	11	286	12369	2468	.49
18:30:13	5.6	-19.8	.0022	.0260	22	237	9952	2468	.51
18:30:43	5.6	-19.9	.0014	.0211	40	197	9317	1778	.61
18:31:13	5.6	-19.9	.0010	.0160	55	175	8960	1088	.65
18:31:43	5.6	-19.9	.0007	.0081	44	191	4092	1778	.57
18:32:13	5.6	-19.9	.0005	.0067	50	179	3204	1778	.64
18:32:43	5.6	-19.9	.0001	.0000	0	294	0	743	.93
18:33:13	5.6	-20.2	.0001	0.0000	0	0	0	8	0.00
18:33:43	5.6	-20.8	.0001	.0000	100	118	23	210	1.00
18:34:13	5.6	-20.7	.0001	0.0000	0	0	0	6	0.00
18:34:43	5.6	-20.9	.0001	0.0000	0	(	0	4	0.00
18:35:13	5.6	-21.2	.0001	0.0000	0	0	0	4	0.00
18:35:43	5.6	-21.3	.0001	0.0000	0	0	0	6	0.00
18:36:13	5.6	-21.3	.0001	0.0000	0	0	0	6	0.00
18:36:43	5.6	-21.3	.0001	0.0000	0	0	0	4	0.00
18:37:13	5.6	-21.4	.0001	.0002	73	162	146	743	.73
18:37:43	5.6	-21.4	.0001	.0004	78	159	244	743	.79
18:38:13	5.6	-21.4	.0002	.0017	75	154	1381	1088	.66
18:38:43	5.6	-21.4	.0004	.0039	68	166	3215	1088	.62
18:39:13	5.6	-21.2	.0001	.0004	75	164	546	743	.52
18:39:43	5.6	-21.3	.0003	.0014	93	132	1884	465	.67
* 18:40:13	5.6	-21.3	.0004	.0039	91	139	4330	743	.71
* 18:40:43	5.6	-21.2	.0004	.0038	82	152	2814	743	.76
* 18:41:13	5.6	-21.0	.0008	.0094	52	177	4462	1778	.62
* 18:41:43	5.6	-21.0	.0008	.0077	31	213	3172	1778	.53
18:42:13	5.6	-21.1	.0009	.0113	39	198	4897	1778	.59
18:42:43	5.6	-20.7	.0002	.0012	44	190	598	1433	.57
18:43:13	5.6	-20.6	.0001	.0000	0	217	1	465	1.00
18:43:43	5.6	-20.7	.0002	.0019	55	175	1099	1088	.64
18:44:13	5.6	-20.7	.0001	.0004	84	144	593	743	.56
18:44:43	5.6	-20.6	.0001	0.0000	0	0	0	6	0.00
18:45:13	5.6	-20.4	.0001	0.0000	0	0	0	8	0.00
18:45:43	5.6	-20.2	.0001	0.0000	0	0	0	6	0.00

START TIME	ALT KM	25 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
18:46:13	5.5	-19.6	.0001	0.0000	0	0	0	10	0.00
18:46:43	5.3	-18.4	.0001	0.0000	0	0	0	18	0.00
18:47:13	5.2	-17.5	.0001	0.0000	0	0	0	14	0.00
18:47:43	5.1	-16.2	.0001	0.0000	0	0	0	4	0.00
18:48:13	4.9	-15.1	.0001	0.0000	0	0	0	4	0.00
18:48:43	4.7	-14.1	.0001	0.0000	0	0	0	4	0.00
18:49:13	4.6	-13.1	.0000	0.0000	0	0	0	4	0.00
18:49:43	4.4	-12.3	.0001	0.0000	0	0	0	4	0.00
18:50:13	4.3	-11.4	.0001	0.0000	0	0	0	4	0.00
18:50:43	4.1	-10.6	.0014	0.0000	0	0	0	30	0.00
18:51:13	3.9	-9.5	.0016	0.0000	0	0	0	30	0.00
18:51:43	3.8	-8.7	.0829	.0113	50	308	41864	1835	.03
18:52:13	3.6	-7.9	.1340	.1202	61	285	109145	1835	.11
18:52:43	3.4	-6.5	.0209	.0212	63	277	14518	1538	.13
18:53:13	3.2	-5.3	.0722	.0238	44	347	52548	1835	.04
18:53:43	3.1	-4.0	.0401	.0078	64	188	43207	1241	.03
18:54:13	3.0	-3.5	.0255	.0054	33	827	21296	1835	.02
18:54:43	2.9	-3.1	.0377	.0088	32	484	39689	1538	.02
18:55:13	2.9	-2.8	.0150	.0023	46	655	16586	1241	.02
18:55:43	2.9	-2.7	.0211	.0093	16	1811	25631	2429	.01
18:56:13	2.9	-2.7	.0000	.0001	100	182	27	181	1.00
18:56:43	2.9	-3.0	.0148	.0023	21	2054	9154	213[illegible]	.01
18:57:13	2.9	-3.2	.0445	.0075	40	386	30417	1241	.04
18:57:43	2.9	-3.4	.0706	.0295	39	380	46211	1538	.05
18:58:13	2.9	-3.5	.1367	.0836	45	332	101117	1835	.07
18:58:43	2.9	-3.7	.1911	.0281	42	377	108580	2726	.01
18:59:13	2.9	-3.7	.1458	.0361	49	321	167194	2132	.02
18:59:43	2.9	-3.7	.1818	.0929	48	318	280424	2132	.03
19:00:13	2.9	-3.7	.1670	.0480	48	342	238339	2429	.01
19:00:43	2.9	-3.8	.1503	.0675	36	611	209340	2726	.01
19:01:13	2.9	-3.8	.1134	.0754	61	202	212526	2132	.03
19:01:43	2.9	-3.8	.1281	.0445	63	175	258301	1538	.03
* 19:02:13	2.9	-3.8	.1360	.0270	54	230	255484	2132	.01
* 19:02:43	2.9	-3.7	.1452	.0104	61	52	133498	1538	.01
* 19:03:13	2.9	-3.7	.1717	.0167	52	219	151061	1835	.02
* 19:03:43	2.9	-3.7	.1300	.0129	41	422	81019	1835	.02
19:04:13	2.9	-3.8	.1044	.0107	30	584	40122	1835	.02
19:04:43	2.9	-3.7	.1013	.0092	13	1158	26310	1835	.02
19:05:13	2.9	-3.8	.0740	.0098	15	1006	17615	1835	.02
19:05:43	3.0	-3.8	.0503	.0144	7	1787	16502	2132	.02
19:06:13	3.0	-3.9	.0654	.0126	30	811	66924	2726	.01
19:06:43	3.0	-4.3	.0999	.0147	43	835	147401	2726	.01
19:07:13	3.0	-4.2	.0530	.0043	61	51	56672	1538	.01
19:07:43	3.0	-3.9	.0323	.0131	20	1773	9489	2726	.02
19:08:13	3.0	-3.8	.0259	.0186	11	2733	19214	3320	.01
19:08:43	3.0	-4.1	.0319	.0376	23	1230	89549	3617	.01
19:09:13	3.0	-4.2	.0304	.0475	24	1441	87302	3914	.01
19:09:43	2.9	-3.9	.0118	.0282	25	780	29626	2726	.02
19:10:13	2.9	-4.0	.0060	.0174	20	1427	45705	2726	.01
19:10:43	2.9	-4.1	.0007	.0235	17	1812	18473	2132	.02
19:11:13	2.9	-4.1	.0004	.0342	31	613	8721	3023	.03
19:11:43	2.9	-4.2	.0018	.0634	30	490	32576	3914	.02
19:12:13	2.9	-4.3	.0018	.0815	47	335	26436	2726	.05
19:12:43	2.9	-4.3	.0008	.0809	53	301	16901	2726	.07
19:13:13	2.9	-4.2	.0001	.0190	32	472	14710	2429	.03
19:13:43	2.9	-4.2	.0001	.0229	27	463	12457	2726	.03

START TIME	ALT KM	25 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
19:14:13	2.9	-4.3	.0000	.0101	24	1286	7386	2132	.03
19:14:43	2.9	-4.2	.0000	.0134	15	912	1664	2429	.06
19:15:13	2.9	-4.1	.0000	.0125	11	1131	888	2132	.10
19:15:43	2.9	-4.2	.0000	.0138	14	1019	1509	2429	.06
19:16:13	2.9	-4.2	.0000	.0183	18	1083	816	2132	.08
19:16:43	2.9	-4.3	.0000	.0095	2	1789	2136	2429	.04
19:17:13	2.9	-4.3	.0000	.0119	2	1898	458	2726	.07
19:17:43	2.9	-4.3	.0000	.0128	17	1073	5787	2429	.03
* 19:18:13	2.9	-4.4	.0000	.0139	14	937	11494	2132	.03
* 19:18:43	2.9	-4.4	.0001	.0111	16	1284	18304	1835	.02
* 19:19:13	2.9	-4.3	.0000	.0149	21	888	29571	2132	.02
* 19:19:43	2.9	-4.2	.0000	.0127	12	1262	23546	2726	.01
19:20:13	2.9	-3.9	.0000	.0054	10	1268	7142	1835	.02
19:20:43	2.9	-4.1	.0000	.0139	17	991	20451	2132	.02
19:21:13	2.9	-4.2	.0000	.0157	2	2082	5911	3023	.02
19:21:43	3.0	-4.3	.0000	.0263	1	2670	5206	3320	.02
19:22:13	3.0	-4.5	.0000	.0238	1	2948	8057	3320	.02
19:22:43	3.0	-4.4	.0000	.0071	9	1253	6611	2429	.02
19:23:13	3.0	-4.4	.0000	.0151	14	803	3035	1538	.11
19:23:43	3.0	-4.2	.0000	.0194	2	1365	941	2726	.07
19:24:13	3.0	-4.0	.0000	.0760	4	1044	2255	2132	.19
19:24:43	2.9	-3.8	.0000	.6403	0	592	3969	4193	.22
19:25:13	2.7	-3.2	.0000	.0565	1	630	3460	4883	.25
19:25:43	2.5	-2.8	.0000	.0536	3	608	3321	4538	.27
19:26:13	2.4	-2.6	.0000	.1444	2	607	9379	4883	.27
19:26:43	2.3	-2.5	.0000	.1742	3	659	12008	5228	.24
19:27:13	2.2	-3.2	.0001	.1578	2	626	9097	5228	.28
19:27:43	2.0	-2.8	.0000	.1261	4	598	9927	4883	.26
19:28:13	1.9	-3.6	.0000	.0770	5	538	8112	4538	.25
19:28:43	1.8	-4.1	.0001	.1007	5	529	9335	5228	.25
19:29:13	1.6	-6.3	.0001	.0932	5	520	8605	4193	.30
19:29:43	1.5	-6.8	.0001	.0940	4	549	8009	4538	.27
19:30:13	1.4	-6.5	.0002	.1571	3	721	9204	4883	.24
19:30:43	1.4	-6.7	.0003	.1762	4	655	12950	5228	.22
19:31:13	1.4	-6.3	.0001	.1071	3	617	7597	5228	.24
19:31:43	1.4	-6.5	.0000	.0504	5	509	4755	4883	.26
* 19:32:13	1.4	-6.6	.0000	.0216	7	481	2444	3503	.30
* 19:32:43	1.4	-6.7	.0000	.0093	21	408	2127	2468	.27
* 19:33:13	1.4	-6.4	.0000	.0159	15	491	2443	4193	.23
* 19:33:43	1.4	-6.4	.0001	.0149	22	467	2959	4193	.21
19:34:13	1.4	-6.1	.0000	.0158	29	320	4053	3158	.23
19:34:43	1.4	-6.2	.0000	.0208	40	343	2032	2132	.60
19:35:13	1.4	-5.6	.0000	.0084	49	313	654	944	.64
19:35:43	1.4	-5.5	.0000	.0042	54	300	1195	1241	.18
19:36:13	1.4	-5.5	.0000	.0045	60	283	3303	944	.15
19:36:43	1.4	-6.0	.0000	.0041	93	199	3440	647	.32
19:37:13	1.5	-5.5	.0000	.0783	73	262	14878	1538	.36
19:37:43	1.4	-5.8	.0000	.0936	77	240	19773	2132	.16
19:38:13	1.4	-5.7	.0000	.1222	77	256	20704	1538	.44
19:38:43	1.4	-4.8	.0000	.0828	85	219	19269	1538	.41
19:39:13	1.4	-4.8	.0000	.0623	91	211	15633	944	.64
19:39:43	1.4	-5.7	.0000	.0590	80	226	11234	944	.62
19:40:13	1.4	-5.7	.0000	.1111	75	260	16268	1835	.37
19:40:43	1.4	-4.7	.0000	.1103	82	244	18809	1538	.46
19:41:13	1.4	-3.9	.0000	.0905	86	232	19137	1241	.52
19:41:43	1.4	-4.7	.0000	.0669	81	241	13682	1538	.38

25 MAR 78 — 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
19:42:13	1.4	-3.0	.0000	.0827	81	250	17465	944	.60
19:42:43	1.4	-2.9	.0001	.0674	75	229	14995	1835	.21
19:43:13	1.4	-2.9	.0001	.0706	62	258	12695	2132	.18
19:43:43	1.4	-3.3	.0001	.0641	78	239	13588	1241	.37
19:44:13	1.4	-2.2	.0000	.0504	74	251	10974	1538	.25
19:44:43	1.4	-.5	.0000	.0194	86	187	8644	1241	.28
19:45:13	1.5	-1.5	.0001	.0215	79	223	8027	1538	.21
19:45:43	1.5	-.5	.0000	.0221	79	249	7534	944	.42
19:46:13	1.5	.3	.0000	.0179	85	228	6009	647	.53
19:46:43	1.5	.1	.0000	.0252	74	229	7499	1538	.16
19:47:13	1.5	-.9	.0001	.0230	89	202	7568	1241	.29
19:47:43	1.5	-1.5	.0001	.0288	72	216	7812	1835	.17
19:48:13	1.5	.3	.0000	.0100	65	190	5253	2132	.05
19:48:43	1.5	-.0	.0001	.0267	68	248	8139	944	.36
19:49:13	1.5	.6	.0001	.0642	53	294	13320	2132	.14
19:49:43	1.5	.9	.0001	.0709	48	321	11829	3023	.07
19:50:13	1.4	-.1	.0000	.0679	54	301	10306	1538	.31
19:50:43	1.4	.1	.0001	.0585	49	313	9620	1835	.17
19:51:13	1.5	.3	.0015	.0703	22	628	9047	2132	.14
19:51:43	1.4	.2	.0075	.0243	39	456	8690	1538	.14
19:52:13	1.4	1.0	.0057	.0190	52	284	10149	2726	.03
19:52:43	1.4	.5	.0096	.0178	61	267	8607	647	.29
19:53:13	1.5	-.4	.0196	.0217	54	288	7982	1241	.19
19:53:43	1.4	-.2	.0240	.0203	57	222	10560	1538	.10
* 19:54:13	1.5	.7	.0073	.0322	55	249	14167	2429	.06
* 19:54:43	1.4	1.2	.0027	.0272	57	263	11350	2132	.08
* 19:55:13	1.4	1.4	.0009	.0245	50	310	4870	944	.37
* 19:55:43	1.5	.7	.0050	.0440	34	399	7473	1241	.23
19:56:13	1.5	.8	.0047	.0435	47	326	12126	2132	.12
19:56:43	1.4	1.3	.0046	.0406	52	295	9548	1538	.20
19:57:13	1.5	1.5	.0037	.0844	15	756	7721	3914	.04
19:57:43	1.4	.9	.0105	.0699	16	827	7214	3320	.05
19:58:13	1.4	1.6	.0021	.1364	30	422	14222	1835	.20
19:58:43	1.4	1.8	.0027	.1050	39	406	12628	1835	.16
19:59:13	1.4	2.1	.0011	.1342	32	431	9057	2726	.12
19:59:43	1.4	1.9	.0013	.1683	47	324	15218	1538	.34
20:00:13	1.5	1.4	.0023	.1613	52	305	15664	3023	.12
20:00:43	1.5	.8	.0020	.0940	61	278	13136	1538	.28
20:01:13	1.4	1.1	.0012	.0989	56	289	10757	1835	.24
20:01:43	1.5	.9	.0071	.1369	23	662	7291	3320	.12
20:02:13	1.6	.9	.0018	.1572	21	717	11586	3617	.08
20:02:43	1.9	-.2	.0104	.4332	2	2712	8208	4508	.05
20:03:13	2.2	-.7	.0090	3.6212	0	3324	13450	4508	.11
20:03:43	2.5	-1.4	.0254	.1899	2	2456	18871	4211	.03
20:04:13	2.7	-2.3	.0352	2.1091	0	3611	28442	4508	.05
20:04:43	2.9	-3.3	.0134	3.3036	0	3268	8689	4508	.14
20:05:13	3.1	-4.3	.0021	3.9715	0	2630	11444	4508	.16
20:05:43	3.3	-5.7	.0021	3.3147	0	1942	10830	4508	.19
20:06:13	3.5	-7.1	.0021	4.3299	0	1757	18584	4508	.19
20:06:43	3.8	-8.0	.0031	5.2262	0	1603	22481	4508	.20
20:07:13	3.9	-9.0	.0028	6.2802	0	1792	19344	4508	.22
20:07:43	4.0	-9.8	.0021	5.0901	0	1762	15576	4508	.22
20:08:13	4.2	-10.8	.0016	3.7679	0	1761	13630	4508	.21
20:08:43	4.4	-11.9	.0022	3.5099	0	1426	14691	4508	.22
20:09:13	4.5	-12.8	.0023	3.6918	0	1489	16441	4508	.22
20:09:43	4.7	-13.6	.0032	8.6936	0	1976	18912	4508	.22

START TIME	ALT KM	26 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
15:50:09	7.1	-31.0	.0024	.0596	2	367	7573	2813	.49
15:50:39	7.1	-31.1	.0024	.0517	2	335	6101	5228	.50
15:51:09	7.1	-31.1	.0025	.0625	2	342	8398	2813	.50
15:51:39	7.1	-31.2	.0026	.0597	2	345	7479	2813	.53
15:52:09	7.1	-31.3	.0028	.0932	2	397	9567	5228	.43
15:52:39	7.1	-31.4	.0037	.1168	2	424	12728	5228	.37
15:53:09	7.1	-31.4	.0032	.0696	3	426	7461	3848	.44
15:53:39	7.1	-31.2	.0035	.1129	2	457	12177	5228	.37
15:54:09	7.1	-31.1	.0035	.1079	2	422	11904	5228	.40
15:54:39	7.1	-31.1	.0034	.0904	2	392	10659	3158	.46
15:55:09	7.1	-31.1	.0034	.0912	2	384	9211	5228	.48
15:55:39	7.1	-31.1	.0027	.0713	1	354	7843	3503	.52
15:56:09	7.1	-31.0	.0028	.0628	2	336	7717	3503	.51
15:56:39	7.1	-30.9	.0028	.0553	3	325	7927	2813	.50
15:57:09	7.1	-31.0	.0022	.0179	5	299	2701	2468	.61
15:57:39	7.1	-30.9	.0026	.0085	27	220	3236	1778	.58
15:58:09	7.1	-31.1	.0032	.0175	16	252	4416	2468	.54
15:58:39	7.2	-31.7	.0028	.0380	2	314	5341	2468	.57
15:59:09	7.3	-32.1	.0029	.0251	9	278	5662	2468	.56
15:59:39	7.3	-32.6	.0031	.0139	44	191	8162	1088	.55
16:00:09	7.3	-32.6	.0031	.0103	33	209	4421	2123	.57
16:00:39	7.3	-32.5	.0035	.0086	29	213	3130	1433	.63
16:01:09	7.3	-32.2	.0042	.0113	25	223	4069	1433	.59
16:01:39	7.3	-32.3	.0040	.0081	12	270	2156	2468	.53
16:02:09	7.3	-32.2	.0025	.0065	16	243	2453	1088	.54
16:02:39	7.3	-32.2	.0027	.0055	23	222	2459	1433	.54
16:03:09	7.3	-32.6	.0020	.0103	18	248	4204	1433	.50
16:03:39	7.3	-32.7	.0016	.0158	14	249	5144	1433	.53
16:04:09	7.3	-32.6	.0015	.0224	6	297	4090	2468	.57
16:04:39	7.3	-32.6	.0017	.0212	7	292	5698	2468	.50
16:05:09	7.3	-32.3	.0019	.0300	18	240	9901	2468	.52
16:05:39	7.3	-32.0	.0016	.0280	36	203	12342	1433	.58
* 16:06:09	7.3	-32.0	.0017	.0292	17	246	9232	2468	.51
* 16:06:39	7.3	-32.3	.0010	.0180	45	189	8656	2468	.56
* 16:07:09	7.3	-32.3	.0016	.0300	35	204	11482	1433	.63
* 16:07:39	7.3	-32.3	.0019	.0326	18	242	9751	2468	.55
16:08:09	7.3	-32.4	.0021	.0353	16	253	11315	2468	.49
16:08:39	7.3	-32.4	.0019	.0351	8	290	8835	2468	.49
16:09:09	7.3	-32.5	.0013	.0220	5	301	4446	2468	.53
16:09:39	7.3	-32.5	.0014	.0278	15	259	7281	2468	.52
16:10:09	7.3	-32.4	.0014	.0275	9	288	5547	2813	.53
16:10:39	7.3	-32.6	.0007	.0091	17	257	2323	2468	.50
16:11:09	7.3	-32.7	.0007	.0058	52	179	3025	1778	.60
16:11:39	7.3	-32.7	.0005	.0031	59	172	2012	1088	.63
16:12:09	7.3	-32.7	.0008	.0096	46	186	5533	1433	.59
16:12:39	7.3	-32.7	.0012	.0189	23	226	6658	1778	.56
16:13:09	7.3	-32.7	.0009	.0165	24	223	6098	1778	.55
16:13:39	7.3	-32.7	.0010	.0196	30	216	6923	3158	.52
16:14:09	7.3	-32.6	.0012	.0134	15	249	3671	1778	.58
16:14:39	7.3	-32.6	.0010	.0166	5	293	3390	2468	.50
16:15:09	7.3	-32.5	.0014	.0184	6	297	4282	2468	.53
16:15:39	7.3	-32.4	.0016	.0284	5	304	5583	2468	.53
* 16:16:09	7.3	-32.1	.0023	.0504	4	307	8790	2468	.53
* 16:16:39	7.3	-32.0	.0024	.0546	4	307	10440	2468	.53
* 16:17:09	7.3	-32.1	.0026	.0605	4	309	10021	2468	.55
* 16:17:39	7.3	-32.3	.0018	.0531	4	346	9415	2468	.58

START TIME	ALT KM	26 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
16:18:09	7.3	-32.3	.0019	.0510	4	310	9991	2468	.51
16:18:39	7.3	-32.2	.0023	.0546	5	307	10638	2468	.51
16:19:09	7.3	-32.2	.0023	.0420	5	305	7399	2468	.56
16:19:39	7.3	-32.0	.0015	.0290	5	299	6039	2468	.51
16:20:09	7.3	-32.0	.0015	.0253	12	276	6775	1433	.56
16:20:39	7.3	-32.3	.0014	.0173	14	278	5456	2468	.51
16:21:09	7.3	-32.4	.0017	.0250	18	244	7698	2123	.56
16:21:39	7.3	-32.7	.0013	.0150	53	178	8166	1088	.65
16:22:09	7.3	-32.9	.0023	.0323	74	164	24513	1088	.67
16:22:39	7.3	-33.2	.0019	.0227	65	170	14636	1088	.67
16:23:09	7.3	-33.2	.0017	.0106	48	183	5895	1088	.63
16:23:39	7.2	-32.3	.0016	.0157	31	208	8296	1088	.54
16:24:09	7.1	-30.9	.0018	.0183	22	228	8124	2468	.50
16:24:39	7.1	-29.7	.0008	.0070	11	276	2637	1088	.45
16:25:09	6.9	-28.8	.0009	.0164	11	291	4960	2468	.46
16:25:39	6.8	-28.1	.0022	.0341	7	305	8707	2468	.46
16:26:09	6.6	-27.3	.0022	.0289	13	273	9042	2468	.45
16:26:39	6.5	-26.2	.0020	.0361	6	316	7995	2468	.43
16:27:09	6.3	-24.9	.0010	.0155	8	302	4034	1433	.49
16:27:39	6.2	-23.5	.0011	.0297	5	323	5424	2123	.50
16:28:09	6.1	-22.8	.0010	.0319	4	383	4511	2468	.45
16:28:39	5.9	-21.9	.0022	.0818	5	413	11550	2813	.38
16:29:09	5.8	-20.6	.0051	.1974	3	509	17867	3848	.35
16:29:39	5.7	-19.8	.0041	.2141	1	562	11342	5228	.34
16:30:09	5.6	-19.5	.0044	.2029	2	539	14578	5228	.33
16:30:39	5.6	-19.6	.0043	.2131	2	525	15819	4193	.37
16:31:09	5.6	-19.6	.0045	.2847	2	556	19612	5228	.33
16:31:39	5.6	-19.7	.0052	.2753	2	556	22951	5228	.31
* 16:32:09	5.6	-19.9	.0036	.2013	2	526	18525	5228	.31
* 16:32:39	5.6	-19.8	.0033	.1709	2	517	14096	5228	.32
* 16:33:09	5.6	-19.7	.0035	.1743	2	540	14096	5228	.31
* 16:33:39	5.6	-19.5	.0040	.2176	1	523	14557	5228	.36
16:34:09	5.6	-19.4	.0042	.1947	2	499	13419	5228	.38
16:34:39	5.6	-19.3	.0045	.1717	3	420	15724	3503	.40
16:35:09	5.6	-19.3	.0038	.1246	3	411	15567	3848	.41
16:35:39	5.6	-19.6	.0033	.1183	4	402	14748	4083	.42
16:36:09	5.7	-20.0	.0021	.0601	3	360	7227	3158	.49
16:36:39	5.7	-19.7	.0011	.0252	19	259	7078	2468	.46
16:37:09	5.7	-20.0	.0008	.0104	7	323	1909	2123	.47
16:37:39	5.7	-20.1	.0009	.0058	10	318	1373	2468	.44
16:38:09	5.7	-20.0	.0008	.0128	22	254	4484	2123	.36
16:38:39	5.6	-19.9	.0018	.0482	7	337	6561	4083	.34
16:39:09	5.6	-19.8	.0019	.0664	3	387	8233	2813	.41
16:39:39	5.7	-19.7	.0105	.0683	3	478	6393	3158	.38
16:40:09	5.6	-19.8	.0039	.0711	2	512	4404	5228	.33
16:40:39	5.6	-19.8	.0047	.1056	2	502	8685	5228	.26
16:41:09	5.7	-19.9	.0043	.1661	1	497	10629	5228	.33
16:41:39	5.7	-20.0	.0033	.1342	2	492	11419	5228	.31
16:42:09	5.7	-20.0	.0052	.1176	2	464	10435	3848	.38
16:42:39	5.7	-20.0	.0028	.1359	3	456	12942	3848	.37
16:43:09	5.7	-19.9	.0045	.2201	3	503	17247	5228	.31
16:43:39	5.7	-19.8	.0030	.1214	2	432	11406	3158	.41
16:44:09	5.7	-19.7	.0023	.0816	4	352	10728	2468	.45
16:44:39	5.7	-19.6	.0021	.0631	3	362	8129	2813	.44
16:45:09	5.7	-19.3	.0013	.0385	3	360	3764	3158	.40
16:45:39	5.6	-19.1	.0010	.0135	14	272	3171	2468	.44

START TIME	ALT KM	26 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
16:46:09	5.6	-18.9	.0006	.0061	31	215	2309	1433	.52
16:46:39	5.6	-19.2	.0014	.0334	10	310	6028	2468	.44
16:47:09	5.6	-19.3	.0014	.0324	3	334	4527	2468	.50
16:47:39	5.6	-19.4	.0021	.0534	3	362	5923	2468	.49
16:48:09	5.6	-19.4	.0012	.0339	3	349	5120	2813	.46
16:48:39	5.6	-19.2	.0022	.0739	2	392	7800	3503	.41
16:49:09	5.6	-19.2	.0032	.1049	2	412	11078	5228	.32
16:49:39	5.6	-19.3	.0028	.1021	2	453	9541	5228	.31
16:50:09	5.6	-19.5	.0021	.0824	4	437	9499	3503	.31
16:50:39	5.7	-19.5	.0015	.0479	4	362	5689	3503	.37
16:51:09	5.7	-19.7	.0016	.0672	2	418	7561	4883	.36
16:51:39	5.7	-19.7	.0022	.1109	3	447	11320	3158	.39
16:52:09	5.7	-19.6	.0039	.2167	2	459	19954	5228	.36
16:52:39	5.7	-19.6	.0024	.1249	4	418	13441	3158	.40
16:53:09	5.7	-19.5	.0028	.1480	3	440	13586	3848	.41
16:53:39	5.7	-19.4	.0039	.2294	2	485	19223	5228	.34
* 16:54:09	5.7	-19.5	.0035	.2057	2	465	19883	5228	.31
* 16:54:39	5.7	-19.6	.0035	.2133	2	534	15134	5228	.33
* 16:55:09	5.7	-19.6	.0032	.2059	2	521	16496	5228	.29
* 16:55:39	5.7	-19.6	.0032	.2080	2	465	17142	5228	.31
16:56:09	5.7	-19.5	.0032	.0803	5	332	13351	2468	.43
16:56:39	5.7	-19.4	.0032	.1213	3	405	11695	3503	.46
16:57:09	5.6	-19.4	.0033	.0867	2	386	9233	2813	.46
16:57:39	5.6	-19.1	.0017	.0542	3	356	6338	2468	.50
16:58:09	5.6	-19.3	.0026	.0770	3	350	9283	2468	.49
16:58:39	5.6	-19.0	.0045	.1466	3	351	18040	2468	.45
16:59:09	5.6	-19.1	.0040	.1447	3	390	14982	2813	.45
16:59:39	5.6	-18.9	.0052	.2131	2	430	20604	5228	.37
17:00:09	5.6	-18.7	.0033	.1246	2	445	9629	3848	.45
17:00:39	5.4	-17.4	.0043	.1600	2	447	12992	5228	.39
17:01:09	5.2	-15.8	.0037	.1565	2	440	12236	5228	.40
17:01:39	5.1	-15.2	.0072	.4265	1	543	24183	5228	.32
17:02:09	5.0	-14.5	.0076	.5760	1	645	18505	5228	.33
17:02:39	4.8	-13.4	.0078	.6069	1	891	16239	5228	.26
17:03:09	4.7	-12.2	.0070	.4539	1	763	16855	5228	.27
17:03:39	4.5	-11.1	.0057	.2685	1	598	10939	5228	.37
17:04:09	4.3	-10.2	.0055	.3074	1	742	13213	5828	.24
17:04:39	4.2	-9.3	.0071	1.7985	1	1513	17623	5228	.22
17:05:09	4.1	-8.4	.0085	7.3823	1	1788	33846	5228	.23
17:05:39	3.9	-7.5	.0070	5.0906	1	1548	33201	5228	.22
17:06:09	3.8	-6.5	.0064	4.1362	1	1408	28071	5228	.26
17:06:39	3.6	-5.7	.0088	6.9360	1	1435	55063	5228	.24
17:07:09	3.5	-5.1	.0099	8.2540	0	1498	62857	5228	.22
17:07:39	3.4	-4.4	.0093	7.6145	0	1553	58234	5228	.21
17:08:09	3.2	-3.6	.0064	5.0937	0	1537	28107	5228	.26
17:08:39	3.1	-2.9	.0046	4.1669	0	1588	21409	5228	.25
17:09:09	3.0	-2.9	.0040	3.5774	0	1768	20503	5228	.21
17:09:39	3.0	-3.1	.0047	4.8408	0	2074	21591	5228	.20
* 17:10:09	3.0	-2.8	.0043	4.1069	0	2010	19910	5228	.20
* 17:10:39	3.0	-2.8	.0035	3.2705	0	1761	15169	5228	.23
* 17:11:09	3.0	-2.7	.0048	4.0202	0	1730	19156	5228	.24
* 17:11:39	3.0	-2.7	.0065	3.8587	0	1903	14833	5228	.23
17:12:09	3.0	-2.7	.0069	5.8726	0	2190	22682	5228	.21
17:12:39	3.0	-2.5	.0035	3.5991	0	2095	12119	5228	.23
17:13:09	3.0	-2.2	.0031	2.3111	0	1803	16569	5228	.18
17:13:39	3.0	-2.1	.0015	1.0033	1	1443	20472	5228	.14

START TIME	ALT KM	26 MAR 78 TEMP C	LWC-SC G/M**3	30 SECOND AVERAGE LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
17:14:09	3.0	-2.7	.0076	1.8737	1	1583	27482	5228	.15
17:14:39	3.0	-2.6	.0028	1.8953	1	1072	18732	5228	.15
17:15:09	3.0	-2.6	.0045	1.9121	8	1607	18458	5228	.18
17:15:39	3.0	-2.5	.0423	.6000	8	1141	27810	5228	.13
17:16:09	3.0	-2.7	.0424	1.1384	7	1270	52093	5228	.11
17:16:39	3.0	-2.5	.0049	1.8787	3	1632	18121	5228	.17
17:17:09	3.0	-2.4	.0073	2.0705	2	1628	18700	5228	.18
17:17:39	3.0	-2.3	.0031	1.1082	2	1346	10149	5228	.23
17:18:09	3.0	-2.3	.0076	2.4299	2	1590	21068	5228	.19
17:18:39	3.0	-2.5	.0270	2.5579	2	1511	68135	5228	.12
17:19:09	3.0	-2.4	.0143	2.1565	3	1416	37761	5228	.16
17:19:39	3.0	-2.3	.0072	4.2578	2	1593	34963	5228	.19
17:20:09	3.0	-2.3	.0056	4.4265	2	1645	28200	5228	.21
17:20:39	3.0	-2.5	.0102	2.4666	2	1601	17348	5228	.21
17:21:09	3.0	-2.7	.0325	2.8082	3	1482	31568	5228	.19
17:21:39	3.0	-2.9	.0406	1.7715	4	1427	33669	5228	.15
* 17:22:09	3.0	-2.7	.0218	1.6511	4	1625	29518	5228	.13
* 17:22:39	3.0	-2.5	.0235	1.0527	14	1192	75458	5228	.09
* 17:23:09	3.0	-2.4	.0204	1.3662	12	1395	82464	5228	.08
* 17:23:39	3.0	-2.4	.0087	3.5428	5	1500	50620	5228	.16
17:24:09	3.0	-2.2	.0067	4.5658	3	1409	42976	5228	.20
17:24:39	3.0	-2.1	.0062	3.7725	3	1458	34039	5228	.21
17:25:09	3.0	-2.0	.0044	3.7571	1	1579	20970	5228	.23
17:25:39	3.0	-2.0	.0030	2.7678	2	1522	16318	5228	.24
17:26:09	3.0	-2.3	.0048	1.5932	3	1285	15572	4083	.24
17:26:39	3.0	-2.4	.0070	1.9694	3	1197	21628	4538	.26
17:27:09	3.0	-2.6	.0036	3.0132	2	1670	23628	5228	.18
17:27:39	3.0	-2.5	.0038	2.5985	3	1604	24774	5228	.17
17:28:09	3.0	-2.4	.0072	1.9525	8	1298	40351	4083	.16
17:28:39	3.0	-2.3	.0094	1.8201	5	1364	39115	5228	.14
17:29:09	3.0	-2.2	.0031	1.2523	7	1267	20316	4193	.19
17:29:39	3.0	-2.3	.0077	2.4758	3	1545	26039	5228	.18
17:30:09	3.0	-2.3	.0067	2.6523	2	1737	20905	5228	.18
17:30:39	3.0	-2.2	.0072	2.3327	3	1909	20012	5228	.13
17:31:09	3.0	-2.3	.0040	2.1483	3	1431	20946	5228	.21
17:31:39	2.8	-2.1	.0128	3.2507	1	1570	19875	5228	.22
17:32:09	2.7	-1.5	.0098	1.9995	4	1784	17174	5228	.17
17:32:39	2.6	-.9	.0152	.9128	5	1741	11405	5228	.14
17:33:09	2.5	-.2	.0105	.1753	11	1191	8112	4538	.10
17:33:39	2.3	.5	.0041	.0297	40	403	1756	2448	.29
17:34:09	2.2	1.4	.0045	.0380	29	454	1835	1778	.35
17:34:39	2.1	1.9	.0077	.0081	10	637	2400	3617	.21
17:35:09	2.0	2.4	.0061	.0910	12	660	3289	2132	.26
17:35:39	2.0	3.0	.0027	.0786	8	730	2981	3023	.13
17:36:09	1.9	3.3	.0205	.1286	7	799	34227	3914	.03
17:36:39	1.8	3.8	.0058	.1849	2	978	11050	3617	.08
17:37:09	1.7	4.8	.0012	.2251	2	1164	3608	3617	.15
17:37:39	1.5	5.2	.0006	.1365	1	1091	1214	3023	.24
17:38:09	1.5	5.6	.0006	.1222	9	914	4416	3914	.07
17:38:39	1.5	6.1	.0004	.1625	4	975	3430	3320	.13
17:39:09	1.5	6.0	.0007	.1909	3	1165	3509	2726	.17
17:39:39	1.4	6.0	.0007	.1615	4	1152	3565	3914	.18
* 17:40:09	1.4	6.3	.0005	.1766	4	1163	3006	3914	.12
* 17:40:39	1.4	6.0	.0017	.1377	3	1144	2242	2429	.21
* 17:41:09	1.4	5.7	.0028	.1498	1	1214	2639	4211	.09
* 17:41:39	1.4	5.9	.0004	.1049	1	1515	1304	3914	.17

26 MAR 78 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
17:42:09	1.5	5.2	.0018	.1734	0	1232	1111	2429	.34
17:42:39	1.5	4.9	.0079	.1501	[illegible]	1345	2253	2726	.17
17:43:09	1.5	5.0	.0274	.1741	4	1221	13611	4508	.04
17:43:39	1.5	5.3	.0091	.1075	3	915	4128	2429	.17
17:44:09	1.5	5.6	.0185	.1383	1	1075	8118	2429	.12
17:44:39	1.5	5.4	.0236	.1722	3	1170	19476	4508	.03
17:45:09	1.5	5.7	.0084	.1524	1	1183	1615	4211	.12
17:45:39	1.5	5.0	.0190	.1965	1	1106	4811	3914	.11
17:46:09	1.5	5.4	.0012	.2580	0	1341	2594	4211	.11
17:46:39	1.5	5.8	.0009	.3048	2	1370	3041	2726	.21
17:47:09	1.5	6.2	.0013	.3762	1	1607	4075	3617	.15
17:47:39	1.4	7.0	.0011	.5169	1	1845	4400	4508	.09
17:48:09	1.4	6.3	.0016	.5548	0	1656	4204	3914	.16
17:48:39	1.4	6.7	.0013	.4611	1	1600	5001	3320	.16
17:49:09	1.4	6.5	.0010	.3769	1	1488	3727	4508	.12
17:49:39	1.4	6.3	.0010	.3619	1	1399	3431	3023	.20
17:50:09	1.5	6.7	.0012	.4667	1	1600	3712	4508	.12
17:50:39	1.5	6.0	.0017	.4772	1	1481	4372	3914	.17
17:51:09	1.5	6.2	.0010	.3582	2	1395	4395	3617	.16
17:51:39	1.5	5.4	.0013	.5101	1	1649	5163	4508	.11
17:52:09	1.5	5.2	.0021	.5923	1	1563	5534	3617	.17
17:52:39	1.5	5.3	.0011	.4296	1	1519	5287	3320	.16
17:53:09	1.5	5.5	.0017	.6240	2	1691	7117	4211	.12
17:53:39	1.5	5.1	.0015	.5229	1	1653	6332	3320	.14
17:54:09	1.5	4.7	.0012	.5344	1	1550	5784	3023	.18
17:54:39	1.5	4.9	.0020	.6485	1	1504	7591	3617	.15
17:55:09	1.5	5.1	.0024	.7197	1	1726	8359	4508	.09
17:55:39	1.5	4.7	.0056	.6413	1	1782	11544	3320	.11
17:56:09	1.5	4.8	.0059	.5483	2	1576	7024	3320	.15
17:56:39	1.5	5.1	.0024	.3320	1	1461	4571	3914	.13
17:57:09	1.5	5.4	.0018	.3892	1	1353	4447	3914	.16
17:57:39	1.5	5.7	.0024	.2944	1	1475	3711	2726	.18
* 17:58:09	1.5	5.6	.0041	.2395	1	1412	4308	2726	.15
* 17:58:39	1.5	6.1	.0011	.2377	1	1396	2049	3320	.20
* 17:59:09	1.5	5.5	.0051	.2874	1	1498	3761	3914	.13
* 17:59:39	1.5	5.3	.0064	.3197	1	1572	3728	3320	.14
18:00:09	1.5	5.4	.0038	.2895	2	1550	4841	2726	.14
18:00:39	1.5	5.0	.0177	.1651	1	1477	3958	2429	.13
18:01:09	1.5	4.7	.0187	.3864	1	1665	8377	3320	.10
18:01:39	1.5	4.3	.0141	.5090	2	1712	8011	4211	.10
18:02:09	1.5	4.1	.0092	.3497	1	1592	6153	3617	.13
18:02:39	1.5	4.4	.0050	.2179	1	1331	3402	3023	.16
18:03:09	1.5	4.7	.0021	.1462	1	1408	1407	2726	.21
18:03:39	1.5	4.9	.0011	.2737	1	1771	2386	3914	.13
18:04:09	1.5	5.5	.0005	.2132	1	1479	2525	3320	.16
18:04:39	1.5	5.1	.0016	.2413	0	1524	2490	3023	.17
18:05:09	1.5	5.0	.0012	.3256	1	1689	3323	3320	.15
18:05:39	1.5	5.4	.0009	.3986	0	1845	2893	4211	.13
18:06:09	1.5	5.0	.0013	.4836	1	1745	3952	4508	.13
18:06:39	1.7	3.6	.0010	.4131	1	1578	4402	4508	.11
18:07:09	1.9	2.1	.0006	.2122	0	1313	1449	2429	.30
18:07:39	2.1	.5	.0006	.6028	1	3209	4597	4508	.08
18:08:09	2.4	-.5	.0035	2.7385	1	3982	15436	4508	.08
18:08:39	2.6	-1.3	.0016	2.9858	0	3020	7155	4508	.15
18:09:09	2.8	-2.0	.0035	8.3215	0	3237	16925	4508	.16
18:09:39	3.0	-3.0	.0036	10.5569	0	2961	19221	4508	.18

26 MAR 78 30 SECOND AVERAGE

START TIME	ALT KM	TEMP C	LWC-SC G/M**3	LWC-TOT G/M**3	LWC % CLD	DO UM	NT N/M**3	LMAX UM	FF
18:10:09	3.2	-3.9	.0049	12.6246	0	2517	30456	4508	.17
18:10:39	3.4	-5.0	.0045	7.9819	0	2433	22920	4508	.17
18:11:09	3.6	-5.9	.0029	4.3737	0	1980	14377	4508	.18
18:11:39	3.8	-6.7	.0032	7.0048	0	2782	17179	4508	.16
18:12:09	3.9	-7.4	.0030	7.1651	0	2628	15158	4508	.18
18:12:39	4.1	-8.4	.0019	3.8089	0	2679	9170	4508	.17
18:13:09	4.2	-9.3	.0015	3.6307	0	2865	7363	4508	.17
18:13:39	4.4	-10.1	.0015	3.8187	0	2800	4757	4508	.22
18:14:09	4.5	-11.1	.0006	.6091	0	1480	1801	3320	.32
18:14:39	4.7	-12.3	.0005	.3015	0	1354	1280	3320	.29
18:15:09	4.8	-13.4	.0006	.6978	0	1644	1320	4508	.23
18:15:39	5.0	-14.5	.0003	.2055	0	1062	943	2429	.43
18:16:09	5.1	-15.3	.0001	.0533	0	922	337	2726	.32
18:16:39	5.2	-16.2	.0004	.1660	0	993	836	2132	.53
18:17:09	5.4	-17.3	.0016	.2394	0	947	1847	2132	.44
18:17:39	5.5	-18.4	.0036	.3412	0	952	2623	2429	.38
18:18:09	5.5	-18.7	.0048	1.6966	0	1295	7882	4508	.23
18:18:39	5.6	-19.1	.0042	1.0358	0	978	5646	2429	.44
18:19:09	5.6	-19.3	.0021	.5442	0	1193	2087	4508	.23


FILME
2