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Addendum IV to Meteorological Factual Report

A mesoscale meteorological review of the COMAIR 3272 crash of 9 January 1997 was prepared by scientists at the National Center for Atmospheric Research at the request of the NTSB. The review is attached (32 pages) .

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Mesoscale analysis of the COMAIR 3272 crash of 9 January 1997

This discussion is to be considered in the context of the synoptic-scale weather data previously presented to the NTSB by NCAR. Here, the focus is placed on the smaller scale elements which are pertinent to the accretion of ice on the COMAIR and on explaining the significant differences in icing reported by the pilots of 4 other aircraft which flew through roughly the same location as the COMAIR within a 10 minute time window.

Regional radar images indicate widespread areas of snow across Michigan at 20z and 21z, essentially to the north of the Ohio/Michigan border (see Figs. 1a,b). Along the edges of this area of snow, there were patches of lower reflectivity, which show up as "holes" in the echo pattern. These patches were evident near Detroit during the period in which the crash occurred. Close examination of the 0.5 degree scan from the Detroit radar (DTX) at 2049z (Fig. 2a) shows widespread reflectivity > 15 dBZ across much of the radar scope, with the weaker echoes to the SE and S. Patches of lower reflectivity are evident in these areas, with values of about 0 to 10 dBZ. One of these patches was in place from approximately 50 to 100 km to the SSW of DTX. A look at the 1.5 and 2.4 degree scans (Figs. 2b,c) indicates that reflectivity values decrease with height in this area. Comair-3272 was flying through this patch of lower reflectivity during the last 6 ½ minutes before the upset occurred. At 2050z, the Comair was at an altitude of ~ 2133 m (~7000 ft) MSL and location of ~ 72 km from the DTX radar at ~ 200 degrees azimuth. Since the DTX radar is at an elevation of 360 m MSL, the Comair was ~1733 m above the radar at a distance of 72 km, corresponding to an elevation angle of ~1.4 degrees. Close examination of the 1.5 degree scan from DTX shows that the reflection off of the skin paint of the Comair may actually be visible at a distance of ~ 65 km and an angle of ~ 200 degrees, where several pixels of > 15 dBZ are embedded within a relatively large area of less than 10 dBZ. However, this location is slightly different from that which was calculated using distances from the FAA tracking radar. Whether or not this was a reflection off of the aircraft, the reflectivity values at the location of the Comair were between -5 and 10 dBZ and relatively low compared to the 10-30 dBZ values within the swath of snow to the NW and N.

Data from the DTX radar have been digitally interpolated to a 150 km by 150 km grid that encompasses the Comair's path of flight before the crash. Horizontal slices (CAPPIs) of radar data were created at 0.8 and 2.3 km MSL from DTX radar volumes which began at 2037z, 2043z and 2049z. These altitudes roughly approximate the height of the 0.5 and 1.5 degree elevation scans at the horizontal location of the Comair at 2050z (~72 km SSW of DTX). Grid spacing was 7.5 km in the horizontal and 1.5 km in the vertical. Superposition of the tracks of the Comair 3272 and several other aircraft on approach to Detroit on the 0.8 km CAPPI from 2049z (Fig. 3a) indicate that these planes were flying on the southeastern edge of the large swath of reflectivity, with most values near 10 dBZ at 0.8km (~1.5 km below flight level). All of the aircraft pass through a patch of lower reflectivity during or just before the

first of two turns on approach to Detroit. This patch will be discussed in further detail and related to the tracks of the aircraft later.

The National Weather Service reporting stations in the vicinity of the crash have also been located on this map. All of the stations (DTW - Detroit MI, YIP - Detroit/Willow MI, ARB - Ann Arbor MI, JXN - Jackson MI, TOL - Toledo OH) were reporting snow at 21z, but details in the observations reveal more information. Detroit was reporting light snow and mist, visibility of 3/4 miles, broken clouds at 600 and 1200 feet and overcast at 1700 feet. Reflectivity values at Detroit were approximately 20 dBZ at this time, but as areas of lower reflectivity moved over Detroit, visibilities at the surface improved to 3 miles and the snow briefly stopped from 2149z to 2201z (see observer comments in Table 1a). Ice pellets were reported at Detroit about 2 ½ hours after the crash, from 2332 to 2347z. Ann Arbor was located on the N edge of the patch, where reflectivity values were approximately 10 dBZ. As the patch of low reflectivity reached Ann Arbor, visibilities rose from 1 mile to 4 miles, and the intensity of the snow decreased (Table 1b). All other stations to the north of the aircraft track were within areas with reflectivity > 14 dBZ reported continuous light snow, had visibilities of 1 mile or less and overcast ceilings varying from 800 to 1700 feet. The decrease in or cessation of snowfall in the areas of low reflectivity indicates that the ice process is less efficient there, thus allowing more opportunity for liquid cloud to exist.

FAA radar-based track data available for five different aircraft near the time of the crash are plotted on the 0.8 km radar cross-section (Fig. 3a). The planes were as follows: Comair 3272 (Embraer 120, red), NW 272 (DC 9, purple), America West 50 (Airbus 320, green), NW 483 (Boeing 757, blue) and NW 208 (Airbus 320, brown). Times for the locations of the aircraft are indicated with symbols on the plot. At 2050z (circles) the Comair was making a turn toward the SE within the patch of low reflectivity, while America West 50 was just ahead of it and NW 272 was just behind it. NW 483 and NW 208 had passed through this area about 5 and 10 minutes earlier, respectively. In post-crash interviews, the pilots of these aircraft reported icing conditions varying from no icing (NW 483) to the worst icing that the pilot had encountered all season (NW 272). Although these planes flew through similar locations within about 10 minutes of each other, close inspection of the tracks and altitude of the aircraft relative to the patch of low reflectivity reveals the source of this discrepancy. A radar cross-section at 2.3 km MSL (Fig. 3b) reveals a slightly larger patch of reflectivity < 8 dBZ (compared to the size of the patch at 0.8 km) at the location of the first turn in the approach pattern. The Comair had descended from 3352 m (11000 ft - all heights MSL) at 2045z and slowed from ~350 knots to ~240 knots before entering the first turn at 2050z (see Table 2a). According to information from Embraer engineers, the airplane was "clean" until it descended to 7,000 feet (~2133 m) MSL, and started to pick up drag at ~204945z, possibly indicating the onset of ice accretion on the aircraft. The Comair reached this altitude when it entered the patch of lower reflectivity at ~204904z, held at 2133 m (seemingly near cloud top) until 205113z, then gradually descended as it flew toward the SE through the low reflectivity patch, reaching an altitude of ~1220m by

205403z. It was during this period that drag counts were increasing, with the most rapid increase in drag counts occurring between 1675 and 1370 m (5500 and 4500 ft), according to Embraer engineers. Reflectivity values in the path of flight during this period of time were between ~4 and 9 dBZ. Once entering cloud top at ~2133 m, the Comair flew through environment of less than 10 dBZ for ~6 ½ minutes (~5 minutes of which the aircraft was picking up drag - supposedly in icing conditions) before attempting to make a left turn on approach to Detroit at 205426z and ~1219 m (4000 ft). During this portion of the flight, the plane was traveling at between 160 and 180 knots in an environment where temperatures were between -6 and -11 C, according to the Detroit balloon borne sounding released at 2300z. Total temperatures calculated for this period were between -3 and -7C. OAT data from the COMAIR apparently indicate slightly warmer temperatures than the DTX sounding, thus bringing total temps closer to 0 C. Aircraft speed calculated from FAA radar fixes indicate that the Comair slowed to approximately 135 knots at 205412z, just before attempting to make the left turn where the upset occurred.

NW 272 (a DC 9) also descended into the patch of low reflectivity at ~2133 m and made a right turn within it, essentially following the path of the Comair, but about two minutes behind it (see Fig. 3b, Table 2b). NW 272 flew at similar altitudes at speeds of 150 to 170 knots, and, thus, had similar total temperatures to the Comair. The pilot reported that this was the worst ice they had seen all season and termed the ice as "extremely heavy to severe" based upon 18 years of operations in the Detroit and Lake Erie areas. They also reported that ice was accreting at a rate of approximately ½ inch of ice per minute, that the plane was flying in solid overcast conditions and that the radar showed little or no returns. When asked to hold altitude, the pilot asked to climb out and did so by making a U-turn within the low reflectivity patch. Overall, NW 272 appeared to be within cloud (below ~2133 m) and within the patch (reflectivity of 10 dBZ or less) for more than 8 minutes.

America West (AWE) flight 50 (an Airbus 320) passed over the top of the Comair at ~2045z and was a minute or so ahead of it at 2050z. This aircraft did not descend to 2133m until after making the initial turn at 2438 m, reaching cloud top at the eastern edge of the low reflectivity patch. This aircraft spent approximately two minutes in areas of less than 10 dBZ at altitudes below 2133m (below cloud top). Flight speeds during this period were between 140 and 180 knots, causing total temperatures of -5 to -7 C (see Table 2c - again, total temperatures would be higher according to the Comair OAT data). The pilot did report moderate rime icing with possible freezing drizzle and light snow. Ice accumulation of approximately 1/4 inch was reported for a 5 to 8 minute exposure, much of which probably occurred in areas of higher reflectivity to the east of the patch. Visible moisture was definitely present but no splattering was reported. The pilot also indicated that light and occasionally moderate turbulence was present. A vertical cross-section taken along the path of the Comair following the first turn (from 2050z to 2054z) with aircraft tracks superimposed shows the patch region as an overall area of lower reflectivity

at all altitudes compared to the surroundings (Fig. 3c). All three aircraft are shown to have been flying in a similar environment, although the America West 50 was exposed with for a lesser time.

NW 483 (a Boeing 757) descended into the center of the patch at ~204630z and crossed through to the eastern edge rather quickly (Fig. 4, Table 2d). This aircraft was traveling speeds of 210 to 280 knots through the patch and had total temperatures of between -3 and 0 C (higher if Comair OAT data are used). The pilot only reported light snow and no icing on approach to Detroit. This aircraft only briefly passed through the low reflectivity patch at relatively high rates of speed and total temperatures, possibly causing it to be relatively unaffected by any supercooled water that existed there. NW 208 (an Airbus 320) essentially crossed over the patch at altitudes > 2200 m between 2038z and 2040z,descending below 2133m into reflectivity of ~10 dBZ on the far east side of the patch (Fig. 5, Table 2e). Also, at this time the patch was slightly smaller in width (according to the 2037z DTX radar data) than it was at 2049z. This pilot of the aircraft only reported rime icing, with 1/2 inch were less accumulation and light snow during descent, probably due to missing most of the patch of low reflectivity.

Overall, the differences in exposure time and aircraft speed are likely to account for the wide variety of icing reported by these pilots in interviews following the crash. This is especially true if, indeed, the top of the icing layer was at ~2133 m MSL. Examination of data from the DTX radar show that when looking toward the SSW (~200 degrees), patchy reflectivity is only evident out to ~55-60 km on the 2.4 degree elevation scan (Fig. 1c), corresponding to an altitude of ~2650-2800 m MSL. This serves as an indicator that cloud top height was near 2500 m MSL, and the pocketed of nature of the reflectivity in this region points towards slightly varying cloud top heights. A close look at the radial velocity field on the 2.4 degree scan (Fig. 6) gives evidence of multiple shear layers within the cloud depth, though the height of the shear layers is slightly different depending upon where you look. Shear was evident at the following altitudes: 680m (from E to S), 1000-1200 m (S to W), 1400-1800 m (WSW to SSE) and from 2200 m to 2650 m (S to NNW to SSW -- irregular changes in layer). Changes in wind vector at the 1400-1800 m shear layer were rather strong as ~15 m/s winds from ~250 degrees were evident near 1400 m (4590 ft) while ~15 m/s winds from ~160 degrees were evident with at 1800 m (5900 ft). This shear vector as a magnitude of approximate 21 m/s from an angle of 215 degrees over cloud depths of approximately 420 m. Using representative values of temperature and lapse rate from the DTX sounding, Richardson number values for this layer were calculated to be ~0.102, exceeding the criteria for the onset of turbulence. It was in this layer (~4500 to ~5500 feet) that the drag counts on the Comair increased the most. The potential for turbulence in this layer may serve as yet another hint that SLD may have existed there. The Comair spent ~2 minutes within or below this range of altitudes (205230-205430z). DTX sounding data also indicate the existence of a shear layer between 1800 and 2675 m, near the top of the layer with relative humanities in excess of 95 percent (relative humidity at 3250 m was 83 percent - possibly indicating that the top of the liquid cloud was near 2675 m, while snow may have existed above this). The temperature at 2675 m was -12.9 C, while it dropped to -15.9 C at 3250 m. The warmer

temperature and nearly liquid saturated relative humidity values at 2675 m closely match the cloud top as indicated by radar reflectivity tops to the SE of the Detroit airport. However, according to data from the Comair engineers, the liquid cloud top appeared to be ~500 m below that. It is possible that some light snow existed in a layer above the liquid cloud deck.

Several pilots reported moderate or greater intensity icing, including some which was mixed in type, between 4,000 and 11,000 feet (1200 and 3350 m) MSL in and around Detroit during this period. Although Canadian PIREPs are rather scarce in our database, one PIREP of moderate mixed icing did occur at London, Ontario when the large area of low reflectivity reached that location.

Data from a microwave radiometer located downstream of the crash site at Toronto (43.964 N, 79.574 W) indicated integrated liquid water contents of 0.05 to 0.8 kg/m2 as the area of warm cloud tops and low radar reflectivity reached the radiometer between the hours of 2300, 9 January and 0200, 10 January (see Figs 1a-b, 7a-c, 8). Tracking of the radar features was not easily done, but the back edge of the reflectivity region (leading edge of the warm cloud tops and low reflectivity) was used to roughly approximate the downstream location of the portion of the storm in which the aircraft crashed. Using this method, the back edge of the radar reflectivity appeared to pass the radiometer near 0000z, 10 January, when liquid water contents were near a short-lived minimum. Water content values were as high as 0.8 near 2300z, then gradually dropped to near zero at 0000z, rose sharply to 0.5 at the 0030z, dropped again to 0.1 by a 0100z, then rose gradually to 0.8 at ~0200z. It is difficult to say which, if any, of these liquid water contents these representative of the water content present at the time and location of the crash. Using representative reflectivity values from the Detroit radar and a range of liquid water content values from the Toronto radiometer, one can calculate an approximate drop diameter range, using a monodisperse distribution of liquid droplets. Assuming the cloud depth was ~2000 m, integrated liquid water contents were 0.05 to 0.8 kg/m2 and that the liquid water content was distributed evenly through the depth of the cloud, the average liquid water content would have been between 0.025 and 0.4 g per cubic meter. Using this range of values and representative reflectivity values of 5 dBZ, we see that expected drop sizes should be from approximately 200 to 400 microns (Fig. 9) -- again, assuming monodisperse distribution of drop size. *We need to check on a more realistic distribution of dropped sizes for drizzle to see if these values are representative.* It is important to note that higher and lower values of LWC and corresponding lower/higher droplet sizes are likely to have existed within portions of the cloud depth, since the liquid water is unlikely to have been evenly distributed through the depth of the cloud.

Overall, the evidence for the existence of icing conditions along the Comair flight track is strong and some hints are present which suggest that SLD may have also existed. The occurrence of several shear layers within the cloud deck, including fairly strong shear zones within the cloud deck (1400-1800 m) and at cloud top (~2600 m), may indicate that wind shear served as a mechanism to form supercooled large drops. This possibility is further supported by a report of possible freezing drizzle by the pilot of America West 50, and reports of extremely heavy to severe icing with some splash back and fast

accumulation rates (1/2 inch per minute) by the pilot of NW 272, both of which passed through the Comair flight environment within a few minutes at similar altitudes and speeds. Furthermore, several observations of ice pellets and/or snow grains (including one where the pellets were described as "not opaque, but not clear, either") by surface stations (Detroit MI, Findlay OH) and individuals (pilot at home in Mason City, MI; fireman on his way to the crash scene) around the Detroit area in the hours surrounding the crash may serve as an indication of either heavily rimed snow flakes or pellets which formed by the freezing of supercooled large drops (possibly freezing drizzle, in this case). In either case, either large drops and/or significant water contents were likely to exist within the cloud. Any pellets which did occur were formed in an environment free of the melting process, since only sub-freezing temperatures were found in sounding data from both Detroit and Wilmington Ohio for 0000z on 10 January.

Fig. 1a
Jan 9-20Z

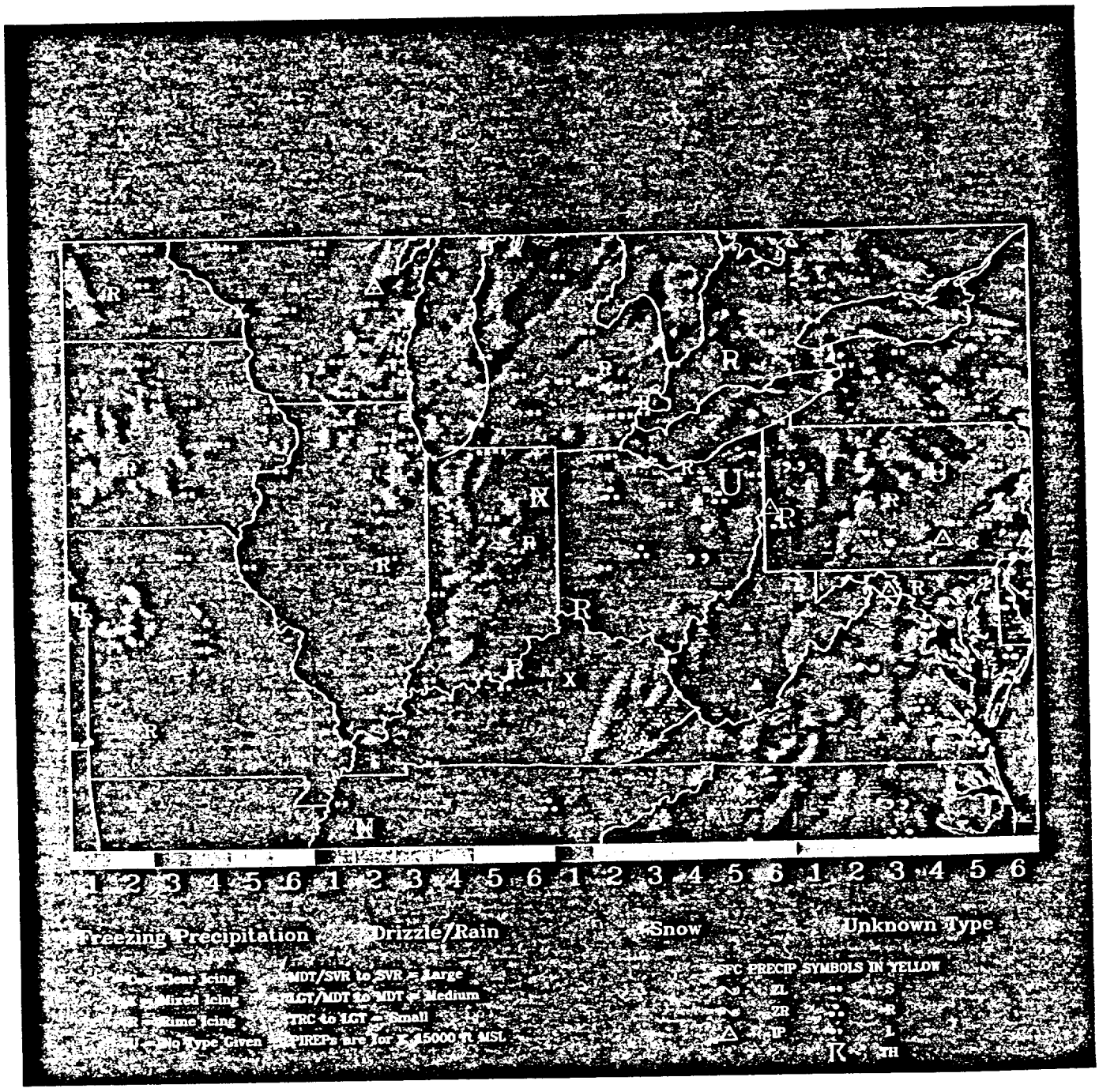


Fig. 1b
Jan 9-21Z

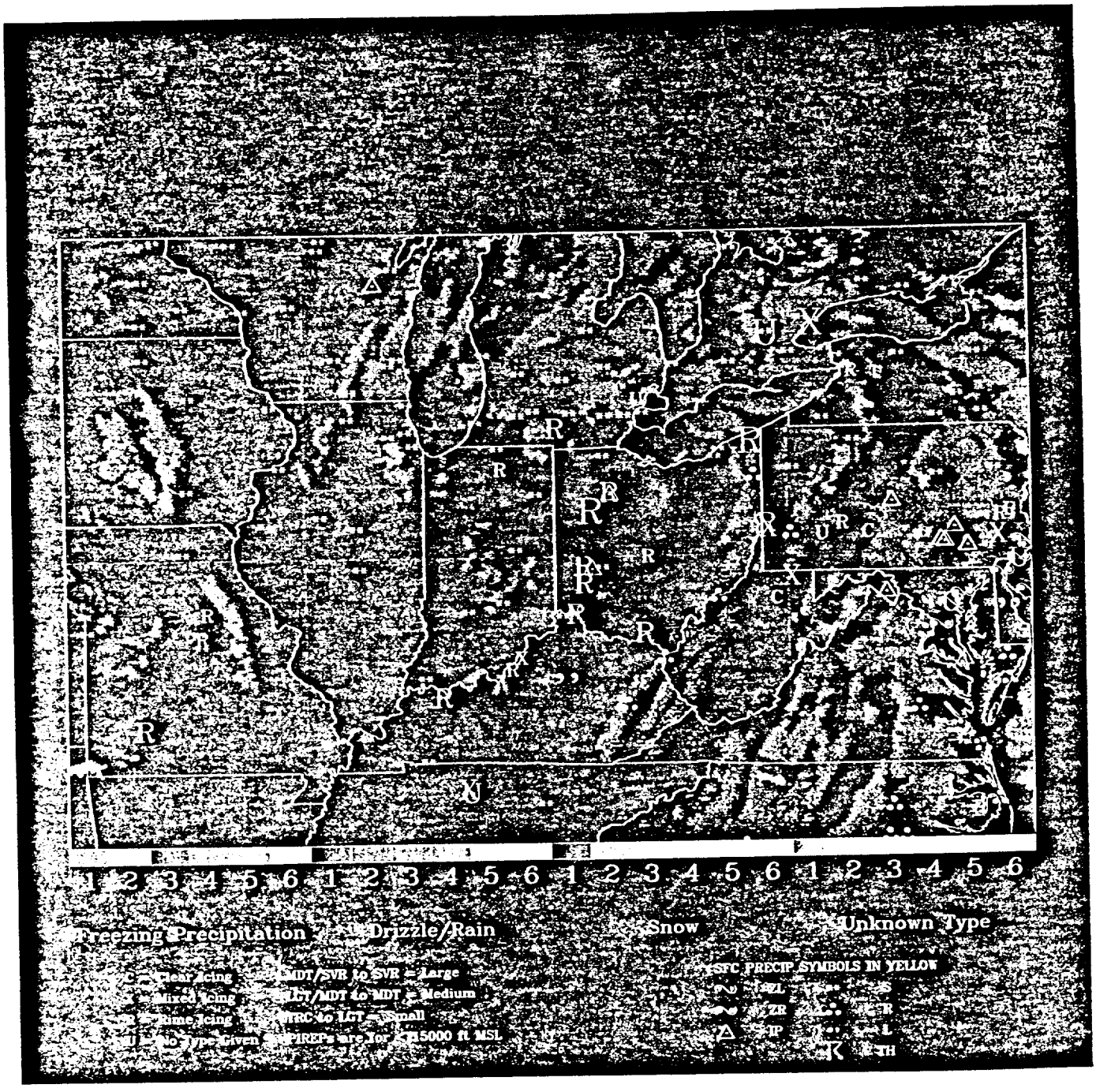


Fig. 2a

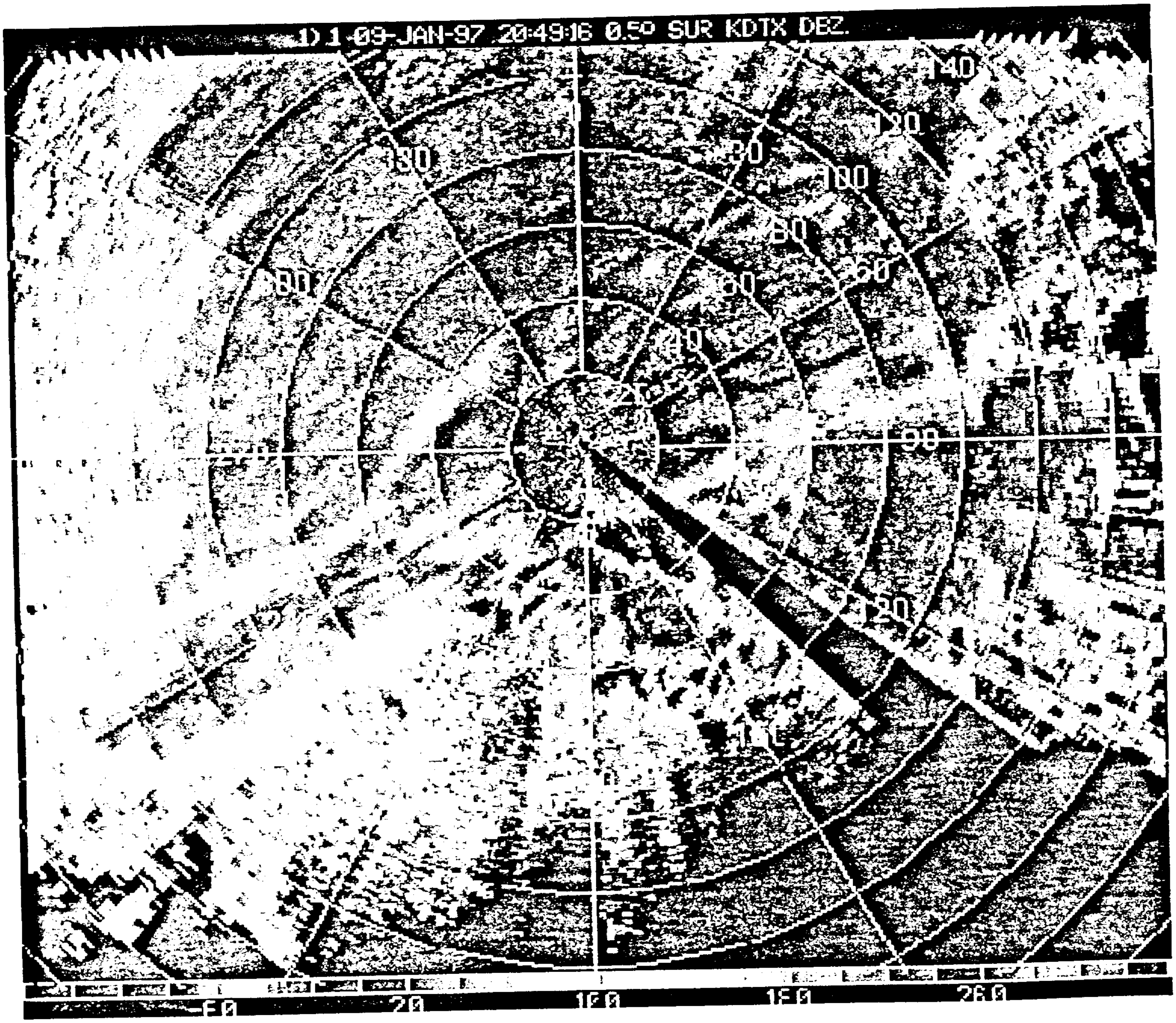


Fig. 2b

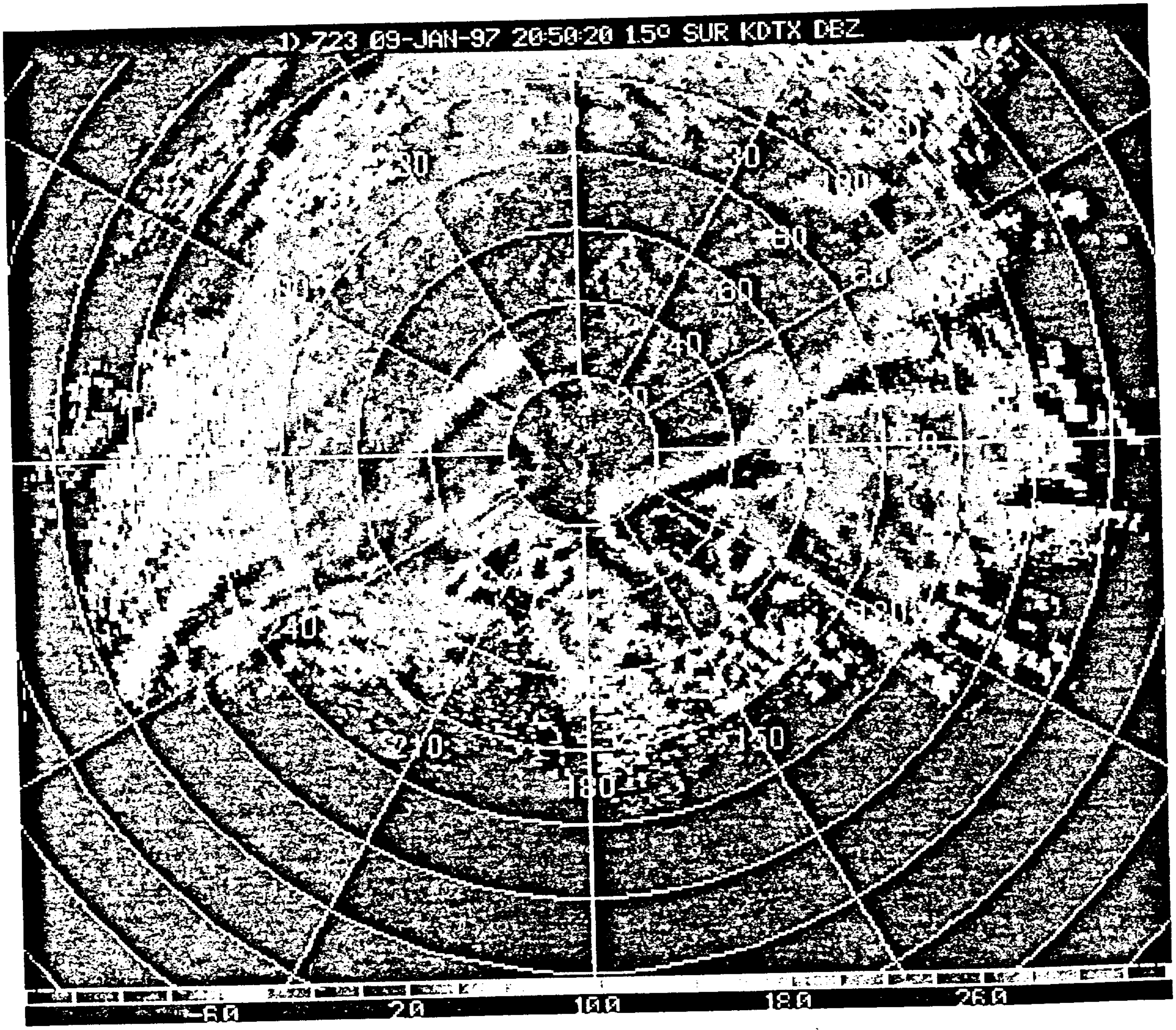


Fig. 2c

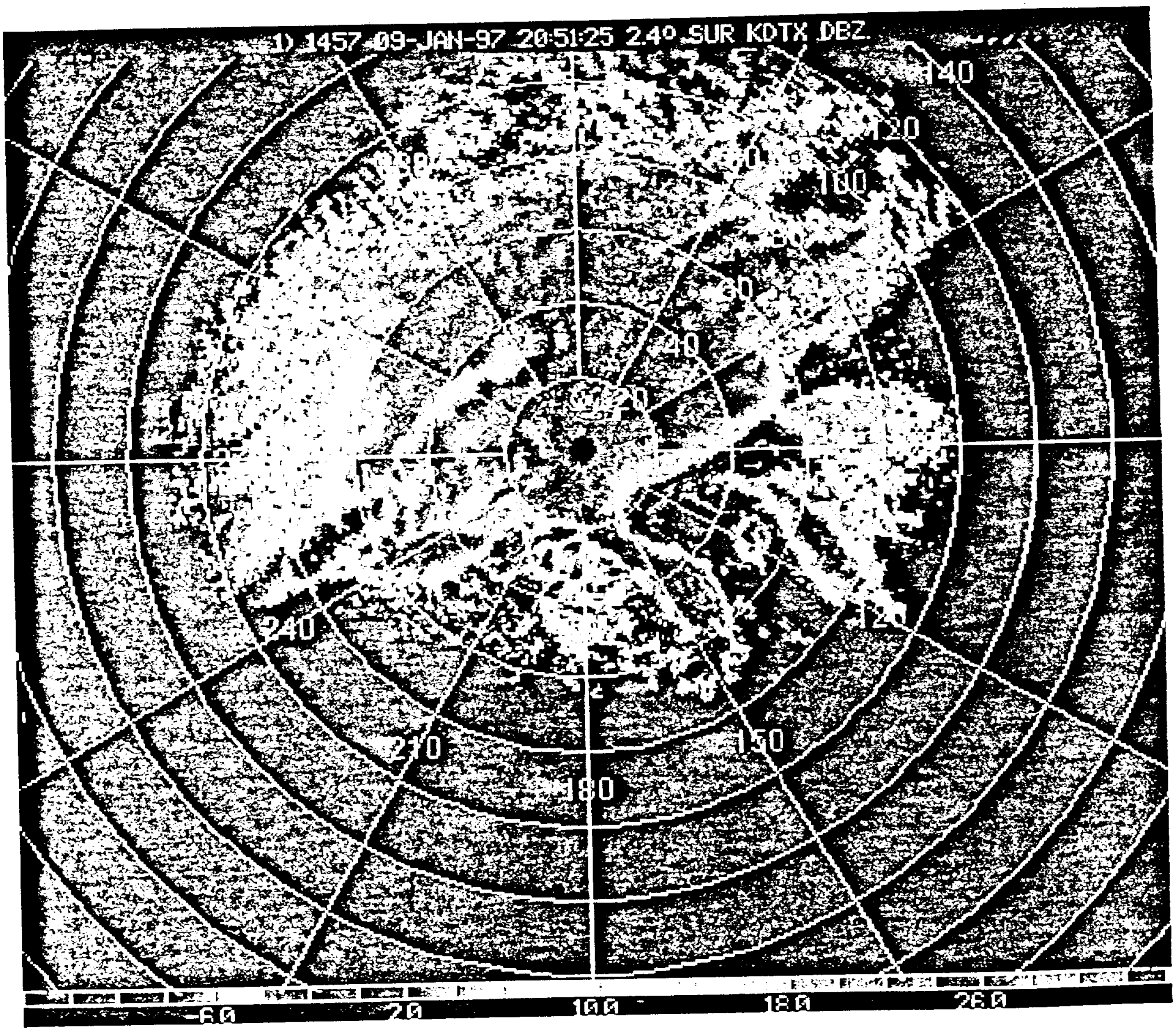

1) 1457 09-JAN-97 20:51:25 2.4° SUR KDTX DBZ
140
120
100
80
40
240
210
180
150
120
-60
20
100
180
260

Fig. 3a

97/ 1/ 9 20 49 16-20 54 4 KDTX Z = 0.80 KM DZ
(AS OF 09/04/97) ORIGIN=(0.00, 0.00) KM X-AXIS= 90.0 DEG
DTX Radar Reflectivity - COMAIR 3272

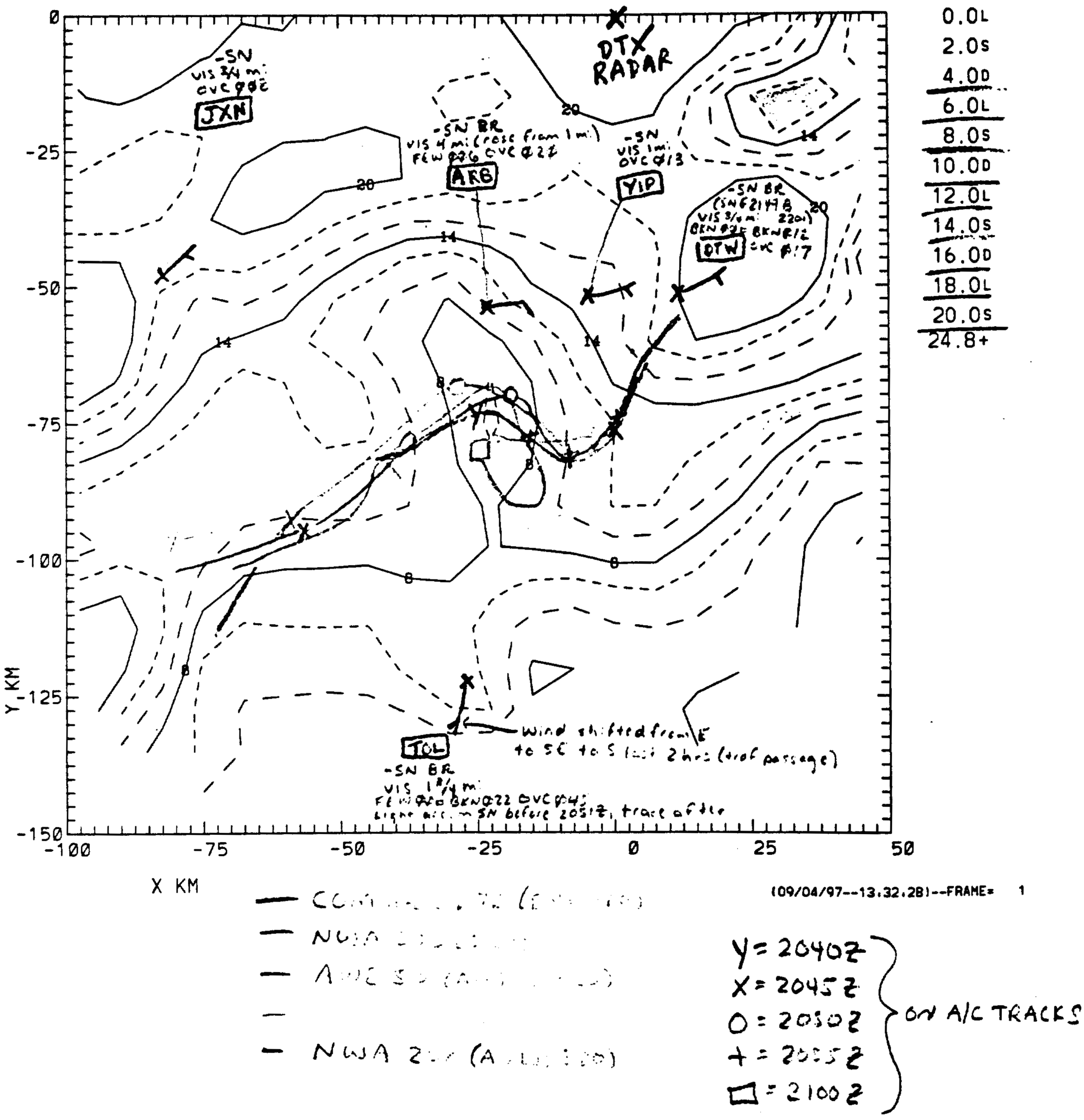
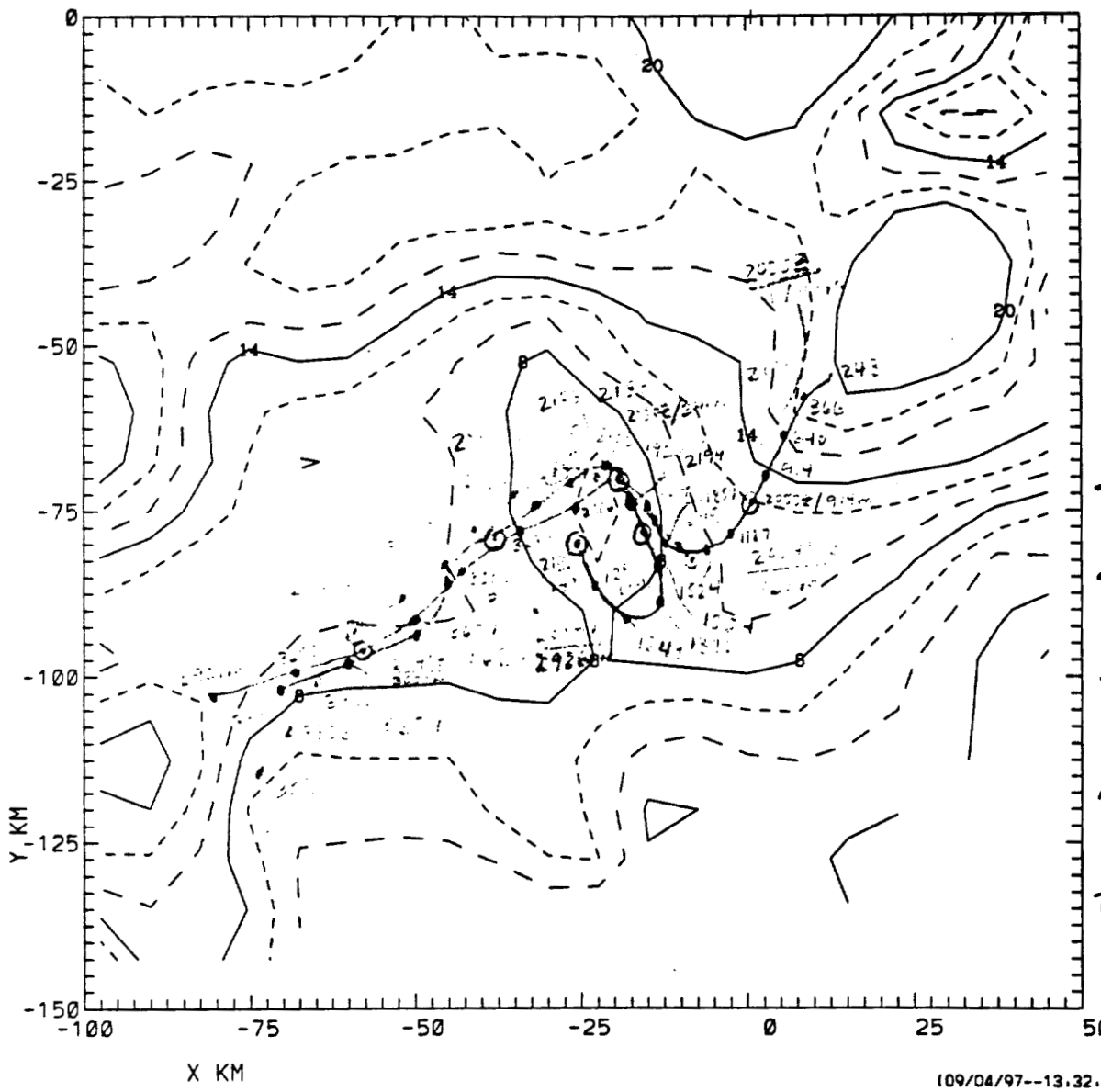


Fig. 5D

97/ 1/ 9 20 49 16-20 54 4 KDTX Z = 2.30 KM DZ
(AS OF 09/04/97) ORIGIN=(0.00, 0.00) KM X-AXIS= 90.0 DEG
DTX Radar Reflectivity - COMAIR 3272

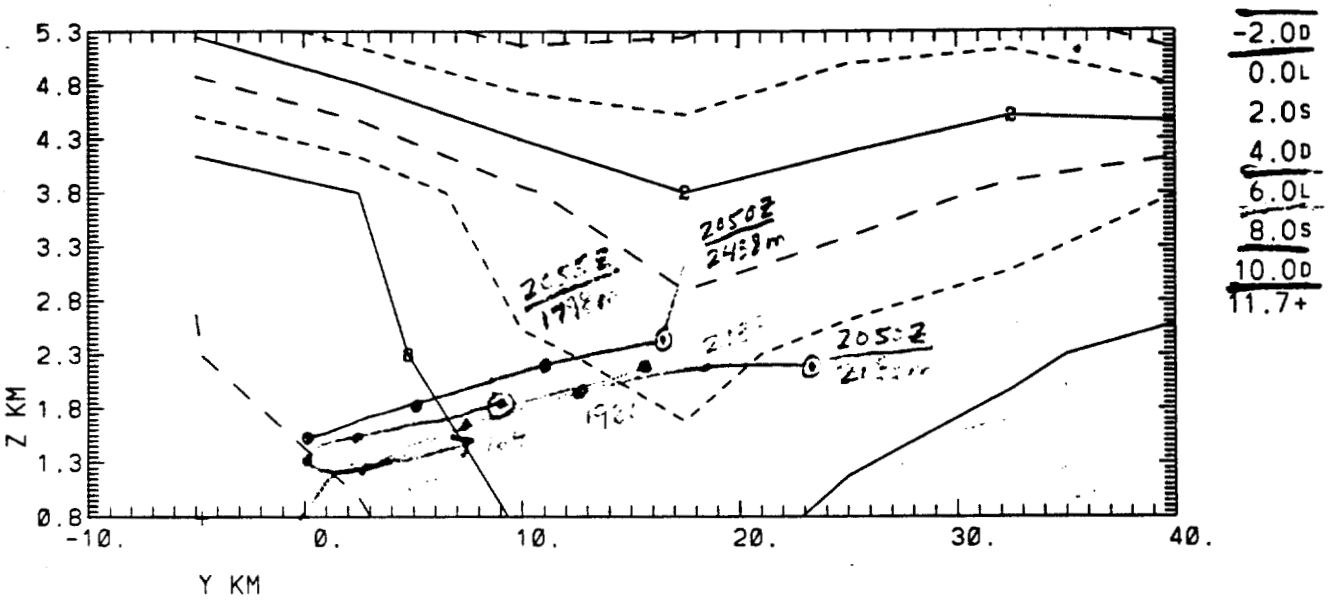


Altitude: (MSL) are plotted every minute
Time: are indicated every 5 minutes.

(09/04/97--13.32.29)--FRAME= 2

Fig. 3c

97/ 1/ 9 20 49 16-20 54 4 KDTX X = -2.50 KM DZ
(AS OF 09/04/97) ORIGIN=(0.00, 0.00) KM X-AXIS= 40.0 DEG
DTX Radar Reflectivity - COMAIR 3272



(09/04/97--12,37,37)--FRAME= 2

Table 1a

UNEDITED SURFACE WEATHER OBSERVATIONS (METAR/SPEC)	LATITUDE	LONGITUDE	STATION ELEVATION IT (MSL)	TIME CONVERSION	DAY	MONTH	YEAR	SID	STATION (TYPE, NAME, STATE)
	42°14'N	83°20'N	633	+5	09	01	1997	DTW	ASOS DETROIT, MI

TYPE VIS	TIME (LST)	WIND				VISIBILITY		PRESENT WEATHER	SKY CONDITION	TEMP °C	DEW POINT °C	ALTI-METER INS.	REMARKS AND SUPPLEMENTAL CODED DATA
		DIR TRUE	SPD KTS	GUST KTS	VARIABILITY TRUE	SURFACE STATUTE MILES	RUNWAY VISUAL RANGE (FEET)						
1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	0054	090	7			10			SCT120	-04	-09	A3009	SLP198 T10441089 11044 21056 56036 (MKE)
M	0154	090	8			10			OVC100	-04	-08	A3007	SLP190 T10391083 (MKE)
M	0254	070	8			10			BKN020 OVC080	-04	-08	A3003	SLP177 T10391078 (MKE)
M	0354	090	9			10			BKN020 OVC090	-03	-08	A2995	PRESFR SLP151 T10331078 58044 (MKE)
M	0454	060	8			10			FEW014 BKN020 OVC080	-04	-07	A2992	PRESFR SLP139 T10391072 (MKE)
S	0512	080	8			10			BKN012 OVC020	-04	-07	A2992	(MKE)
M	0554	070	15	18		10			OVC010	-04	-07	A2987	PRESFR SLP122 T10391067 (MKE)
S	0630	070	12	17		1 1/2M		-SN BR	BKN008 OVC013	-04	-07	A2983	SFC VIS 2 SNB02 PRESFR P0000 (MKE)
M	0654	070	13	18		1 1/4M		-SN BR	OVC006	-04	-06	A2982	TWR VIS 1 1/2 SNB02 PRESFR SLP107 P0000 600 00 T10441061 11033 21044 58043 (MKE)
S	0717	060	14	20		1 1/2M		-SN BR	OVC010	-04	-06	A2975	PRESFR P0000 (MKE)
M	0754	070	15	19		1 1/2M		-SN BR	BKN010 OVC029	-04	-06	A2972	PRESFR SLP073 P0000 T10441056 (EJB)
S	0819	040	12	18		2		-SN BR	OVC012	-04	-06	A2969	PRESFR P0000 (EJB)
S	0838	050	12			3		-SN BR	OVC010	-04	-06	A2966	TWR VIS 4 UPB31E34SNE31B34 PRESFR P0000 (EJ B)
M	0854	070	11			3		-SN BR	OVC010	-04	-06	A2967	TWR VIS 4 UPB31E34SNE31B34 PRESRR SLP057 P0 000 T10441061 (EJB)
S	0933	070	12	21		2		-SN BR	OVC012	-03	-04	A2964	PRESFR P0000 (EJB)
M	0954	060	18	24		2		-SN BR	OVC014	-03	-04	A2958	PRESFR SLP024 P0000 60000 T10281044 58076 (EJB)
S	0959	060	16	24		2		-FZRASN	OVC014	-03	-04	A2956	FZRAB57 PRESFR P0000 (EJB)
M	1054	070	13	21		2		-FZRASN	OVC012	-03	-05	A2952	FZRAB1457 PRESFR SLP005 P0000 T10331050 (EJ B)
S	1100	090	11	19		3/4		-FZRASN	OVC012	-03	-05	A2953	SFC VIS 1 P0000 (EJB)
S	1110	080	14	23		1/2		-FZRASN	FEW005 BKN012 OVC017	-03	-04	A2951	TWR VIS 3/4 P0000 (EJB)
S	1118	070	11	19		3/4		-SN	FEW005 BKN012 OVC017	-03	-04	A2951	FZRAE12 P0000 (EJB)
S	1144	070	13			3/4		-SN BR	BKN005 BKN012 OVC017	-03	-05	A2946	FZRAE12 PRESFR P0000 (EJB)
M	1154	070	18	25		3/4		-SN BR	BKN005 OVC014	-04	-05	A2944	FZRAE12 PRESFR SLP977 P0000 T10391050 (EJB)
S	1231	070	9			3/4		-SN BR	FEW005 OVC011	-04	-05	A2938	PK WND 07026/1659 PRESFR P0000 (EJB)
M	1254	070	11	17		3/4		-SN BR	SCT005 BKN011 OVC014	-04	-05	A2935	PK WND 07026/1659 PRESFR SLP946 4/002 P0000 60000 T10391050 11028 21044 58085 (EJB)
S	1344	070	11			1/2		SN	BKN004 BKN009 OVC013	-04	-05	A2928	PRESFR P0000 (EJB)
M	1354	060	9			1/2		SN	BKN006 OVC013	-04	-05	A2927	PRESFR SLP919 P0000 T10391050 (EJB)
S	1405	060	12			1/2		SN	BKN004 OVC008	-04	-04	A2926	PRESFR P0000 (EJB)
S	1433	040	7			1/2		-SN	FEW004 BKN008 OVC015	-03	-04	A2923	SFC VIS 3/4 PRESFR P0000 (EJB)
M	1454	040	7			1/2		SN	BKN006 OVC011	-03	-04	A2922	PRESFR SLP900 P0000 T10331044 (EJB)
S	1524	070	7			1/2		-SN	SCT006 BKN016 OVC023	-03	-04	A2921	SFC VIS 1 P0000 (EJB)
S	1526	070	6			1		-SN	SCT006 BKN014 OVC021	-03	-04	A2921	TWR VIS 1 1/2 P0000 (EJB)
S	1529	070	6			1 1/4M		-SN	SCT006 BKN016 OVC021	-03	-04	A2920	TWR VIS 1 1/2 P0000CNCL (EJB)
S	1540	070	5			1 1/2M		-SN BR	BKN006 BKN011 OVC021	-03	-04	A2919	SFC VIS 2 1/2 P0000 (TBA)
S	1541	060	6			1 1/2M		-SN BR	SCT006 BKN011 OVC019	-03	-03	A2919	SFC VIS 2 1/2 P0000CNCL (TBA)
M	1554	070	5			3/4		-SN BR	BKN006 BKN012 OVC017	-02	-03	A2919	TWR VIS 1 CIG 004V009 SLP891 P0000 60000 T1 0221033 56055 (TBA)
S	1603	080	3			1		-SN BR	SCT006 SCT009 OVC014	-02	-03	A2918	P0000 (TBA)
S	1606	080	3			1		-SN BR	FEW006 BKN009 OVC016	-02	-03	A2918	P0000CNCL (TBA)
S	1619	000	0			1		-SN BR	SCT006 BKN009 OVC014	-02	-03	A2917	SFC VIS 1 3/4 CIG 006V011 P0000 (TBA)
M	1654	150	3			1		BR	BKN007 OVC012	-02	-03	A2916	SFC VIS 3 SNE49 CIG 005V009 SLP880 P0000 T1 0221028 (TBA)
S	1704	160	3			1		-SN BR	FEW007 OVC012	-02	-03	A2915	SFC VIS 2 1/2 SNB01 P0000 (TBA)
S	1739	200	15			4		-SN BR	SCT010 OVC015	-02	-03	A2915	SNB01 P0000 (TBA)
M	1754	210	16			7		-SN	OVC014	-02	-03	A2916	SNB01 SLP880 P0000 T10171033 (TBA)

*** Cont. on Next Page ***

table 1a cont'd

UNEDITED SURFACE WEATHER OBSERVATIONS (METAR/SPEC)	LATITUDE	LONGITUDE	STATION ELEVATION FT (MSL)	TIME CONVERSION	DAY	MONTH	YEAR	SID	STATION (TYPE, NAME, STATE)
	42°14'N	83°20'N	633	+5	09	01	1997	DTW	ASOS DETROIT, MI

TYPE M/S	TIME (LST)	WIND				VISIBILITY		PRESENT WEATHER	SKY CONDITION	TEMP	DEW POINT	ALTIMETER	REMARKS AND SUPPLEMENTAL CODED DATA
		DIR TRUE	SPD KTS	GUST KTS	VARIABILITY TRUE	SURFACE STATUTE MILES	RUNWAY VISUAL RANGE (FEET)			°C	°C	INS.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
M	1854	220	21	27		1 3/4M		-SN BLSN	BKN017 OVC021	-02	-04	A2916	PK WND 22027/2333 TWR VIS 3 PEB32E47 SLP881 4/004 P0000 60000 T10221044 11017 21039 550
S	1904	220	17			3		-SN BLSN	BKN017 OVC023	-03	-04	A2916	SFC VIS 4 P0000 (TBA)
S	1918	220	22			2		-SN	BKN017 OVC022	-03	-05	A2916	TWR VIS 3 P0000 (TBA)
S	1925	210	18	29		1 1/2M		-SN	BKN017 OVC024	-03	-05	A2916	PK WND 21029/0019 TWR VIS 2 1/2 P0000 (TBA)
M	1954	220	18			1		-SN BR	SCT010 OVC018	-03	-04	A2916	PK WND 21029/0019 TWR VIS 2 1/2 SLP881 P0000 T10331044 (TBA)
S	1958	220	18			1		-SN BR	SCT007 BKN014 OVC018	-03	-04	A2916	P0000 (TBA)
S	2044	220	19	25		3		-SN BR	OVC015	-03	-05	A2916	TWR VIS 4 P0000 (TBA)
M	2054	220	21			7		-SN	BKN015 OVC024	-03	-06	A2916	SLP883 P0000 T10331056 (TBA)
S	2104	220	20			2 1/2M		-SN BR	BKN017 OVC022	-03	-06	A2916	TWR VIS 4 P0000 (TBA)
M	2154	230	18	26		3		-SN BR	BKN017 BKN025 OVC030	-04	-06	A2917	PK WND 22026/0250 TWR VIS 4 SLP884 P0000 60000 T10391061 53002 (TBA)
M	2254	240	18	25		10			BKN022 BKN028 OVC065	-04	-08	A2918	PK WND 24031/0259 SLP887 SNE41 P0000 T10441078 (TBA)
M	2354	240	18			10			OVC022	-04	-08	A2919	PK WND 23027/0405 SLP892 P0000 T10441083 41017 1050 (TBA)
									*** End of File ***				

Table 1a cont'd

UNEDITED SURFACE WEATHER OBSERVATIONS (METAR/SPEC)

LATITUDE	LONGITUDE	STATION ELEVATION FT (MSL)	TIME CONVERSION	DAY	MONTH	YEAR	SID	STATION (TYPE, NAME, STATE)
42°14'N	83°20'N	633	+5	09	01	1997	DTW	ASOS DETROIT, MI

TIME LST	TOTAL SKY COVER (0–8)	TEMP. DRY-BULB	DEW POINT	TEMP. WET BULB	RELATIVE HUMIDITY (%)	STATION PRESSURE (INS)	PRESSURE TENDENCY	NET 3-HR CHANGE	HOURLY PRECIPITATION (INS)	HR
16	17	18	19	20	21	22	23	24	25	
0054		-4.4	-8.9	-58	71	29.41	6	036	0.00	00-01
0154		-3.9	-8.3	-53	72	29.39			0.00	01-02
0254		-3.9	-7.8	-51	75	29.35			0.00	02-03
0354		-3.3	-7.8	-47	71	29.27	8	044	0.00	03-04
0454		-3.9	-7.2	-50	78	29.24			0.00	04-05
0554		-3.9	-6.7	-48	81	29.19			0.00	05-06
0654		-4.4	-6.1	-50	88	29.14	8	043	T	06-07
0754		-4.4	-5.6	-48	91	29.05			T	07-08
0854		-4.4	-6.1	-50	88	29.00			T	08-09
0954		-2.8	-4.4	-34	89	28.91	6	076	T	09-10
1054		-3.3	-5.0	-39	88	28.85			T	10-11
1154		-3.9	-5.0	-43	92	28.77			T	11-12
1254		-3.9	-5.0	-43	92	28.68	6	085	T	12-13
1354		-3.9	-5.0	-43	92	28.60			T	13-14
1454		-3.3	-4.4	-37	92	28.55			T	14-15
1554		-2.2	-3.3	-26	92	28.52	6	055	T	15-16
1654		-2.2	-2.8	-24	96	28.50			T	16-17
1754		-1.7	-3.3	-23	89	28.50			T	17-18
1854		-2.2	-4.4	-30	85	28.50	5	008	T	18-19
1954		-3.3	-4.4	-37	92	28.50			T	19-20
2054		-3.3	-5.6	-41	84	28.50			T	20-21
2154		-3.9	-6.1	-46	85	28.51	3	002	T	21-22
2254		-4.4	-7.8	-55	77	28.52			T	22-23
2354		-4.4	-8.3	-56	75	28.52			T	23-24

SYNOPTIC DATA

TIME	NO	LOW CLOUD TYPE	MID CLOUD TYPE	HIGH CLOUD TYPE	MAX TEMP (.1 C)	MIN TEMP (.1 C)	PRECIP (INS)	SNOW FALL (INS)	SNOW DEPTH (INS)	STATION PRESSURE (INS)	BAROGRAPH	BAR. CORR.	LOCAL USE
26	27	28	29	30	31	32	33	34	35	36	37	38	39

WEATHER AND OBSTRUCTION TO VISION

TYPE	BEGIN	ENDED	TYPE	BEGIN	ENDED	TYPE	BEGIN	ENDED	TYPE	BEGIN	ENDED
40	41	42	40	41	42	40	41	42	40	41	42
-FZRA	1050	1115	-SN	1750	1755						
-SN	1115	1255	-SN	1805	1835						
BR	1130	1155	BR	1835	1850						
FZFG	1155	1200	BLSN	1850	1915						
BR	1200	1255	-SN	1850	2050						
SN	1255	1300	BR	1940	2050						
FZFG	1255	1300	UP	2050	2055						
-SN	1300	1340	-SN	2055	2245						
BR	1300	1340	BR	2100	2155						
FZFG	1340	1345	-RA	2305	2310						
SN	1340	1355									
-SN	1355	1400									
SN	1400	1425									
-SN	1425	1455									
SN	1455	1505									
-SN	1505	1650									
BR	1535	1550									
BR	1600	1755									
-SN	1705	1745									

SUMMARY OF THE DAY (MIDNIGHT TO MIDNIGHT)

PEAK WINDS			FASTEST 2-MIN WIND			SUNRISE TIME (LST)	SUNSET TIME (LST)	TOTAL SUNSHINE (MIN)	PERCENT PSBL SUNSHINE	CHARACTER SUNRISE	CHARACTER SUNSET	SKY COVER		24-HR MAX TEMP. (0.1 C)	24-HR MIN TEMP. (0.1 C)	24-HR PRECIP. WATER EQUIV (INS)	24-HR SNOW-FALL UNMLTD	1200 UTC SNOW DEPTH (INS)	WATER EQUIV. (INS)	STATION PRESSURE	SEA LEVEL PRESSU
SPEED (KTS)	DIREC-TION	TIME (LST)	SPEED (KTS)	DIREC-TION	TIME (LST)							SUNRISE TO SUNSET	MIDNIGHT TO MIDNIGHT								
43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
36	240	2210	30	230	2211			M	M					-1.7	-5.0	T					

TIME CHECK–CLOCK CORRECT TO THE NEAREST MINUTE AT: / / /

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA 65 :

Table 1b

SURFACE WEATHER OBSERVATIONS (METAR/SPECI)

LATITUDE	LONGITUDE	STATION ELEVATION Ft (MSL)	TIME CONVERSION (LST to UTC)	DAY	MONTH	YEAR	SID	STATION (Type, Name, State)
42° 13' N	83° 45' W	839	(+) 5 Hrs.	09	01	97	KARB	ATCT, ANN ARBOR, MI

TYPE M/S	TIME ☐ LST ☑ UTC	WIND DIRECTION (True)	WIND SPEED (Knots)	WIND GUST (Knots)	WIND VARIABILITY (True)	VISIBILITY SURFACE	VISIBILITY TOWER	RUNWAY VISUAL RANGE (Feet)	PRESENT WEATHER	SKY CONDITION	TEMP (°C)	DEW POINT (°C)	ALTIMETER SETTING (Ins.)	REMARKS AND SUPPLEMENTAL CODED DATA	TOTAL SKY COVER (0-8)	TEMP. DRY BULB (0.1°C)	TEMP. WET BULB (0.1°C)	STATION PRESSURE (Ins.)
M	1247	080	14	23		2			-SN	OVC 013			2973		8			
M	1347	070	12	20		5			-SN	SCT012 BKN020 OVC030			2968		8			
S	1423	070	12	20		2			-SN	OVC010			2965		8			
M	1452	070	15	24		1			-SN BR	OVC010			2958		8			
M	1547	060	12	19		3/4			-SN BR	SCT009 BKN012 OVC019			2951		8			
M	1648	070	10			1 1/4			-SN BR	OVC010			2946		8			
M	1749	070	10	19		1			-SN BR	OVC014			2935	PRESFR	8			
S	1830	060	12			4			-SN BR	OVC012			2931		8			
M	1847	070	15			1			-SN BR	OVC010			2929		8			
M	1947	080	13			1			-SN BR	BKN010 OVC030			2923		8			
M	2053	090	08			4			-SN BR	FEW006 OVC020			2920		8			
S	2121	100	08			2 1/2			-SN BR	BKN016 OVC021			2918		8			
M	2150	110	05			1 1/2			-SN BR	OVC011			2917		8			
M	2250	210	08			5			-SN BR	OVC016			2916		8			
M	2345	220	15			5			-SN BR	OVC015			2916		8			
M	0045	240	18			3			-SN BR	OVC025			2917	LAST	8			
S	0058	240	18			1			-SN BR	OVC022			2917	LAST	8			

TIME ☐ LST ☐ UTC	NO.	PRECIP. (Ins.)	SNOW FALL (Ins.)	SNOW DEPTH (Ins.)	MAX. TEMP. (0.1°C)	MIN. TEMP. (0.1°C)	STATION PRESSURE	BAROGRAPH	BARO. CORR.
MID. TO									
	1								
	2								
	3								
	4								
MID									

SUMMARY OF DAY (Midnight to Midnight)

24-HR. MAXIMUM TEMP. (0.1°C)	24-HR. MINIMUM TEMP. (0.1°C)	24-HR. PRECIP. WATER EQUIV. (Ins.)	24-HR. SNOWFALL UNMLTD. (Ins.)	1200 UTC SNOW DEPTH (Ins.)

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA

TIMECHECK – CLOCK CORRECT TO NEAREST MINUTE AT: / /

Table 1b cont'd

SURFACE WEATHER OBSERVATIONS (METAR/SPECI)

Latitude	Longitude	Station Elevation Ft. (MSL)	Time Conversion (LST to UTC)	Day	Month	Year	SID	Station (Type, Name, State)
42° 13' N	83° 45' W	839	+ 5 Hrs	10	01	97	KARB	ATCT, ANN ARBOR, MI

Type M/S (1)	Time ☑ LST ☐ UTC (2)	Wind Direction (True) (3)	Wind Speed (Knots) (4)	Wind Gust (Knots) (5)	Wind Variability (True) (6)	Visibility Surface (7a)	Visibility Tower (7b)	Runway Visual Range (Feet) (8)	Present Weather (9)	Sky Condition (10)	Temp (°C) (11)	Dew Point (°C) (12)	Altimeter Setting (Ins.) (13)	Remarks and Supplemental Coded Data (14)	Total Cover (0-8) (17)	Temp. Dry Bulb (0.1°C) (18)	Temp. Wet Bulb (0.1°C) (19)	Sta. Press. (Ins.) (20)
M	1256	250	10			1 3/4			-SN	OVC015			2920		8			
M	1346	250	12			1 3/4			-SN	OVC030			2921		8			
M	1441	240	13			1 3/4			-SN BR	BKN025 OVC035			2922		8			
M	1545	230	15	G21		3/4			-SN BR	BKN010 OVC020			2924		8			
S	1620	260	15	G25		10				BKN015			2925		7			
M	1650	240	15	G26		7				SCT015 BKN020 BKN050			2926		7			
M	1755	240	20	G28		7				BKN020 BKN100			2928		7			
M	1845	240	20	28		7			BLSN	SCT020 BKN100			2928		7			
M	1945	240	20	G30		8			BL SN	SCT020 BKN045 OVC080			2930		8			
M	2050	240	20	G30		10			BLSN	BKN045 BKN090			2935		7			
M	2150	230	22	30		7			BLSN	SCT030 OVC047			2938		8			
M	2245	230	24	30		2 1/2			-SN BR	BKN024 OVC046			2940		8			
S	2301	230	25	32		1			-SN BR	BKN024 OVC044			2940		8			
M	2345	240	20			1 1/2			-SN BLSN	BKN016 OVC025			2944		8			
M	0045	240	15	20		2 1/2			-SN BLSN	OVC040			2946	(A51	8			

Time ☐ LST ☐ UTC (26)	No. (27)	Precip. (Ins.) (33)	Snow Fall (Ins.) (34)	Snow Depth (Ins.) (35)	Max. Temp. (0.1°C) (31)	Min. Temp. (0.1°C) (32)	Station Pressure (36)	Barograph (37)	Baro. Corr. (38)
MID. TO									
	1								
	2								
	3								
	4								
MID									

Summary of Day (Midnight to Midnight)

24-Hr. Maximum Temp. (0.1°C) (57)	24-Hr. Minimum Temp. (0.1°C) (58)	24-Hr. Precip. Water Equiv. (Ins.) (59)	24-Hr. Snowfall (Ins.) (60)	1200 UTC Snow Depth (Ins.) (61)

REMARKS, NOTES AND MISCELLANEOUS PHENOMENA (66)

TIMECHECK – CLOCK CORRECT TO NEAREST MINUTE (R) / /

MF1M-10C (1-96) (PRESCRIBED BY FMH-1) U.S. DEPARTMENT OF COMMERCE, NOAA, NATIONAL WEATHER SERVICE (SUPERSEDES MF1-10C – PREVIOUS VERSION) *U.S.GPO

Table 2a

HHMMSS	XDTX	YDTX	ALT(m)	SMSPD(kt)	TSND(C)	TTOT(C)
204218	-72.520	-115.388	3352.800	-99.900	-99.900	-99.900
204222	-72.168	-114.684	3352.800	-99.900	-99.900	-99.900
204227	-71.483	-114.221	3352.800	342.820	-14.500	0.979
204232	-71.242	-113.425	3352.800	324.163	-14.500	-0.660
204236	-70.779	-112.962	3352.800	326.336	-14.500	-0.474
204241	-70.316	-112.258	3352.800	328.182	-14.500	-0.314
204245	-69.853	-111.573	3352.800	328.182	-14.500	-0.314
204250	-69.390	-111.110	3352.800	343.682	-14.500	1.057
204255	-69.168	-110.184	3352.800	324.052	-14.500	-0.669
204259	-68.576	-109.832	3352.800	347.982	-14.500	1.449
204304	-68.113	-109.129	3352.800	321.328	-14.500	-0.901
204308	-67.779	-108.443	3352.800	328.143	-14.500	-0.318
204313	-67.316	-107.869	3352.800	317.776	-14.500	-1.200
204318	-66.853	-107.277	3352.800	333.122	-14.500	0.116
204322	-66.502	-106.480	3352.800	322.494	-14.500	-0.802
204327	-66.150	-105.888	3352.800	342.510	-14.500	0.951
204332	-65.576	-105.203	3352.800	312.577	-14.500	-1.631
204336	-65.224	-104.629	3352.800	330.344	-14.500	-0.127
204341	-64.872	-103.925	3352.800	320.899	-14.500	-0.937
204346	-64.409	-103.240	3352.800	332.028	-14.500	0.020
204350	-63.835	-102.777	3352.800	329.438	-14.500	-0.206
204355	-63.483	-102.073	3352.800	320.457	-14.500	-0.974
204359	-63.150	-101.388	3352.800	313.630	-14.500	-1.545
204404	-62.798	-100.795	3352.800	309.080	-14.500	-1.918
204409	-62.335	-100.221	3352.800	305.622	-14.500	-2.198
204413	-61.872	-99.647	3352.800	333.438	-14.500	0.144
204418	-61.520	-98.832	3352.800	331.357	-14.500	-0.039
204422	-60.946	-98.369	3352.800	335.985	-14.500	0.368
204427	-60.594	-97.684	3352.800	321.770	-14.500	-0.863
204432	-60.242	-96.981	3352.800	301.985	-14.500	-2.489
204436	-59.779	-96.629	3352.800	314.919	-14.500	-1.438
204441	-59.446	-95.832	3352.800	315.108	-14.500	-1.422
204445	-59.094	-95.129	3352.800	341.594	-14.500	0.869
204450	-58.742	-94.443	3352.800	310.333	-14.500	-1.815
204455	-58.279	-93.981	3352.800	291.519	-14.500	-3.307
204459	-57.816	-93.518	3352.800	280.248	-14.500	-4.156
204504	-57.465	-92.925	3352.800	283.380	-14.500	-3.923
204508	-56.891	-92.592	3352.800	281.684	-14.500	-4.049
204513	-56.428	-92.129	3078.480	288.157	-13.000	-2.064
204518	-55.854	-91.666	3352.800	282.477	-14.500	-3.990
204522	-55.279	-91.425	3352.800	281.092	-14.500	-4.093
204527	-54.687	-91.203	3352.800	259.404	-14.500	-5.637
204531	-54.224	-90.851	3352.800	303.077	-14.500	-2.402
204536	-53.298	-91.073	3352.800	307.601	-14.500	-2.038
204541	-52.965	-90.499	3352.800	334.087	-14.500	0.201
204545	-52.613	-89.814	3352.800	365.214	-14.500	3.068
204550	-51.687	-90.499	3352.800	383.646	-14.500	4.886
204555	-51.113	-89.925	3352.800	348.602	-14.500	1.506
204559	-50.650	-89.684	3352.800	275.268	-14.500	-4.520
204604	-50.057	-89.462	3352.800	231.521	-14.500	-7.440
204608	-49.724	-89.110	3352.800	255.130	-14.500	-5.927
204613	-49.131	-88.758	3322.320	244.564	-14.500	-6.622
204618	-48.668	-88.425	3322.320	268.436	-14.500	-5.009
204622	-48.205	-87.962	3291.840	263.734	-14.500	-5.339
204627	-47.742	-87.499	3261.360	280.943	-14.500	-4.104
204631	-47.409	-86.907	3230.880	294.888	-14.500	-3.047
204636	-47.057	-86.221	3200.400	262.615	-14.500	-5.416
204641	-46.705	-85.981	3169.920	248.569	-14.500	-6.362
204645	-46.354	-85.518	3139.440	259.084	-14.500	-5.659
204650	-46.131	-84.721	3108.960	267.516	-13.000	-3.574
204655	-45.780	-84.370	3078.480	280.794	-13.000	-2.615
204659	-45.428	-83.795	3048.000	244.449	-13.000	-5.130
204704	-45.094	-83.333	2987.040	266.003	-13.000	-3.681
204708	-44.854	-82.740	2956.560	265.840	-13.000	-3.692
204713	-44.502	-82.166	2926.080	265.840	-13.000	-3.692
204718	-44.168	-81.703	2865.120	276.010	-12.700	-2.666
204722	-43.928	-81.018	2834.640	278.251	-12.700	-2.503
204727	-43.576	-80.425	2804.160	278.251	-12.700	-2.503
204731	-43.243	-79.962	2773.680	258.464	-12.700	-3.901
204736	-42.780	-79.629	2743.200	258.298	-12.700	-3.913
204741	-42.428	-79.036	2682.240	258.658	-12.700	-3.888
204745	-41.854	-78.925	2651.760	286.886	-12.700	-1.860
204750	-41.502	-78.240	2621.280	277.481	-11.500	-1.359
204754	-40.928	-77.999	2590.800	289.163	-11.500	-0.487
204759	-40.465	-77.536	2560.320	262.352	-11.500	-2.435
204804	-40.002	-77.184	2529.840	254.926	-11.500	-2.941
204808	-39.650	-76.721	2499.360	249.395	-11.500	-3.308
204813	-39.076	-76.499	2438.400	259.725	-11.500	-2.615
204817	-38.613	-76.036	2407.920	274.612	-11.500	-1.568
204822	-38.020	-75.684	2377.440	269.655	-11.500	-1.923
204827	-37.557	-75.333	2346.960	256.425	-11.000	-2.340
204831	-37.094	-74.999	2316.480	241.405	-11.000	-3.324
204836	-36.631	-74.647	2286.000	263.587	-11.000	-1.849
204841	-36.057	-74.184	2255.520	266.487	-11.000	-1.647
204845	-35.706	-73.721	2225.040	281.376	-11.000	-0.572
204850	-35.132	-73.370	2194.560	248.040	-11.000	-2.897
204855	-34.669	-73.147	2164.080	248.180	-11.000	-2.888
204859	-34.206	-72.796	2164.080	235.065	-11.000	-3.722
204904	-33.743	-72.444	2133.600	251.324	-11.000	-2.681
204908	-33.169	-72.221	2133.600	259.517	-11.000	-2.129
204913	-32.706	-71.759	2133.600	251.224	-11.000	-2.687
204918	-32.243	-71.518	2133.600	259.072	-11.000	-2.160
204922	-31.669	-71.166	2133.600	241.276	-11.000	-3.333
204927	-31.206	-70.944	2133.600	262.656	-11.000	-1.914
204932	-30.613	-70.592	2133.600	234.952	-11.000	-3.729
204936	-30.150	-70.481	2133.600	257.368	-11.000	-2.276
204941	-29.576	-70.129	2133.600	234.818	-11.000	-3.738
204945	-29.113	-69.907	2133.600	253.599	-11.000	-2.529
204950	-28.539	-69.666	2133.600	231.059	-11.000	-3.968
204955	-28.076	-69.444	2133.600	253.637	-11.000	-2.527
204959	-27.502	-69.092	2133.600	249.747	-11.000	-2.785
205004	-27.039	-68.740	2133.600	260.516	-11.000	-2.061
205008	-26.446	-68.629	2133.600	239.108	-11.000	-3.470
205013	-25.983	-68.388	2133.600	239.565	-11.000	-3.441
205018	-25.409	-68.277	2133.600	221.773	-11.000	-4.522
205022	-24.946	-68.277	2133.600	211.934	-11.000	-5.084
205027	-24.483	-68.277	2133.600	203.044	-11.000	-5.570
205031	-24.020	-68.518	2103.120	196.330	-10.200	-5.123
205036	-23.669	-68.740	2103.120	190.536	-10.200	-5.418
205041	-23.335	-68.981	2103.120	186.597	-10.200	-5.614
205045	-22.983	-69.314	2133.600	180.877	-11.000	-6.691
205050	-22.632	-69.444	2133.600	181.480	-11.000	-6.662
205054	-22.280	-69.666	2133.600	192.072	-11.000	-6.141
205059	-21.817	-70.018	2133.600	174.195	-11.000	-7.003
205104	-21.595	-70.129	2133.600	175.733	-11.000	-6.933
205108	-21.243	-70.370	2133.600	166.220	-11.000	-7.361
205113	-20.780	-70.592	2133.600	191.354	-11.000	-6.177
205117	-20.428	-70.833	2103.120	166.221	-10.200	-6.561
205122	-20.206	-70.944	2072.640	167.788	-10.200	-6.492
205127	-19.743	-71.166	2072.640	154.612	-10.200	-7.051
205131	-19.502	-71.407	2042.160	201.531	-10.200	-4.851
205136	-19.039	-71.759	2011.680	185.699	-10.200	-5.658
205141	-18.706	-71.981	2011.680	198.772	-10.200	-4.996
205145	-18.354	-72.221	1981.200	174.275	-10.200	-6.200
205150	-18.002	-72.444	1950.720	187.978	-10.200	-5.546
205154	-17.650	-72.796	1950.720	184.448	-10.200	-5.719
205159	-17.317	-73.018	1920.240	179.812	-10.200	-5.941
205204	-16.965	-73.147	1920.240	179.416	-10.200	-5.960
205208	-16.613	-73.481	1889.760	182.947	-10.200	-5.792
205213	-16.261	-73.721	1859.280	186.661	-9.300	-4.711
205217	-15.928	-73.944	1859.280	175.682	-9.300	-5.235

Table 2b

HHMMSS	XDTX	YDTX	ALT(m)	SMSPD(kt)	TSND(C)	TTOT(C)
204513	-79.687	-105.777	4084.320	-99.900	-99.900	-99.900
204518	-78.761	-105.314	4053.840	-99.900	-99.900	-99.900
204522	-77.835	-104.962	4023.360	424.572	-19.800	3.942
204527	-76.909	-104.629	3992.880	408.696	-19.800	2.200
204531	-76.113	-104.166	3992.880	420.941	-19.800	3.538
204536	-75.187	-103.573	3962.400	416.673	-19.800	3.067
204541	-74.261	-103.351	3931.920	439.241	-19.800	5.611
204545	-73.205	-103.110	3901.440	426.326	-19.800	4.139
204550	-72.279	-102.777	3901.440	419.109	-19.800	3.335
204555	-71.483	-102.314	3870.960	419.109	-18.000	5.135
204559	-70.427	-102.073	3840.480	410.207	-18.000	4.163
204604	-69.631	-101.610	3810.000	435.295	-18.000	6.957
204608	-68.576	-101.388	3779.520	428.603	-18.000	6.195
204613	-67.650	-100.925	3779.520	435.380	-18.000	6.966
204618	-66.724	-100.573	3749.040	417.914	-18.000	5.003
204622	-65.798	-100.332	3718.560	425.804	-18.000	5.880
204627	-64.761	-99.999	3718.560	421.295	-18.000	5.377
204631	-63.946	-99.536	3688.080	413.461	-18.000	4.516
204636	-63.150	-99.073	3688.080	399.743	-18.000	3.047
204641	-62.224	-98.721	3657.600	407.047	-18.000	3.823
204645	-61.298	-98.369	3657.600	412.122	-18.000	4.370
204650	-60.483	-97.906	3657.600	403.555	-18.000	3.450
204655	-59.557	-97.684	3627.120	389.242	-18.000	1.955
204659	-58.742	-97.332	3657.600	389.242	-18.000	1.955
204704	-57.928	-96.869	3657.600	392.791	-18.000	2.321
204708	-57.002	-96.629	3657.600	389.151	-18.000	1.946
204713	-56.205	-96.295	3657.600	368.127	-18.000	-0.151
204718	-55.502	-95.943	3657.600	355.431	-18.000	-1.361
204722	-54.687	-95.592	3657.600	342.497	-18.000	-2.550
204727	-54.002	-95.240	3657.600	355.722	-18.000	-1.334
204731	-53.187	-94.906	3657.600	349.881	-18.000	-1.876
204736	-52.502	-94.443	3657.600	352.027	-18.000	-1.678
204741	-51.798	-94.092	3657.600	328.194	-18.000	-3.813
204745	-51.113	-93.851	3657.600	321.572	-18.000	-4.380
204750	-50.409	-93.518	3627.120	319.241	-18.000	-4.577
204754	-49.724	-93.166	3627.120	329.659	-18.000	-3.686
204759	-49.020	-92.814	3627.120	314.775	-18.000	-4.950
204804	-48.446	-92.462	3627.120	313.765	-18.000	-5.033
204808	-47.742	-92.129	3627.120	297.763	-18.000	-6.322
204813	-47.168	-91.777	3627.120	306.830	-18.000	-5.600
204817	-46.705	-91.203	3627.120	303.144	-18.000	-5.896
204822	-46.243	-90.610	3627.120	309.774	-18.000	-5.361
204827	-46.020	-89.925	3596.640	297.922	-15.900	-4.210
204831	-45.557	-89.462	3566.160	296.953	-15.900	-4.286
204836	-45.317	-88.758	3535.680	284.142	-15.900	-5.266
204841	-44.743	-88.536	3505.200	320.704	-15.900	-2.354
204845	-44.631	-87.610	3444.240	322.809	-15.900	-2.175
204850	-44.391	-86.907	3413.760	326.210	-15.900	-1.884
204854	-43.928	-86.444	3383.280	301.323	-15.900	-3.941
204859	-43.465	-85.870	3352.800	286.892	-14.500	-3.659
204904	-43.002	-85.407	3322.320	298.724	-14.500	-2.747
204908	-42.428	-84.944	3261.360	287.050	-14.500	-3.647
204913	-41.965	-84.481	3230.880	289.061	-14.500	-3.495
204917	-41.502	-84.018	3200.400	289.060	-14.500	-3.495
204922	-41.039	-83.444	3200.400	305.466	-14.500	-2.210
204927	-40.687	-82.740	3169.920	299.777	-14.500	-2.664
204931	-40.113	-82.518	3139.440	297.527	-14.500	-2.841
204936	-39.650	-81.944	3108.960	281.279	-13.000	-2.579
204941	-39.187	-81.481	3078.480	286.810	-13.000	-2.166
204945	-38.724	-81.018	3048.000	289.060	-13.000	-1.995
204950	-38.150	-80.555	3017.520	278.712	-13.000	-2.769
204954	-37.798	-80.092	2956.560	287.979	-13.000	-2.077
204959	-37.224	-79.629	2926.080	276.461	-13.000	-2.933
205004	-36.761	-79.166	2865.120	286.652	-12.700	-1.877
205008	-36.298	-78.703	2834.640	288.827	-12.700	-1.713
205013	-35.706	-78.240	2773.680	290.594	-12.700	-1.578
205017	-35.243	-77.777	2743.200	300.358	-12.700	-0.818
205022	-34.669	-77.314	2712.720	278.568	-12.700	-2.479
205027	-34.206	-76.962	2682.240	279.267	-12.700	-2.428
205031	-33.632	-76.610	2682.240	259.311	-12.700	-3.844
205036	-33.169	-76.258	2651.760	279.097	-12.700	-2.440
205041	-32.706	-75.684	2651.760	271.100	-12.700	-3.020
205045	-32.132	-75.462	2621.280	281.291	-11.500	-1.079
205050	-31.669	-74.999	2621.280	261.366	-11.500	-2.503
205054	-31.206	-74.647	2590.800	254.769	-11.500	-2.951
205059	-30.743	-74.296	2560.320	254.769	-11.500	-2.951
205104	-30.280	-73.833	2499.360	254.908	-11.500	-2.942
205108	-29.817	-73.481	2468.880	268.513	-11.500	-2.004
205113	-29.224	-73.147	2438.400	258.322	-11.500	-2.711
205117	-28.761	-72.796	2377.440	264.118	-11.500	-2.312
205122	-28.187	-72.555	2346.960	252.153	-11.000	-2.626
205127	-27.835	-72.092	2286.000	293.559	-11.000	0.350
205131	-27.150	-71.518	2255.520	264.300	-11.000	-1.799
205136	-26.798	-71.296	2225.040	264.300	-11.000	-1.799
205141	-26.335	-70.944	2194.560	222.895	-11.000	-4.456
205145	-25.872	-70.592	2164.080	257.272	-11.000	-2.282
205150	-25.298	-70.240	2133.600	254.241	-11.000	-2.486
205154	-24.835	-69.907	2133.600	254.241	-11.000	-2.486
205159	-24.372	-69.555	2133.600	251.520	-11.000	-2.668
205204	-23.909	-69.092	2133.600	239.686	-11.000	-3.433
205208	-23.446	-68.981	2103.120	245.182	-10.200	-2.282
205213	-22.872	-68.740	2133.600	245.512	-11.000	-3.061
205218	-22.280	-68.981	2133.600	246.170	-11.000	-3.018
205222	-21.817	-68.851	2133.600	210.009	-11.000	-5.191
205227	-21.483	-68.981	2133.600	209.981	-11.000	-5.193
205231	-21.021	-69.444	2133.600	179.564	-11.000	-6.753
205236	-20.780	-69.555	2133.600	210.228	-11.000	-5.179
205240	-20.428	-70.018	2133.600	154.614	-11.000	-7.851
205245	-20.317	-70.240	2133.600	174.838	-11.000	-6.974
205250	-20.095	-70.592	2133.600	131.241	-11.000	-8.731
205254	-19.965	-70.833	2133.600	140.526	-11.000	-8.399
205259	-19.743	-71.055	2133.600	143.244	-11.000	-8.297
205304	-19.502	-71.407	2133.600	163.278	-11.000	-7.489
205308	-19.280	-71.759	2133.600	175.788	-11.000	-6.930
205313	-19.039	-72.092	2133.600	161.818	-11.000	-7.551
205317	-18.817	-72.333	2133.600	176.822	-11.000	-6.882
205322	-18.576	-72.796	2133.600	164.312	-11.000	-7.444
205327	-18.354	-73.018	2133.600	176.875	-11.000	-6.879
205331	-18.113	-73.370	2133.600	149.561	-11.000	-8.054
205336	-17.891	-73.610	2133.600	163.231	-11.000	-7.491
205340	-17.650	-73.944	2133.600	164.325	-11.000	-7.443
205345	-17.428	-74.296	2133.600	178.170	-11.000	-6.819
205350	-17.187	-74.647	2133.600	169.717	-11.000	-7.206
205354	-17.187	-74.999	2103.120	158.422	-10.200	-6.894
205359	-17.076	-75.333	2103.120	165.558	-10.200	-6.590
205403	-16.965	-75.796	2072.640	165.643	-10.200	-6.586
205408	-16.965	-76.147	2072.640	150.867	-10.200	-7.202
205413	-16.965	-76.388	2042.160	133.240	-10.200	-7.862
205417	-16.854	-76.721	2042.160	155.743	-10.200	-7.005
205422	-16.613	-77.184	2011.680	155.801	-10.200	-7.003
205426	-16.613	-77.425	1981.200	150.484	-10.200	-7.217
205431	-16.391	-77.647	1950.720	160.374	-10.200	-6.812
205436	-16.039	-78.110	1950.720	173.422	-10.200	-6.239
205440	-15.798	-78.351	1920.240	173.574	-10.200	-6.232
205445	-15.576	-78.573	1889.760	151.584	-10.200	-7.174
205449	-15.224	-78.814	1859.280	163.322	-9.300	-5.787
205454	-15.002	-79.166	1828.800	177.542	-9.300	-5.148
205459	-14.650	-79.388	1798.320	176.441	-9.300	-5.200
205503	-14.409	-79.740	1798.320	163.051	-9.300	-5.798
205508	-14.187	-79.962	1767.840	164.487	-9.300	-5.736
205512	-13.947	-80.314	1737.360	163.552	-9.300	-5.777

Table 2c

HHMMSS	XDTX	YDTX	ALT(m)	SMSPD(kt)	TSND(C)	TTOT(C)
204250	-80.390	-104.388	3992.880	-99.900	-99.900	-99.900
204255	-79.575	-104.036	3931.920	-99.900	-99.900	-99.900
204259	-78.761	-103.703	3901.440	378.976	-19.800	-0.883
204304	-77.835	-103.573	3840.480	395.337	-18.000	2.585
204309	-76.909	-103.240	3810.000	387.787	-18.000	1.806
204313	-76.224	-102.777	3779.520	373.160	-18.000	0.340
204318	-75.409	-102.536	3718.560	366.526	-18.000	-0.306
204322	-74.594	-102.073	3688.080	381.229	-18.000	1.142
204327	-73.668	-101.962	3657.600	386.774	-18.000	1.703
204332	-72.872	-101.610	3657.600	371.301	-18.000	0.158
204336	-72.057	-101.388	3627.120	371.948	-18.000	0.222
204341	-71.242	-100.925	3627.120	365.529	-18.000	-0.402
204346	-70.427	-100.795	3627.120	365.427	-18.000	-0.412
204350	-69.742	-100.332	3627.120	354.932	-18.000	-1.408
204355	-68.927	-99.999	3657.600	341.167	-18.000	-2.670
204359	-68.242	-99.758	3657.600	335.303	-18.000	-3.192
204404	-67.539	-99.406	3657.600	337.998	-18.000	-2.953
204409	-66.724	-99.073	3657.600	349.184	-18.000	-1.941
204413	-65.927	-98.943	3657.600	348.227	-18.000	-2.029
204418	-65.224	-98.610	3657.600	346.524	-18.000	-2.184
204422	-64.409	-98.258	3627.120	335.338	-18.000	-3.189
204427	-63.724	-98.018	3627.120	344.450	-18.000	-2.373
204432	-62.909	-97.795	3657.600	341.811	-18.000	-2.612
204436	-62.094	-97.555	3657.600	346.675	-18.000	-2.171
204441	-61.409	-97.221	3657.600	338.709	-18.000	-2.890
204445	-60.705	-96.869	3657.600	321.100	-18.000	-4.420
204450	-60.020	-96.629	3657.600	335.521	-18.000	-3.173
204455	-59.205	-96.295	3657.600	333.001	-18.000	-3.395
204459	-58.520	-95.943	3657.600	341.728	-18.000	-2.619
204504	-57.816	-95.592	3657.600	335.825	-18.000	-3.146
204508	-57.002	-95.481	3657.600	342.174	-18.000	-2.579
204513	-56.205	-95.240	3657.600	347.005	-18.000	-2.140
204518	-55.391	-95.129	3657.600	359.110	-18.000	-1.015
204522	-54.687	-94.555	3657.600	357.717	-18.000	-1.146
204527	-53.891	-94.443	3657.600	360.536	-18.000	-0.880
204531	-53.428	-93.740	3657.600	341.192	-18.000	-2.667
204536	-52.724	-93.388	3657.600	374.118	-18.000	0.435
204541	-51.687	-93.388	3657.600	359.394	-18.000	-0.988
204545	-50.983	-93.166	3657.600	359.468	-18.000	-0.981
204550	-50.298	-92.814	3657.600	329.689	-18.000	-3.684
204555	-49.483	-92.592	3657.600	334.243	-18.000	-3.286
204559	-48.798	-92.240	3657.600	344.633	-18.000	-2.357
204604	-48.094	-91.777	3657.600	336.530	-18.000	-3.083
204608	-47.409	-91.425	3657.600	346.902	-18.000	-2.150
204613	-46.705	-90.962	3657.600	341.800	-18.000	-2.613
204618	-46.020	-90.499	3657.600	339.226	-18.000	-2.844
204622	-45.428	-90.036	3657.600	357.357	-18.000	-1.180
204627	-44.743	-89.351	3657.600	347.264	-18.000	-2.117
204631	-44.168	-88.888	3657.600	357.631	-18.000	-1.154
204636	-43.465	-88.425	3627.120	337.059	-18.000	-3.037
204641	-42.891	-87.832	3627.120	351.848	-18.000	-1.695
204645	-42.187	-87.369	3596.640	339.435	-15.900	-0.725
204650	-41.613	-86.907	3566.160	344.554	-15.900	-0.264
204655	-40.798	-86.573	3535.680	342.315	-15.900	-0.466
204659	-40.224	-85.981	3505.200	354.931	-15.900	0.692
204704	-39.539	-85.518	3474.720	352.051	-15.900	0.424
204708	-38.835	-85.055	3474.720	339.678	-15.900	-0.703
204713	-38.261	-84.592	3444.240	341.851	-15.900	-0.508
204718	-37.557	-84.129	3444.240	324.981	-15.900	-1.990
204722	-36.983	-83.666	3413.760	335.490	-15.900	-1.076
204727	-36.409	-83.092	3383.280	335.692	-15.900	-1.058
204731	-35.706	-82.629	3352.800	342.393	-14.500	0.941
204736	-35.020	-82.277	3322.320	355.782	-14.500	2.172
204741	-34.317	-81.703	3291.840	329.838	-14.500	-0.171
204745	-33.743	-81.351	3291.840	325.395	-14.500	-0.554
204750	-33.169	-80.888	3261.360	316.110	-14.500	-1.339
204754	-32.465	-80.425	3261.360	316.831	-14.500	-1.279
204759	-31.891	-80.092	3230.880	318.880	-14.500	-1.107
204804	-31.428	-79.499	3230.880	305.218	-14.500	-2.230
204808	-30.743	-79.166	3200.400	308.799	-14.500	-1.941
204813	-30.150	-78.814	3169.920	306.749	-14.500	-2.107
204817	-29.576	-78.351	3139.440	292.100	-14.500	-3.262
204822	-29.113	-77.888	3108.960	303.371	-13.000	-0.878
204827	-28.428	-77.536	3108.960	296.378	-13.000	-1.431
204831	-27.835	-77.184	3078.480	284.731	-13.000	-2.322
204836	-27.372	-76.851	3048.000	270.689	-13.000	-3.349
204841	-26.909	-76.388	3017.520	275.423	-13.000	-3.009
204845	-26.335	-75.925	3017.520	291.540	-13.000	-1.805
204850	-25.761	-75.573	2987.040	289.287	-13.000	-1.978
204854	-25.298	-75.110	2956.560	269.363	-13.000	-3.444
204859	-24.835	-74.759	2926.080	254.903	-13.000	-4.442
204904	-24.372	-74.407	2895.600	256.187	-13.000	-4.356
204908	-23.798	-74.073	2865.120	271.377	-12.700	-3.000
204913	-23.206	-73.721	2834.640	283.371	-12.700	-2.124
204917	-22.743	-73.259	2773.680	277.692	-12.700	-2.543
204922	-22.169	-73.018	2743.200	282.427	-12.700	-2.194
204927	-21.706	-72.444	2712.720	271.939	-12.700	-2.960
204931	-21.354	-71.981	2682.240	279.935	-12.700	-2.379
204936	-20.669	-71.870	2621.280	265.945	-11.500	-2.185
204941	-20.095	-71.629	2590.800	273.347	-11.500	-1.659
204945	-19.502	-71.407	2560.320	258.369	-11.500	-2.708
204950	-18.928	-71.407	2529.840	251.525	-11.500	-3.167
204954	-18.354	-71.407	2468.880	225.991	-11.500	-4.773
204959	-17.891	-71.407	2438.400	232.142	-11.500	-4.402
205004	-17.317	-71.629	2407.920	224.633	-11.500	-4.854
205008	-16.854	-71.870	2377.440	231.730	-11.500	-4.427
205013	-16.391	-72.092	2377.440	205.990	-11.500	-5.911
205017	-16.039	-72.333	2346.960	204.160	-11.000	-5.510
205022	-15.687	-72.684	2346.960	190.794	-11.000	-6.205
205027	-15.335	-72.907	2346.960	211.429	-11.000	-5.112
205031	-14.872	-73.259	2346.960	183.982	-11.000	-6.542
205036	-14.650	-73.481	2316.480	196.668	-11.000	-5.906
205040	-14.298	-73.833	2286.000	165.650	-11.000	-7.386
205045	-13.947	-73.944	2255.520	180.021	-11.000	-6.732
205050	-13.724	-74.296	2225.040	180.021	-11.000	-6.732
205054	-13.372	-74.647	2225.040	196.174	-11.000	-5.931
205059	-13.261	-75.110	2194.560	188.479	-11.000	-6.321
205103	-13.150	-75.462	2164.080	154.520	-11.000	-7.855
205108	-13.021	-75.684	2164.080	154.635	-11.000	-7.851
205113	-12.909	-76.147	2133.600	162.330	-11.000	-7.529
205117	-12.687	-76.499	2103.120	177.814	-10.200	-6.036
205122	-12.558	-76.851	2072.640	160.187	-10.200	-6.820
205127	-12.447	-77.184	2042.160	153.533	-10.200	-7.095
205131	-12.335	-77.536	2011.680	154.922	-10.200	-7.039
205136	-12.224	-77.888	1981.200	158.168	-10.200	-6.905
205140	-12.095	-78.240	1981.200	155.768	-10.200	-7.004
205145	-11.984	-78.573	1950.720	153.465	-10.200	-7.098
205149	-11.872	-78.925	1920.240	152.708	-10.200	-7.129
205154	-11.761	-79.277	1889.760	170.993	-10.200	-6.349
205159	-11.632	-79.740	1859.280	178.774	-9.300	-5.091
205203	-11.410	-80.092	1859.280	161.743	-9.300	-5.854
205208	-11.298	-80.314	1828.800	131.607	-9.300	-7.019
205213	-11.169	-80.555	1798.320	145.344	-9.300	-6.518
205217	-10.706	-80.777	1767.840	167.079	-9.300	-5.623
205222	-10.372	-81.018	1737.360	182.599	-9.300	-4.908
205226	-10.021	-81.129	1706.880	181.032	-9.300	-4.984
205231	-9.558	-81.351	1676.400	177.175	-9.300	-5.165
205236	-9.206	-81.481	1645.920	174.865	-9.300	-5.273
205240	-8.854	-81.592	1645.920	172.671	-9.300	-5.373
205245	-8.391	-81.703	1615.440	164.978	-9.000	-5.415
205249	-8.169	-81.944	1584.960	181.245	-9.000	-4.673

Fig. 4

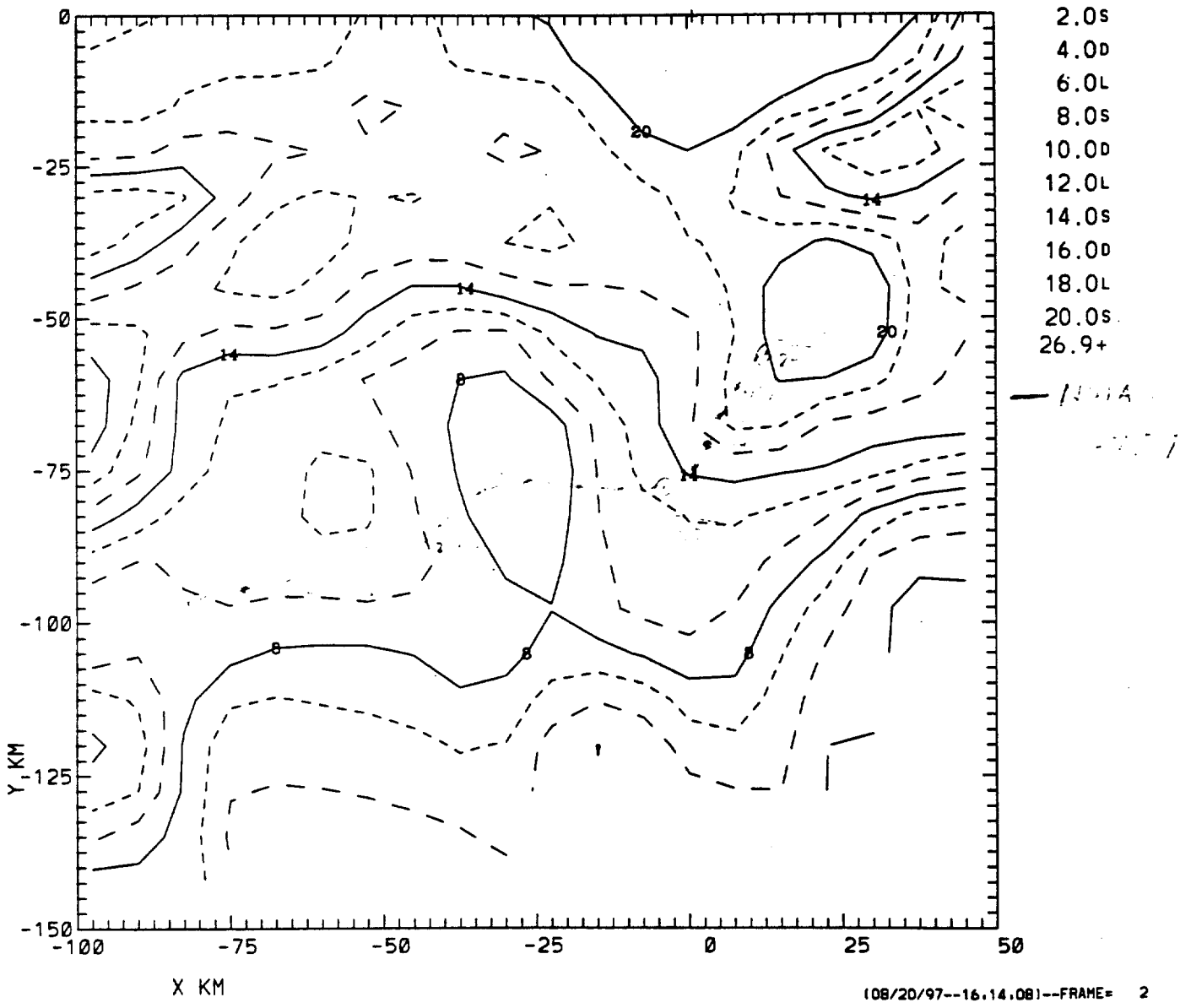

97/ 1/ 9 20 43 25-20 48 8 KDTX Z = 2.30 KM DZ
(AS OF 08/20/97) ORIGIN=(0.00, 0.00) KM X-AXIS= 90.0 DEG
DTX Radar Reflectivity - COMAIR 3272
2.0S
4.0D
6.0L
8.0S
10.0D
12.0L
14.0S
16.0D
18.0L
20.0S
26.9+
Y, KM
X KM
0
-25
-50
-75
-100
-125
-150
-100
-75
-50
-25
0
25
50
20
14
8
(08/20/97--16.14.08)--FRAME= 2

Fig. 5

97/ 1/ 9 20 37 34-20 42 23 KDTX Z = 2.30 KM DZ
(AS OF 08/21/97) ORIGIN=(0.00, 0.00) KM X-AXIS= 90.0 DEG
DTX Radar Reflectivity - COMAIR 3272

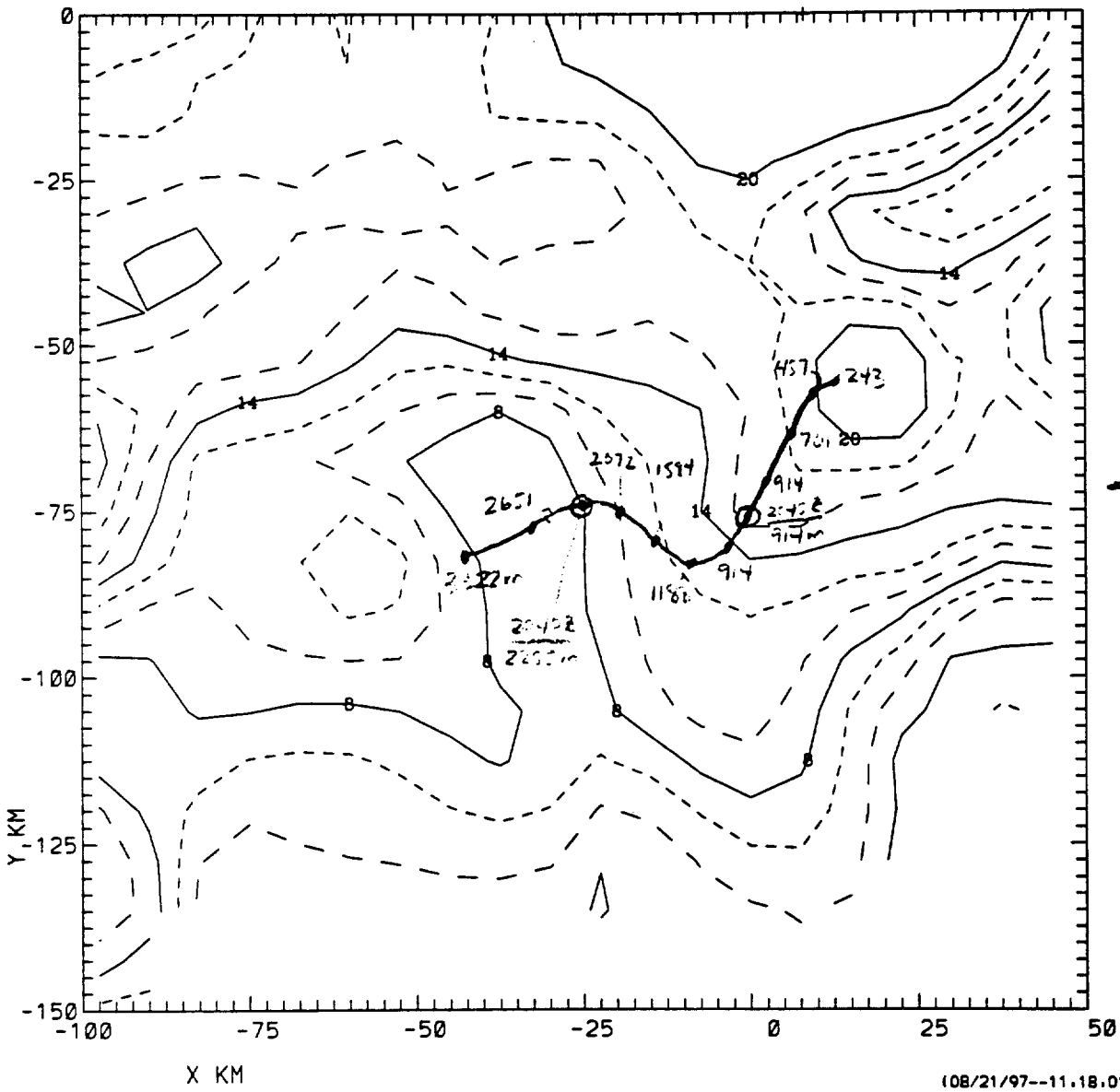


Table 2d

locns_xyz.nwa483 Tue Aug 26 17:27:50 1997 1

HHMMSS	XDTX	YDTX	ALT(m)	SMSPD(kt)	TSND(C)	TTOT(C)
203955	-82.594	-98.610	3657.600	-99.900	-99.900	-99.900
203960	-82.131	-97.795	3657.600	-99.900	-99.900	-99.900
204004	-81.779	-96.869	3657.600	383.330	-18.000	1.354
204009	-81.075	-96.518	3657.600	371.281	-18.000	0.156
204014	-80.279	-96.166	3657.600	335.593	-18.000	-3.166
204018	-79.575	-95.943	3657.600	327.041	-18.000	-3.913
204023	-78.890	-95.703	3657.600	325.716	-18.000	-4.027
204027	-78.187	-95.240	3657.600	337.825	-18.000	-2.969
204032	-77.372	-95.369	3657.600	345.285	-18.000	-2.297
204037	-76.576	-95.369	3657.600	327.130	-18.000	-3.905
204041	-75.872	-95.481	3657.600	325.881	-18.000	-4.013
204046	-75.057	-95.481	3657.600	329.216	-18.000	-3.725
204050	-74.261	-95.592	3657.600	316.040	-18.000	-4.845
204055	-73.668	-95.369	3657.600	316.884	-18.000	-4.774
204059	-72.872	-95.481	3657.600	320.223	-18.000	-4.494
204104	-72.057	-95.703	3657.600	352.584	-18.000	-1.626
204109	-71.242	-95.943	3657.600	333.587	-18.000	-3.343
204113	-70.557	-95.943	3657.600	315.155	-18.000	-4.918
204118	-69.853	-95.832	3657.600	314.441	-18.000	-4.977
204123	-69.039	-96.055	3657.600	299.624	-18.000	-6.176
204127	-68.576	-95.703	3657.600	361.504	-18.000	-0.787
204132	-67.539	-96.166	3657.600	340.902	-18.000	-2.693
204136	-66.853	-96.295	3657.600	373.871	-18.000	0.410
204141	-66.039	-96.295	3657.600	312.155	-18.000	-5.166
204146	-65.335	-96.406	3657.600	347.941	-18.000	-2.055
204150	-64.409	-96.629	3657.600	330.889	-18.000	-3.579
204155	-63.724	-96.518	3657.600	332.899	-18.000	-3.404
204159	-63.020	-96.629	3657.600	293.297	-18.000	-6.670
204204	-62.335	-96.629	3657.600	310.154	-18.000	-5.330
204209	-61.520	-96.629	3627.120	326.241	-18.000	-3.982
204213	-60.705	-96.758	3657.600	349.069	-18.000	-1.951
204218	-59.909	-96.518	3657.600	338.227	-18.000	-2.933
204222	-59.205	-96.295	3657.600	325.676	-18.000	-4.030
204227	-58.631	-95.832	3657.600	336.129	-18.000	-3.119
204232	-57.705	-95.832	3657.600	337.124	-18.000	-3.031
204236	-57.002	-95.592	3657.600	349.711	-18.000	-1.892
204241	-56.205	-95.369	3657.600	341.765	-18.000	-2.616
204246	-55.391	-95.129	3657.600	347.844	-18.000	-2.064
204250	-54.687	-94.777	3627.120	336.559	-18.000	-3.081
204255	-54.002	-94.443	3627.120	321.419	-18.000	-4.393
204259	-53.298	-94.203	3627.120	312.030	-18.000	-5.176
204304	-52.613	-93.981	3627.120	317.867	-18.000	-4.692
204309	-51.909	-93.629	3657.600	315.398	-18.000	-4.898
204313	-51.224	-93.388	3657.600	315.632	-18.000	-4.879
204318	-50.520	-93.166	3627.120	313.112	-18.000	-5.087
204322	-49.835	-92.814	3657.600	297.502	-18.000	-6.343
204327	-49.261	-92.592	3657.600	314.510	-18.000	-4.972
204332	-48.557	-92.129	3657.600	286.245	-18.000	-7.208
204336	-48.094	-91.777	3657.600	314.127	-18.000	-5.003
204341	-47.520	-91.203	3657.600	276.990	-18.000	-7.895
204346	-47.057	-90.851	3627.120	300.991	-18.000	-6.068
204350	-46.483	-90.388	3596.640	290.057	-15.900	-4.819
204355	-45.891	-89.925	3596.640	300.684	-15.900	-3.992
204359	-45.428	-89.462	3566.160	300.506	-15.900	-4.006
204404	-44.854	-88.999	3505.200	291.702	-15.900	-4.693
204409	-44.280	-88.647	3474.720	291.702	-15.900	-4.693
204413	-43.817	-88.184	3444.240	282.473	-15.900	-5.391
204418	-43.243	-87.832	3383.280	301.740	-15.900	-3.908
204422	-42.650	-87.258	3352.800	296.061	-14.500	-2.955
204427	-42.076	-87.036	3322.320	307.340	-14.500	-2.059
204432	-41.613	-86.444	3261.360	273.566	-14.500	-4.643
204436	-41.150	-86.110	3230.880	292.989	-14.500	-3.194
204441	-40.687	-85.518	3169.920	280.372	-14.500	-4.146
204445	-40.113	-85.184	3139.440	292.256	-14.500	-3.250
204450	-39.650	-84.721	3108.960	276.508	-13.000	-2.930
204455	-39.187	-84.258	3048.000	287.075	-13.000	-2.145
204459	-38.613	-83.795	3017.520	291.935	-13.000	-1.775
204504	-38.020	-83.444	2956.560	283.591	-13.000	-2.407
204508	-37.557	-83.092	2926.080	281.333	-13.000	-2.575
204513	-37.094	-82.518	2865.120	271.929	-12.700	-2.961
204518	-36.520	-82.277	2804.160	283.404	-12.700	-2.121
204522	-35.946	-81.944	2773.680	287.711	-12.700	-1.797
204527	-35.483	-81.351	2712.720	292.256	-12.700	-1.450
204531	-35.020	-80.888	2682.240	289.125	-12.700	-1.690
204536	-34.557	-80.425	2651.760	276.667	-12.700	-2.618
204541	-33.983	-80.092	2590.800	281.526	-11.500	-1.061
204545	-33.391	-79.740	2560.320	295.225	-11.500	-0.020
204550	-32.928	-79.166	2499.360	291.784	-11.500	-0.286
204555	-32.465	-78.703	2468.880	289.709	-11.500	-0.445
204559	-31.891	-78.351	2407.920	280.642	-11.500	-1.127
204604	-31.317	-77.999	2377.440	282.640	-11.500	-0.978
204608	-30.854	-77.536	2316.480	282.639	-11.000	-0.478
204613	-30.280	-77.184	2286.000	266.230	-11.000	-1.665
204618	-29.817	-76.851	2255.520	280.131	-11.000	-0.664
204622	-29.224	-76.388	2194.560	281.808	-11.000	-0.540
204627	-28.539	-76.388	2164.080	286.095	-11.000	-0.220
204631	-27.965	-76.258	2164.080	263.693	-11.000	-1.842
204636	-27.372	-76.388	2133.600	240.609	-11.000	-3.375
204641	-26.909	-76.147	2133.600	274.238	-11.000	-1.095
204645	-26.224	-76.610	2133.600	257.656	-11.000	-2.256
204650	-25.761	-76.721	2103.120	269.979	-10.200	-0.600
204655	-25.187	-76.962	2072.640	220.606	-10.200	-3.790
204659	-24.724	-77.073	2042.160	243.711	-10.200	-2.377
204704	-24.132	-77.314	1981.200	230.095	-10.200	-3.227
204708	-23.669	-77.536	1950.720	231.499	-10.200	-3.141
204713	-23.206	-77.647	1920.240	208.937	-10.200	-4.450
204717	-22.743	-77.777	1889.760	223.332	-10.200	-3.631
204722	-22.169	-77.999	1859.280	228.386	-9.300	-2.430
204727	-21.706	-78.240	1828.800	227.843	-9.300	-2.463
204731	-21.243	-78.351	1798.320	221.260	-9.300	-2.852
204736	-20.780	-78.703	1798.320	212.944	-9.300	-3.328
204740	-20.317	-78.703	1767.840	218.232	-9.300	-3.027
204745	-19.854	-78.925	1737.360	203.287	-9.300	-3.857
204750	-19.391	-78.925	1706.880	217.229	-9.300	-3.085
204754	-18.817	-78.925	1676.400	209.972	-9.300	-3.493
204759	-18.354	-78.925	1645.920	225.784	-9.300	-2.586
204804	-17.780	-78.925	1584.960	213.584	-9.000	-2.992
204808	-17.317	-78.814	1554.480	212.278	-9.000	-3.065
204813	-16.854	-78.814	1524.000	196.690	-9.000	-3.905
204817	-16.391	-78.814	1463.040	213.121	-9.000	-3.018
204822	-15.798	-78.814	1432.560	216.167	-9.000	-2.845
204827	-15.335	-78.703	1402.080	231.606	-9.000	-1.935
204831	-14.761	-78.814	1371.600	215.290	-7.600	-1.495
204836	-14.298	-78.703	1341.120	213.549	-7.600	-1.594
204840	-13.835	-78.703	1310.640	229.399	-7.600	-0.669
204845	-13.150	-78.703	1280.160	212.878	-7.600	-1.631
204850	-12.798	-78.703	1249.680	228.552	-7.600	-0.720
204854	-12.224	-78.703	1219.200	198.196	-7.600	-2.426
204859	-11.761	-78.573	1188.720	231.033	-7.600	-0.570
204903	-11.169	-78.573	1158.240	215.471	-7.600	-1.485
204908	-10.706	-78.573	1127.760	230.127	-7.600	-0.625
204913	-10.132	-78.573	1127.760	227.368	-7.600	-0.791
204917	-9.558	-78.462	1097.280	212.705	-6.300	-0.341
204922	-9.206	-78.462	1066.800	210.815	-6.300	-0.446
204926	-8.632	-78.462	1066.800	195.400	-6.300	-1.271
204931	-8.169	-78.462	1036.320	210.463	-6.300	-0.466
204936	-7.706	-78.351	1036.320	212.214	-6.300	-0.368
204940	-7.132	-78.351	1036.320	212.214	-6.300	-0.368
204945	-6.669	-78.351	1005.840	213.558	-6.300	-0.293
204949	-6.206	-78.240	1005.840	197.995	-6.300	-1.137
204954	-5.743	-78.240	975.360	204.714	-6.300	-0.780

Table 2c

HHMMSS	XDTX	YDTX	ALT(m)	SMSPD(kt)	TSND(C)	TTOT(C)
203804	-40.465	-83.444	3322.320	-99.900	-99.900	-99.900
203809	-39.872	-82.981	3261.360	-99.900	-99.900	-99.900
203814	-39.187	-82.518	3200.400	335.096	-14.500	0.290
203818	-38.613	-81.944	3139.440	347.054	-14.500	1.364
203823	-38.020	-81.351	3108.960	324.507	-13.000	0.870
203827	-37.446	-81.018	3048.000	338.310	-13.000	2.075
203832	-36.872	-80.314	2987.040	338.914	-13.000	2.129
203837	-36.169	-79.851	2926.080	351.355	-13.000	3.260
203841	-35.706	-79.277	2865.120	349.338	-12.700	3.374
203846	-35.020	-78.703	2804.160	325.496	-12.700	1.254
203850	-34.446	-78.351	2743.200	335.344	-12.700	2.112
203855	-33.854	-77.777	2712.720	325.420	-12.700	1.248
203860	-33.280	-77.184	2651.760	334.650	-12.700	2.050
203904	-32.706	-76.721	2590.800	348.918	-11.500	4.535
203909	-32.002	-76.147	2529.840	325.459	-11.500	2.451
203914	-31.428	-75.796	2499.360	335.967	-11.500	3.367
203918	-30.854	-75.221	2468.880	311.674	-11.500	1.294
203923	-30.280	-74.759	2438.400	325.008	-11.500	2.413
203927	-29.687	-74.296	2407.920	316.769	-11.500	1.716
203932	-29.002	-73.944	2377.440	308.495	-11.500	1.035
203936	-28.428	-73.610	2346.960	316.293	-11.000	2.176
203941	-27.613	-73.481	2316.480	313.912	-11.000	1.979
203946	-26.909	-73.259	2316.480	299.271	-11.000	0.796
203950	-26.335	-73.259	2286.000	281.172	-11.000	-0.587
203955	-25.650	-73.370	2255.520	262.123	-11.000	-1.950
203960	-25.058	-73.481	2255.520	268.967	-11.000	-1.472
204004	-24.483	-73.721	2225.040	238.427	-11.000	-3.513
204009	-24.020	-73.721	2225.040	259.680	-11.000	-2.118
204014	-23.335	-74.073	2225.040	244.282	-11.000	-3.140
204018	-22.872	-74.296	2194.560	269.245	-11.000	-1.452
204023	-22.280	-74.536	2194.560	245.426	-11.000	-3.067
204027	-21.706	-74.647	2194.560	240.023	-11.000	-3.412
204032	-21.243	-74.759	2164.080	221.779	-11.000	-4.522
204037	-20.780	-74.999	2164.080	206.571	-11.000	-5.380
204041	-20.317	-75.110	2164.080	228.209	-11.000	-4.141
204046	-19.743	-75.333	2164.080	208.967	-11.000	-5.249
204050	-19.391	-75.462	2164.080	208.967	-11.000	-5.249
204055	-18.928	-75.573	2103.120	187.329	-10.200	-5.578
204059	-18.465	-75.684	2072.640	185.528	-10.200	-5.666
204104	-18.113	-75.796	2042.160	191.861	-10.200	-5.352
204109	-17.650	-76.036	2011.680	181.308	-10.200	-5.870
204113	-17.317	-76.258	1950.720	190.354	-10.200	-5.428
204118	-16.965	-76.499	1920.240	175.449	-10.200	-6.146
204122	-16.613	-76.721	1889.760	179.082	-10.200	-5.976
204127	-16.261	-76.962	1828.800	185.945	-9.300	-4.746
204132	-15.928	-77.314	1798.320	173.536	-9.300	-5.334
204136	-15.687	-77.536	1737.360	173.434	-9.300	-5.338
204141	-15.335	-77.777	1706.880	163.040	-9.300	-5.799
204145	-15.002	-77.999	1676.400	176.987	-9.300	-5.174
204150	-14.761	-78.351	1645.920	187.040	-9.300	-4.692
204155	-14.409	-78.703	1615.440	185.813	-9.000	-4.452
204159	-14.076	-78.925	1584.960	185.711	-9.000	-4.457
204204	-13.835	-79.277	1554.480	160.853	-9.000	-5.592
204208	-13.613	-79.499	1524.000	279.752	-9.000	1.308
204213	-12.687	-80.314	1493.520	219.614	-9.000	-2.648
204218	-12.687	-80.314	1432.560	198.364	-9.000	-3.817
204222	-12.558	-80.425	1402.080	69.450	-9.000	-8.365
204227	-12.335	-80.666	1371.600	139.642	-7.600	-5.032
204231	-11.984	-81.018	1341.120	196.167	-7.600	-2.532
204236	-11.521	-81.351	1310.640	238.612	-7.600	-0.101
204241	-10.947	-81.592	1280.160	183.781	-7.600	-3.151
204245	-10.835	-81.592	1249.680	188.365	-7.600	-2.927
204250	-10.243	-81.703	1249.680	165.860	-7.600	-3.977
204255	-9.780	-81.703	1219.200	217.774	-7.600	-1.354
204259	-9.317	-81.592	1188.720	197.998	-7.600	-2.437
204304	-8.854	-81.592	1158.240	213.672	-7.600	-1.587
204308	-8.280	-81.592	1158.240	196.030	-7.600	-2.539
204313	-7.928	-81.592	1127.760	211.445	-7.600	-1.711
204318	-7.354	-81.481	1097.280	197.248	-6.300	-1.176
204322	-6.891	-81.481	1066.800	201.705	-6.300	-0.941
204327	-6.539	-81.351	1036.320	200.232	-6.300	-1.019
204331	-5.965	-81.351	1036.320	185.498	-6.300	-1.768
204336	-5.613	-81.240	1005.840	212.526	-6.300	-0.351
204340	-5.039	-81.240	975.360	184.174	-6.300	-1.832
204345	-4.687	-81.129	944.880	207.397	-6.300	-0.635
204350	-4.224	-80.888	944.880	197.271	-6.300	-1.174
204354	-3.761	-80.666	914.400	218.703	-6.300	0.000
204359	-3.539	-80.203	914.400	213.742	-6.300	-0.283
204403	-3.187	-79.851	914.400	201.553	-6.300	-0.949
204408	-2.965	-79.499	914.400	201.129	-6.300	-0.972
204413	-2.724	-79.036	914.400	187.426	-6.300	-1.673
204417	-2.502	-78.703	914.400	188.864	-6.300	-1.602
204422	-2.261	-78.351	914.400	187.040	-6.300	-1.692
204427	-1.910	-77.999	914.400	202.995	-6.300	-0.873
204431	-1.687	-77.536	914.400	211.542	-6.300	-0.406
204436	-1.336	-77.184	914.400	197.862	-6.300	-1.144
204440	-1.113	-76.851	914.400	198.907	-6.300	-1.089
204445	-0.873	-76.388	914.400	188.922	-6.300	-1.599
204450	-0.650	-76.036	914.400	202.722	-6.300	-0.887
204454	-0.299	-75.684	914.400	201.249	-6.300	-0.966
204459	-0.058	-75.221	914.400	201.149	-6.300	-0.971
204503	0.164	-74.870	914.400	199.208	-6.300	-1.073
204508	0.516	-74.536	914.400	185.875	-6.300	-1.749
204513	0.739	-74.184	914.400	187.413	-6.300	-1.674
204517	0.979	-73.833	914.400	190.035	-6.300	-1.544
204522	1.201	-73.370	914.400	190.035	-6.300	-1.544
204526	1.553	-73.147	914.400	203.277	-6.300	-0.858
204531	1.794	-72.684	914.400	191.089	-6.300	-1.491
204536	2.016	-72.333	914.400	192.527	-6.300	-1.418
204540	2.257	-71.981	914.400	186.045	-6.300	-1.741
204545	2.590	-71.629	914.400	195.060	-6.300	-1.289
204550	2.720	-71.166	914.400	201.316	-6.300	-0.962
204554	3.053	-70.833	914.400	193.250	-6.300	-1.381
204559	3.294	-70.481	914.400	197.996	-6.300	-1.137
204603	3.516	-70.018	914.400	191.740	-6.300	-1.458
204608	3.757	-69.666	914.400	202.995	-6.300	-0.873
204613	4.109	-69.314	914.400	180.080	-6.300	-2.029
204617	4.220	-68.981	914.400	188.627	-6.300	-1.614
204622	4.572	-68.629	914.400	192.385	-6.300	-1.425
204626	4.794	-68.166	914.400	214.514	-6.300	-0.239
204631	5.146	-67.814	883.920	197.864	-6.300	-1.143
204635	5.257	-67.462	853.440	204.301	-4.700	0.797
204640	5.609	-66.999	822.960	189.034	-4.700	0.007
204645	5.831	-66.666	792.480	197.138	-4.700	0.419
204649	6.072	-66.314	762.000	185.540	-4.700	-0.166
204654	6.424	-65.962	731.520	187.831	-4.700	-0.053
204659	6.646	-65.610	701.040	185.690	-4.700	-0.158
204703	6.887	-65.277	701.040	175.606	-4.700	-0.638
204708	7.109	-64.925	670.560	175.739	-4.700	-0.632
204712	7.350	-64.573	640.080	176.341	-4.700	-0.604
204717	7.572	-64.222	640.080	175.739	-4.700	-0.632
204722	7.813	-63.888	609.600	163.018	-5.700	-2.200
204726	8.035	-63.648	579.120	164.454	-5.700	-2.138
204731	8.275	-63.296	579.120	154.926	-5.700	-2.539
204735	8.387	-62.962	548.640	157.064	-5.700	-2.451
204740	8.609	-62.722	518.160	157.167	-5.700	-2.447
204744	8.850	-62.370	518.160	151.967	-5.700	-2.658
204749	9.072	-62.148	487.680	142.248	-5.700	-3.035
204754	9.201	-61.907	487.680	138.519	-5.700	-3.173
204758	9.424	-61.573	457.200	143.254	-5.700	-2.997
204803	9.664	-61.333	426.720	156.756	-5.700	-2.464

Fig. 6

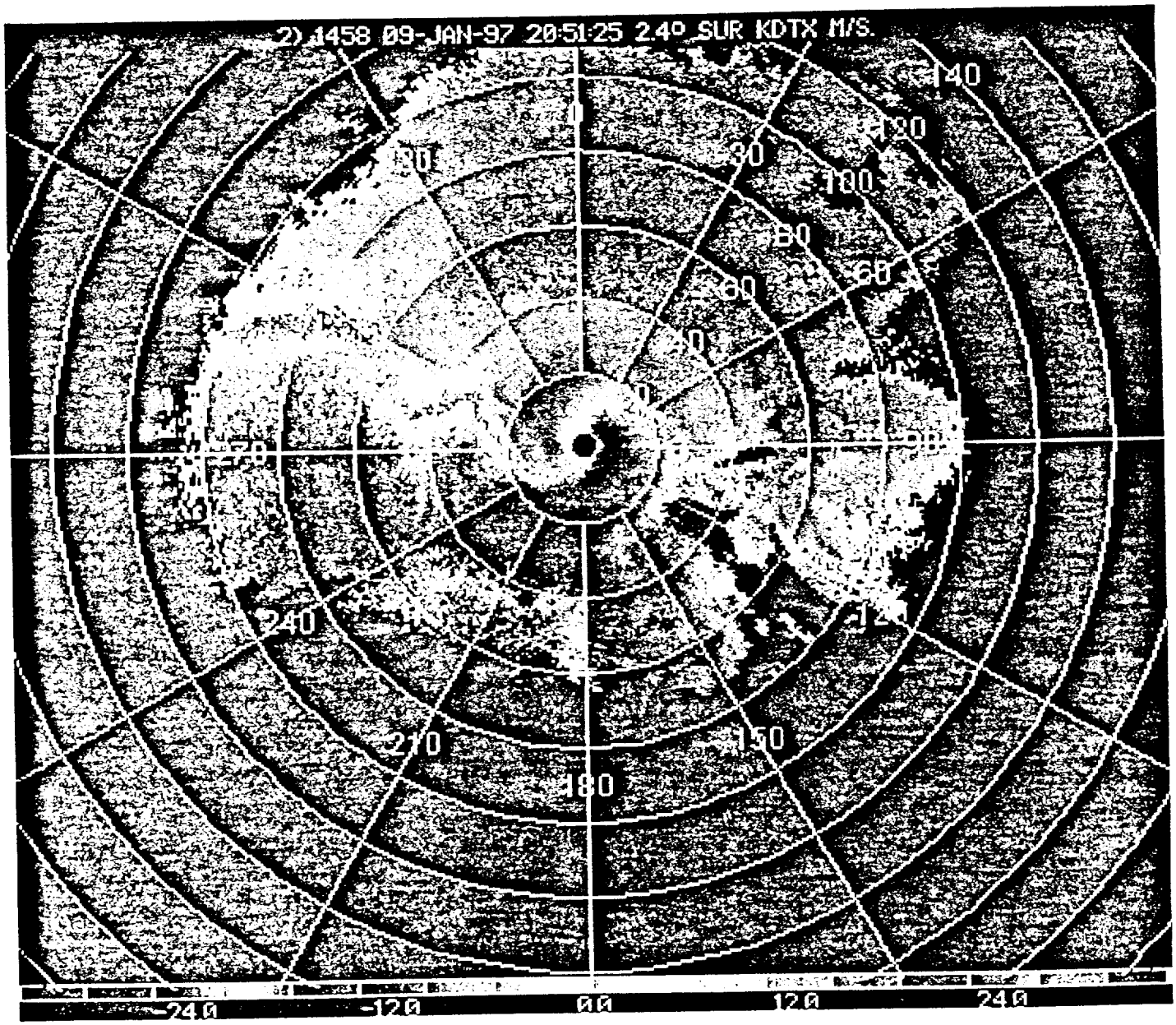

2) 1458 09-JAN-97 20:51:25 2.4° SUR KDTX M/S
140
120
100
80
60
30
0
240
210
180
150
-24.0
-12.0
0.0
12.0
24.0

Fig 7a
Jan 9-22Z

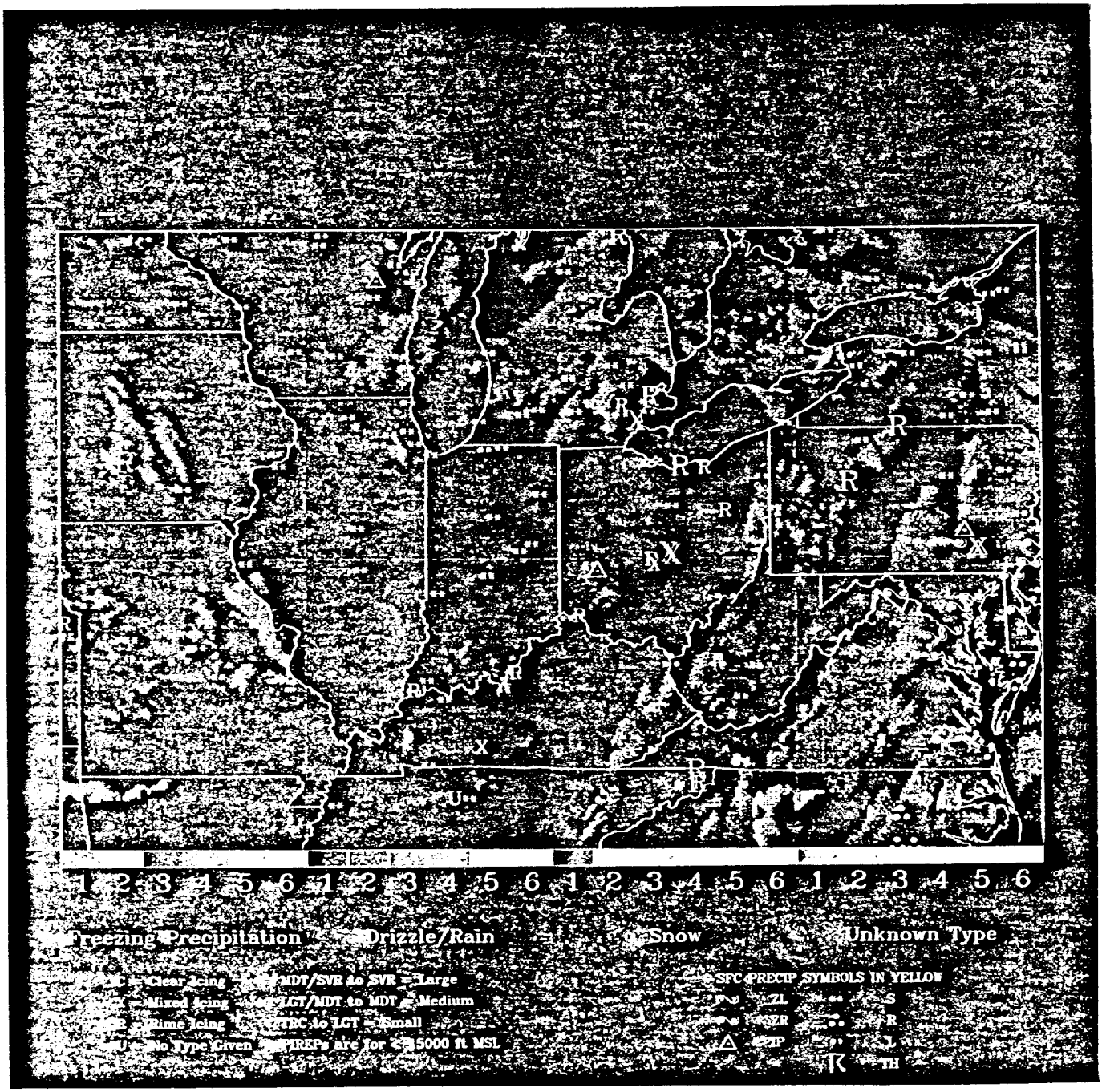


Fig. 7b

Jan 9 - 23Z

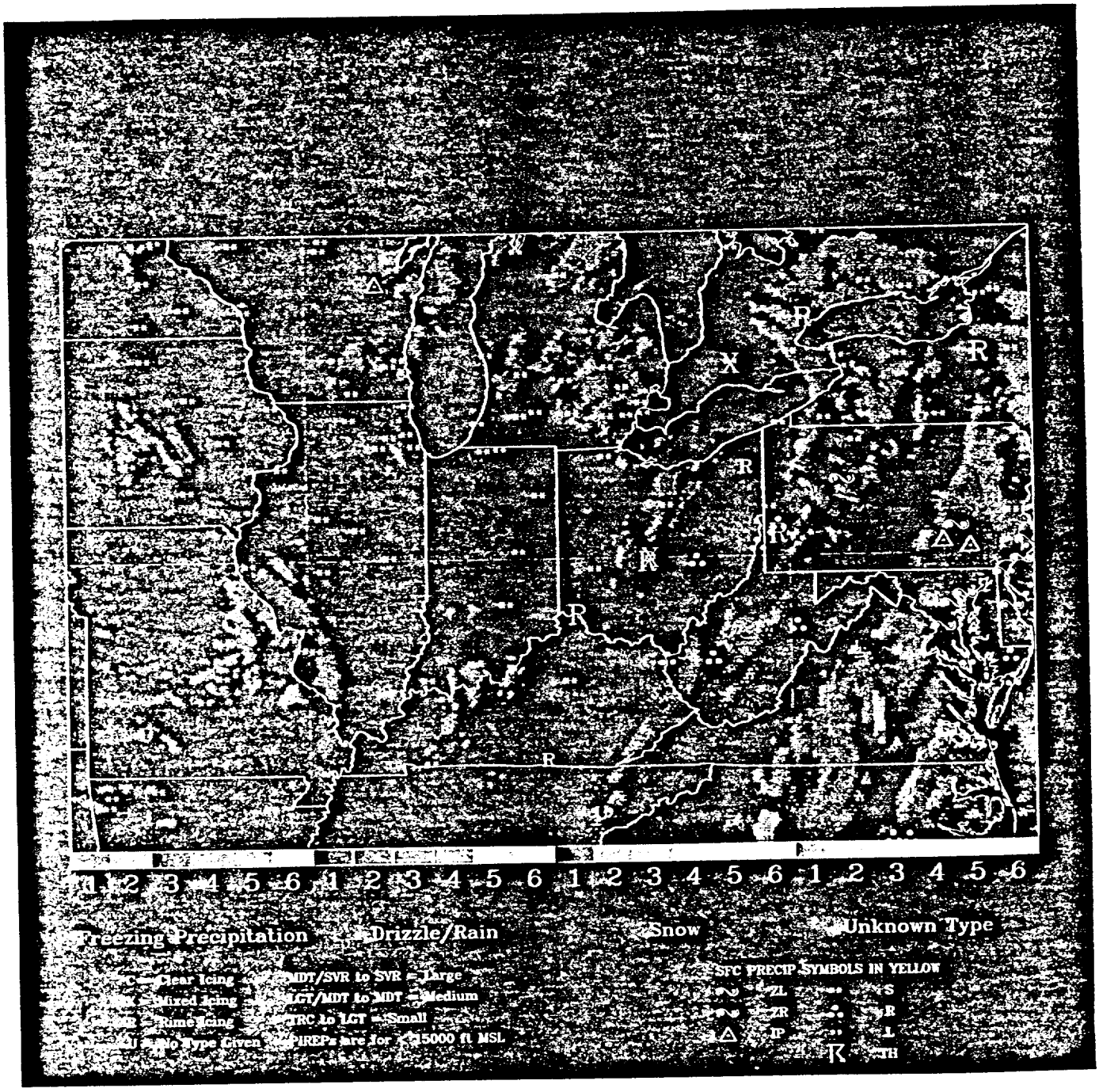


Fig 7c
Jan 10 - 00Z

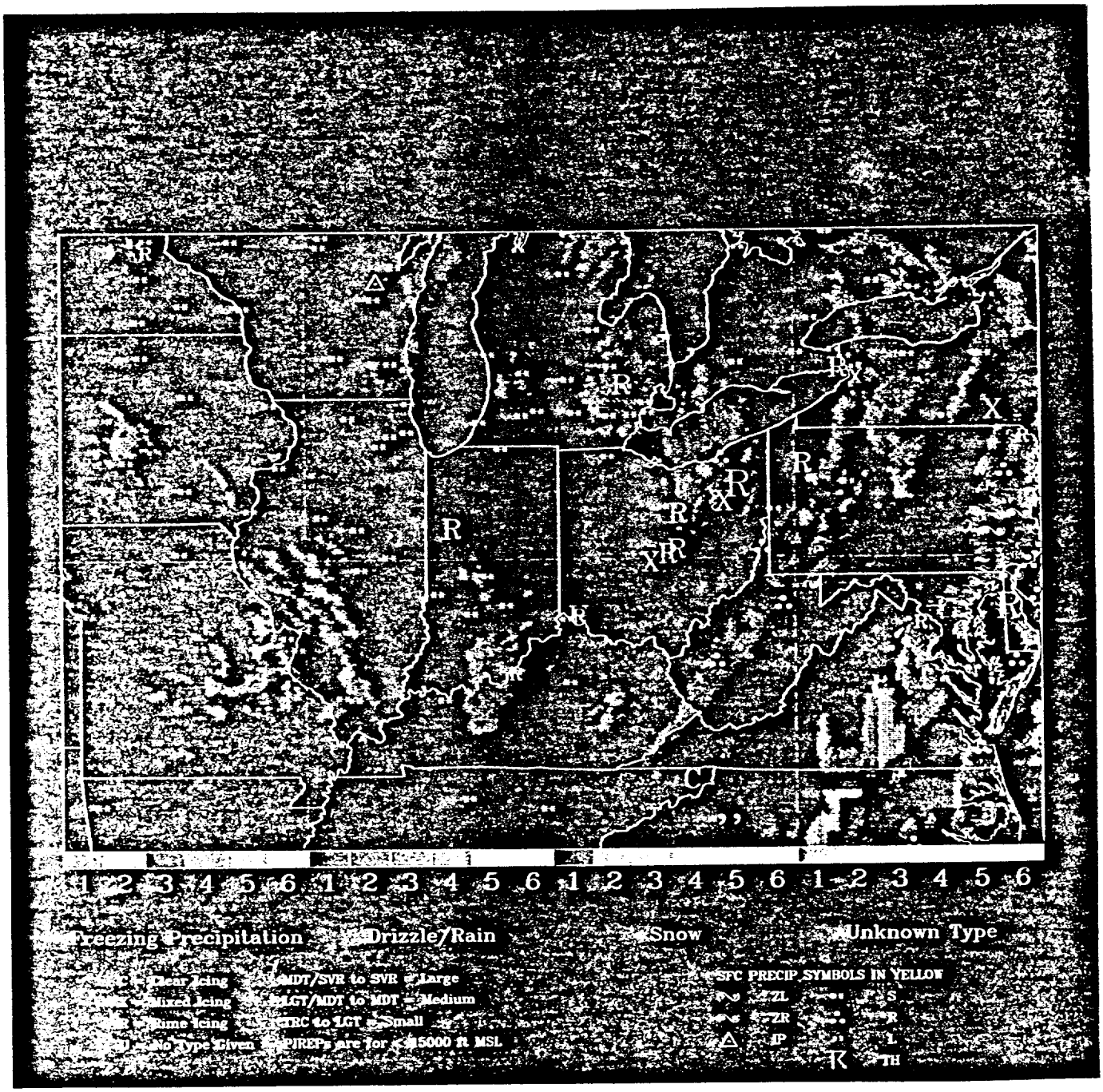
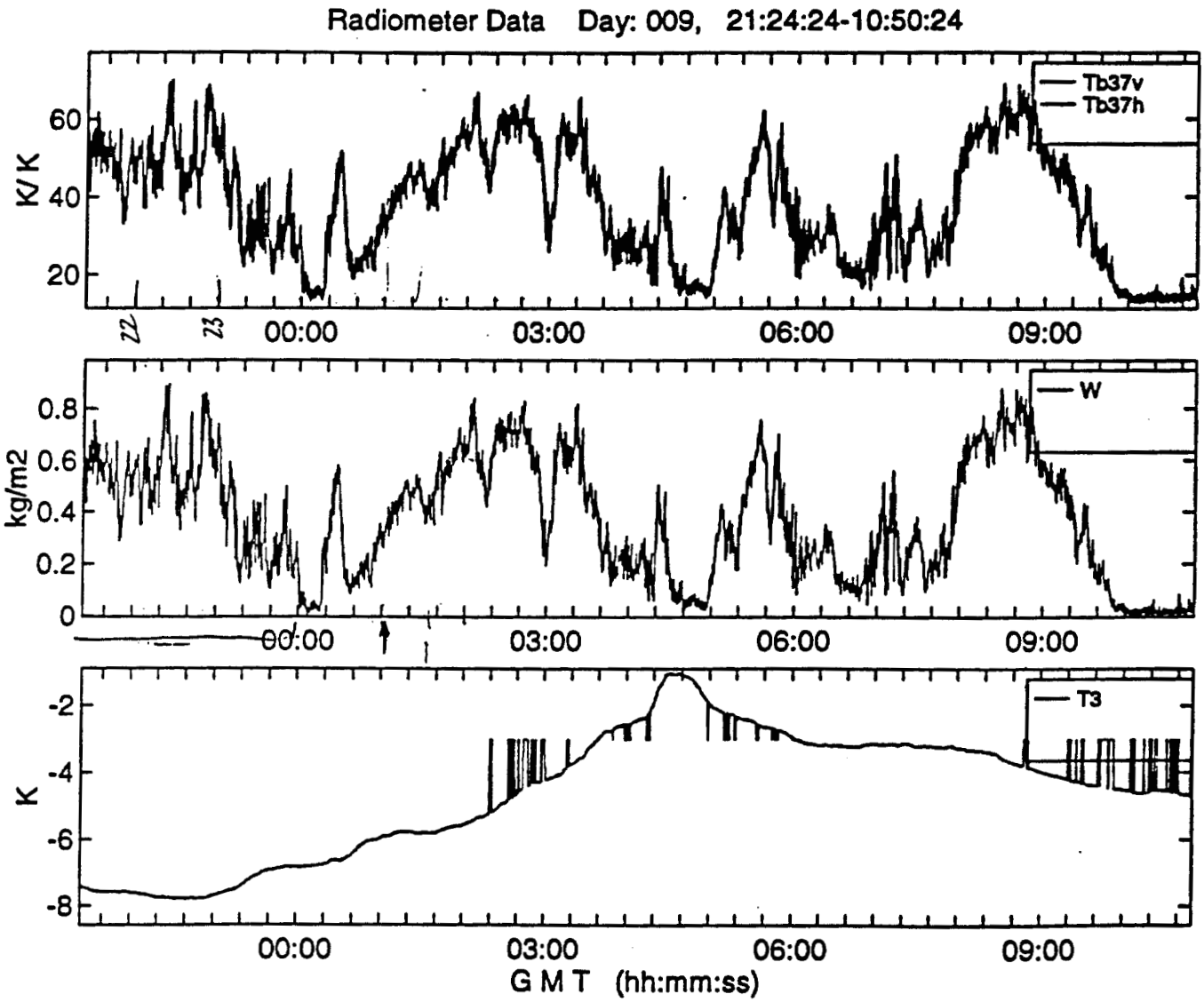
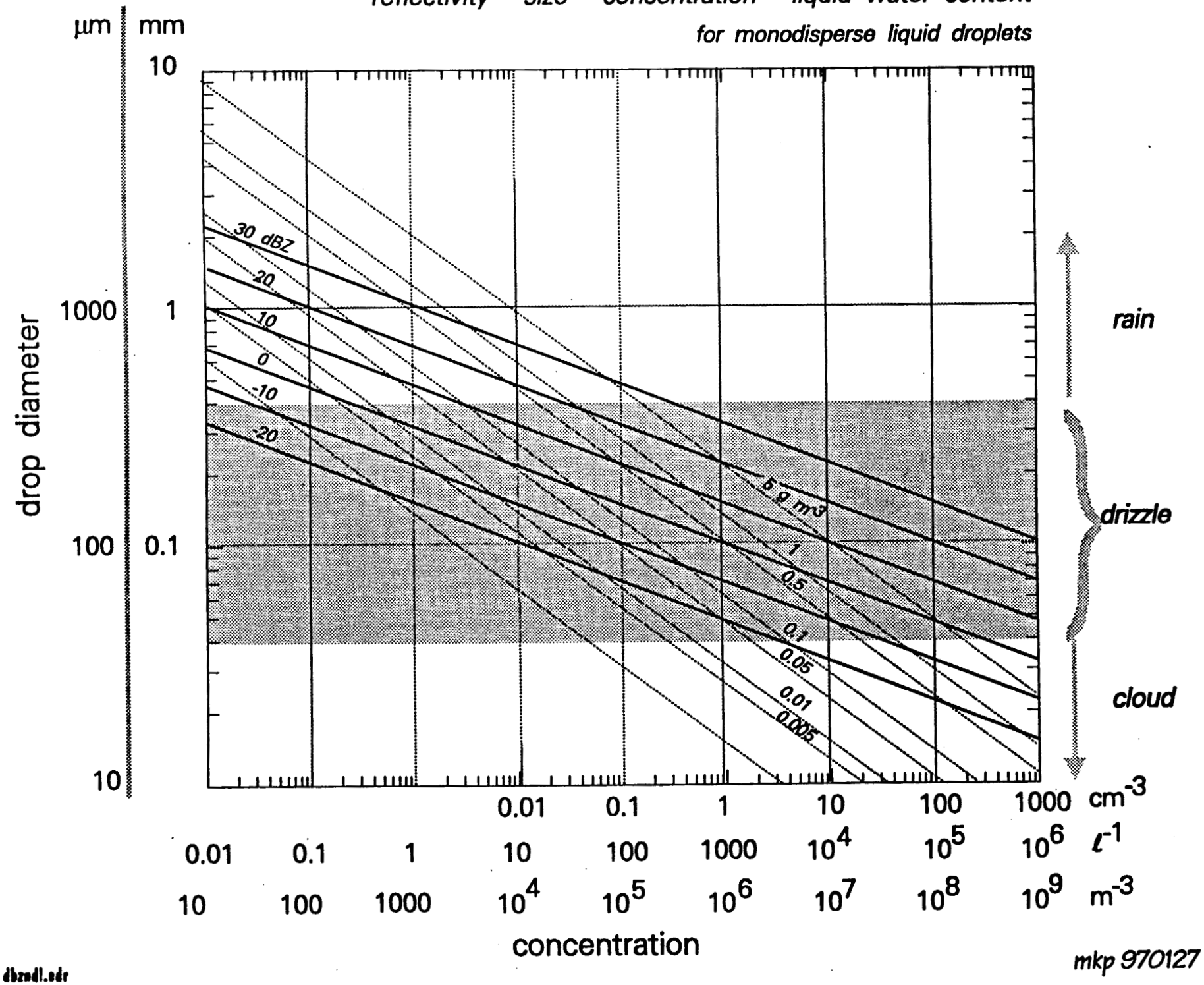


Fig. 8

AES radiometer

Toronto area: 43.964N, 79.579




reflectivity - size - concentration - liquid water content
for monodisperse liquid droplets
µm
mm
10
1000
1
100
0.1
10
drop diameter
30 dBZ
20
10
0
-10
-20
6.9 m3
1
0.5
0.1
0.05
0.01
0.005
rain
drizzle
cloud
0.01
0.1
1
10
100
1000
cm-3
0.01
0.1
1
10
100
1000
10^4
10^5
10^6
ℓ-1
10
100
1000
10^4
10^5
10^6
10^7
10^8
10^9
m-3
concentration
mkp 970127
dbzndl.cdr