

U OF M RADIATION LAB MILLIMETER-WAVE SNOW DATA

SUMMARY OF ALL DATA AND GROUND-TRUTH

FEBRUARY-MARCH 1990

1/27/90
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1. INTRODUCTION

This report is a summary of the millimeter-wave active and passive data taken on snow at the Matthaei Botanical Gardens and on the North Campus Diag between February 26, 1990 and March 7, 1990. It includes seven angular sets on dry snow, three diurnal experiments and all associated ground-truth.

The first six data sets were taken at the Matthaei Botanical Garden and the remaining four sets were taken on the west edge of the North Campus Diag. Views of the experimental sites are seen in Figs. 1-1 and 1-2.

For a discussion of prior work and a review of the equipment and techniques used to obtain this data see Austin, R. T., T. F. Haddock and F. T. Ulaby "An Investigation of the Diurnal Variation of Backscatter from Snow at Millimeter-wave Frequencies," Radiation Laboratory Final Report Number 022872-2-T, Department of Electrical Engineering and Computer Science, The University of Michigan, Ann Arbor, MI, 9 May 1989.

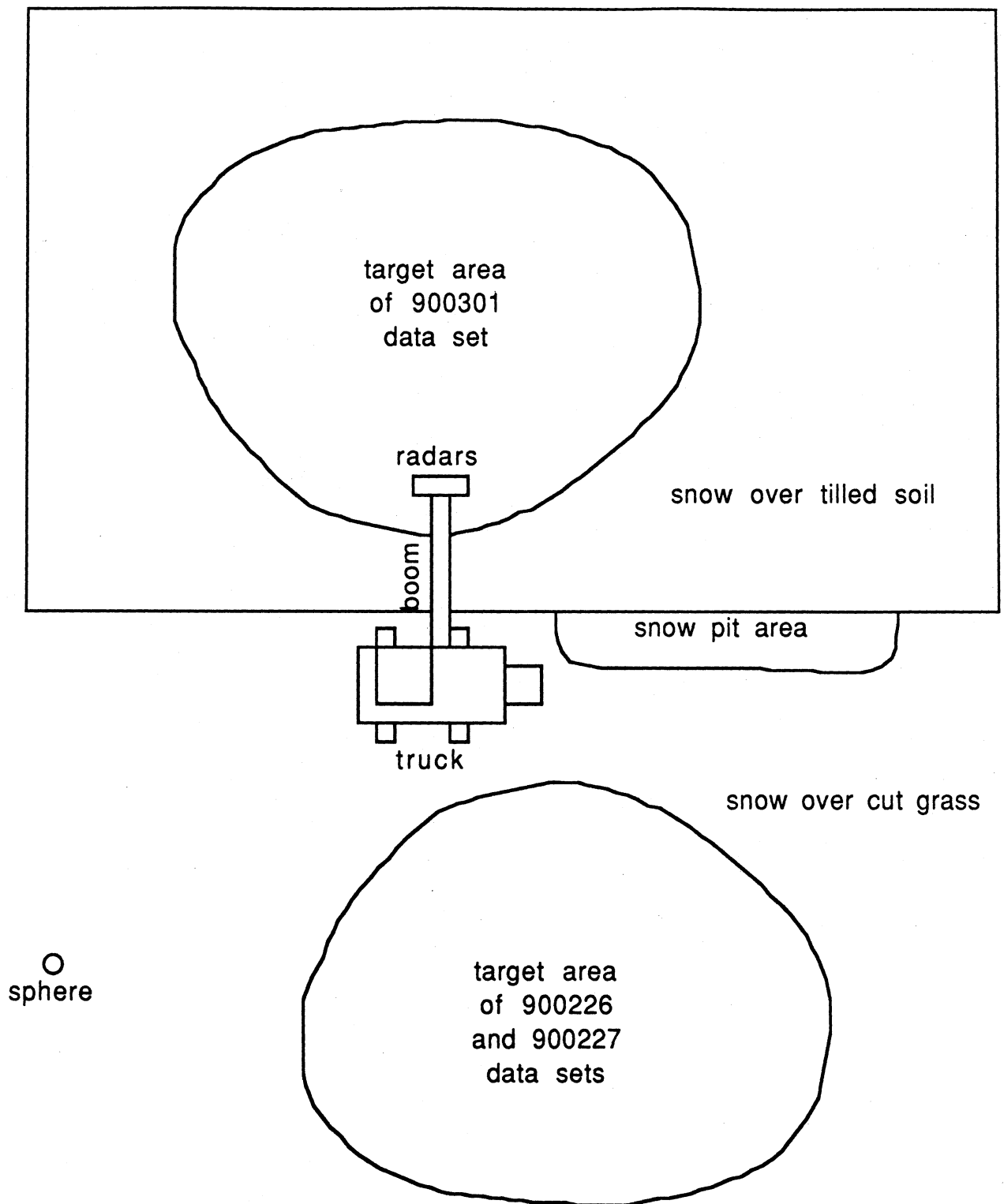


Figure 1-1: Experimental site set-up at Matthaei Botanical Gardens.

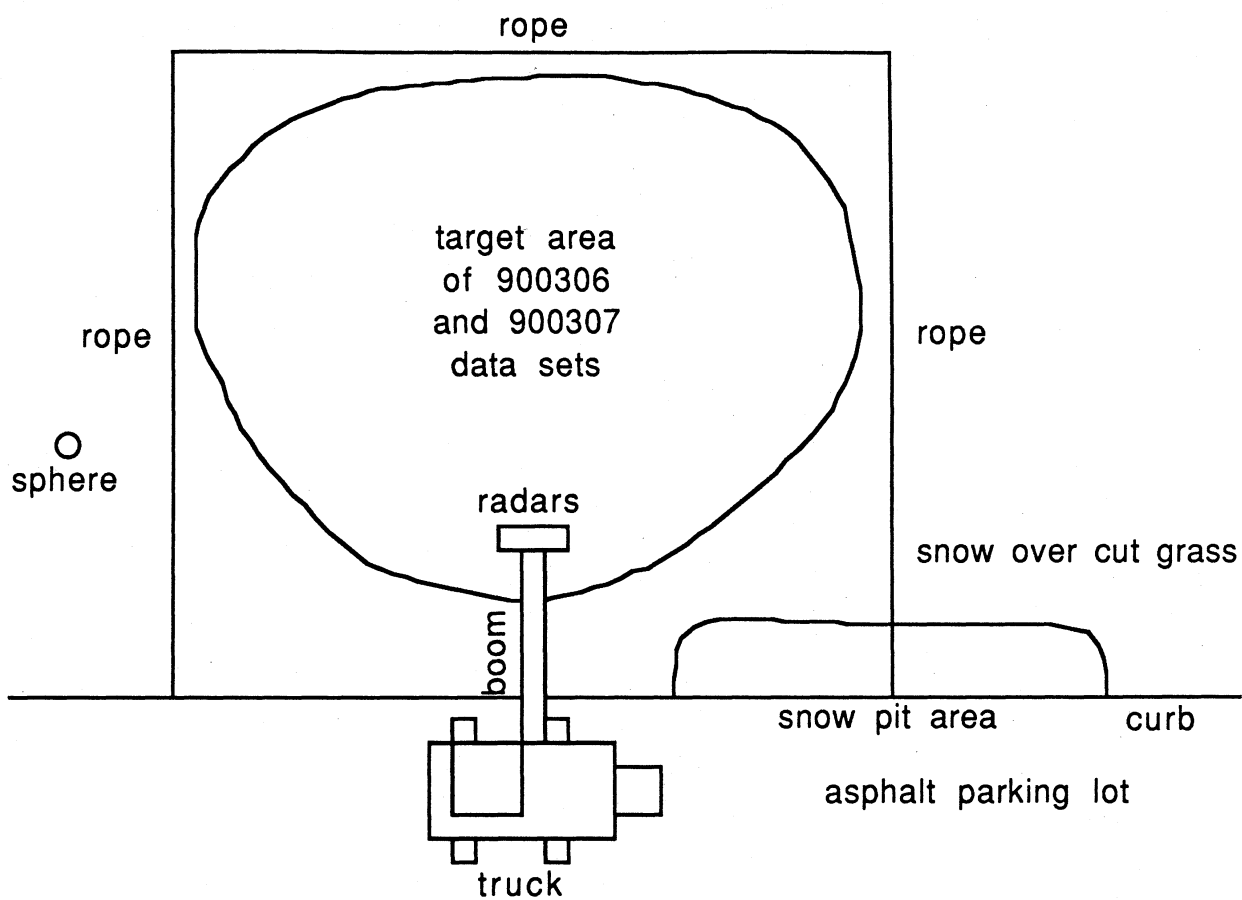


Figure 1-2: Experimental site set-up at North Campus Diag

2. RADAR AND RADIOMETER DATA

2.1 Tabulated Form of Data

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	2.400	-0.360	2.300	4.700	1.300	4.400	5.800	2.500	4.800
15.0	2.400	-2.500	0.600	3.100	-0.450	3.600	5.300	2.400	5.700
30.0	-0.710	-4.900	-1.100	2.800	-0.820	1.900	5.500	2.700	5.200
45.0	-1.500	-4.800	-2.700	1.300	-2.000	1.200	4.700	1.900	4.000
60.0	-3.500	-8.100	-4.300	1.100	-5.300	-0.620			

Table 2.1-1: Data set 900226SM1.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	6.600	1.000	6.000	7.700	4.200	7.000	10.600	4.600	11.500
15.0	2.000	-2.000	2.600	4.760	1.100	4.900	6.300	2.100	8.300
30.0	0.920	-3.500	1.400	3.800	0.270	5.300	5.400	2.400	6.500
45.0	-1.100	-4.800	-1.700	2.200	-2.200	0.660	5.500		6.700
60.0	-3.400	-8.200	-4.300	-0.400	-4.600	-1.500	4.000		4.700

Table 2.1-2: Data set 900226SM2.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	1.200	-3.670	1.880	4.500	1.500	3.300	5.600	2.900	7.400
15.0	1.500	-3.700	0.600	4.200	1.300	3.200	6.100	4.200	7.700
30.0	0.500	-3.900	0.600	4.300	0.660		6.000	2.500	6.200
45.0	-0.630	-5.300		2.900	-0.500	2.100	4.600	2.700	5.900
60.0	-3.600	-7.800	-3.700	-0.180	-5.400	-0.600	4.000	2.400	4.900

Table 2.1-3: Data set 900226RO2.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	6.400	1.100	6.800	6.900	1.400	4.800	6.420	2.550	
15.0	1.500	-2.200	1.000	3.300	0.600	4.000	7.050	2.050	3.790
30.0	0.820	-3.200	0.350	3.300	-0.100	2.100	5.100	2.500	4.300
45.0	-0.730	-3.800	-1.500	1.600	-1.600	1.200	4.200	1.700	3.000
60.0	-2.700	-6.800	-3.200	-0.900	-4.100	-1.200	2.600	0.800	

Table 2.1-4: Data set 900227SM.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	1.200	-4.000	1.200	1.700	-0.750	0.230	4.460		4.300
15.0	0.670	-3.200	-0.029	1.400	-1.800	1.300	3.600	2.600	3.300
30.0	0.500	-4.000	-0.770	2.300		1.700		1.800	2.800
45.0	-1.100	-4.700	-1.600	1.300	-1.900	0.900	3.500	1.100	2.000
60.0	-3.200	-7.400	-4.400	-0.600	-4.600	-1.800	2.000	0.700	

Table 2.1-5: Data set 900227RO.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0		-5.600		1.300	-3.200	1.800	3.700	-1.400	5.800
15.0	-3.900	-5.400	-1.200	0.800	-2.700	2.500	2.700	-0.570	3.500
30.0	-2.700	-7.400	-2.200	-0.080	-2.500	1.300	0.800	-1.800	1.900
45.0	-3.700	-6.900	-3.300	-1.100	-4.100	-1.100	1.100	-2.800	1.200
60.0	-3.800	-7.800	-3.900	-3.400	-7.100	-3.500	-0.600	-3.300	-1.000

Table 2.1-7: Data set 900306A.

angle	35VV	35VH	35HH	94VV	94VH	94HH	140VV	140VH	140HH
0.0	-1.800	-3.900	0.330	2.500	-0.900	2.500	5.600	1.500	6.900
15.0	-2.600	-4.400	-2.000	3.100	-0.260	2.500	3.900	1.700	5.300
30.0	-2.100	-4.700	-0.720	2.400	-0.720	2.500	2.800	0.280	3.200
45.0	-1.500	-4.300	-2.600	0.390	-2.720	0.510	2.800	-0.430	2.300
60.0	-3.500	-7.300	-3.500	-0.920	-5.500	-2.100	0.830	-2.400	0.110

Table 2.1-9: Data set 900307A.

Time (hours)	35VV (dB)	Time (hours)	35VH (dB)	Time (hours)	35HH (dB)
8.017	-0.300	8.050	-4.200	8.067	-0.200
8.533	-0.330	8.567	-4.300	8.600	
9.600	-0.400	9.633	-4.000	9.650	0.600
10.267	-2.400	10.300	-5.800	10.317	-2.300
10.883	-0.600	10.917	-5.700	10.933	-0.890
11.500	-6.500	11.533	-11.700	11.567	-6.400
12.217	-14.000	12.267		12.300	-16.300
12.850	-13.000	13.083		12.917	-18.000
13.900	-12.600	13.833			
14.550	-12.100	14.550		14.617	-15.500
16.667	-9.500	16.700		16.850	-7.600
17.550	-8.400	17.600		17.767	-6.300
18.283	-8.700	18.300		18.400	-6.400
19.333	-4.500	19.367	-8.100	19.433	-3.300
20.500	-3.800	20.533	-4.900	20.667	-1.900
21.367	-2.200	21.400	-5.300	21.450	-0.300
22.117	-1.500	22.150	-4.500	22.217	-0.770
22.700	-0.670	22.717	-3.900	22.767	-0.010

Time (hours)	94VV (dB)	Time (hours)	94VH (dB)	Time (hours)	94HH (dB)
8.117	3.900	8.150	0.700	8.167	2.700
8.700	3.550	8.733	1.800	8.783	2.900
9.700	3.900	9.733	0.760	9.767	2.300
10.367	3.300	10.400	0.270	10.433	2.400
10.983	4.100	11.017	-1.500	11.033	1.600

11.600	-0.230	11.650	-4.800	11.733	-1.200
12.367	-2.700	12.400	-9.000	12.417	-5.300
13.217	-4.100	13.250	-10.100	13.283	-5.400
14.083	-3.500	14.117	-8.800	14.150	-3.600
14.850	-2.540	14.883	-7.730	14.933	-4.100
15.550	-0.860	15.600	-6.600	15.633	-2.400
16.150	-0.380	16.200	-5.750	16.250	-1.020
16.950	1.300	16.967	-2.700	16.983	-0.160
17.833	2.300	17.867	-0.270	17.900	1.300
18.517	3.000	18.633	-0.100	18.583	2.600
19.183	3.600	19.217	-0.200	19.233	3.400
19.917	3.600	19.950	0.900	19.900	2.500
20.817	3.900	20.867	0.490	20.900	3.600
21.617	3.700	21.650	0.190	21.683	2.920
22.317	4.900	22.350	-0.560	22.383	3.500
Time	140VV	Time	140VH	Time	140HH
(hours)	(dB)	(hours)	(dB)	(hours)	(dB)
8.383	4.300	8.417	3.600	8.450	4.700
9.450	6.900	9.483	4.200	9.517	6.100
10.133	7.300	10.150		10.183	6.700
10.733	6.900	10.750	5.010	10.783	6.500
11.350	5.400	11.400	3.500	11.433	5.300
11.767	5.000	11.800	3.300	11.833	5.000
12.883	2.800	12.750	0.780	12.783	2.200
13.500	-0.100	13.550	-2.600	13.583	-0.630
14.400	3.750	14.433	1.200	14.467	2.640
15.333	3.720	15.367	1.280	15.383	3.480
15.917	4.600	15.933	1.300	15.967	3.000
16.533	5.220	16.567	0.730	16.600	5.140
17.383	4.540	17.417	1.600	17.467	4.800
18.067	4.800	18.100	2.300	18.133	5.400
18.817	5.400	18.883	1.900	18.917	4.500
19.500	6.200	19.533	2.500	19.567	5.500
20.267	4.600	20.300	2.600	20.350	4.900
21.200	4.480	21.233	2.300	21.267	4.600
21.983	5.200	22.017	3.000	22.033	5.100
22.583	4.350	22.617	1.600	22.633	4.800

Table 2.1-6: Data set 900301.

Time (hours)	35VV (dB)	Time (hours)	35VH (dB)	Time (hours)	35HH (dB)
8.3170	-1.10	8.3170	-4.50	9.0660	-0.56
9.0660	-1.80	9.2330	-4.40	10.7000	-2.40
9.2330	-0.98	10.7000	-5.20	11.5500	-2.30
10.7000	-1.90	11.5500	-7.10	12.6330	-5.70
11.5500	-3.10	12.6330	-10.30	13.2330	-7.60
12.6330	-6.00	13.2330	-13.00	13.8330	-10.40
13.2330	-8.80	13.8330	-13.40	14.5330	-10.50
13.8330	-10.80	14.5330	-15.00	15.5670	-9.10
14.5330	-12.00	15.5670	-14.00	16.1500	-9.00
15.5670	-11.70	16.1500	-13.90	17.0170	-8.10
16.1500	-10.80	17.0170	-13.00	17.7670	-6.60
17.0170	-10.40	17.7670	-11.20	18.4500	-2.70
17.7670	-7.90	18.4500	-8.40	19.1500	-2.70
18.4500	-4.90	19.1500	-7.80	19.7000	-2.30
19.1500	-3.50	19.7000	-6.90	20.5170	-2.70
19.7000	-3.10	20.5170	-6.70	21.1670	-1.80
20.5170	-2.90	21.1670	-6.00	21.7500	-2.00
21.1670	-2.80	21.7500	-6.14		
21.7500	-3.90	21.9170	-5.80		
21.9170	-3.35				

Time (hours)	94VV (dB)	Time (hours)	94VH (dB)	Time (hours)	94HH (dB)
8.3170	0.3	8.3170	-3.70	8.3170	0.1
9.3670	0.8	9.3670	-2.60	10.4330	0.0
10.9000	-0.5	11.8670	-4.80	10.9000	0.2
11.8670	-2.3	12.8170	-10.50	11.8670	-1.9
12.8170	-4.5	13.4170	-11.60	12.8170	-4.1
13.4170	-6.2	14.2300	-13.20	13.4170	-6.0
14.2300	-8.2	14.7170	-13.20	14.2300	-7.2
14.7170	-6.5	15.7500	-13.30	14.7170	-6.7
15.7500	-6.5	16.4170	-9.60	15.7500	-6.2
16.4170	-5.2	17.0170	-9.30	16.4170	-6.1
17.0170	-4.8	17.7670	-5.50	17.0170	-3.6
17.7670	-3.0	18.4500	-4.70	17.7670	-1.2
18.4500	-0.7	19.1500	-4.40	18.4500	-1.4
19.1500	-0.9	19.7000	-3.80	19.1500	-0.5
19.7000	-0.2	20.5170	-2.60	19.7000	-0.6

20.5170	-0.3	21.1670	-4.20	20.5170	-1.0
21.1670	-0.5			21.1670	-1.7

Time (hours)	140VV (dB)	Time (hours)	140VH (dB)	Time (hours)	94HH (dB)
8.3170	5.4	8.3170	2.5	8.3170	6.4
11.2000	3.2	11.2000	0.7	11.2000	4.5
12.3000	1.8	12.3000	-2.2	12.3000	1.9
13.0330	1.4	13.0330	-3.5	13.0330	2.0
13.5670	-0.5	13.5670	-4.7	13.5670	0.2
14.2300	1.2	14.2300	-1.7	14.2300	2.4
14.9330	2.5	14.9330	-0.3	14.9330	4.0
15.9000	2.5	15.9000	0.1	15.9000	3.5
17.0170	2.8	17.0170	0.1	16.8500	3.3
17.7670	3.1	17.7670	-0.3	17.0170	3.0
18.4500	2.6	18.4500	0.1	17.7670	3.5
19.1500	2.7	19.1500	0.3	18.4500	2.5
20.5170	2.0	21.1670	-0.4	19.1500	3.9
21.1670	1.7			20.5170	2.1
				21.1670	2.8

Table 2.1-8: Data set 900306D.

Time (hours)	35VV (dB)	Time (hours)	35VH (dB)	Time (hours)	35HH (dB)
8.9000	-0.58	8.9000	-1.80	8.9000	-0.47
10.1000	-0.59	10.1000	-4.40	10.1000	-1.30
11.1830	-2.10	11.9670	-9.50	11.1830	-2.80
11.9670	-5.80	12.7830	-13.20	11.9670	-5.80
12.7830	-9.70	13.6670	-15.30	12.7830	-9.90
13.6670	-13.00	14.7000	-18.00	13.6670	-12.50
14.7000	-15.30	15.7170	-15.00	14.7000	-13.80
15.7170	-14.00	18.5500	-7.80	15.7170	-11.50
17.0670	-11.40	19.2830	-6.40	17.0670	-9.10
18.5500	-5.60	19.8330	-5.80	18.5500	-4.90
19.2830	-4.90	20.4330	-4.10	19.2830	-2.60
19.8330	-2.10			19.8330	-1.50
20.4330	-1.30			20.4330	-2.30

Time (hours)	94VV (dB)	Time (hours)	94VH (dB)	Time (hours)	94HH (dB)
9.1670	0.4	9.8830	-2.60	9.1670	1.3
9.8830	0.6	10.6000	-3.40	10.6000	0.2
10.6000	1.0	11.5000	-5.20	11.5000	-1.4
11.5000	0.3	12.2000	-5.10	12.2000	-2.5
12.2000	-2.4	13.1670	-10.20	13.1670	-6.2
13.1670	-6.7	13.9000	-12.00	13.9000	-6.3
13.9000	-5.9	15.0000	-12.00	15.0000	-5.1
15.0000	-5.8	15.5330	-12.00	15.5330	-4.8
15.5330	-5.4	16.5000	-9.60	16.5000	-4.5
16.5000	-3.9	16.8330	-7.60	16.8330	-3.6
16.8330	-2.6	17.6500	-4.70	17.6500	-2.4
17.6500	-1.7	18.2670	-5.00	18.2670	0.7
18.2670	-1.0	19.1330	-2.70	19.1330	0.2
19.1330	0.6	19.6830	-3.50	19.6830	-0.0
19.6830	1.0	20.2330	-1.30	20.2330	0.4
20.2330	0.7				

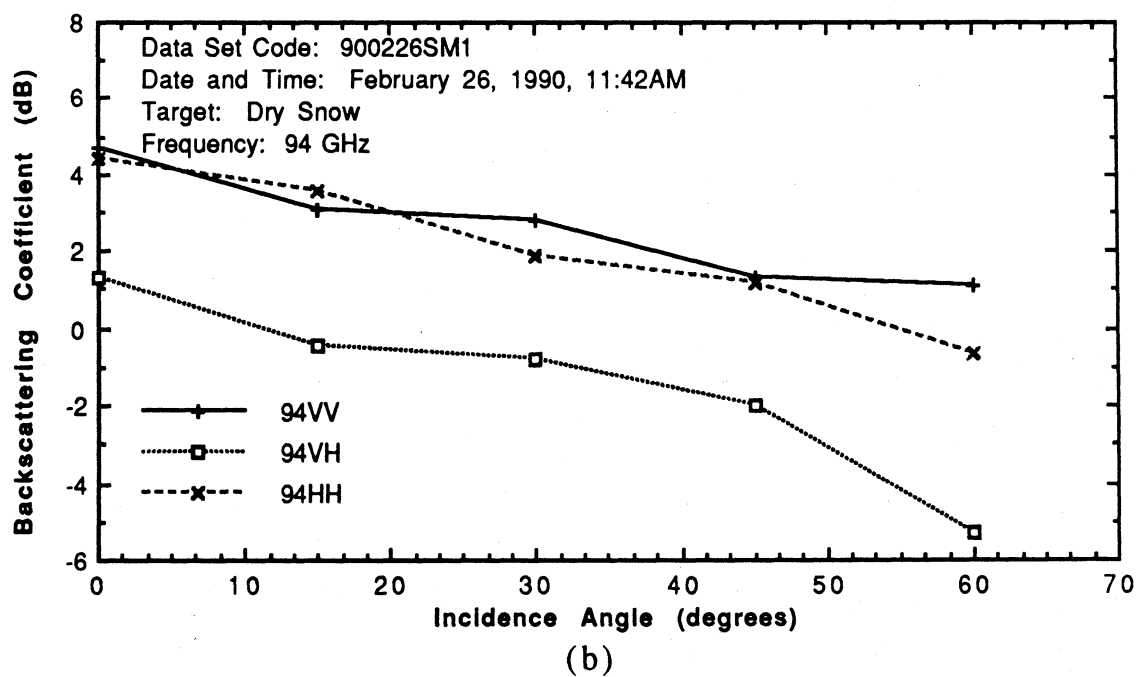
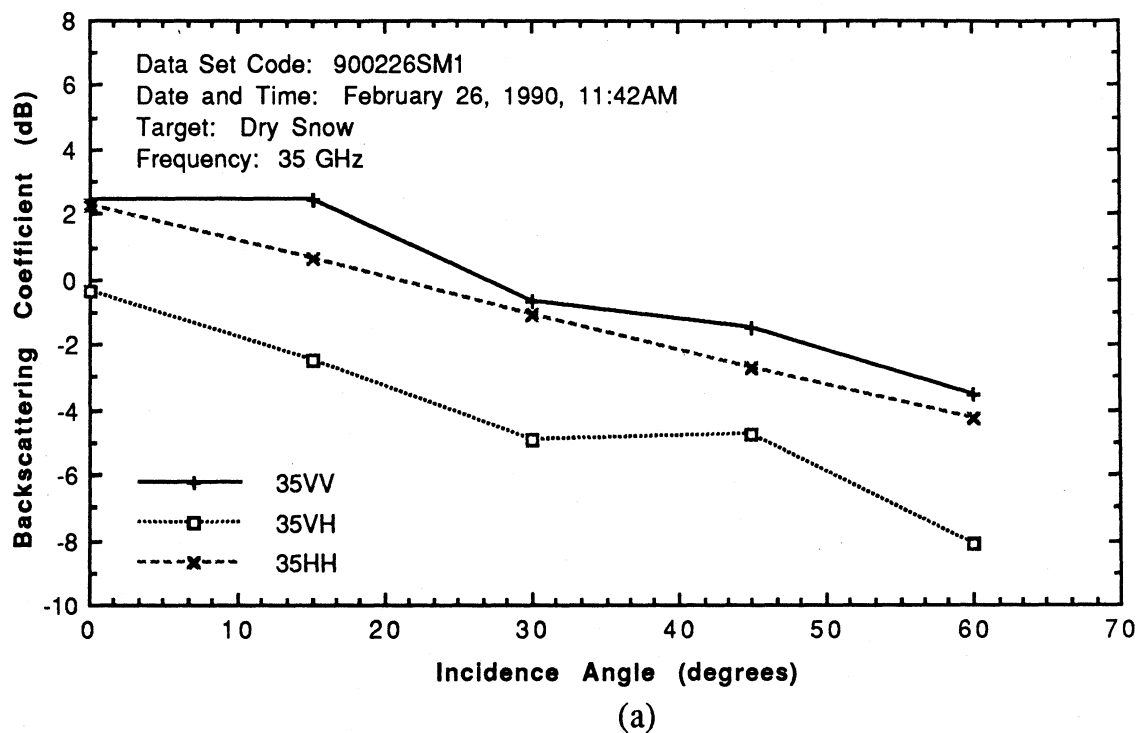
Time (hours)	140VV (dB)	Time (hours)	140VH (dB)	Time (hours)	94HH (dB)
9.6000	3.90	9.6000	1.3	9.6000	4.60
10.8670	3.91	10.8670	-0.2	10.8670	4.80
11.7330	4.20	11.7330	0.1	11.7330	4.70
12.2000	2.50	12.2000	-1.9	12.2000	2.40
13.4330	3.20	14.4830	-1.3	13.4330	3.90
14.4830	2.80	15.2330	-0.8	14.4830	3.90
15.2330	3.80	16.0170	-0.1	15.2330	3.90
16.0170	4.30	16.6670	0.1	16.0170	4.30
16.6670	4.10	17.2330	0.9	16.6670	5.40
17.2330	5.00	18.1000	0.7	17.2330	5.70
18.7000	4.00	19.4500	0.5	18.1000	4.30
19.4500	3.50	20.0170	0.8	18.7000	4.90
20.0170	4.10			19.4500	3.50
				20.0170	3.94

Table 2.1-10: Data set 900307D.

Time (hours)	140 Snow (K)	140 Sky (K)
8.250	181.570	99.600
9.267	194.800	106.100
10.000	184.000	112.800
10.500	190.100	86.900
11.250	205.500	101.530
11.967	228.900	102.700
12.600	242.200	101.200
13.367	244.200	97.850
14.350	232.500	85.500
15.000	227.100	82.200
15.667	219.300	92.000
16.333	214.800	94.000
17.050	193.400	85.500
17.967	167.400	72.200
18.667	167.400	80.000
20.100	177.700	72.500
21.017	169.400	74.280
21.917	172.400	93.400
22.450	167.500	91.600

Table 2.1-11: Radiometric data from 900301.

2.2 Graphic Form of Data



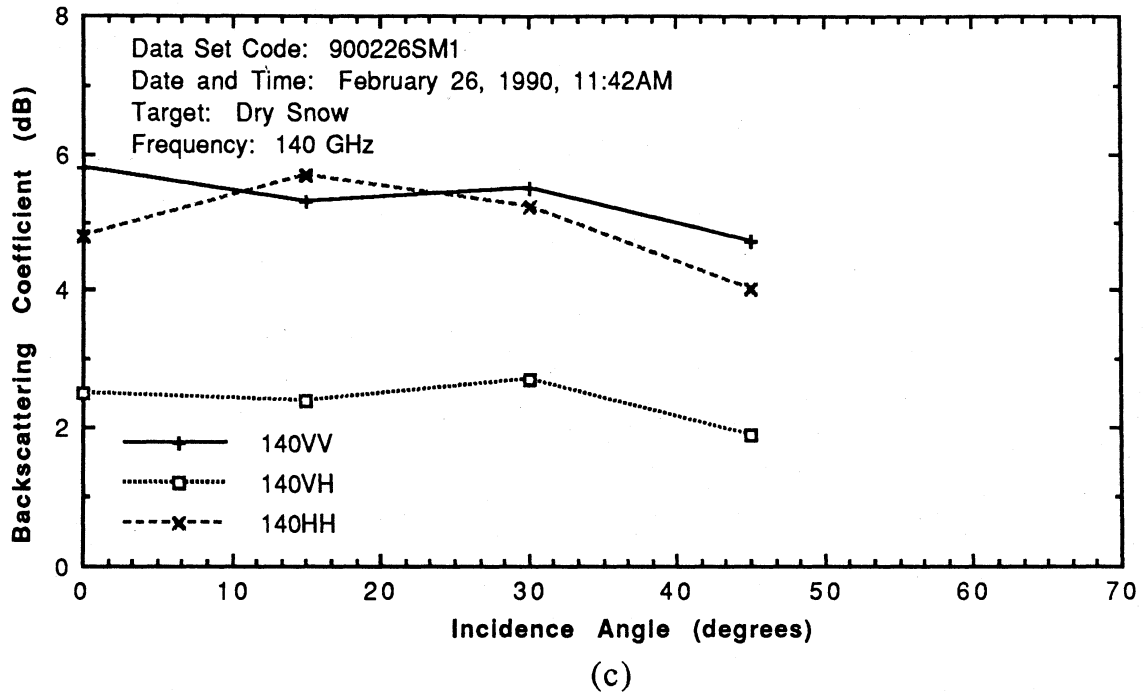
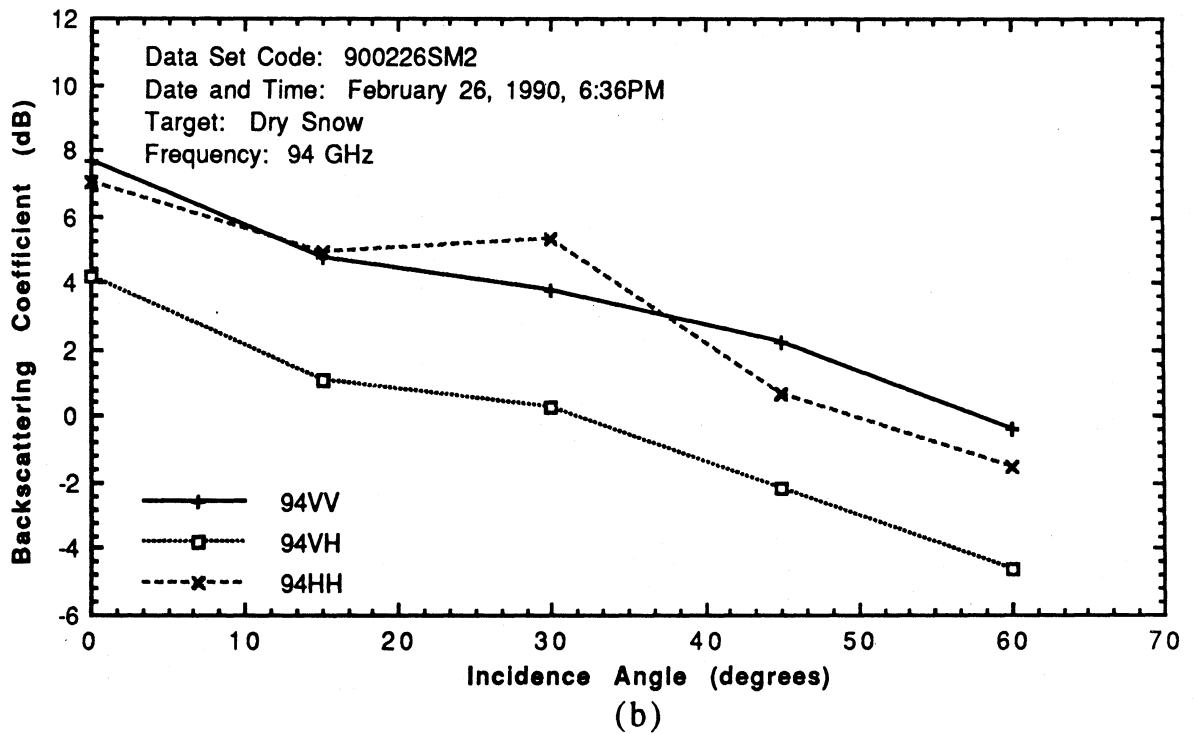
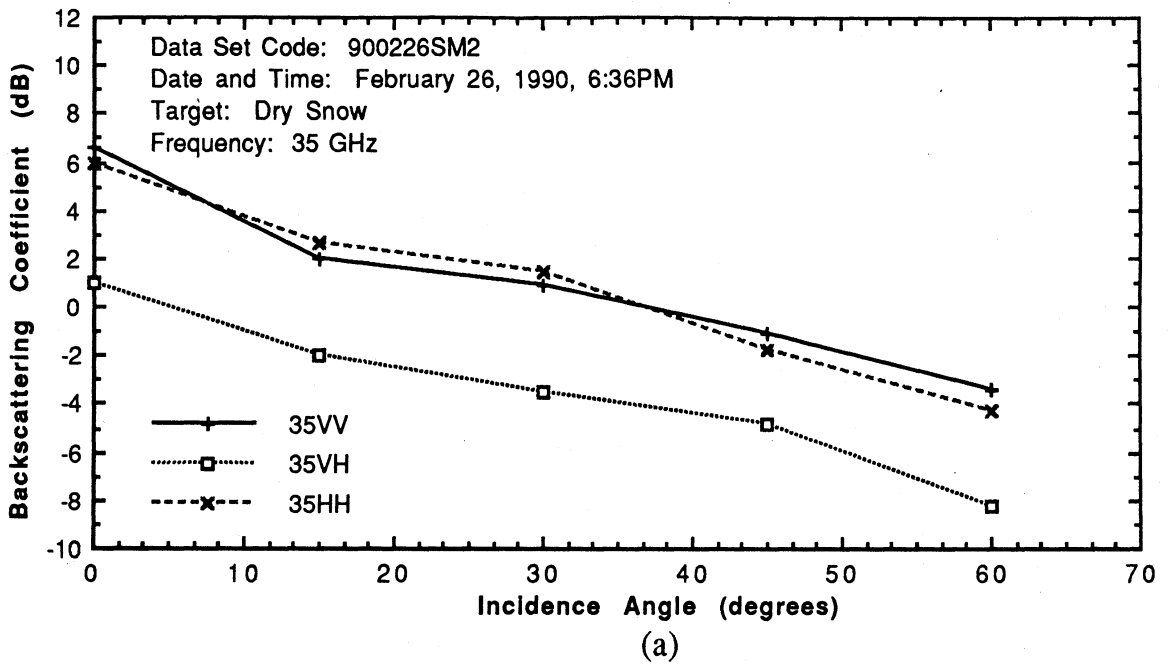
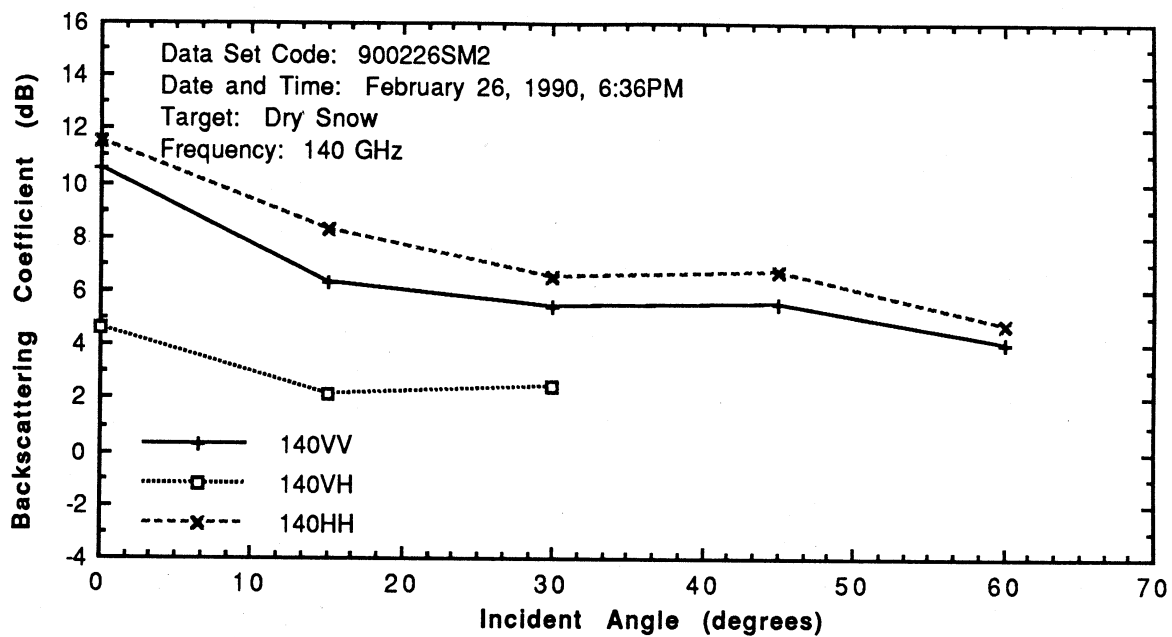


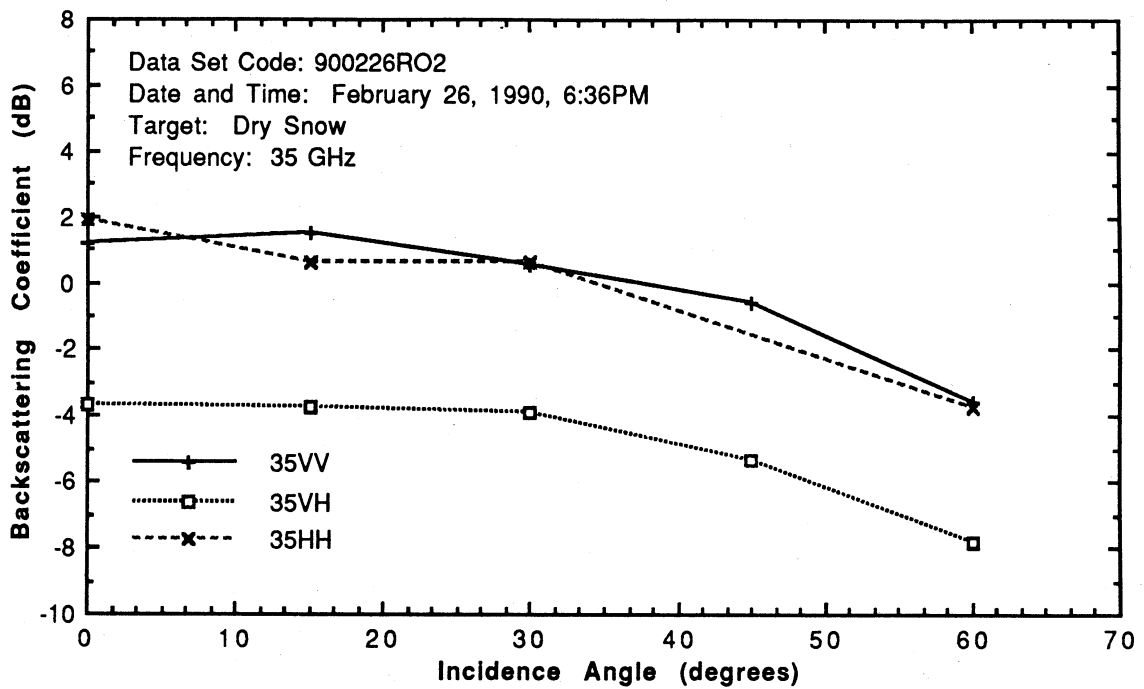
Figure 2.2-1: Backscattering coefficient from dry snow as a function of incidence angle for natural-surface snow on 900226, first set.



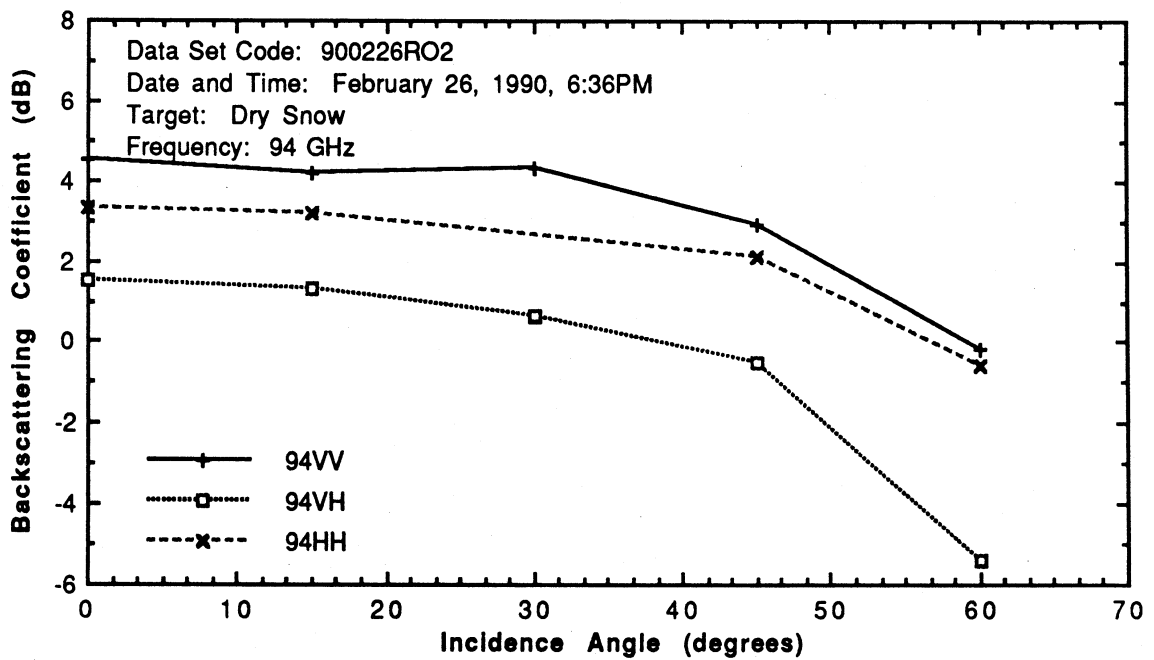


(c)

Figure 2.2-2: Backscattering coefficient from dry snow as a function of incidence angle for natural-surface snow on 900226, second set.



(a)



(b)

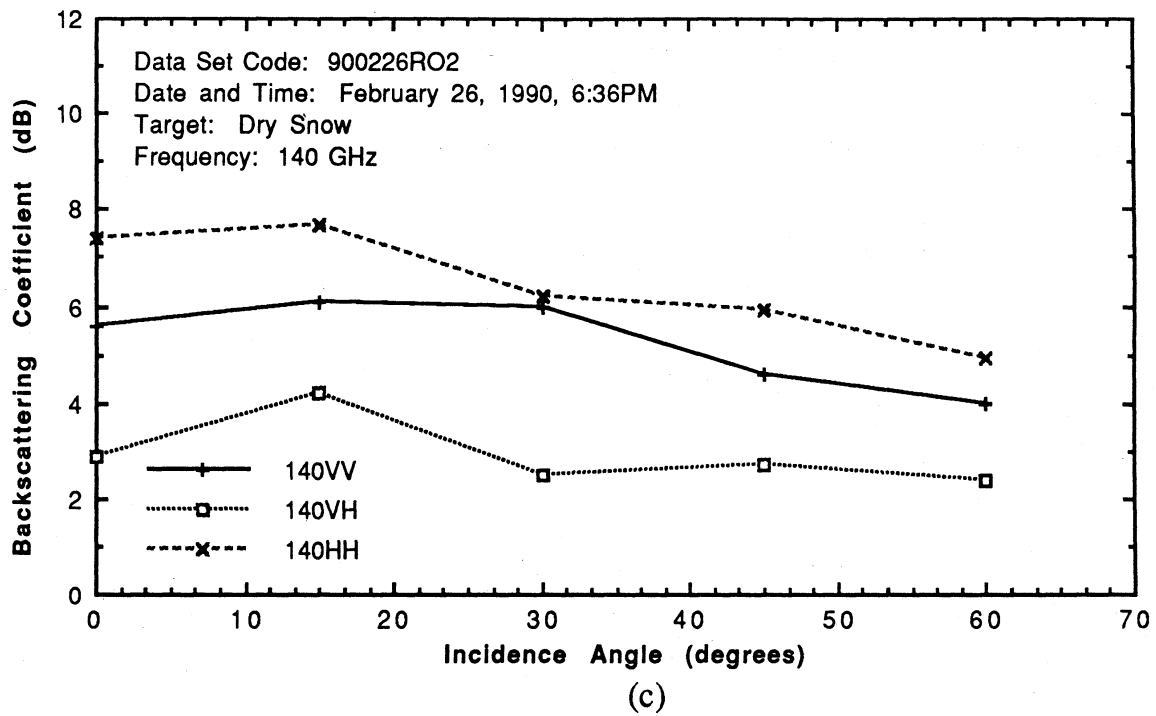
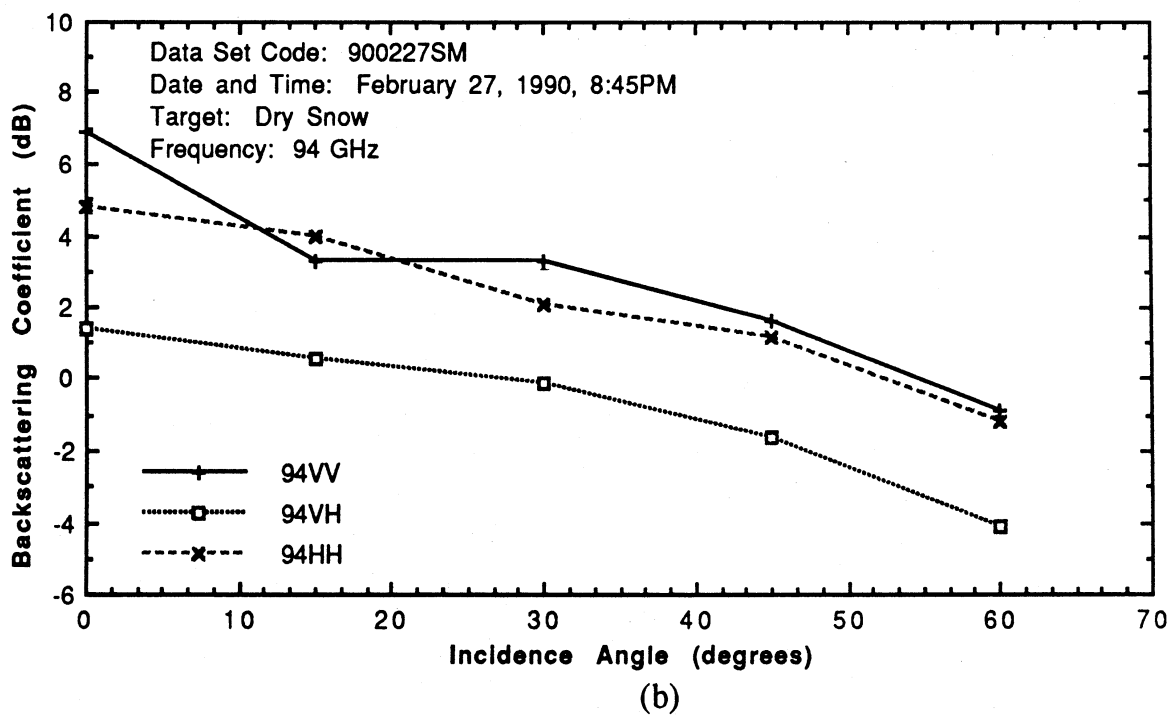
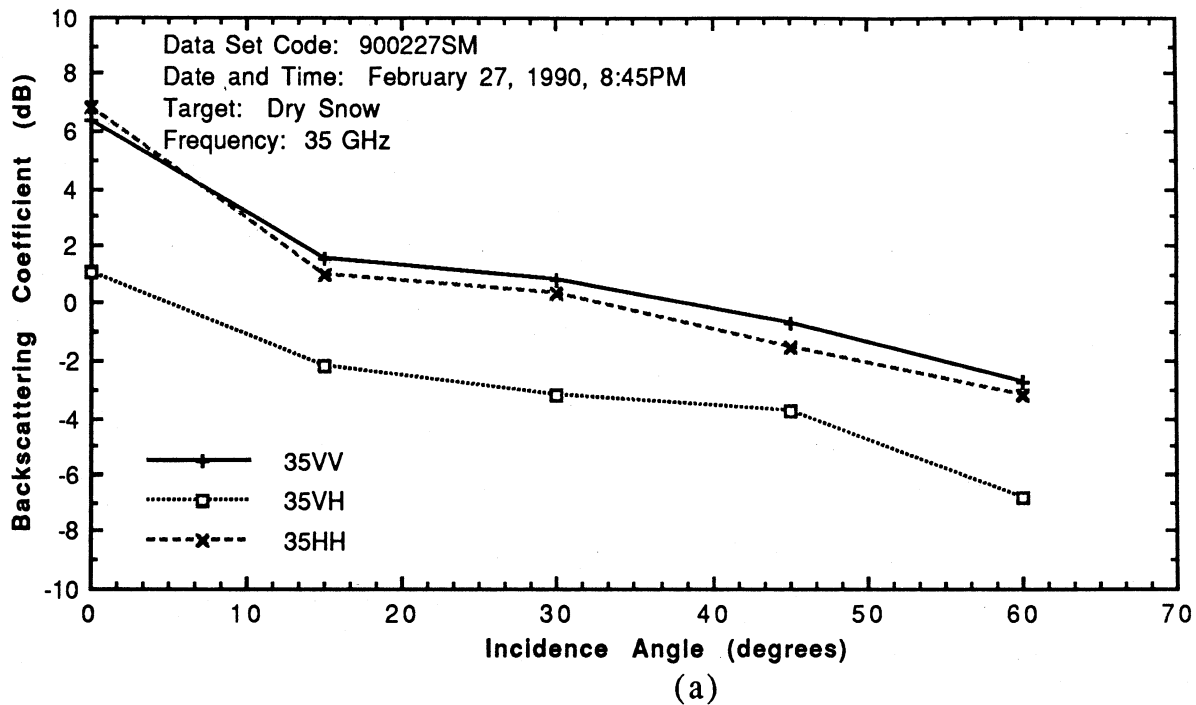


Figure 2.2-3: Backscattering coefficient from dry snow as a function of incidence angle for snow with an artificially-roughened surface on 900226.



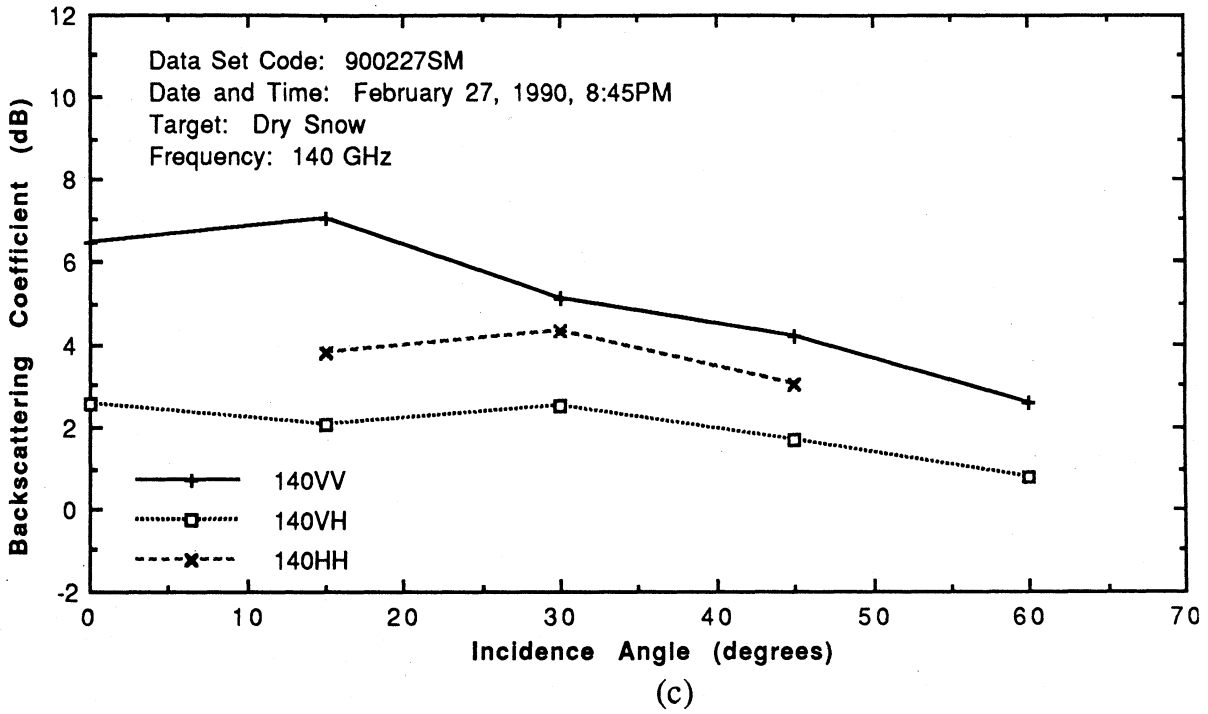
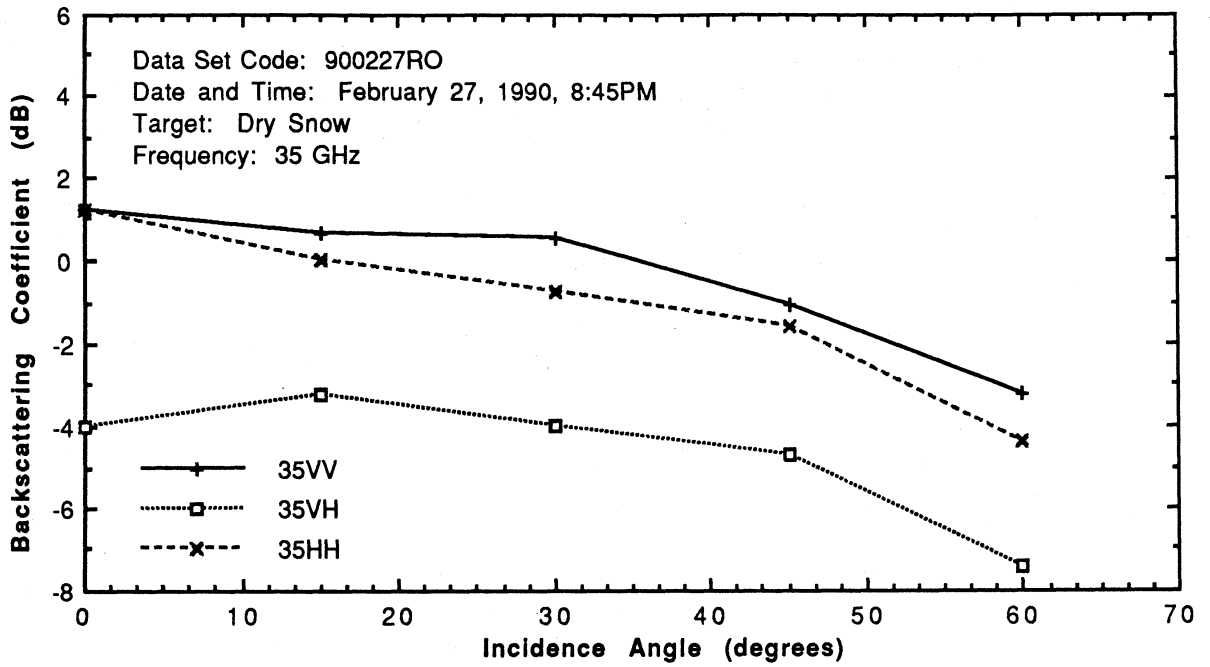
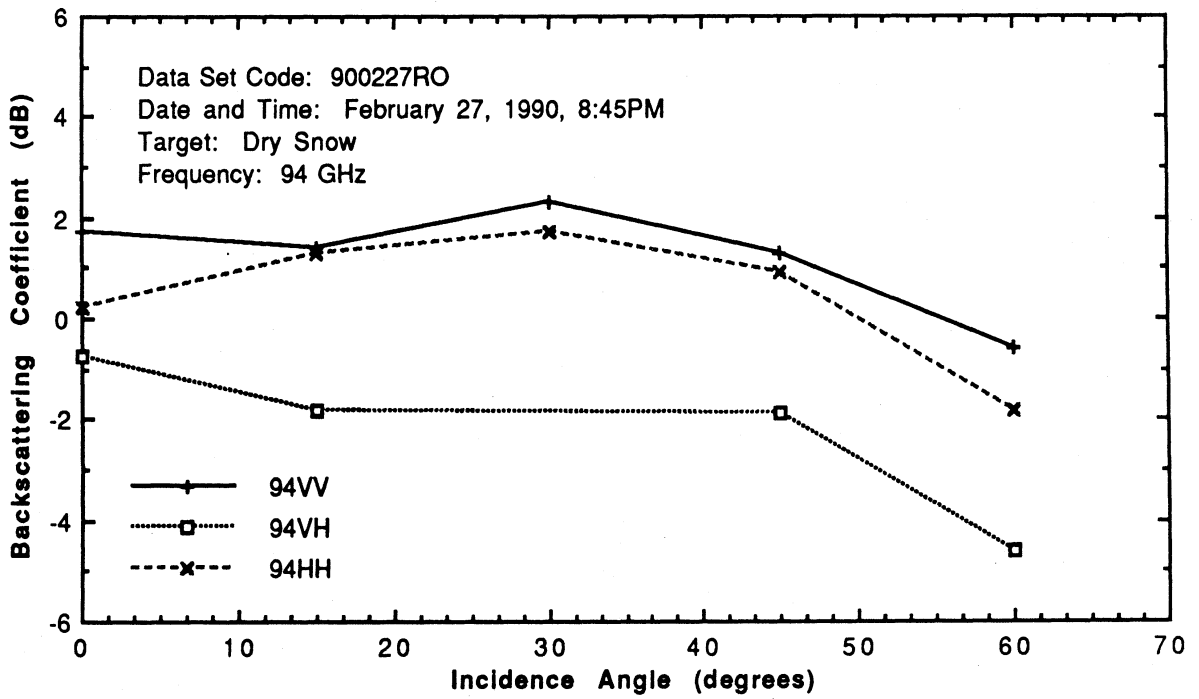


Figure 2.2-4: Backscattering coefficient from dry snow as a function of incidence angle for natural-surface snow on 900227.



(a)



(b)

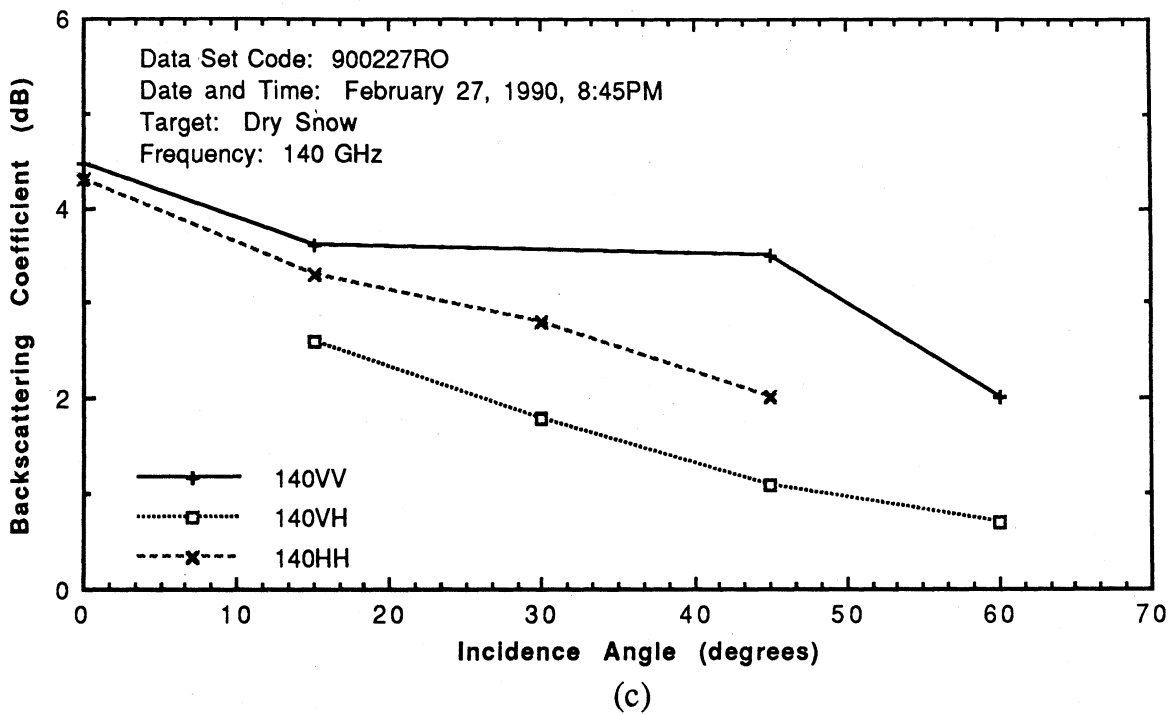
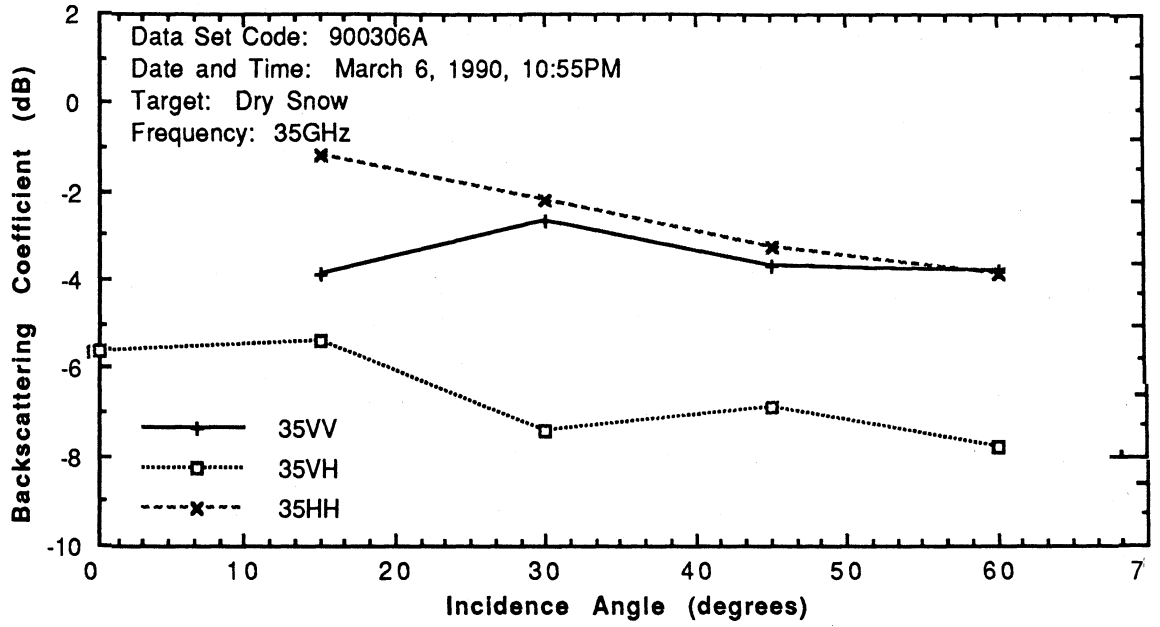
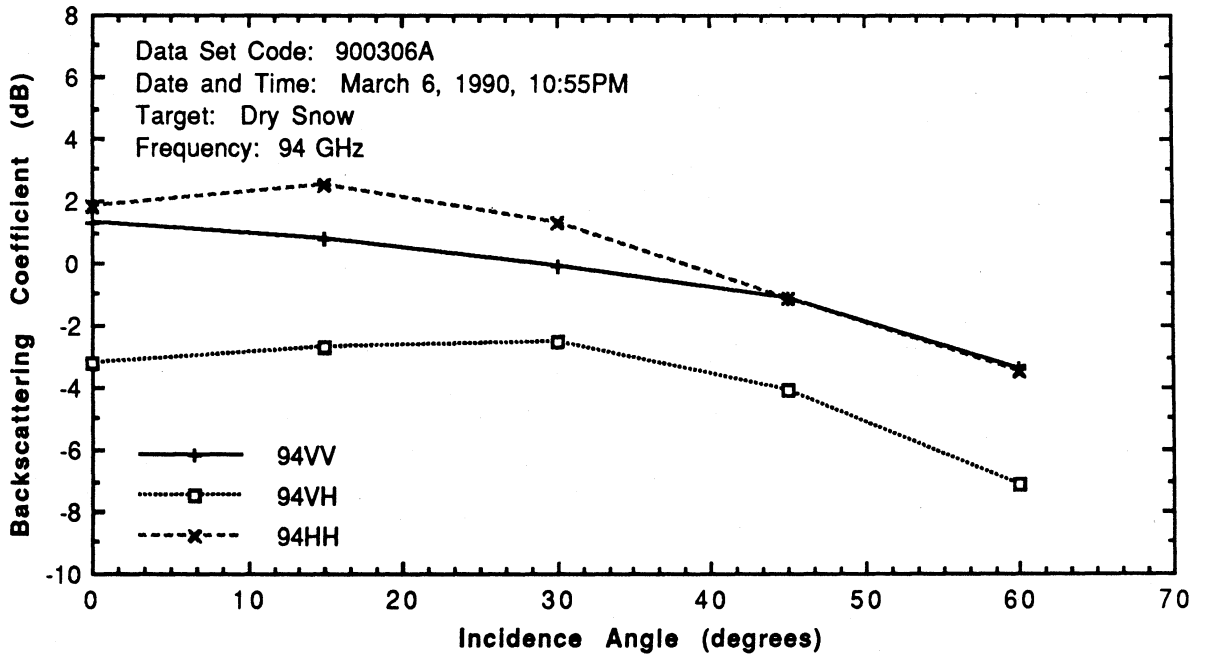


Figure 2.2-5: Backscattering coefficient from dry snow as a function of incidence angle for snow with an artificially-roughened surface on 900227.



(a)



(b)

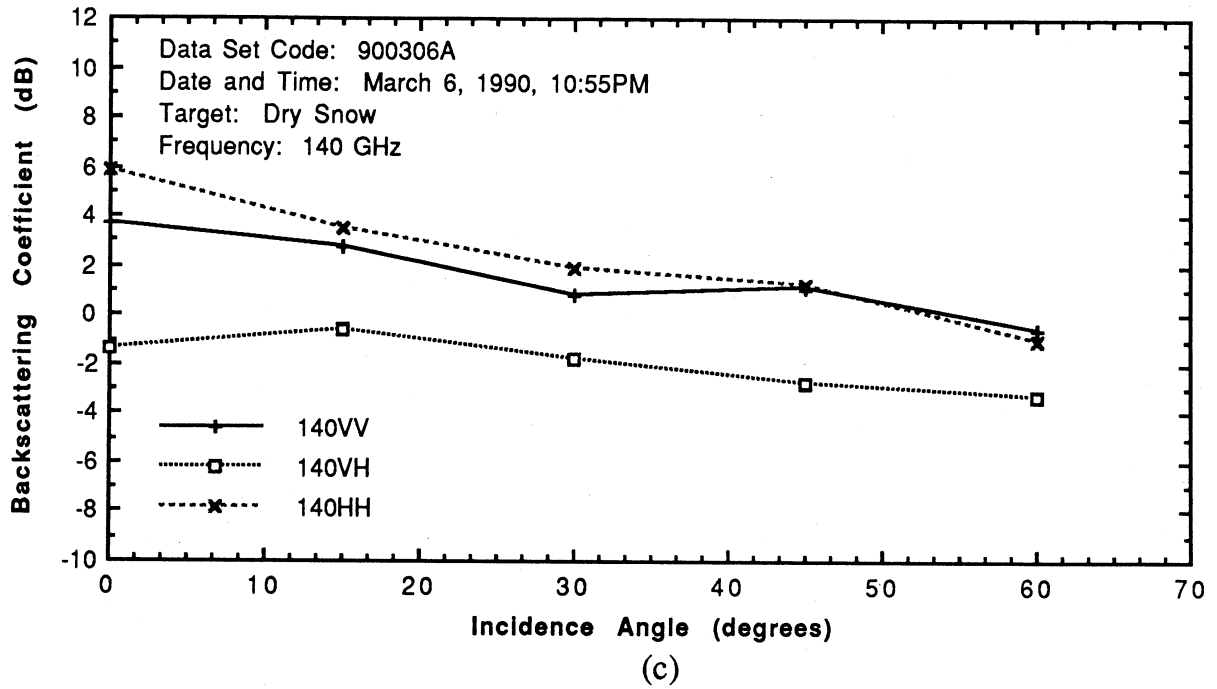
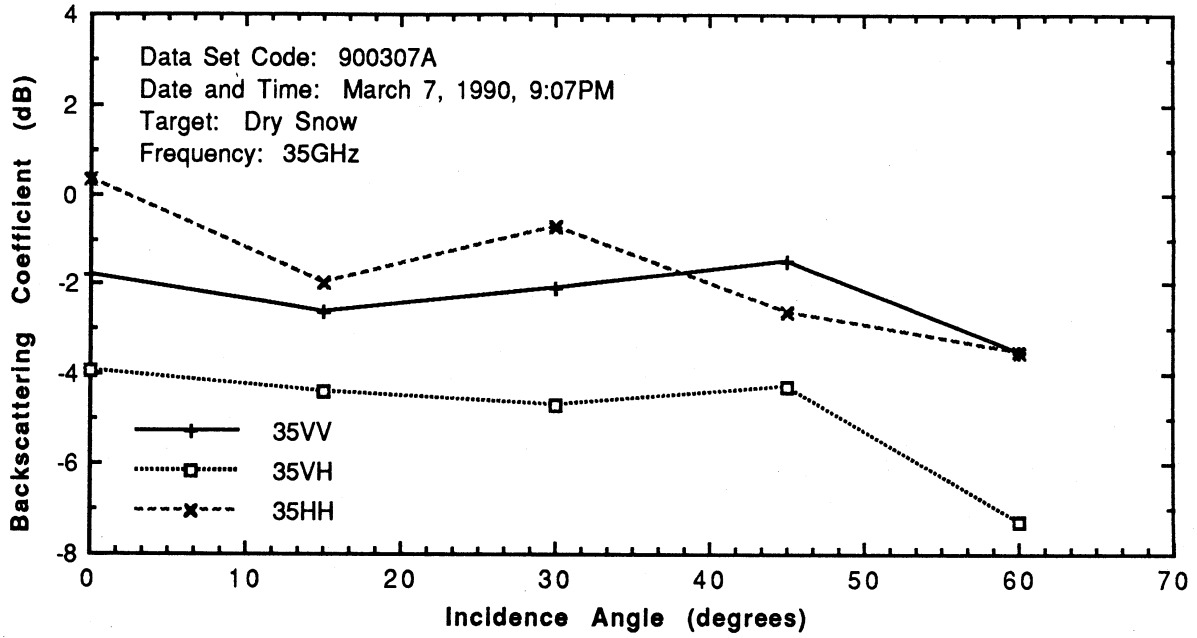
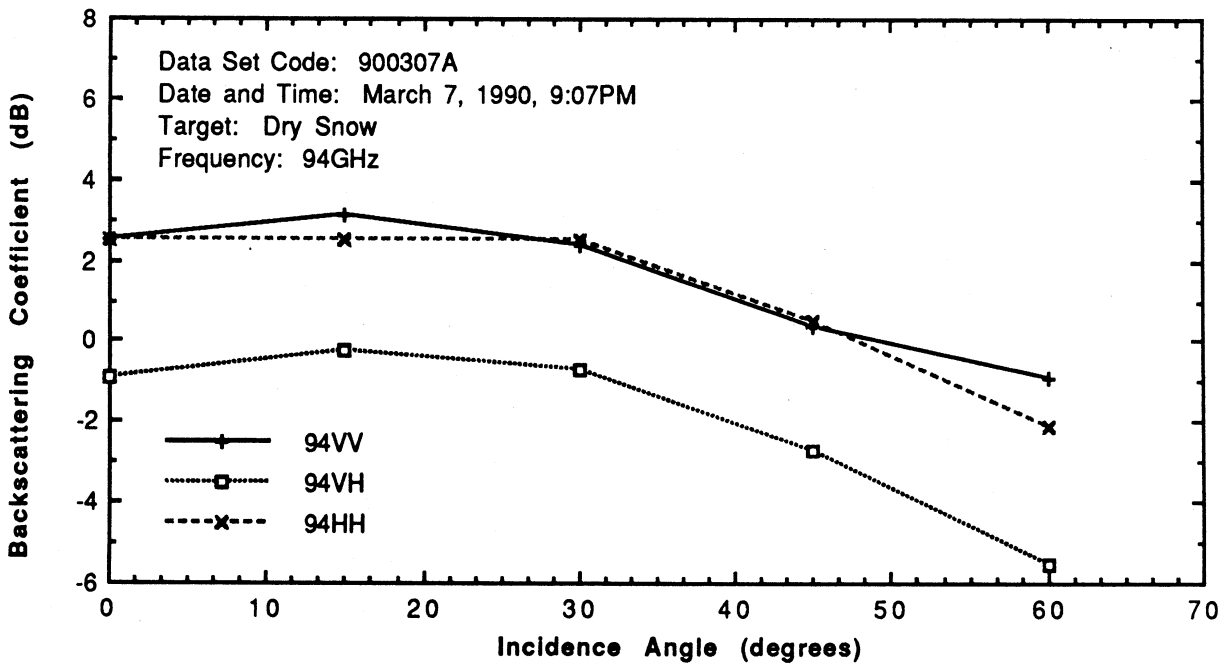


Figure 2.2-6: Backscattering coefficient from dry snow as a function of incidence angle for natural-surface snow on 900306.



(a)



(b)

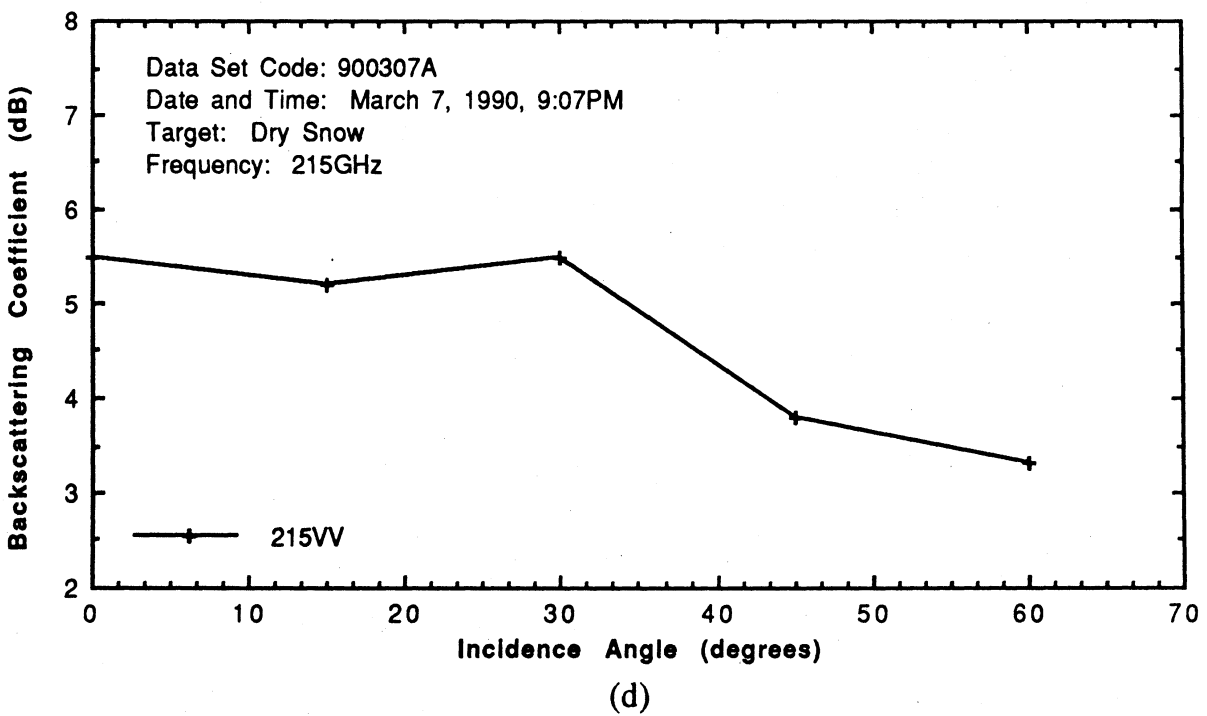
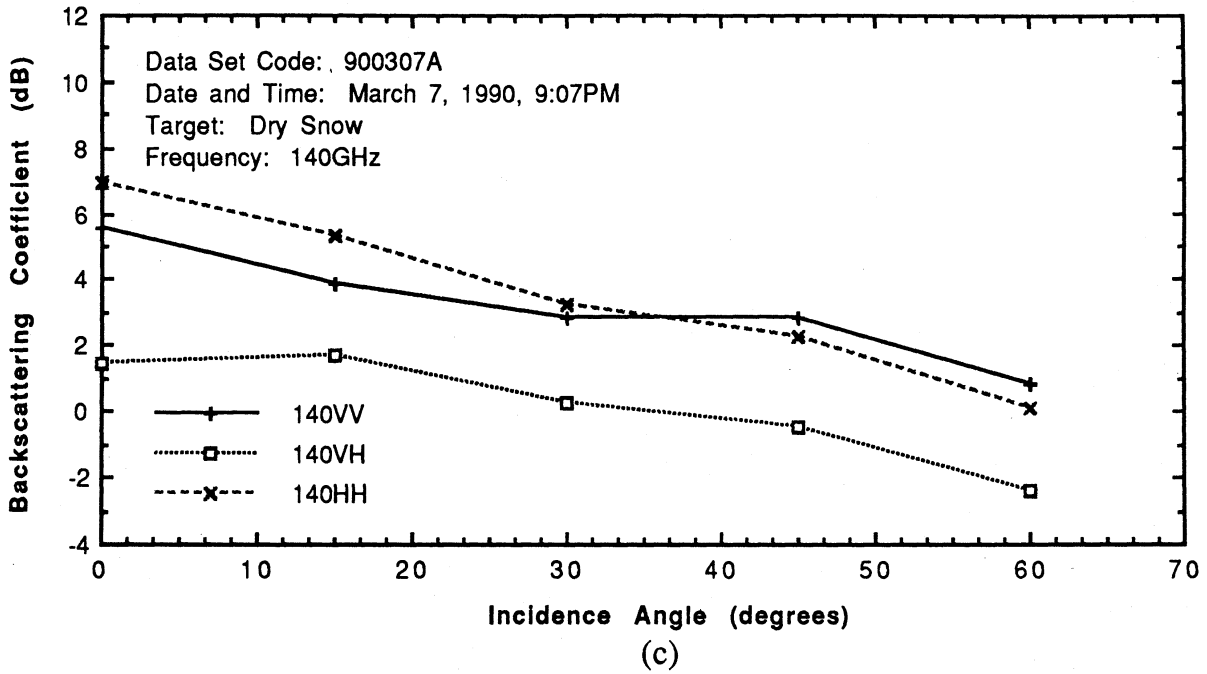
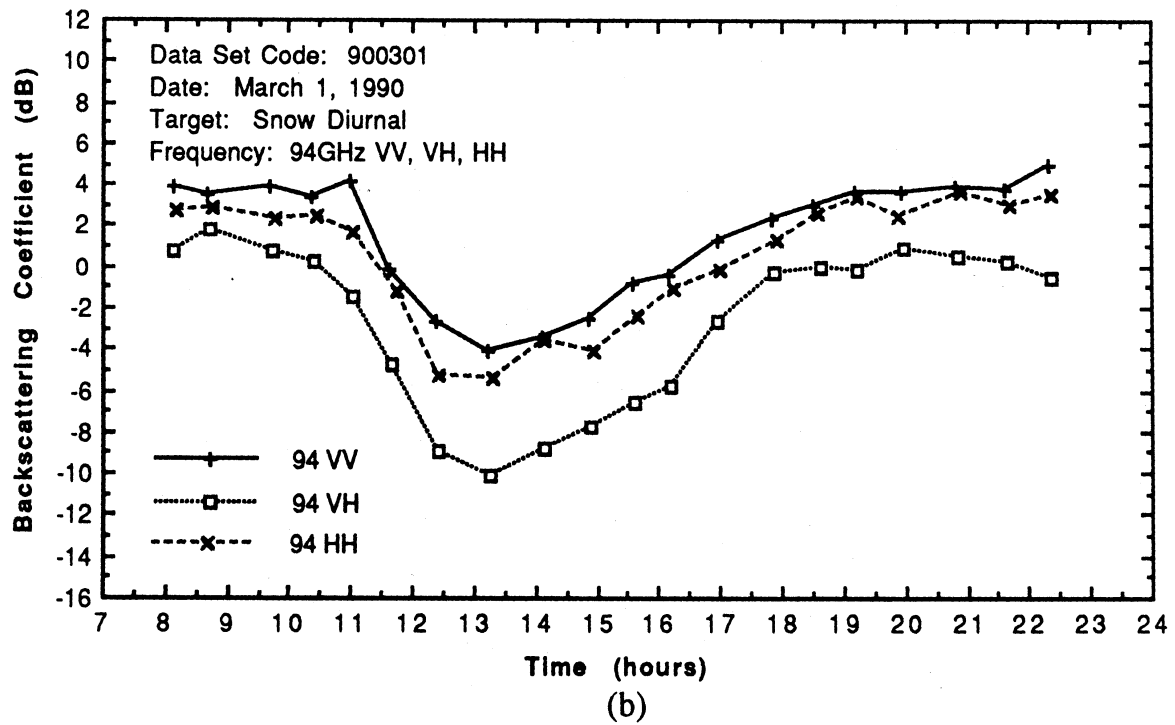
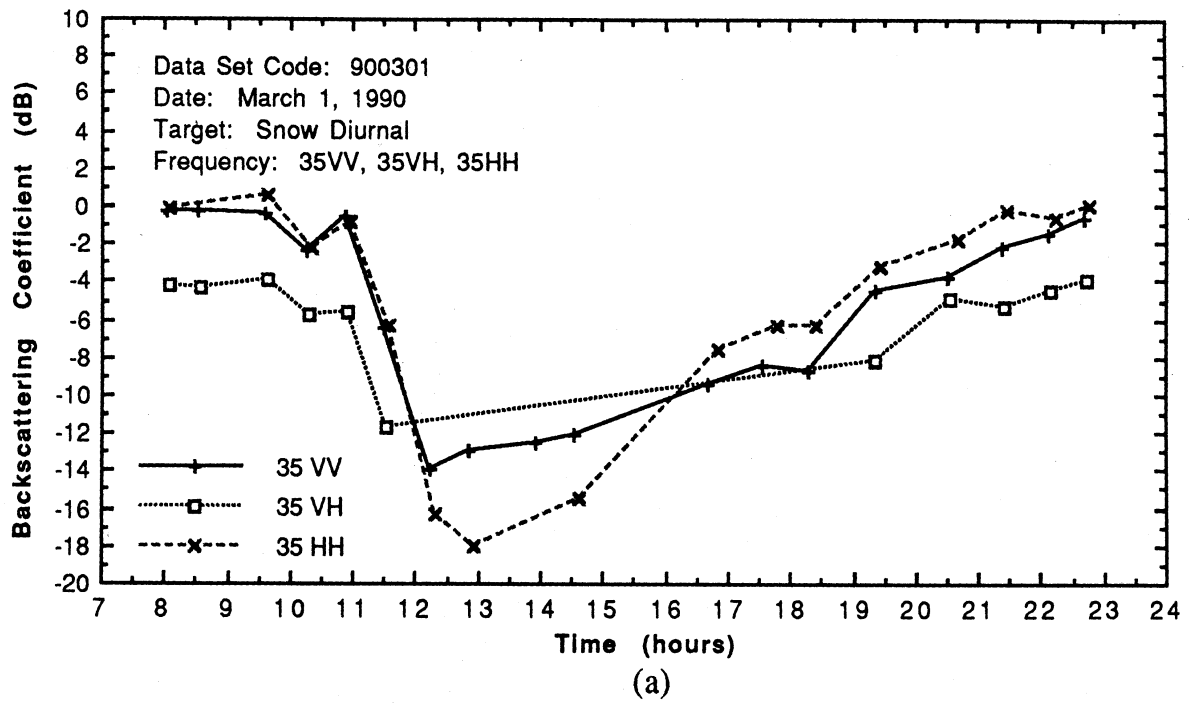
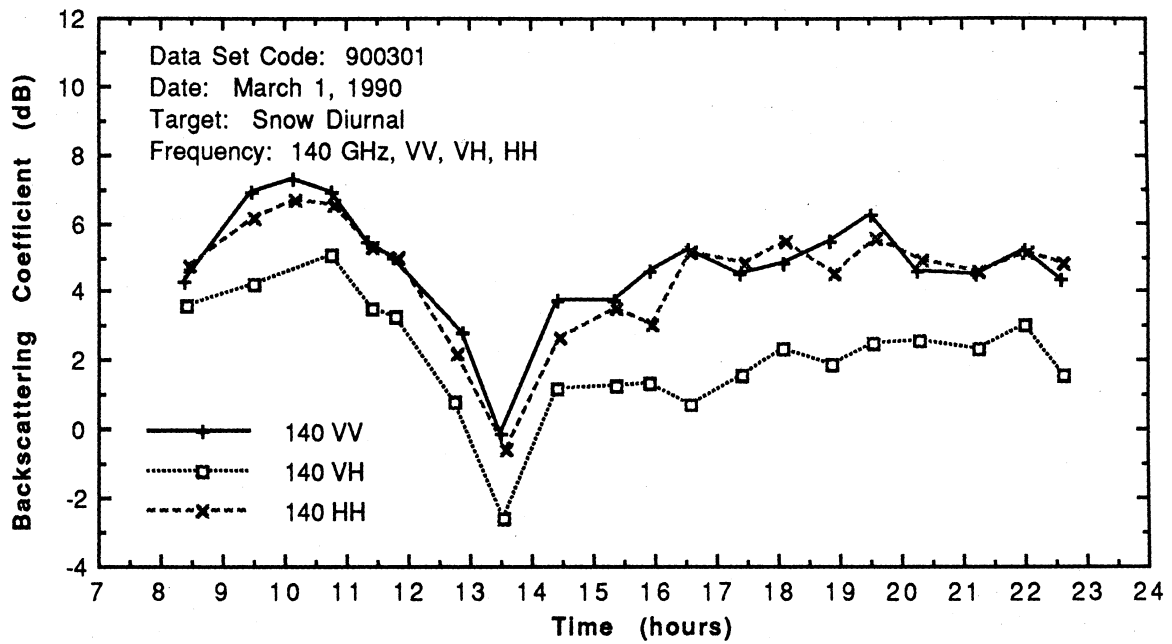


Figure 2.2-7: Backscattering coefficient from dry snow as a function of incidence angle for natural-surface snow on 900307.





(c)
 Figure 2.2-8: Backscattering coefficient from natural-surface snow as a function of time of the day on 900301.

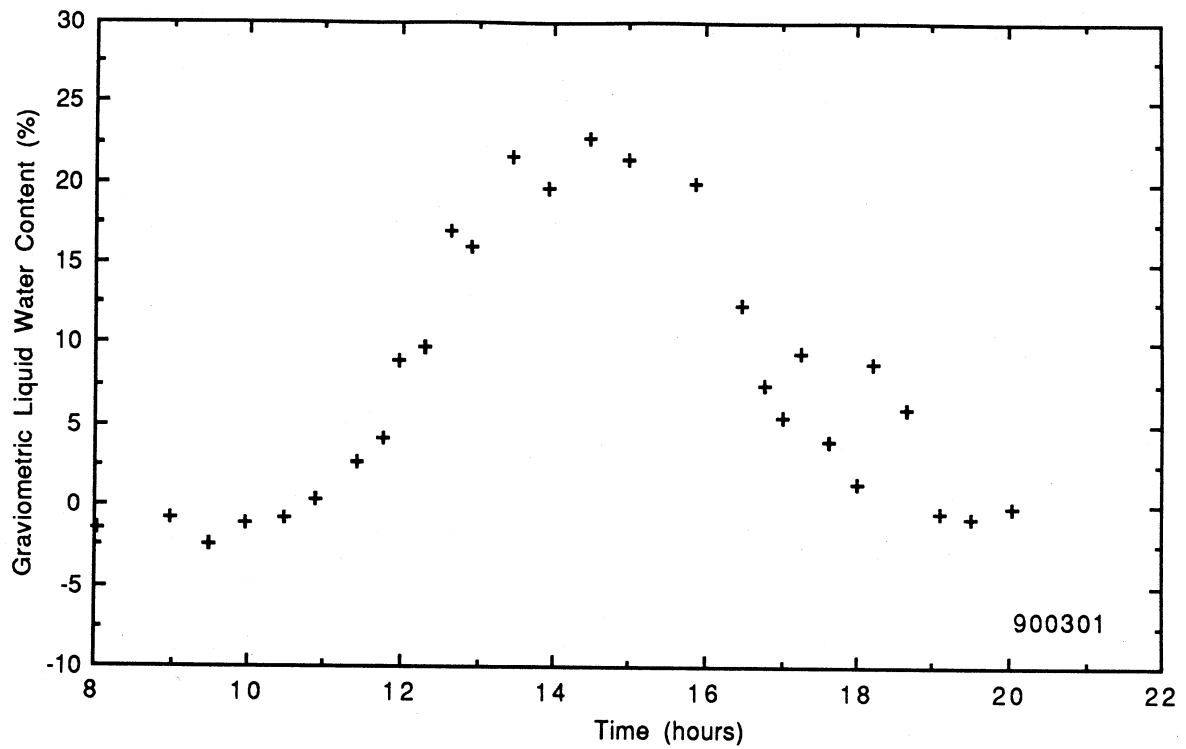


Figure 2.2-9: Liquid water content in the top 3cm of snow on 900301

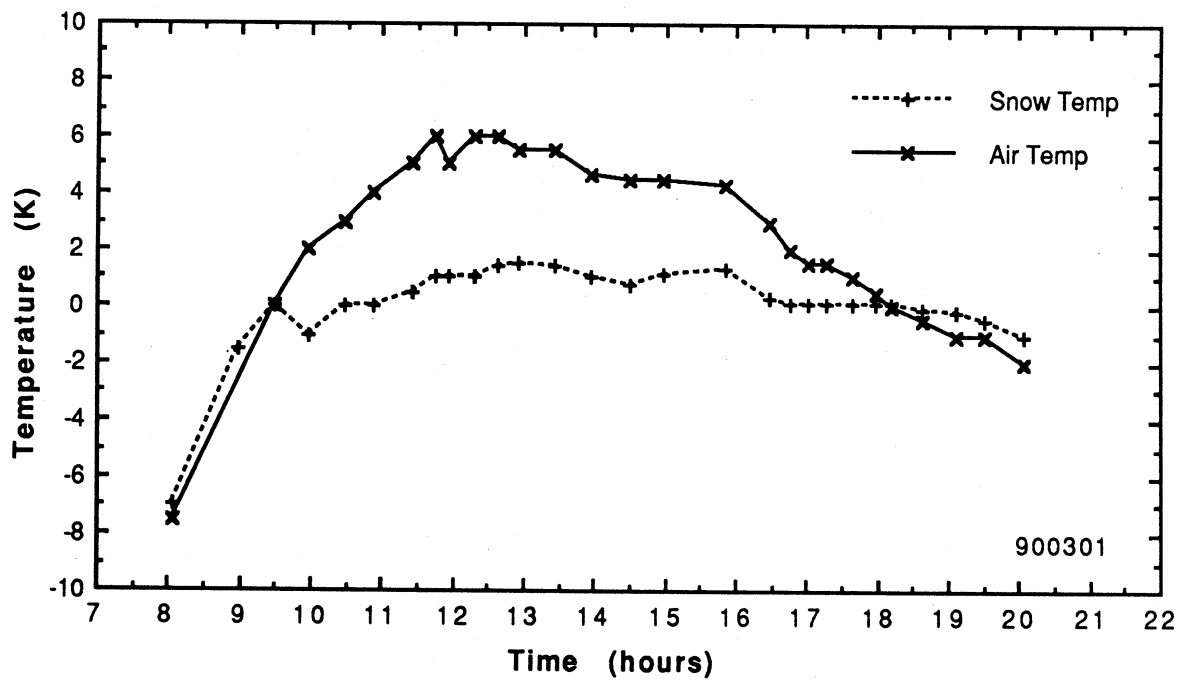


Figure 2.2-10: Air temperature and snow surface temperature on 900301

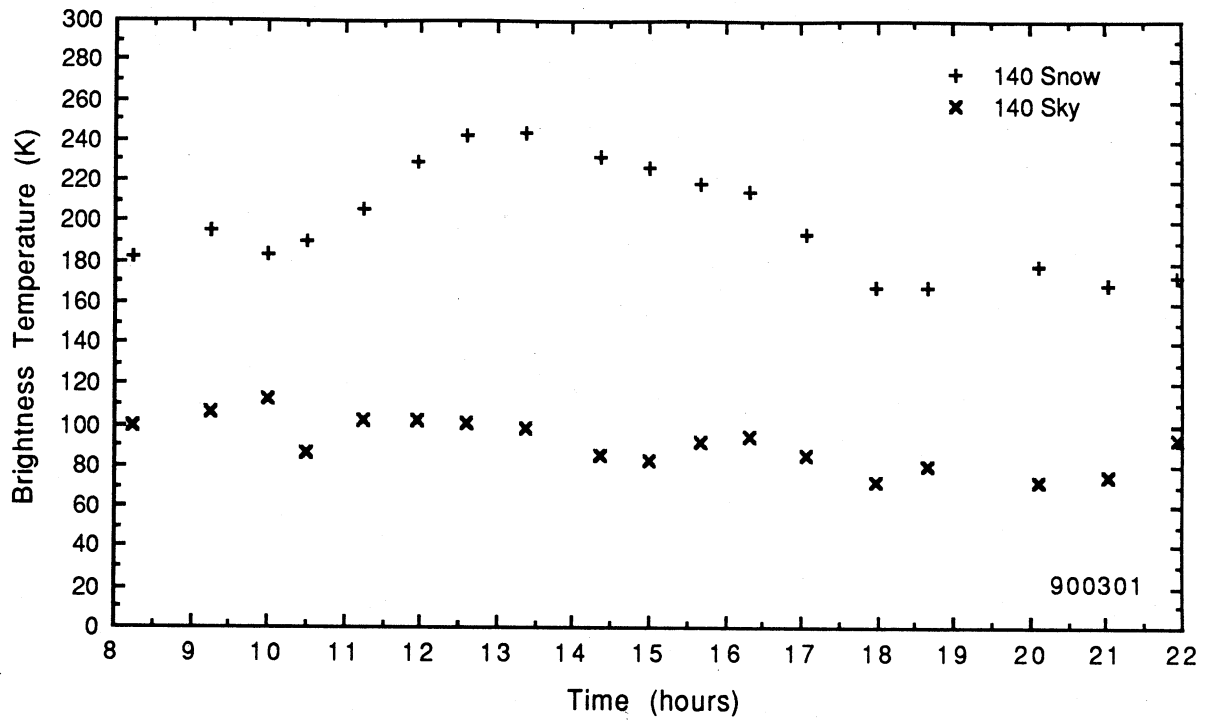
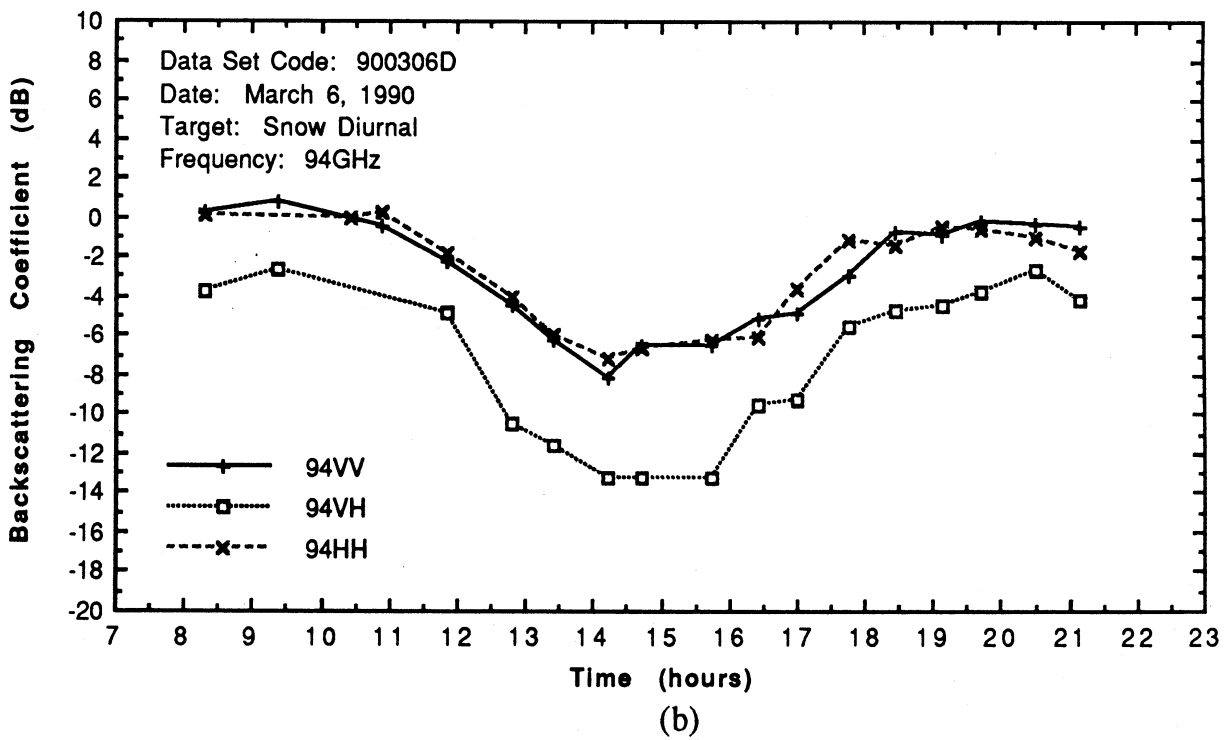
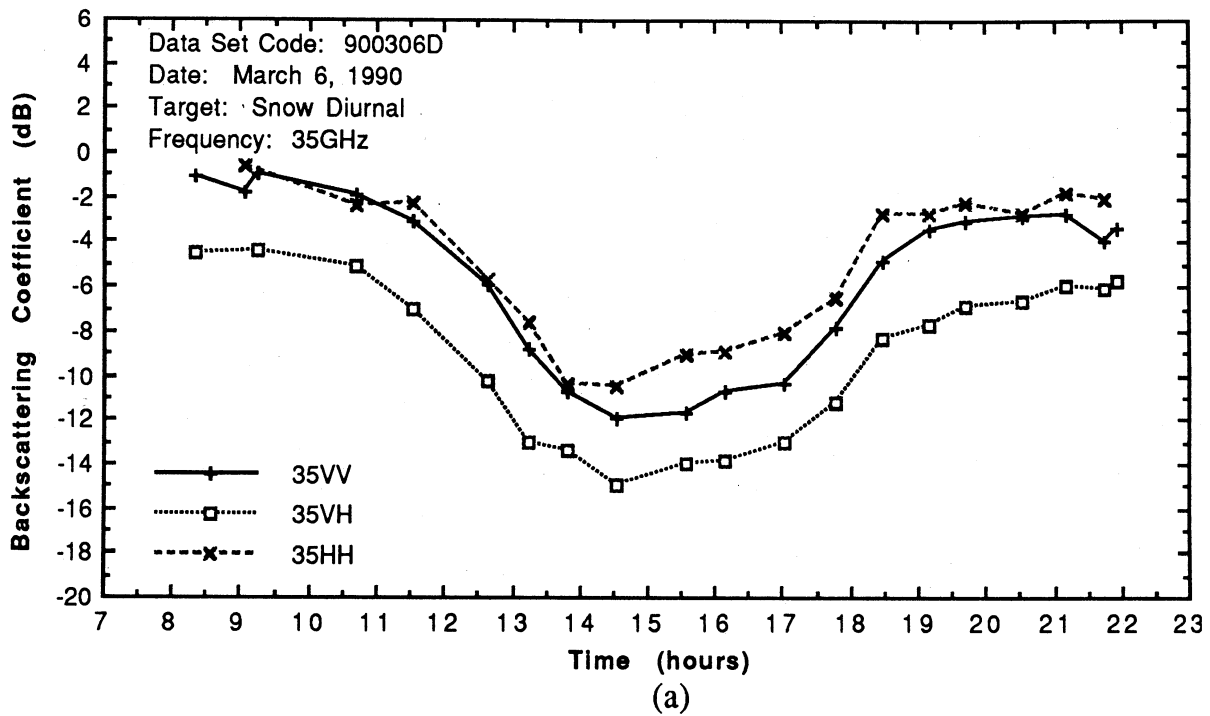


Figure 2.2-11: Radiometer data on 900301



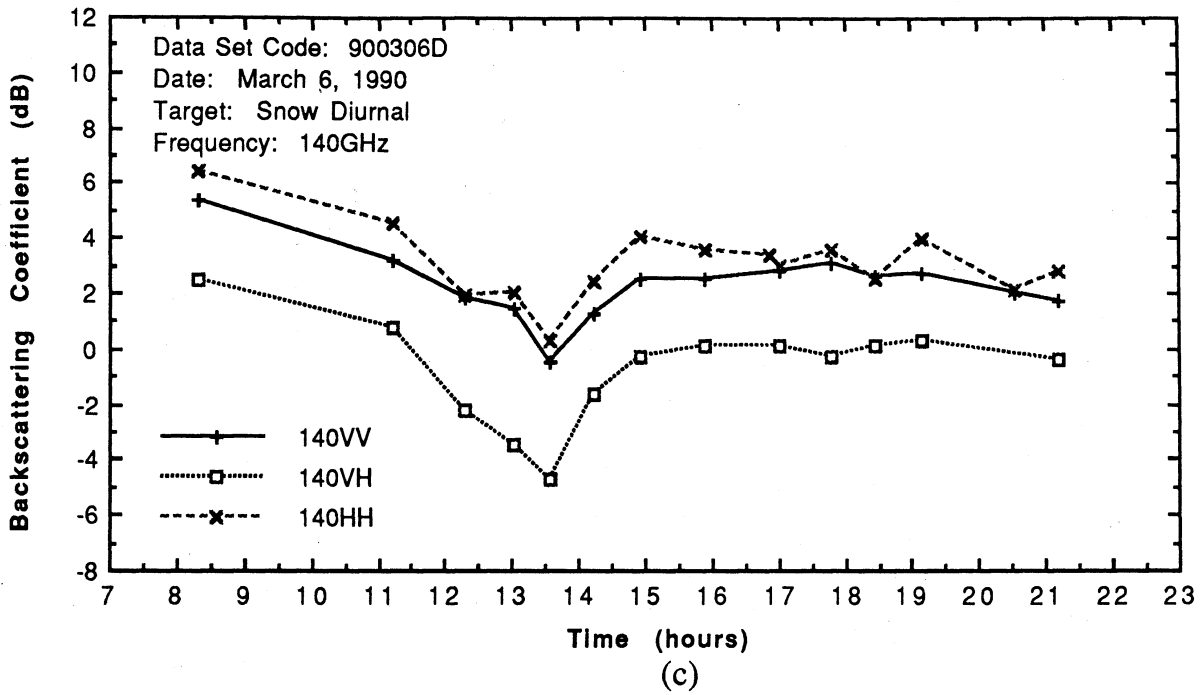


Figure 2.2-12: Backscattering coefficient from natural-surface snow as a function of time of the day on 900306.

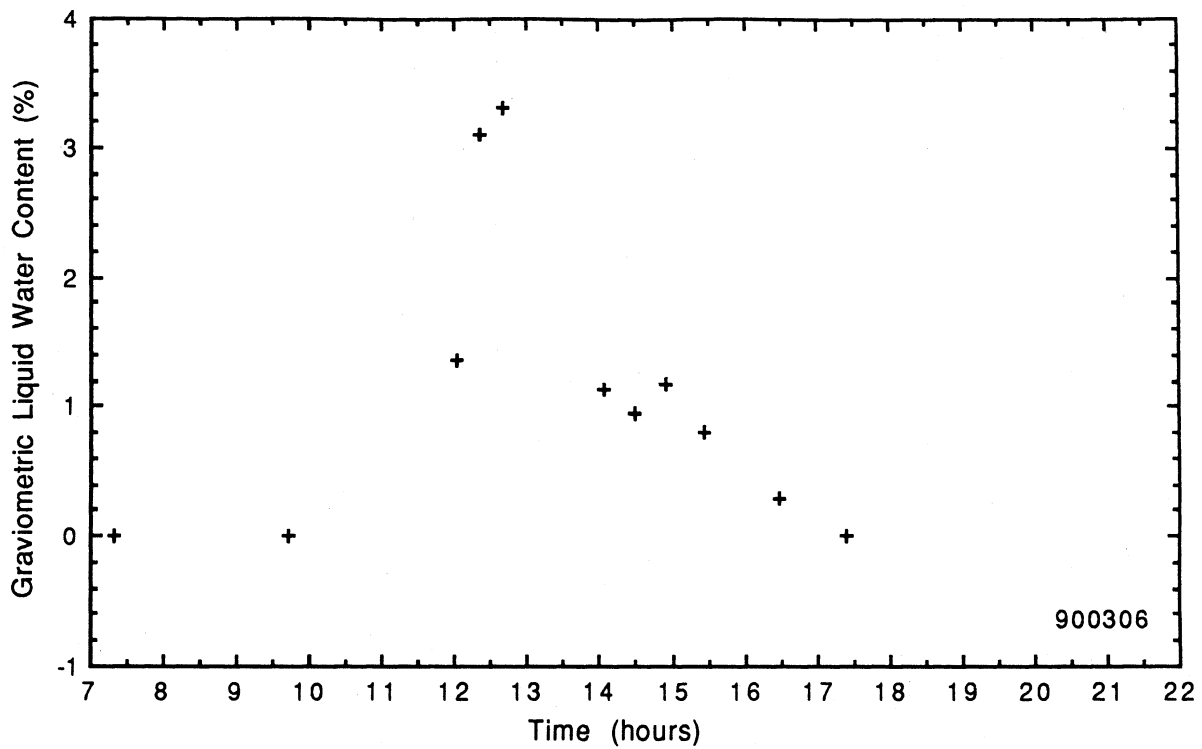


Figure 2.2-13: Liquid water content in the top 3cm of snow on 900306

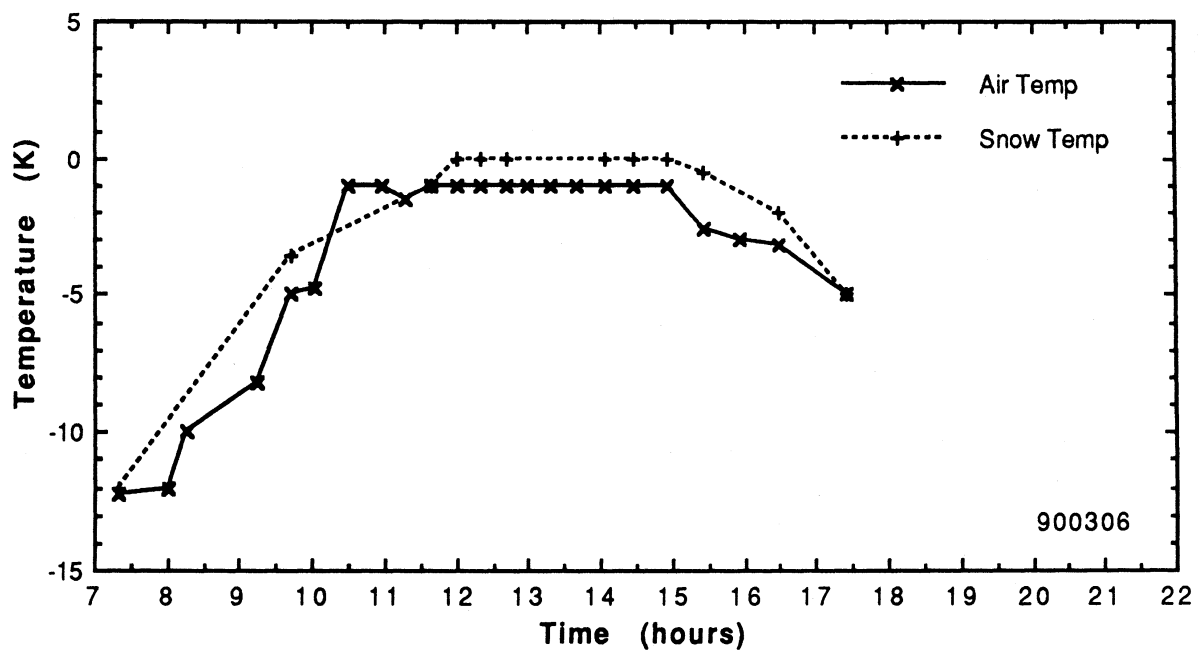
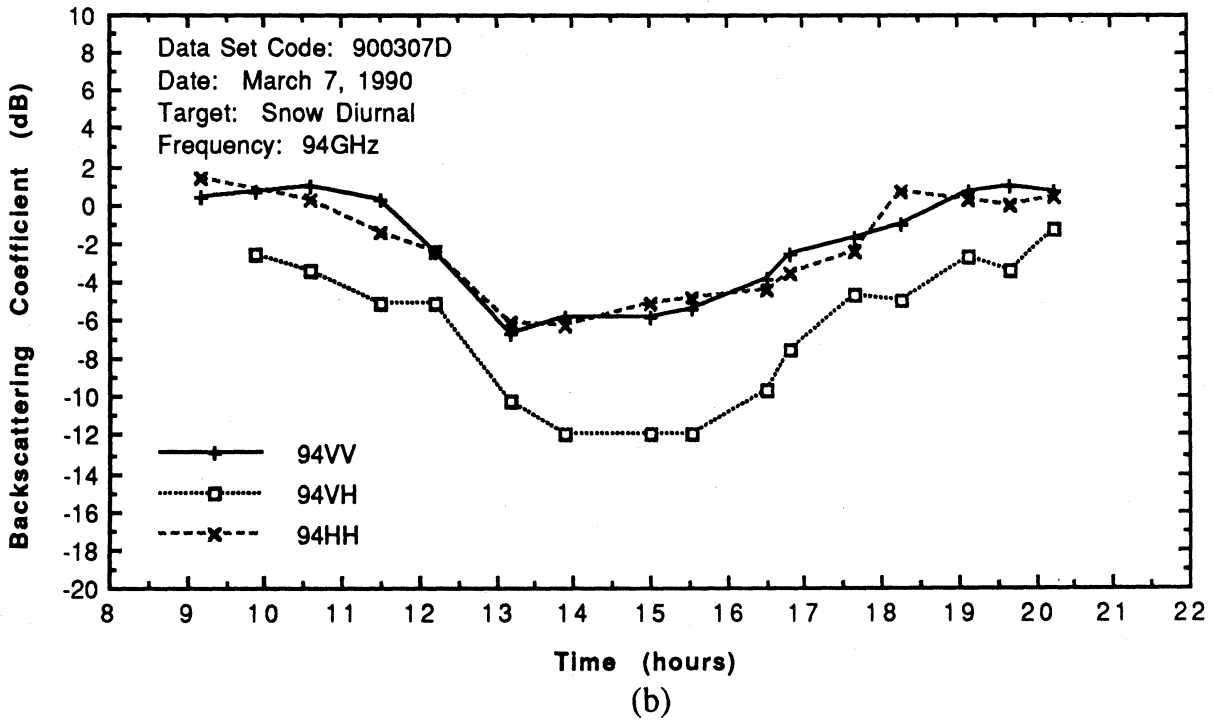
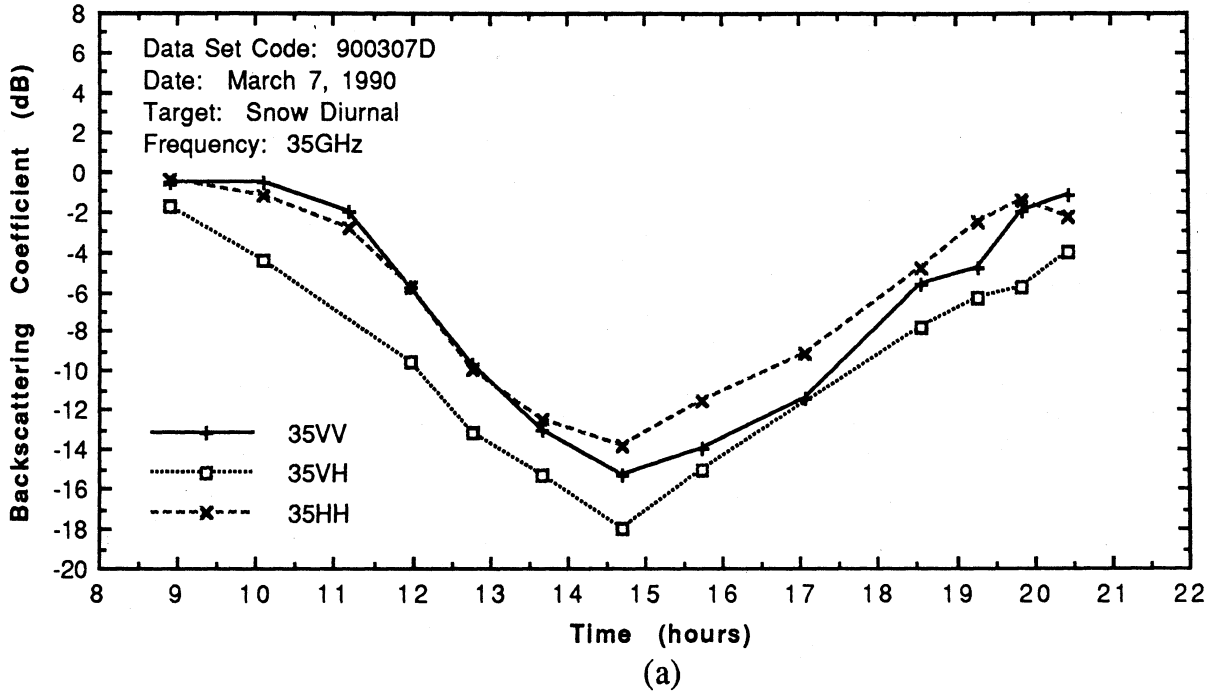
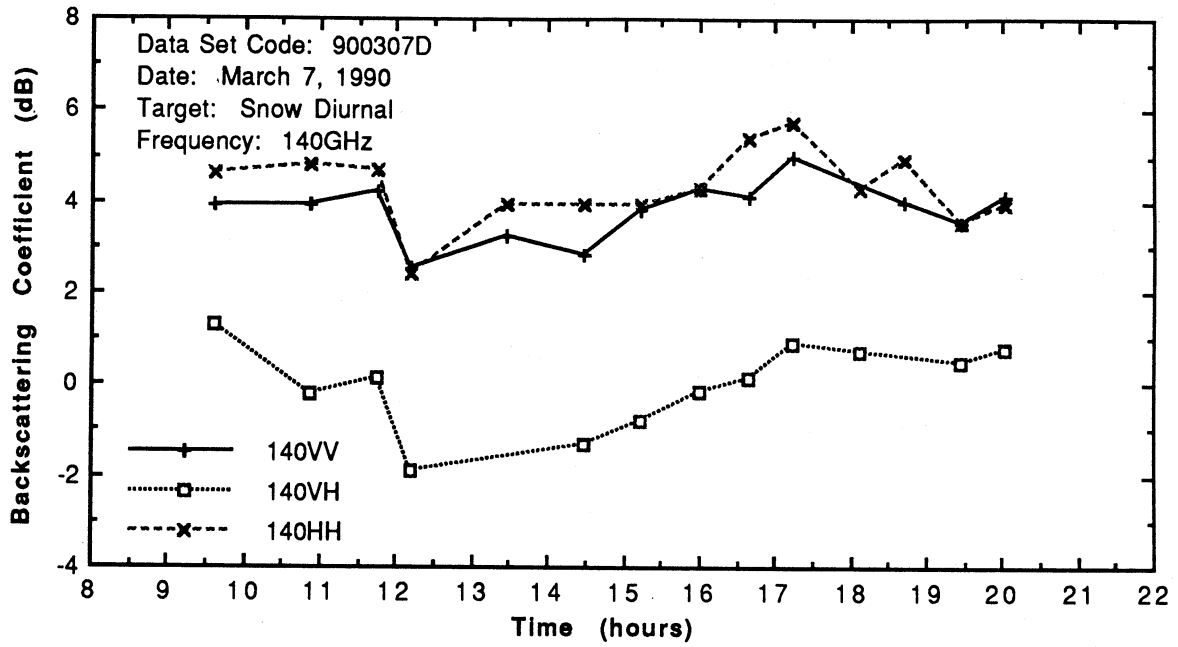


Figure 2.2-14: Air Temperature and snow surface temperature on 900306





(c)

Figure 2.2-15: Backscattering coefficient from natural-surface snow as a function of time of day on 900307

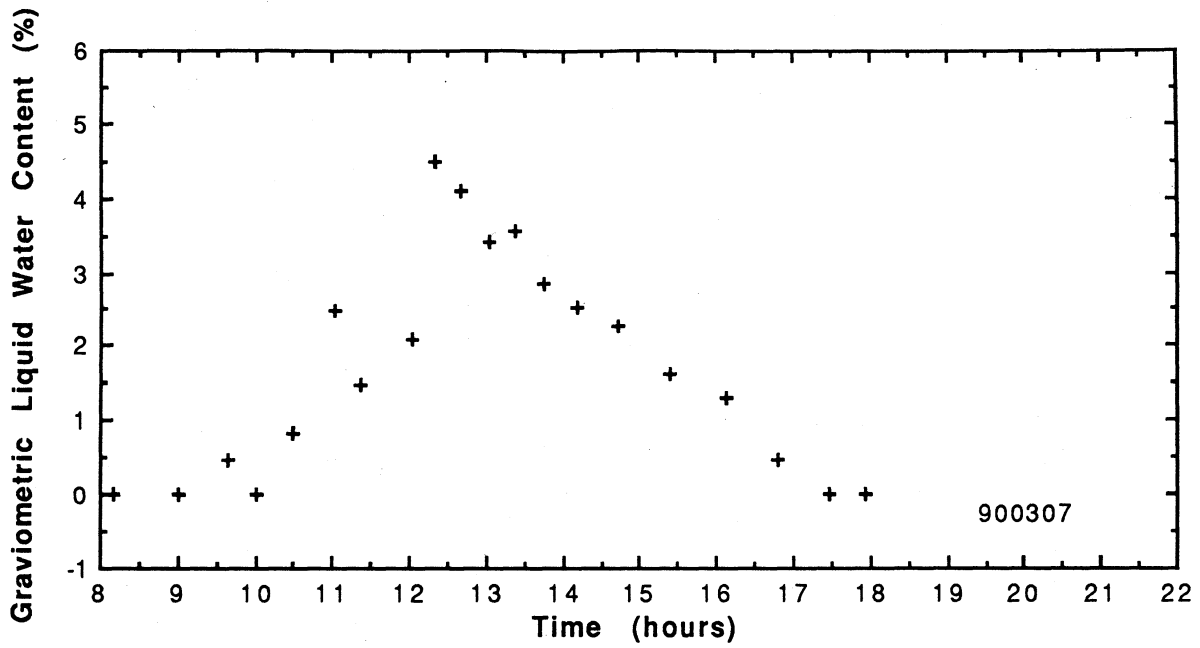


Figure 2.2-16: Liquid water content in the top 3cm of snow on 900307

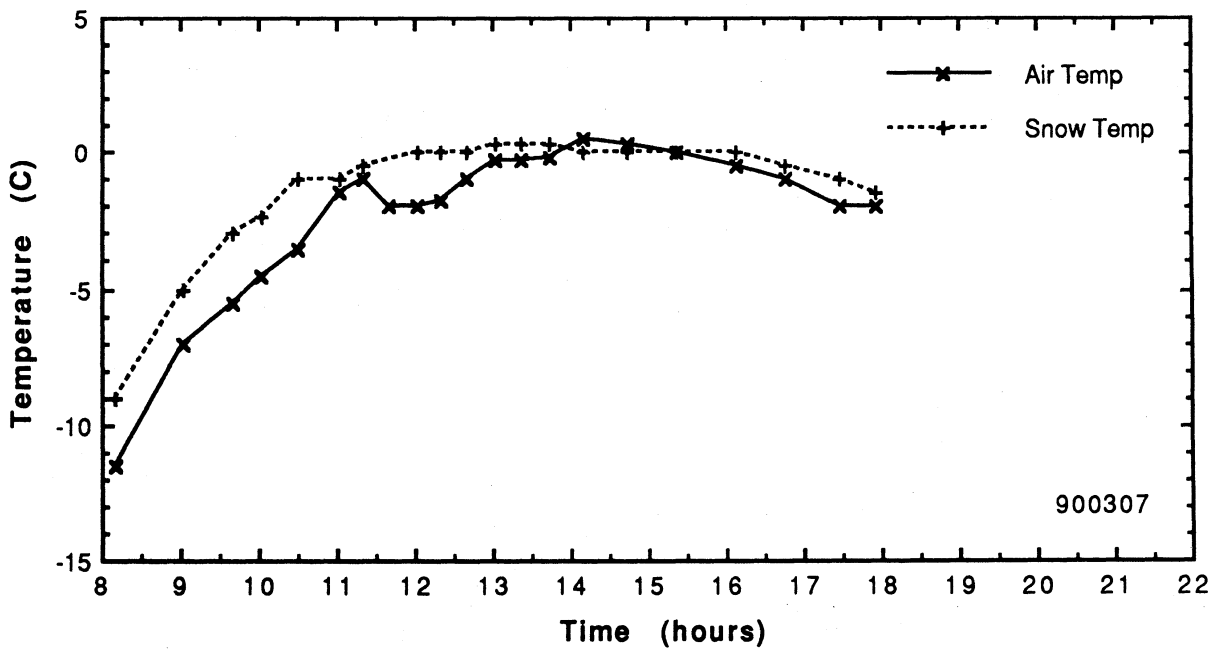


Figure 2.2-17: Air temperature and snow surface temperature on 900307

3. GROUND-TRUTH

3.1 Snowflake Sizes and Types

The following table lists the microscopic data on the snowflakes that was taken from the top two centimeters of the snow surface with each data set. Photographs of some of these flakes, taken through the microscope, can be seen in section 3.6 below.

SNOWFLAKE SIZES AND TYPES

<u>DATE</u> (YYMMDD)	<u>FLAKE SIZE</u> (mm diam.)	<u>COMMENTS</u>
900226	0.1	irregular crystals, unmetamorphosed
900227	0.5 to 1.5	irregular crystals, some early metamorphism
900301	1 to 2.0	irregular crystals, more advanced metamorphism
900306	0.1	needles and hexagonal plates, unmetamorphosed, 0.5 to 1.5 mm diameter graupel on the surface
900307	0.1 to 0.3	needles and irregular crystals, some early metamorphism

Table 3.1-1: Snowflake Sizes and Types for all data.

3.2 Temperatures

The following snow temperatures were taken during radar measurements. All were taken at the surface of the snow. Additional information on snow and air temperatures can be seen in the plots for the diurnal runs.

SNOW TEMPERATURES AND WETNESSES

<u>DATE</u> (YYMMDD)	<u>SNOW</u> <u>TEMP.</u> (DEG C)	<u>CONDITION</u> (WET/DRY)
900226SM1	-8.9	Dry
900226SM2	-8.9	Dry
900226RO2	-8.9	Dry
900227SM	-6.1	Dry
900227RO	-6.1	Dry
900301		Diurnal
900306D		Diurnal
900306A	-8.0	Dry
900307D		Diurnal

Table 3.2-1: Snow temperatures taken at liquid-water content measurements.

3.3 Densities and Depths

The following is a listing of all measurements of snow densities in the top two centimeters of the snow.

DENSITIES AND DEPTHS

<u>DATE</u> (YYMMDD)	<u>TIME</u> (for diurnals) (HHMM)	<u>DENSITY</u> (G/CM ³)	<u>DEPTH</u> (cm)
900226SM1		0.11	18
900226SM2		0.11	18
900226RO2		0.11	18
900227SM		0.18	16
900227RO		0.18	16
900301	1547 2000	0.32 0.23	10
900306A		0.14	9
900306D	0900 1230	0.11 0.14	9 9
900307A		0.17	5
900307D	0830 1115 1630	0.18 0.17 0.17	5 5 5

Table 3.3-1: Snow densities for all data.

3.4 Surface Roughnesses

The following values of surface roughnesses were calculated from photographs of a Cartesian grid inserted into the snow. These photographs can be seen in section 3.6.

SURFACE ROUGHNESSES		
<u>DATE</u> (YYMMDD)	<u>RMS ROUGHNESS</u> (cm)	<u>STATE</u>
900226SM1	0.2	natural
900226SM2	0.2	natural
900226RO2	1.8	roughened
900227SM	0.3	natural
900227RO	1.2	roughened
900301	0.3	natural
900306D	0.3	natural
900306A	0.3	natural
900307D	0.2	natural
900307A	0.2	natural

Table 3.4-1: Snow surface roughnesses for all data.

3.5 Liquid Water Content

The following measurements were made by the cold calorimetry method, as described in U of M Radiation Lab report number 022872-2-T, (referenced p.2 of this report). Negative values are, of course, the result of measurement errors, and reflect our measurement accuracy of a few percent of total liquid water content.

Liquid Water Content measurements were made only for the diurnal experiments. The snow surface temperatures during all the angular sets were below -6.0 C, and it is assumed that the snow was dry.

GRAVIMETRIC LIQUID WATER CONTENT

900301 Liquid Water Content:

Time (hours)	GLWC (%)	Snow Temp (C)	Air Temp (C)
8.050	-1.400	-7.000	-7.500
8.967	-0.800	-1.500	
9.483	-2.400	0.000	0.000
9.950	-1.200	-1.000	2.000
10.483	-0.700	0.000	3.000
10.867	0.300	0.000	4.000
11.417	2.700	0.500	5.000
11.767	4.200	1.000	6.000
11.950	9.000	1.000	5.000
12.300	0.700	1.000	6.000
12.633	16.900	1.400	6.000
12.917	16.000	1.500	5.500
13.450	21.600	1.400	5.500
13.933	19.600	1.000	4.700
14.483	22.800	0.800	4.500
14.983	21.400	1.100	4.500
15.867	20.000	1.300	4.300
16.483	12.400	0.300	3.000
16.767	7.500	0.100	2.000
17.017	5.500	0.100	1.500
17.267	9.400	0.100	1.500
17.633	4.100	0.050	1.000
17.983	1.400	0.050	0.500

18.200	8.800	0.050	0.000
18.650	6.000	-0.050	-0.500
19.100	-0.500	-0.200	-1.000
19.500	-0.800	-0.500	-1.000
20.050	-0.000	-1.000	-2.000

900306LWC:

Time (hours)	GLWC (%)	Snow Temp (C)	Air Temp (C)
7.330	0.000	-12.000	-12.200
8.020			12.000
8.270			-10.000
9.230			-8.200
9.700	0.000	-3.600	-5.000
10.020			-4.800
10.500			-1.000
10.980			-1.000
11.300			-1.500
11.650		-1.000	-1.000
12.020	1.400	0.000	-1.000
12.350	3.100	0.000	-1.000
12.680	3.300	0.000	-1.000
12.980			-1.000
13.300			-1.000
13.670			-1.000
14.050	1.100	0.000	-1.000
14.480	0.900	0.000	-1.000
14.920	1.200	0.000	-1.000
15.450	0.800	-0.500	-2.600
15.950			-3.000
16.470	0.300	-2.000	-3.200
17.420	0.000	-5.000	-5.000

900307LWC

Time (hours)	GLWC (Fractional)	Snow Temp (C)	Air Temp (C)
8.180	0.000	-9.000	-11.500
9.020	0.000	-5.000	-7.000
9.650	0.500	-3.000	-5.500
10.020	0.000	-2.400	-4.600
10.500	0.800	-1.000	-3.600
11.020	2.500	-1.000	-1.500
11.350	1.500	-0.500	-1.000
11.650			-2.000
12.030	2.100	0.000	-2.000
12.330	4.500	0.000	-1.800
12.650	4.100	0.000	-1.000
13.030	3.400	0.300	-0.300
13.380	3.500	0.300	-0.300
13.750	2.800	0.300	-0.200
14.180	2.500	0.000	0.500
14.720	2.300	0.000	0.300
15.370	1.600	0.000	0.000
16.120	1.300	0.000	-0.500
16.780	0.500	-0.500	-1.000
17.470	0.000	-1.000	-2.000
17.950	0.000	-1.500	-2.000

Table 3.5-1: Snow liquid water content by mass for all data.

3.6 Photographs



Figure 3.6-1: Overall scene of data collection site for smooth snow, 900226.

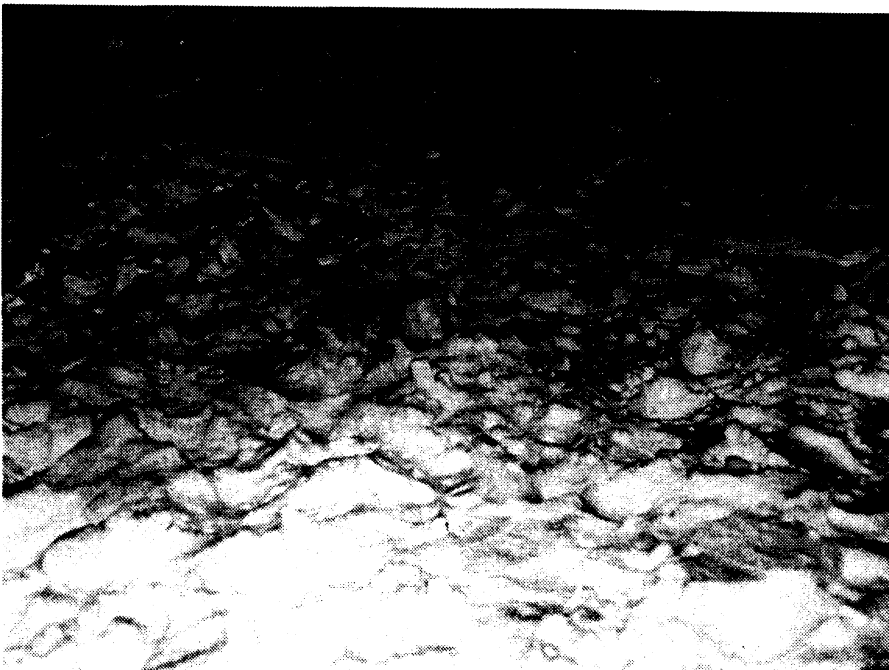


Figure 3.6-2: Overall scene of data collection site for rough snow, 900226.

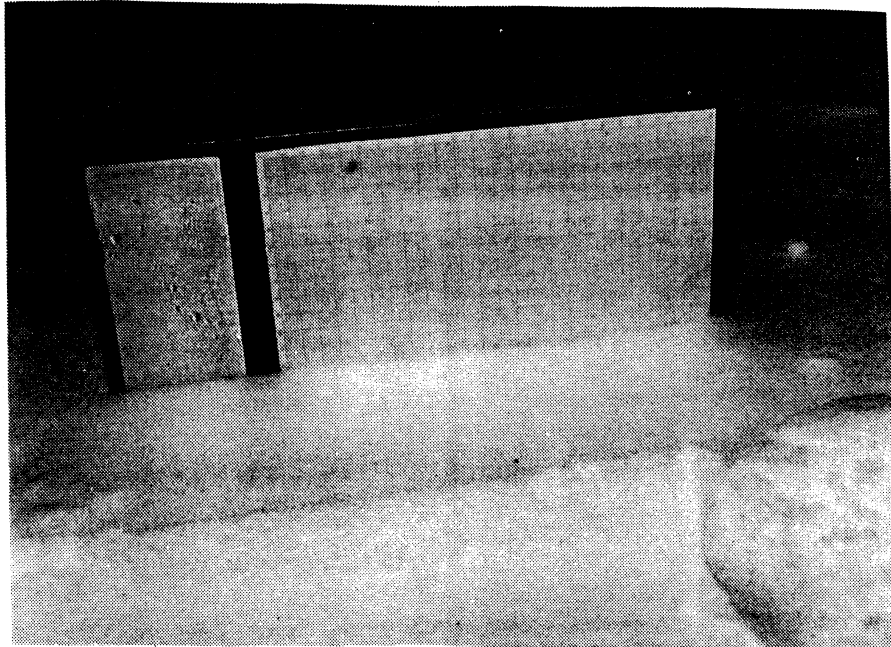


Figure 3.6-3: Surface profile with one-centimeter grid for smooth snow from data collection site, 900226.



Figure 3.6-4: Surface profile with one-centimeter grid for rough snow from data collection site, 900226.

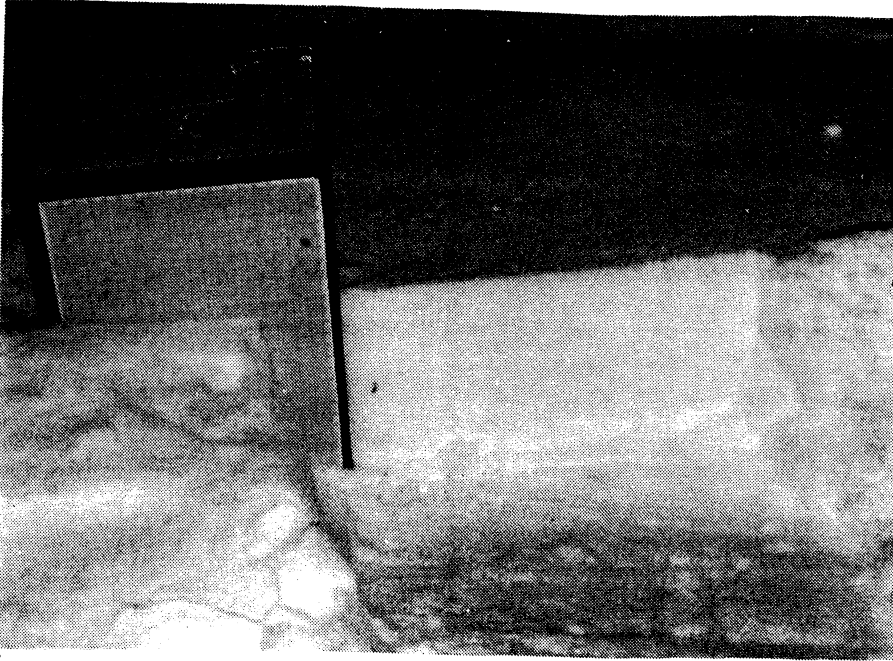


Figure 3.6-5: Snow pit for data collection site, 900226.

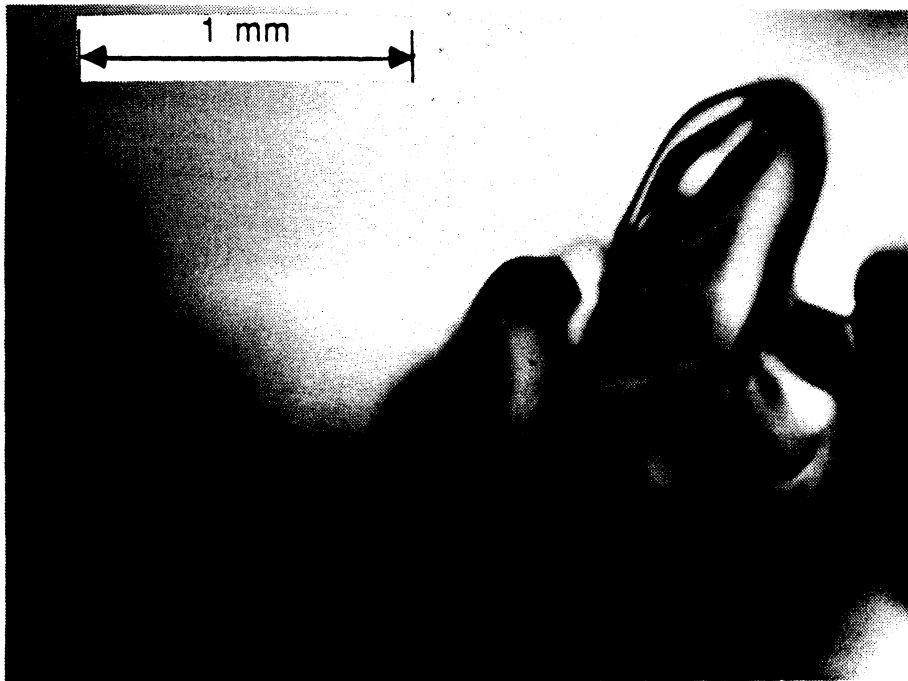


Figure 3.6-6: Metamorphised surface crystal, 900226.

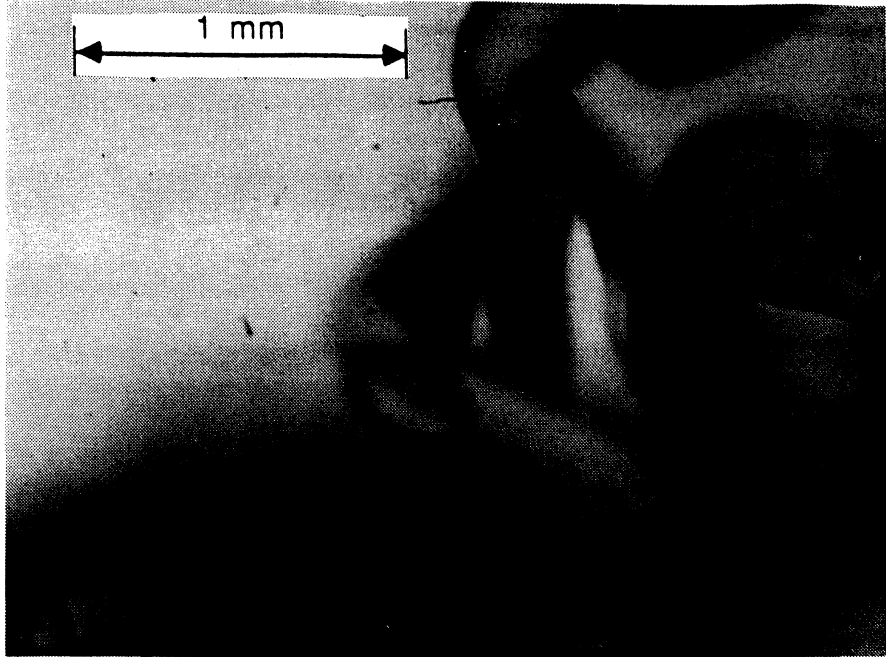


Figure 3.6-7: Metamorphised surface crystal, 900226.



Figure 3.6-8: Overall scene of data collection site for smooth snow, 900227.

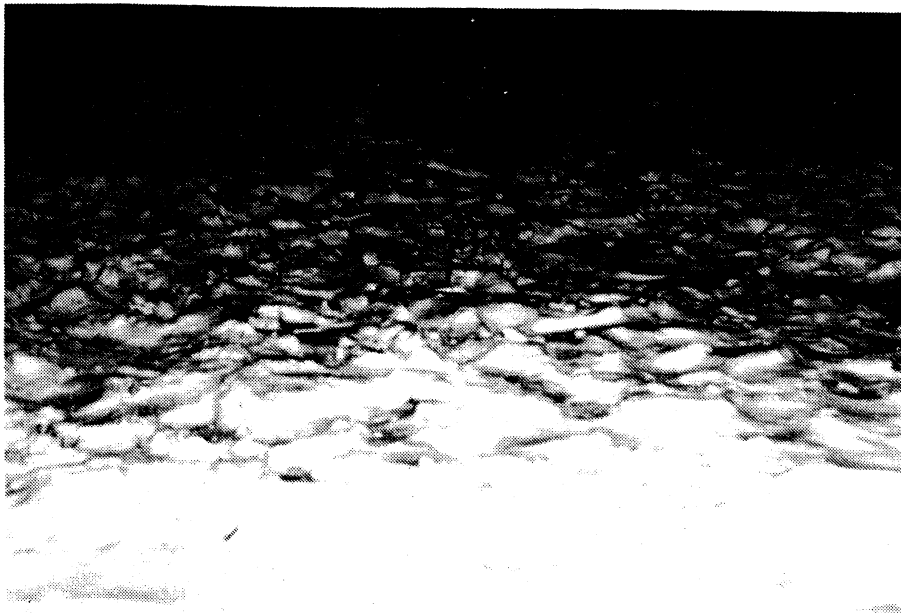


Figure 3.6-9: Overall scene of data collection site for rough snow, 900227.

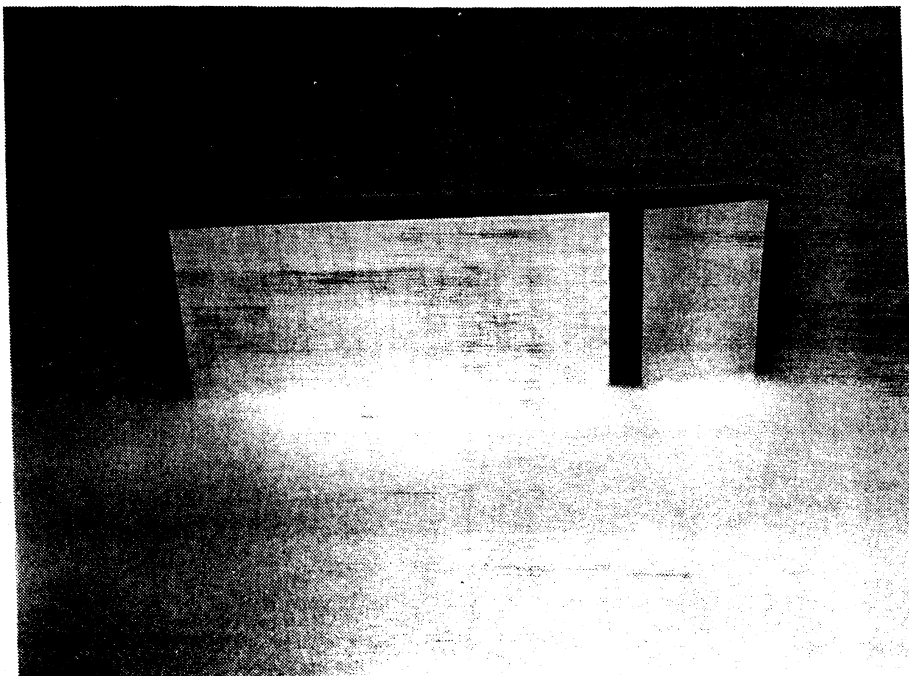


Figure 3.6-10: Surface profile with one-centimeter grid for smooth snow from data collection site, 900227.

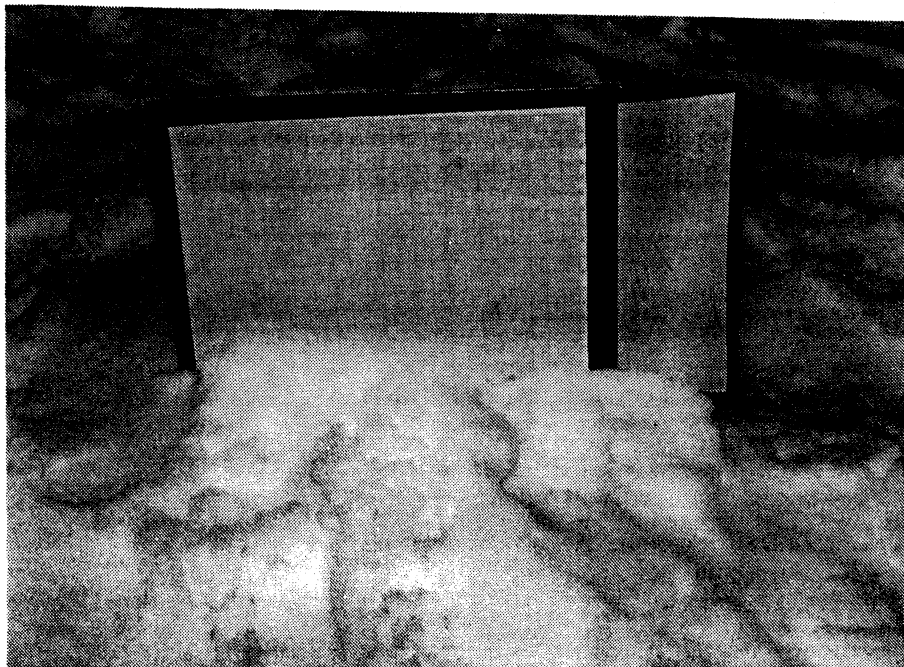


Figure 3.6-11: Surface profile with one-centimeter grid for rough snow from data collection site, 900227.



Figure 3.6-12: Snow pit for data collection site of 900227.

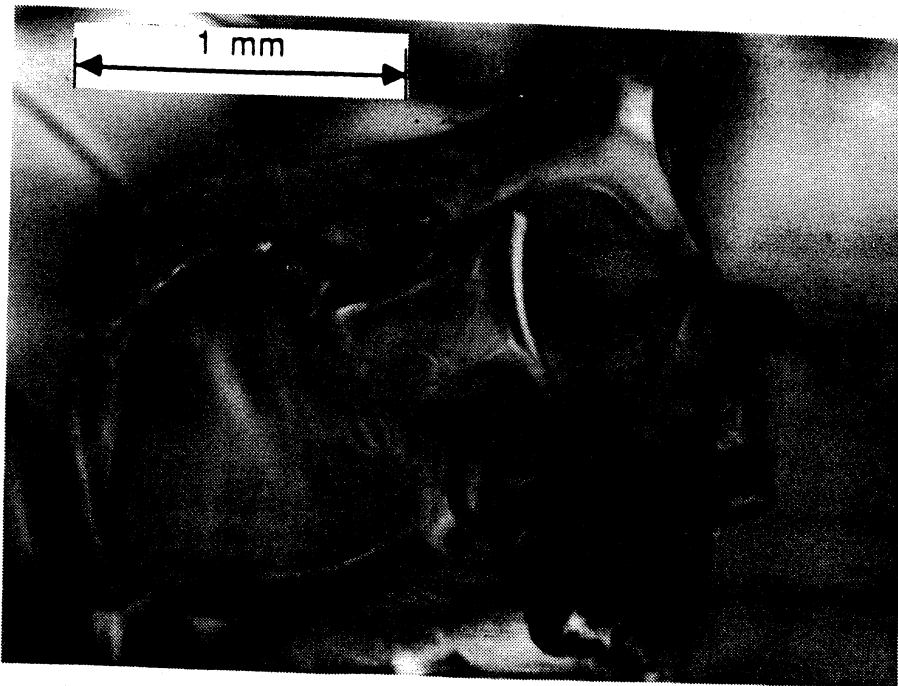


Figure 3.6-13: Metamorphised surface crystal, 900227.

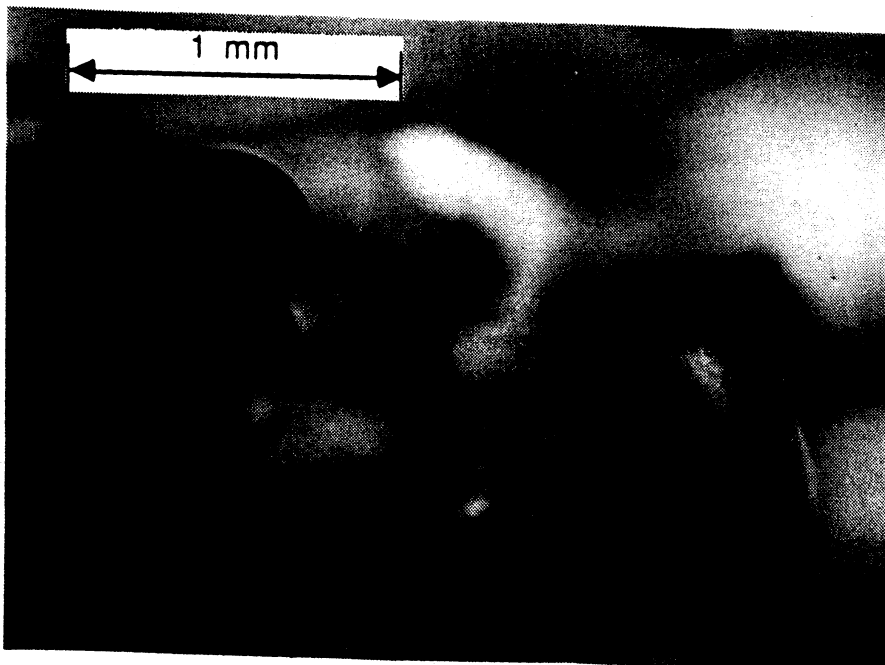


Figure 3.6-14: Metamorphised surface crystal, 900227.



Figure 3.6-15: Overall scene of data collection site, 900301.

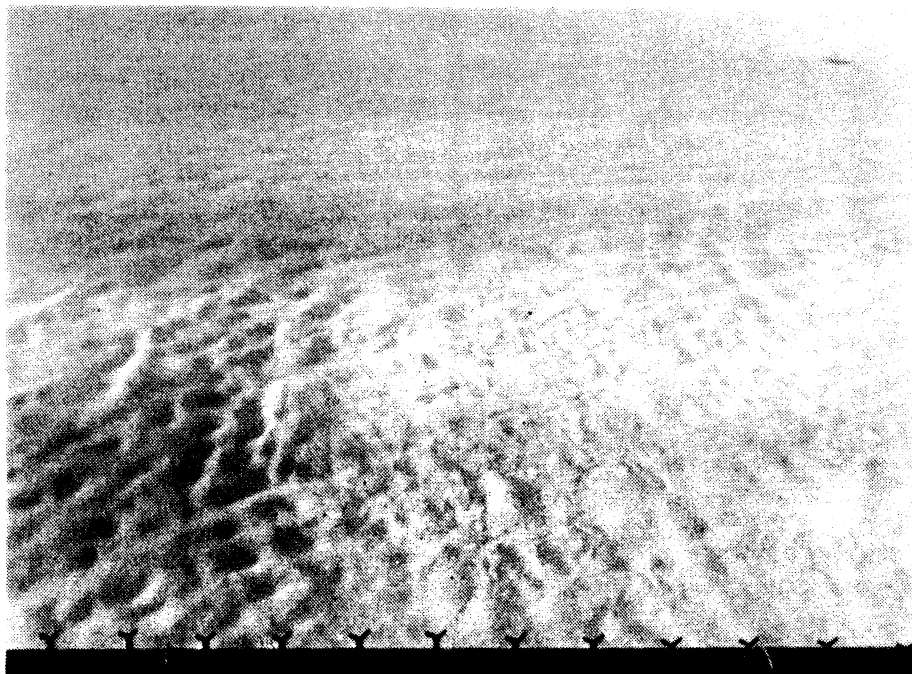


Figure 3.6-16: Overall scene of data collection site, 900301.

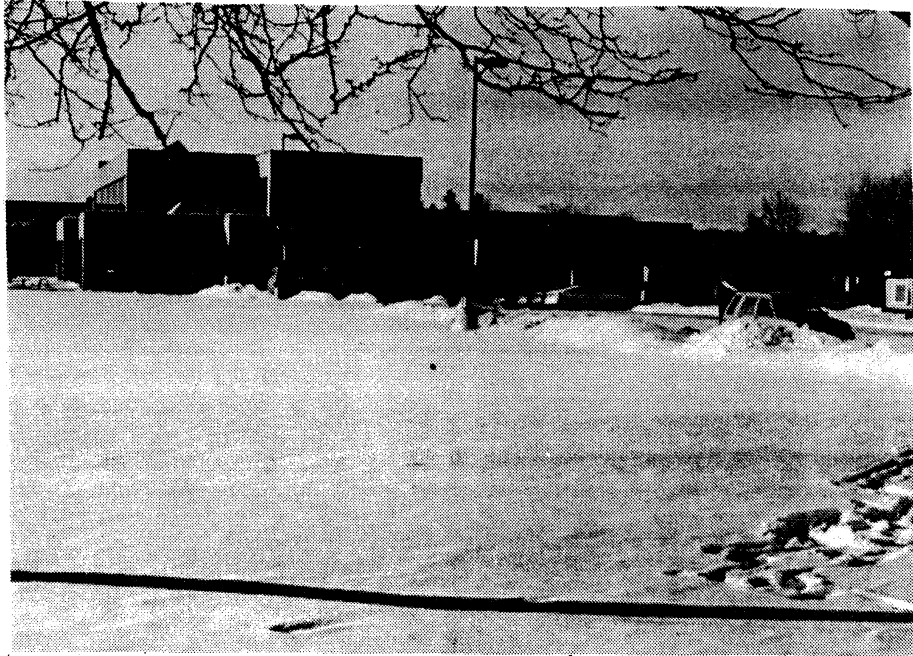


Figure 3.6-17: Overall scene of data collection site, 900306.

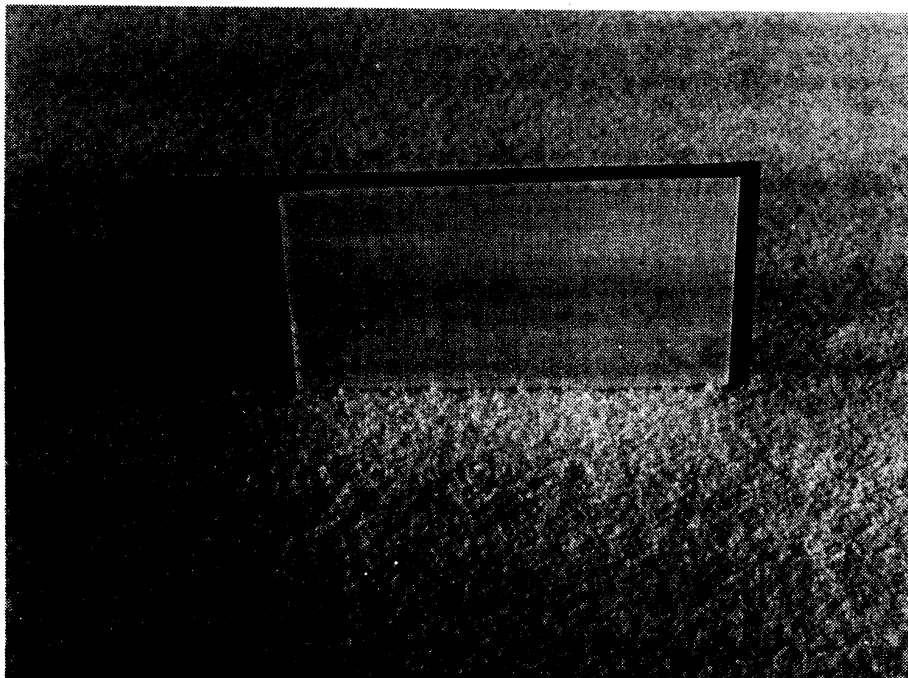


Figure 3.6-18: Surface profile with one-centimeter grid for data collection site, 900306.

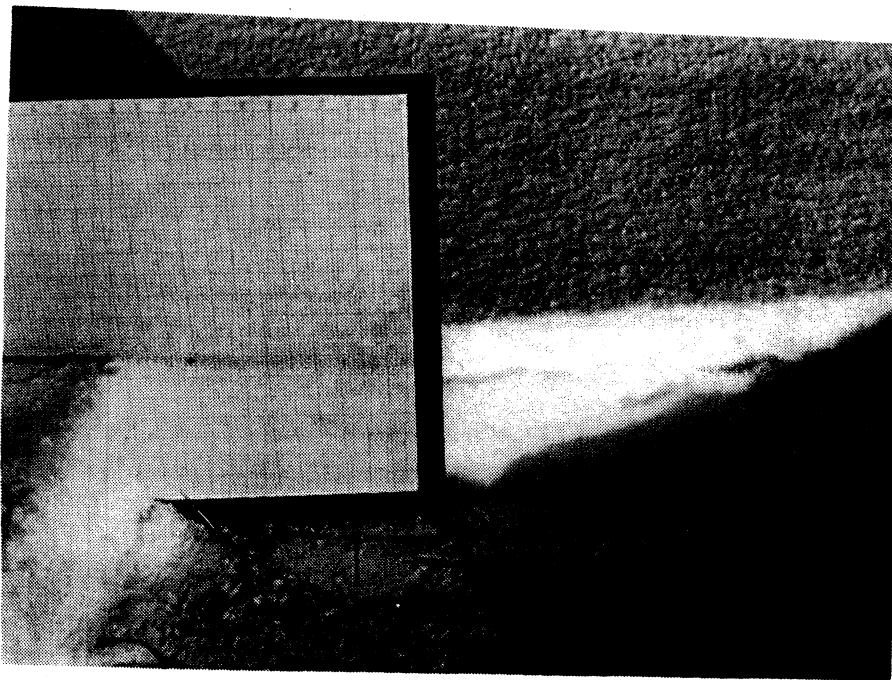


Figure 3.6-19: Snow pit for data collection site, 900306.

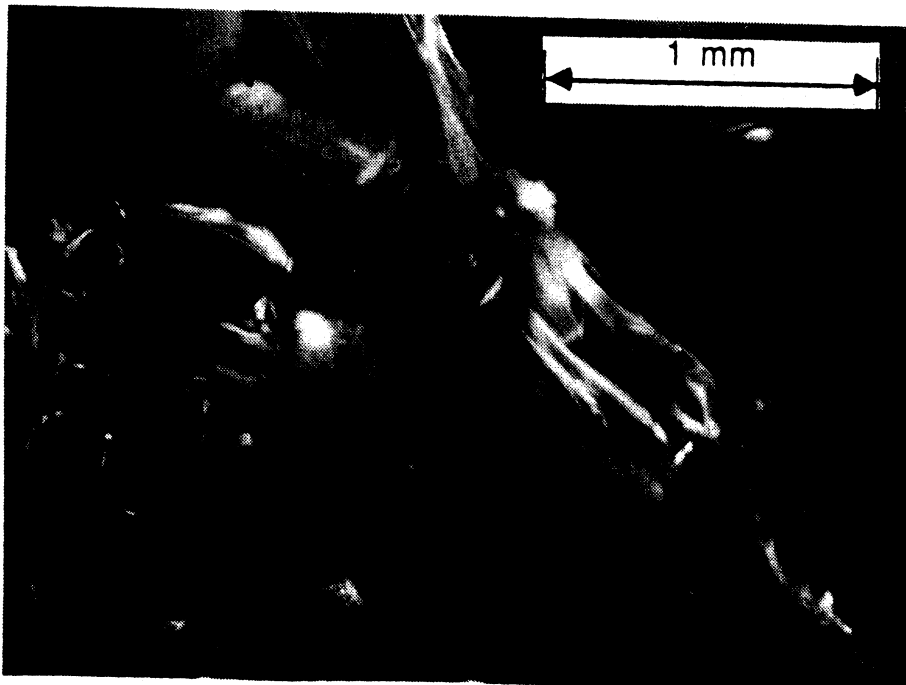


Figure 3.6-20: Metamorphised surface crystal, 900306.

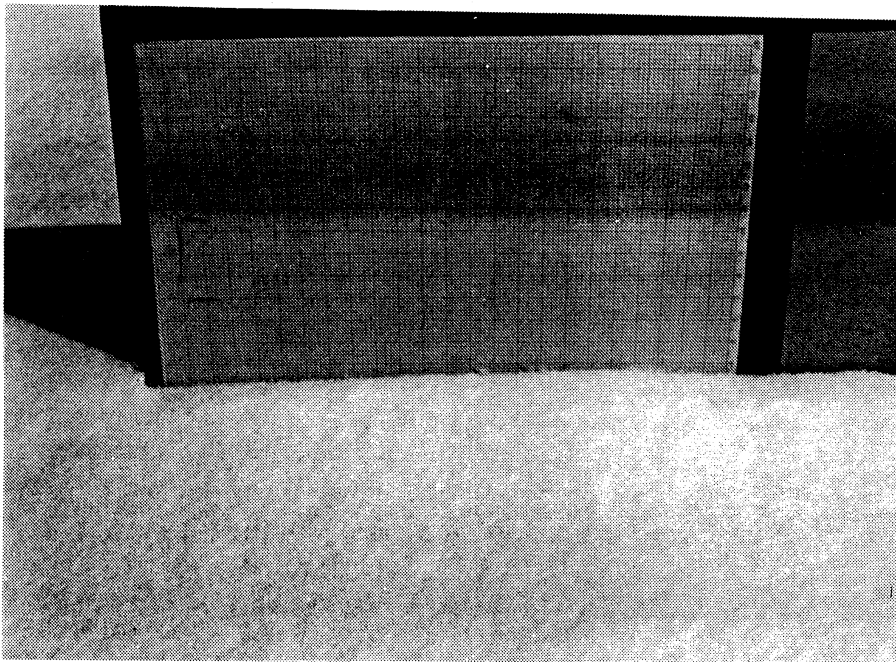


Figure 3.6-21: Surface profile with one-centimeter grid for data collection site, 900307.



Figure 3.6-22: Snow pit for data collection site, 900307.

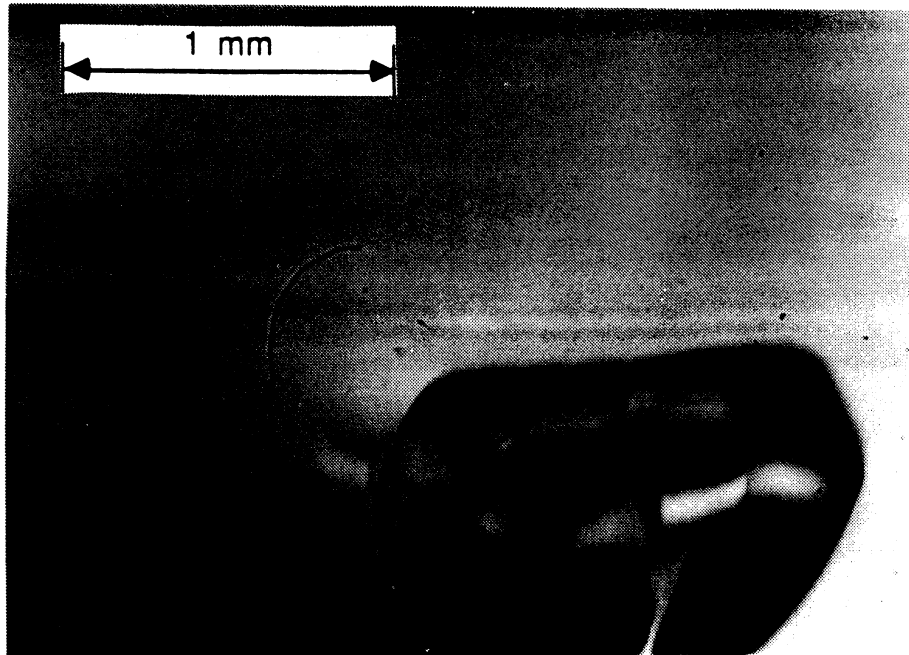


Figure 3.6-23: Metamorphised surface crystal, 900307.