April 1994 SIR-C/X-SAR Mission: Ancillary Data Report
Raco, Michigan Site

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Abstract

This report documents the ancillary measurements taken during the period April 3 - 20 at the Raco supersite in conjunction with the April 1994 SIR-C/X-SAR mission. For this mission, data collection concentrated on time-sensitive measurements in the following categories:

1. Surface properties:
    a. snow depth, wetness, and density
    b. soil status (frozen/unfrozen), moisture, bulk density, and temperature
2. Canopy properties: vegetation moisture/dielectric properties
3. Meteorological conditions: temperature and precipitation

In addition, an array of calibration targets planned specifically for the SIR-C/X-SAR mission was deployed and monitored.

This report provides an introduction to the site, followed by measurement methodologies for each of the ground measurement efforts, summary data tables, and more detailed data in the form of appendices. Electronic versions of the summary data tables and appendices are available on request. Requests may be sent to: dobson@engin.umich.edu

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1. Introduction

1.1 PROJECT OBJECTIVES

On April 9, 1994, the SIR-C/X-SAR instruments were launched on an 11-day mission on the NASA space shuttle Endeavor. Several supersites received frequent overflights, the Raco supersite in the upper peninsula of Michigan being among them. This site was imaged twelve times between April 9 and April 19. The purpose of the mission was to acquire SAR image data for the investigation and analysis of previously defined ecological and environmental questions particularly those related to global climate change. Specifically, six research objectives were linked to the Raco site:

Table 1. April 1994 SIR-C/X-SAR Project Objectives: Raco Supersite

Objectives
1. Estimation of above ground living vegetation biomass
2. Estimation of vegetation canopy moisture content
3. Estimation of snow depth and wetness
4. Estimation of soil condition and moisture content
5. Image classification
6. Image calibration

A team of 17 scientists from the University of Michigan Radiation Laboratory made a number of ancillary measurements during this period in order to meet these objectives. Data collection concentrated on time-sensitive measurements including snowpack conditions, vegetation and soil moisture, and weather data. In addition, an array of calibration targets planned specifically for the SIR-C/X-SAR mission was deployed and monitored. This report presents a summary of the ground data taken during the period April 3 - 20 in conjunction with the space shuttle overflights. It contains a brief introduction to the site, followed by measurement methodologies for each of the

ground measurement tasks, summary data tables, and more detailed data in the form of appendices. Other less time sensitive measurements such as forest composition and biomass were made during the summers 1992-94 and are not included here. Electronic versions of the summary data tables and appendices are available on request. Requests may be sent to: dobson@engin.umich.edu

1.2 THE SITE

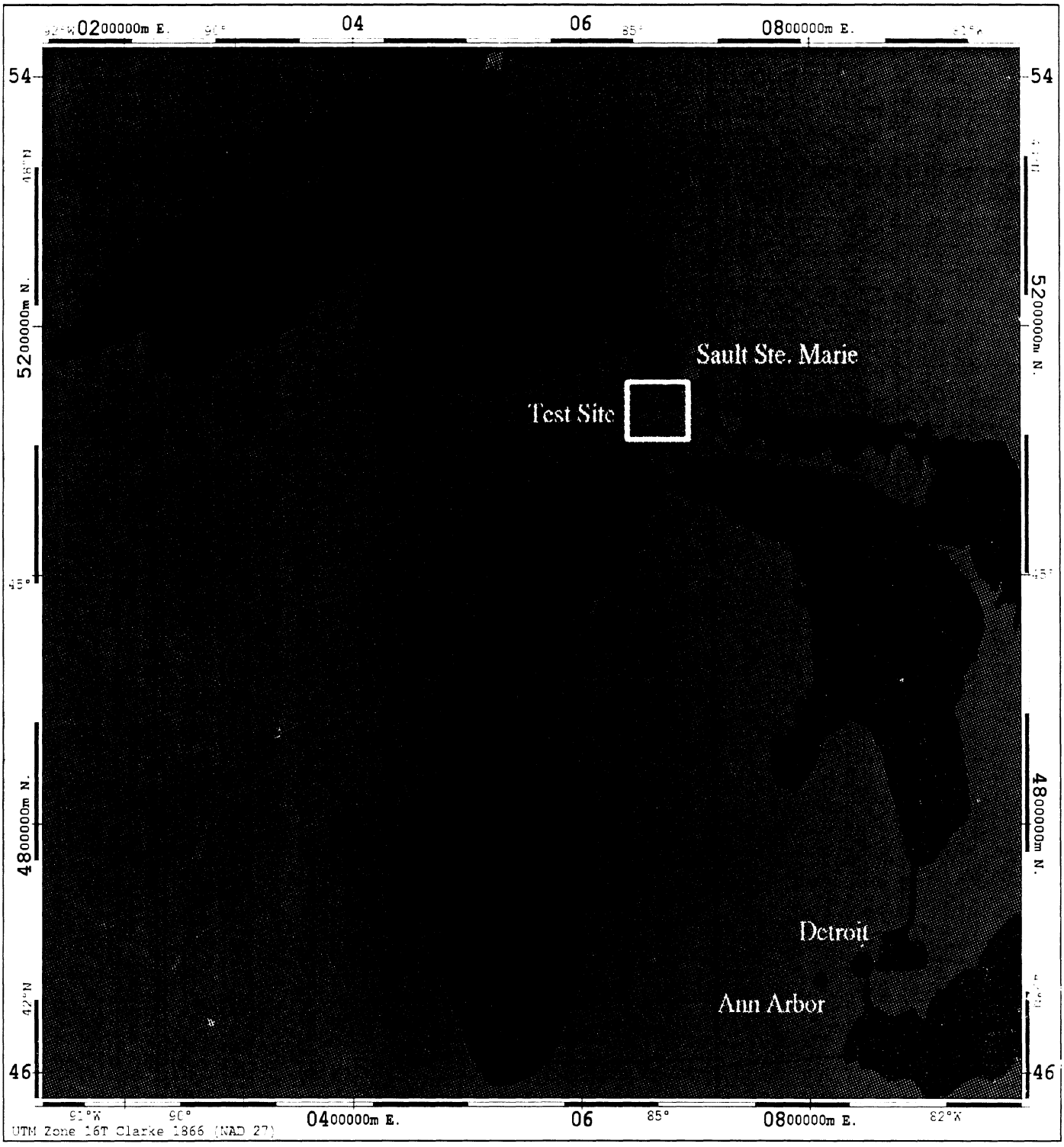
The Raco supersite, centered on 46.392° N. Latitude and 84.885° W. Longitude, is located in Chippewa County in the eastern part of Michigan's Upper Peninsula. The area under study and imaged in the SIR-C/X-SAR crossover region is approximately 20 km E-W and 20 km N-S. Much of the study site, and all of the forest test stands used for ground truth data, are within the boundaries of the Eastern Division of the Hiawatha National Forest. The map *SIR-C/X-SAR Supersite: Raco, Michigan* shows the location of the SIR-C/X-SAR test site in Michigan.

1.2.1 Physiography

The site contains several distinct physiographic regions. A large area of excessively drained glacial outwash sands (the Raco Plains) dominates the northeast quadrant. The southeast quadrant contains an extensive poorly drained wetland area. Moderately well drained morainal features interspersed with low-lying somewhat poorly drained areas comprise the western half. The northern edge of the site borders Lake Superior. Agricultural areas on lake plain border the northeast, and the Delirium Wilderness wetlands border the south and southeast. Forested areas on morainal till continue to the west.

1.2.2 Climate

Regional climate is characterized by a mean annual temperature of 5°C, July average temperature of 24.5°C, January average temperature of -14°C, growing season of approximately 130 days, and mean annual precipitation of 79 cm. The SIR-C/X-SAR overflight occurred at a time of great seasonal change, the spring thaw. This results in a breakup of the ice pack on the great lakes and rapid reductions in the thickness of the terrestrial snow pack.



SIR-C Supersite: Raco, Michigan

Kilometers 100 0 100 200 300 400 500

Miles 100 0 100 200

On the day of the launch, the extensive ice cover on nearby Whitefish Bay in Lake Superior and the terrestrial snow cover in the area ranged from about 20 cm in forest clearings to over 50 cm in heavily forested areas. In the forested areas, the smallest amount of snow cover was found in deciduous forests (aspen and northern hardwoods), and the greatest amounts in conifer forest (pines and lowland conifers). Variable temperature and wind conditions throughout the mission lead to the breakup and movement of the ice pack from Whitefish Bay and had reduced the snow pack to 0 cm in clearings and less than 30 cm in forested areas. At the same time, the near-surface layer of the soil in forest clearings, generally frozen to at least 5 cm at launch, had thawed and drained (in sandy soils) by the end of the mission on April 19. Within the forest, all woody vegetation maintained above freezing temperatures throughout the mission.

1.2.3 Forest Composition

The Raco site's situation on the ecotone between the north-temperate and boreal forest biomes, its diversity of forest communities of varying ages and densities, and its forest stands of large geographical extent made it an ideal NASA supersite.

Present on the drier outwash are upland conifer communities; on the low sites lowland conifer or forested wetlands communities; on the richer sites either late successional northern hardwoods or early successional aspen communities. The map *Land Cover--SIR-C/X-SAR Supersite: Raco Michigan* depicts the generalized land cover distribution for the test region. Table 2 lists the forest communities and dominant species which have been studied throughout the duration of the SIR-C/X-SAR project.

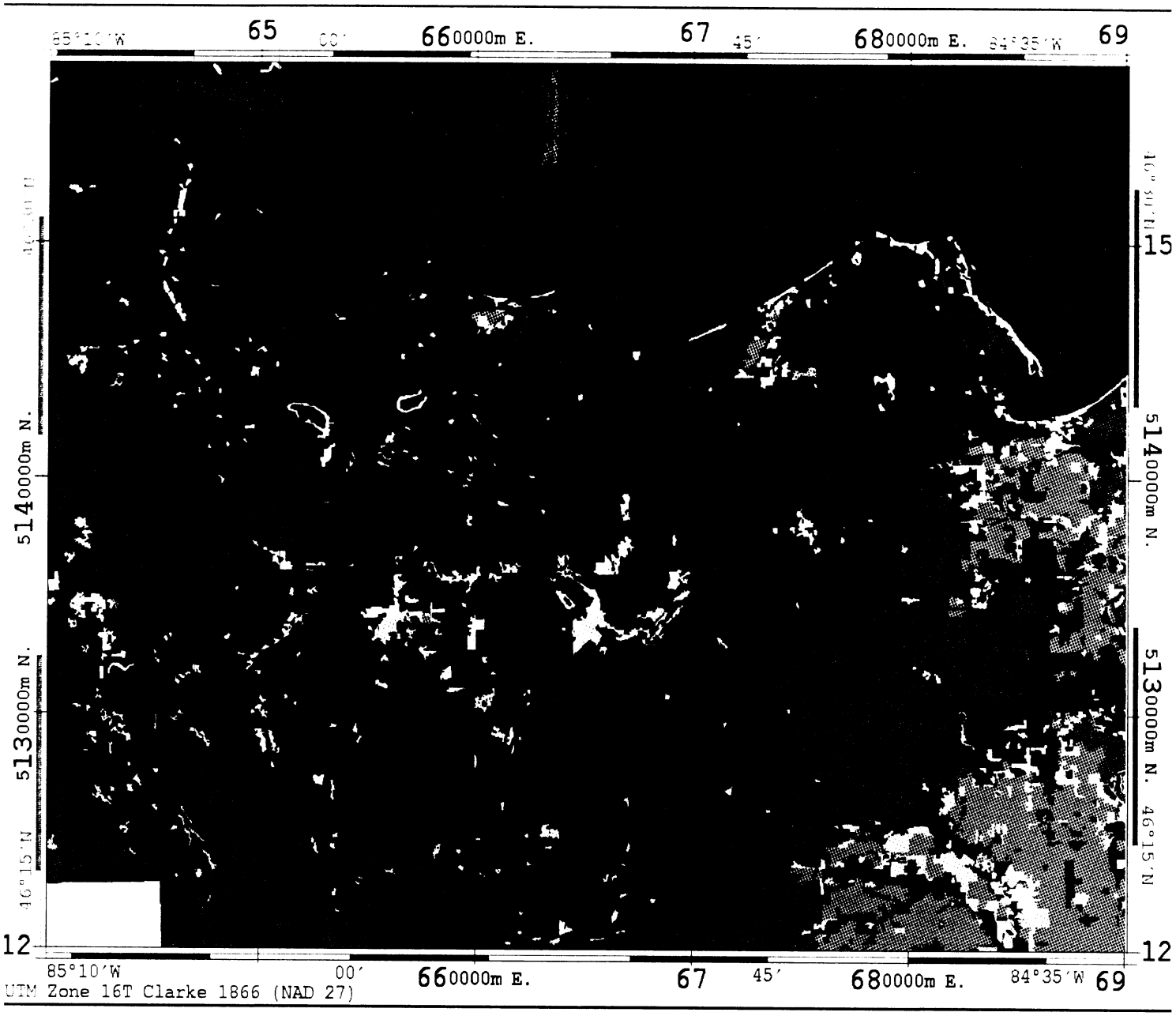
Over the past four years, sixty-six forest test stands representing the distribution of forest communities, ages, and densities found at the Raco site have been sampled. These have been described statistically and compiled into an extensive ground-truth database providing estimates of species composition, height, density, diameter, crown depth, LAI, and biomass [1,2,3]. While these data are documented in separate reports, the test stand locations are depicted on the map *SIR-C/X-SAR Test Stands and Calibration Sites* .

Table 2: Forest Communities and Dominant Species Studied During the SIR-C/X-SAR Project

Upland Conifer
Jack Pine (*Pinus banksiana*)
Red Pine (*Pinus resinosa*)
White Pine (*Pinus strobus*)
Lowland Conifer
Black Spruce (*Picea mariana*)
White Spruce (*Picea glauca*)
Northern White Cedar (*Thuja occidentalis*)
Balsam Fir (*Abies balsemea*)
Larch (*Larix laricina*)
Northern Hardwoods - late successional species
Sugar Maple (*Acer saccharum*)
Red Maple (*Acer rubrum*)
Beech (*Fagus grandifolia*)
Yellow Birch (*Betula alleghaniensis*)
Paper Birch (*Betula papyrifera*)
Hemlock (*Tsuga canadensis*)
Aspen - early successional species
Trembling Aspen (*Populus tremuloides*)
Bigtooth Aspen (*Populus grandidentata*)
Pin Cherry (*Prunus Pensylvanica*)

1.3 THE SIR-C/X-SAR OVERFLIGHT

The SIR-C/X-SAR flight path including overlap region is also depicted on the map *SIR-C/X-SAR Test Stands and Calibration Sites*. The ascending path had a track angle of 52° - 53°, and the descending path a track angle of 127° - 133°. Except for the precipitation gauge network, almost all ground-truth data represented in this report were collected within the approximately 20 km x 20 km path overlap region. The time of the overflights ranged form 5:25 a.m. to 2:55 p.m. local time (EDT). Information pertaining to specific overflights, such as date and time, data take number, ascending/descending, look angle, and local incidence angle, can be found in Section 2.1, Table 4: *Calibration Targets*.



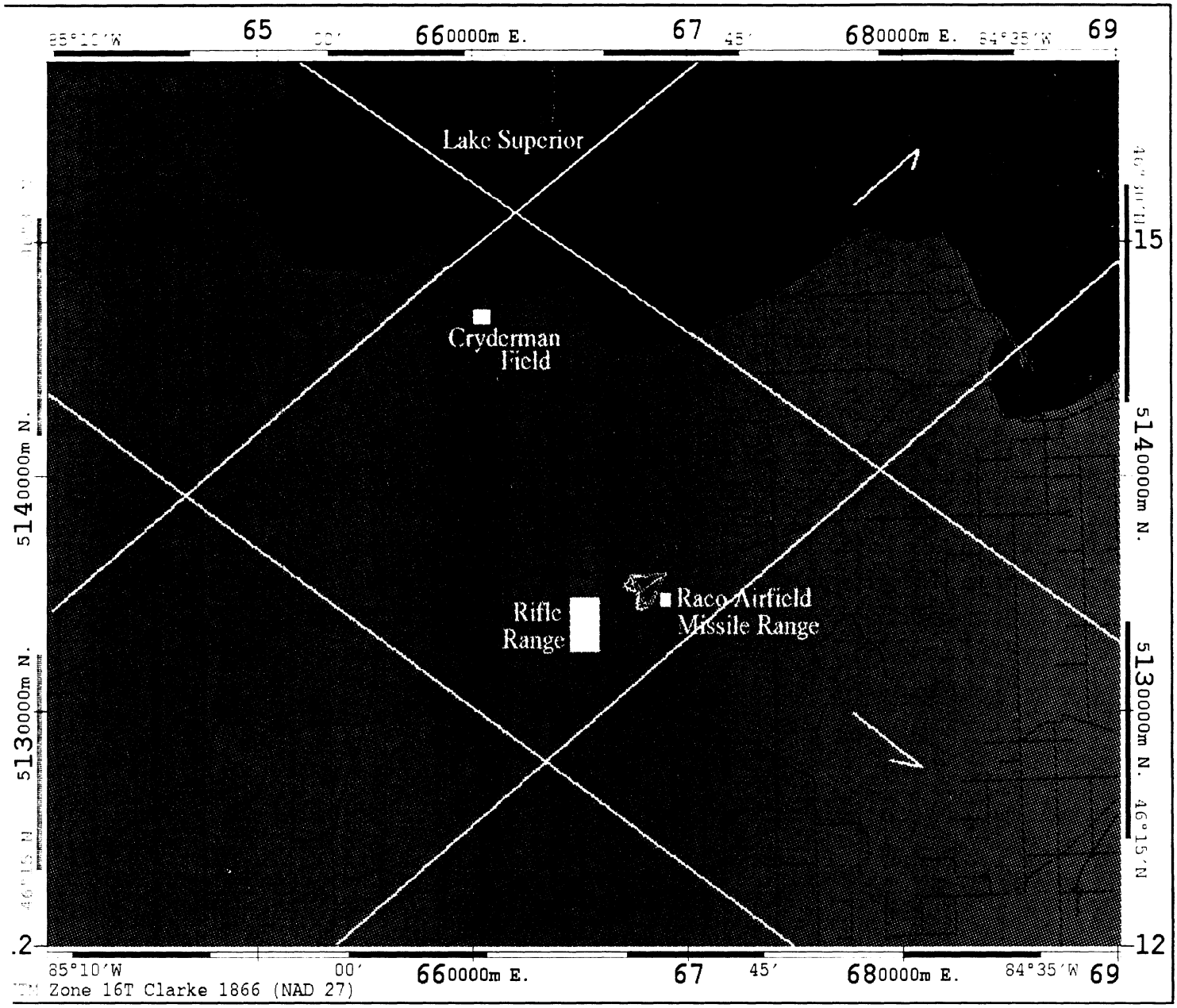
Land Cover

SIR-C Supersite: Raco, Michigan

Kilometers 10 0 10 20

Miles 10 0 10

- Northern hardwood
- Conifer
- Wetland
- Water
- Agriculture
- Rangeland
- Urban
- Airport



SIR-C Test Stands and Calibration Sites

Raco, Michigan Supersite

Kilometers 10 0 10 20

Miles 10 0 10

- Forest test stands
- Calibration sites
- SIR-C imaged swath

2 Ancillary Measurement Methodologies and Data Summaries

With the exception of calibration, discussed in section 2.1, ancillary data collection concentrated on measuring physical scene properties known or expected to be time varying the during the April time frame. These fell into three general categories:

1. Surface properties:
    a. snow depth, wetness, and density
    b. soil status (frozen/unfrozen), moisture, bulk density, and temperature
2. Canopy properties: vegetation moisture/dielectric properties
3. Meteorological conditions: temperature and precipitation

A snow pit procedure was used to capture snowpack wetness and density at varying times of the diurnal cycle, under both shaded and unshaded conditions. Two pits, one shaded and one unshaded, were dug and measurements made at specific intervals along the vertical face of the snowpack. This procedure, with results, are summarized in section 2.2.1, and detailed in Appendices A and B. To assess mean snow depth, wetness, and density, plus soil moisture, bulk density, and temperature in representative forest test stands and clearings, a series of transects were run in the chosen areas and measurements made at determined horizontal intervals. This procedure and its results are presented in section 2.2.2 and detailed in Appendices C and D.

Forest canopy moisture status was estimated by measuring tree dielectric properties in three ways. These were 1) to assess the general moisture status for all species of interest for the April time frame, 2) to determine temporal variance in moisture, and 3) to assess moisture differences between species size/age classes. The sampling frames, measurement procedures, and summary results are presented in section 2.3 and Appendices E and F.

Meteorological data were collected by several means. Weather stations in the area provided data, and precipitation measurements were obtained from a network of 21 precipitation gauges deployed specifically for the SIR-C/X-SAR mission project. These data are discussed and reported in section 2.4 plus Appendices G and H.

For each of these measurement procedures, the following sections provide 1) a table outlining the hypotheses, objectives, and methods, 2) an explanation of the methodology, and 3) results in the form of summary tables.

2.1 CALIBRATION

Development of image calibration algorithms has been a goal throughout the duration of the SIR-C/X-SAR project. The objectives and methods used for assuring accurate calibration for the April mission imagery were as follows.

Table 3: Calibration: Objectives and Methods

Objective	Method
1. Absolute calibration of SIR-C/X-SAR imagery acquired at L,C, and X bands	1a. Deploy and monitor appropriate point targets 1b. Measure backscatter for area extended targets with a calibrated scatterometer system.
2. Accurate calibration over the geographical extent of the imaged scenes	2. Place 16 targets in several locations

Appropriate calibration targets needed to be distributed in open areas within the area imaged by the sensors. Both passive and active targets were deployed. Six 1.07 m trihedrals and one C-band parc were located at the Rifle Range near the Raco Airfield. Two 2.4 m trihedrals were located at the Raco Airfield. Four 2.4 m trihedrals, one L-band single antenna polarimetric active radar calibrator (saparc), one C-band saparc, and one C-band parc were located at Cryderman Field.

Details regarding target positioning, including gps derived coordinates, target type, and measured elevation angles and azimuths, can be found in Table 4: *Calibration Targets.* The three target locations are depicted on the map *SIR-C/X-SAR Test Stands and Calibration Sites.* Targets were repositioned and/or monitored for accurate positioning before each overflight using electronic levels and Brunton compasses.

Scatterometer measurements were made at L, C, and X-bands in conjunction with each SIR-C/X-SAR overpass. These measurements were made at Cryderman field. These measurements are not described herein.

Table 4: Calibration Targets

Calibration Target Plan at Raco Supersite April 1994 Mission Local magnetic declination is 6.138° W All PARCs 1 1.0000 -1 -1.0000					MET (dd/hh:mm:ss) Orbit No. Data-Take No. Ascending/Descending North/South Looking (from Shuttle) Look Angle (relative to SIR-C) Local Incidence Angle SIR-C Azimuth Heading (True North) Target Azimuth (True North) Target Looking (N/S) Target Azimuth (Mag. North)			00/07:50:29 6 6.1 D S 30.14 31.387 127.461 127.86 N 134			01/07:32:17 22 22.2 D S 19.33 20.132 128.428 127.86 N 134		
			Location											
Site	Target Name	/ Descending	Latitude	Longitude	Target Type	Size (cm)	Max. RCS (dBm^2)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)
RIFLE RANGE	T2-1	A/D	46.3337	-84.8593	Trihedral	107		30.5	128.9	1.7	30.7	127.9	0.8
	T2-2	A/D	46.3360	-84.8575	Trihedral	107		29.2	128.9	1.1	15.6	155.9	16.6
	T2-3	A/D	46.3453	-84.8497	Trihedral	107		29.6	127.9	5.8	7.5	152.9	15.7
	T2-4	A/D	46.3452	-84.8512	Trihedral	107		27.2	124.9	1.4	29.6	129.9	0.4
	T2-5	A/D	46.3481	-84.8487	Trihedral	107		30.0	128.9	1.3	30.5	128.9	1.0
	T2-6	A/D	46.3506	-84.8500	Trihedral	107		31.2	127.9	-0.5	28.7	129.9	0.1
	P4	A/D	46.3362	-84.8592	C-PARC #2		42.4	31.4	127.4	0.1	30.1	128.9	0.8
RACO AIRFIELD	T1-5	A/D	46.3468	-84.8058	Trihedral	240		30.3	128.9	0.6	29.8	128.9	0.2
	T1-6	A/D			Trihedral	240							
CRYDERMAN FIELD	T1-1	A/D	46.4591	-84.9070	Trihedral	240		31.0	126.9	0.0	30.4	127.9	0.0
	T1-2	A/D	46.4562	-84.9093	Trihedral	240		31.5	128.9	1.1	30.2	127.9	1.4
	T1-3	A/D	46.4561	-84.9130	Trihedral	240		31.3	125.9	0.5	31.6	127.9	0.3
	T1-4	A/D	46.4571	-84.9152	Trihedral	240		31.0	126.9	0.8	31.4	126.9	0.7
	P1	A/D	46.4578	-84.9104	L-SAPARC			32.1	125.9	1.0	19.9	127.9	0.4
	P2	A/D	46.4597	-84.9102	C-SAPARC			?	?	?	20.2	128.9	yes
	P3	A/D	46.4583	-84.9126	C-PARC #1		44.5	?	?	?	19.4	128.9	0.3
			Date						**Saturday**			**Sunday**	
			Day						**9-Apr**			**10-Apr**	
			Time						**14:55:29**			**14:32:17**	

		04/00:25:22 66 66.2 A S 21.65 22.65 51.853 232.86 N 239			05/00:05:44 82 82.2 A S 29.53 30.849 52.341 232.86 N 239			05/06:15:43 86 86.4 D N 23.77 24.531 131.101 311.86 S 318			05/23 45 41 98 98 12 A S 35 512 36 801 52.911 232 86 N 239		
Site	Target Name	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)
RIFLE RANGE	T2-1	30.6	53.9	0.1	30.2	236.9	0.1	30.9	310.9	0.2	9.9	232 4	0 4
	T2-2	31.6	53.9	0.9	30.6	233.9	0.1	30.0	313.9	0.3	9 9	233 4	0 4
	T2-3	29.6	54.9	0.5	28.5	234.9	0.2	29.9	315.9	0.4	9 9	232 4	0 1
	T2-4	29.6	52.9	0.7	29.2	237.9	-0.3	30.5	311.9	0.2	9.3	233 9	0 0
	T2-5	30.9	53.9	0.5	30.4	235.9	0.8	30.2	309.9	-0.2	10.1	233 9	0 1
	T2-6	30.5	53.9	0.9	30.7	233.9	1.2	30.5	311.9	1.0	10.2	232 9	0 0
	P4	20.7	52.9	0.1	30.8	232.9	0.1	24.5	311.9	0.0	36.8	232 9	0 0
RACO	T1-5				30.5	231.9	0.4	30.1	311.9	0.1	9.8	232 8	0 2
AIRFIELD	T1-6				30.0	233.9	0.7	30.3	312.9	0.1	11.0	233 1	0 2
CRYDERMAN	T1-1	30.4	53.9	0.5	30.0	233.9	0.5	30.0	312.9	0.0	.	.	.
FIELD	T1-2	30.6	53.9	0.3	30.2	232.9	0.0	29.6	311.9	0.6	.	.	.
	T1-3	30.9	51.9	1.0	31.0	233.9	0.1	29.6	311.9	0.2	10 3	236 9	0 0
	T1-4	31.1	52.9	-0.6	31.1	232.9	0.7	30.0	311.9	0.4	11 1	232 9	0 6
	P1	21.6	51.9	0.5	30.9	232.9	0.8	24.9	312.9	0.1	35 1	239 9	2 0
	P2	23.4	52.9	ok	30.7	235.9	ok	24.8	310.9	ok	36.5	236 9	ok
	P3	22.8	52.9	0.5	29.2	235.9	1.1	24.5	311.9	0.4	37 2	241 9	0 3
			Wednesday 13-Apr 7:30:22			**Thursday 14-Apr 7:10:44**			**Thursday 14-Apr 13:20:43**			**Friday 15-Apr 6:50:41**	

		06/05:55:33 102 102.41 D N 30.701 31.747 131.674 311.86 S 318			06/23:25:12 114 114.1 A S 40.09 41.799 53.567 232.86 N 239			07/05:34:57 118 118.6 D N 35.903 37.268 131.959 311.86 S 318			08/05 13 57 134 134 3 D N 39 787 41 306 132 328 311 86 S 318		
Site	Target Name	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)
RIFLE RANGE	T2-1	29.6	312.9	0.5	11.0	232.9	0.0	-	-	-	-	-	
	T2-2	29.9	313.4	0.5	10.6	231.9	0.0	-	-	-	-	-	
	T2-3	29.8	311.4	0.4	10.8	232.9	0.2	-	-	-	-	-	
	T2-4	-	-	-	10.9	233.9	0.2	9.7	311.9	0.4	10.4	309 9	0 3
	T2-5	30.0	311.9	0.3	10.3	232.9	0.2	9.9	311.9	0.1	9.7	312 9	0 0
	T2-6	-	-	-	10.6	231.9	0.4	9.7	310.9	0.4	9.6	310 9	0 5
	P4	31.7	311.9	0.0	41.8	232.9	0.0	37.3	311.9	0.0	41.0	313 9	0 0
RACO	T1-5	29.3	313.4	0.4	9.3	234.7	0.3	-	-	-	-	-	
AIRFIELD	T1-6	30.4	311.9	0.1	10.6	232.7	0.3	10.7	313.9	1.0	18.7	317.9	1 2
CRYDERMAN	T1-1	-	-	-	12.2	223.9	2.9	11.0	311.9	0.4	10.5	311 9	0 4
FIELD	T1-2	-	-	-	-	-	-	9.4	314.9	2.3	10.8	318 9	1 3
	T1-3	29.5	312.9	0.0	15.1	230.9	1.6	-	-	-	-		
	T1-4	30.0	313.9	0.4	9.9	232.9	1.0	-	-	-	-		
	P1	31.0	310.9	<2.0	41.7	232.9	2.0	?	?	?	42.0	312 9	1 4
	P2	31.4	310.9	ok	40.9	227.9	ok	37.0	312.9	ok	42 1	312 9	ok
	P3	32.4	313.9	0.4	41.2	232.9	0.3	37.6	311.9	0.5	41.4	313 9	0 8
			Friday 15-Apr 13:00:33			**Saturday 16-Apr 6:30:12**			**Saturday 16-Apr 12:39:57**			**Sunday 17-Apr 12:18:57**	

		09/04:52:22 150 150.2 D N 42.55 44.308 132.785 311.86 S 318			09/22:20:59 162 162.3 A S 47.325 49.67 54.17 232.86 N 239		
Site	Target Name	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)	Elevation Angles (From horizontal)	Azimuth (from True north)	Level (degrees)
RIFLE RANGE	T2-1				10.6	52.9	0.1
	T2-2				10.4	52.9	0.0
	T2-3				10.6	52.9	0.1
	T2-4	10.1	311.9	-0.3			
	T2-5	9.6	312.4	-0.1			
	T2-6	9.6	311.9	-0.6			
	P4	43.8	311.9	0.5			
RACO AIRFIELD	T1-5	10.0	59-6.14	0.0	10.0	52.9	0.0
	T1-6	10.0	311.9	0.0			
CRYDERMAN FIELD	T1-1	10.4	310.9	0.4			
	T1-2	10.4	318.9	1.5			
	T1-3	11.4	51.9	0.4			
	T1-4	10.8	51.9	1.2			
	P1	44.9	312.9	0.3			
	P2	44.2	313.9	?			
	P3	43.8	312.9	0.6			
			Monday 18-Apr 11:57:22			Tuesday 19-Apr 5:25:59	

2.2 SNOW AND SOIL

2.2.1 Snow Pack Wetness and Density: Shaded vs. Unshaded Snow Pit Measurements

This procedure was undertaken in order to provide the ancillary data necessary for determining the effect of snow wetness and density on SIR-C/X-SAR image backscatter as outlined below:

Table 5: Snow Wetness and Density: Hypotheses, Objectives, and Methods

Hypothesis	Objective	Method
1. Snow wetness and density varies with degree of shading by a vegetation canopy.	1. Measure snowpack wetness and density under differing degrees of shading found in the test site.	1. Take measurements in two snow pits - one completely unshaded and one completely shaded.
2. Snow wetness and density varies with the diurnal oscillation of air temperature.	2. Account for snowpack wetness and density as a function of time.	2. Take measurements concurrently with shuttle overflights ranging from 7:10 a.m.-2:55 p.m. EDT.

Due to the nature of the data collection technique, the equipment used, and especially the strong time-dependence of the quantities being measured, it was not possible to measure these quantities in all ideally desired conditions/locations to meet objective one. A compromise plan tracked the snow behavior in each of two scenarios, totally exposed to the sun, and totally shaded from the sun. These approximated the conditions found in clearings vs. under coniferous forest canopies during the month of April.

The following describes the methods used in characterizing snowpack wetness and density. A bare area between the road and the fence at Cryderman field was chosen as a test site. In this location there existed a fairly large (9 m X 12 m), unperturbed expanse of snow approximately 45 cm deep. A canopy was erected which provided continuous shade over a patch of snow approximately 1.5 m X by 5 m. Another patch of snow of equivalent dimensions parallel to and approximately 3 m away from the shaded patch was designated as the sun-exposed patch.

Snow pits were dug down to the ground at the beginnings of each of these two areas. The snow pits could accommodate a person to sit on a stool in order to make dielectric measurements using a snow probe on the facing snow

wall. A tether (microwave cables) connected the snow probe to equipment located in the back of a station wagon approximately twenty feet away. A gasoline-powered generator supplied electricity to the test equipment. In addition to the person in the snow pit, another person sat in the vehicle operating a computer. The two parties communicated via radio headsets.

The snow probe gives estimates of the dielectric constant of snow, e's and e"s; and these are then used to determine the density ρs and liquid water content m_v of the snow [4]. Tests using the snow probe showed that the natural variance for snow wetness and density, even within essentially the same region of the snowpack, was such that a single measurement contained a prohibitively high level of uncertainty. For this reason, five independent measurements were made for each horizontal layer in a depth profile[4]. Each measurement took approximately one-half minute.

To facilitate measurement of a depth profile (of both snow wetness and density) in the shortest amount of time, a compromise was necessary with respect to the level of spatial detail obtained. The following describes the strategy applied. After clearing a fresh snow interface, sets of five measurements were made in each of several designated depth "blocks". For example, "block 1" always sampled the top 2.5 centimeters. The next 5 cm region became "block 2". After this, each succeeding 10 cm region was designated as a block. In this fashion, fairly high spatial detail was obtained near the top of the snowpack while allowing the completion of the entire profile in a reasonable amount of time. Using the scheme above, the entire profile for a 46 cm deep snowpack could be collected in 15-20 minutes.

Although it would have been ideal to obtain simultaneous measurements in both the shaded and the unshaded pits, in practice this was not possible. By moving back and forth between the two pits a very close approximation was achieved. Two blocks in one pit would be measured, then the operator would move over to the other and measure the first four blocks, then move back to the first, etc. This made the total measurement time for complete profiles on each of the two pits about one hour. To address the question of time variation on snow wetness and density, one depth profile was carried out as coincident as possible with the shuttle overflights (which for this procedure ranged from 7:10 a.m. to 2:55 p.m. local time). Partial or full depth profiles were completed during a time frame before the shuttle overflights.

Table 6: Summary of Snow Pit Measurements at Cryderman Field

						OBSERVATIONS				
						Total Snowpack			Top 2.5 cm of Snowpack	
Date	Shaded or Unshaded	Time of Observation (start/stop)	Taken Pre-Flight or During Flight	Time of Overflight	SIR-C / X-SAR Datatake	Depth (cm)	Avg. Density (g/cm3)	Avg. Moisture (% vol.)	Avg. Density (g/cm3)	Avg Moisture (% vol.)
4/9/94	S	14:00/14:40	P	14:55	6.1	41.9	0.48	3.8	0.52	5.1
	U	14:00/14:40	P			47.0	0.43	5.0	0.39	5.0
	S	14:42/15:43	D			41.9	0.42	4.3	0.40	5.1
	U	14:42/15:43	D			47.0	0.43	4.4	0.39	6.2
4/10/94	S	12:40/13:33	P	14:32	22.2	40.7	0.37	5.0	0.35	5.2
	U	12:40/13:33	P			45.7	0.42	6.1	0.40	6.7
	S	13:37/14:37	D			40.7	0.41	4.7	0.41	5.1
	U	13:37/14:37	D			45.7	0.42	5.4	0.40	6.9
4/11/94	S	10:46/11:58			none	38.1	0.39	2.3	0.45	2.6
	U	10:46/11:58				45.8	0.42	2.0	0.46	3.5
4/13/94	S	6:17/7:09	P	7:30	66.2	33.0	0.38	3.4	0.48	3.4
	U	6:17/7:09	P			33.0	0.40	4.5	0.43	4.5
	S	7:11/8:01	D			33.0	0.42	2.5	0.45	2.7
	U	7:11/8:01	D			33.0	0.45	4.1	0.44	3.7
4/14/94	S	6:30/7:24	D	7:10	82.2	30.5	0.38	2.3	0.43	2.9
	U	6:30/7:24	D			30.5	0.39	3.9	0.41	2.6

A summary of the snow wetness and density results appears as Table 6: *Summary of Snow Pit Measurements at Cryderman Field.* Information is organized by day and differentiates the shaded or unshaded condition, and whether the measurements were taken pre-overflight or during the overflight. Total snowpack depth is given, and averages are presented for p_S, and m_V for both the entire pack and for the top 2.5 cm. As an example, the plots in Figure 1 present the April 14 p_S and m_V results. Basic hydrologic theory suggests that increasing snowpack wetness and density should vary directly with rising temperature and inversely with degree of shading (0-100% cover). These plots illustrate the expected increase in wetness and density in the unshaded condition vs. shaded condition. The remaining plots are provided in Appendix B. The data in Appendix A provide the mean density and moisture plus the uncertainty in the estimate of the means for each of the discrete depth blocks.

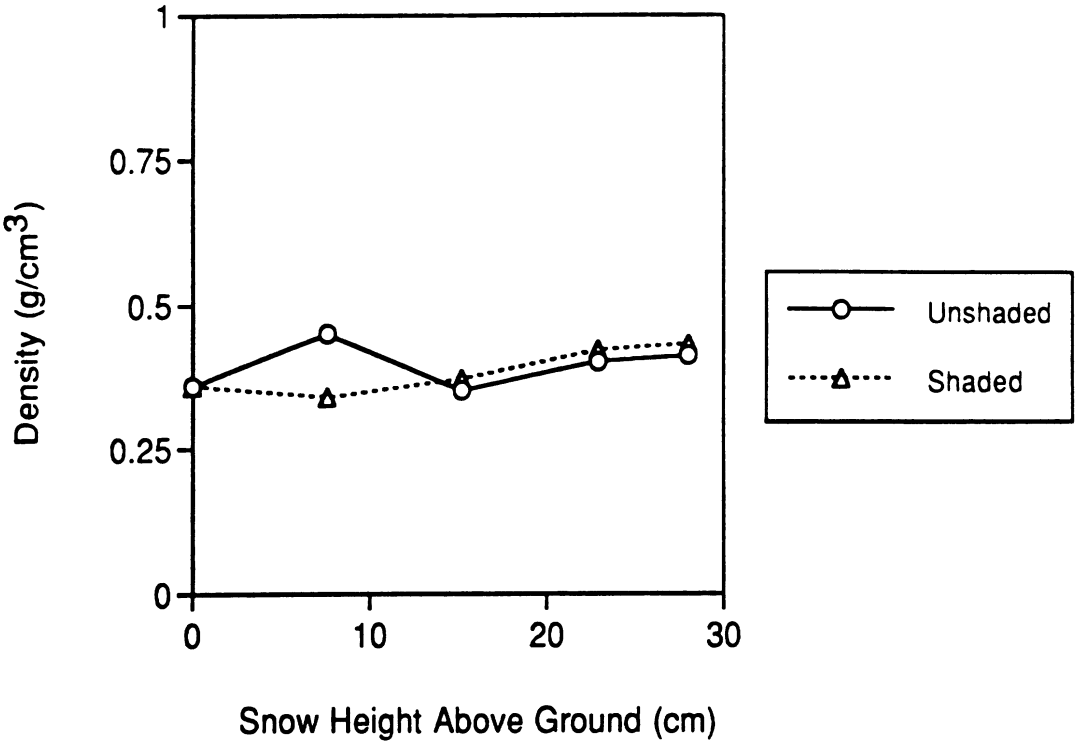
2.2.2 Snow and Soil Properties in Clearings and Forest Stands

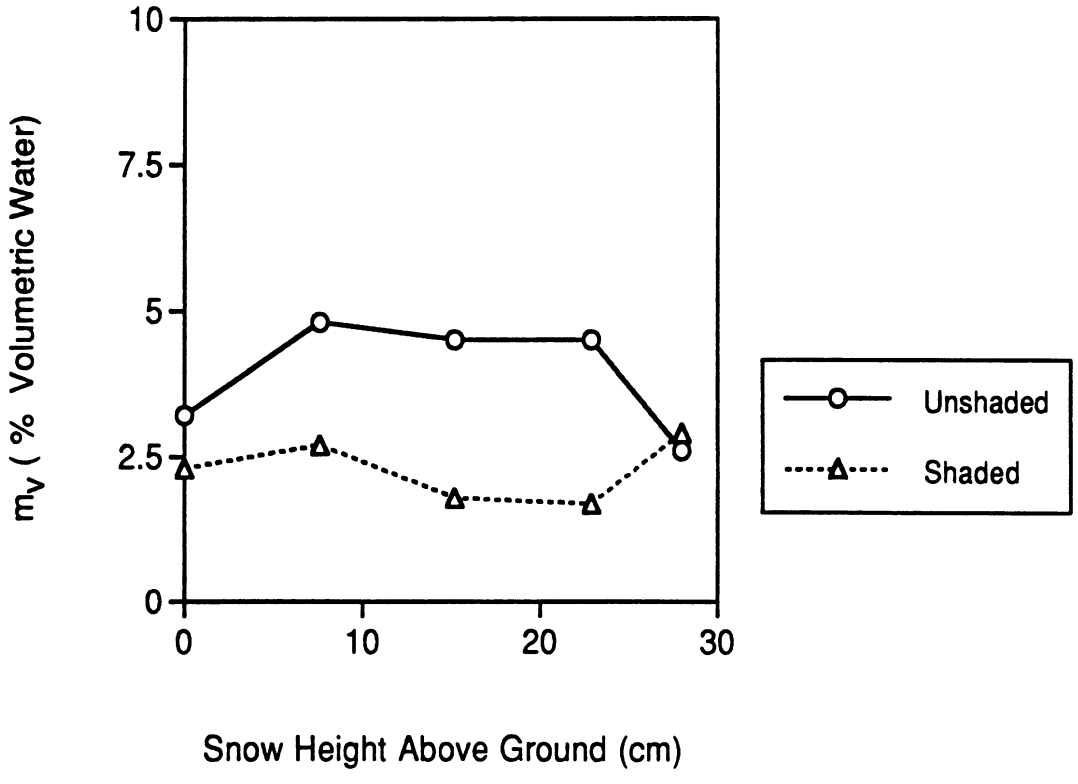
Snow and soil properties identified for study during the April SIR-C/X-SAR project and expected to have implications for image backscatter analysis were measured based on the following:

Table 7: Snow and Soil Properties: Hypotheses, Objectives, and Methods

Hypothesis	Objective	Method
1. Snow depth, moisture, and density vary as a function of crown density which is controlled by species composition and age class.	1. Measure snow depth, moisture, and density in forest stands and clearings selected to provide a cross-section of the forest communities and ages	1. Sample snow properties at set intervals along two 100 m transects in each of 13 forest stands and clearings representative of the test site.
2. Snow depth, moisture, and density varies with distance from Lake Superior.	2. Quantify the effect of distance from Lake Superior on snow depth, moisture, and density.	2. Sample snow properties at set intervals along two 100 m transects in a set of clearings located at increasing distances from Lake Superior.
3. April soil moisture and bulk density varies with soil type. Soil type and species composition are closely related.	3. Measure soil moisture and bulk density in forest stands and clearings selected to provide a cross-section of the forest communities and ages at the site.	3. Sample soil properties at set intervals along two 100 m transects in each of 13 forest stands and clearings representative of the test site.
4. April soil moisture varies with the status of the snow pack.	4. Quantify the status of the snow pack as per objective 1.	4. Completed in Method one above.
5. April soil moisture varies with temperature.	5. Measure the temperature of the air and soil at each site.	5. Record the air temperature for each site and the soil temperature for each sample point along two 100 m transects.

Figure 1: Snow Density: Shaded vs. Unshaded
and Snow M_V: Shaded vs. Unshaded
4/14/1994





Since there is a very close association between soil type and forest community type, soil properties could be subsampled by measurement of the forest stands and clearings used by the snow transects. The locations, vegetation cover types, and age classes examined during two measurement phases (one immediately before the launch and one at the end of the mission), are listed in Table 8: *Snow/Soil Transects Locations and Vegetation Types.* Thirteen locations were examined during the phase 1 effort and 14 during phase 2. The notation e.g. T2-T3, refers to trihedral locations at Cryderman field and the Rifle Range.

Table 8: Snow/Soil Transects Locations and Vegetation Types

Location	Vegetation Type	Date of Observation	
		Phase 1	Phase 2
Cryderman field	Short grass - (Hayfield)	4/3/94	
Cryderman (T2-T3)	Short grass - (Hayfield)		4/17/94
Cryderman (T2-T3)	Short grass - (Hayfield)		4/18/94
Clearing 3	Short grass - (Wheat field)	4/6/9	
Clearing 4	Short shrub/grass < 1m (Clearcut)	4/5/94	
Clearing by Stands 33 & 34	Short shrubs/grass < 2m	4/3/94	
Rifle Range (T2-1)	Short grass		4/18/94
Rifle Range (T2-2)	Short grass		4/18/94
Rifle Range (T2-4)	Short grass		4/18/94
Rifle Range (T2-5)	Short grass		4/18/94
Rifle Range (T2-6)	Short grass		4/18/94
Rifle Range (P-4 parc)	Short grass		4/18/94
Stand 22	Red Pine plantation - pole	4/6/94	4/16/94
Stand 23	Red and White Pine - mature	4/5/94	4/16/94
Stand 24	Jack Pine - mature	4/5/94	4/17/94
Stand 31	Northern Hardwoods - pole/mature	4/4/94	4/17/94
Stand 32	Northern White-cedar - mature	4/4/94	4/16/9
Stand 33	Aspen - sapling	4/4/94	
Stand 34	Aspen - overmature	4/3/94	
Stand 43	Red Pine - mature	4/5/94	4/17/94
Stand 90	Black Spruce - mature	4/7/94	

The snow and soil properties data were collected in two phases, the first between April 3-7, just prior to the beginning of the SIR-C/X-SAR overflights, and the second between April 16-18, shortly before the final overflight on April 19. This two-phase operation captured the change in snow and soil conditions of the spring thaw that occurred throughout the overflight period. A complete set

of snow and soil measurements was undertaken for the first phase and a somewhat abbreviated form of the procedure with less emphasis on snow and more on soil properties was performed during the second phase.

2.2.2.1 Phase 1: April 3-7

For each forest stand or clearing examined, two 100 m transects were undertaken. A transect typically began at least 15 m in from the baseline (generally along a road) of the stand or clearing to avoid edge effects. The second 100 meter transect ran parallel to the first but offset from it by approximately 50 meters.

The snow depth was measured and recorded at a 10 meter interval. At every 50 meters on a transect, starting with zero meters, more detailed information was collected. At these locations, a snow tube was used to collect a bulk volumetric sample of the total snowpack. In addition, a pit was dug down to the ground, to collect a volumetric sample of the soil. Temperature measurements were made of the soil.

All of the soil samples collected were weighed immediately after collection. Next, the samples were baked in an oven at 110° C to remove the moisture, then re-weighed. In this way water mass fraction and, for the volumetric samples of the first measurement phase, volumetric water content were computed for the soil samples. Snow water equivalent was also calculated based on the field quantities measured.

In most cases, some physical description of the ground layer was recorded. These descriptions contained such information as the presence of an ice layer, and if so its thickness; the presence, character, depth, etc. of a ground litter layer; and whether these elements (ice and/or litter) were collected as part of the volumetric soil sample. This information has importance to determining the dielectric constant of the ground using the value for volumetric moisture obtained by baking the sample. There may be a large water fraction, but if it existed as ice, the dielectric constant would not be large.

2.2.2.2 Phase 2: April 16-18

Towards the end of the mission, an abbreviated form of the above procedure was performed. In this case, no volumetric samples of either snow or soil were collected. Two transects were run as before with snow depth measurements made at 10 m intervals. Snow pits were dug at 50 m intervals

Table 9: Summary of Transects Snow and Soil Properties

Stand or Location	Date	Phase	Along Transects		At Sample Locations			
			Transect Linear Snow Fraction	Avg. Snow Depth (cm)	Avg. Snow Density (g/cm3)	Avg. Soil Bull Density (g/cm3)	Avg. Soil Gravimetric Moisture (dry wt. g/g)	Is Ice Present in Soil?
Cryderman field	4/3/94	1	0.30	10.5	NA	0.32	2.39	Y
Cryderman field, T2-3	4/17/94	2	0.00	0.0	NA	NA	0.47	N
Cryderman field, T2-3	4/18/94	2	0.00	0.0	NA	NA	NA	N
Clearing 3	4/6/94	1	0.95	18.4	0.30	0.69	0.47	Y
Clearing 4	4/5/94	1	0.91	30.7	0.32	0.56	1.33	Y
Clearing by stands 33&34	4/3/94	1	1.00	37.2	0.41	0.65	0.83	Y
Rifle Range, T2-T6	4/18/94	2	0.00	0.0	NA	NA	0.23	N
Rifle Range, T2-T5	4/18/94	2	0.00	0.0	NA	NA	0.27	N
Rifle Range, T2-T3	4/18/94	2	0.00	0.0	NA	NA	0.16	N
Rifle Range, T2-T4	4/18/94	2	0.00	0.0	NA	NA	0.17	N
Rifle Range, T2-T2	4/18/94	2	0.00	0.0	NA	NA	0.15	N
Rifle Range, T2-T1	4/18/94	2	0.00	0.0	NA	NA	0.17	N
Rifle Range, P-4 (parc)	4/18/94	2	0.00	0.0	NA	NA	2.33	N
Stand 22	4/6/94	1	1.00	36.5	0.34	0.40	1.08	Y
	4/16/94	2	1.00	25.5	NA	NA	0.59	N
Stand 23	4/5/94	1	1.00	35.0	0.30	0.29	2.37	N
	4/16/94	2	0.90	6.9	NA	NA	NA	N

Table 9: Summary of Transects Snow and Soil Properties

Stand or Location	Date	Phase	Along Transects		At Sample Locations			
			Transect Linear Snow Fraction	Avg. Snow Depth (cm)	Avg. Snow Density (g/cm3)	Avg. Soil Bull Density (g/cm3)	Avg. Soil Gravimetric Moisture (dry wt. g/g)	Is Ice Present in Soil?
Stand 24	4/5/94	1	1.00	45.6	0.29	0.14	6.02	Y
	4/17/94	2	0.90	22.9	NA	NA	4.72	N
Stand 31	4/4/94	1	1.00	48.3	0.37	0.53	0.82	Y
	4/17/94	2	1.00	25.4	NA	NA	3.51	N
Stand 32	4/4/94	1	1.00	36.5	0.34	0.03	14.89	Y
	4/16/94	2	1.00	32.0	NA	NA	32.76	N
Stand 33	4/4/94	1	1.00	56.3	0.35	0.72	0.34	Y
Stand 34	4/3/94	1	1.00	48.2	0.38	0.55	0.70	N
Stand 43	4/5/94	1	1.00	39.2	0.30	0.39	3.71	Y
	4/17/94	2	1.00	16.5	NA	NA	1.04	N
Stand 90	4/7/94	1	1.00	37.3	0.30	0.06	7.08	Y

and a non-volumetric sample of the soil collected. In these cases, the quality of the ground was described either as "wet" or "saturated" (the result of a general thaw).

Several general trends had been expected for the two phases and the measurement results confirmed these. Because the buds had not yet broken on deciduous species in April, coniferous canopies afforded a higher degree of shading. Snow depth was therefore expected to be greatest underneath coniferous forests, intermediate under deciduous forests, and least in clearings. Typically, the insulating properties of the snow cover prevent forest soil from being completely frozen in April. Soil moisture conditions were expected to be partially frozen or unfrozen. Moisture conditions were expected to be at or near field capacity for unfrozen soil, with soil type and bulk density the controlling factors for field capacity. There was expected to be a substantial decrease in the snow pack over the mission, and indeed the snow pack reduction in the clearings reached 100% by the end of the mission. The snow pack reduction over all forest communities sampled averaged 46.3%.

Table 9: *Summary of Transects Snow and Soil Properties* provides a summary of the results for each stand or clearing for both measurement phases. Transect snow linear fraction and average snow depth of the 10 m interval locations, plus average snow density, average soil bulk density, and average soil gravimetric moisture (dry wt.) of the 50 m interval sample locations are given for phase 1. The data collected during phase 2 (also summarized in Table 9) include transect snow linear fraction, average snow depth of the 10 m interval locations, and average soil gravimetric moisture (dry wt.) of the 50 m interval location. Results were calculated according to the following:

Transect snow linear fraction

$$(1) \qquad \frac{\Sigma \text{lengths along two 100m transects which were snow covered}}{200\text{m}}$$

Average snow depth of the 10 m interval locations (cm)

$$(2) \qquad d = \frac{1}{n}\sum_{i=1}^{n} d_i$$

where n = the number of sample points, and d_i = sample point snow depth (cm)

Average snow density (g/cm^3)

$$(3) \quad \rho_S = \frac{1}{n} \sum_{i=1}^{n} \left[\frac{Mi}{l * \pi * r^2} \right]$$

where n= the number of sample points, Mi = weight of snow sample (g), l=length of snow sample (cm), r= radius of snow tube (cm)

Average soil bulk density (g/cm^3)

$$(4) \quad Db = \frac{1}{n} \sum_{i=1}^{n} \left[\frac{Mi}{l * \pi * r^2 * ci} \right]$$

where n = the number of sample points, Mi = soil sample dry wt. (g), l = length of soil core (cm), r = radius of soil core (cm), and Ci = n of cores in sample

Average soil gravimetric moisture (dry wt. g/g)

$$(5) \quad Mg = \frac{1}{n} \sum_{i=1}^{n} \left[\frac{MW_i - MD_i}{MD_i} \right]$$

where MW_i = soil sample wet wt. (g), MD_i = soil sample dry wt. (g), and n = the number of sample points

Appendix C: *Snow and Soil Results for Transects in Clearings and Forest Stands - Phase 1*, lists individual measurements for each 50 m sample location, provides several additional measures including snow water equivalent, soil temperature, soil wet and dry sample weights, soil gravimetric moisture (wet wt.), and soil volume fraction. It also includes the written physical descriptions of the soil layer when available. Appendix D: *Snow and Soil Results for Transects in Clearings and Forest Stands - Phase 2*, presents

additional data including individual measurements for each 50 m sample location. Other measures include soil condition (wet/saturated), wet and dry soil sample weights, soil water weight, and soil gravimetric moisture. Calculations were as follows:

The product of (2) and (3) result in snow water equivalent (Weq)

(6) $$Weq = ds * \rho ws$$

where ds = snow depth (cm), and ρws = density of wet snow (g/cm^3)

Soil gravimetric moisture (wet wt. g/g)

(7) $$Mg = \frac{MWi - MDi}{MWi}$$

where MWi = soil sample wet wt. (g), MDi = soil sample dry wt. (g)

Soil water volume fraction (cm^3/cm^3)

(8) $$\theta = \left[\frac{MWi - MDi}{l * \pi * r^2 * nc} \right]$$

where MWi = soil sample wet wt. (g), MDi = soil sample dry wt. (g), l = length of soil core (cm), r = radius of soil core (cm), and nc = number of cores in sample

2.3 VEGETATION DIELECTRIC PROPERTIES

Ancillary data for two sets of canopy properties were required for the SIR-C/X-SAR experiment: 1) those related to the quantity of biomass, and 2) those related to moisture status and temperature. The biomass quantities were considered static within the April SIR-C/X-SAR mission and biomass data had been collected during summers 1992-94. Those properties related to moisture (dielectric properties) and temperature are unique to any mission period and may vary over the period. Therefore, in order to describe the moisture status of

the vegetation canopy, dielectric measurements were taken during the April SIR-C/X-SAR mission as set forth in the following table.

Table 10: Vegetation Dielectric Properties: Hypotheses, Objectives, and Methods

Hypothesis	Objective	Method
1. Canopy moisture conditions will be unique to the mission period and will vary by species and temperature.	1. Determine the dielectric properties for all tree species of interest at the time of the mission.	1. Complete detailed dielectric profiles using dielectric probes. Do this for at least one tree each of the nine tree species of interest. Record air and tree temperature.
2. Dielectric properties may vary on a diurnal basis.	2. Track e' over at least the time range of the overflights and over a 24-hour period if possible.	2. Attach dielectric probes to trees and program them to take continuous measurements over part or all of the diurnal cycle.
3. Dielectric properties will vary by species size/age class.	3. Evaluate the within species variance in e' related to tree size and age.	3. Measure e' at three depths (bark, cambium, xylem) for 10 trees each of 13 species size/age classes.

Dielectric measurements of trees had been made at the Raco site during early April in 1990 and 1992, and these provided the basis for the assumptions in the above hypotheses. Findings indicated that in April trunks and main stems were generally thawed, and warm daytime temperatures encouraged the upward movement of sap in some species (particularly the sugar maples).

2.3.1 Dielectric Depth Profiles

Two meet objective one, dielectric measurements were made as a function of depth into tree trunks. These detailed profiles were carried out for one individual each of the nine tree species of interest (in nine different test stands). The species, stands, sampling dates, and probe used are listed in Table 11: *Dielectric Measurements Completed During the April SIR-C/X-SAR Mission* in the column "e' vs. Depth."

Measurements were made approximately at 1-2 mm intervals until several mm past the cambium, then every 5 mm, and increasing to every 10 mm for large individuals. For this and the other two sampling procedures, data were collected using portable dielectric probes (P, L, and C-bands) coupled with

Table 11: Dielectric Measurements Completed during the April SIR-C Project

Species	Size Class	e' vs Depth				e' vs Time				e' per Stand			
		Date	Stand	Probe	Filename	Date	Stand	Probe	Filename	Date	Stand	Probe	Filename
Beech	mature	NA				NA				4/17/94	86	P148 C127	redga rcdga
Beech	pole	4/3/94	31	L102	rad3ae	4/3/94 4/11/94	31 31	C103 C127C P148X	rbd3ae rcdaa redaa	4/9/94	31	P148 C127	red9a rcd9a
Bigtooth Aspen	mature	4/5/94	34	L102	rad5ae	4/5/94	34	C103	rbd5ae	4/10/94 (Azimuthal sampling)	34	P148 C127	redba, rcdba
Bigtooth Aspen	sapling	NA				NA				4/12/94	34	P148 C127	redba rcdba
Black Spruce	pole	4/5/94 4/15/94	32	L102 C127	rad5ae rcdebe	4/5/94	32	C127	rcd5ae	4/15/94	32	P148 C127	redeb rcdeb
Jack Pine	mature	4/4/94	23	L102	rad4ae	4/4/94	23	P148	red4ae	4/16/94	24	P148 C127	redfb rcdfb
Jack Pine	sapling	NA				NA				4/14/94	36	P148 C127	reddb rcdda
N. White-Cedar	mature	4/5/94 4/15/94	32	L102 C127	rad5ae rcdebe	4/5/94	32	P148	red5a	4/15/94	32	P148 C127	redea rcdea
Red Maple	mature	4/3/94	31	L102	rad3ae	NA				4/9/94	31	P148 C127	red9a rcd9a
Red Pine	mature	4/4/94	23	L102	rad4ae	4/4/94	23	C103	rbd4ae	4/14/94	43	P148 C127	redda rcdda
Red Pine	sapling	NA				NA				4/14/94	22	P148 C127	redda rcdda
Sugar Maple	mature	4/3/94	31	L102	rad3ae	NA				NA			
Sugar Maple	pole	NA				4/3/94	31	C120	rdd3ae	4/12/94	31	P148 C127	redba rcdba
White Pine	mature	4/4/94	23	L102	rad4ae	4/4/94	23	C127	rcd4a	4/16/94	23,	P148 C127	redfa rcdfa

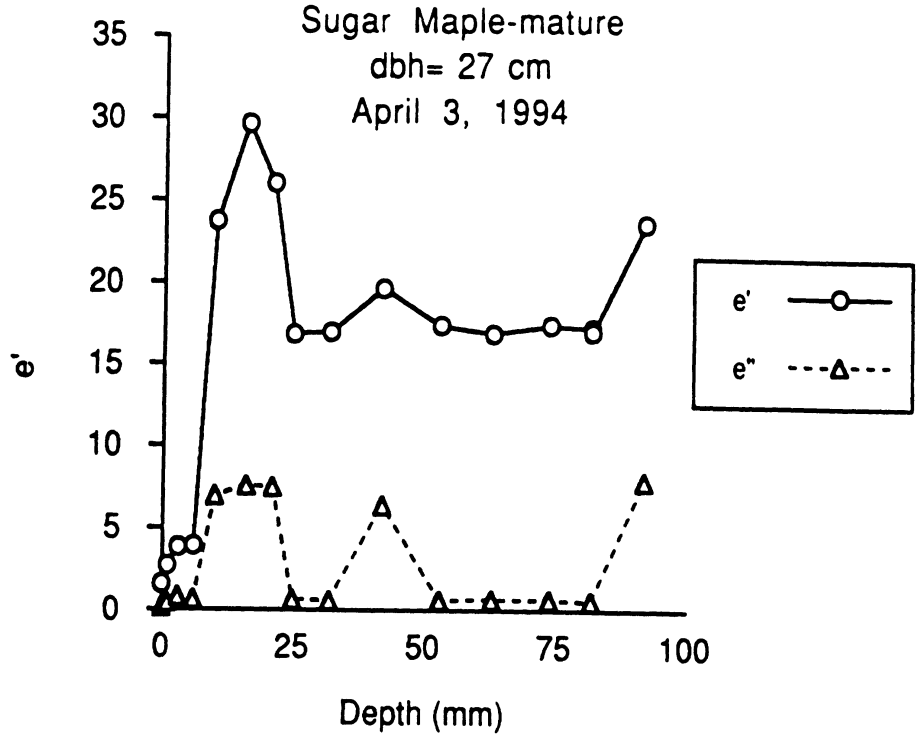
programmable HP calculators [5]. Each probe measurement results in an estimate of e' and e" the real and imaginary parts respectively of the complex dielectric constant. In this case data were taken in the field as reflection coefficients and later converted to e. Because the L-band probe failed on April 6, only the detailed depth profiles completed between April 3-5 used the L-band probe. Unusually low values in the profiles for black spruce and northern white-cedar on April 5 are attributed to equipment failure (see Appendix E). The temperature of the air and interior bole was taken for each tree measured. Figure 2 gives the dielectric depth profile of sugar maple and white pine taken April 3 and 4 at L-band. Appendix E provides a complete set of the plots.

While making dielectric depth measurements, two additional methodology issues arose. Because it was possible that bole freeze/thaw status could vary by the trunk azimuth (e.g., south facing vs. north facing) an effort to be consistent in the side of the tree measured was adopted. In general most trees were measured on the south side. Maple trees had flowing sap and this posed some logistical problems. An attempt was made to swab the sap out of the drilled holes, but this practice did not seem to make a difference and so it was later abandoned.

2.3.2 Temporal Variance in Dielectric

To meet objective two it was necessary to determine if the dielectric changed as a function of time at least through the time range of the overflights and, if possible, throughout a 24 hr. cycle. It was expected that while in a late-winter state where there was not an extreme diurnal change in air and soil temperature and humidity, there might be a diurnal trend in bole moisture status in some species. If there was a significant change, most likely during the day as trees warmed, other tree dielectric measurements would require adjustment with respect to time of day to reflect the moisture status at the time a particular overflight. To test this, dielectric probes were attached to trees and programmed to take measurements every 15 minutes from early morning through late afternoon (the range of overflight times). One tree, a large pole-size beech was monitored over a 24-hour cycle. The species, size classes, and probes used on the trees monitored for diurnal trends are listed in the third column (e' vs. Time) of Table 11. Figure 3 shows e' as a function of time (11 a.m. - 5 p.m. EDT) for two species, sugar maple and red pine. The actively

Figure 2: Dielectric Depth Profiles: Sugar Maple and White Pine at L-band



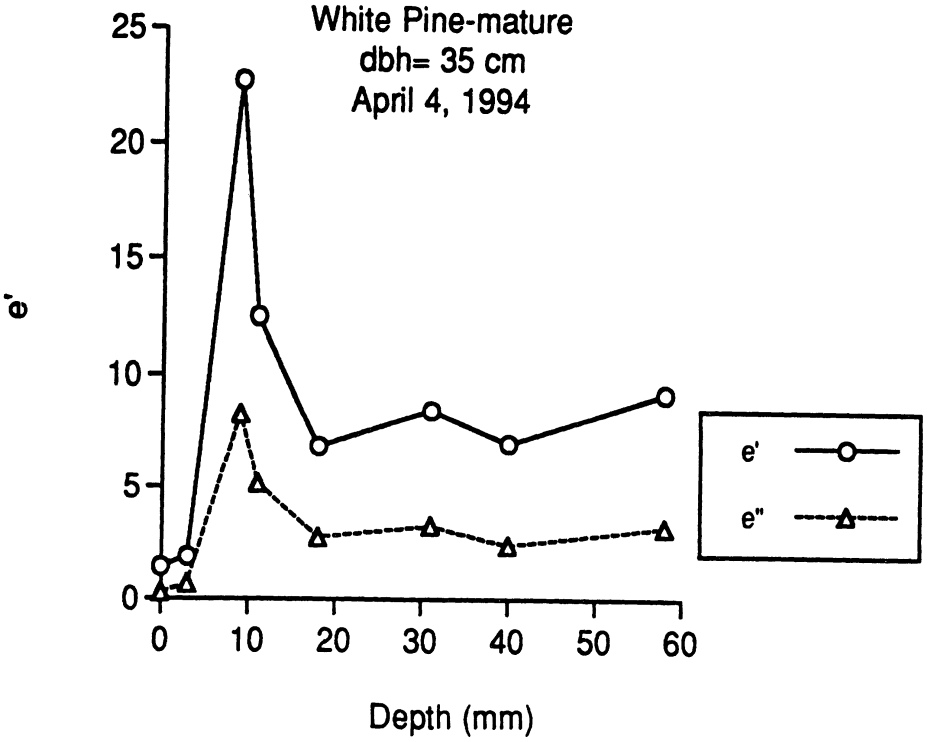
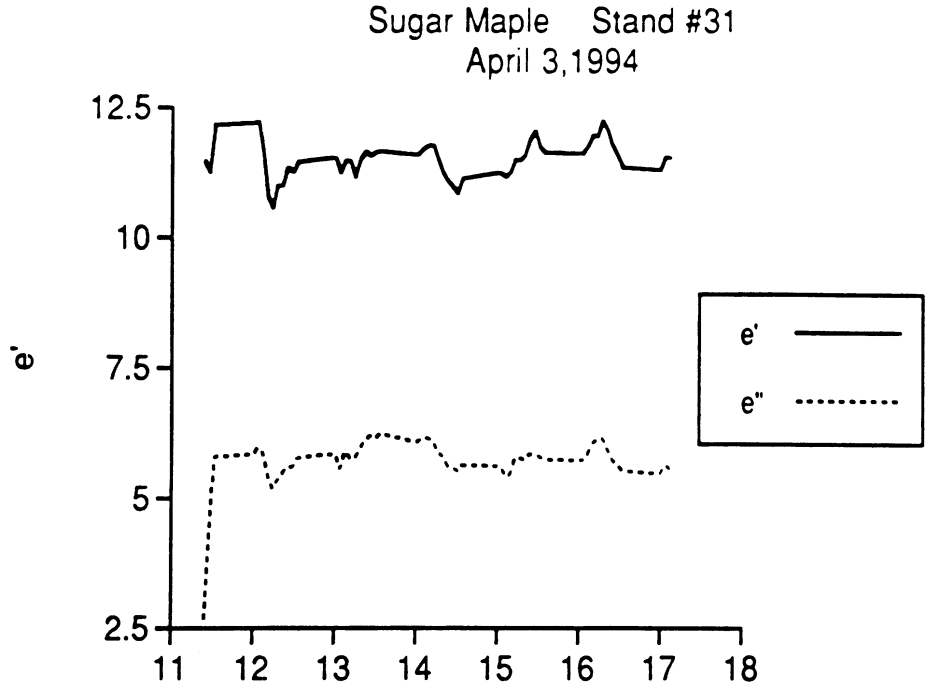


Figure 3: Temporal Variance in Dielectric:
Sugar Maple and Red Pine at C-band



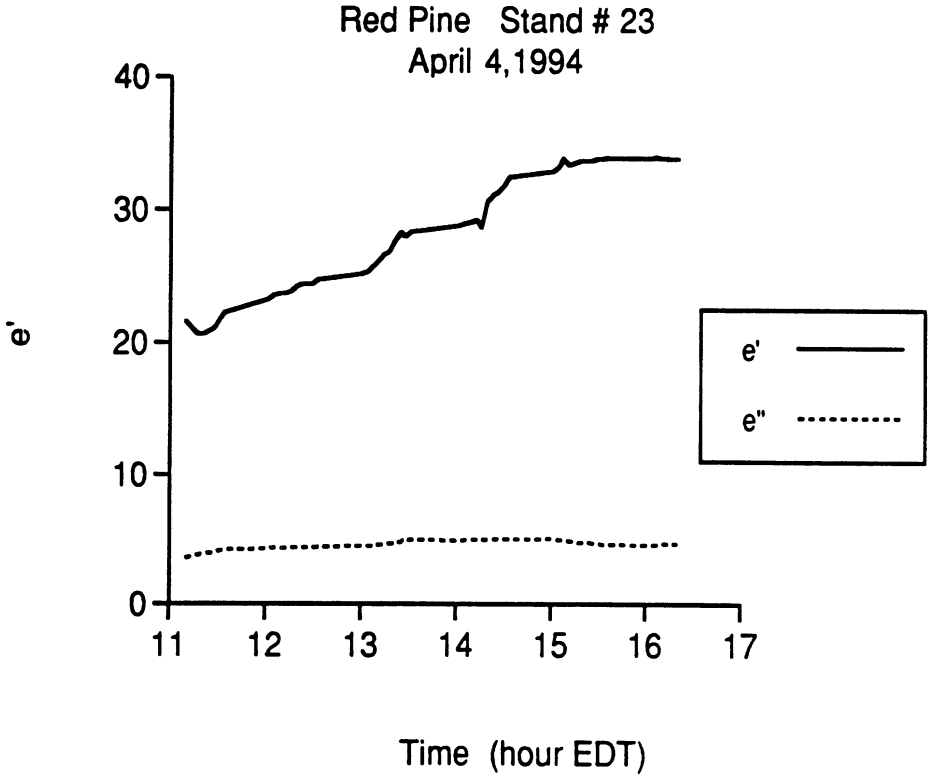


Table 12: Summary of Dielectric Properties by Species Size/Age Class

DATE	STAND	SPECIES	SIZECLASS	DEPTH	P-BAND							C-BAND						
					e'	e' Stddev	e"	e" Stddev	# of trees	Avg. depth (mm)	Avg. dbh (cm)	e'	e' Stddev	e"	e" Stddev	# of trees	Avg depth (mm)	Avg dbh (cm)
4.17.1994	86	Beech	mature	Bark	4.2	2.7	0.4	0.4	7	0	35.0	5.1	2.2	0.5	0 5	9	0	38 0
				Cambium	27.8	3.6	5.5	0.7	7	5	37.1	6.5	2.1	3 0	1 3	9	5	39 3
				Xylem	15.2	1.3	2.1	0.3	9	28	39.8	9.2	1.7	3.5	0 4	10	28	39 1
4.09.1994	31	Beech	pole	Bark	3.9	1.0	0.9	1.2	5	0	14.1	4.7	1.0	0.5	0 2	6	0	13 6
				Cambium	2.6	0.6	1.1	1.9	4	3	13.0	2.7	0.6	0.2	0 2	6	2	13 6
				Xylem	6.3	1.2	0.6	0.6	4	16	12.1	6.0	2.2	1.8	0.9	5	11	13 3
4.12.1994	34	Bigtooth Aspen	sapling	Bark	7.5	2.0	0.8	0.3	5	0	7.0	8.3	3.2	1.7	1 1	6	0	6 9
				Xylem	11.0	5.3	1.4	0.9	6	17	6.9	8.8	1.8	3.0	1.1	6	17	6 9
1.01.1900	34	Bigtooth Aspen	mature	Bark	1.9	0.3	0.1	0.4	12	0	30.7	2.9	0.0	0.0	0 0	12	0	30 7
				Cambium	6.9	1.2	0.7	0.7	12	6	6.4	7.2	0.7	1.2	0 6	12	6	30 7
				Xylem	14.1	0.4	1.2	0.4	12	22	6.4	10.7	0.4	3 3	0 4	12	22	30 7
4.15.1994	32	Black Spruce	pole	Bark	10.7	2.4			10	0		3.4	1.3	1.0	0 2	10	0	17 3
				Cambium	10.7	1.6			10	7		7.5	1.4	3 4	0 2	10	3	17 1
				Xylem	11.0	1.5			10	24		5.1	1.5	1 9	0 5	10	22	17 3
4.16.1994	24	Jack Pine	mature	Bark	4.4	0.8	0.2	0.2	10	0	23.6	3.0	1.0	0.8	0 4	9	0	23 5
				Cambium	40.8	7.3	6.2	1.4	9	6	23.5							
				Xylem	17.0	2.5	1.9	0.5	9	32	23.5	6.3	1.0	3.5	0 2	10	32	23 6
4.14.1994	36	Jack Pine	sapling	Bark	2.4	1.4	0.2	0.2	10	0	8.2	3.4	1.4	0.4	1.4	9	0	8 2
				Cambium	33.1	3.6	8.5	1.5	9	2	8.2	8.8	1.4	3.0	0.3	6	2	8 6
				Xylem	9.3	3.5	1.4	0.5	10	31	8.2	0.2	0.2	0.1	0.1	10	31	8 2
4.15.1994	32	N White Cedar	mature	Bark	13.4	7.6	1.7	0.9	10	0	26.6	7.5	2.2	2.3	0 9	10	0	28 6
				Cambium	31.8	4.4	6.1	2.5	10	6	27.3	6.0	1.1	3.3	0 7	10	6	27 3
				Xylem	4.9	1.9	0.8	0.4	9	43	28.8	5.5	2.4	1.4	0 8	9	43	28 8
4.09.1994	31	Red Maple	mature	Bark	1.8	0.4	0.5	0.9	9	0	26.6	2.3	1.0	0.3	0 2	7	0	28 4
				Cambium	30.1	10.8	2.6	1.5	7	7	27.1	6.7	2.2	2.2	1 1	7	6	27 0
				Xylem	30.3	5.8	2.9	1.2	8	38	27.5	6.1	1.9	2.7	0 6	9	38	26 1
4.14.1994	43	Red Pine	mature	Bark	7.1	3.4	0.8	0.3	6	0	34.3	5.7	1.4	1.4	0.4	10	0	34 1
				Cambium	13.4	4.3	1.7	0.5	9	22	33.9	8.7	1.3	3.2	0 6	10		
				Xylem	16.8	8.0	1.7	0.8	4	23	32.6	8.1	2.2	3 4	0 9	10	82	34 1
4.14.1994	22	Red Pine	sapling	Bark	4.2	1.3	0.6	0.3	8	0	11.4	3.5	1.3	0 7	0 4	10	0	11 7
				Cambium	39.8	3.6	7.4	2.0	8	3	10.7	5.9	2.3	3 2	0 4	10	3	11 5
				Xylem	14.6	4.2	2.0	0.8	8	24	12.0	10.8	2 0	3 9	0 9	10	25	11 5
4.12.1994	31	Sugar Maple	pole	Bark	2.3	0.4	0.2	0.2	8	0	18.0	2.6	1 0	0 3	0 2	10	0	17 6
				Cambium	40.3	6.8	4.8	0.5	7	5	18.1	3.6	1 8	2 6	0 4	10	5	17 6
				Xylem	39.6	3.6	4.1	0.8	9	21	17.6	4.6	1 3	2 6	0 3	9	22	17 9
4.16.1994	23	White Pine	mature	Bark	3.7	1.1	0.6	0.3	9	0	34.7	3.2	1 4	0 7	0 4	9	0	34 7
				Cambium	37.7	5.6	7.0	1.0	6	11	35.1	4.0	2 8	3 4	0 3	2	14	36 4
				Xylem	18.6	3.5	2.9	0.6	10	42	35.1	6.2	1.4	3 4	0 7	10	42	35 1

photosynthesizing red pine shows a rise in e' throughout the course of the afternoon. Plots for all trees measured can be found in Appendix F.

2.3.3 Dielectric Properties by Species Size/Age Class

To meet the third objective, dielectric measurements were taken during the mission to determine how e' varied by species and size/age class. Measurements were taken at each of two (P, C) wavelengths at three different depths (outer bark, cambium, and xylem). This was done for up to 10 trees of each size/age class selected (sapling 2.5 - 12.4 cm, pole 12.5 - 24 cm, and mature ≥ 25 cm), for each of the nine tree species of interest. The 13 species size/age classes, and the nine test stands sampled are given in Table 11, in the column "e' per Stand." The expectation was that the dielectric constant would be highest for the cambium layer even during the early April time period. In general, this was confirmed as detailed in Table 12: *Summary of Dielectric Properties by Species Size/Age Class*. Table 12 provides the following measurements for each species size/age class at three depths (bark, cambium, and xylem) for both P and C-bands: average e' (dielectric constant, real part), average e" (dielectric constant, imaginary part), the standard deviations for both e' and e", the number of trees sampled, average depth to bark, cambium, and xylem, and average diameter of the trees sampled. Note that while each tree was measured at the three depths, occasional probe measurements were not good, thus the number of trees sampled and average diameter may be different at each depth for a species size/age class.

2.4 WEATHER DATA

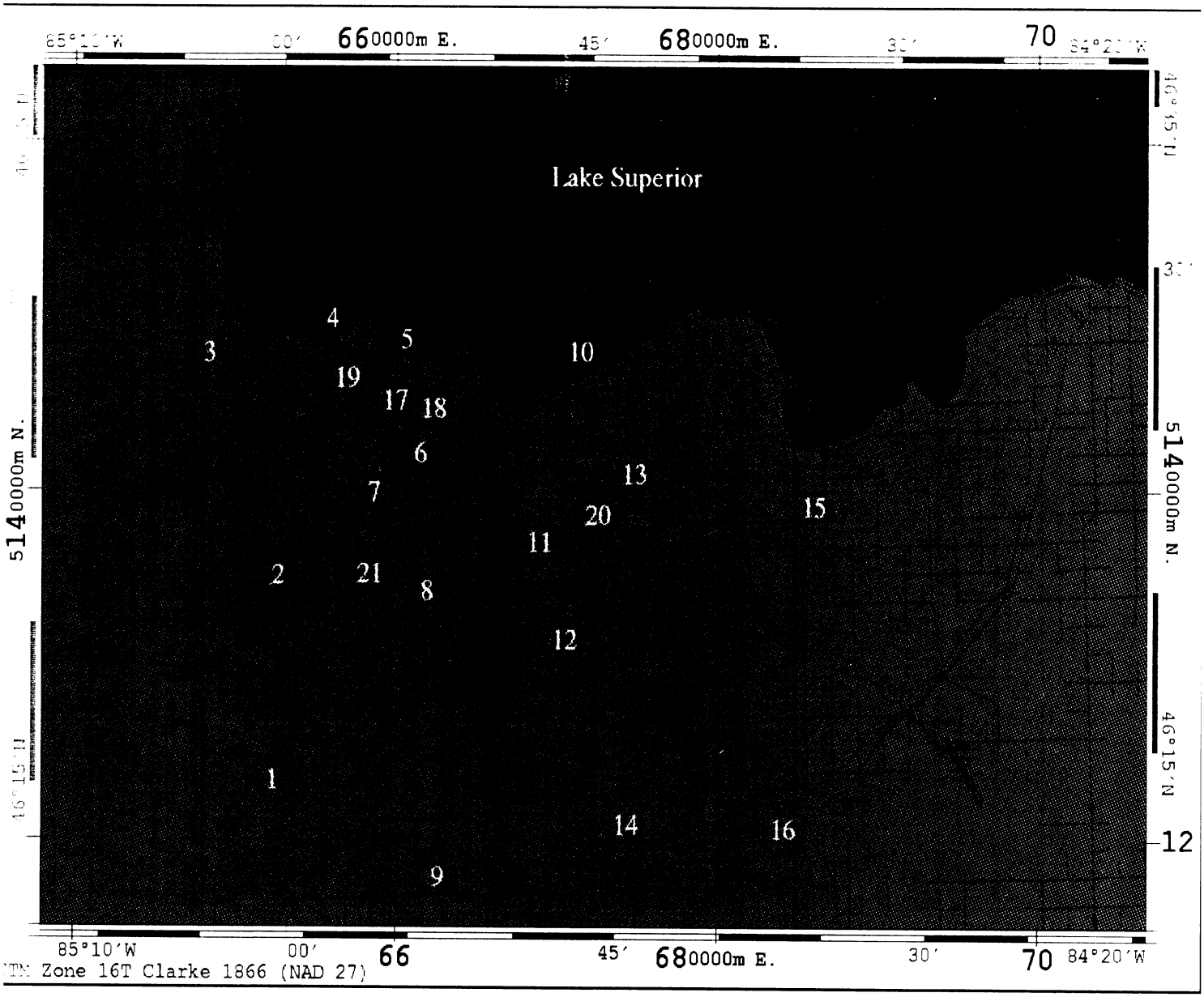
The SIR-C/X-SAR mission occurred during a time of rapidly changing weather conditions. To analyze a specific image or detect change over the mission time frame in several images, weather data, especially precipitation, would be needed as outlined in the following table.

Table 13: Weather Data: Hypotheses, Objectives, and Methods

Hypothesis	Objective	Method
1. Precipitation will vary over the 20 km x 20 km primary target area during any given precipitation event.	1. Acquire precipitation data at a level of detail sufficient for contouring incident total precipitation over the 20 km x 20 km primary target area.	1. Deploy a network of 21 precipitation gauges and take measurements after each precipitation event.
2. Forest canopies intercept a percentage of total precipitation with interception percent dependent upon species composition.	2. Determine precipitation interception for each of five forest communities present in the test site.	2. Locate five rain gauges under each forest community and locate an additional five of the 21 gauges in adjacent open areas.
3. Other weather parameters will also vary over the mission duration and will be useful in image and ground data analysis.	3. Collect data on wind speed, air pressure, humidity, and precipitation.	3. Acquire daily weather maps from NOAA and hourly weather reports (wind, pressure, humidity, and precipitation) from the Smithers station at the Raco Airfield.

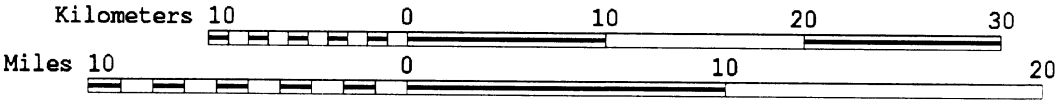
The array of 21 gauges was designed with 16 deployed in a 4 x 4 array in forest clearings. The remaining 5 were placed such that one was within each type of forest community (red pine, jack pine, lowland conifer, northern hardwoods, and aspen) and paired with gauges in nearby or adjacent clearings. All gauge locations were chosen for ease of access by all weather roads and trails. Monitoring of the precipitation gauges extended over the period April 3 to 16. The gauge locations are shown on the map *SIR-C/X-SAR Precipitation Gauge Network.*

The equal likelihood of experiencing rain or snow, necessitated a rain gauge design that could accommodate both types of precipitation at a minimal cost. The solution was a collection of 42 large, 6" diameter empty coffee cans, complete with lids. To prevent evaporation, each can was prepared by pouring in a thin layer of vegetable oil on the bottom. Cans were then weighed and mounted on top of 6' lengths of re-bar driven into the ground at 21 locations. Each can had taped to it a 5-6" piece of 3/4" PVC plumbing pipe with the top end plugged up with foam and a piece of duct tape. With this setup, it was possible to mount the cans on top of each re-bar by placing the attached PVC pipe over the tip of the bar. Thus, after a precipitation event, cans could be quickly covered and brought back to home for weighing, and new cans brought



SIR-C Precipitation Gauge Network

Raco, Michigan, April, 1994



- Gauges in open
- Gauges under forest canopy

to the field as replacements . The time required to pick up all 21 cans was a minimum of 4 hours.

Summary data for the precipitation gauges is presented in Table 15: *Precipitation (cm of water) during the SIR-C/X-SAR Experiment*, and includes gps derived rain gauge coordinates, precipitation amounts for each precipitation event, and total precipitation for the period April 3 - 16. Table 14:

Table 14: Intercepted Precipitation

Gauge Under Canopy	Community Type	Stand #	Gauge in Associated Clearing	Net Difference in Total Precipitation (4/3 - 4/10) in cm
17	Aspen Sapling	33	6	+0.396
18	Northern Hardwoods	31	6	-0.520* (*4/14-4/16)
19	Lowland Conifer	32	4	-2.339
20	Jack Pine	24	13	-0.521
21	Red Pine	43	8	-1.213

Intercepted Precipitation provides the paired rain gauge locations and net difference in precipitation. Appendix G gives hourly data for wind, temperature, humidity, and precipitation as reported from the Smithers station at the Raco Airfield. Figure 4: *Temperature and Monthly Precipitation, April 1 - April 20* is a plot of the temperature and cumulative monthly precipitation data in Appendix G. Appendix H consists of Michigan daily precipitation maps showing the geographical extent of any precipitation events during the mission period.

Table 15: Precipitation (cm of water) during the SIR-C Experiment

Gauges in Clearings	UTM Coordinates		4/3 - 4/7	4/7 - 4/13	4/13 - 4/14	4/14-4/16	Total Precipitation (4/3 to 4/16)
RG01	653398.85	5124818.76	0.801	****	****	1.345	****
RG02	652479.55	5134204.71	0.954	0.712	1.495	1.023	4.184
RG03	647640.57	5149001.97	1.013	0.388	1.546	0.852	3.798
RG04	656312.88	5148039.79	1.248	0.382	1.520	0.912	4.062
RG05	660790.98	5146916.28	1.200	0.357	1.554	0.920	4.031
RG06	660899.85	5143693.21	0.909	0.452	1.507	1.074	3.941
RG07	658631.58	5140861.27	1.084	0.543	1.604	1.112	4.344
RG08	660763.18	5134753.08	0.790	0.662	**	2.553	4.005
RG09	661386.03	5116773.78	0.621	1.168	1.396	1.586	4.771
RG10	670155.78	5146167.49	0.962	0.616	1.431	0.854	3.863
RG11	668914.72	5135953.98	0.581	0.616	1.456	1.104	3.757
RG12	668993.52	5131243.72	0.752	0.659	1.448	1.326	4.185
RG13	673771.39	5141224.64	0.651	0.543	1.561	1.373	4.128
RG14	675229.71	5118710.74	0.868	0.885	1.573	1.500	4.827
RG15	686746.80	5138424.14	0.731	0.476	1.609	****	****
RG16	683283.12	5122152.11	0.864	0.777	1.579	1.436	4.656
Average:			0.877	0.616	1.520	1.265	4.182
Std. Dev:			0.195	0.215	0.067	0.431	0.348

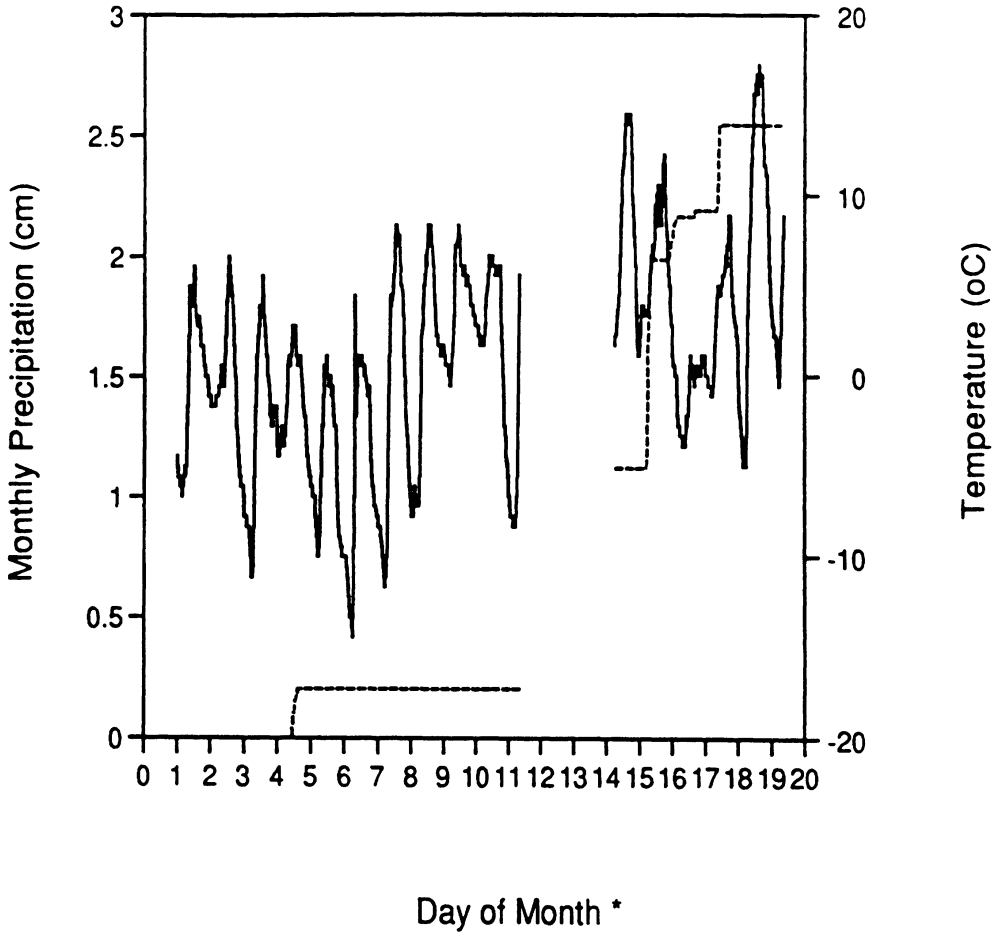
Gauges under Canopy	UTM Coordinates		4/3 - 4/7	4/7 - 4/13	4/13 - 4/14	4/14-4/16	Net Precipitation (4/3 to 4/16)
RG17	660858.628	5143738.68	1.031	0.431	1.957	0.918	4.337
RG18	660872.907	5143976.052	0.988	0.091	****	0.554	****
RG19	656312.071	5147989.564	0.258	0.086	1.086	0.292	1.723
RG20	673850.986	5138062.151	0.599	0.461	1.563	0.984	3.607
RG21	658456.838	5134201.062	0.421	0.404	1.372	0.595	2.792
Average:			0.659	0.295	1.495	0.669	3.115
Std. Dev:			0.342	0.189	0.365	0.284	1.122

All Gauges	UTM Coordinates		4/3 - 4/7	4/7 - 4/13	4/13 - 4/14	4/14-4/16	Net Precipitation (4/3 to 4/16)
Average:			0.825	0.536	1.514	1.116	3.945
Std. Dev:			0.247	0.249	0.165	0.473	0.723

**** = data not available for this period

** = data recorded 4/16 represents precipitation acumulation from 4/13/ - 4/16

Figure 4:
Temperature and Monthly Rain
April 1 - April 20



(* Note: data missing for 4/11 - 4/13)

3 References

[1]Structure, Composition and above-ground biomass of SIR-C/ERS-1 sample stands at Pellston and Raco, Michigan, USA, 1990-91.

[2]Structure, Composition and above-ground biomass of SIR-C/ERS-1 sample stands at Raco, Michigan, USA, 1992.

[3]Structure, Composition and above-ground biomass of SIR-C/ERS-1 sample stands at Raco, Michigan, USA, 1993.

[4] Kendra, J. R., F.T. Ulaby, and K. Sarabandi, *Snow Probe for* In Situ *Determination of Wetness and Density*, IEEE Transactions on Geosciences and Remote Sensing, 1994, In Press.

[5] Brunfeldt, D.R. Manual for Portable Dielectric Probe, Applied Microwave Corp: Lawrence, KS, January 1989.

APPENDIX A:
SNOW WETNESS AND DENSITY
AT CRYDERMAN FIELD SNOW PITS

Snow Wetness and Density
April 9, 1994

4/9/94 Unshaded--Pre-Overflight		
Average ht. above ground(cm)	Moisture (%vol.)	Density (g/cm3)
47.0	5.00	0.39
43.2	5.30	0.46
36.8	4.80	0.45
29.2	4.90	0.42
Averages:	5.00	0.43

4/9/94 Shaded--Pre-Overflight		
Average ht. above ground(cm)	Moisture (%vol.)	Density (g/cm3)
41.9	5.10	0.52
38.1	3.50	0.48
31.8	3.80	0.59
24.1	2.70	0.33
Averages:	3.78	0.48

4/9/94 Unshaded--During Overflight		
Average ht. above ground(cm)	Moisture (%vol.)	Density (g/cm3)
47.0	6.20	0.39
43.2	4.10	0.48
36.9	4.20	0.49
29.2	4.80	0.49
21.6	4.00	0.39
11.4	2.80	0.32
Averages:	4.35	0.43

4/9/94 Shaded--During Overflight		
Average ht. above ground(cm)	Moisture (%vol.)	Density (g/cm3)
41.9	5.10	0.40
38.1	4.40	0.53
31.8	5.80	0.61
24.1	1.70	0.33
16.5	4.90	0.32
6.4	4.10	0.31
Averages:	4.33	0.42

Snow Wetness and Density
April 10, 1994

4/10/94 Unshaded -- Pre-Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
43.2	45.7	6.72	1.48	0.40	0.07
38.1	43.2	6.84	1.33	0.42	0.06
30.5	38.1	6.07	1.99	0.41	0.03
22.9	30.5	4.86	1.30	0.43	0.03
15.2	22.9				
0.0	15.2				
Averages:		6.12	1.53	0.42	0.05

4/10/94 Shaded -- Pre-Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
38.1	40.7	5.18	1.10	0.35	0.08
33.0	38.1	4.68	0.51	0.48	0.04
25.4	33.0	3.45	1.44	0.39	0.09
17.8	25.4	4.50	1.87	0.34	0.06
10.2	17.8	7.20	2.17	0.32	0.04
0.0	10.2	5.12	2.17	0.32	0.13
Averages:		5.02	1.54	0.37	0.07

4/10/94 Unshaded -- During Ov Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
43.2	45.7	6.86	1.59	0.40	0.06
38.1	43.2	6.62	0.67	0.51	0.09
30.5	38.1	5.55	0.82	0.43	0.11
22.9	30.5	6.04	1.74	0.47	0.03
15.2	22.9	3.86	1.26	0.38	0.06
0.0	15.2	3.64	1.25	0.36	0.06
Averages:		5.43	1.22	0.42	0.07

4/10/94 Shaded -- During Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
38.1	40.7	5.14	1.43	0.41	0.13
33.0	38.1	4.40	1.20	0.55	0.06
25.4	33.0	4.90	2.60	0.47	0.10
17.8	25.4	3.34	1.26	0.39	0.04
10.2	17.8	4.80	1.11	0.33	0.05
0.0	10.2	5.60	1.00	0.33	0.13
Averages:		4.70	1.43	0.41	0.08

* here s.d. represents the "uncertainty in the estimate of the mean" and is computed as: $s.d. = \frac{\sigma}{\sqrt{n}}$

Snow Wetness and Density
April 11, 1994

4/11/94 Unshaded					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
43.2	45.8	3.5	1.2	0.46	0.04
38.1	43.2	1.2	1.4	0.42	0.05
30.5	38.1	1.0	0.4	0.45	0.05
22.9	30.5	0.7	0.2	0.42	0.07
15.2	22.9	3.1	1.5	0.38	0.05
0.0	15.2	2.5	1.2	0.36	0.03
Averages:		2.0	1.0	0.42	0.05

4/11/94 Shaded					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
35.5	38.1	2.6	0.8	0.45	0.04
30.5	35.7	0.9	0.4	0.58	0.07
2.9	30.5	0.8	0.2	0.38	0.05
15.2	22.9	0.9	0.3	0.30	0.02
7.6	15.2	5.5	1.0	0.35	0.02
0.0	7.6	3.3	1.5	0.26	0.06
Averages:		2.3	0.7	0.39	0.04

* here s.d. represents the "uncertainty in the estimate of the mean" and is computed as: $s.d. = \frac{\sigma}{\sqrt{n}}$

Snow Wetness and Density
April 13, 1994

4/13/94 Unshaded -- Pre-Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
30.5	33.0	4.5	1.1	0.43	0.04
25.4	30.5	3.9	1.0	0.38	0.11
17.8	25.4	5.1	0.5	0.38	0.03
10.2	17.8	4.8	1.2	0.41	0.03
0.0	10.2	4.3	0.7	0.42	0.07
Averages:		4.5	0.9	0.40	0.06

4/13/94 Shaded -- Pre-Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
30.5	33.0	3.4	0.4	0.48	0.09
25.4	30.5	2.8	0.9	0.40	0.18
17.8	25.4	2.4	0.5	0.35	0.07
10.2	17.8	4.6	1.2	0.34	0.08
0.0	10.2	4.1	0.9	0.35	0.05
Averages:		3.4	0.8	0.38	0.09

4/13/94 Unshaded -- During Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
30.5	33.0	3.7	0.6	0.44	0.05
25.4	30.5	4.4	0.7	0.45	0.03
17.8	25.4				
10.2	17.8				
0.0	10.2				
Averages:		4.1	0.7	0.45	0.04

4/13/94 Shaded -- During Overflight					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
30.5	33.0	2.7	0.4	0.45	0.07
25.4	30.5	2.2	0.7	0.41	0.08
17.8	25.4	2.6	0.3	0.40	0.06
10.2	17.8				
0.0	10.2				
Averages:		2.5	0.5	0.42	0.07

* here s.d. represents the "uncertainty in the estimate of the mean" and is computed as: $s.d. = \frac{\sigma}{\sqrt{n}}$

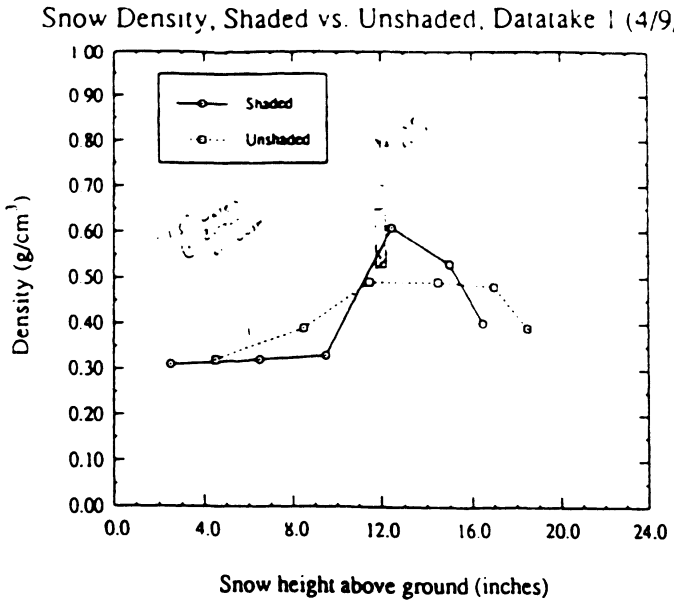
Snow Wetness and Density
April 14, 1994

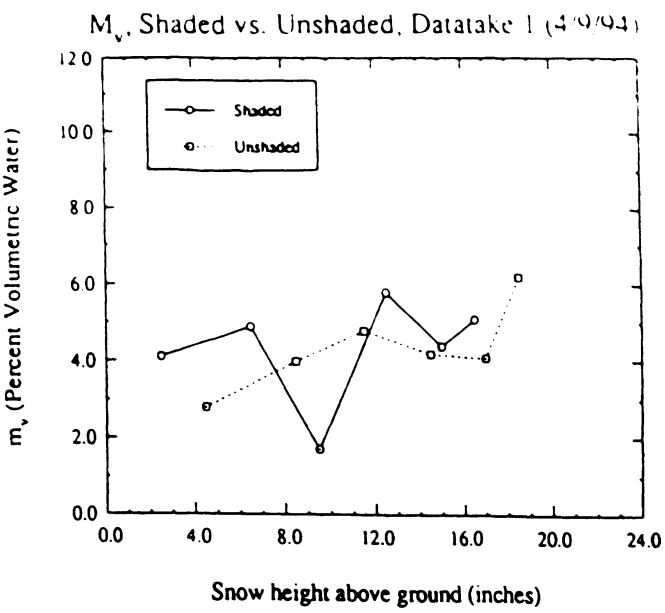
4/14/94 Unshaded					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
28.0	30.5	2.6	0.5	0.41	0.02
22.9	28.0	4.5	0.7	0.40	0.04
15.2	22.9	4.5	1.3	0.35	0.04
7.6	15.2	4.8	2.4	0.45	0.10
0.0	7.6	3.2	0.9	0.36	0.03
Averages:		3.9	1.1	0.39	0.05

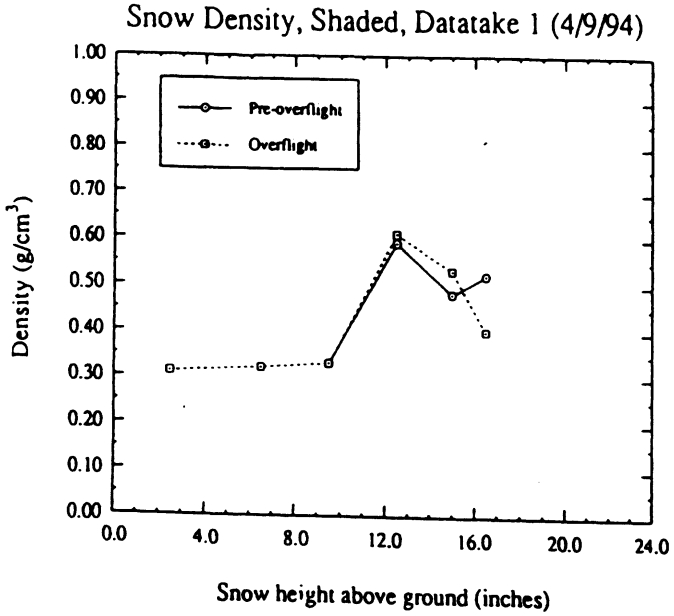
4/14/94 Shaded					
Bottom ht. above ground(cm)	Top ht. above ground(cm)	Moisture (% vol.)	Moisture s.d. *	Density (g/cm3)	Density s.d.*
28.0	30.5	2.9	0.6	0.43	0.06
22.9	28.0	1.7	0.2	0.42	0.02
15.2	22.9	1.8	0.2	0.37	0.02
7.6	15.2	2.7	0.9	0.34	0.05
0.0	7.6	2.3	0.5	0.36	0.03
Averages:		2.3	0.5	0.38	0.04

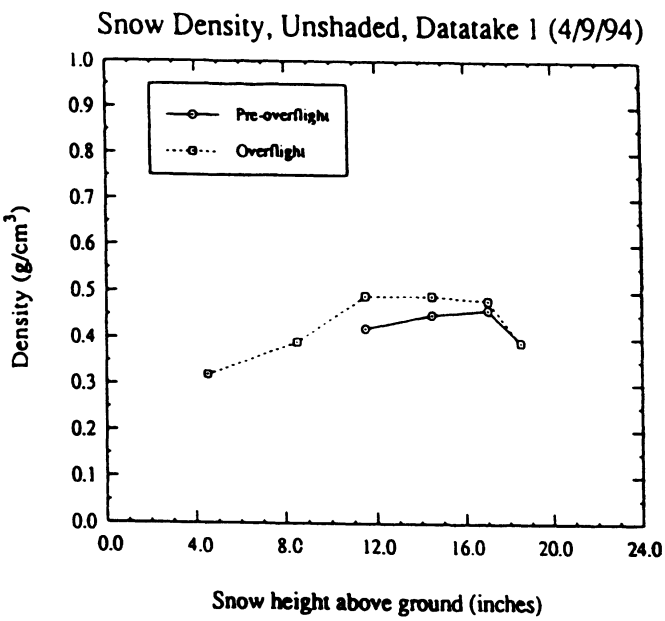
* here s.d. represents the "uncertainty in the estimate of the mean" and is computed as: $s.d. = \frac{\sigma}{\sqrt{n}}$

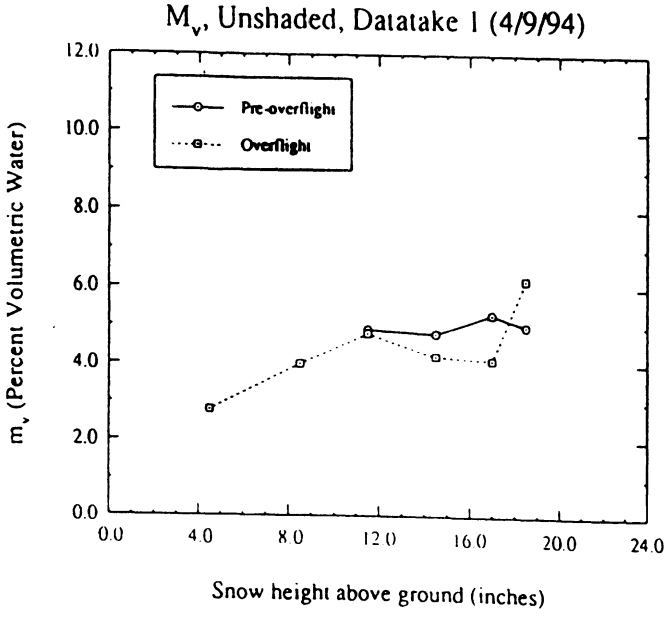
APPENDIX B:
SNOW PIT WETNESS AND DENSITY PLOTS

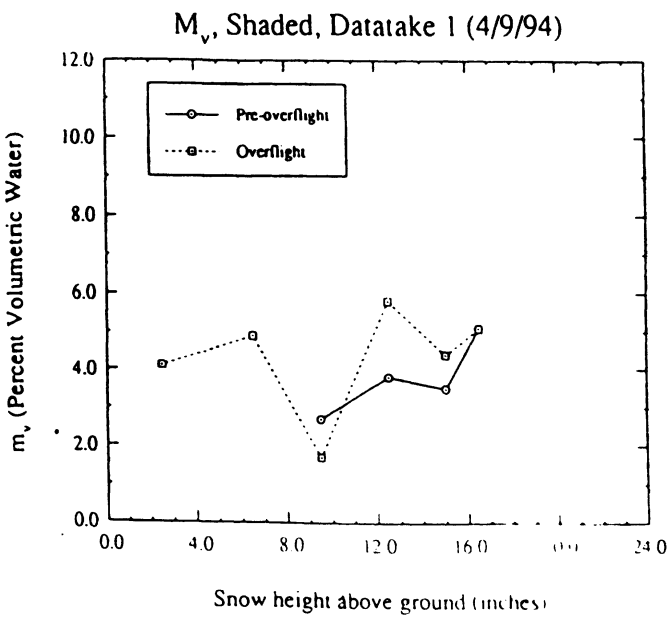

Snow Density, Shaded vs. Unshaded, Datatake 1 (4/9/94)
Shaded
Unshaded
Density (g/cm^3)
Snow height above ground (inches)

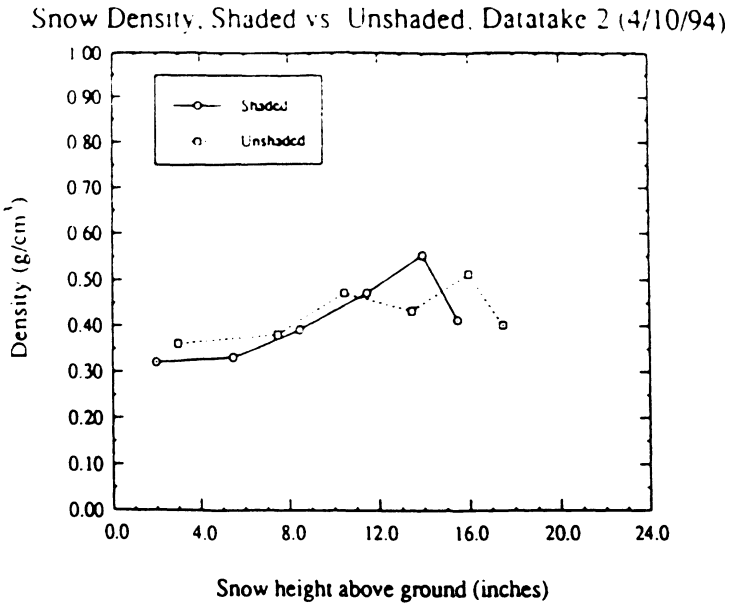

M_v, Shaded vs. Unshaded, Datatake 1 (4/9/94)
Shaded
Unshaded
m_v (Percent Volumetric Water)
Snow height above ground (inches)

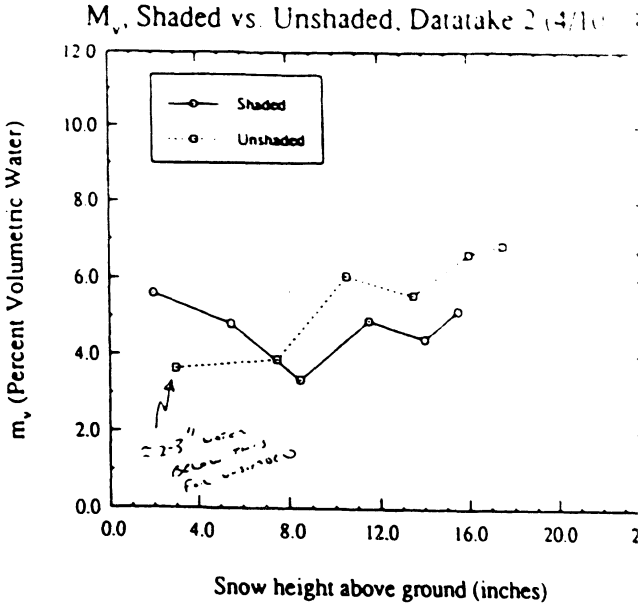

Snow Density, Shaded, Datatake 1 (4/9/94)
Pre-overflight
Overflight
Density (g/cm^3)
Snow height above ground (inches)

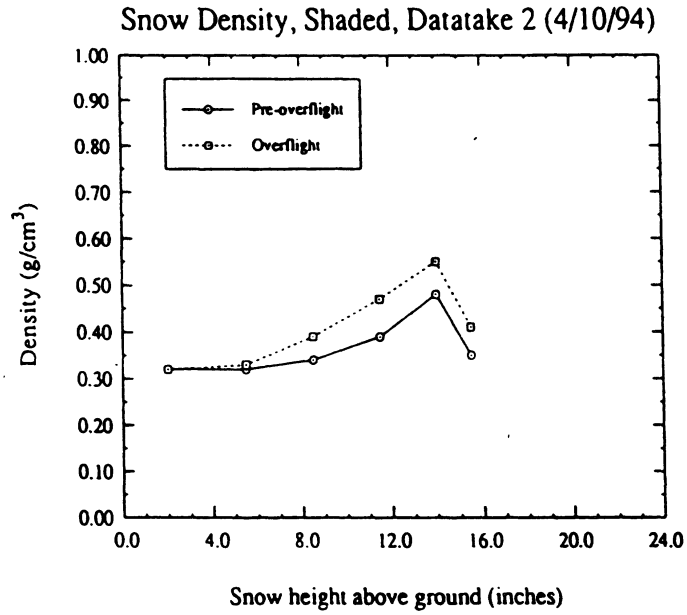

Snow Density, Unshaded, Datatake 1 (4/9/94)
Pre-overflight
Overflight
Density (g/cm^3)
Snow height above ground (inches)

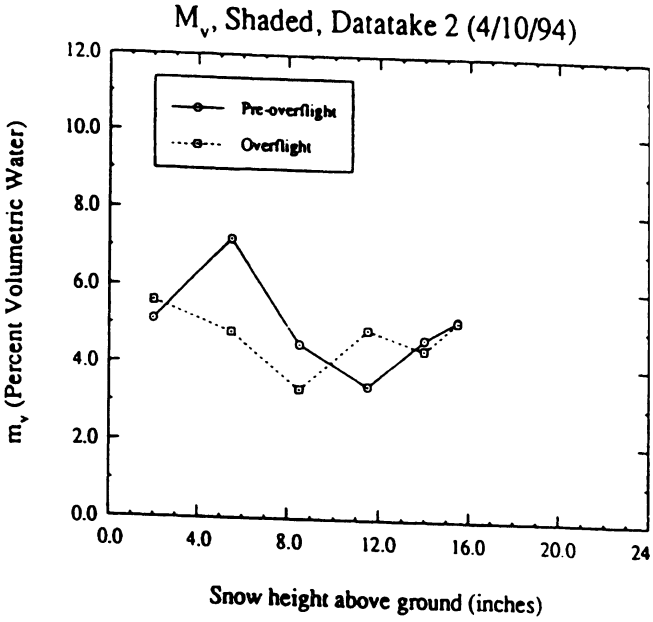

M_v, Unshaded, Datatake 1 (4/9/94)
Pre-overflight
Overflight
m_v (Percent Volumetric Water)
Snow height above ground (inches)

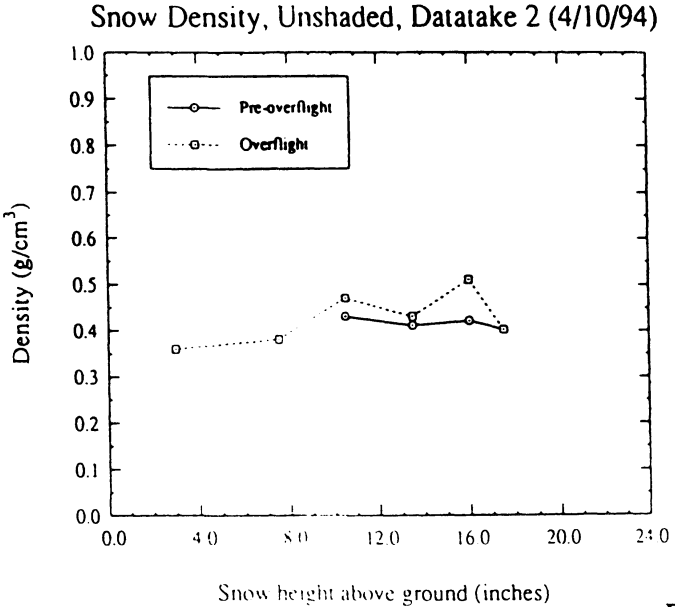

M_v, Shaded, Datatake 1 (4/9/94)
Pre-overflight
Overflight
m_v (Percent Volumetric Water)
Snow height above ground (inches)

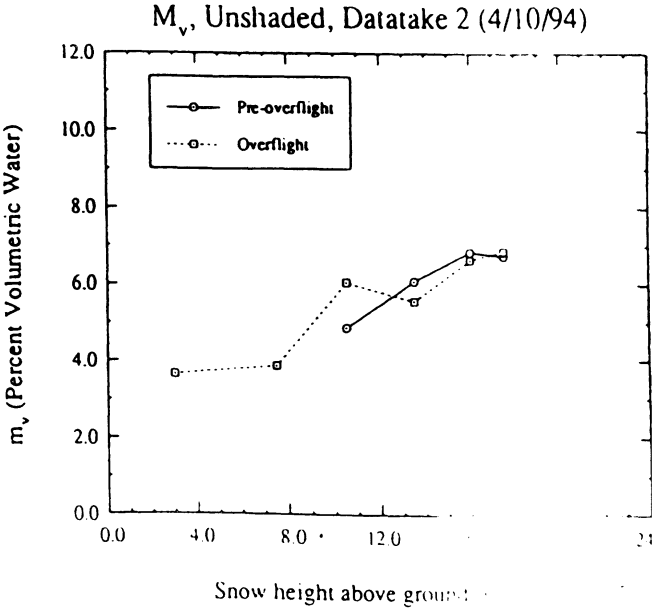

Snow Density, Shaded vs Unshaded, Datatake 2 (4/10/94)
Shaded
Unshaded
Density (g/cm^3)
Snow height above ground (inches)

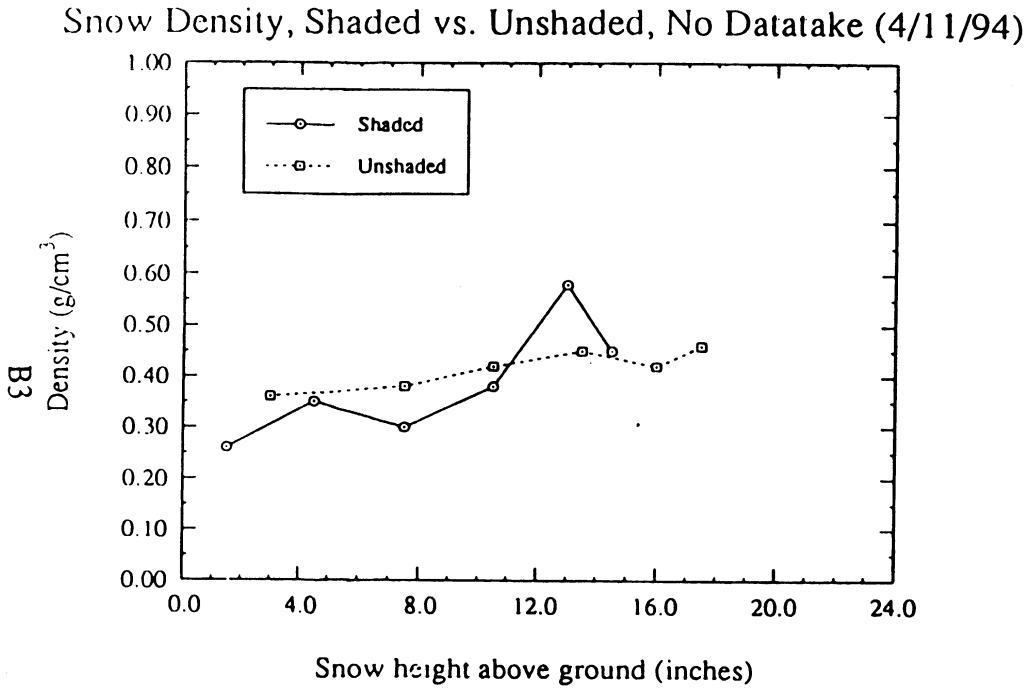

M_v, Shaded vs Unshaded, Datatake 2
Shaded
Unshaded
m_v (Percent Volumetric Water)
Snow height above ground (inches)

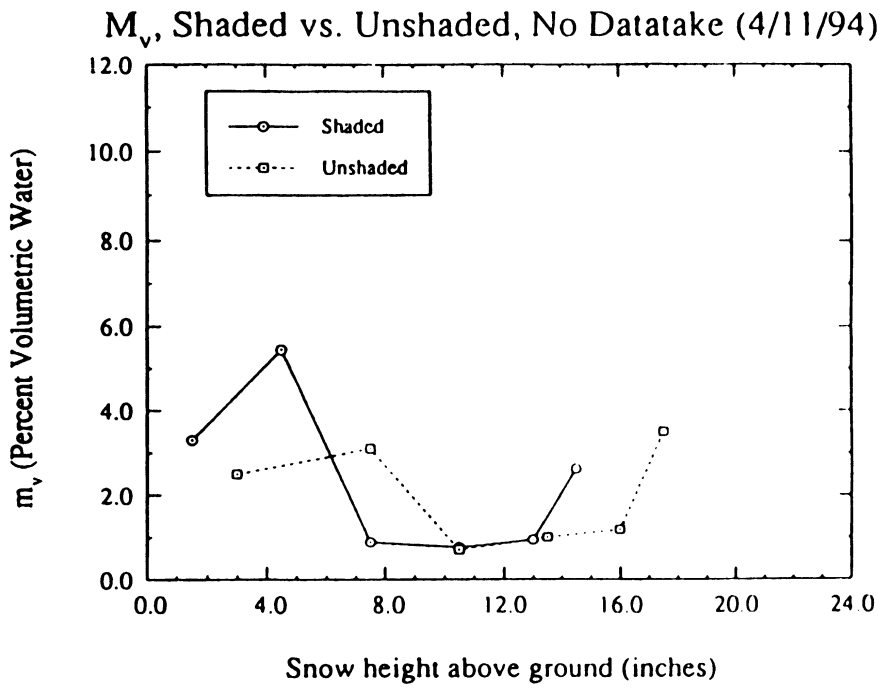

Snow Density, Shaded, Datatake 2 (4/10/94)
Pre-overflight
Overflight
Density (g/cm^3)
Snow height above ground (inches)

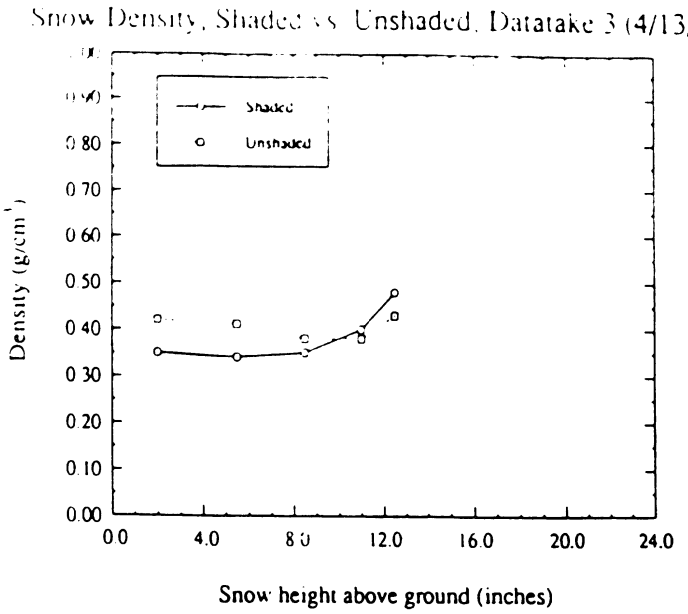

M_v, Shaded, Datatake 2 (4/10/94)
Pre-overflight
Overflight
m_v (Percent Volumetric Water)
Snow height above ground (inches)

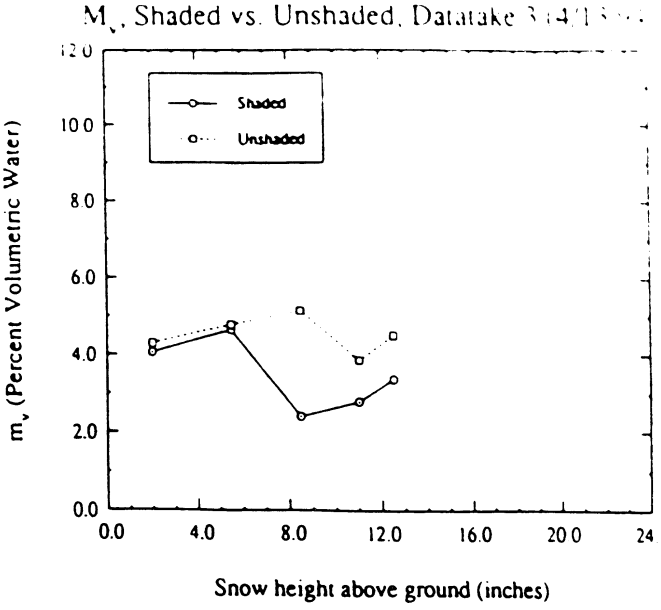

Snow Density, Unshaded, Datatake 2 (4/10/94)
Pre-overflight
Overflight
Density (g/cm^3)
Snow height above ground (inches)

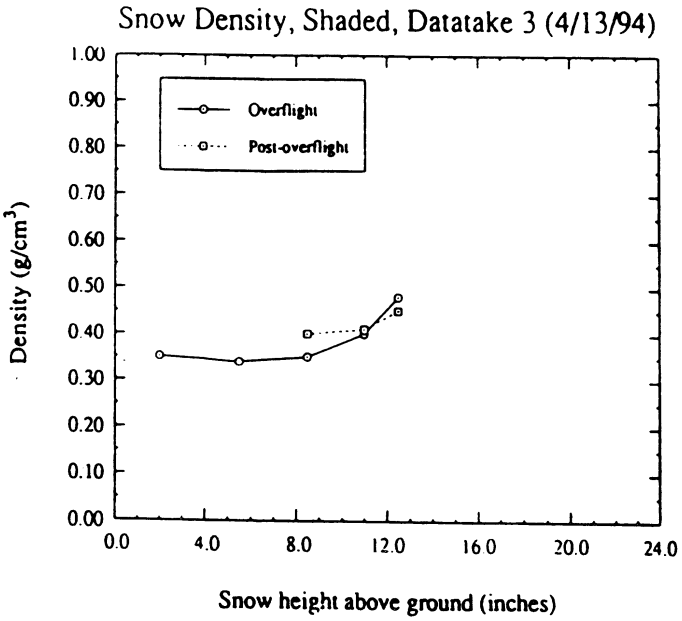

M_v, Unshaded, Datatake 2 (4/10/94)
Pre-overflight
Overflight
m_v (Percent Volumetric Water)
Snow height above ground

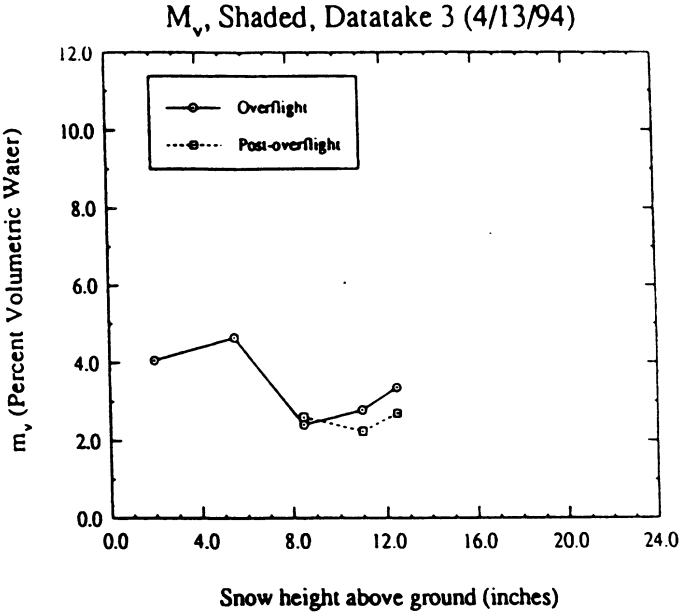

Snow Density, Shaded vs. Unshaded, No Datatake (4/11/94)
Shaded
Unshaded
Density (g/cm^3)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
4.0
8.0
12.0
16.0
20.0
24.0
Snow height above ground (inches)

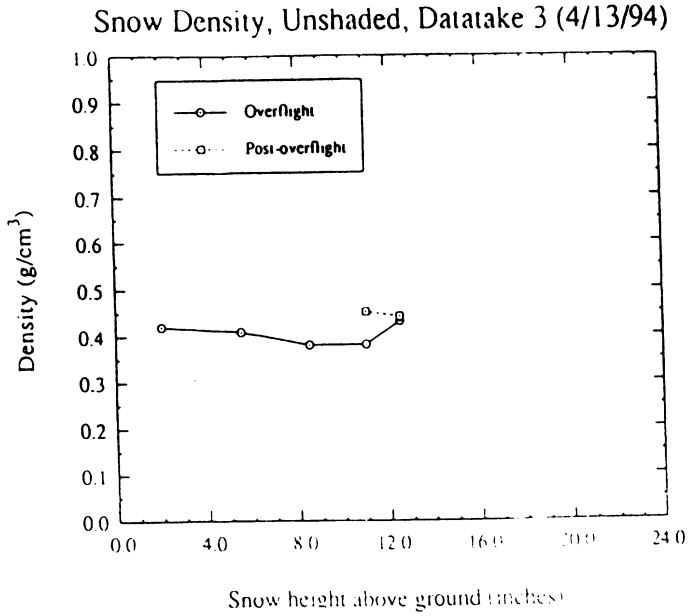

M_v, Shaded vs. Unshaded, No Datatake (4/11/94)
Shaded
Unshaded
m_v (Percent Volumetric Water)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
Snow height above ground (inches)

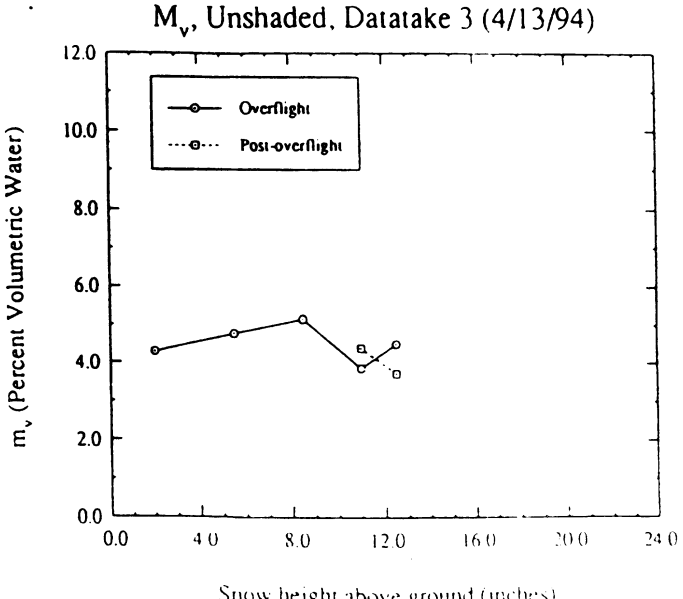

Snow Density, Shaded vs. Unshaded, Datatake 3 (4/13/94)
Shaded
Unshaded
Density (g/cm³)
Snow height above ground (inches)

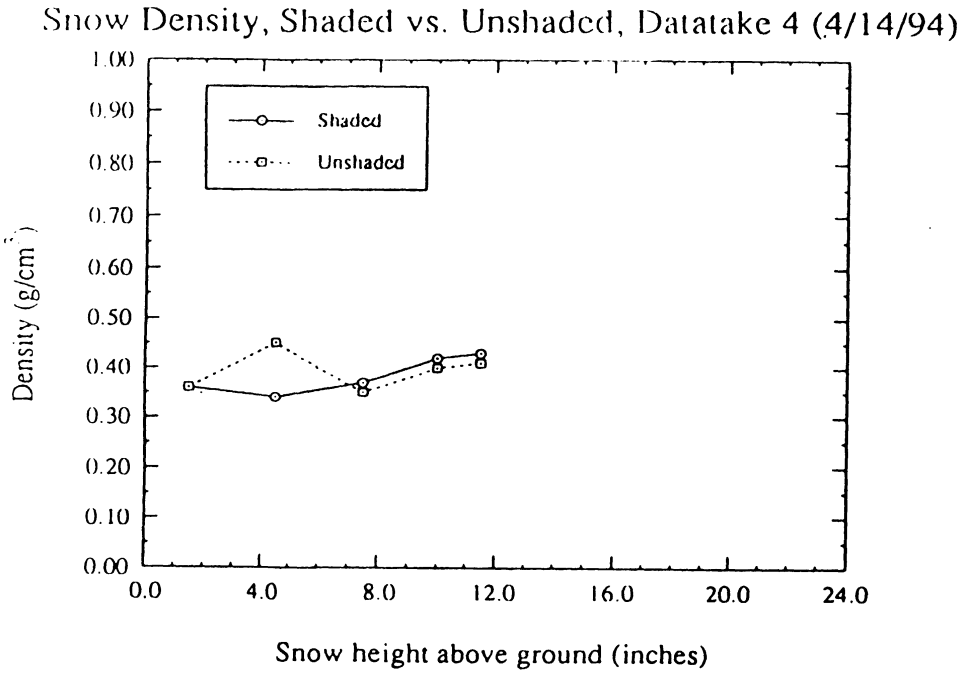

Shaded
Unshaded
m_v (Percent Volumetric Water)
Snow height above ground (inches)

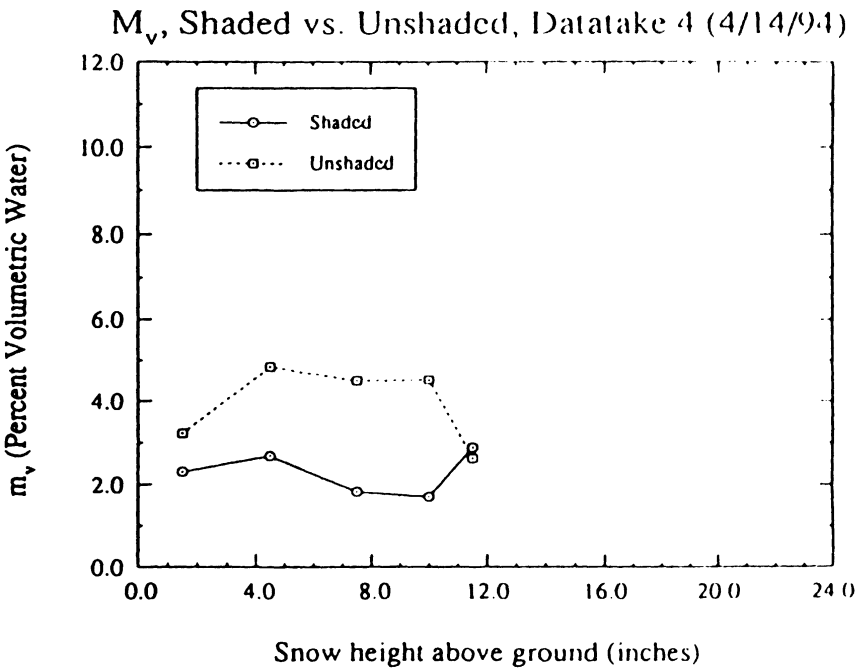

Snow Density, Shaded, Datatake 3 (4/13/94)
Overflight
Post-overflight
Density (g/cm³)
Snow height above ground (inches)


M_v, Shaded, Datatake 3 (4/13/94)
Overflight
Post-overflight
m_v (Percent Volumetric Water)
Snow height above ground (inches)


Snow Density, Unshaded, Datatake 3 (4/13/94)
Overflight
Post-overflight
Density (g/cm³)
Snow height above ground (inches)


M_v, Unshaded, Datatake 3 (4/13/94)
Overflight
Post-overflight
m_v (Percent Volumetric Water)
Snow height above ground (inches)


Snow Density, Shaded vs. Unshaded, Datatake 4 (4/14/94)
Shaded
Unshaded
Density (g/cm³)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
4.0
8.0
12.0
16.0
20.0
24.0
Snow height above ground (inches)


M$_v$, Shaded vs. Unshaded, Datatake 4 (4/14/94)
Shaded
Unshaded
m$_v$ (Percent Volumetric Water)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
4.0
8.0
12.0
16.0
20.0
24.0
Snow height above ground (inches)

APPENDIX C:
SNOW AND SOIL RESULTS FOR CLEARINGS AND FOREST STANDS: PHASE 1

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Cryderman Field**	1	NA	NA	NA	NA	0.0	95.78	29.51	66.27	0.69	0.44	0.20	2.25
Date:	4/3/94	2	NA	NA	NA	NA	0.0	12.56	1.81	10.75	0.86	0.11	0.02	5.94
Time:	11:05 AM	3	NA	NA	NA	NA	0.0	19.47	10.38	9.09	0.47	0.35	0.40	0.88
Air temperature (°C):	1.6	4	NA	NA	NA	NA	0.2	36.60	8.99	27.61	0.75	0.69	0.22	3.07
Transect avg. snow depth (cm), +/- one standard deviation:	10.5 +/- 4.1	5	NA	NA	NA	NA	0.0	56.45	25.71	30.74	0.54	0.51	0.43	1.20
Transect snow linear fraction:	0.3	6	NA	NA	NA	NA	0.0	90.65	45.25	45.40	0.50	0.66	0.66	1.00
Sample (column) averages:							0.0				0.64	0.46	0.32	2.39

NOTES: CRYDERMAN FIELD: Flattened down hayfield; material is 5 - 15 cm thick, ground seems to be frozen, very shallow layer of snow and ice

Sample #2: sample is almost exclusively ice.

Sample # 3: have about 7.5 cm of pure ice on top of ground (collected?)

Sample #4: 7 cm of vegetation plus wet ice; below this much water

Sample #5: 4 cm of ice, freeze layer at least 15 cm here

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Clearing #3 (at Raco airfield)**	1	8.00	124.00	1.53	0.19	2.4	128.72	87.34	41.38	0.32	0.33	0.69	0.47
Date	4/6/94	2	21.00	422.60	5.21	0.25	NA	103.11	69.10	34.01	0.33	0.27	0.55	0.49
Time	10:07AM	3	16.50	399.50	4.93	0.30	NA	125.87	81.72	44.15	0.35	0.35	0.65	0.54
Air temperature (°C)	-0.4	4	34.00	1058.00	13.05	0.38	NA	96.23	69.61	26.62	0.28	0.26	0.69	0.38
Transect avg. snow depth (cm), +/- one standard deviation	18.4+/-14.0	5	52.00	1374.00	16.95	0.33	2.0	128.91	95.33	33.58	0.26	0.30	0.84	0.35
Transect snow linear fraction	0.95	6	41.00	1118.30	13.79	0.34	NA	105.24	66.65	38.59	0.37	NA	NA	0.58
Sample (column) averages:			28.75		9.24	0.30	2.2				0.32	0.30	0.69	0.47

NOTES: CLEARING #3: Crushed down wheat. Snow mixed up with the wheat/grass

Sample # 1: ~9 cm of snow on top of 18 cm of solid ice

Sample #2: More snow (~20 cm), less ice, (~13cm)

Sample #3: Very well defined ice layer beneath snow; 4 cm snow, then 13 cm very coarse icy snow, then 9 cm ice

Sample #4: Ice layer only 2.4 cm thick here

Sample #5: Wetness between snow and ice (1 cm) layers. Soil seems to be frozen

Sample #6: Very similar to sample 5, ice ~ 2 cm

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Clearing by stands 33 & 34**	1	46.00	1375.40	16.96	0.37	0.5	108.15	90.64	17.51	0.16	0.14	0.72	0.19
Date	4/3/94	2	36.00	1201.40	14.82	0.41	NA	94.01	31.38	62.63	0.67	0.45	0.23	2.00
Time	5:06pm	3	40.00	1383.70	17.07	0.43	NA	32.72	19.07	13.65	0.42	0.56	0.78	0.72
Air temperature (°C)	6.2	4	36.00	1229.20	15.16	0.42	NA	28.69	20.25	8.44	0.29	0.37	0.88	0.42
Transect avg. snow depth (cm), +/- one standard deviation	37.2+/-6.7													
Transect snow linear fraction	1													
Sample (column) averages:			39.50		16.00	0.41	0.5				0.38	0.38	0.65	0.83

NOTES: CLEARING BY STANDS 33 & 34

Sample #3: 3 cm of ice on top, didn't collect; Below frozen solid but also lots of water on top

Sample #4: 1 cm ice on top not collected; Ground totally frozen, little or no wetness observed

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Clearing 4 (near fish hatchery)**	1	40.00	1125.10	13.88	0.35	1.9	62.08	15.55	46.53	0.75	0.53	0.18	2.99
Date	4/5/94	2					5.8	123.04	102.11	20.93	0.17	0.17	0.81	0.20
Time	2:45pm	3	26.00	676.00	8.34	0.32								
Air temperature (°C)	4.1	4	31.50	936.30	11.55	0.37	NA	67.43	23.63	43.80	0.65	0.50	0.27	1.85
Transect avg. snow depth (cm), +/- one standard deviation	30.7+/-12.5	5	21.00	447.50	5.52	0.26								
Transect snow linear fraction	0.91	6					2.1	157.64	125.44	32.20	0.20	0.26	1.00	0.26
Sample (column) averages:			29.63		9.82	0.32	3.3				0.44	0.36	0.56	1.33

NOTES: CLEARING #4 (near fish hatchery)

Sample #2: Occurs in an "island" of very torn-up irregular terrain; appears like the result of heavy machinery; variable litter, not collected; ground is pure sand, very moist

Sample #3: Adjacent to an area like #2, except have snow cover here; cannot find ground as it's covered with a tangle of tree trunks

Sample #4: Frozen soil, difficult to reach due to a massive amount of trees/twigs

Sample #5: Over some trunks, so no sample collected

Sample #6: Same as sample #5

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 22**	1	35.00	1123.00	13.85	0.40	1.8	105.52	82.80	22.72	0.22	0.20	0.73	0.27
Date	4/6/94	2	50.00	1367.60	16.87	0.34	NA	93.72	57.23	36.49	0.39	0.32	0.51	0.64
Time	12:47PM	3	32.00	873.40	10.77	0.34	NA	76.73	33.86	42.87	0.56	0.38	0.30	1.27
Air temperature (°C)	2.5	4	40.00	1048.90	12.94	0.32	1.5	70.58	31.68	38.90	0.55	0.39	0.31	1.23
Transect avg. snow depth (cm), +/- one standard deviation	36.5+/-13.6	5	37.00	904.20	11.15	0.30	NA	44.35	17.21	27.14	0.61	0.36	0.23	1.58
Transect snow linear fraction	1	6	11.00				NA	122.83	49.71	73.12	0.60	0.45	0.30	1.47
Sample (column) averages:			34.17		13.12	0.34	1.7				0.49	0.35	0.40	1.08

NOTES: STAND 22: Pole size red pine plantation at Raco Airfield

Sample #1: < 0.5 cm litter

Sample #2: 1.5 cm ice under snow; litter not included in sample

Sample #3: < 2 cm ice over 50% of patch; soil surface seems quite frozen

Sample #4: ~1 cm of ice/letter; not included in sample

Sample #6: Under a tree; snow not collected; thicker ice layer here (~12cm) and soil visibly wet below ice

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 23**	1	29.00	787.40	9.71	0.33	1.9	48.31	17.94	30.37	0.63	0.34	0.20	1.69
Date	4/5/94	2	36.00	846.00	10.44	0.29	NA	72.16	50.73	21.43	0.30	0.17	0.40	0.42
Time	1:05PM	3	37.00	704.30	8.69	0.23	NA	56.61	7.11	49.50	0.87	0.39	0.06	6.96
Air temperature (°C)	0.8	4	31.00	735.60	9.07	0.29	NA	82.79	35.66	47.13	0.57	0.47	0.35	1.32
Transect avg. snow depth (cm), +/- one standard deviation	35.0+/-6.8	5	42.00	1038.80	12.81	0.31	2.0	65.88	50.82	15.06	0.23	0.17	0.58	0.30
Transect snow linear fraction	1	6	34.00	978.50	12.07	0.35	NA	47.65	10.56	37.09	0.78	0.42	0.12	3.51
Sample (column) averages:			34.83		10.47	0.30	2.0				0.56	0.33	0.29	2.37

NOTES: STAND 23: Mature red and white pine

Sample #1: Soil unfrozen

Sample #2: Spongy litter layer, removed ~5cm of obvious litter, then collected

Sample #3: Lots of soft green pine sprigs under snow; didn't separate litter for sample

Sample #5: ~4cm of litter, easy to remove, didn't collect

Sample #6: Difficult to remove litter from soil; included litter in sample

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 24**	1	38.00	848.40	10.46	0.28	2.0	56.60	9.20	47.40	0.84	0.42	0.08	5.15
Date	4/5/94	2	53.00	1214.40	14.98	0.28	NA	108.20	62.52	45.68	0.42	0.33	0.45	0.73
Time	4:40PM	3	46.00	1063.80	13.12	0.29	NA	54.54	4.97	49.57	0.91	0.39	0.04	9.97
Air temperature (°C)	-0.4	4	37.00	885.10	10.92	0.30	NA	66.65	15.43	51.22	0.77	0.45	0.14	3.32
Transect avg. snow depth (cm), +/- one standard deviation	45.6+/-5.9	5	48.00	1179.00	14.54	0.30	1.1	49.94	9.97	39.97	0.80	0.40	0.10	4.01
Transect snow linear fraction	1	6	37.00	945.90	11.67	0.32	NA	50.50	3.63	46.87	0.93	0.41	0.03	12.91
Sample (column) averages:			43.17		12.62	0.29	1.6				0.78	0.40	0.14	6.02

NOTES: STAND 24: Mature jack pine

Sample #1: Ground seems very frozen at least until 5 cm depth

Sample #2: No obvious loose litter

Sample #5: Lots of grass and pine sprigs; ground not as forzen here

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	Stand 31	1	46.00	1442.10	17.79	0.39	NA	72.23	19.80	52.43	0.73	0.42	0.16	2.65
Date	4/4/94	2	54.00	1556.20	19.19	0.36	1.6	105.26	92.07	13.19	0.13	0.10	0.73	0.14
Time	1:00pm	3	51.00	1466.60	18.09	0.35	NA	137.02	119.33	17.69	0.13	0.14	0.95	0.15
Air temperature (°C)	2	4	49.00	1419.50	17.51	0.36	NA	77.16	54.12	23.04	0.30	0.17	0.39	0.43
Transect avg. snow depth (cm), +/- one standard deviation	48.3+/-2.7	5	41.00	1403.90	17.32	0.42	1.1	96.29	48.76	47.53	0.49	0.38	0.39	0.97
Transect snow linear fraction	1	6	56.00	1448.50	17.87	0.32	NA	108.19	67.29	40.90	0.38	0.33	0.53	0.61
Sample (column) averages:			49.50		17.96	0.37	1.4				0.36	0.26	0.53	0.82

NOTES: STAND 31: Pole size northern hardwoods

Sample #2: 1.5 cm litter, soil unfrozen

Sample #3: 4-5 cm litter, not collected; ground below unfrozen

Sample #4: 4-5 cm litter, unfrozen soil

Sample #5: Hard; took top 5 cm including litter

Sample #6: Frozen; took top 5 cm including litter

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 32**	1	28.00	950.60	11.73	0.42	frozen	41.85	2.35	39.50	0.94	0.39	0.02	16.81
Date	4/4/94	2	43.00	952.80	11.75	0.27	frozen	62.15	4.59	57.56	0.93	0.46	0.04	12.54
Time	3:30pm	3	60.00	1339.80	16.53	0.28	NA	80.86	6.51	74.35	0.92	0.49	0.04	11.42
Air temperature (°C)	2.2	4	36.00	1091.90	13.47	0.37	NA	55.28	3.78	51.50	0.93	0.34	0.03	13.62
Transect avg. snow depth (cm), +/- one standard deviation	36.5+/-5.9	5	36.00	1027.20	12.67	0.35	NA	45.32	4.25	41.07	0.91	0.41	0.04	9.66
Transect snow linear fraction	1	6	35.00	927.80	11.44	0.33	NA	43.63	1.66	41.97	0.96	0.42	0.02	25.28
Sample (column) averages:			39.67		12.93	0.34					0.93	0.42	0.03	14.89

NOTES: STAND 32: Mature northern white-cedar

Sample #1: Dense forest; mostly n. white-cedar with some black spruce

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 33**	1	56.00	1564.10	19.29	0.34	0.6	101.44	81.44	20.00	0.20	0.16	0.65	0.25
Date	4/4/94	2	57.00	1533.20	18.91	0.33	NA	96.23	85.11	11.12	0.12	0.09	0.68	0.13
Time	9:30 AM	3	54.00	1465.80	18.08	0.33	NA	56.84	41.46	15.38	0.27	0.36	0.96	0.37
Air temperature (°C)	1.6	4	50.00	1340.10	16.53	0.33	NA	26.40	13.59	12.81	0.49	0.50	0.53	0.94
Transect avg. snow depth (cm), +/- one standard deviation	56.3+/-3.4	5	43.00	1375.90	16.97	0.39	1.0	132.95	111.28	21.67	0.16	0.14	0.74	0.19
Transect snow linear fraction	1	6	52.00	1514.60	18.68	0.36	?	117.73	99.79	17.94	0.15	0.14	0.79	0.18
Sample (column) averages:			52.00		18.08	0.35	0.8				0.23	0.23	0.72	0.34

NOTES: STAND 33: Aspen sapling, densly stocked

Sample #1: 3-4 cm organic matter, unfrozen; soft soil

Sample #2: ~2 cm organic matter, unfrozen, on top of unfrozen soil

Sample #3: 1.5 cm litter and ice, ground harder, more forzen; collected top 5 cm below litter layer

Sample #4: Ice layer 1-1.5 cm deep; soft soil below

Sample #4: 5 cm litter, not collected

Sample #6: ~3 cm litter, not collected

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	Stand 34	1	47.00	1466.20	18.08	0.38	0.7	53.92	32.40	21.52	0.40	0.38	0.57	0.66
Date	4/3/94	2	54.00	1817.80	22.42	0.42	NA	43.83	26.85	16.98	0.39	0.44	0.69	0.63
Time	1:20pm	3	44.00	1330.30	16.41	0.37	NA	54.12	32.58	21.54	0.40	0.31	0.47	0.66
Air temperature (°C)	5.3	4	44.00	1336.20	16.48	0.37	NA	49.63	22.11	27.52	0.55	0.48	0.39	1.24
Transect avg. snow depth (cm), +/- one standard deviation	48.2+/-4.2	5	52.00	1456.50	17.97	0.35	0.4	66.96	49.09	17.87	0.27	0.26	0.71	0.36
Transect snow linear fraction	1	6	48.00	1483.20	18.29	0.38	0.5	52.06	32.45	19.61	0.38	0.29	0.47	0.60
Sample (column) averages:			48.17		18.28	0.38	0.5				0.40	0.36	0.55	0.70

NOTES: STAND 34: Overmature aspen / norther hardwoods

Sample #1: 10 cm wet/unfrozen, below which much drier in appearance; top part loose, organic

Sample #2: Layer system present: dark layer (wet/organic), light layer (dry, sandy); sample is dark layer only

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	Stand 43	1	41.00	1013.00	12.49	0.30	1.1	55.10	6.26	48.84	0.89	0.39	0.05	7.80
Date	4/5/94	2	40.00	877.00	10.82	0.27	NA	75.01	36.97	38.04	0.51	0.30	0.29	1.03
Time	9:42AM	3	36.00	938.50	11.58	0.32	1.6	93.89	63.97	29.92	0.32	0.30	0.64	0.47
Air temperature (°C)	-4.1	4	50.00	1097.60	13.54	0.27	NA	62.21	4.73	57.48	0.92	0.38	0.03	12.15
Transect avg. snow depth (cm), +/- one standard deviation	39.2+/-4.3	5	49.00	1151.00	14.20	0.29	NA	97.33	74.79	22.54	0.23	0.22	0.74	0.30
Transect snow linear fraction	1	6	39.00	1006.10	12.41	0.32	NA	68.99	46.08	22.91	0.33	0.30	0.61	0.50
Sample (column) averages:			42.50		12.51	0.30	1.4				0.53	0.32	0.39	3.71

NOTES: STAND 43: Mature red pine

Sample #1: Ground very frozen; top 5 cm primarily litter

Sample #2: Fresh pine green material below the snow; ground below is not frozen solid

Sample #3: Not much green stuff here; 2-3 cm litter, not included in sample

Sample #4: 1-2 cm litter, not collected

Sample #5: 5 cm frozen litter is included in sample; soil almost frozen beneath

Sample #6: Frozen ground, sample includes litter

		Snow					Soil							
		Sample number	Snow depth (cm)	Snow wt. (g)	Snow water equivalent (cm)	Snow density (g/cm3)	Soil temp. (°C)	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil water volume fraction (cm3/cm3)	Soil bulk density (g/cm3)	Soil gravimetric moisture (dry wt. g/g)
Location	**Stand 90**	1	50.00	1253.40	15.46	0.31	1.6	52.64	13.96	38.68	0.73	0.22	0.08	2.77
Date	4/7/94	2	43.50	1107.70	13.66	0.31	NA	49.67	9.08	40.59	0.82	0.36	0.08	4.47
Time	9:54 AM	3	34.50	939.20	11.58	0.34	NA	55.75	3.56	52.19	0.94	0.44	0.03	14.66
Air temperature (°C)	-3.4	4	52.00	1435.80	17.71	0.34	NA							
Transect avg. snow depth (cm), +/- one standard deviation	37.3+/-12.1	5	38.00	488.90	6.03	0.16	NA	40.46	4.10	36.36	0.90	0.44	0.05	8.87
Transect snow linear fraction	1	6	41.00	1152.10	14.21	0.35	2.7	49.52	8.80	40.72	0.82	0.27	0.06	4.63
Sample (column) averages:			43.17	1062.85	13.11	0.30	2.2				0.84	0.35	0.06	7.08

NOTES: STAND 90: Mature black spruce

Sample #1: Moist, black, spongy soil

Sample #2: Very icy snow, difficult to shovel, really have to break it up; surface topology of stand is very irregular

Sample #5: Soil seems frozen here

Sample #6: Soil soft, unfrozen, moist, like samples 1 & 2

APPENDIX D:
SNOW AND SOIL RESULTS FOR CLEARINGS AND FOREST STANDS: PHASE 2

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Cryderman Field @ T2-T3**	1	Sat'd	157.51	104.70	52.81	0.34	0.50
Date:	4/17/94	2	Sat'd	151.57	102.04	49.53	0.33	0.49
Time:	3:30pm	3	Sat'd	201.95	141.73	60.22	0.30	0.42
Transect avg. snow depth (cm), +/- one standard deviation:	0							
Transect snow linear fraction:	0							
Sample (column) averages:				170.34	116.16	54.19	0.32	0.47

CRYDERMAN FIELD: hayfield

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Cryderman field T2-T3**	1	sat'd					
Date:	4/18/94	2	sat'd					
Time:	1:10 AM	3	sat'd					
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	sat'd					
Transect snow linear fraction:	0	5	sat'd					
		6	sat'd					
		7	sat'd					
		8	sat'd					
		9	sat'd					
		10	sat'd					

CRYDERMAN FIELD: Hayfield

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-6**	1	wet	179.32	156.65	22.67	0.13	0.14
Date:	4/18/94	2	wet	156.94	134.94	22.00	0.14	0.16
Time:	9:55am	3	wet	189.67	159.73	29.94	0.16	0.19
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	139.01	96.88	42.13	0.30	0.43
Transect snow linear fraction:	0							
Sample (column) averages:				166.24	137.05	29.19	0.18	0.23

RIFLE RANGE, T2-6: Rifle range near Raco Airport; samples taken between trihedrals 2 and 6

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-5**	1	wet	158.29	123.74	34.55	0.22	0.28
Date:	4/18/94	2	wet	157.73	136.68	21.05	0.13	0.15
Time:	10:25am	3	wet	204.37	170.95	33.42	0.16	0.20
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	135.74	93.98	41.76	0.31	0.44
Transect snow linear fraction:	0							
Sample (column) averages:				164.03	131.34	32.70	0.21	0.27

RIFLE RANGE, T2-5: Rifle range near Raco airport; samples taken between trihedrals 2 and 5

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-3**	1	wet	148.80	125.98	22.82	0.15	0.18
Date:	4/18/94	2	wet	191.61	176.05	15.56	0.08	0.09
Time:	10:35am	3	wet	198.11	176.93	21.18	0.11	0.12
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	175.01	138.22	36.79	0.21	0.27
Transect snow linear fraction:	0							
Sample (column) averages:				178.38	154.30	24.09	0.14	0.16

RIFLE RANGE, T2-3: Rifle range near Raco airport; samples taken between trihedrals 2 and 3

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-4**	1	wet	143.03	120.79	22.24	0.16	0.18
Date:	4/18/94	2	wet	160.40	135.33	25.07	0.16	0.19
Time:	10:45am	3	wet	177.20	161.54	15.66	0.09	0.10
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	148.96	123.72	25.24	0.17	0.20
Transect snow linear fraction:	0							
Sample (column) averages:				157.40	135.35	22.05	0.14	0.17

RIFLE RANGE, T2-4: Rifle range near Raco airport; samples taken between trihedrals 2 and 4

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-2**	1	wet	184.40	155.84	28.56	0.15	0.18
Date:	4/18/94	2	wet	118.25	100.73	17.52	0.15	0.17
Time:	11:00am	3	wet	184.15	156.77	27.38	0.15	0.17
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	165.54	157.76	7.78	0.05	0.05
Transect snow linear fraction:	0							
Sample (column) averages:				163.09	142.78	20.31	0.12	0.15

RIFLE RANGE, T2-2: Rifle range near Raco airport; samples taken between trihedrals 2 and ?

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, T2-1**	1	wet	147.80	124.38	23.42	0.16	0.19
Date:	4/18/94	2	wet	193.98	173.12	20.86	0.11	0.12
Time:	11:10am	3	wet	155.65	130.54	25.11	0.16	0.19
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	156.80	131.75	25.05	0.16	0.19
Transect snow linear fraction:	0							
Sample (column) averages:								
Sample (column) averages:				163.56	139.95	23.61	0.15	0.17

RIFLE RANGE, T2-1: Rifle range near Raco Airport; samples taken between trihedrals 2 and 1

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Rifle Range, P-4 (parc)**	1	wet	153.37	124.09	29.28	0.19	0.24
Date:	4/18/94	2	wet	125.26	97.46	27.80	0.22	0.29
Time:	11:25am	3	wet	88.66	9.58	79.08	0.89	8.25
Transect avg. snow depth (cm), +/- one standard deviation:	0	4	wet	131.57	85.42	46.15	0.35	0.54
Transect snow linear fraction:	0							
Sample (column) averages:								
Sample (column) averages:				124.72	79.14	45.58	0.41	2.33

RIFLE RANGE, P-4 (parc): Rifle range near Raco Airport; samples taken at parc-4

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 22**	1	wet	183.76	131.84	51.92	0.28	0.39
Date:	4/16/94	2	sat'd	154.50	98.76	55.74	0.36	0.56
Time:	12:10 PM	3	sat'd	191.86	134.13	57.73	0.30	0.43
Transect avg. snow depth (cm), +/- one standard deviation:	25.5+/-15.0	4	wet	178.20	113.77	64.43	0.36	0.57
Transect snow linear fraction:	1	5	wet	186.75	149.06	37.69	0.20	0.25
		6	wet	169.05	72.58	96.47	0.57	1.33
Sample (column) averages:				177.35	116.69	60.66	0.35	0.59

STAND 22: Sapling/pole size red pine plantation

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 23**	1	wet					
Date:	4/16/94	2	wet					
Time:	10:00am	3	wet					
Transect avg. snow depth (cm), +/- one standard deviation:	6.9+/-5.4	4	wet					
Transect snow linear fraction:	0.9	5	sat'd					
Sample (column) averages:		6	wet					

STAND 23: Mature red and white pine

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 24**	1	wet	66.99	7.88	59.11	0.88	7.50
Date:	4/17/94	2	wet	139.40	74.48	64.92	0.47	0.87
Time:	2:15pm	3	wet	88.99	27.25	61.74	0.69	2.27
Transect avg. snow depth (cm), +/- one standard deviation:	22.9+/-5.2	4	wet	69.51	5.10	64.41	0.93	12.63
Transect snow linear fraction:	0.9	5	wet	122.15	59.17	62.98	0.52	1.06
		6	wet	92.53	18.49	74.04	0.80	4.00
Sample (column) averages:				96.60	32.06	64.53	0.71	4.72

STAND 24: Mature jack pine

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 31**	1	wet	117.76	68.27	49.49	0.42	0.72
Date:	4/17/94	2	wet	84.97	45.43	39.54	0.47	0.87
Time:	11:15am	3	wet	59.15	4.64	54.51	0.92	11.75
Transect avg. snow depth (cm), +/- one standard deviation:	25.4+/-3.2	4	wet	107.38	64.52	42.86	0.40	0.66
Transect snow linear fraction:	1	5	wet	93.21	42.63	50.58	0.54	1.19
		6	wet	90.66	13.26	77.40	0.85	5.84
Sample (column) averages:				92.19	39.79	52.40	0.60	3.51

STAND 31: Pole size northern hardwoods

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 32**	1	Sat'd	174.61	4.54	170.07	0.97	37.46
Date:	4/16/94	2	Sat'd	93.19	1.89	91.30	0.98	48.31
Time:	2:30pm	3	Sat'd	90.90	2.39	88.51	0.97	37.03
Transect avg. snow depth (cm), +/- one standard deviation:	32.0+/-12.6	4	Sat'd	104.36	4.49	99.87	0.96	22.24
Transect snow linear fraction:	1	5	Sat'd	83.51	3.10	80.41	0.96	25.94
		6	Sat'd	74.95	2.82	72.13	0.96	25.58
Sample (column) averages:				103.59	3.21	100.38	0.97	32.76

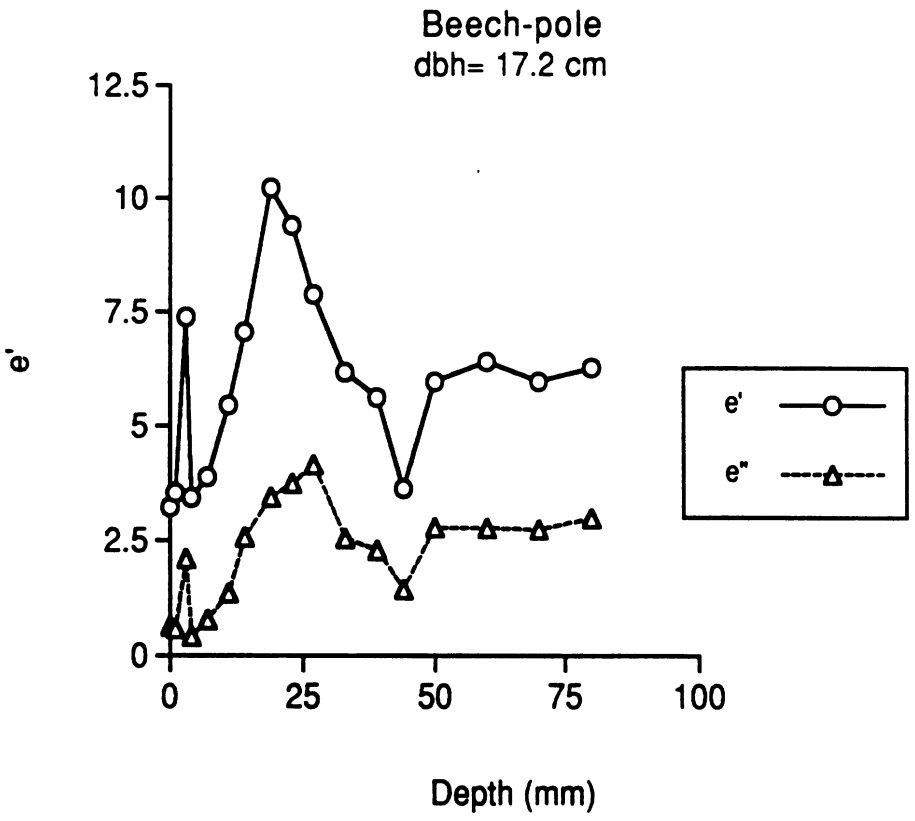
STAND 32: Mature northern white-cedar

		Soil						
		Sample number	Soil condition	Soil wet sample wt. (g)	Soil dry sample wt. (g)	Soil water wt. (g)	Soil gravimetric moisture (wet wt. g/g)	Soil gravimetric moisture (dry wt. g/g)
Location:	**Stand 43**	1	wet	145.70	104.20	41.50	0.28	0.40
Date:	4/17/94	2	wet	146.00	105.88	40.12	0.27	0.38
Time:	9:10am	3	wet	144.03	105.38	38.65	0.27	0.37
Transect avg. snow depth (cm), +/- one standard deviation:	16.5+/-6.8	4	wet	88.10	20.17	67.93	0.77	3.37
Transect snow linear fraction:	1	5	wet	78.92	31.45	47.47	0.60	1.51
		6	wet	128.86	104.38	24.48	0.19	0.23
Sample (column) averages:				121.94	78.58	43.36	0.40	1.04

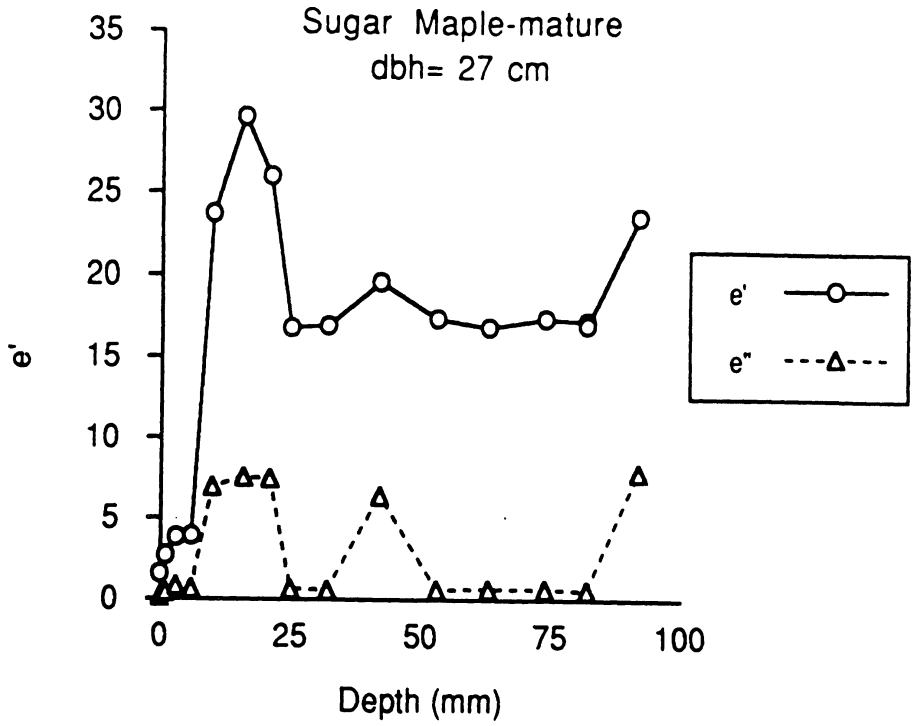
STAND 43: Mature red pine plantation

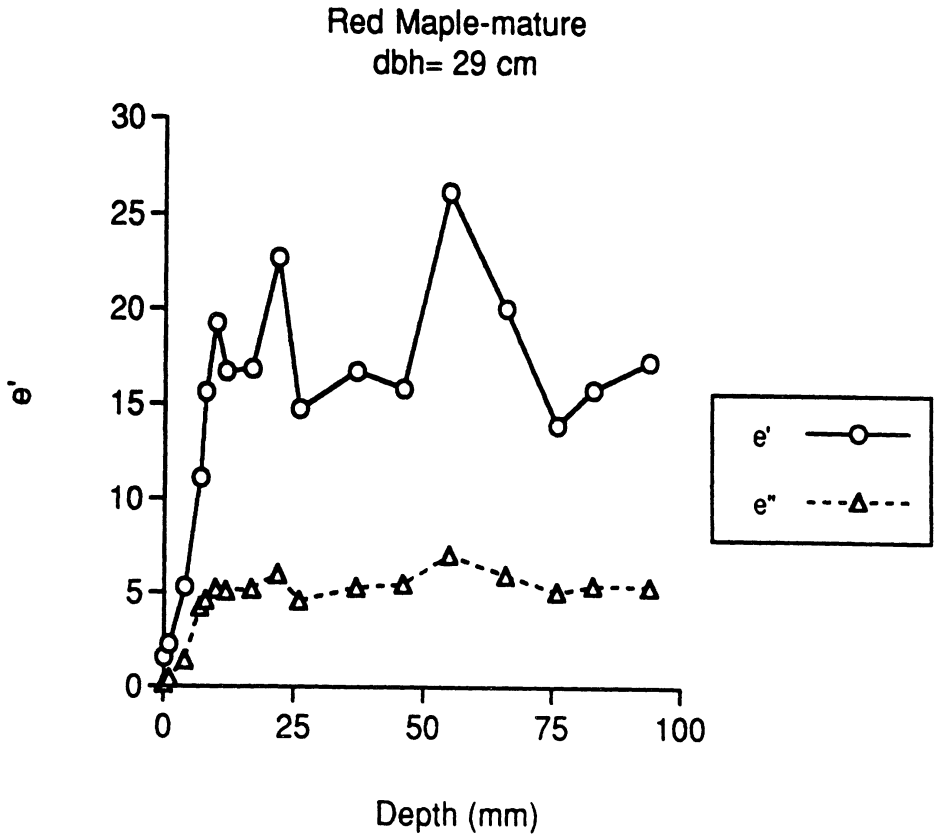
APPENDIX E:
VEGETATION DIELECTRIC PLOTS: e' vs. Depth

Dielectric Depth Profile
April 3, 1994
L-Band



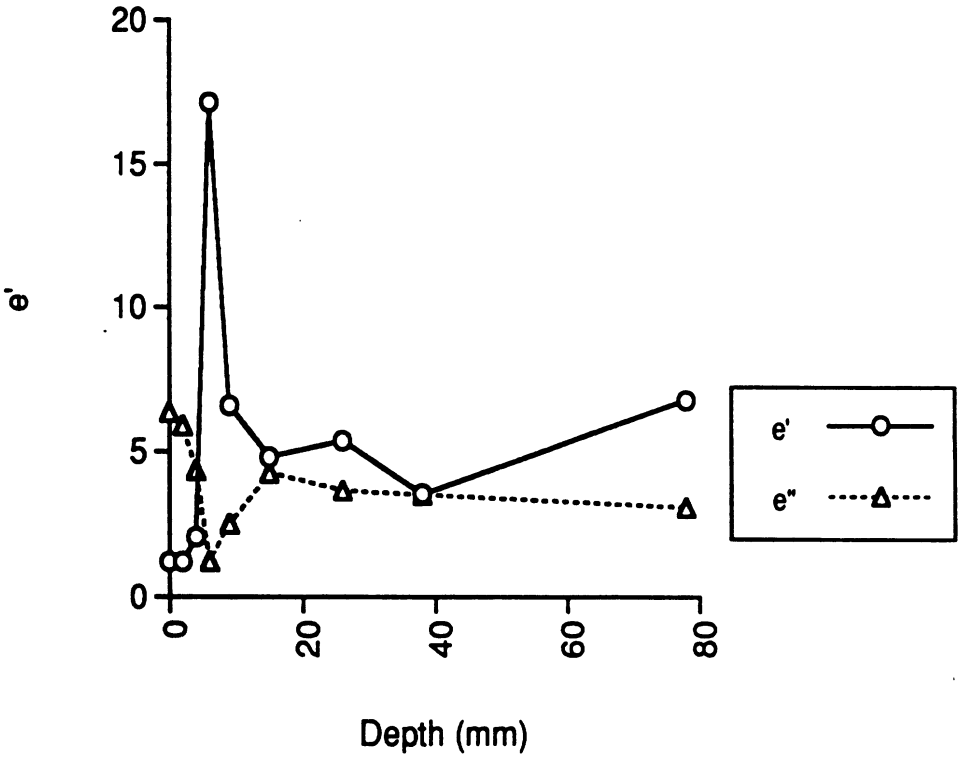
Dielectric Depth Profiles
April 3, 1994
L-Band





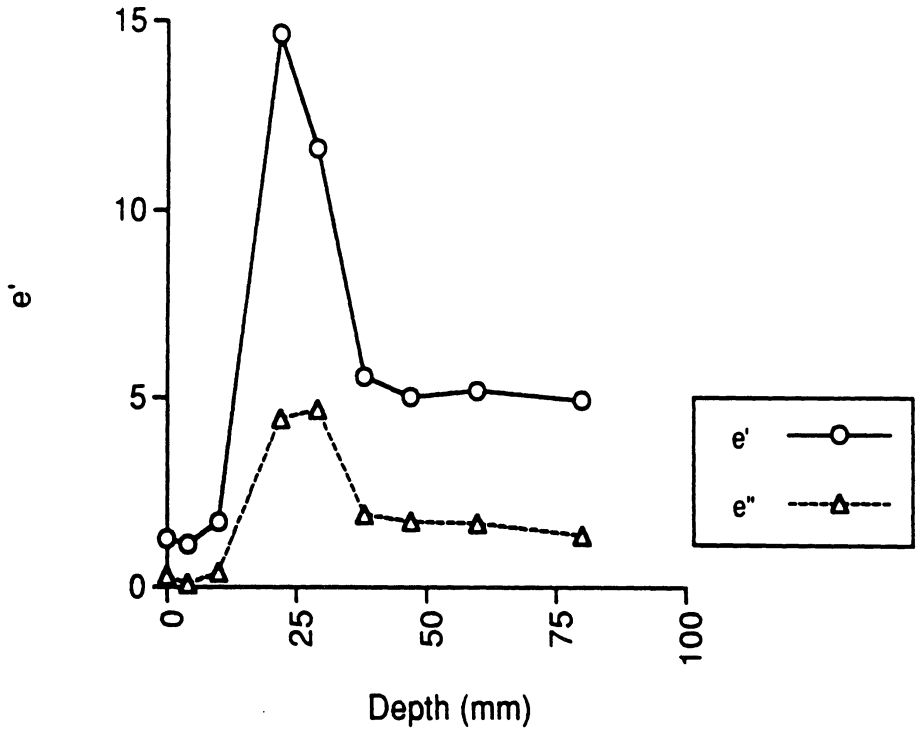
Dielectric Depth Profile
April 4, 1994
L-Band

Jack Pine-Mature
dbh=29 cm

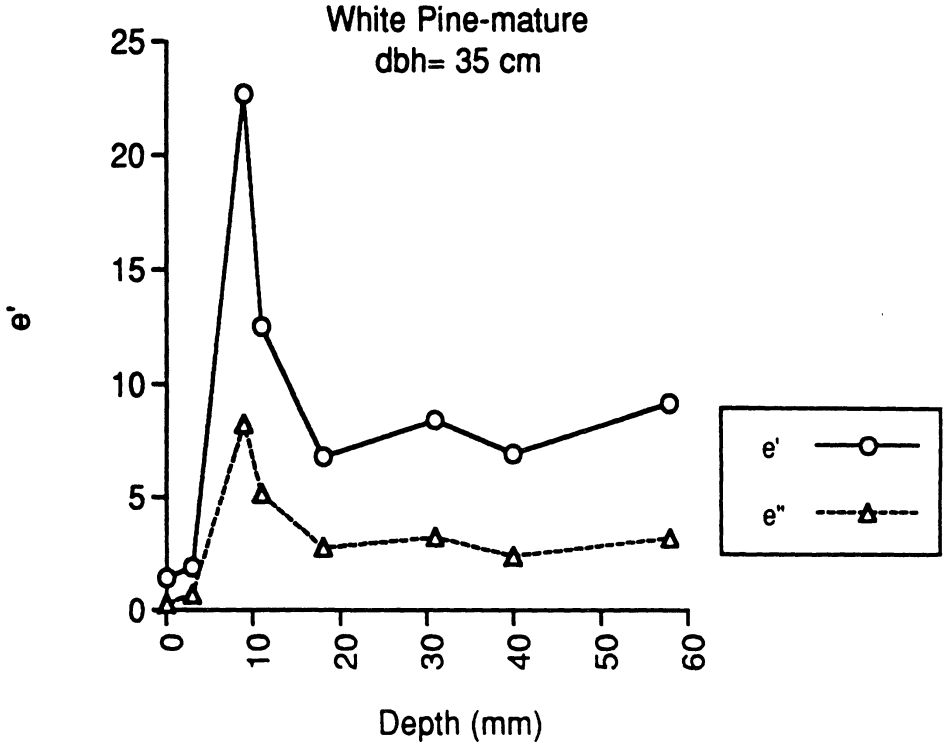


Dielectric Depth Profiles
April 4, 1994
L-Band

Red Pine-mature
dbh= 41 cm

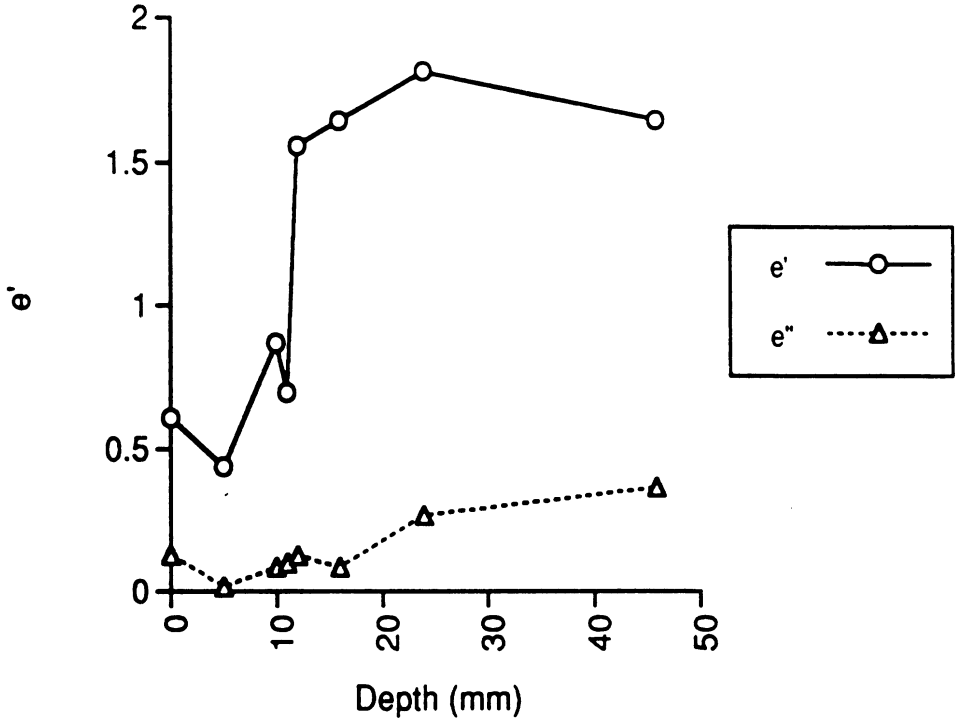


White Pine-mature
dbh= 35 cm

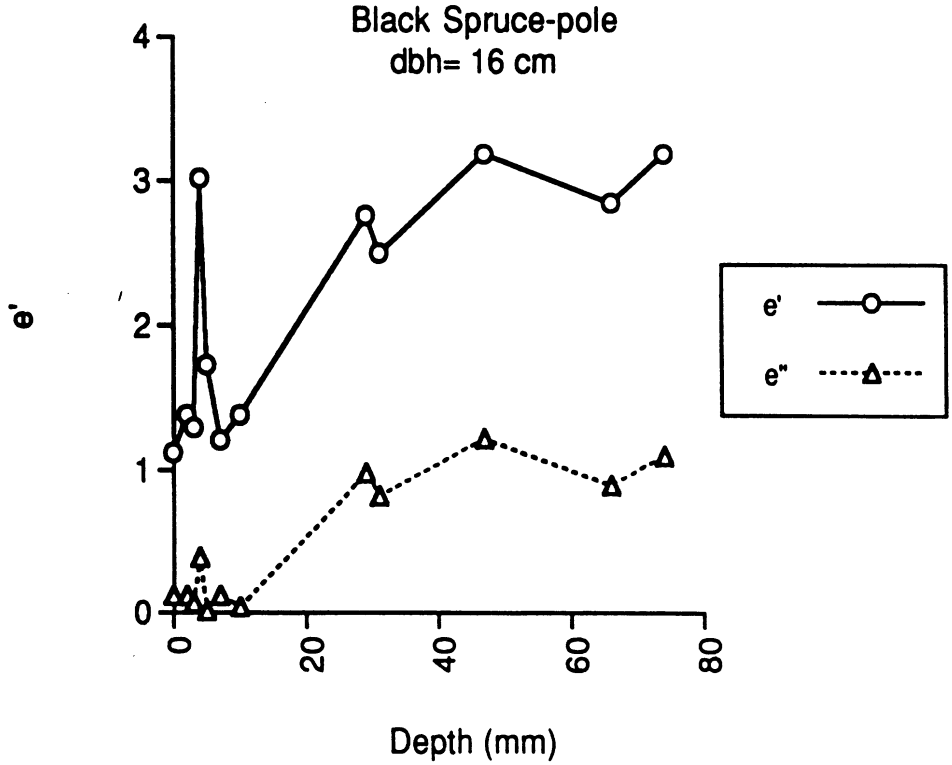


Dielectric Depth Profiles
April 5,1994
L-Band

N White Cedar-mature
dbh=40 cm

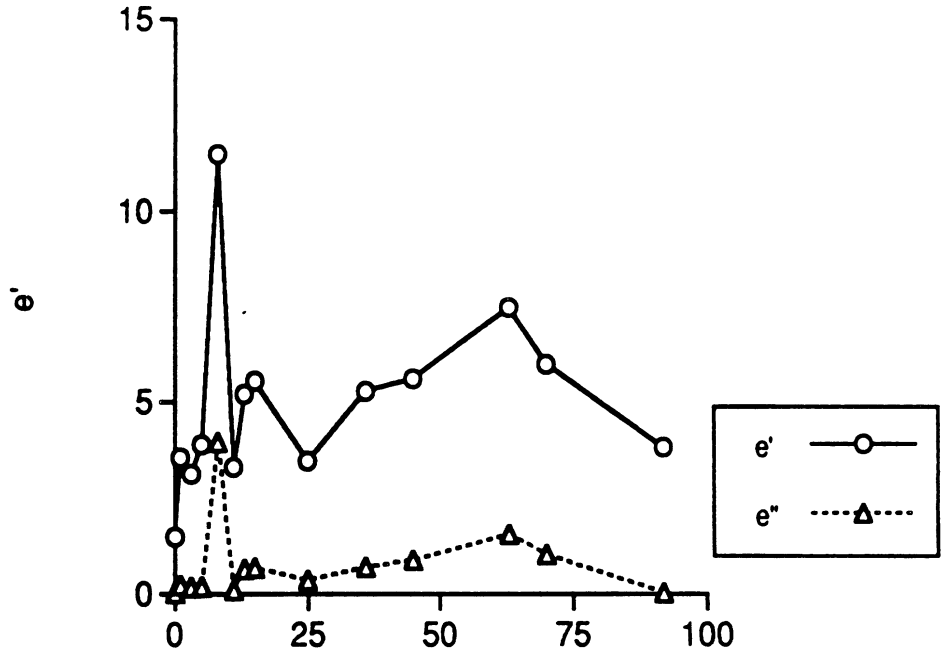


Black Spruce-pole
dbh= 16 cm



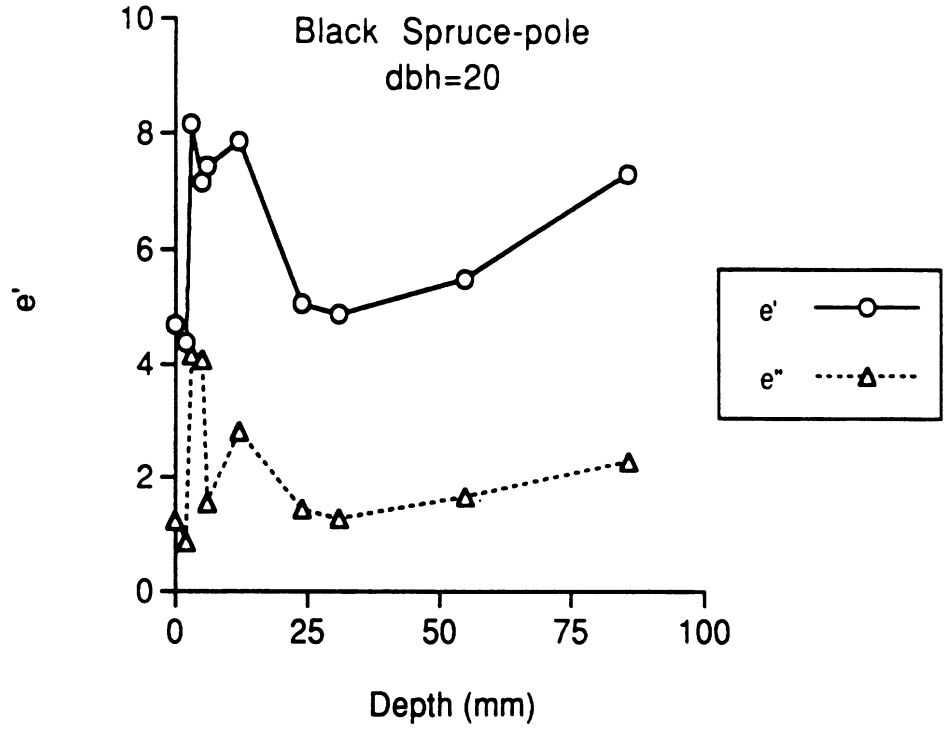
Dielectric Depth Profile
April 5, 1994
L-Band

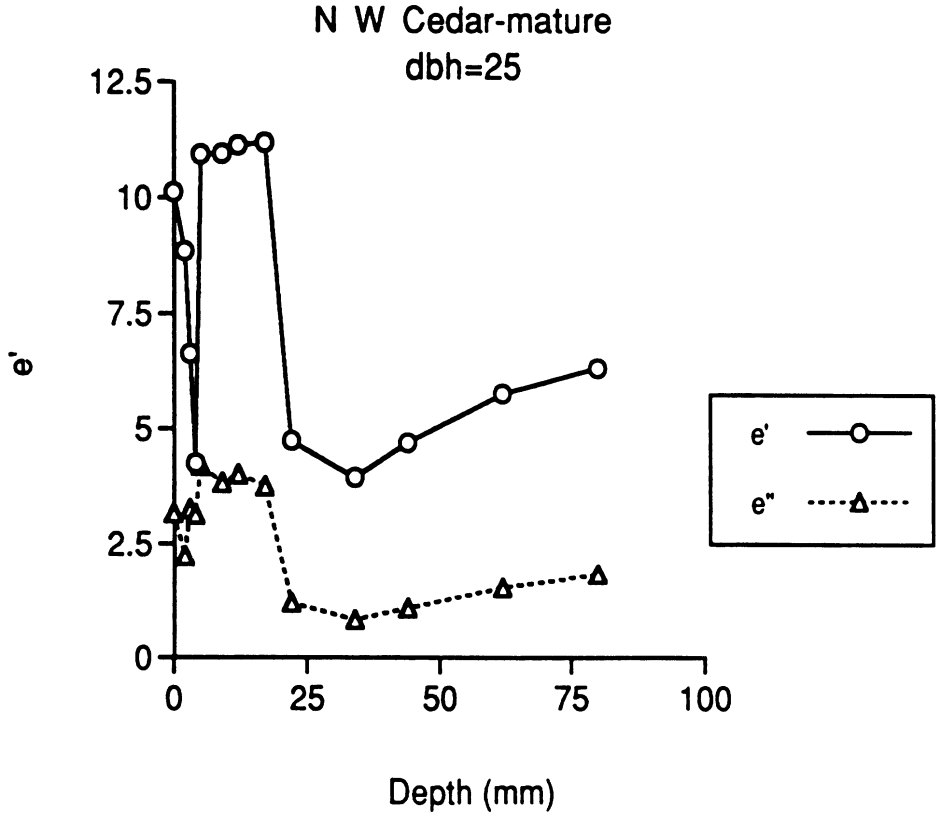
Bigtooth Aspen-mature
dbh=29.3 cm



Depth (mm)

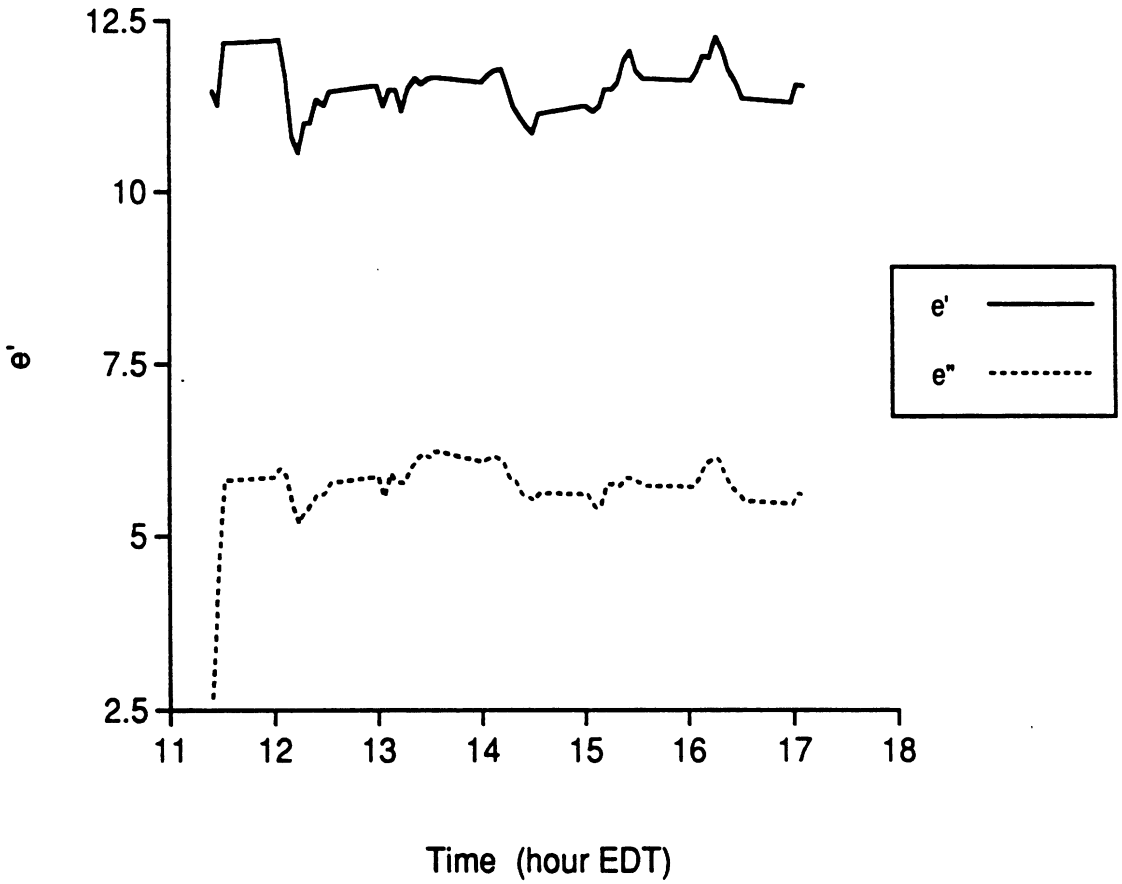
Dielectric Depth Profiles
April 15, 1994
C-Band



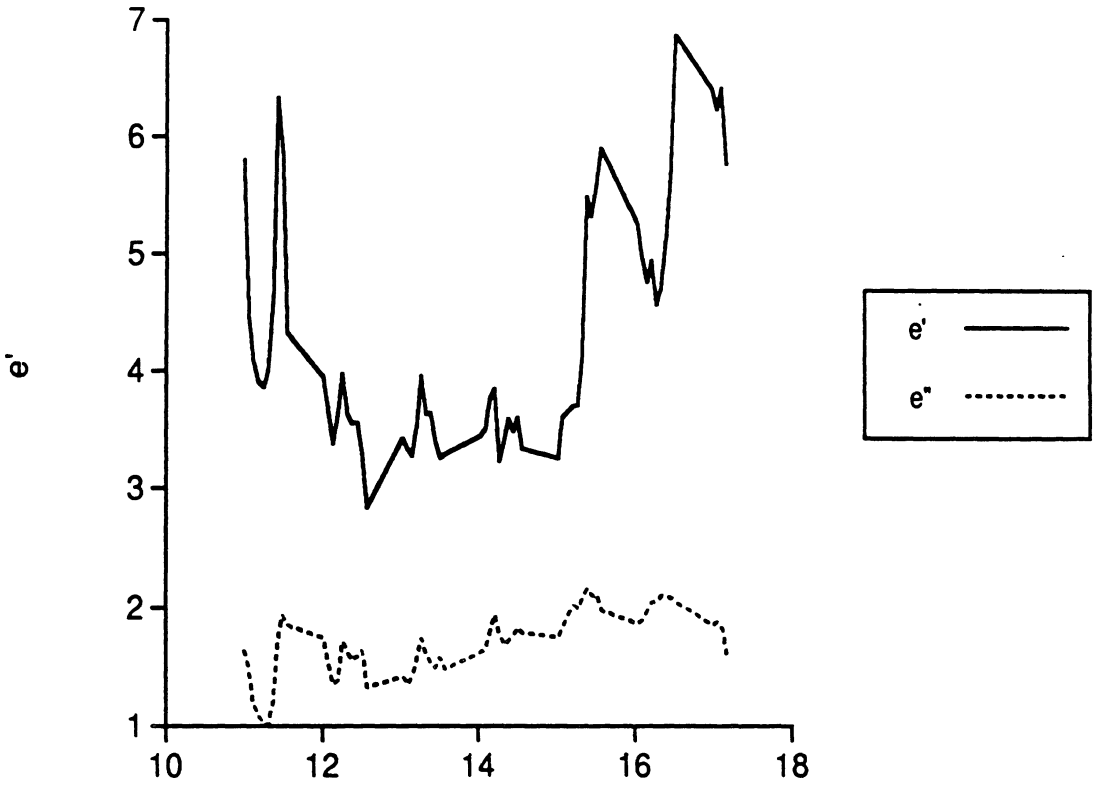


APPENDIX F:
VEGETATION DIELECTRIC PLOTS: e' vs. Time

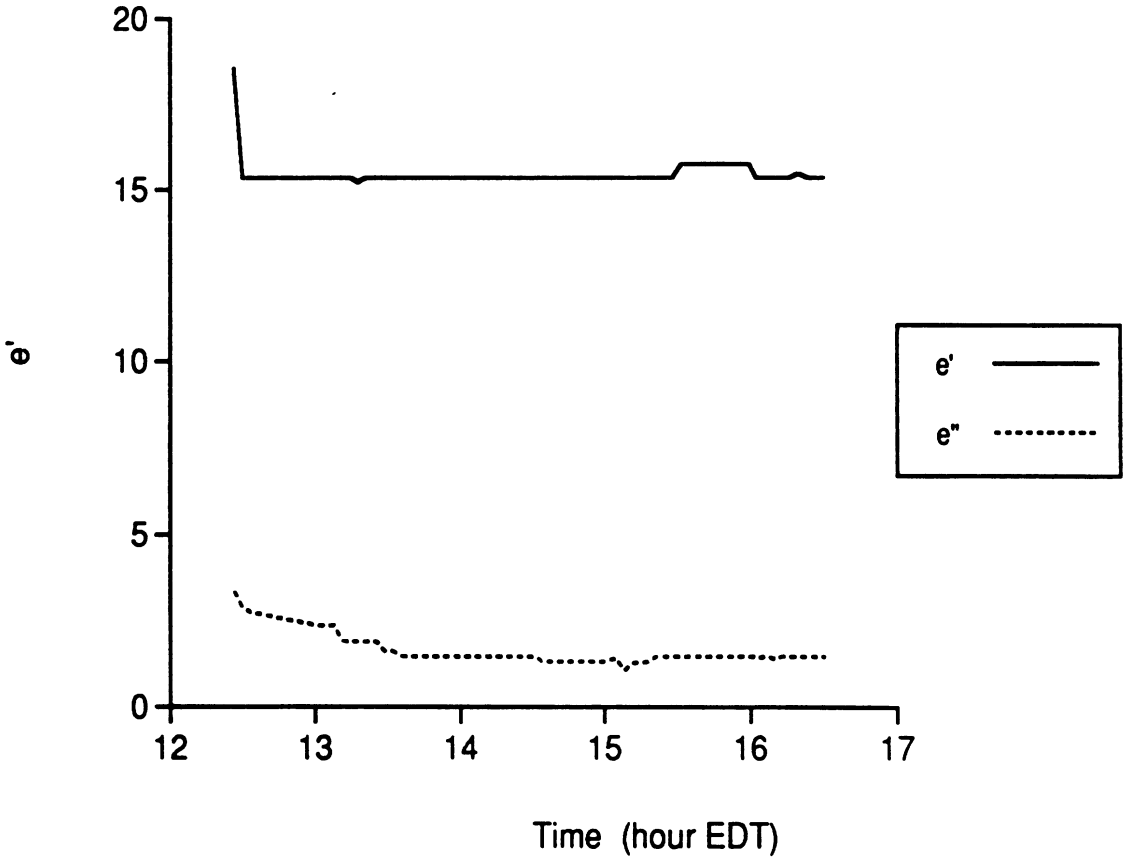
Temporal Variance in Tree Dielectric
Sugar Maple Stand #31
April 3,1994
C-Band



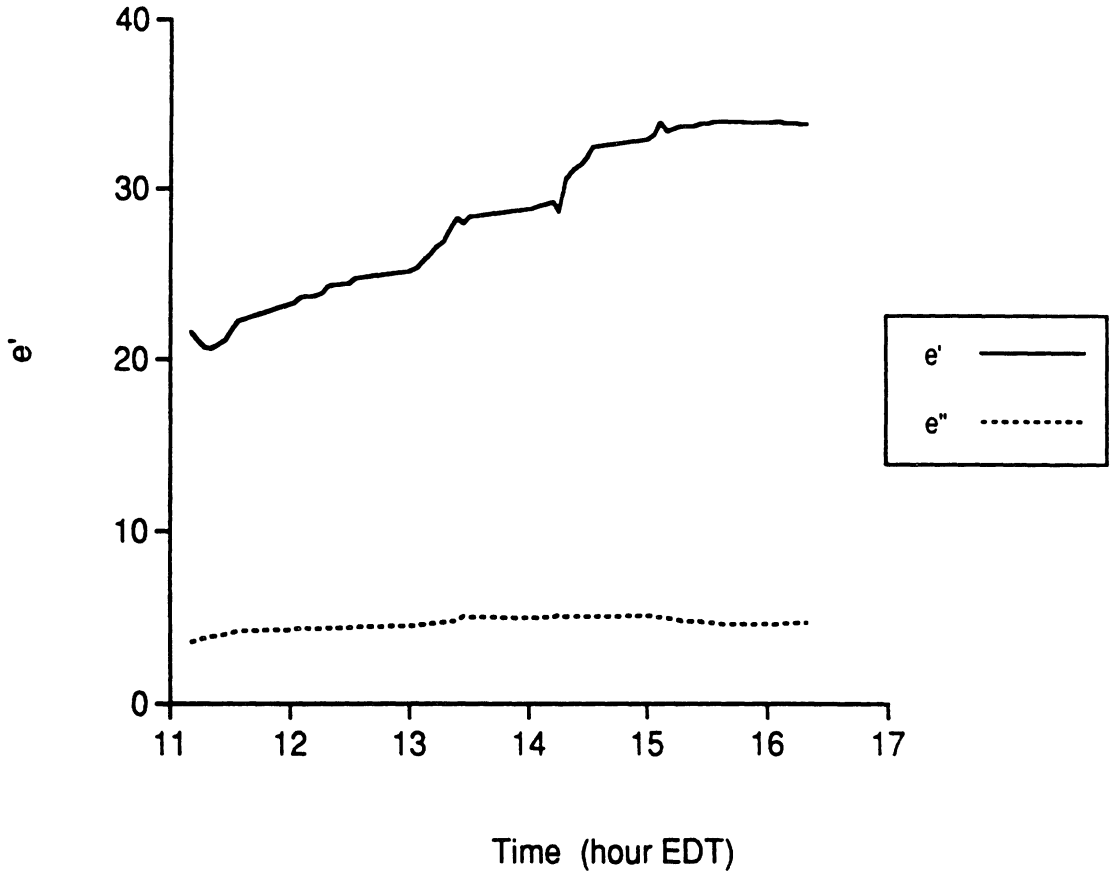
Temporal Variance in Tree Dielectric
April 3, 1994
Beech Stand #31
C-Band



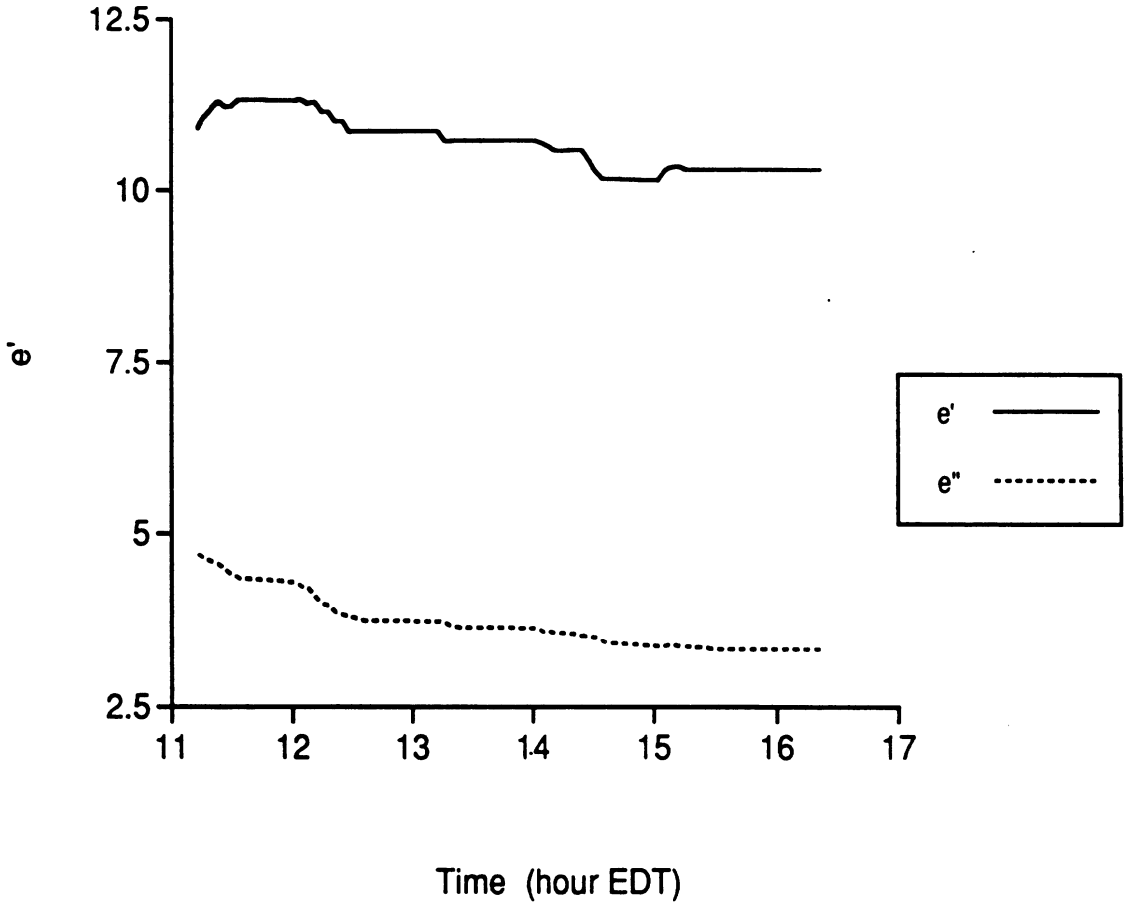
Temporal Variance in Tree Dielectric
Jack Pine Stand # 23
April 4, 1994
P-Band



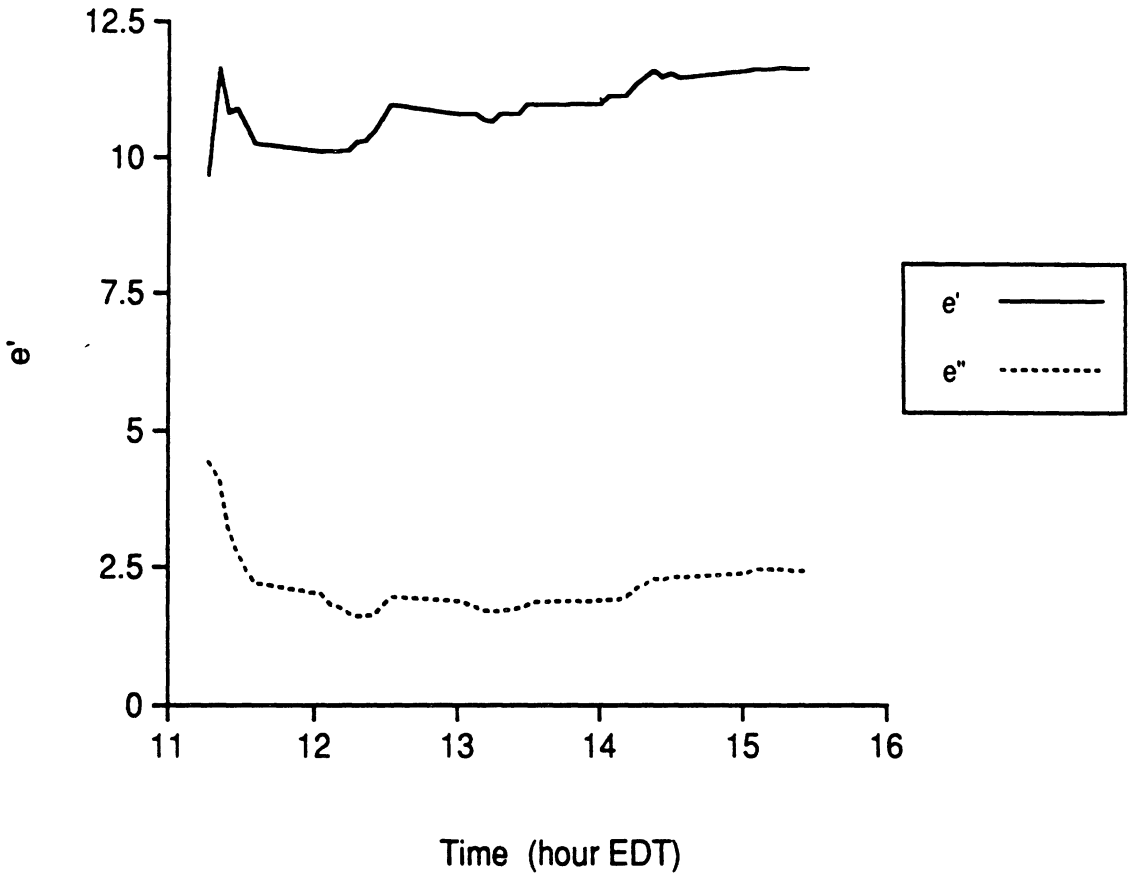
Temporal Variance in Tree Dielectric
Red Pine Stand # 23
April 4,1994
C-Band



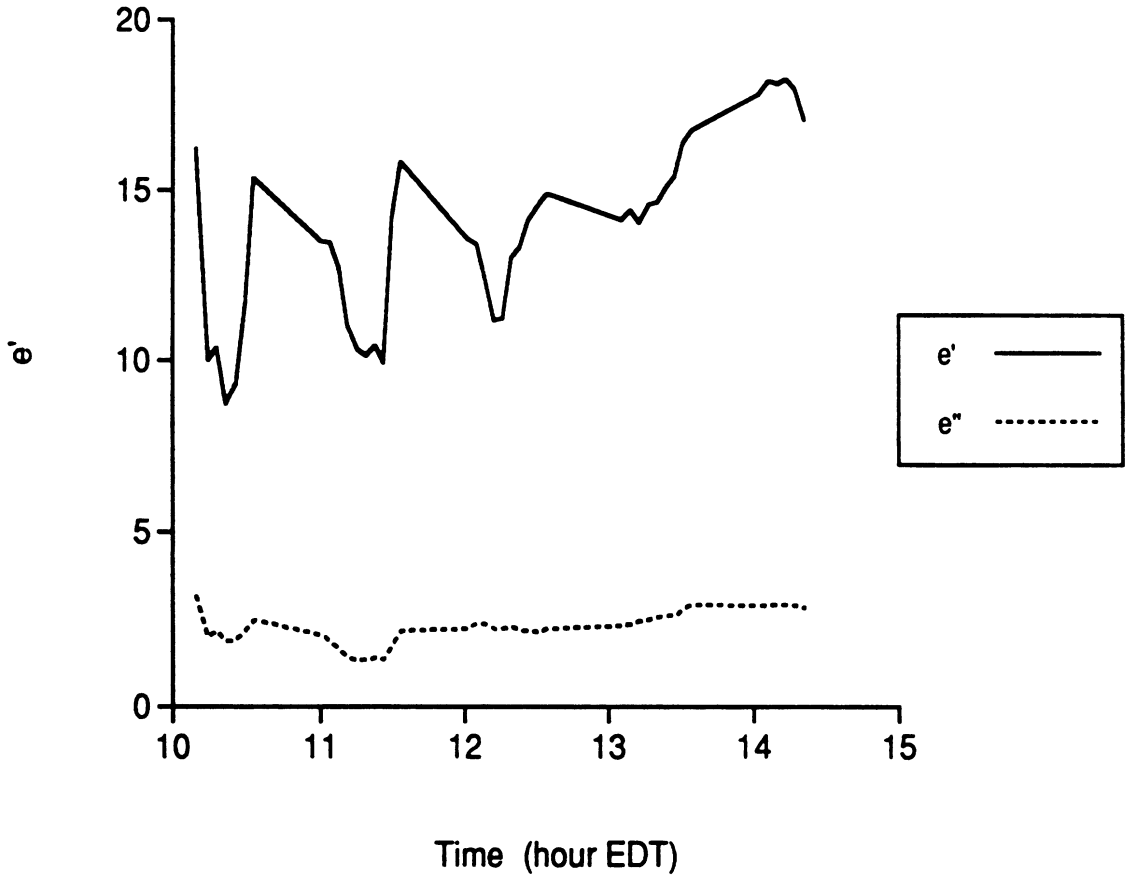
Temporal Variance in Tree Dielectric
White Pine Stand #23
April 4,1994
C-Band



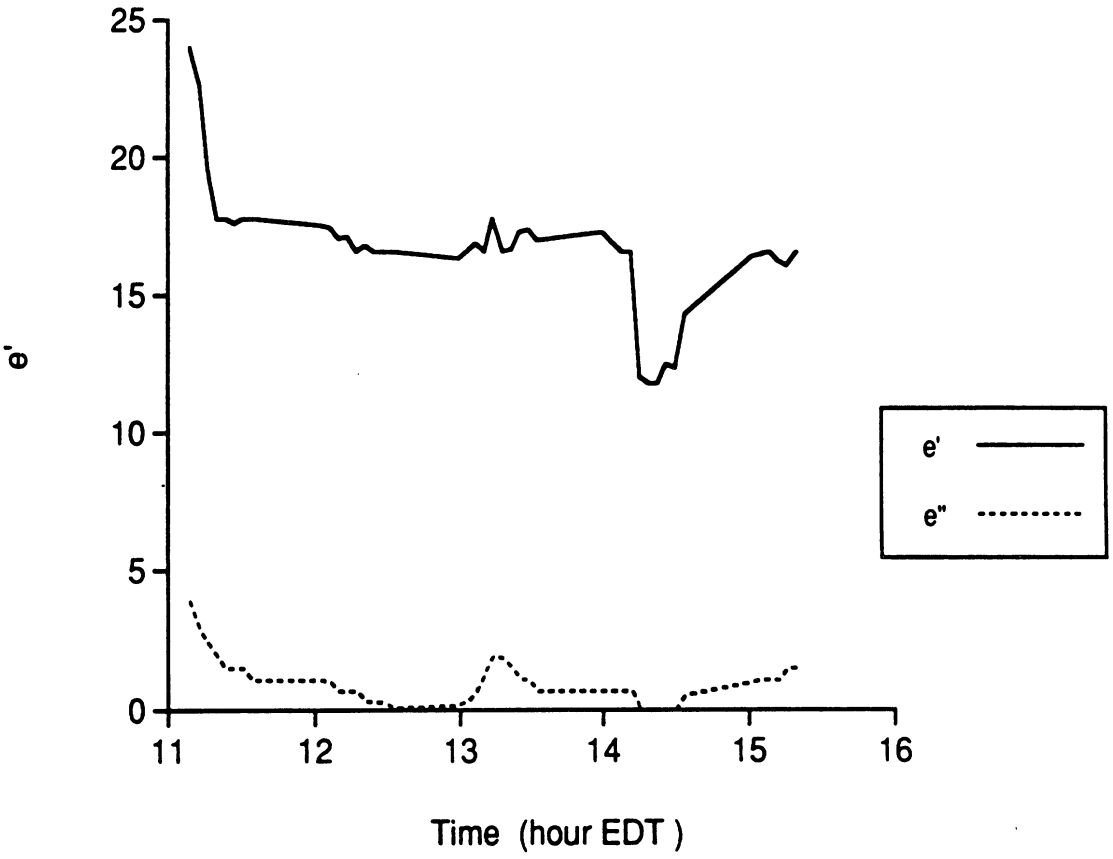
Temporal Variance in Tree Dielectric
Black Spruce Stand #32
April 5, 1994
C-Band



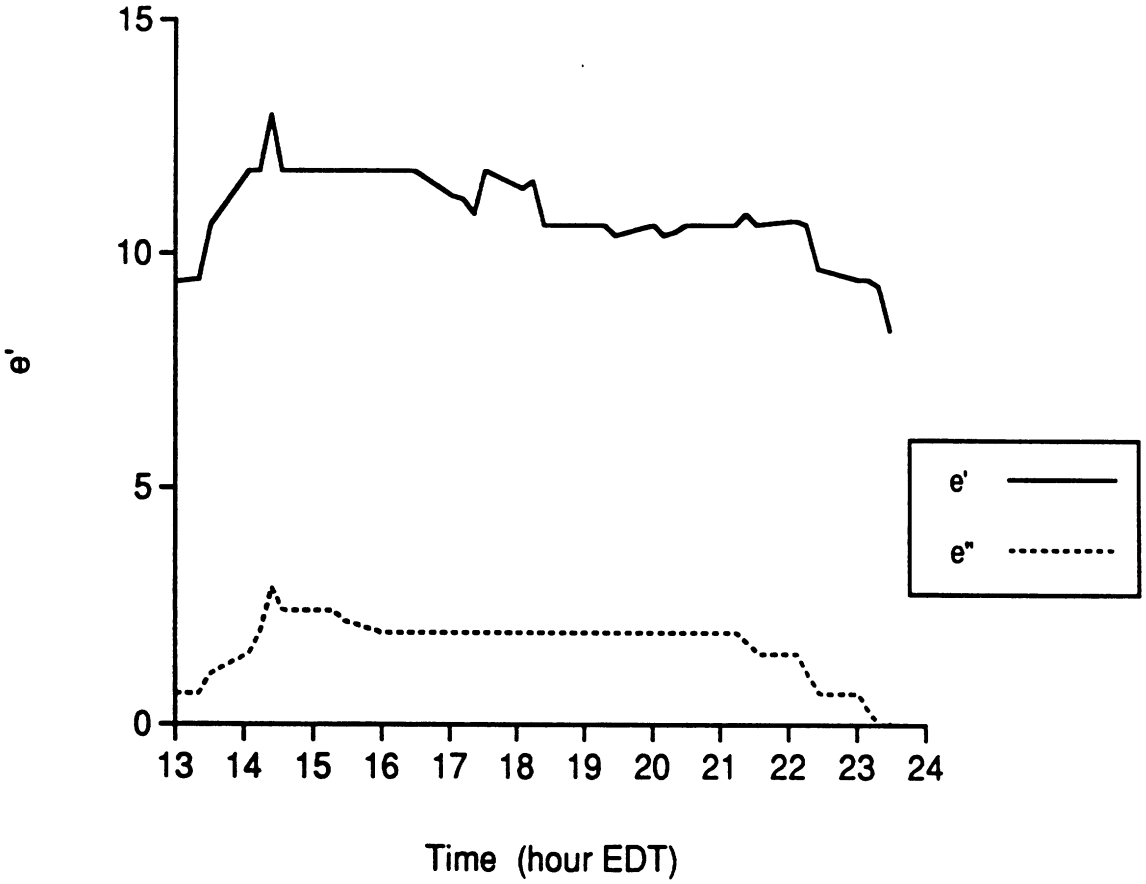
Temporal Variance in Tree Dielectric
Bigtooth Aspen Stand #34
April 5, 1994
C-Band



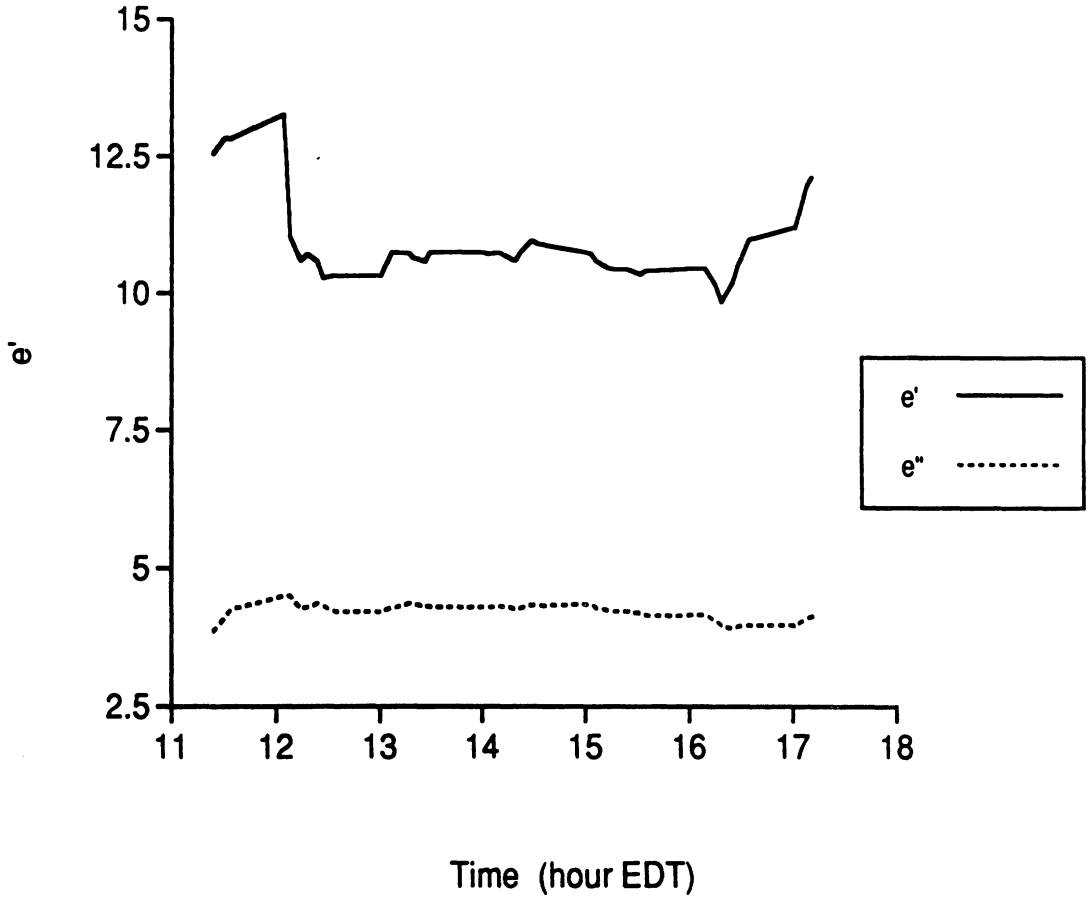
Temporal Variance in Tree Dielectric
N White Cedar Stand #32
April 5,1994
P-Band



Temporal Variance in Tree Dielectric
Beech Stand #31
April 11,1994
P-Band



Temporal Variance in Tree Dielectric
Beech Stand #31
April 11, 1994
C-Band



APPENDIX G:
HOURLY WEATHER DATA:
RACO AIRFIELD, 3/25/94 - 4/19/94

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
0:30	3/25/94	NW	4.8	-8.89	8.89	-8.89	0%	75.39	0.00	0.71	0.00
1:00	3/25/94	NNW	8	-8.89	8.89	-8.89	0%	75.34	0.00	0.71	0.00
1:30	3/25/94	NW	6.4	-9.44	9.44	-8.89	0%	75.34	0.00	0.71	0.00
2:00	3/25/94	NNW	4.8	-9.44	8.89	-8.89	0%	75.39	0.00	0.71	0.00
2:30	3/25/94	NNW	8	-9.44	10.00	-9.44	0%	75.39	0.00	0.71	0.00
3:00	3/25/94	NNW	9.6	-9.44	10.56	-8.89	0%	75.44	0.00	0.71	0.00
3:30	3/25/94	NNW	9.6	-9.44	11.11	-9.44	0%	75.44	0.00	0.71	0.00
4:00	3/25/94	NNW	14.4	-9.44	11.67	-9.44	0%	75.49	0.00	0.71	0.00
4:30	3/25/94	NNW	12.8	-9.44	11.11	-9.44	0%	75.54	0.00	0.71	0.00
5:00	3/25/94	NNW	12.8	-9.44	11.11	-9.44	0%	75.54	0.00	0.71	0.00
5:30	3/25/94	NNW	14.4	-9.44	11.11	-9.44	0%	75.59	0.00	0.71	0.00
6:00	3/25/94	NNW	11.2	-9.44	11.11	-9.44	0%	75.59	0.00	0.71	0.00
6:30	3/25/94	NNW	11.2	-10.00	11.67	-9.44	0%	75.64	0.00	0.71	0.00
7:00	3/25/94	NNW	12.8	-9.44	11.67	-9.44	0%	75.64	0.00	0.71	0.00
7:30	3/25/94	NNW	9.6	-7.22	11.67	-8.89	0%	75.69	0.00	0.71	0.00
8:00	3/25/94	N	11.2	-8.33	10.56	-8.33	0%	75.74	0.00	0.71	0.00
8:30	3/25/94	N	14.4	-5.00	12.22	-7.22	0%	75.74	0.00	0.71	0.00
9:00	3/25/94	NNW	12.8	-3.33	13.89	-5.56	0%	75.74	0.00	0.71	0.00
9:30	3/25/94	NNW	11.2	-2.22	16.67	-5.56	0%	75.79	0.00	0.71	0.00
10:00	3/25/94	N	17.6	-1.67	22.78	-4.44	0%	75.84	0.00	0.71	0.00
10:30	3/25/94	NNW	9.6	-0.56	22.22	-3.89	0%	75.90	0.00	0.71	0.00
11:00	3/25/94	NNW	11.2	0.00	18.89	-3.33	0%	75.95	0.00	0.71	0.00
11:30	3/25/94	NNW	11.2	0.00	19.44	-2.78	0%	76.00	0.00	0.71	0.00
12:00	3/25/94	NNW	11.2	0.00	19.44	-1.67	0%	76.00	0.00	0.71	0.00
12:30	3/25/94	NNE	12.8	0.00	19.44	-1.67	0%	76.05	0.00	0.71	0.00
13:00	3/25/94	N	11.2	0.00	20.00	-1.11	9%	76.05	0.00	0.71	0.00
13:30	3/25/94	NNW	9.6	-3.33	20.00	0.00	13%	76.05	0.00	0.71	0.00
14:00	3/25/94	NNW	8	-2.78	20.56	1.11	12%	76.05	0.00	0.71	0.00
14:30	3/25/94	NNW	9.6	-3.33	21.11	1.67	12%	76.10	0.00	0.71	0.00
15:00	3/25/94	NNW	6.4	-2.78	22.22	2.22	12%	76.10	0.00	0.71	0.00
15:30	3/25/94	NNW	6.4	-3.33	20.56	2.22	10%	76.10	0.00	0.71	0.00
16:00	3/25/94	N	9.6	-3.89	21.11	1.67	10%	76.10	0.00	0.71	0.00
16:30	3/25/94	NE	8	-3.89	20.00	1.67	10%	76.10	0.00	0.71	0.00
17:00	3/25/94	NNW	11.2	-4.44	21.67	1.11	10%	76.10	0.00	0.71	0.00
17:30	3/25/94	N	11.2	-4.44	21.67	0.56	11%	76.10	0.00	0.71	0.00
18:00	3/25/94	N	8	-5.00	21.11	0.00	11%	76.10	0.00	0.71	0.00
18:30	3/25/94	NNE	6.4	-5.56	20.00	-1.67	11%	76.10	0.00	0.71	0.00
19:00	3/25/94	ENE	4.8	-6.67	18.89	-4.44	0%	76.10	0.00	0.71	0.00
19:30	3/25/94	NE	3.2	-7.78	17.78	-6.11	13%	76.05	0.00	0.71	0.00
20:00	3/25/94	ENE	0	-9.44	17.22	-7.78	0%	76.05	0.00	0.71	0.00
20:30	3/25/94	WNW	0	-11.67	16.11	-9.44	17%	76.00	0.00	0.71	0.00
21:00	3/25/94	W	0	-11.67	15.56	-10.56	13%	76.00	0.00	0.71	0.00
21:30	3/25/94	NW	0	-12.78	14.44	-11.67	17%	75.95	0.00	0.71	0.00
22:00	3/25/94	NW	0	-13.89	13.89	-12.78	12%	75.95	0.00	0.71	0.00
22:30	3/25/94	NNW	0	-14.44	12.78	-13.33	13%	75.90	0.00	0.71	0.00
23:00	3/25/94	NW	0	-15.00	12.22	-14.44	14%	75.84	0.00	0.71	0.00
23:30	3/25/94	NNE	0	-15.56	11.67	-15.00	13%	75.79	0.00	0.71	0.00
Min	3/26/94	ENE	0	-16.67	5.00	-15.56	0%	75.34	0.00	0.71	0.00
Max	3/26/94	N	25.6	0.56	26.11	2.78	19%	76.15	0.00	0.71	0.00
0:30	3/26/94	NW	0	-16.67	10.56	-16.11	7%	75.74	0.00	0.71	0.00
1:00	3/26/94	NW	0	-16.67	10.00	-16.11	11%	75.69	0.00	0.71	0.00
1:30	3/26/94	NNW	0	-16.67	8.89	-16.67	10%	75.69	0.00	0.71	0.00
2:00	3/26/94	NW	0	-16.11	9.44	-16.67	10%	75.64	0.00	0.71	0.00
2:30	3/26/94	SW	0	-16.67	8.33	-16.67	12%	75.64	0.00	0.71	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
3:00	3/26/94	W	0	-15.56	7.78	-16.11	12%	75.59	0.00	0.71	0.00
3:30	3/26/94	ENE	0	-15.56	7.22	-15.56	11%	75.54	0.00	0.71	0.00
4:00	3/26/94	NNW	0	-15.00	6.67	-15.56	11%	75.54	0.00	0.71	0.00
4:30	3/26/94	S	0	-15.56	6.11	-15.56	11%	75.54	0.00	0.71	0.00
5:00	3/26/94	SE	0	-15.56	5.56	-15.56	10%	75.54	0.00	0.71	0.00
5:30	3/26/94	ENE	0	-15.56	5.00	-15.56	10%	75.49	0.00	0.71	0.00
6:00	3/26/94	SSW	0	-15.56	5.00	-15.56	9%	75.49	0.00	0.71	0.00
6:30	3/26/94	WNW	0	-16.11	4.44	-15.56	11%	75.49	0.00	0.71	0.00
7:00	3/26/94	ENE	0	-14.44	4.44	-15.00	11%	75.44	0.00	0.71	0.00
7:30	3/26/94	E	0	-11.11	8.33	-12.22	11%	75.49	0.00	0.71	0.00
8:00	3/26/94	SE	1.6	-7.22	9.44	-8.89	14%	75.54	0.00	0.71	0.00
8:30	3/26/94	SE	8	-6.11	7.78	-5.56	0%	75.54	0.00	0.71	0.00
9:00	3/26/94	SE	8	-3.89	8.89	-3.33	0%	75.54	0.00	0.71	0.00
9:30	3/26/94	SSE	11.2	0.56	11.67	0.56	0%	75.49	0.00	0.71	0.00
10:00	3/26/94	SE	12.8	0.56	12.78	2.22	0%	75.49	0.00	0.71	0.00
10:30	3/26/94	SSE	11.2	1.11	13.89	2.78	0%	75.49	0.00	0.71	0.00
11:00	3/26/94	SSE	14.4	2.78	13.33	3.89	0%	75.54	0.00	0.71	0.00
11:30	3/26/94	SSE	11.2	6.67	15.00	4.44	0%	75.54	0.00	0.71	0.00
12:00	3/26/94	SSE	14.4	5.56	15.56	6.67	12%	75.49	0.00	0.71	0.00
12:30	3/26/94	SSE	9.6	6.67	16.67	6.11	12%	75.49	0.03	0.74	0.05
13:00	3/26/94	SSE	9.6	6.11	16.67	6.67	12%	75.49	0.10	0.81	0.15
13:30	3/26/94	SSE	19.2	6.11	17.78	7.78	0%	75.49	0.18	0.89	0.15
14:00	3/26/94	SE	16	4.44	18.33	8.33	11%	75.49	0.28	0.99	0.20
14:30	3/26/94	SE	16	4.44	17.78	6.67	11%	75.49	0.30	1.02	0.05
15:00	3/26/94	ESE	12.8	4.44	18.33	6.11	8%	75.49	0.30	1.02	0.00
15:30	3/26/94	SE	16	4.44	21.11	6.11	10%	75.49	0.30	1.02	0.00
16:00	3/26/94	SE	12.8	3.33	20.00	5.56	9%	75.54	0.30	1.02	0.00
16:30	3/26/94	SE	17.6	2.78	19.44	4.44	13%	75.54	0.30	1.02	0.00
17:00	3/26/94	SE	16	1.67	18.89	3.89	13%	75.49	0.30	1.02	0.00
17:30	3/26/94	SSE	22.4	1.11	20.00	3.33	13%	75.49	0.30	1.02	0.00
18:00	3/26/94	SE	12.8	0.56	18.89	2.22	12%	75.49	0.30	1.02	0.00
18:30	3/26/94	SSE	14.4	0.00	17.78	1.11	13%	75.49	0.30	1.02	0.00
19:00	3/26/94	SE	17.6	-1.11	17.22	0.00	13%	75.44	0.30	1.02	0.00
19:30	3/26/94	E	6.4	-1.67	18.33	-1.11	14%	75.39	0.30	1.02	0.00
20:00	3/26/94	ESE	9.6	-2.22	17.22	-1.67	0%	75.39	0.30	1.02	0.00
20:30	3/26/94	SE	11.2	-2.78	16.11	-2.22	15%	75.34	0.30	1.02	0.00
21:00	3/26/94	SE	8	-2.78	16.11	-2.78	16%	75.34	0.30	1.02	0.00
21:30	3/26/94	SE	12.8	-2.78	15.00	-2.22	16%	75.34	0.30	1.02	0.00
22:00	3/26/94	SE	11.2	-2.22	15.00	-2.22	15%	75.29	0.30	1.02	0.00
22:30	3/26/94	SE	11.2	-2.22	16.11	-1.67	12%	75.23	0.30	1.02	0.00
23:00	3/26/94	SE	16	-2.22	14.44	-1.67	17%	75.18	0.30	1.02	0.00
23:30	3/26/94	SE	11.2	-1.67	15.56	-1.67	14%	75.18	0.30	1.02	0.00
Min	3/27/94	NNW	0	-12.78	4.44	-16.67	0%	75.13	0.00	1.02	0.00
Max	3/27/94	SE	30.4	8.89	21.67	8.33	21%	75.74	0.00	1.02	0.20
0:30	3/28/94	NNW	1.6	-2.22	9.44	-1.67	0%	74.78	0.00	1.12	0.00
1:00	3/28/94	ENE	3.2	-2.22	9.44	-1.67	13%	74.78	0.00	1.12	0.00
1:30	3/28/94	NNW	3.2	-2.22	8.89	-1.67	16%	74.78	0.00	1.12	0.00
2:00	3/28/94	NE	3.2	-2.22	8.89	-1.67	12%	74.78	0.00	1.12	0.00
2:30	3/28/94	N	3.2	-2.22	8.89	-1.67	13%	74.73	0.00	1.12	0.00
3:00	3/28/94	NNW	3.2	-2.22	8.89	-2.22	0%	74.73	0.00	1.12	0.00
3:30	3/28/94	NNW	1.6	-2.22	8.33	-2.22	0%	74.73	0.00	1.12	0.00
4:00	3/28/94	NNE	3.2	-2.78	8.33	-2.22	17%	74.73	0.00	1.12	0.00
4:30	3/28/94	W	3.2	-2.78	9.44	-2.22	0%	74.73	0.00	1.12	0 00
5:00	3/28/94	WSW	0	-2.78	10.00	-2.22	0%	74.78	0.00	1.12	0 00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
5:30	3/28/94	NW	1.6	-2.78	9.44	-2.22	15%	74.78	0.00	1.12	0.00
6:00	3/28/94	N	3.2	-2.78	10.00	-2.78	14%	74.83	0.00	1.12	0.00
7:00	3/28/94	NNE	6.4	-2.78	9.44	-2.78	0%	74.83	0.00	1.12	0.00
7:30	3/28/94	NNE	4.8	-2.22	10.00	-2.22	0%	74.88	0.00	1.12	0.00
8:00	3/28/94	N	4.8	-1.11	13.33	-1.11	0%	74.88	0.00	1.12	0.00
8:30	3/28/94	N	4.8	-0.56	13.33	0.00	14%	74.98	0.00	1.12	0.00
9:00	3/28/94	ENE	4.8	-0.56	17.22	0.56	9%	74.98	0.00	1.12	0.00
9:30	3/28/94	ENE	4.8	-0.56	14.44	0.56	8%	75.03	0.00	1.12	0.00
10:00	3/28/94	SE	6.4	1.67	15.00	2.22	9%	75.08	0.00	1.12	0.00
10:30	3/28/94	E	8	0.56	15.00	1.67	12%	75.08	0.00	1.12	0.00
11:00	3/28/94	ESE	9.6	1.11	15.56	2.22	14%	75.08	0.00	1.12	0.00
11:30	3/28/94	ENE	9.6	2.22	15.00	3.33	0%	75.08	0.00	1.12	0.00
12:00	3/28/94	ENE	6.4	2.22	20.00	3.89	0%	75.13	0.00	1.12	0.00
12:30	3/28/94	ENE	9.6	1.11	17.22	2.22	0%	75.18	0.00	1.12	0.00
13:00	3/28/94	ESE	6.4	3.33	23.89	3.89	0%	75.23	0.00	1.12	0.00
13:34	3/28/94	ENE	8	2.22	27.22	3.33	0%	75.34	0.00	1.12	0.00
14:00	3/28/94	ESE	6.4	2.78	21.67	3.33	0%	75.39	0.00	1.12	0.00
14:30	3/28/94	ENE	4.8	2.78	21.67	3.33	0%	75.39	0.00	1.12	0.00
15:00	3/28/94	ENE	4.8	1.67	20.00	2.78	0%	75.39	0.00	1.12	0.00
15:30	3/28/94	ENE	3.2	1.11	20.00	1.67	0%	75.39	0.00	1.12	0.00
16:00	3/28/94	NNW	3.2	0.56	18.89	1.67	0%	75.39	0.00	1.12	0.00
16:30	3/28/94	N	8	-1.11	17.78	0.56	0%	75.39	0.00	1.12	0.00
17:00	3/28/94	NNE	9.6	-1.11	17.22	-0.56	0%	75.39	0.00	1.12	0.00
17:30	3/28/94	NNE	6.4	-1.11	16.67	-0.56	0%	75.39	0.00	1.12	0.00
18:00	3/28/94	NNE	9.6	-1.11	16.11	-1.11	0%	75.39	0.00	1.12	0.00
18:30	3/28/94	NNE	9.6	-1.67	15.56	-1.11	0%	75.39	0.00	1.12	0.00
19:00	3/28/94	N	8	-2.22	15.00	-1.67	0%	75.39	0.00	1.12	0.00
19:30	3/28/94	N	9.6	-2.22	15.00	-1.67	0%	75.39	0.00	1.12	0.00
20:00	3/28/94	NNE	4.8	-2.22	15.56	-1.67	0%	75.39	0.00	1.12	0.00
20:30	3/28/94	NNW	3.2	-2.22	15.56	-1.67	0%	75.44	0.00	1.12	0.00
21:00	3/28/94	N	4.8	-2.22	17.22	-1.67	11%	75.49	0.00	1.12	0.00
21:30	3/28/94	N	4.8	-2.22	16.11	-1.67	0%	75.49	0.00	1.12	0.00
22:00	3/28/94	N	3.2	-2.22	15.56	-1.67	0%	75.49	0.00	1.12	0.00
22:30	3/28/94	ENE	11.2	-2.22	15.00	-1.67	16%	75.49	0.00	1.12	0.00
23:00	3/28/94	E	9.6	-2.22	15.00	-1.67	0%	75.49	0.00	1.12	0.00
23:30	3/28/94	ENE	4.8	-2.22	13.89	-1.67	12%	75.49	0.00	1.12	0.00
Min	3/29/94	NNW	0	-2.78	8.33	-4.44	0%	74.37	0.00	1.12	0.00
Max	3/29/94	E	19.2	3.89	27.78	4.44	18%	75.49	0.00	1.12	0.00
0:30	3/29/94	ENE	8	-2.78	13.89	-2.22	14%	75.49	0.00	1.12	0.00
1:00	3/29/94	ENE	8	-2.78	13.33	-2.78	13%	75.49	0.00	1.12	0.00
1:30	3/29/94	ENE	8	-3.33	13.89	-2.78	17%	75.49	0.00	1.12	0.00
2:00	3/29/94	ENE	8	-3.33	12.78	-2.78	15%	75.49	0.00	1.12	0.00
2:30	3/29/94	ENE	8	-3.33	12.22	-2.78	11%	75.49	0.00	1.12	0.00
3:00	3/29/94	NE	4.8	-3.33	12.22	-3.33	17%	75.49	0.00	1.12	0.00
3:30	3/29/94	NE	6.4	-3.89	11.67	-3.33	0%	75.49	0.00	0.00	0.00
4:00	3/29/94	NE	4.8	-3.89	11.67	-3.33	16%	75.49	0.00	1.12	0.00
4:30	3/29/94	NE	6.4	-4.44	11.11	-3.89	17%	75.49	0.00	1.12	0.00
5:00	3/29/94	NE	4.8	-5.00	11.11	-4.44	0%	75.54	0.00	1.12	0.00
5:30	3/29/94	ENE	8	-5.00	10.56	-4.44	0%	75.54	0.00	1.12	0.00
6:00	3/29/94	ENE	4.8	-5.56	10.56	-5.00	0%	75.59	0.00	1.12	0.00
6:30	3/29/94	ENE	6.4	-5.56	10.56	-5.00	0%	75.59	0.00	1.12	0.00
7:00	3/29/94	NE	6.4	-5.56	13.33	-5.00	0%	75.64	0.00	1.12	0.00
7:30	3/29/94	NE	8	-5.00	11.11	-4.44	0%	75.69	0.00	1.12	0.00
8:00	3/29/94	NNE	9.6	-5.00	13.89	-4.44	0%	75.69	0.00	1.12	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
8:30	3/29/94	ENE	4.8	-2.22	20.00	-3.33	0%	75.74	0.00	1.12	0.00
9:00	3/29/94	ENE	9.6	-1.67	23.89	-2.78	0%	75.84	0.00	1.12	0.00
9:30	3/29/94	ENE	6.4	-0.56	19.44	-1.67	0%	75.95	0.00	1.12	0.00
10:00	3/29/94	NNE	6.4	1.67	20.00	0.00	0%	75.95	0.00	1.12	0.00
10:30	3/29/94	NNE	4.8	3.33	21.67	0.56	0%	75.95	0.00	1.12	0.00
11:00	3/29/94	NNW	8	0.56	18.89	0.56	0%	76.00	0.00	1.12	0.00
11:30	3/29/94	NNW	9.6	-0.56	18.33	0.56	0%	76.00	0.00	1.12	0.00
12:00	3/29/94	N	9.6	2.78	19.44	1.67	0%	75.95	0.00	1.12	0.00
12:30	3/29/94	NNW	8	1.11	18.89	1.67	0%	76.00	0.00	1.12	0.00
13:00	3/29/94	NNE	8	0.56	21.11	1.67	0%	76.00	0.00	1.12	0.00
13:30	3/29/94	NNW	11.2	0.56	21.11	1.67	0%	76.05	0.00	1.12	0.00
14:00	3/29/94	N	11.2	-0.56	21.11	2.22	0%	76.05	0.00	1.12	0.00
14:30	3/29/94	~NW	8	0.00	21.67	2.78	0%	76.10	0.00	1.12	0.00
15:00	3/29/94	NNW	11.2	0.56	22.22	2.78	0%	76.10	0.00	1.12	0.00
15:30	3/29/94	NNE	12.8	-0.56	22.22	2.22	0%	76.15	0.00	1.12	0.00
16:00	3/29/94	NNW	12.8	-0.56	22.22	1.11	0%	76.15	0.00	1.12	0.00
16:30	3/29/94	N	12.8	-0.56	22.22	1.67	0%	76.20	0.00	1.12	0.00
17:00	3/29/94	NNE	9.6	-1.67	22.22	1.11	0%	76.20	0.00	1.12	0.00
17:30	3/29/94	N	11.2	-2.22	21.11	0.00	0%	76.25	0.00	1.12	0.00
18:00	3/29/94	NNW	11.2	-2.78	20.56	0.00	0%	76.25	0.00	1.12	0.00
18:30	3/29/94	NW	9.6	-3.33	19.44	-1.67	0%	76.25	0.00	1.12	0.00
19:00	3/29/94	NNW	12.8	-4.44	18.33	-3.33	0%	76.25	0.00	1.12	0.00
19:30	3/29/94	NNW	9.6	-5.00	17.22	-4.44	0%	76.25	0.00	1.12	0.00
20:00	3/29/94	NNW	8	-6.11	16.67	-5.00	0%	76.25	0.00	1.12	0.00
20:30	3/29/94	NNW	12.9	-6.11	15.56	-6.11	0%	76.20	0.00	1.12	0.00
21:00	3/29/94	NNW	9.6	-6.67	15.00	-6.11	0%	76.20	0.00	1.12	0.00
21:30	3/29/94	NNW	9.6	-7.22	14.44	-6.67	0%	76.15	0.00	1.12	0.00
22:00	3/29/94	NNW	6.4	-7.22	13.89	-6.67	0%	76.15	0.00	1.12	0.00
22:30	3/29/94	NW	9.6	-7.22	13.89	-6.67	0%	76.15	0.00	1.12	0.00
23:00	3/29/94	NW	6.4	-7.22	13.33	-7.22	0%	76.10	0.00	1.12	0.00
23:30	3/29/94	NNW	4.8	-6.67	12.78	-6.67	0%	76.10	0.00	1.12	0.00
Min	3/30/94	W	1.6	-7.22	10.56	-10.56	0%	75.44	0.00	1.12	0.00
Max	3/30/94	NNW	22.4	3.89	25.00	3.33	52%	76.25	0.00	1.12	0.00
0:30	3/30/94	NNW	6.4	-7.22	12.22	-7.22	0%	76.10	0.00	1.12	0.00
1:00	3/30/94	NNW	6.4	-7.78	11.67	-7.22	0%	76.10	0.00	1.12	0.00
1:30	3/30/94	NNW	4.8	-8.33	11.67	-7.78	0%	76.10	0.00	1.12	0.00
2:00	3/30/94	W	1.6	-8.89	11.11	-8.33	0%	76.05	0.00	1.12	0.00
2:30	3/30/94	WSW	1.6	-10.56	10.56	-9.44	0%	76.05	0.00	1.12	0.00
3:00	3/30/94	WSW	1.6	-11.67	10.00	-11.11	16%	76.10	0.00	1.12	0.00
3:30	3/30/94	WSW	1.6	-12.22	10.00	-11.67	17%	76.05	0.00	1.12	0.00
4:00	3/30/94	WSW	3.2	-12.22	9.44	-12.22	13%	76.05	0.00	1.12	0.00
4:30	3/30/94	WSW	0	-13.89	8.89	-12.78	13%	76.05	0.00	1.12	0.00
5:00	3/30/94	W	3.2	-11.67	8.33	-12.22	18%	76.00	0.00	1.12	0.00
5:30	3/30/94	WSW	3.2	-12.22	7.78	-12.22	0%	76.00	0.00	1.12	0.00
6:00	3/30/94	WSW	3.2	-12.22	7.78	-12.22	19%	76.00	0.00	1.12	0.00
6:30	3/30/94	W	3.2	-11.67	7.22	-11.67	16%	76.00	0.00	1.12	0.00
7:00	3/30/94	WSW	1.6	-8.89	10.00	-11.11	15%	76.00	0.00	1.12	0.00
7:30	3/30/94	SW	3.2	1.11	10.56	-8.33	13%	76.05	0.00	1.12	0.00
8:00	3/30/94	WSW	3.2	5.56	11.67	-6.11	14%	76.10	0.00	1.12	0.00
8:30	3/30/94	WSW	3.2	6.67	18.33	-2.78	13%	76.15	0.00	1.12	0.00
9:00	3/30/94	W	9.6	7.78	22.22	-1.11	13%	76.25	0.00	1.12	0.00
11:36	3/30/94	WSW	17.6	7.22	19.44	1.11	0%	76.30	0.00	1.12	0.00
12:00	3/30/94	W	9.6	7.78	20.00	2.22	0%	76.30	0.00	1.12	0.00
12:30	3/30/94	WSW	11.2	5.00	20.00	1.67	0%	76.25	0.00	1.12	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
13:00	3/30/94	WSW	11.2	5.00	19.44	2.22	0%	76.20	0.00	1.12	0.00
13:30	3/30/94	WSW	20.8	1.11	19.44	0.56	0%	76.20	0.00	1.12	0.00
14:00	3/30/94	WSW	22.4	1.11	19.44	0.56	0%	76.15	0.00	1.12	0.00
14:30	3/30/94	SW	20.8	0.56	20.00	0.56	0%	76.10	0.00	1.12	0.00
15:00	3/30/94	SW	25.6	0.56	20.56	0.56	0%	76.10	0.00	1.12	0.00
15:30	3/30/94	SW	24	0.00	21.11	0.56	0%	76.10	0.00	1.12	0.00
16:00	3/30/94	SW	22.4	-0.56	21.11	0.00	0%	76.10	0.00	1.12	0.00
16:30	3/30/94	SW	17.6	-0.56	19.44	0.00	0%	76.10	0.00	1.12	0.00
17:00	3/30/94	WSW	22.4	-1.11	18.33	0.00	0%	76.05	0.00	1.12	0.00
17:30	3/30/94	SW	27.2	-1.11	17.78	-0.56	0%	76.00	0.00	1.12	0.00
18:00	3/30/94	WSW	17.6	-1.67	17.78	-0.56	14%	76.00	0.00	1.12	0.00
18:30	3/30/94	WSW	12.8	-2.22	16.67	-1.67	12%	75.95	0.00	1.12	0.00
19:00	3/30/94	WSW	14.4	-2.78	15.56	-2.22	12%	75.95	0.00	1.12	0.00
19:30	3/30/94	SW	16	-3.33	15.00	-2.78	12%	75.90	0.00	1.12	0.00
20:00	3/30/94	WSW	12.8	-3.33	13.89	-2.78	11%	75.84	0.00	1.12	0.00
20:30	3/30/94	WSW	11.2	-3.89	13.33	-3.33	10%	75.84	0.00	1.12	0.00
21:00	3/30/94	WSW	9.6	-3.89	12.22	-3.33	9%	75.79	0.00	1.12	0.00
21:30	3/30/94	SW	11.2	-3.89	11.67	-3.33	10%	75.74	0.00	1.12	0.00
22:00	3/30/94	WSW	12.8	-3.89	11.11	-3.33	9%	75.69	0.00	1.12	0.00
22:30	3/30/94	WSW	9.6	-3.89	10.56	-3.33	9%	75.69	0.00	1.12	0.00
23:00	3/30/94	WSW	12.8	-3.33	15.56	-2.78	7%	75.64	0.00	1.12	0.00
23:30	3/30/94	WSW	9.6	-3.89	11.67	-3.33	7%	75.64	0.00	1.12	0.00
Min	3/31/94	WNW	0	-13.89	6.67	-12.78	0%	75.59	0.00	1.12	0.00
Max	3/31/94	SW	40	10.56	28.89	2.22	68%	76.40	0.00	1.12	0.00
0:30	3/31/94	WSW	11.2	-2.78	10.00	-2.78	7%	75.59	0.00	1.12	0.00
1:00	3/31/94	WSW	11.2	-3.33	9.44	-2.78	0%	75.49	0.00	1.12	0.00
1:30	3/31/94	WSW	11.2	-3.33	8.89	-2.78	0%	75.49	0.00	1.12	0.00
2:00	3/31/94	WSW	8	-3.89	8.33	-3.33	0%	75.44	0.00	1.12	0.00
2:30	3/31/94	WSW	8	-3.33	8.33	-2.78	0%	75.39	0.00	1.12	0.00
3:00	3/31/94	WSW	8	-3.33	8.33	-2.78	0%	75.39	0.00	1.12	0.00
3:30	3/31/94	SW	9.6	-3.33	8.33	-3.33	0%	75.34	0.00	1.12	0.00
4:00	3/31/94	SW	11.2	-3.33	8.33	-3.33	0%	75.34	0.00	1.12	0.00
4:30	3/31/94	WSW	12.8	-3.89	8.33	-3.33	0%	75.29	0.00	1.12	0.00
5:00	3/31/94	WSW	8	-3.89	10.00	-3.33	0%	75.29	0.00	1.12	0.00
5:30	3/31/94	WSW	6.4	-4.44	8.89	-3.89	0%	75.29	0.00	1.12	0.00
6:00	3/31/94	WSW	8	-4.44	10.00	-4.44	0%	75.29	0.00	1.12	0.00
6:30	3/31/94	WSW	8	-5.00	13.33	-4.44	59%	75.29	0.00	1.12	0.00
7:00	3/31/94	WSW	11.2	-3.89	10.56	-3.89	66%	75.34	0.00	1.12	0.00
7:30	3/31/94	WSW	9.6	2.78	16.67	-2.78	66%	75.34	0.00	1.12	0.00
8:00	3/31/94	WSW	11.2	4.44	18.89	-1.67	58%	75.44	0.00	1.12	0.00
8:30	3/31/94	WSW	11.2	5.00	15.56	-0.56	55%	75.44	0.00	1.12	0.00
9:00	3/31/94	WSW	11.2	7.78	13.89	1.11	59%	75.44	0.00	1.12	0.00
9:30	3/31/94	SW	16	10.56	16.11	2.22	56%	75.39	0.00	1.12	0.00
10:00	3/31/94	SW	12.8	11.11	17.78	2.78	50%	75.39	0.00	1.12	0.00
10:30	3/31/94	SW	16	11.67	17.78	3.89	54%	75.34	0.00	1.12	0.00
11:00	3/31/94	SW	11.2	10.00	15.56	5.00	49%	75.34	0.00	1.12	0.00
11:30	3/31/94	WSW	12.8	11.11	15.56	5.56	47%	75.34	0.00	1.12	0.00
12:00	3/31/94	WSW	9.6	12.22	16.67	6.67	44%	75.29	0.00	1.12	0.00
12:30	3/31/94	WSW	11.2	10.56	17.22	5.56	40%	75.29	0.00	1.12	0.00
13:00	3/31/94	SSW	20.8	8.89	17.22	5.56	49%	75.29	0.00	1.12	0.00
13:30	3/31/94	SSW	19.2	6.67	17.78	5.56	45%	75.34	0.00	1.12	0.00
14:00	3/31/94	WSW	14.4	6.67	18.89	6.11	51%	75.34	0.00	1.12	0.00
14:30	3/31/94	SW	20.8	6.11	18.89	6.11	50%	75.34	0.00	1.12	0 00
15:00	3/31/94	SW	16	6.11	18.33	5.56	51%	75.34	0.00	1.12	0 00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
15:30	3/31/94	NNW	6.4	6.11	18.33	6.67	46%	75.34	0.00	1.12	0.00
16:00	3/31/94	WSW	12.8	6.67	18.33	6.11	47%	75.34	0.00	1.12	0.00
16:30	3/31/94	NNW	8	5.00	17.78	6.11	46%	75.39	0.00	1.12	0.00
17:00	3/31/94	NNW	6.4	3.89	17.22	5.00	46%	75.39	0.00	1.12	0.00
17:30	3/31/94	NE	6.4	2.78	18.89	3.89	50%	75.39	0.00	1.12	0.00
18:00	3/31/94	NNW	4.8	2.22	17.22	2.78	57%	75.44	0.00	1.12	0.00
18:30	3/31/94	N	1.6	1.11	16.67	2.22	60%	75.39	0.00	1.12	0.00
19:00	3/31/94	NNW	3.2	0.56	16.11	1.67	63%	75.39	0.00	1.12	0.00
19:30	3/31/94	NNW	3.2	0.00	16.11	1.11	62%	75.39	0.00	1.12	0.00
20:00	3/31/94	NNW	0	16.11	0.56	0.56	64%	75.39	0.00	1.12	0.00
20:30	3/31/94	W	0	-0.56	15.56	0.00	65%	75.39	0.00	1.12	0.00
21:00	3/31/94	WNW	0	-0.56	15.00	0.00	64%	75.39	0.00	1.12	0.00
21:30	3/31/94	NNW	1.6	-0.56	15.00	-0.56	71%	75.39	0.00	1.12	0.00
22:00	3/31/94	WNW	0	-1.11	17.78	-0.56	72%	75.39	0.00	1.12	0.00
22:30	3/31/94	W	0	-3.33	16.67	-1.67	75%	75.39	0.00	1.12	0.00
23:00	3/31/94	NW	1.6	-3.89	17.22	-2.78	68%	75.44	0.00	1.12	0.00
23:30	3/31/94	NW	0	-4.44	16.11	-3.33	77%	75.39	0.00	1.12	0.00
Min	4/1/94	NW	0	-5.00	8.33	-7.22	0%	75.29	0.00	0.00	0.00
Max	4/1/94	SSW	33.6	13.89	19.44	7.78	84%	75.64	0.00	0.00	0.00
0:30	4/1/94	W	0	-5.00	15.00	-4.44	76%	75.39	0.00	0.00	0.00
1:00	4/1/94	NW	0	-5.56	13.89	-5.00	74%	75.34	0.00	0.00	0.00
1:30	4/1/94	SW	0	-6.67	13.33	-5.56	78%	75.34	0.00	0.00	0.00
2:00	4/1/94	SSE	0	-5.56	13.33	-5.56	80%	75.29	0.00	0.00	0.00
2:30	4/1/94	NNW	1.6	-6.11	12.78	-5.56	81%	75.29	0.00	0.00	0.00
3:00	4/1/94	NW	0	-7.22	12.22	-6.11	92%	75.23	0.00	0.00	0.00
3:30	4/1/94	W	0	-7.22	12.22	-6.11	94%	75.23	0.00	0.00	0.00
4:00	4/1/94	WSW	0	-7.22	12.22	-6.67	92%	75.23	0.00	0.00	0.00
4:30	4/1/94	SSW	0	-6.67	12.22	-6.11	96%	75.29	0.00	0.00	0.00
5:00	4/1/94	NW	0	-5.56	11.67	-6.11	96%	75.29	0.00	0.00	0.00
5:30	4/1/94	WSW	1.6	-5.00	11.11	-5.56	93%	75.23	0.00	0.00	0.00
6:00	4/1/94	WNW	0	-5.56	11.11	-5.00	93%	75.29	0.00	0.00	0.00
6:30	4/1/94	WSW	0	-6.11	10.56	-5.56	92%	75.29	0.00	0.00	0.00
7:00	4/1/94	WSW	0	-3.33	10.56	-5.00	89%	75.29	0.00	0.00	0.00
7:30	4/1/94	SW	0	-2.22	11.11	-2.78	83%	75.34	0.00	0.00	0.00
8:00	4/1/94	N	1.6	-0.56	11.67	-1.67	72%	75.34	0.00	0.00	0.00
8:30	4/1/94	N	3.2	6.11	11.67	0.00	60%	75.34	0.00	0.00	0.00
9:00	4/1/94	ENE	8	6.11	12.22	2.22	43%	75.34	0.00	0.00	0.00
9:30	4/1/94	NNE	4.8	8.89	13.89	5.00	28%	75.34	0.00	0.00	0.00
10:00	4/1/94	NNW	6.4	5.00	12.22	4.44	30%	75.39	0.00	0.00	0.00
10:30	4/1/94	NE	9.6	3.89	12.78	3.89	29%	75.44	0.00	0.00	0.00
11:00	4/1/94	N	8	3.89	12.78	3.89	27%	75.49	0.00	0.00	0.00
11:30	4/1/94	NNE	8	3.33	13.33	4.44	29%	75.49	0.00	0.00	0.00
12:00	4/1/94	NNE	4.8	4.44	13.89	5.00	27%	75.49	0.00	0.00	0.00
12:30	4/1/94	NNE	6.4	5.56	13.89	6.11	30%	75.54	0.00	0.00	0.00
13:00	4/1/94	NNE	3.2	5.00	13.89	5.56	34%	75.54	0.00	0.00	0.00
13:30	4/1/94	N	11.2	3.33	13.89	3.89	39%	75.54	0.00	0.00	0.00
14:00	4/1/94	N	12.8	2.22	14.44	3.33	40%	75.54	0.00	0.00	0.00
14:30	4/1/94	NE	12.8	1.67	13.89	2.78	44%	75.54	0.00	0.00	0.00
15:00	4/1/94	NNE	12.8	1.67	13.89	2.78	46%	75.54	0.00	0.00	0.00
15:30	4/1/94	NNE	4.8	2.22	13.89	2.78	48%	75.54	0.00	0.00	0.00
16:00	4/1/94	ENE	9.6	2.22	13.89	3.33	47%	75.54	0.00	0.00	0.00
16:30	4/1/94	NNE	4.8	2.22	13.33	2.78	48%	75.54	0.00	0.00	0.00
17:00	4/1/94	ENE	8	1.67	12.78	2.22	48%	75.49	0.00	0.00	0.00
17:30	4/1/94	ENE	6.4	1.11	12.78	1.67	51%	75.49	0.00	0.00	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
18:00	4/1/94	ENE	4.8	1.11	12.22	1.67	50%	75.49	0.00	0.00	0.00
18:30	4/1/94	E	3.2	1.11	11.67	1.67	52%	75.49	0.00	0.00	0.00
19:00	4/1/94	SSE	0	0.56	11.67	1.11	56%	75.49	0.00	0.00	0.00
19:30	4/1/94	ESE	1.6	0.00	11.11	0.56	60%	75.49	0.00	0.00	0.00
20:00	4/1/94	ENE	3.2	0.00	11.11	0.56	61%	75.49	0.00	0.00	0.00
20:30	4/1/94	ESE	4.8	0.00	10.56	0.00	63%	75.49	0.00	0.00	0.00
21:00	4/1/94	SE	6.4	0.00	10.00	0.00	68%	75.49	0.00	0.00	0.00
21:30	4/1/94	SE	9.6	-0.56	10.00	0.00	78%	75.49	0.00	0.00	0.00
22:00	4/1/94	ENE	8	-1.11	9.44	-0.56	84%	75.44	0.00	0.00	0.00
22:30	4/1/94	ESE	4.8	-1.11	9.44	-1.11	86%	75.44	0.00	0.00	0.00
23:00	4/1/94	SSE	6.4	-1.11	9.44	-1.11	88%	75.39	0.00	0.00	0.00
23:30	4/1/94	ESE	3.2	-1.11	8.89	-1.11	87%	75.39	0.00	0.00	0.00
Min	4/2/94	W	0	-8.33	8.89	-6.67	24%	75.18	0.00	0.00	0.00
Max	4/2/94	SSE	19.2	12.22	15.56	6.11	100%	75.54	0.00	0.00	0.00
0:30	4/2/94	ESE	3.2	-1.67	8.33	-1.11	89%	75.34	0.00	0.00	0.00
1:00	4/2/94	ESE	6.4	-1.67	8.33	-1.11	90%	75.29	0.00	0.00	0.00
1:30	4/2/94	SE	4.8	-1.67	8.33	-1.67	90%	75.29	0.00	0.00	0.00
2:00	4/2/94	SE	4.8	-2.22	7.78	-1.67	90%	75.23	0.00	0.00	0.00
2:30	4/2/94	ENE	6.4	-2.22	7.78	-1.67	92%	75.18	0.00	0.00	0.00
3:00	4/2/94	ENE	4.8	-2.22	7.78	-1.67	93%	75.18	0.00	0.00	0.00
3:30	4/2/94	ESE	6.4	-2.22	7.78	-1.67	92%	75.13	0.00	0.00	0.00
4:00	4/2/94	ESE	11.2	-1.67	7.22	-1.67	93%	75.08	0.00	0.00	0.00
4:30	4/2/94	SE	11.2	-1.67	7.22	-1.67	91%	75.03	0.00	0.00	0.00
5:00	4/2/94	SE	12.8	-1.67	6.67	-1.11	90%	74.98	0.00	0.00	0.00
5:30	4/2/94	SE	11.2	-1.11	6.67	-1.11	88%	74.93	0.00	0.00	0.00
6:00	4/2/94	SE	16	-1.11	6.67	-1.11	87%	74.93	0.00	0.00	0.00
6:30	4/2/94	SE	16	-1.11	6.67	-0.56	88%	74.88	0.00	0.00	0.00
7:00	4/2/94	SE	16	-1.11	6.11	-0.56	88%	74.83	0.00	0.00	0.00
7:30	4/2/94	SE	16	-0.56	6.11	-0.56	83%	74.83	0.00	0.00	0.00
8:00	4/2/94	SE	12.8	0.00	6.11	0.00	82%	74.73	0.00	0.00	0.00
8:30	4/2/94	SE	14.4	0.00	6.11	0.56	78%	74.73	0.00	0.00	0.00
9:00	4/2/94	SE	17.6	-0.56	6.11	0.00	75%	74.63	0.00	0.00	0.00
9:30	4/2/94	SE	16	-1.11	6.11	0.00	81%	74.63	0.00	0.00	0.00
10:00	4/2/94	ESE	12.8	-1.11	6.11	-0.56	90%	74.52	0.00	0.00	0.00
10:30	4/2/94	SE	20.8	-1.67	6.11	0.00	82%	74.52	0.00	0.00	0.00
11:00	4/2/94	SE	12.8	-0.56	6.67	1.11	77%	74.42	0.00	0.00	0.00
11:30	4/2/94	SSE	22.4	2.22	7.22	2.22	73%	74.42	0.00	0.00	0.00
12:00	4/2/94	SE	14.4	5.56	8.89	3.33	71%	74.37	0.00	0.00	0.00
12:30	4/2/94	SE	12.8	5.00	9.44	5.00	67%	74.32	0.00	0.00	0.00
13:00	4/2/94	SE	17.6	5.56	10.00	6.11	64%	74.32	0.00	0.00	0.00
13:30	4/2/94	S	11.2	6.11	10.00	6.67	62%	74.32	0.00	0.00	0.00
14:00	4/2/94	S	8	7.22	11.11	6.11	66%	74.37	0.00	0.00	0.00
14:30	4/2/94	SW	16	6.67	10.56	5.56	69%	74.32	0.00	0.00	0.00
15:00	4/2/94	WNW	12.8	6.67	10.56	5.56	64%	74.37	0.00	0.00	0.00
15:30	4/2/94	WNW	11.2	3.89	10.56	5.00	64%	74.42	0.00	0.00	0.00
16:00	4/2/94	WSW	8	3.33	10.00	3.89	67%	74.47	0.00	0.00	0.00
16:30	4/2/94	WNW	12.8	1.67	10.00	2.78	73%	74.52	0.00	0.00	0.00
17:00	4/2/94	W	12.8	0.56	10.00	1.67	80%	74.52	0.00	0.00	0.00
17:30	4/2/94	WNW	12.8	0.00	10.56	0.56	81%	74.57	0.00	0.00	0.00
18:00	4/2/94	W	12.8	-0.56	10.00	0.00	80%	74.63	0.00	0.00	0.00
18:30	4/2/94	WNW	17.6	-2.22	9.44	-1.11	82%	74.68	0.00	0.00	0.00
19:00	4/2/94	NW	14.4	-3.89	8.89	-2.78	83%	74.73	0.00	0.00	0.00
19:30	4/2/94	NW	8	-4.44	8.33	-3.89	87%	74.73	0.00	0.00	0.00
20:00	4/2/94	NW	12.8	-5.00	8.33	-4.44	86%	74.83	0.00	0.00	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
20:30	4/2/94	NW	16	-5.56	7.78	-5.00	86%	74.88	0.00	0.00	0.00
21:00	4/2/94	NNW	20.8	-5.56	7.78	-5.56	90%	74.88	0.00	0.00	0.00
21:30	4/2/94	NNW	16	-6.11	7.78	-5.56	93%	74.88	0.00	0.00	0.00
22:00	4/2/94	NNW	16	-6.11	7.78	-6.11	94%	74.93	0.00	0.00	0.00
22:30	4/2/94	NNW	12.8	-6.11	7.78	-6.11	93%	74.98	0.00	0.00	0.00
23:00	4/2/94	NNW	20.8	-6.67	7.22	-6.11	91%	74.93	0.00	0.00	0.00
23:30	4/2/94	NNW	14.4	-7.22	7.22	-6.67	91%	74.93	0.00	0.00	0.00
Min	4/3/94	SE	1.6	-7.78	6.11	-7.22	57%	74.32	0.00	0.00	0.00
Max	4/3/94	SSE	41.6	8.89	11.67	7.22	95%	75.39	0.00	0.00	0.00
0:30	4/3/94	NNW	12.8	-7.78	7.22	-7.22	90%	74.98	0.00	0.00	0.00
1:00	4/3/94	NNW	12.8	-7.78	7.22	-7.78	89%	74.98	0.00	0.00	0.00
1:30	4/3/94	NNW	9.6	-7.78	7.22	-7.78	92%	75.03	0.00	0.00	0.00
2:00	4/3/94	NNW	9.6	-8.33	7.22	-7.78	94%	75.08	0.00	0.00	0.00
2:30	4/3/94	NNW	9.6	-8.33	6.67	-7.78	93%	75.08	0.00	0.00	0.00
3:00	4/3/94	NNW	9.6	-8.33	6.67	-8.33	94%	75.08	0.00	0.00	0.00
3:30	4/3/94	NNW	9.6	-8.33	6.11	-8.33	93%	75.08	0.00	0.00	0.00
4:00	4/3/94	N	9.6	-8.89	6.11	-8.33	93%	75.08	0.00	0.00	0.00
4:30	4/3/94	NNW	3.2	-9.44	6.11	-8.89	92%	75.13	0.00	0.00	0.00
5:00	4/3/94	WNW	1.6	-10.00	5.56	-9.44	97%	75.13	0.00	0.00	0.00
5:30	4/3/94	WSW	0	-11.11	5.00	-10.00	100%	75.18	0.00	0.00	0.00
6:00	4/3/94	WSW	1.6	-11.67	5.00	-11.11	100%	75.18	0.00	0.00	0.00
6:30	4/3/94	WSW	0	-11.11	4.44	-11.11	100%	75.23	0.00	0.00	0.00
7:00	4/3/94	WSW	1.6	-6.67	4.44	-10.56	100%	75.23	0.00	0.00	0.00
7:30	4/3/94	WSW	4.8	1.67	4.44	-8.33	93%	75.23	0.00	0.00	0.00
8:00	4/3/94	WSW	4.8	4.44	4.44	-5.56	81%	75.23	0.00	0.00	0.00
8:30	4/3/94	WNW	4.8	7.22	5.00	-3.33	69%	75.23	0.00	0.00	0.00
9:00	4/3/94	NW	8	4.44	6.11	-1.67	52%	75.23	0.00	0.00	0.00
9:30	4/3/94	WNW	4.8	7.78	7.78	0.00	47%	75.23	0.00	0.00	0.00
10:00	4/3/94	NNE	8	6.67	16.11	1.11	43%	75.29	0.00	0.00	0.00
10:30	4/3/94	NE	6.4	5.00	16.67	1.67	39%	75.39	0.00	0.00	0.00
11:00	4/3/94	NE	6.4	6.67	15.00	2.78	35%	75.39	0.00	0.00	0.00
11:30	4/3/94	SW	3.2	9.44	15.56	3.89	35%	75.44	0.00	0.00	0.00
12:00	4/3/94	NNE	9.6	5.00	16.67	3.89	36%	75.39	0.00	0.00	0.00
12:30	4/3/94	WSW	11.2	7.22	16.11	3.33	38%	75.39	0.00	0.00	0.00
13:00	4/3/94	WSW	6.4	6.11	16.67	3.33	40%	75.39	0.00	0.00	0.00
13:30	4/3/94	WSW	9.6	4.44	17.22	3.89	34%	75.39	0.00	0.00	0.00
14:00	4/3/94	WNW	8	5.00	17.22	5.56	33%	75.39	0.00	0.00	0.00
14:30	4/3/94	SW	28.8	2.78	17.78	3.33	49%	75.39	0.00	0.00	0.00
15:00	4/3/94	SW	19.2	2.22	17.78	2.78	48%	75.39	0.00	0.00	0.00
15:30	4/3/94	SW	20.8	1.11	18.33	2.22	52%	75.39	0.00	0.00	0.00
16:00	4/3/94	WSW	16	5.00	17.78	1.67	52%	75.39	0.00	0.00	0.00
16:30	4/3/94	SW	17.6	4.44	17.78	1.11	56%	75.39	0.00	0.00	0.00
17:00	4/3/94	SW	19.2	3.89	17.22	1.11	54%	75.34	0.00	0.00	0.00
17:30	4/3/94	SW	20.8	1.11	16.67	0.00	55%	75.34	0.00	0.00	0.00
18:00	4/3/94	SW	17.6	-1.67	16.11	-0.56	60%	75.34	0.00	0.00	0.00
18:30	4/3/94	SW	19.2	-2.22	15.00	-1.11	63%	75.29	0.00	0.00	0.00
19:00	4/3/94	SW	12.8	-3.33	13.89	-2.22	69%	75.23	0.00	0.00	0.00
19:30	4/3/94	SSW	9.6	-3.89	13.33	-2.22	75%	75.18	0.00	0.00	0.00
20:00	4/3/94	S	9.6	-3.33	12.78	-2.78	79%	75.18	0.00	0.00	0.00
20:30	4/3/94	SSW	6.4	-3.33	12.22	-2.78	79%	75.18	0.00	0.00	0.00
21:00	4/3/94	SSW	9.6	-2.78	11.67	-2.22	99%	75.13	0.00	0.00	0.00
21:30	4/3/94	SSW	12.8	-2.22	11.11	-1.67	99%	75.08	0.00	0.00	0.00
22:00	4/3/94	SW	14.4	-2.22	10.56	-1.67	99%	75.08	0.00	0.00	0.00
22:30	4/3/94	WSW	9.6	-2.78	10.00	-1.67	100%	75.03	0.00	0.00	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
23:00	4/3/94	WSW	1.6	-4.44	10.00	-2.22	100%	75.03	0.00	0.00	0.00
23:30	4/3/94	WSW	4.8	-2.78	9.44	-1.67	100%	75.03	0.00	0.00	0.00
Min	4/4/94	N	0	-13.33	2.78	-11.11	31%	74.42	0.00	0.00	0.00
Max	4/4/94	SW	35.2	11.67	18.33	6.11	100%	75.44	0.00	0.00	0.00
0:30	4/4/94	SW	0	-7.22	9.44	-3.33	100%	74.98	0.00	0.00	0.00
1:00	4/4/94	WSW	3.2	-6.11	8.89	-3.89	100%	74.98	0.00	0.00	0.00
1:30	4/4/94	SSW	1.6	-8.89	8.89	-4.44	100%	74.93	0.00	0.00	0.00
2:00	4/4/94	SW	3.2	-5.00	8.33	-4.44	100%	74.93	0.00	0.00	0.00
2:30	4/4/94	WSW	3.2	-3.89	8.33	-3.89	100%	74.93	0.00	0.00	0.00
3:00	4/4/94	WSW	1.6	-3.89	8.33	-3.33	100%	74.93	0.00	0.00	0.00
3:30	4/4/94	SW	3.2	-3.33	7.78	-3.33	100%	74.93	0.00	0.00	0.00
4:00	4/4/94	WSW	0	-4.44	7.78	-2.78	100%	74.93	0.00	0.00	0.00
4:30	4/4/94	WSW	3.2	-5.56	7.78	-3.89	100%	74.93	0.00	0.00	0.00
5:00	4/4/94	WSW	1.6	-5.00	7.78	-3.89	100%	74.93	0.00	0.00	0.00
5:30	4/4/94	WSW	4.8	-4.44	7.78	-3.89	100%	74.93	0.00	0.00	0.00
6:00	4/4/94	WSW	3.2	-3.89	7.22	-3.33	100%	74.93	0.00	0.00	0.00
6:30	4/4/94	W	0	-3.33	7.22	-3.33	100%	74.93	0.00	0.00	0.00
7:00	4/4/94	WSW	3.2	-2.22	7.78	-2.22	100%	74.93	0.00	0.00	0.00
7:30	4/4/94	WSW	3.2	-1.11	8.89	-1.67	90%	74.93	0.00	0.00	0.00
8:00	4/4/94	WSW	3.2	1.11	10.00	-0.56	85%	74.98	0.00	0.00	0.00
8:30	4/4/94	WSW	4.8	2.78	12.78	0.56	82%	74.98	0.00	0.00	0.00
9:00	4/4/94	WSW	4.8	2.22	11.11	1.11	88%	75.03	0.00	0.00	0.00
9:30	4/4/94	SSW	6.4	1.11	12.78	0.56	94%	75.03	0.00	0.00	0.00
10:00	4/4/94	SSW	3.2	1.11	12.22	1.11	95%	75.03	0.00	0.00	0.00
10:30	4/4/94	SW	1.6	1.67	13.89	1.11	94%	75.08	0.00	0.00	0.00
11:00	4/4/94	SW	3.2	0.56	14.44	1.67	93%	75.08	0.00	0.00	0.00
11:30	4/4/94	SSE	4.8	1.67	14.44	2.78	89%	75.08	0.05	0.05	0.10
12:00	4/4/94	S	3.2	1.11	13.89	2.22	91%	75.03	0.10	0.10	0.10
12:30	4/4/94	S	1.6	1.11	15.00	2.78	89%	75.03	0.10	0.10	0.00
13:00	4/4/94	SE	6.4	1.11	13.89	2.78	90%	75.03	0.15	0.15	0.10
13:30	4/4/94	S	3.2	0.56	13.33	2.22	93%	75.03	0.15	0.15	0.00
14:00	4/4/94	S	4.8	0.56	13.89	1.11	99%	74.98	0.18	0.18	0.05
14:30	4/4/94	S	4.8	0.56	13.33	1.11	97%	74.93	0.18	0.18	0.00
15:00	4/4/94	S	6.4	0.00	13.33	0.56	100%	74.98	0.20	0.20	0.05
15:30	4/4/94	SW	8	0.00	12.78	0.56	100%	74.98	0.20	0.20	0.00
16:00	4/4/94	SW	3.2	0.00	12.78	0.56	99%	74.98	0.20	0.20	0.00
16:30	4/4/94	WSW	3.2	0.00	13.33	1.11	96%	74.93	0.20	0.20	0.00
17:00	4/4/94	NNW	4.8	-0.56	12.78	1.11	99%	74.93	0.20	0.20	0.00
17:30	4/4/94	NNE	4.8	-0.56	12.78	0.00	100%	74.98	0.20	0.20	0.00
18:00	4/4/94	N	6.4	-1.11	12.78	-0.56	100%	74.98	0.20	0.20	0.00
18:30	4/4/94	NNW	4.8	-1.11	12.22	-1.11	100%	74.98	0.20	0.20	0.00
19:00	4/4/94	NNW	9.6	-1.67	12.22	-1.67	100%	74.98	0.20	0.20	0.00
19:30	4/4/94	N	8	-2.78	12.22	-2.22	100%	74.98	0.20	0.20	0.00
20:00	4/4/94	NNW	9.6	-3.33	12.22	-2.22	100%	74.98	0.20	0.20	0.00
20:30	4/4/94	NNW	9.6	-3.33	12.22	-2.78	100%	75.03	0.20	0.20	0.00
21:00	4/4/94	NNW	4.8	-4.44	12.22	-3.89	100%	75.03	0.20	0.20	0.00
21:30	4/4/94	NNW	8	-5.00	12.22	-4.44	100%	75.08	0.20	0.20	0.00
22:00	4/4/94	NNW	6.4	-5.56	11.67	-4.44	100%	75.08	0.20	0.20	0.00
22:30	4/4/94	NNW	6.4	-5.56	11.67	-5.00	100%	75.08	0.20	0.20	0.00
23:00	4/4/94	NNW	4.8	-5.56	11.67	-5.56	100%	75.08	0.20	0.20	0.00
23:30	4/4/94	NW	6.4	-6.11	11.11	-5.56	100%	75.03	0.20	0.20	0.00
Min	4/5/94	WSW	0	-8.89	7.22	-5.56	81%	74.63	0.00	0.20	0.00
Max	4/5/94	NW	20.8	3.89	17.78	2.78	100%	75.13	0.00	0.20	0.10
0:30	4/5/94	NNW	8	-6.67	11.11	-6.11	100%	74.98	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
1:00	4/5/94	NNW	6.4	-6.67	11.11	-6.11	100%	74.98	0.00	0.20	0.00
1:30	4/5/94	NNW	4.8	-6.11	10.56	-6.11	100%	74.98	0.00	0.20	0.00
2:00	4/5/94	NNW	4.8	-6.67	10.56	-6.11	100%	74.98	0.00	0.20	0.00
2:30	4/5/94	NNW	1.6	-7.22	10.56	-6.67	100%	75.03	0.00	0.20	0.00
3:00	4/5/94	NNW	4.8	-7.22	10.00	-6.67	100%	75.03	0.00	0.20	0.00
3:30	4/5/94	NNW	6.4	-7.22	10.56	-6.67	100%	75.03	0.00	0.20	0.00
4:00	4/5/94	N	6.4	-8.89	10.56	-7.78	100%	75.03	0.00	0.20	0.00
4:30	4/5/94	N	8	-10.00	10.56	-8.33	100%	75.03	0.00	0.20	0.00
5:00	4/5/94	NNW	4.8	-10.00	10.56	-8.89	100%	75.08	0.00	0.20	0.00
5:30	4/5/94	NNW	4.8	-10.56	10.00	-9.44	100%	75.08	0.00	0.20	0.00
6:00	4/5/94	N	4.8	-11.11	10.00	-10.00	100%	75.08	0.00	0.20	0.00
6:30	4/5/94	NNW	3.2	-11.11	14.44	-10.00	100%	75.13	0.00	0.20	0.00
7:00	4/5/94	N	4.8	-10.00	15.56	-8.89	100%	75.23	0.00	0.20	0.00
7:30	4/5/94	NNW	8	-3.89	16.67	-6.67	93%	75.34	0.00	0.20	0.00
8:00	4/5/94	NNE	9.6	-1.67	13.89	-5.56	86%	75.34	0.00	0.20	0.00
8:30	4/5/94	NNW	9.6	0.56	14.44	-3.89	81%	75.34	0.00	0.20	0.00
9:00	4/5/94	NNW	9.6	1.67	16.67	-2.78	75%	75.39	0.00	0.20	0.00
9:30	4/5/94	NNE	8	3.33	17.22	-2.78	72%	75.44	0.00	0.20	0.00
10:00	4/5/94	N	9.6	4.44	17.22	-1.11	65%	75.49	0.00	0.20	0.00
10:30	4/5/94	NNW	4.8	5.56	17.22	0.56	61%	75.49	0.00	0.20	0.00
11:00	4/5/94	NNW	9.6	5.56	17.22	0.56	63%	75.49	0.00	0.20	0.00
11:30	4/5/94	NNW	12.8	5.00	17.78	0.56	62%	75.54	0.00	0.20	0.00
12:00	4/5/94	NNW	11.2	5.56	18.33	1.11	60%	75.54	0.00	0.20	0.00
12:30	4/5/94	N	14.4	5.56	18.33	0.00	59%	75.59	0.00	0.20	0.00
13:00	4/5/94	N	12.8	5.56	18.33	0.00	62%	75.59	0.00	0.20	0.00
13:30	4/5/94	NNE	11.2	6.11	18.89	-0.56	60%	75.59	0.00	0.20	0.00
14:00	4/5/94	NW	12.8	6.11	18.89	0.00	56%	75.64	0.00	0.20	0.00
14:30	4/5/94	N	11.2	7.22	19.44	0.00	59%	75.64	0.00	0.20	0.00
15:00	4/5/94	NNW	12.8	5.56	19.44	-1.11	64%	75.69	0.00	0.20	0.00
15:30	4/5/94	NNW	11.2	4.44	20.00	-0.56	61%	75.69	0.00	0.20	0.00
16:00	4/5/94	NNW	8	5.00	20.00	-0.56	58%	75.74	0.00	0.20	0.00
16:30	4/5/94	N	14.4	2.78	19.44	-1.67	59%	75.74	0.00	0.20	0.00
17:00	4/5/94	NNW	16	1.11	19.44	-2.22	55%	75.79	0.00	0.20	0.00
17:30	4/5/94	N	14.4	-1.11	18.33	-2.78	57%	75.79	0.00	0.20	0.00
18:00	4/5/94	NNW	11.2	-5.00	18.33	-2.78	59%	75.79	0.00	0.20	0.00
18:30	4/5/94	NNW	14.4	-6.67	17.78	-3.89	64%	75.79	0.00	0.20	0.00
19:00	4/5/94	NNW	12.8	-7.78	16.11	-6.11	72%	75.79	0.00	0.20	0.00
19:30	4/5/94	NNW	12.8	-8.89	15.56	-7.22	79%	75.79	0.00	0.20	0.00
20:00	4/5/94	NNW	9.6	-9.44	14.44	-8.33	80%	75.79	0.00	0.20	0.00
20:30	4/5/94	NNW	11.2	-9.44	13.89	-8.89	80%	75.79	0.00	0.20	0.00
21:00	4/5/94	NNW	11.2	-10.00	12.78	-8.89	82%	75.74	0.00	0.20	0.00
21:30	4/5/94	NNW	11.2	-10.00	12.22	-9.44	95%	75.69	0.00	0.20	0.00
22:00	4/5/94	NNW	8	-10.00	11.67	-9.44	95%	75.64	0.00	0.20	0.00
22:30	4/5/94	NNW	9.6	-10.56	11.11	-10.00	100%	75.64	0.00	0.20	0.00
23:00	4/5/94	NNW	8	-10.56	10.56	-10.00	100%	75.64	0.00	0.20	0.00
23:30	4/5/94	NNW	8	-10.56	10.00	-10.00	100%	75.64	0.00	0.20	0.00
Min	4/6/94	NW	1.6	-11.67	9.44	-10.00	52%	74.98	0.00	0.20	0.00
Max	4/6/94	N	30.4	8.33	20.00	2.22	100%	75.79	0.00	0.20	0.00
0:30	4/6/94	NNW	8	-10.56	9.44	-10.00	100%	75.59	0.00	0.20	0.00
1:00	4/6/94	NNW	8	-10.56	8.89	-10.00	98%	75.59	0.00	0.20	0.00
1:30	4/6/94	NNW	9.6	-10.56	8.89	-10.00	100%	75.59	0.00	0.20	0.00
2:00	4/6/94	NNW	8	-10.56	8.33	-10.00	100%	75.54	0.00	0.20	0.00
2:30	4/6/94	N	9.6	-11.11	7.78	-10.56	100%	75.54	0.00	0.20	0.00
3:00	4/6/94	NNW	6.4	-11.11	7.78	-11.11	100%	75.54	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
3:30	4/6/94	NNW	4.8	-12.22	7.22	-11.67	100%	75.54	0.00	0.20	0.00
4:00	4/6/94	NNW	3.2	-12.78	6.67	-12.22	100%	75.54	0.00	0.20	0.00
4:30	4/6/94	NNE	1.6	-13.33	6.67	-12.78	100%	75.54	0.00	0.20	0.00
5:00	4/6/94	N	4.8	-13.33	6.11	-13.33	100%	75.54	0.00	0.20	0.00
5:30	4/6/94	NNE	3.2	-13.33	5.56	-13.33	100%	75.54	0.00	0.20	0.00
6:00	4/6/94	N	3.2	-13.33	5.56	-13.89	100%	75.49	0.00	0.20	0.00
6:30	4/6/94	NE	1.6	-15.00	7.22	-14.44	100%	75.54	0.00	0.20	0.00
7:00	4/6/94	N	3.2	-11.67	7.78	-13.33	99%	75.59	0.00	0.20	0.00
7:30	4/6/94	NE	4.8	-1.11	7.78	-9.44	88%	75.64	0.00	0.20	0.00
8:00	4/6/94	ENE	8	2.22	8.33	-6.67	62%	75.64	0.00	0.20	0.00
8:30	4/6/94	ENE	8	4.44	11.67	4.44	51%	75.69	0.00	0.20	0.00
9:00	4/6/94	ESE	6.4	7.78	13.33	-2.22	47%	75.74	0.00	0.20	0.00
9:30	4/6/94	SE	6.4	8.89	16.67	-0.56	56%	75.84	0.00	0.20	0.00
10:00	4/6/94	SE	1.6	10.56	17.22	0.56	56%	75.90	0.00	0.20	0.00
10:30	4/6/94	ENE	3.2	10.56	17.78	1.11	50%	75.90	0.00	0.20	0.00
11:00	4/6/94	ESE	6.4	11.11	18.33	1.11	46%	75.95	0.00	0.20	0.00
11:30	4/6/94	NE	11.2	8.89	19.44	0.56	52%	76.00	0.00	0.20	0.00
12:00	4/6/94	NNW	11.2	7.78	21.11	1.11	46%	76.00	0.00	0.20	0.00
12:30	4/6/94	NNW	11.2	6.11	22.22	1.11	36%	76.00	0.00	0.20	0.00
13:00	4/6/94	NNW	12.8	7.22	23.33	1.11	37%	76.00	0.00	0.20	0.00
13:30	4/6/94	NE	12.8	8.89	22.78	0.56	39%	76.05	0.00	0.20	0.00
14:00	4/6/94	NNW	16	8.89	22.78	0.56	37%	76.00	0.00	0.20	0.00
14:30	4/6/94	NNE	12.8	8.33	22.78	0.00	43%	76.00	0.00	0.20	0.00
15:00	4/6/94	N	12.8	8.89	23.33	0.56	42%	76.00	0.00	0.20	0.00
15:30	4/6/94	N	9.6	8.89	22.78	0.00	45%	75.95	0.00	0.20	0.00
16:00	4/6/94	NNE	9.6	7.22	22.78	-0.56	47%	75.95	0.00	0.20	0.00
16:30	4/6/94	NNE	9.6	5.56	22.78	-1.11	46%	76.00	0.00	0.20	0.00
17:00	4/6/94	NNW	17.6	2.22	22.22	-0.56	42%	76.00	0.00	0.20	0.00
17:30	4/6/94	N	12.8	-3.33	21.11	-0.56	41%	76.00	0.00	0.20	0.00
18:00	4/6/94	NNW	11.2	-3.89	21.11	-0.56	38%	76.00	0.00	0.20	0.00
18:30	4/6/94	N	11.2	-4.44	20.00	-1.67	44%	76.00	0.00	0.20	0.00
19:00	4/6/94	NNW	8	-5.56	18.89	-3.89	52%	75.95	0.00	0.20	0.00
19:30	4/6/94	NNW	8	-6.11	17.78	-5.56	61%	75.90	0.00	0.20	0.00
20:00	4/6/94	NNW	9.6	-6.67	16.67	-6.11	84%	75.90	0.00	0.20	0.00
20:30	4/6/94	NNW	9.6	-7.22	15.56	-6.11	92%	75.90	0.00	0.20	0.00
21:00	4/6/94	NNW	9.6	-7.22	15.00	-6.67	90%	75.84	0.00	0.20	0.00
21:30	4/6/94	NNW	8	-7.22	14.44	-7.22	98%	75.84	0.00	0.20	0.00
22:00	4/6/94	NNW	9.6	-7.78	13.33	-7.22	89%	75.79	0.00	0.20	0.00
22:30	4/6/94	NNW	9.6	-7.78	12.78	-7.22	95%	75.74	0.00	0.20	0.00
23:00	4/6/94	NNW	8	-7.78	12.22	-7.78	100%	75.74	0.00	0.20	0.00
23:30	4/6/94	NNW	9.6	-8.33	11.67	-7.78	89%	75.74	0.00	0.20	0.00
Min	4/7/94	SSW	0	-17.22	-0.56	-16.11	35%	75.13	0.00	0.20	0.00
Max	4/7/94	NNE	27.2	12.78	24.44	2.22	100%	76.05	0.00	0.20	0.00
0:30	4/7/94	N	6.4	-8.33	10.56	-7.78	85%	75.74	0.00	0.20	0.00
1:00	4/7/94	NNW	6.4	-8.33	10.00	-8.33	100%	75.74	0.00	0.20	0.00
1:30	4/7/94	NNW	8	-8.89	10.00	-8.33	100%	75.69	0.00	0.20	0.00
2:00	4/7/94	NNW	6.4	-8.89	9.44	-8.33	100%	75.69	0.00	0.20	0.00
2:30	4/7/94	NNW	8	-8.89	8.89	-8.33	100%	75.69	0.00	0.20	0.00
3:00	4/7/94	NNW	4.8	-9.44	8.33	-8.89	100%	75.69	0.00	0.20	0.00
3:30	4/7/94	NNW	4.8	-10.56	7.78	-9.44	100%	75.69	0.00	0.20	0.00
4:00	4/7/94	NNW	4.8	-10.56	7.78	-10.00	100%	75.74	0.00	0.20	0.00
4:30	4/7/94	NNW	3.2	-11.11	7.22	-10.56	100%	75.74	0.00	0.20	0.00
5:00	4/7/94	W	0	-12.78	6.67	-11.11	100%	75.74	0.00	0.20	0.00
5:30	4/7/94	NNW	3.2	-11.67	6.11	-11.67	100%	75.74	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
6:00	4/7/94	NNW	3.2	-11.11	6.11	-11.11	100%	75.79	0.00	0.20	0.00
6:30	4/7/94	WSW	0	-11.67	12.78	-11.11	97%	75.84	0.00	0.20	0.00
7:00	4/7/94	SW	0	-3.33	15.00	-10.00	91%	75.95	0.00	0.20	0.00
7:30	4/7/94	NNW	4.8	2.78	12.78	-6.67	84%	76.05	0.00	0.20	0.00
8:00	4/7/94	NNW	6.4	5.56	13.33	-3.33	75%	76.05	0.00	0.20	0.00
8:30	4/7/94	NNW	4.8	9.44	14.44	-0.56	66%	76.10	0.00	0.20	0.00
9:00	4/7/94	NNW	4.8	8.33	15.00	1.11	54%	76.15	0.00	0.20	0.00
9:30	4/7/94	NNW	4.8	12.78	17.22	3.33	48%	76.05	0.00	0.20	0.00
10:00	4/7/94	WSW	4.8	15.00	18.89	4.44	44%	76.20	0.00	0.20	0.00
10:30	4/7/94	SW	6.4	16.67	20.00	3.89	43%	76.25	0.00	0.20	0.00
11:00	4/7/94	NNW	6.4	15.56	21.11	4.44	41%	76.30	0.00	0.20	0.00
11:30	4/7/94	SW	9.6	16.11	22.22	5.00	42%	76.35	0.00	0.20	0.00
12:05	4/7/94	W	9.6	14.44	22.78	5.56	40%	76.40	0.00	0.20	0.00
12:30	4/7/94	NNW	6.4	14.44	24.44	6.11	47%	76.40	0.00	0.20	0.00
13:00	4/7/94	NNW	11.2	12.78	25.00	7.78	34%	76.40	0.00	0.20	0.00
13:30	4/7/94	SW	8	12.22	24.44	8.33	36%	76.45	0.00	0.20	0.00
14:00	4/7/94	NW	3.2	6.11	23.89	8.33	39%	76.45	0.00	0.20	0.00
14:30	4/7/94	NNW	14.4	5.56	24.44	7.78	37%	76.45	0.00	0.20	0.00
15:00	4/7/94	NNW	12.8	5.56	25.00	7.78	35%	76.45	0.00	0.20	0.00
15:30	4/7/94	N	9.6	5.00	24.44	7.22	38%	76.45	0.00	0.20	0.00
16:00	4/7/94	NW	6.4	5.00	24.44	7.78	36%	76.50	0.00	0.20	0.00
16:30	4/7/94	WSW	12.8	3.33	23.89	6.11	49%	76.50	0.00	0.20	0.00
17:00	4/7/94	SW	11.2	3.33	24.44	5.00	51%	76.50	0.00	0.20	0.00
17:30	4/7/94	SW	12.8	2.78	22.22	5.00	52%	76.56	0.00	0.20	0.00
18:00	4/7/94	SW	14.4	1.67	23.33	4.44	56%	76.50	0.00	0.20	0.00
18:30	4/7/94	SW	12.8	1.11	22.22	3.33	69%	76.50	0.00	0.20	0.00
19:00	4/7/94	SW	12.8	0.00	21.11	1.11	76%	76.50	0.00	0.20	0.00
19:30	4/7/94	SW	9.6	-1.67	20.00	0.00	73%	76.50	0.00	0.20	0.00
20:00	4/7/94	SW	11.2	-2.22	18.89	-1.11	90%	76.45	0.00	0.20	0.00
20:30	4/7/94	WSW	4.8	-3.33	18.33	-2.22	94%	76.45	0.00	0.20	0.00
21:00	4/7/94	SW	4.8	-3.89	17.22	-2.78	93%	76.45	0.00	0.20	0.00
21:30	4/7/94	WSW	1.6	-5.00	16.67	-3.89	100%	76.40	0.00	0.20	0.00
22:00	4/7/94	SW	1.6	-6.11	16.11	-5.00	100%	76.40	0.00	0.20	0.00
22:30	4/7/94	SSW	0	-6.67	15.00	-5.56	100%	76.40	0.00	0.20	0.00
23:00	4/7/94	SW	0	-7.22	14.44	-6.11	100%	76.40	0.00	0.20	0.00
23:30	4/7/94	W	0	-7.22	13.89	-6.67	100%	76.40	0.00	0.20	0.00
Min	4/8/94	NNW	0	-13.33	6.11	-11.67	34%	75.69	0.00	0.20	0.00
Max	4/8/94	WSW	32	18.33	26.11	8.89	100%	76.56	0.00	0.20	0.00
0:30	4/8/94	SW	0	-7.22	12.78	-6.67	100%	76.35	0.00	0.20	0.00
1:00	4/8/94	E	0	-7.22	11.67	-7.22	100%	76.30	0.00	0.20	0.00
1:30	4/8/94	ESE	0	-7.78	11.11	-7.78	100%	76.30	0.00	0.20	0.00
2:00	4/8/94	S	0	-8.33	10.56	-7.78	100%	76.25	0.00	0.20	0.00
2:30	4/8/94	S	0	-7.78	10.00	-7.78	100%	76.20	0.00	0.20	0.00
3:00	4/8/94	S	3.2	-6.67	9.44	-7.22	100%	76.20	0.00	0.20	0.00
3:30	4/8/94	S	3.2	-5.56	8.89	-6.11	100%	76.20	0.00	0.20	0.00
4:00	4/8/94	NW	0	-7.22	8.33	-6.67	100%	76.20	0.00	0.20	0.00
4:30	4/8/94	S	0	-7.22	7.78	-7.22	100%	76.15	0.00	0.20	0.00
5:00	4/8/94	S	3.2	-7.22	7.22	-7.22	100%	76.15	0.00	0.20	0.00
5:30	4/8/94	SSE	4.8	-6.67	6.67	-6.67	100%	76.15	0.00	0.20	0.00
6:00	4/8/94	SSW	0	-8.33	6.11	-7.22	100%	76.15	0.00	0.20	0.00
6:30	4/8/94	SSE	1.6	-7.22	7.22	-7.22	100%	76.15	0.00	0.20	0.00
7:00	4/8/94	SSE	4.8	-1.11	10.56	-5.56	100%	76.15	0.00	0.20	0.00
7:30	4/8/94	SSE	6.4	2.22	13.33	-3.33	87%	76.20	0.00	0.20	0.00
8:00	4/8/94	SSE	6.4	5.56	15.00	-1.11	77%	76.25	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
8:48	4/8/94	SSE	9.6	10.56	18.33	2.22	63%	76.35	0.00	0.20	0.00
9:00	4/8/94	S	6.4	11.11	17.78	2.78	63%	76.35	0.00	0.20	0.00
9:30	4/8/94	S	4.8	11.11	17.22	3.89	57%	76.35	0.00	0.20	0.00
10:00	4/8/94	S	9.6	7.78	21.67	5.00	48%	76.35	0.00	0.20	0.00
10:30	4/8/94	SSW	16	12.22	20.56	5.00	48%	76.40	0.00	0.20	0.00
11:00	4/8/94	SSW	19.2	10.56	19.44	5.56	48%	76.40	0.00	0.20	0.00
11:30	4/8/94	SSW	6.4	17.22	20.00	6.67	44%	76.35	0.00	0.20	0.00
12:00	4/8/94	SSW	12.8	12.78	19.44	6.11	47%	76.30	0.00	0.20	0.00
12:30	4/8/94	S	11.2	12.22	20.56	7.78	42%	76.30	0.00	0.20	0.00
13:00	4/8/94	SSE	28.8	12.22	20.56	8.33	41%	76.25	0.00	0.20	0.00
13:30	4/8/94	SSE	25.6	12.78	21.11	7.78	43%	76.20	0.00	0.20	0.00
14:00	4/8/94	S	12.8	10.00	21.11	7.78	42%	76.20	0.00	0.20	0.00
14:30	4/8/94	SSE	27.2	7.78	20.56	7.22	43%	76.15	0.00	0.20	0.00
15:00	4/8/94	55E	16	10.56	21.11	8.33	43%	76.10	0.00	0.20	0.00
15:30	4/8/94	SSE	17.6	8.33	21.11	7.78	41%	76.10	0.00	0.20	0.00
16:00	4/8/94	SE	19.2	6.11	20.56	6.67	47%	76.05	0.00	0.20	0.00
16:30	4/8/94	ESE	11.2	5.00	19.44	6.11	50%	75.95	0.00	0.20	0.00
17:00	4/8/94	SE	14.4	5.00	18.89	5.56	55%	75.95	0.00	0.20	0.00
17:30	4/8/94	SE	16	3.33	17.78	4.44	58%	75.90	0.00	0.20	0.00
18:00	4/8/94	SE	17.6	2.78	17.22	3.89	62%	75.90	0.00	0.20	0.00
18:30	4/8/94	SE	12.8	2.22	16.11	2.78	66%	75.79	0.00	0.20	0.00
19:00	4/8/94	SE	14.4	1.67	15.56	2.22	70%	75.74	0.00	0.20	0.00
19:30	4/8/94	SE	17.6	1.67	15.00	2.22	86%	75.74	0.00	0.20	0.00
20:00	4/8/94	SE	8	1.11	14.44	1.67	94%	75.64	0.00	0.20	0.00
20:30	4/8/94	SE	11.2	1.11	13.89	1.67	94%	75.59	0.00	0.20	0.00
21:00	4/8/94	SE	11.2	1.11	13.33	1.67	88%	75.49	0.00	0.20	0.00
21:30	4/8/94	SSE	17.6	1.11	12.78	1.67	86%	75.54	0.00	0.20	0.00
22:00	4/8/94	SSE	14.4	1.11	12.22	1.11	86%	75.49	0.00	0.20	0.00
22:30	4/8/94	SSE	12.8	1.11	11.67	1.11	87%	75.49	0.00	0.20	0.00
23:00	4/8/94	SE	14.4	1.11	11.67	1.67	85%	75.39	0.00	0.20	0.00
23:30	4/8/94	SE	12.8	1.11	11.11	1.67	84%	75.34	0.00	0.20	0.00
Min	4/9/94	SSW	0	-11.11	5.56	-7.78	40%	75.23	0.00	0.20	0.00
Max	4/9/94	SSE	40	17.22	21.67	8.33	100%	76.40	0.00	0.20	0.00
0:30	4/9/94	SE	14.4	1.11	10.00	1.67	81%	75.18	0.00	0.20	0.00
1:00	4/9/94	SE	11.2	1.11	10.00	1.67	80%	75.13	0.00	0.20	0.00
1:30	4/9/94	SE	12.8	0.56	9.44	1.11	79%	75.08	0.00	0.20	0.00
2:00	4/9/94	SE	11.2	1.11	9.44	1.11	81%	75.03	0.00	0.20	0.00
2:30	4/9/94	SE	14.4	0.56	8.89	0.56	84%	74.98	0.00	0.20	0.00
3:00	4/9/94	SE	19.2	0.00	8.33	0.56	86%	74.88	0.00	0.20	0.00
3:30	4/9/94	SSE	12.8	0.00	8.33	0.56	89%	74.83	0.00	0.20	0.00
4:00	4/9/94	SSE	17.6	0.00	7.78	0.56	90%	74.78	0.00	0.20	0.00
4:30	4/9/94	SSE	9.6	-0.56	7.78	0.00	93%	74.78	0.00	0.20	0.00
5:00	4/9/94	SSE	8	-1.11	7.22	0.00	99%	74.68	0.00	0.20	0.00
5:30	4/9/94	SE	6.4	-1.67	7.22	-0.56	100%	74.68	0.00	0.20	0.00
6:00	4/9/94	SE	8	-1.11	7.22	-0.56	100%	74.63	0.00	0.20	0.00
6:30	4/9/94	SE	6.4	-0.56	6.67	0.00	100%	74.63	0.00	0.00	0.00
7:00	4/9/94	SE	9.6	1.67	6.67	1.11	100%	74.52	0.00	0.20	0.00
7:30	4/9/94	SE	9.6	2.22	7.78	1.67	99%	74.52	0.00	0.20	0.00
8:00	4/9/94	SSE	19.2	3.33	8.33	2.78	100%	74.47	0.00	0.20	0.00
8:30	4/9/94	SSE	12.8	7.22	8.33	3.33	91%	74.42	0.00	0.20	0.00
9:00	4/9/94	S	9.6	14.44	9.44	6.67	84%	74.42	0.00	0.20	0.00
9:30	4/9/94	SW	35.2	12.22	10.00	7.22	76%	74.37	0.00	0.20	0.00
10:00	4/9/94	SW	36.8	13.33	11.11	7.22	73%	74.42	0.00	0.20	0.00
10:30	4/9/94	SW	22.4	15.56	11.67	7.22	72%	74.42	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
11:00	4/9/94	SW	27.2	16.67	12.78	7.78	68%	74.47	0.00	0.20	0.00
11:30	4/9/94	SW	20.8	16.11	13.33	8.33	65%	74.52	0.00	0.20	0.00
12:00	4/9/94	WSW	14.4	8.89	12.78	7.78	68%	74.57	0.00	0.20	0.00
12:30	4/9/94	SW	16	8.33	12.78	7.78	66%	74.63	0.00	0.20	0.00
13:00	4/9/94	SW	24	5.00	12.22	6.11	73%	74.68	0.00	0.20	0.00
13:30	4/9/94	SW	14.4	7.22	12.78	6.11	71%	74.68	0.00	0.20	0.00
14:00	4/9/94	SW	25.6	7.22	12.78	6.11	70%	74.73	0.00	0.20	0.00
14:30	4/9/94	WSW	17.6	5.56	12.22	5.56	76%	74.73	0.00	0.20	0.00
15:00	4/9/94	WSW	17.6	7.22	12.22	6.11	73%	74.73	0.00	0.20	0.00
15:30	4/9/94	WSW	20.8	6.11	12.22	6.11	75%	74.73	0.00	0.20	0.00
16:00	4/9/94	SW	17.6	6.67	12.78	6.11	75%	74.73	0.00	0.20	0.00
16:30	4/9/94	WSW	14.4	5.56	12.22	5.56	77%	74.73	0.00	0.20	0.00
17:00	4/9/94	WSW	12.8	5.00	11.67	5.00	79%	74.78	0.00	0.20	0.00
17:30	4/9/94	WSW	11.2	5.00	11.67	5.56	78%	74.83	0.00	0.20	0.00
18:00	4/9/94	WSW	4.8	4.44	11.67	5.56	78%	74.83	0.00	0.20	0.00
18:30	4/9/94	WSW	1.6	3.89	11.11	5.00	79%	74.88	0.00	0.20	0.00
19:00	4/9/94	WSW	8	3.89	11.11	5.00	79%	74.88	0.00	0.20	0.00
19:30	4/9/94	WNW	6.4	3.33	11.11	5.00	81%	74.93	0.00	0.20	0.00
20:00	4/9/94	WSW	6.4	3.33	11.11	4.44	82%	74.93	0.00	0.20	0.00
20:30	4/9/94	W	8	2.78	11.11	3.89	82%	74.98	0.00	0.20	0.00
21:00	4/9/94	WSW	4.8	2.78	10.56	3.89	83%	74.98	0.00	0.20	0.00
21:30	4/9/94	W	6.4	2.22	10.56	3.89	85%	75.03	0.00	0.20	0.00
22:00	4/9/94	WNW	3.2	2.22	10.56	3.33	85%	75.03	0.00	0.20	0.00
22:30	4/9/94	WSW	3.2	2.22	10.56	3.33	86%	75.03	0.00	0.20	0.00
23:00	4/9/94	WNW	4.8	1.67	10.56	3.33	86%	75.03	0.00	0.20	0.00
23:30	4/9/94	W	6.4	1.67	10.56	2.78	88%	75.03	0.00	0.20	0.00
Min	4/10/94	SW	0	-2.22	5.00	-1.11	57%	74.37	0.00	0.20	0.00
Max	4/10/94	SW	59.2	18.33	13.89	8.89	100%	75.29	0.00	0.20	0.00
0:30	4/10/94	WNW	4.8	1.67	10.00	2.78	89%	75.03	0.00	0.20	0.00
1:00	4/10/94	WNW	6.4	1.67	10.00	2.78	90%	75.03	0.00	0.20	0.00
1:30	4/10/94	WNW	8	1.67	10.00	2.78	92%	75.03	0.00	0.20	0.00
2:00	4/10/94	WNW	9.6	1.67	9.44	2.78	92%	75.08	0.00	0.20	0.00
2:30	4/10/94	WNW	6.4	1.67	9.44	2.22	92%	75.08	0.00	0.20	0.00
3:00	4/10/94	WSW	6.4	1.67	9.44	2.22	92%	75.08	0.00	0.20	0.00
3:30	4/10/94	WNW	8	1.11	9.44	2.22	91%	75.08	0.00	0.20	0.00
4:00	4/10/94	NW	8	0.00	9.44	1.67	95%	75.08	0.00	0.20	0.00
4:30	4/10/94	WNW	6.4	0.56	9.44	1.67	95%	75.13	0.00	0.20	0.00
5:00	4/10/94	WNW	8	0.56	9.44	1.67	93%	75.18	0.00	0.20	0.00
5:30	4/10/94	WNW	8	0.56	9.44	1.67	95%	75.18	0.00	0.20	0.00
6:00	4/10/94	NNW	6.4	0.56	9.44	1.67	94%	75.18	0.00	0.20	0.00
6:30	4/10/94	NW	6.4	0.56	9.44	1.67	93%	75.23	0.00	0.20	0.00
7:00	4/10/94	NW	8	3.33	10.00	2.22	88%	75.34	0.00	0.20	0.00
7:30	4/10/94	NW	11.2	3.89	10.00	2.78	86%	75.34	0.00	0.20	0.00
8:00	4/10/94	NNW	9.6	7.22	10.56	3.89	82%	75.39	0.00	0.20	0.00
8:30	4/10/94	NW	11.2	10.00	11.67	4.44	78%	75.44	0.00	0.20	0.00
9:00	4/10/94	NW	16	15.56	13.33	5.00	74%	75.49	0.00	0.20	0.00
9:00	4/10/94	NNW	20.8	16.11	12.78	5.56	72%	75.54	0.00	0.20	0.00
10:00	4/10/94	NNW	14.4	17.22	13.89	6.67	69%	75.59	0.00	0.20	0.00
10:30	4/10/94	NW	12.8	12.22	13.33	6.11	71%	75.64	0.00	0.20	0.00
11:00	4/10/94	NNW	20.8	22.22	14.44	6.67	66%	75.74	0.00	0.20	0.00
11:30	4/10/94	NNW	22.4	14.44	14.44	6.11	66%	76.05	0.00	0.20	0.00
12:00	4/10/94	NNW	17.6	15.56	15.00	6.11	62%	75.79	0.00	0.20	0.00
12:30	4/10/94	NNW	19.2	18.89	15.00	6.67	61%	75.84	0.00	0.20	0.00
13:00	4/10/94	NNW	14.4	15.00	15.56	6.11	64%	75.90	0.00	0.20	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
13:30	4/10/94	NNW	20.8	15.56	15.56	6.11	63%	75.95	0.00	0.20	0.00
14:00	4/10/94	NNW	16	21.11	16.11	6.11	63%	76.00	0.00	0.20	0.00
14:30	4/10/94	NNW	24	18.89	17.22	5.56	63%	76.00	0.00	0.20	0.00
15:00	4/10/94	NNW	14.4	19.44	17.78	6.11	60%	76.05	0.00	0.20	0.00
15:30	4/10/94	NNW	12.8	17.78	18.33	5.56	64%	76.10	0.00	0.20	0.00
16:00	4/10/94	NNW	14.4	17.22	19.44	5.56	62%	76.15	0.00	0.20	0.00
16:30	4/10/94	NNW	11.2	15.00	18.89	5.56	62%	76.20	0.00	0.20	0.00
17:00	4/10/94	NNW	12.8	12.78	18.89	5.56	60%	76.25	0.00	0.20	0.00
17:30	4/10/94	NNW	8	11.11	18.89	6.11	57%	76.30	0.00	0.20	0.00
18:00	4/10/94	NNW	11.2	3.89	18.89	6.11	57%	76.35	0.00	0.20	0.00
18:30	4/10/94	NNW	8	1.11	18.33	6.11	58%	76.35	0.00	0.20	0.00
19:00	4/10/94	NNW	9.6	0.00	17.78	2.78	72%	76.40	0.00	0.20	0.00
19:30	4/10/94	WNW	3.2	-1.11	17.22	1.11	79%	76.40	0.00	0.20	0.00
20:00	4/10/94	WNW	1.6	-2.78	16.67	0.00	85%	76.45	0.00	0.20	0.00
20:30	4/10/94	WSW	0	-3.89	15.56	-1.11	90%	76.45	0.00	0.20	0.00
21:00	4/10/94	WSW	1.6	-4.44	15.56	-2.78	94%	76.45	0.00	0.20	0.00
21:30	4/10/94	WNW	1.6	-4.44	14.44	-2.78	95%	76.45	0.00	0.20	0.00
22:00	4/10/94	WNW	0	-4.44	14.44	-3.33	98%	76.45	0.00	0.20	0.00
22:30	4/10/94	WSW	0	-5.56	13.89	-4.44	100%	76.45	0.00	0.20	0.00
23:00	4/10/94	ESE	1.6	-5.56	13.33	-5.00	100%	76.45	0.00	0.20	0.00
23:30	4/10/94	WSW	0	-6.11	12.78	-5.56	100%	76.50	0.00	0.20	0.00
Min	4/11/94	SW	0	-6.11	9.44	-5.56	55%	75.03	0.00	0.20	0.00
Max	4/11/94	NNW	41.6	25.56	20.00	7.22	100%	76.50	0.00	0.20	0.00
0:30	4/11/94	WNW	0	-6.11	11.67	-6.11	100%	76.50	0.00	0.20	0.00
1:00	4/11/94	NE	1.6	-6.67	11.11	-6.67	100%	76.50	0.00	0.20	0.00
1:30	4/11/94	NNW	0	-6.67	11.11	-6.67	100%	76.50	0.00	0.20	0.00
2:00	4/11/94	NW	0	-6.67	10.56	-7.22	100%	76.50	0.00	0.20	0.00
2:30	4/11/94	NNW	0	-7.22	10.00	-7.78	100%	76.50	0.00	0.20	0.00
3:00	4/11/94	WNW	0	-7.22	9.44	-7.78	100%	76.50	0.00	0.20	0.00
3:30	4/11/94	WSW	0	-7.22	9.44	-7.78	100%	76.50	0.00	0.20	0.00
4:00	4/11/94	NNW	0	-7.22	8.89	-8.33	100%	76.50	0.00	0.20	0.00
4:30	4/11/94	ENE	1.6	-7.22	8.89	-8.33	100%	76.50	0.00	0.20	0.00
5:00	4/11/94	NNE	0	-7.22	8.33	-8.33	100%	76.50	0.00	0.20	0.00
5:30	4/11/94	N	0	-7.78	8.33	-8.33	100%	76.50	0.00	0.20	0.00
6:00	4/11/94	NNW	0	-7.22	7.78	-8.33	100%	76.50	0.00	0.20	0.00
6:30	4/11/94	NNW	0	-6.11	7.78	-7.78	100%	76.50	0.00	0.20	0.00
7:00	4/11/94	SW	0	-1.11	9.44	-5.56	98%	76.56	0.00	0.20	0.00
7:30	4/11/94	WSW	0	8.89	10.00	-2.78	92%	76.61	0.00	0.20	0.00
8:00	4/11/94	SW	3.2	15.00	13.33	0.56	85%	76.71	0.00	0.20	0.00
8:30	4/11/94	SW	3.2	16.67	12.78	3.33	69%	76.76	0.00	0.20	0.00
9:00	4/11/94	SW	3.2	12.78	14.44	5.56	61%	76.76	0.00	0.20	0.00
Min	4/14/94	SE	0	-17.22	7.22	-8.89	33%	74.02	0.00	1.12	0.00
Max	4/14/94	SE	36.8	27.22	22.78	13.89	100%	76.96	0.00	1.12	0.41
6:30	4/14/94	SW	11.2	1.67	11.11	1.67	100%	74.27	0.00	1.12	0.00
7:00	4/14/94	SW	11.2	1.67	11.11	2.22	100%	74.27	0.00	1.12	0.00
7:30	4/14/94	SW	19.2	2.78	11.11	2.22	100%	74.27	0.00	1.12	0.00
8:00	4/14/94	SW	19.2	2.78	11.11	2.78	100%	74.27	0.00	1.12	0.00
8:30	4/14/94	SW	16	3.89	11.11	3.33	100%	74.27	0.00	1.12	0.00
9:00	4/14/94	SW	19.2	4.44	11.11	3.89	100%	74.32	0.00	1.12	0.00
9:30	4/14/94	SW	14.4	6.11	11.67	4.44	100%	74.32	0.00	1.12	0.00
10:00	4/14/94	SW	22.4	9.44	12.22	5.56	99%	74.37	0.00	1.12	0.00
10:30	4/14/94	SW	19.2	15.00	13.33	6.67	95%	74.37	0.00	1.12	0.00
11:00	4/14/94	SSW	20.8	17.22	13.89	8.33	92%	74.42	0.00	1.12	0.00
11:30	4/14/94	SW	19.2	17.22	16.11	9.44	84%	74.47	0.00	1.12	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
12:00	4/14/94	SSW	22.4	15.56	16.11	11.11	75%	74.47	0.00	1.12	0.00
12:30	4/14/94	WSW	17.6	18.33	16.11	11.67	71%	74.52	0.00	1.12	0.00
13:00	4/14/94	SSW	25.6	19.44	17.22	12.22	68%	74.57	0.00	1.12	0.00
13:30	4/14/94	SW	16	22.78	17.78	13.33	67%	74.57	0.00	1.12	0.00
14:00	4/14/94	WSW	25.6	20.00	18.33	13.89	61%	74.63	0.00	1.12	0.00
14:30	4/14/94	WSW	17.6	21.67	18.89	14.44	59%	74.68	0.00	1.12	0.00
15:00	4/14/94	SW	22.4	19.44	19.44	14.44	59%	74.73	0.00	1.12	0.00
15:30	4/14/94	WSW	19.2	18.89	20.00	14.44	58%	74.73	0.00	1.12	0.00
16:00	4/14/94	WSW	19.2	18.33	20.56	13.89	60%	74.83	0.00	1.12	0.00
16:30	4/14/94	SW	22.4	16.67	20.56	13.89	62%	74.83	0.00	1.12	0.00
17:00	4/14/94	SW	19.2	15.00	20.56	13.89	64%	74.88	0.00	1.12	0.00
17:30	4/14/94	WSW	9.6	15.56	21.11	14.44	62%	74.88	0.00	1.12	0.00
18:00	4/14/94	SW	12.8	11.67	21.11	13.89	65%	74.93	0.00	1.12	0.00
18:30	4/14/94	WSW	11.2	10.00	20.56	12.22	71%	74.98	0.00	1.12	0.00
19:00	4/14/94	WSW	9.6	8.33	20.00	10.00	100%	75.03	0.00	1.12	0.00
19:30	4/14/94	WSW	11.2	6.67	19.44	8.89	100%	75.08	0.00	1.12	0.00
20:00	4/14/94	WSW	4.8	6.11	18.89	7.78	100%	75.08	0.00	1.12	0.00
20:30	4/14/94	WSW	1.6	3.33	18.33	7.22	100%	75.08	0.00	1.12	0.00
21:00	4/14/94	NW	1.6	2.78	18.33	6.11	96%	75.08	0.00	1.12	0.00
21:30	4/14/94	NW	1.6	1.11	17.78	4.44	98%	75.08	0.00	1.12	0.00
22:00	4/14/94	S	0	0.00	17.22	2.78	99%	75.08	0.00	1.12	0.00
22:30	4/14/94	W	0	0.00	17.22	1.67	100%	75.08	0.00	1.12	0.00
23:00	4/14/94	SSW	0	-1.11	16.67	1.11	100%	75.08	0.00	1.12	0.00
23:30	4/14/94	SE	1.6	-0.56	16.67	1.11	100%	75.08	0.00	1.12	0.00
Min	4/15/94	WSW	0	-1.11	8.33	-2.22	57%	74.22	0.00	1.12	0.00
Max	4/15/94	SW	41.6	22.78	21.11	15.00	100%	75.13	0.00	1.12	0.00
0:30	4/15/94	SSE	4.8	1.67	15.56	1.67	100%	75.03	0.00	1.12	0.00
1:00	4/15/94	SE	1.6	0.56	15.56	1.67	100%	74.93	0.00	1.12	0.00
1:30	4/15/94	ESE	6.4	1.67	15.00	2.22	100%	74.88	0.00	1.12	0.00
2:00	4/15/94	SE	6.4	3.33	15.00	3.33	100%	74.88	0.00	1.12	0.00
2:30	4/15/94	ESE	6.4	2.22	15.00	3.89	100%	74.83	0.00	1.12	0.00
3:00	4/15/94	SE	3.2	2.22	14.44	3.89	100%	74.78	0.00	1.12	0.00
3:30	4/15/94	ESE	6.4	2.78	14.44	3.89	100%	74.78	0.00	1.12	0.00
4:00	4/15/94	ENE	9.6	2.78	14.44	3.33	100%	74.68	0.00	1.12	0.00
4:30	4/15/94	E	8	2.22	13.89	3.33	100%	74.63	0.00	1.12	0.00
5:00	4/15/94	ESE	6.4	2.78	13.89	3.33	100%	74.63	0.00	1.12	0.00
5:30	4/15/94	SE	8	2.78	13.33	3.33	100%	74.63	0.00	1.12	0.00
6:00	4/15/94	SE	12.8	2.22	13.33	3.33	100%	74.68	0.05	1.17	0.10
6:30	4/15/94	SE	11.2	2.78	13.33	3.33	100%	74.63	0.46	1.57	0.81
7:00	4/15/94	ESE	9.6	3.89	13.33	3.89	100%	74.42	0.61	1.73	0.30
7:30	4/15/94	ENE	11.2	5.00	15.56	4.44	100%	74.32	0.61	1.73	0.00
8:00	4/15/94	ESE	12.8	5.00	15.00	5.56	100%	74.27	0.76	1.88	0.30
8:30	4/15/94	ESE	12.8	5.56	13.89	6.11	100%	74.27	0.81	1.93	0.10
9:00	4/15/94	SE	16	5.56	13.89	6.67	100%	74.27	0.81	1.93	0.00
9:30	4/15/94	SE	22.4	6.11	13.89	6.67	100%	74.22	0.86	1.98	0.10
10:00	4/15/94	ESE	12.8	7.22	13.89	7.22	100%	74.12	0.86	1.98	0.00
10:30	4/15/94	SE	16	5.56	13.89	6.67	100%	74.07	0.86	1.98	0.00
11:00	4/15/94	SE	16	7.22	13.89	7.22	100%	73.96	0.86	1.98	0.00
11:30	4/15/94	SSE	17.6	9.44	14.44	9.44	100%	73.96	0.86	1.98	0.00
12:00	4/15/94	SE	17.6	7.22	13.89	8.89	100%	73.96	0.86	1.98	0.00
12:30	4/15/94	SE	9.6	8.33	13.89	8.33	100%	73.91	0.86	1.98	0.00
13:00	4/15/94	SE	11.2	9.44	14.44	10.00	94%	73.86	0.86	1.98	0.00
13:30	4/15/94	E	12.8	8.33	14.44	8.89	97%	73.86	0.86	1.98	0.00
14:00	4/15/94	SE	12.8	11.67	15.00	10.56	93%	73.81	0.86	1.98	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
14:30	4/15/94	SE	9.6	8.33	14.44	9.44	99%	73.86	0.86	1.98	0.00
15:00	4/15/94	SE	11.2	7.22	14.44	8.33	100%	73.76	0.86	1.98	0.00
15:30	4/15/94	SE	16	7.22	13.89	8.33	100%	73.76	0.86	1.98	0.00
16:00	4/15/94	SSE	9.6	7.22	13.89	8.33	100%	73.76	0.86	1.98	0.00
16:30	4/15/94	SSE	16	8.89	14.44	9.44	100%	73.71	0.86	1.98	0.00
17:00	4/15/94	SSE	11.2	11.11	15.00	10.56	99%	73.71	0.86	1.98	0.00
17:30	4/15/94	SSW	19.2	11.67	15.00	11.67	86%	73.66	0.86	1.98	0.00
18:00	4/15/94	SW	32	12.22	15.56	12.22	75%	73.66	0.86	1.98	0.00
18:30	4/15/94	SW	30.4	10.00	15.56	11.67	75%	73.61	0.86	1.98	0.00
19:00	4/15/94	SW	30.4	8.33	15.00	10.00	84%	73.61	0.86	1.98	0.00
19:30	4/15/94	SW	41.6	7.22	14.44	8.33	88%	73.66	0.86	1.98	0.00
20:00	4/15/94	SW	36.8	6.67	14.44	7.78	87%	73.66	0.86	1.98	0.00
20:30	4/15/94	SW	28.8	5.56	13.89	6.67	86%	73.66	0.86	1.98	0.00
21:00	4/15/94	SW	41.6	5.00	13.33	6.11	90%	73.66	0.86	1.98	0.00
21:30	4/15/94	SW	28.8	4.44	13.33	5.00	92%	73.61	0.86	1.98	0.00
22:00	4/15/94	SSW	30.4	4.44	13.33	5.00	91%	73.51	0.86	1.98	0.00
22:30	4/15/94	SW	43.2	2.22	12.78	3.33	100%	73.51	0.91	2.03	0.10
23:00	4/15/94	S	16	2.22	12.78	2.78	100%	73.41	0.94	2.06	0.05
23:30	4/15/94	SSW	27.2	1.67	12.78	2.78	100%	73.36	0.94	2.06	0.00
Min	4/15/94	S	0	0.56	12.78	1.11	73%	72.90	0.00	2.06	0.00
Max	4/15/94	SSW	64	12.78	17.22	12.78	100%	75.03	0.00	2.06	0.81
0:30	4/16/94	SSW	27.2	0.56	12.22	1.11	100%	73.30	0.00	2.06	0.00
1:00	4/16/94	SSW	20.8	0.56	12.78	1.11	100%	73.30	0.03	2.08	0.05
1:30	4/16/94	SW	30.4	0.00	11.67	0.56	100%	73.30	0.05	2.11	0.05
2:00	4/16/94	SW	27.2	0.00	11.11	0.56	100%	73.25	0.08	2.13	0.05
2:30	4/16/94	SW	36.8	0.00	11.11	0.00	100%	73.25	0.08	2.13	0.00
3:00	4/16/94	SW	24	-0.56	10.56	0.00	100%	73.25	0.08	2.13	0.00
3:30	4/16/94	WSW	17.6	-1.11	10.56	0.00	100%	73.36	0.10	2.16	0.05
4:00	4/16/94	W	17.6	-1.67	10.56	-1.11	100%	73.41	0.10	2.16	0.00
4:30	4/16/94	WSW	20.8	-2.78	10.00	-2.22	100%	73.46	0.10	2.16	0.00
5:00	4/16/94	WSW	19.2	-2.78	10.00	-2.78	100%	73.46	0.10	2.16	0.00
5:30	4/16/94	WSW	11.2	-3.33	9.44	-2.78	100%	73.51	0.10	2.16	0.00
6:00	4/16/94	WSW	14.4	-3.89	9.44	-3.33	96%	73.51	0.10	2.16	0.00
6:30	4/16/94	WNW	11.2	-3.33	9.44	-3.33	96%	73.56	0.10	2.16	0.00
7:00	4/16/94	WNW	12.8	-3.33	9.44	-3.33	94%	73.56	0.10	2.16	0.00
7:30	4/16/94	WSW	9.6	-3.33	15.56	-3.33	97%	73.66	0.10	2.16	0.00
8:00	4/16/94	WNW	11.2	-2.78	11.67	-3.89	97%	73.76	0.10	2.16	0.00
8:30	4/16/94	WSW	12.8	-3.33	11.11	-3.89	97%	73.76	0.10	2.16	0.00
8:00	4/16/94	WNW	9.6	-2.78	10.56	-3.89	98%	73.76	0.10	2.16	0.00
9:30	4/16/94	WNW	8	-2.22	10.56	-3.89	98%	73.81	0.10	2.16	0.00
10:00	4/16/94	NW	9.6	-2.22	10.00	-3.33	89%	73.86	0.10	2.16	0.00
10:30	4/16/94	WNW	11.2	-1.11	10.56	-2.22	84%	73.86	0.10	2.16	0.00
11:00	4/16/94	WNW	8	-1.67	10.00	-2.78	86%	73.91	0.10	2.16	0.00
11:30	4/16/94	NW	8	-1.67	10.00	-2.22	80%	73.96	0.10	2.16	0.00
12:00	4/16/94	WNW	14.4	-1.67	10.00	-2.22	78%	73.96	0.10	2.16	0.00
12:30	4/16/94	NW	11.2	0.00	15.00	0.00	74%	74.02	0.10	2.16	0.00
13:00	4/16/94	WSW	14.4	0.00	12.22	0.56	78%	74.12	0.10	2.16	0.00
13:30	4/16/94	NW	14.4	0.56	12.22	1.11	78%	74.12	0.10	2.16	0.00
14:00	4/16/94	WNW	12.8	-0.56	12.22	0.00	79%	74.17	0.10	2.16	0.00
14:30	4/16/94	NW	11.2	-0.56	12.22	0.00	90%	74.22	0.10	2.16	0.00
15:00	4/16/94	NW	6.4	-1.11	12.22	0.56	93%	74.22	0.10	2.16	0.00
15:30	4/16/94	NW	11.2	-1.11	12.22	0.00	100%	74.27	0.10	2.16	0.00
16:00	4/16/94	WNW	14.4	-1.11	12.78	-0.56	100%	74.32	0.10	2.16	0.00
16:30	4/16/94	WNW	17.6	-1.11	12.22	0.00	99%	74.37	0.13	2.18	0.05

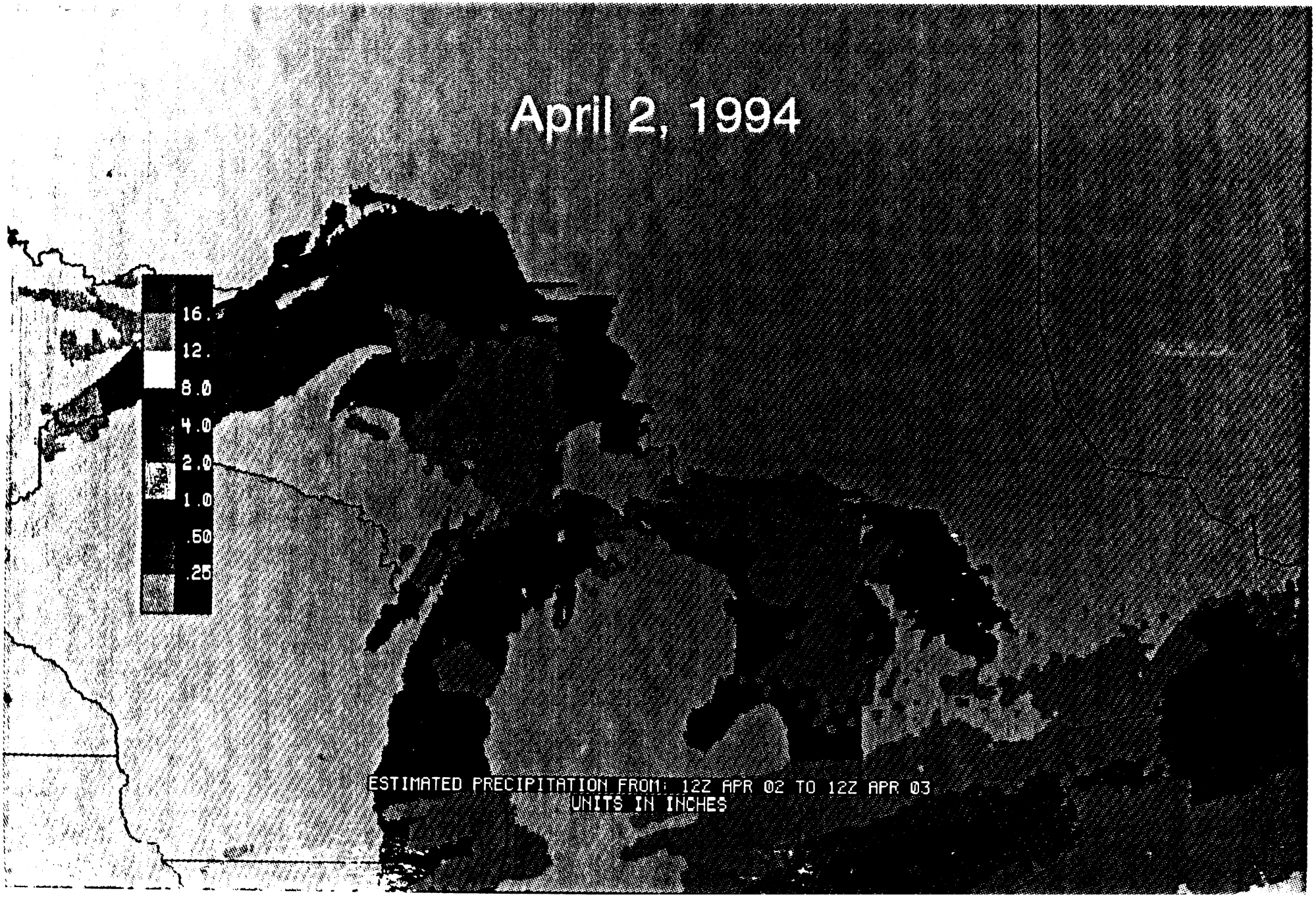
Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
17:00	4/16/94	NW	17.6	-1.11	12.78	0.00	98%	74.42	0.13	2.18	0.00
17:30	4/16/94	NW	20.8	-1.11	12.22	0.00	97%	74.47	0.13	2.18	0.00
18:00	4/16/94	WNW	11.2	-1.11	12.22	0.56	99%	74.52	0.13	2.18	0.00
18:30	4/16/94	WNW	16	-1.11	12.22	0.00	100%	74.52	0.13	2.18	0.00
19:00	4/16/94	WNW	16	-1.11	12.22	0.00	99%	74.57	0.13	2.18	0.00
19:30	4/16/94	WSW	11.2	-1.11	12.22	0.00	99%	74.63	0.13	2.18	0.00
20:00	4/16/94	NW	19.2	-1.11	12.22	0.00	96%	74.63	0.13	2.18	0.00
20:30	4/16/94	NW	11.2	-1.11	12.22	0.00	91%	74.68	0.13	2.18	0.00
21:00	4/16/94	NW	11.2	-1.11	12.22	0.56	86%	74.63	0.13	2.18	0.00
21:30	4/16/94	NW	14.4	-1.11	12.22	1.11	81%	74.63	0.13	2.18	0.00
22:00	4/16/94	NW	16	-1.11	12.22	1.11	73%	74.68	0.13	2.18	0.00
22:30	4/16/94	WNW	20.8	-1.11	12.22	1.11	72%	74.63	0.13	2.18	0.00
23:00	4/16/94	NW	22.4	-1.11	12.22	1.11	69%	74.63	0.13	2.18	0.00
23:30	4/16/94	NW	12.8	-1.11	12.22	1.11	69%	74.63	0.13	2.18	0.00
Min	4/17/94	WNW	1.6	-3.89	8.89	-4.44	68%	73.25	0.00	2.18	0.00
Max	4/17/94	SSW	52.8	1.67	17.22	1.67	100%	74.68	0.00	2.18	0.00
0:30	4/17/94	NW	9.6	-1.11	12.22	0.56	71%	74.63	0.00	2.18	0.00
1:00	4/17/94	NW	17.6	-1.67	12.22	0.00	70%	74.63	0.00	2.18	0.00
1:30	4/17/94	NW	12.8	-1.67	12.78	0.00	69%	74.63	0.00	2.18	0.00
2:00	4/17/94	NW	12.8	-1.67	12.22	0.00	69%	74.63	0.00	2.18	0.00
2:30	4/17/94	NW	16	-1.67	12.78	0.00	68%	74.63	0.00	2.18	0.00
3:00	4/17/94	WNW	11.2	-1.67	12.78	-0.56	71%	74.68	0.00	2.18	0.00
3:30	4/17/94	NW	14.4	-1.67	12.78	-0.56	70%	74.68	0.00	2.18	0.00
4:00	4/17/94	NW	14.4	-1.67	12.78	-0.56	71%	74.68	0.00	2.18	0.00
4:30	4/17/94	WNW	11.2	-1.67	12.78	-0.56	70%	74.68	0.00	2.18	0.00
5:00	4/17/94	NW	14.4	-1.67	12.78	-1.11	72%	74.73	0.00	2.18	0.00
5:30	4/17/94	NW	11.2	-2.22	12.22	-1.11	72%	74.73	0.00	2.18	0.00
6:00	4/17/94	NW	11.2	-1.67	12.22	-1.11	71%	74.73	0.00	2.18	0.00
6:30	4/17/94	NW	11.2	-1.67	12.22	-0.56	67%	74.78	0.00	2.18	0.00
7:00	4/17/94	NW	14.4	-1.11	12.22	0.56	60%	74.78	0.00	2.18	0.00
7:30	4/17/94	WNW	16	-1.11	12.78	1.67	58%	74.83	0.00	2.18	0.00
8:00	4/17/94	NW	16	-0.56	13.33	2.78	54%	74.83	0.00	2.18	0.00
8:30	4/17/94	NNW	22.4	-0.56	13.89	3.33	51%	74.88	0.00	2.18	0.10
9:00	4/17/94	NW	14.4	1.11	13.89	3.89	49%	74.88	0.05	2.18	0.00
9:30	4/17/94	WNW	14.4	5.00	15.00	4.44	49%	74.93	0.20	2.24	0.30
10:00	4/17/94	NW	16	13.89	15.56	5.00	50%	74.98	0.36	2.39	0.00
10:30	4/17/94	WNW	20.8	15.00	16.11	4.44	51%	75.03	0.36	2.54	0.00
11:30	4/17/94	WNW	11.2	15.56	16.11	4.44	51%	75.08	0.36	2.54	0.00
11:30	4/17/94	NW	16	17.22	16.11	4.44	52%	75.13	0.36	2.54	0.00
12:00	4/17/94	WNW	17.6	17.22	16.11	5.00	52%	75.13	0.36	2.54	0.00
12:30	4/17/94	WNW	20.8	17.78	16.11	5.00	49%	75.18	0.36	2.54	0.00
13:00	4/17/94	NW	16	16.67	16.67	5.56	45%	75.23	0.36	2.54	0.00
13:30	4/17/94	WNW	17.6	16.11	16.67	5.56	42%	75.29	0.36	2.54	0.00
14:00	4/17/94	NNW	19.2	16.67	16.67	5.56	38%	75.29	0.36	2.54	0.00
14:30	4/17/94	NNW	22.4	15.00	17.22	6.11	37%	75.29	0.36	2.54	0.00
15:00	4/17/94	NNW	22.4	15.00	17.22	6.67	35%	75.34	0.36	2.54	0.00
15:30	4/17/94	WNW	12.8	15.00	17.78	6.11	36%	75.34	0.36	2.54	0.00
16:00	4/17/94	NW	6.4	15.56	17.78	7.22	39%	75.34	0.36	2.54	0.00
16:30	4/17/94	WNW	19.2	12.22	17.78	7.22	36%	75.39	0.36	2.54	0.00
17:00	4/17/94	NW	11.2	12.22	17.78	7.78	35%	75.39	0.36	2.54	0.00
17:30	4/17/94	NW	17.6	9.44	18.33	8.89	35%	75.44	0.36	2.54	0.00
18:00	4/17/94	NW	14.4	6.11	18.33	8.89	34%	75.44	0.36	2.54	0.00
18:30	4/17/94	WNW	11.2	3.89	18.33	8.33	36%	75.44	0.36	2.54	0.00
19:00	4/17/94	WNW	9.6	2.78	17.22	5.56	42%	75.44	0.36	2.54	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
19:30	4/17/94	NW	12.8	2.22	16.67	4.44	45%	75.44	0.36	2.54	0.00
20:00	4/17/94	NW	14.4	1.67	16.11	4.44	45%	75.44	0.36	2.54	0.00
20:30	4/17/94	WNW	11.2	1.11	15.56	3.89	48%	75.44	0.36	2.54	0.00
21:00	4/17/94	WNW	4.8	1.11	15.00	3.33	49%	75.44	0.36	2.54	0.00
21:30	4/17/94	W	4.8	-0.56	14.44	2.78	51%	75.44	0.36	2.54	0.00
22:00	4/17/94	WSW	4.8	-0.56	13.89	2.78	54%	75.39	0.36	2.54	0.00
22:30	4/17/94	WNW	6.4	-0.56	13.33	2.22	56%	75.39	0.36	2.54	0.00
23:00	4/17/94	WNW	4.8	-0.56	12.78	2.22	56%	75.34	0.36	2.54	0.00
23:30	4/17/94	W	6.4	-0.56	12.78	1.67	57%	75.34	0.36	2.54	0.00
Min	4/18/94	SSE	0	-2.22	10.56	-1.67	33%	74.57	0.00	2.54	0.00
Max	4/18/94	NW	48	20.56	18.89	9.44	72%	75.44	0.00	2.54	0.30
0:30	4/18/94	WSW	3.2	-1.67	11.67	0.56	62%	75.34	0.00	2.54	0.00
1:00	4/18/94	WSW	3.2	-3.33	11.11	-0.56	68%	75.34	0.00	2.54	0.00
1:30	4/18/94	WSW	1.6	-3.89	11.11	-1.67	73%	75.29	0.00	2.54	0.00
2:00	4/18/94	WSW	1.6	-3.89	10.56	-2.22	75%	75.29	0.00	2.54	0.00
2:30	4/18/94	WSW	0	-4.44	10.00	-2.78	81%	75.29	0.00	2.54	0.00
3:00	4/18/94	WSW	1.6	-4.44	10.00	-3.33	84%	75.29	0.00	2.54	0.00
3:30	4/18/94	SW	0	-4.44	9.44	-3.89	86%	75.29	0.00	2.54	0.00
4:00	4/18/94	SW	1.6	-5.00	8.89	-4.44	89%	75.29	0.00	2.54	0.00
4:30	4/18/94	SW	0	-5.56	8.89	-5.00	96%	75.23	0.00	2.54	0.00
5:00	4/18/94	SW	0	-5.56	8.33	-5.00	95%	75.23	0.00	2.54	0.00
5:30	4/18/94	WSW	0	-5.56	8.33	-5.00	99%	75.18	0.00	2.54	0.00
6:00	4/18/94	WSW	3.2	-5.00	7.78	-5.00	95%	75.18	0.00	2.54	0.00
6:30	4/18/94	WSW	4.8	-2.78	7.78	-3.33	83%	75.18	0.00	2.54	0.00
7:00	4/18/94	SW	9.6	3.33	7.78	0.56	65%	75.18	0.00	2.54	0.00
7:30	4/18/94	SSW	11.2	7.78	8.89	3.33	62%	75.13	0.00	2.54	0.00
8:00	4/18/94	S	6.4	7.22	12.22	5.00	58%	75.13	0.00	2.54	0.00
8:30	4/18/94	S	9.6	10.00	10.56	6.67	63%	75.18	0.00	2.54	0.00
9:00	4/18/94	S	8	13.89	12.22	8.33	60%	75.13	0.00	2.54	0.00
9:30	4/18/94	SSW	11.2	14.44	14.44	10.56	55%	75.13	0.00	2.54	0.00
10:00	4/18/94	SSW	17.6	16.67	14.44	11.67	52%	75.13	0.00	2.54	0.00
10:30	4/18/94	S	19.2	14.44	14.44	12.78	46%	75.08	0.00	2.54	0.00
11:00	4/18/94	SSW	16	15.56	14.44	13.33	48%	75.03	0.00	2.54	0.00
11:30	4/18/94	S	14.4	20.00	15.56	15.56	42%	74.98	0.00	2.54	0.00
12:00	4/18/94	SSW	35.2	17.78	16.11	15.00	41%	74.93	0.00	2.54	0.00
12:30	4/18/94	SSW	30.4	20.56	16.67	16.11	37%	74.88	0.00	2.54	0.00
13:00	4/18/94	SSW	28.8	17.78	16.67	16.11	32%	74.88	0.00	2.54	0.00
13:30	4/18/94	SSW	25.6	17.22	17.22	16.67	31%	74.83	0.00	2.54	0.00
14:00	4/18/94	S	14.4	14.44	16.67	15.56	33%	74.78	0.00	2.54	0.00
14:30	4/18/94	S	11.2	15.56	16.67	15.56	34%	74.68	0.00	2.54	0.00
15:00	4/18/94	SSW	17.6	16.67	16.67	16.11	34%	74.68	0.00	2.54	0.00
15:30	4/18/94	S	19.2	19.44	17.22	17.22	33%	74.57	0.00	2.54	0.00
16:00	4/18/94	SW	20.8	15.00	16.67	16.11	35%	74.57	0.00	2.54	0.00
16:30	4/18/94	S	11.2	15.00	16.67	16.11	36%	74.47	0.00	2.54	0.00
17:00	4/18/94	S	14.4	15.56	17.22	16.67	37%	74.47	0.00	2.54	0.00
17:30	4/18/94	SW	27.2	15.56	17.22	16.67	39%	74.42	0.00	2.54	0.00
18:00	4/18/94	WSW	14.4	12.22	17.22	14.44	47%	74.47	0.00	2.54	0.00
18:30	4/18/94	SW	20.8	11.11	16.67	12.78	62%	74.42	0.00	2.54	0.00
19:00	4/18/94	SW	16	10.56	16.67	11.67	68%	74.37	0.00	2.54	0.00
19:30	4/18/94	WSW	8	9.44	16.11	11.67	71%	74.37	0.00	2.54	0.00
20:00	4/18/94	WSW	12.8	10.00	16.11	11.11	73%	74.32	0.00	2.54	0.00
20:30	4/18/94	WSW	12.8	9.44	16.11	11.11	76%	74.32	0.00	2.54	0.00
21:00	4/18/94	WSW	9.6	7.22	15.56	9.44	81%	74.37	0.00	2.54	0.00
21:30	4/18/94	NNW	17.6	6.67	15.56	9.44	69%	74.47	0.00	2.54	0.00

Time	Date	Wind direction	Wind speed (kph)	Aux temp (°C)	Inside temp (°C)	Outside temp (°C)	Humidity (%)	Pressure (cm)	Daily rain (cm)	Monthly rain (cm)	Rainfall rate (cm)
22:00	4/18/94	NNW	12.8	5.56	15.00	7.78	81%	74.47	0.00	2.54	0.00
22:30	4/18/94	NW	16	4.44	14.44	6.11	96%	74.57	0.00	2.54	0.00
23:00	4/18/94	NNW	22.4	2.78	14.44	4.44	94%	74.63	0.00	2.54	0.00
23:30	4/18/94	NNW	17.6	2.22	13.89	3.89	93%	74.68	0.00	2.54	0.00
Min	4/19/94	WSW	0	-5.56	5.56	-7.22	25%	74.27	0.00	2.54	0.00
Max	4/19/94	SSW	54.4	22.22	17.22	17.78	99%	75.34	0.00	2.54	0.00
0:30	4/19/94	NNW	11.2	1.67	13.33	3.33	90%	74.68	0.00	2.54	0.00
1:00	4/19/94	NW	12.8	1.11	12.78	3.33	89%	74.73	0.00	2.54	0.00
1:30	4/19/94	NW	9.6	0.56	12.78	2.78	91%	74.78	0.00	2.54	0.00
2:00	4/19/94	NW	12.8	0.56	12.22	2.78	97%	74.78	0.00	2.54	0.00
2:30	4/19/94	NW	9.6	0.56	12.22	2.22	92%	74.83	0.00	2.54	0.00
3:00	4/19/94	NW	6.4	0.00	11.67	2.22	94%	74.83	0.00	2.54	0.00
3:30	4/19/94	NNW	16	0.00	11.67	2.22	100%	74.88	0.00	2.54	0.00
4:00	4/19/94	NNW	16	0.00	11.11	1.67	100%	74.88	0.00	2.54	0.00
4:30	4/19/94	NNW	9.6	-1.11	11.11	1.11	100%	74.93	0.00	2.54	0.00
5:00	4/19/94	NW	3.2	-1.67	11.11	0.56	100%	74.93	0.00	2.54	0.00
5:30	4/19/94	WNW	4.8	-2.22	10.56	0.00	100%	74.98	0.00	2.54	0.00
6:00	4/19/94	WNW	3.2	-2.22	10.56	-0.56	97%	74.98	0.00	2.54	0.00
6:30	4/19/94	W	4.8	-1.11	10.00	0.00	90%	75.03	0.00	2.54	0.00
7:00	4/19/94	WSW	3.2	4.44	10.00	2.22	77%	75.03	0.00	2.54	0.00
7:30	4/19/94	WSW	3.2	11.67	10.00	3.89	74%	75.03	0.00	2.54	0.00
8:00	4/19/94	WSW	8	13.89	10.00	5.00	69%	75.03	0.00	2.54	0.00
8:30	4/19/94	WSW	11.2	16.11	10.56	6.11	67%	75.03	0.00	2.54	0.00
9:00	4/19/94	WSW	14.4	15.00	10.56	7.78	64%	74.98	0.00	2.54	0.00
9:30	4/19/94	WSW	12.8	20.00	11.11	8.89	52%	74.98	0.00	2.54	0.00

APPENDIX H:
MICHIGAN DAILY PRECIPITATION MAPS

April 1, 1994
16.
12.
8.0
4.0
2.0
1.0
.50
.25
ESTIMATED PRECIPITATION FROM: 12Z APR 01 TO 12Z APR 02
UNITS IN INCHES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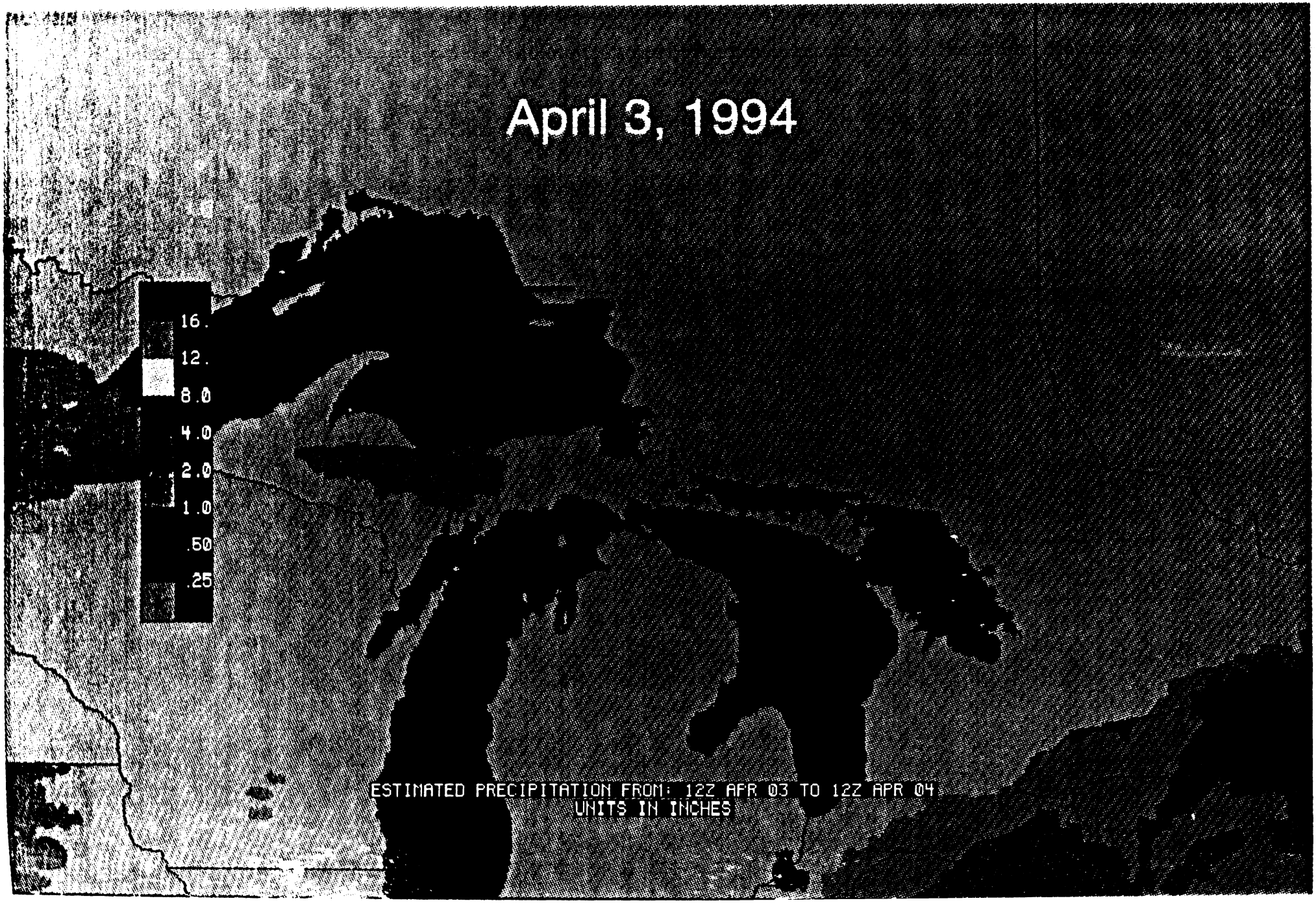
ESTIMATED PRECIPITATION FROM: 12Z APR 02 TO 12Z APR 03
UNITS IN INCHES

H2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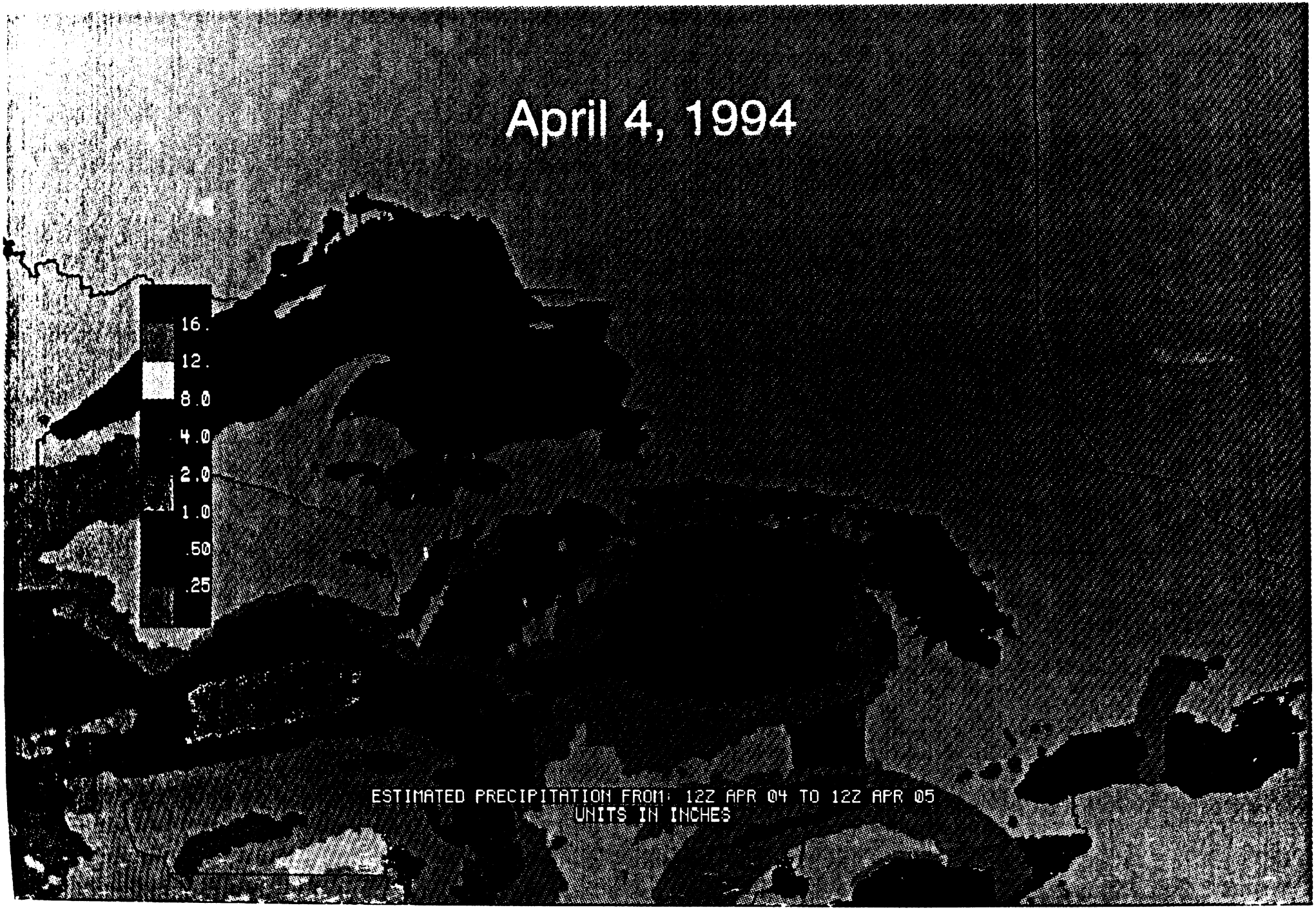
ESTIMATED PRECIPITATION FROM: 12Z APR 03 TO 12Z APR 04
UNITS IN INCHES

H3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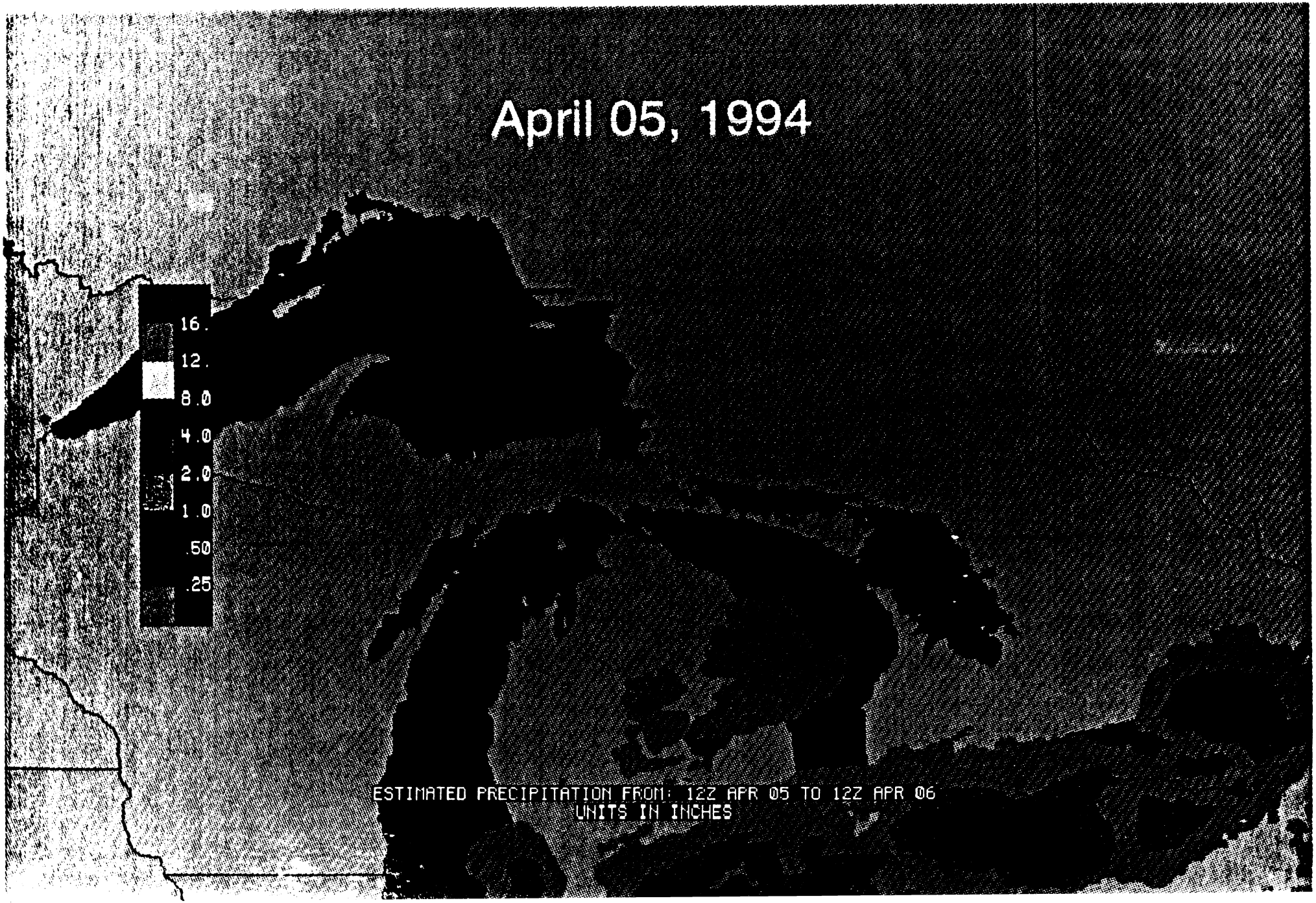
ESTIMATED PRECIPITATION FROM: 12Z APR 04 TO 12Z APR 05
UNITS IN INCHES

H4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1.0
.50
.25
ESTIMATED PRECIPITATION FROM: 12Z APR 05 TO 12Z APR 06
UNITS IN INCHES

H5

April 06, 1994
16.
12.
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2.0
1.0
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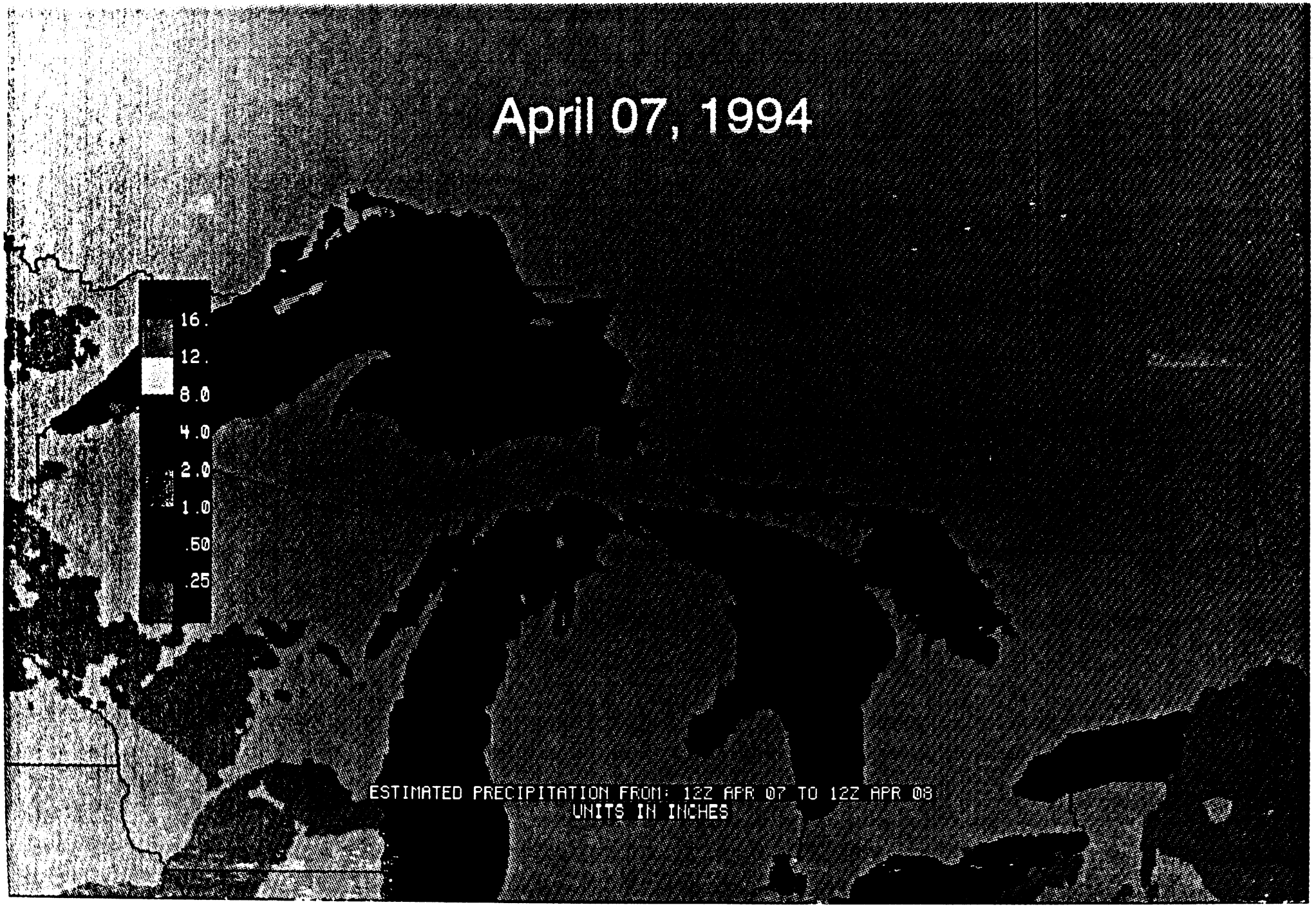
.25
ESTIMATED PRECIPITATION FROM: 12Z APR 06 TO 12Z APR 07
UNITS IN INCHES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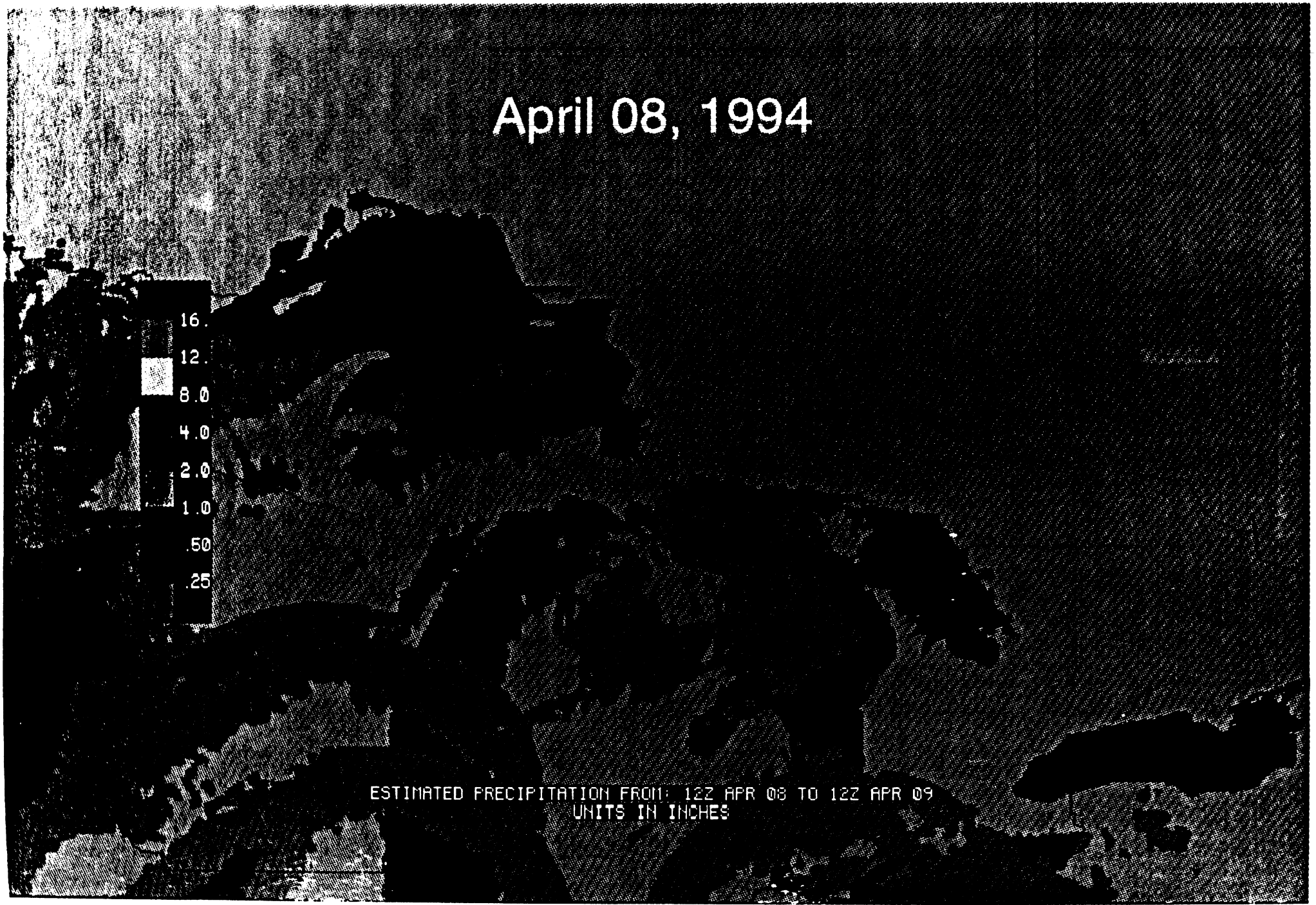
UNITS IN INCHES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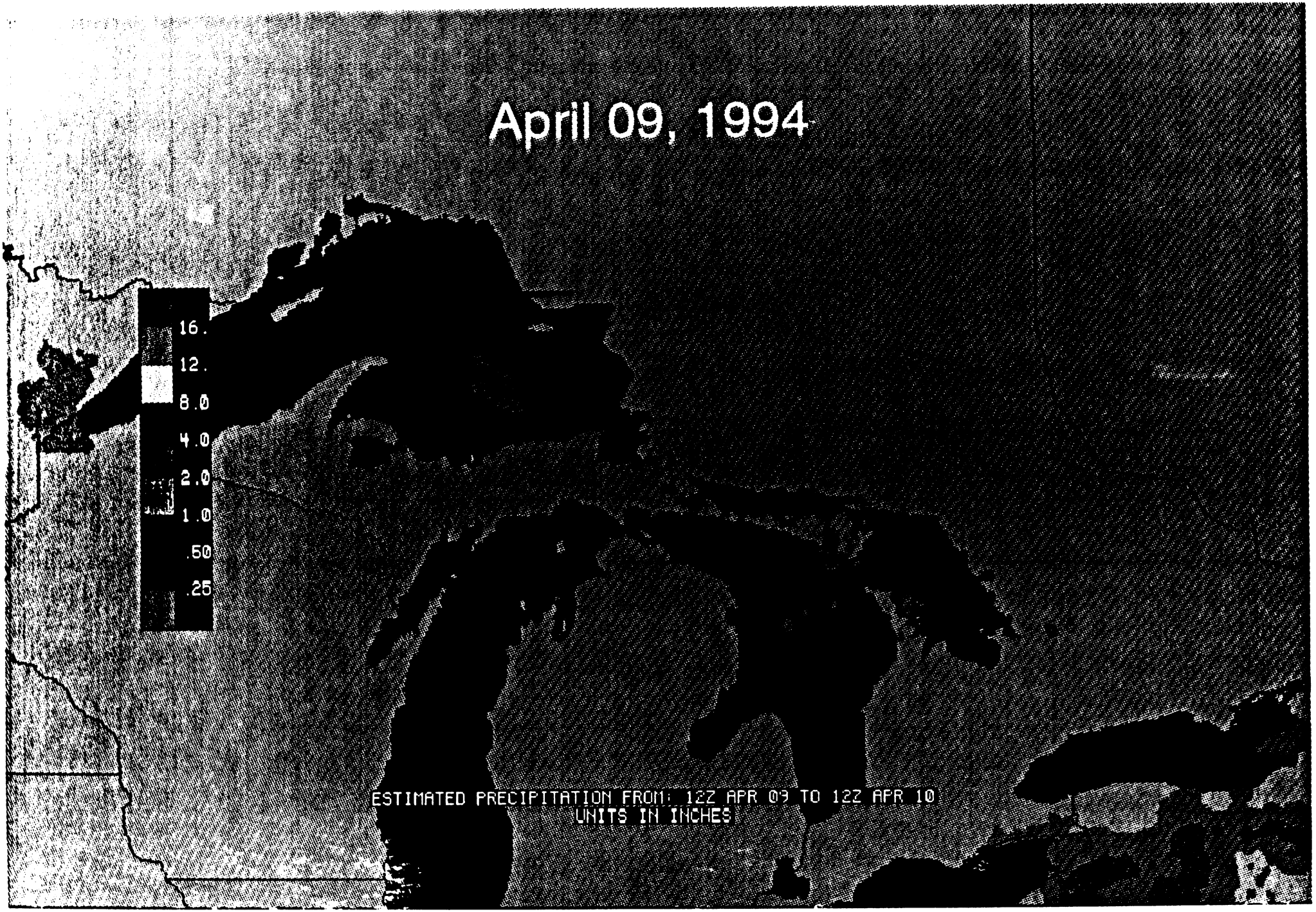
ESTIMATED PRECIPITATION FROM: 12Z APR 08 TO 12Z APR 09
UNITS IN INCHES

H8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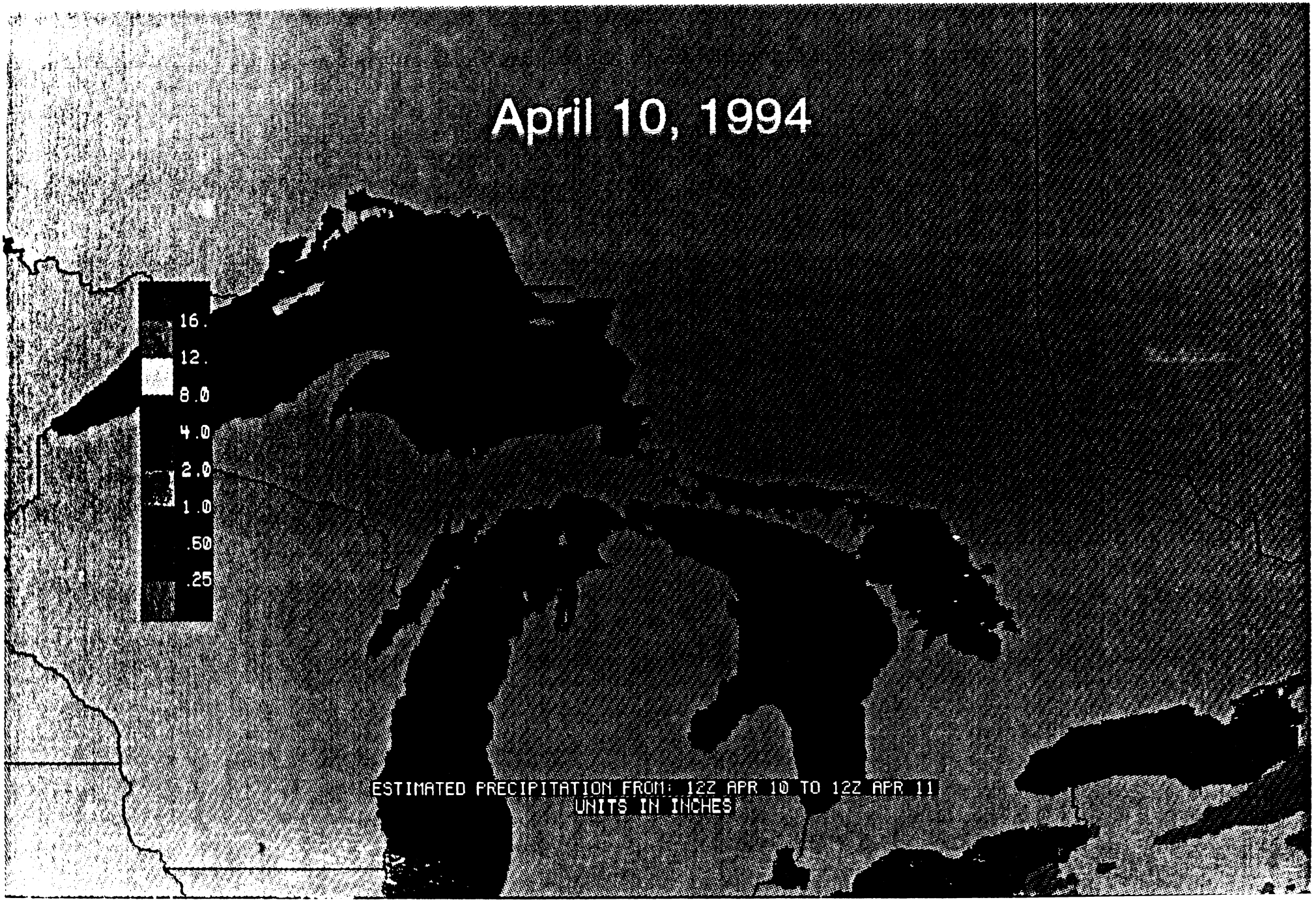
ESTIMATED PRECIPITATION FROM: 12Z APR 09 TO 12Z APR 10
UNITS IN INCHES

H9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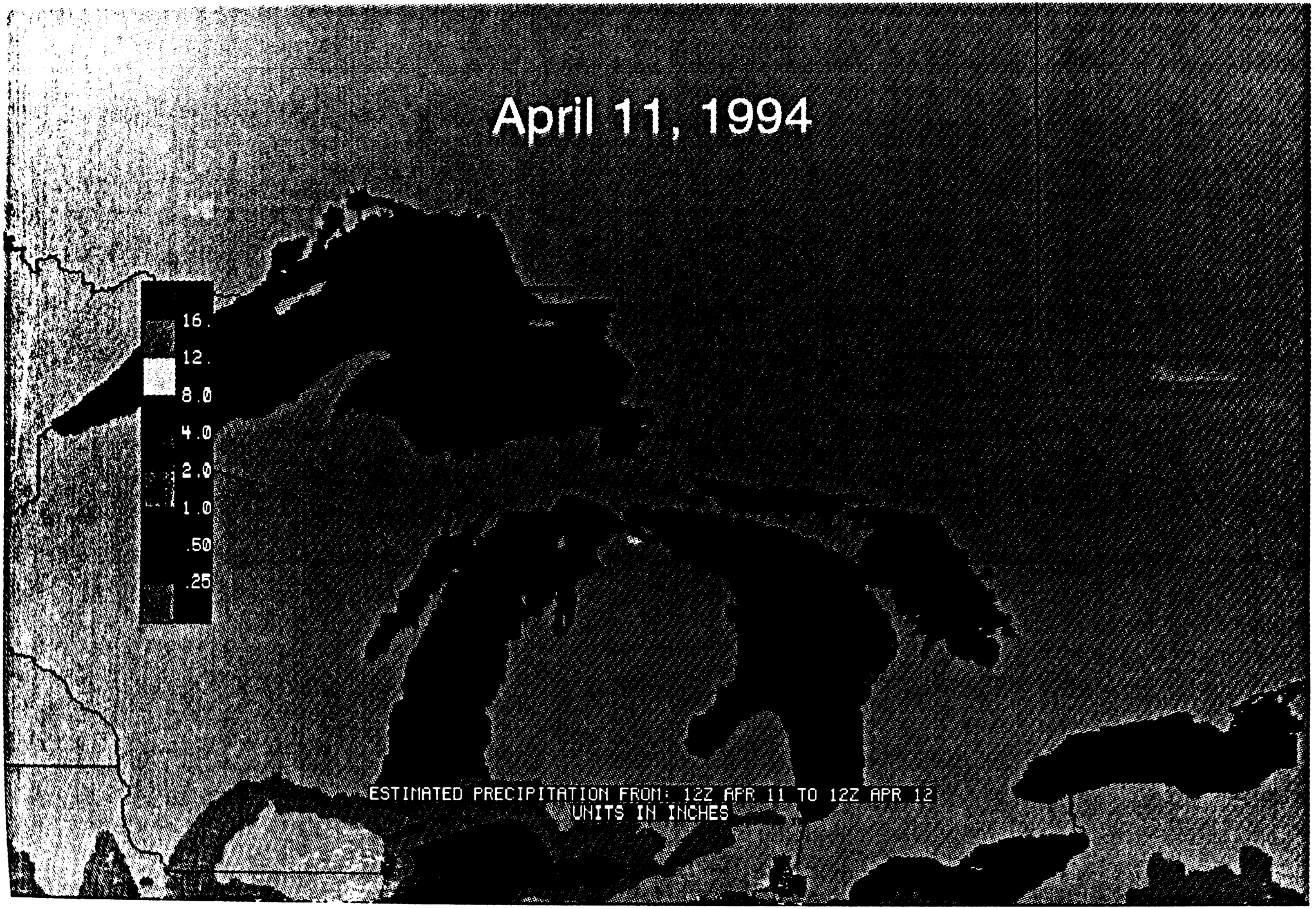
ESTIMATED PRECIPITATION FROM: 12Z APR 10 TO 12Z APR 11
UNITS IN INCHES

H10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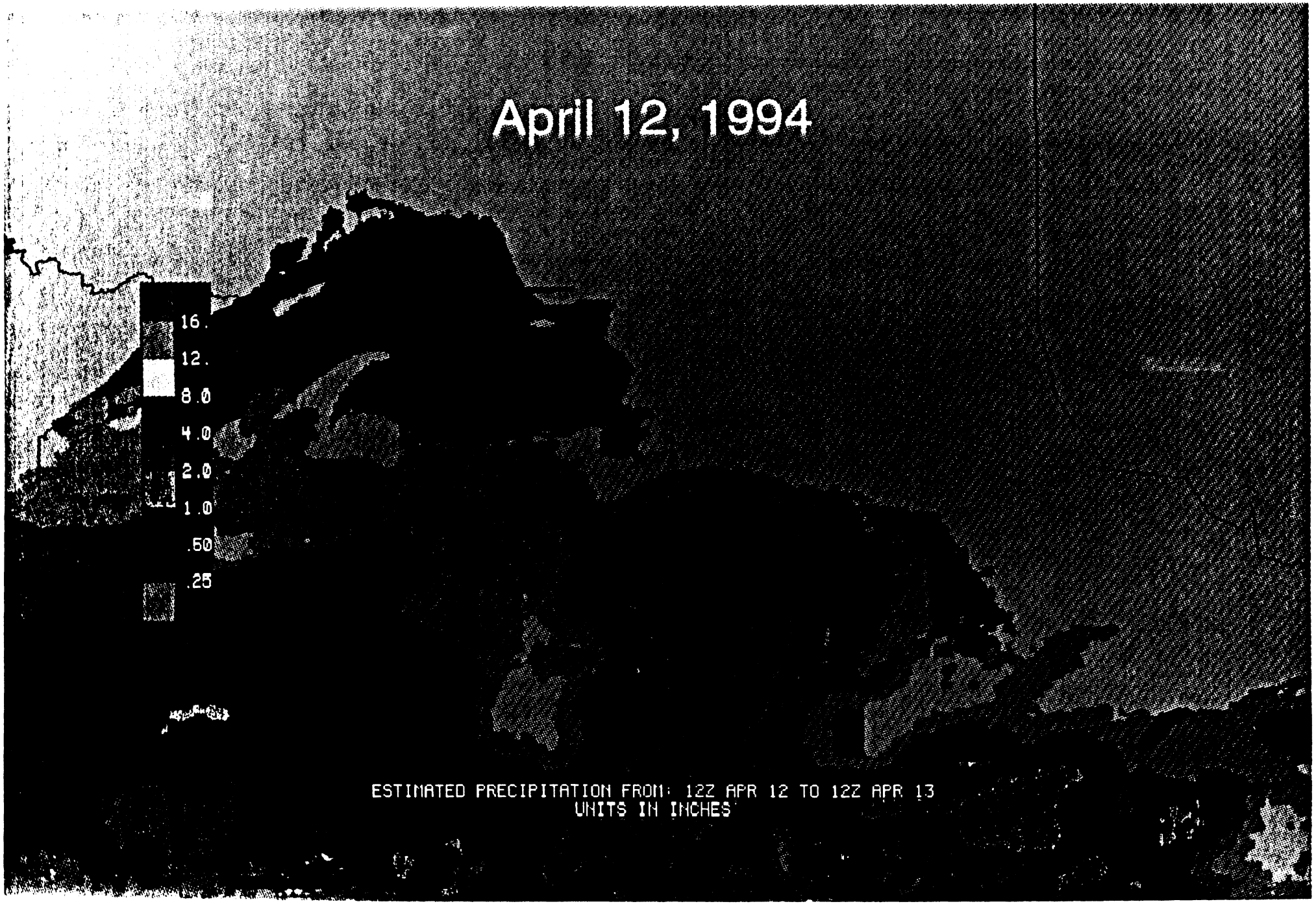
ESTIMATED PRECIPITATION FROM: 12Z APR 11 TO 12Z APR 12
UNITS IN INCHES

H11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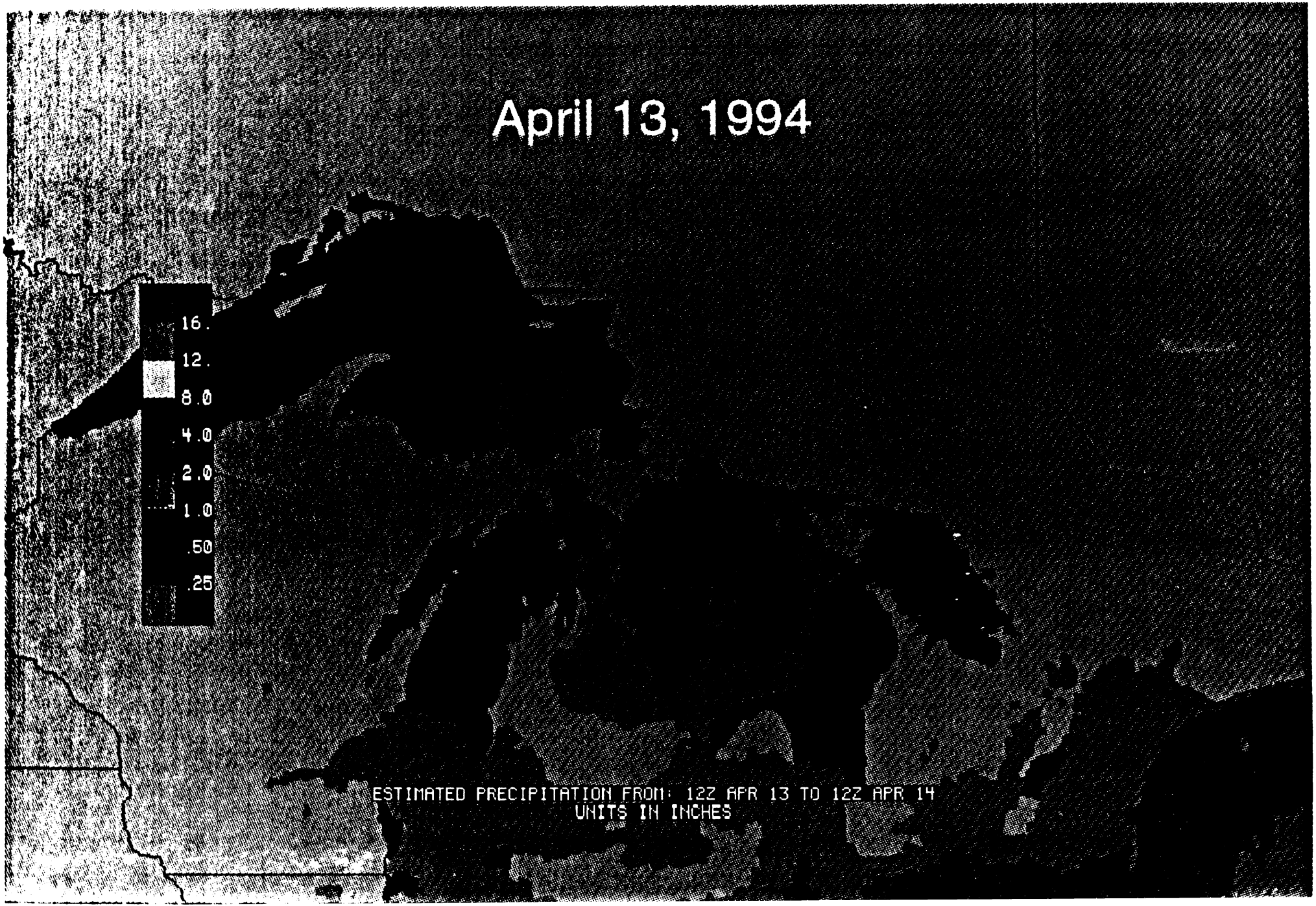
UNITS IN INCHES

H12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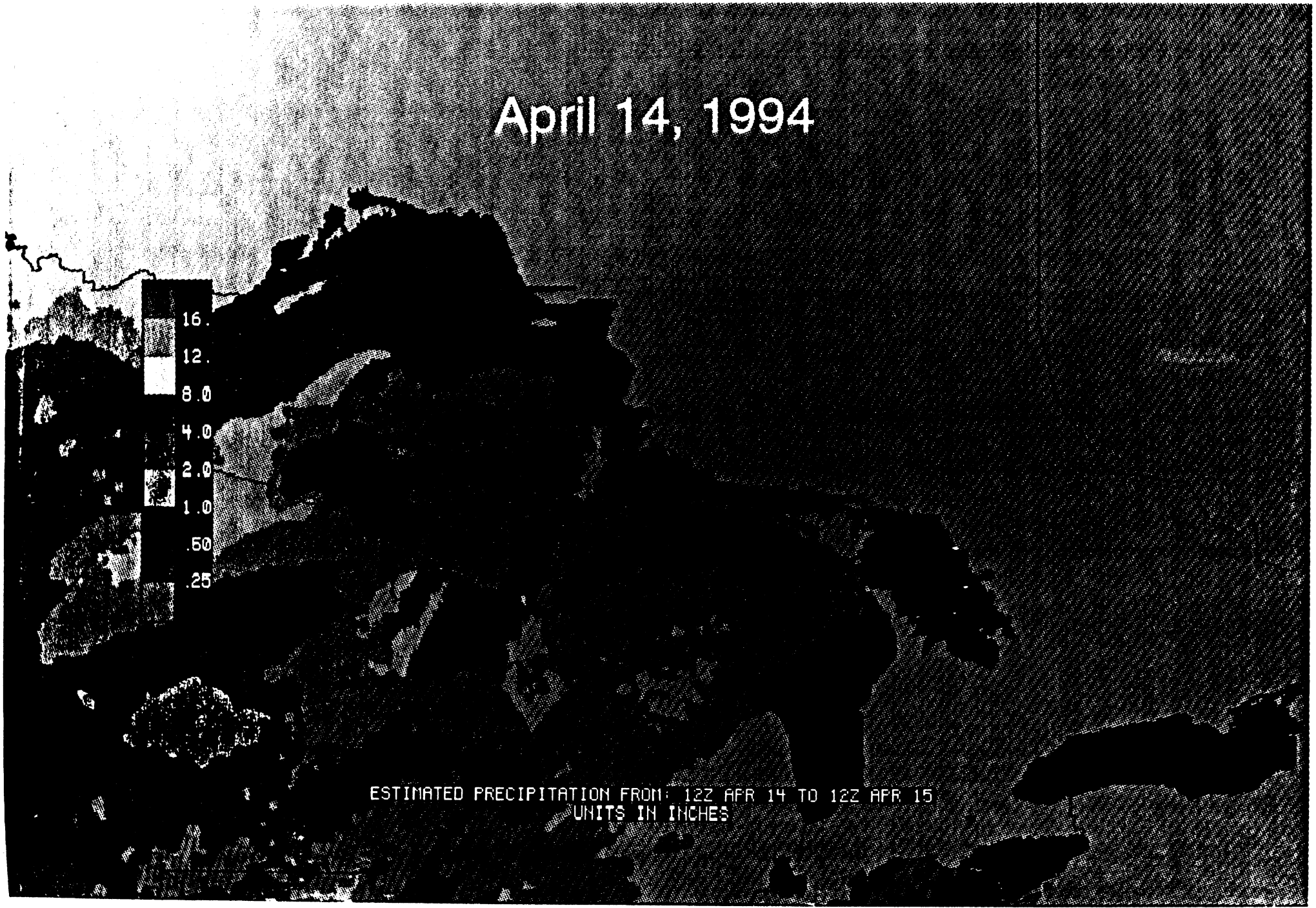
UNITS IN INCHES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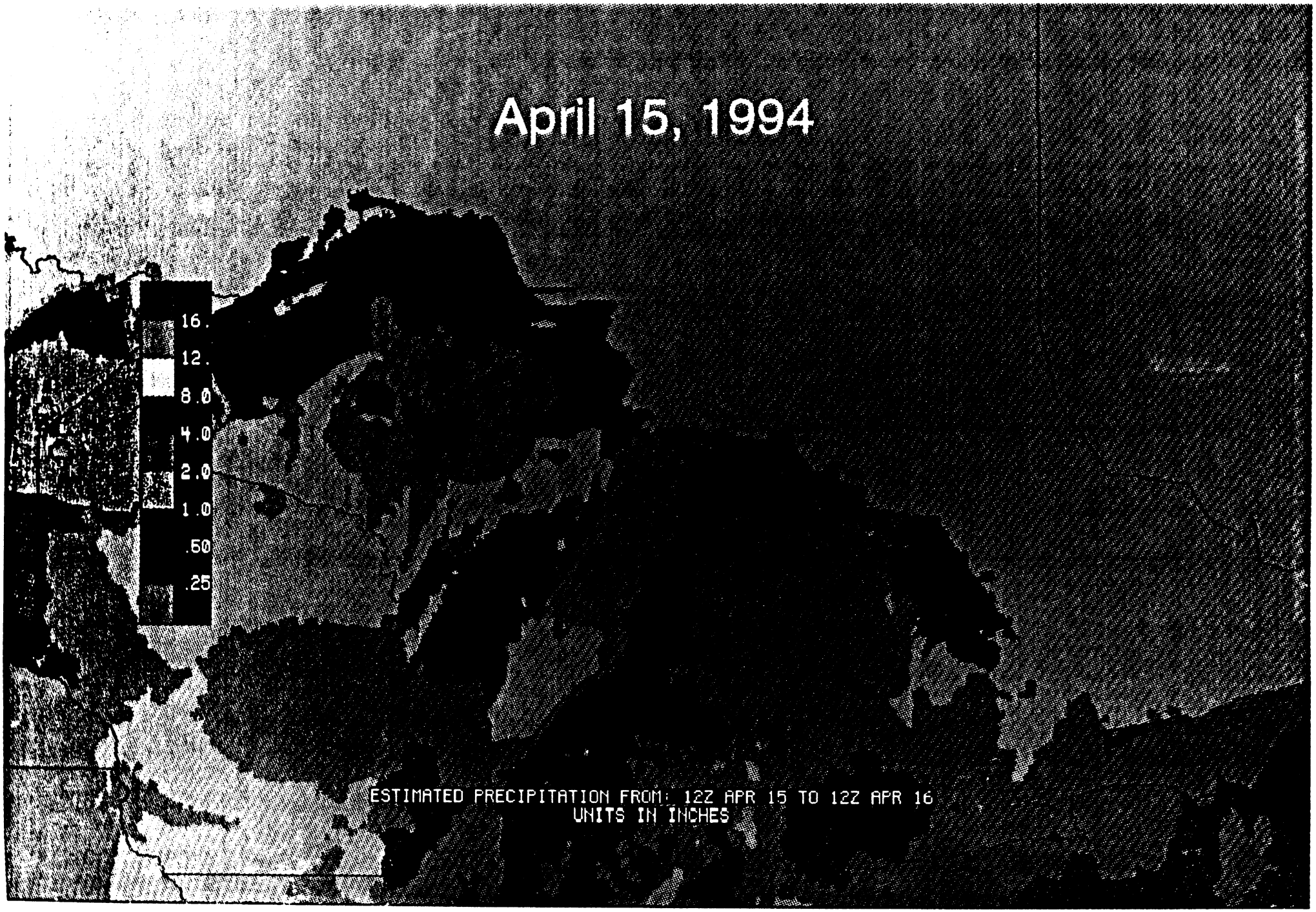
UNITS IN INCHES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ESTIMATED PRECIPITATION FROM: 12Z APR 15 TO 12Z APR 16
UNITS IN INCHES

H15

April 16, 1994
16.
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2.0
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.50
.25
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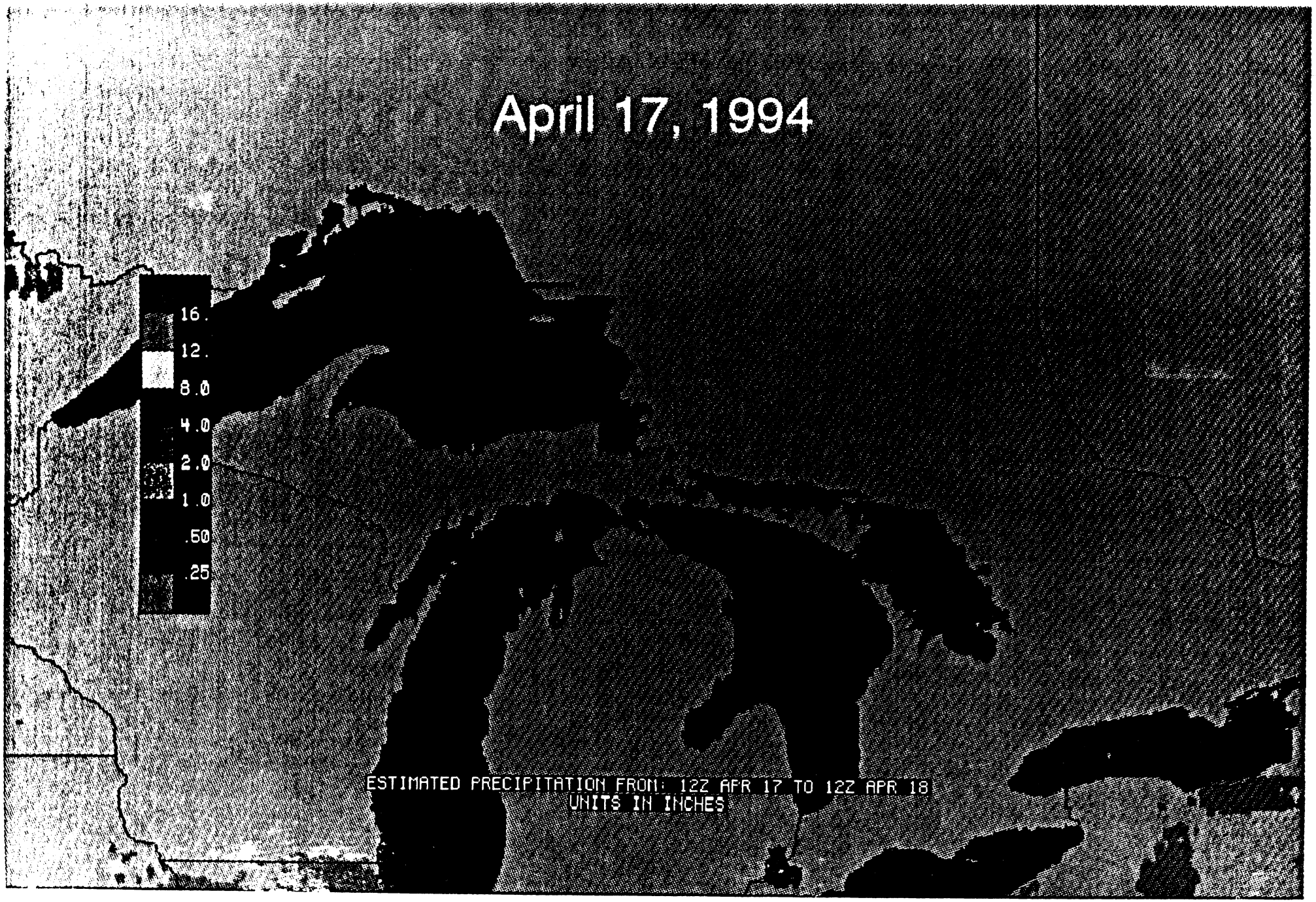
UNITS IN INCHES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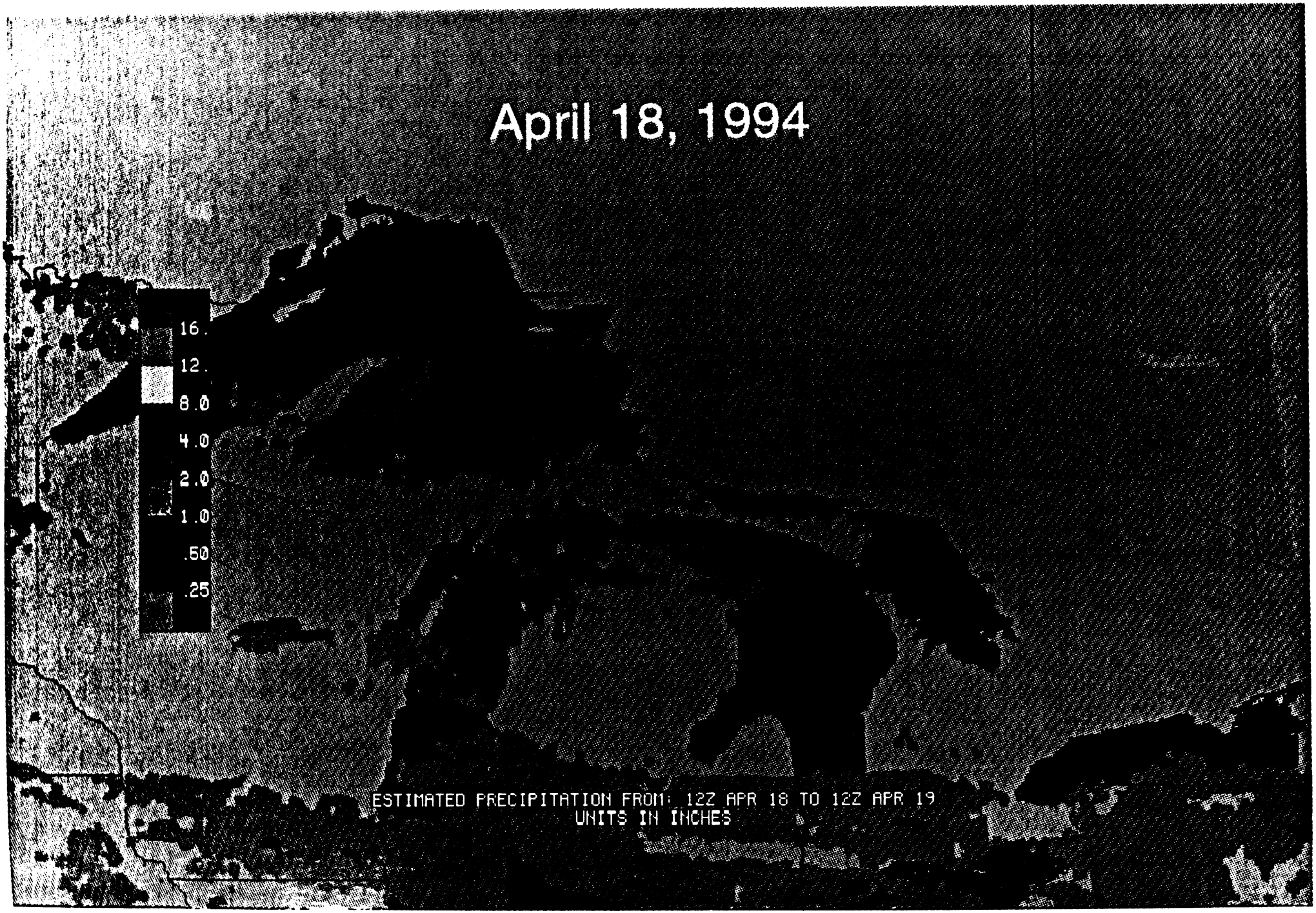
UNITS IN INCHES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1.0
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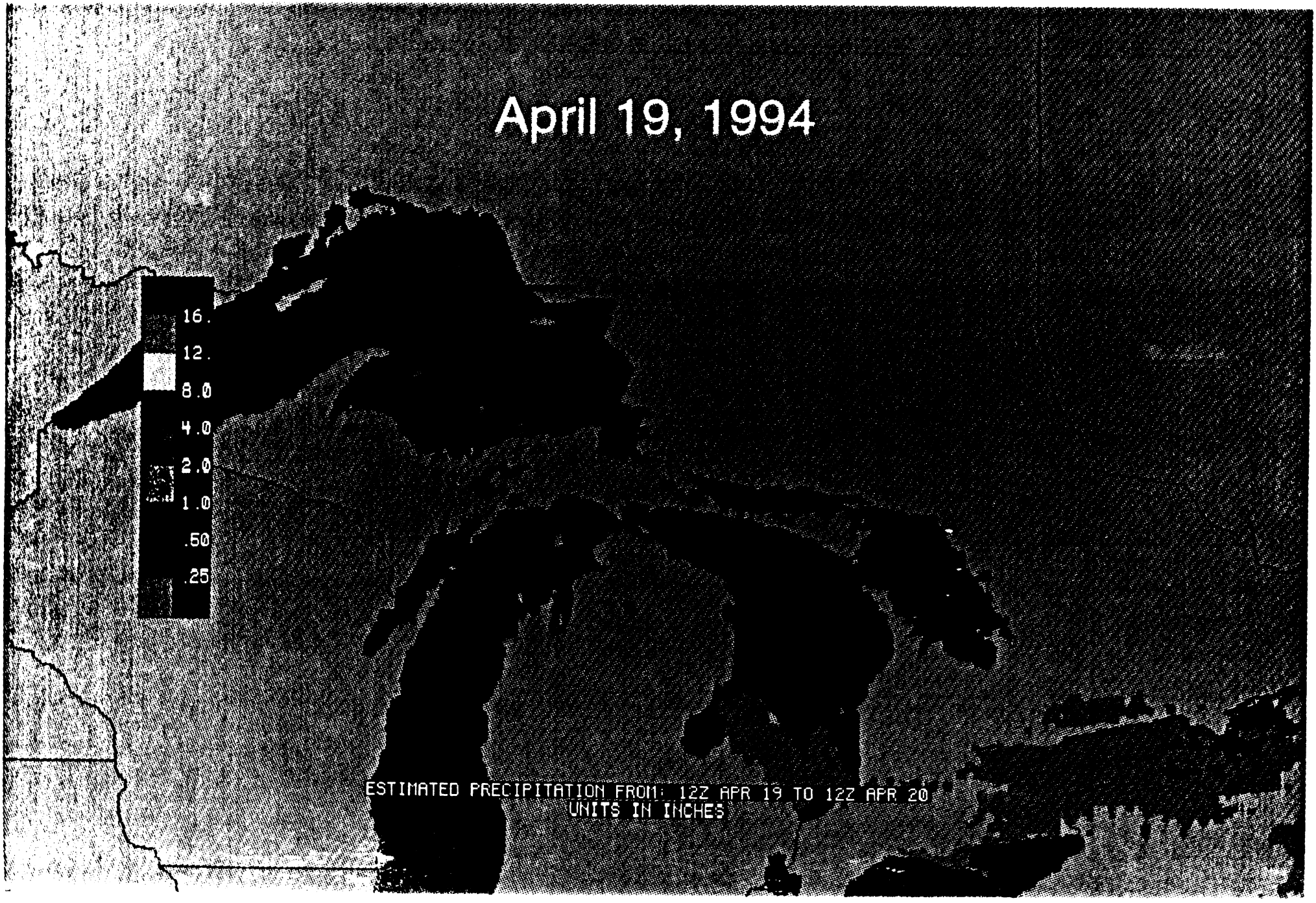
UNITS IN INCHES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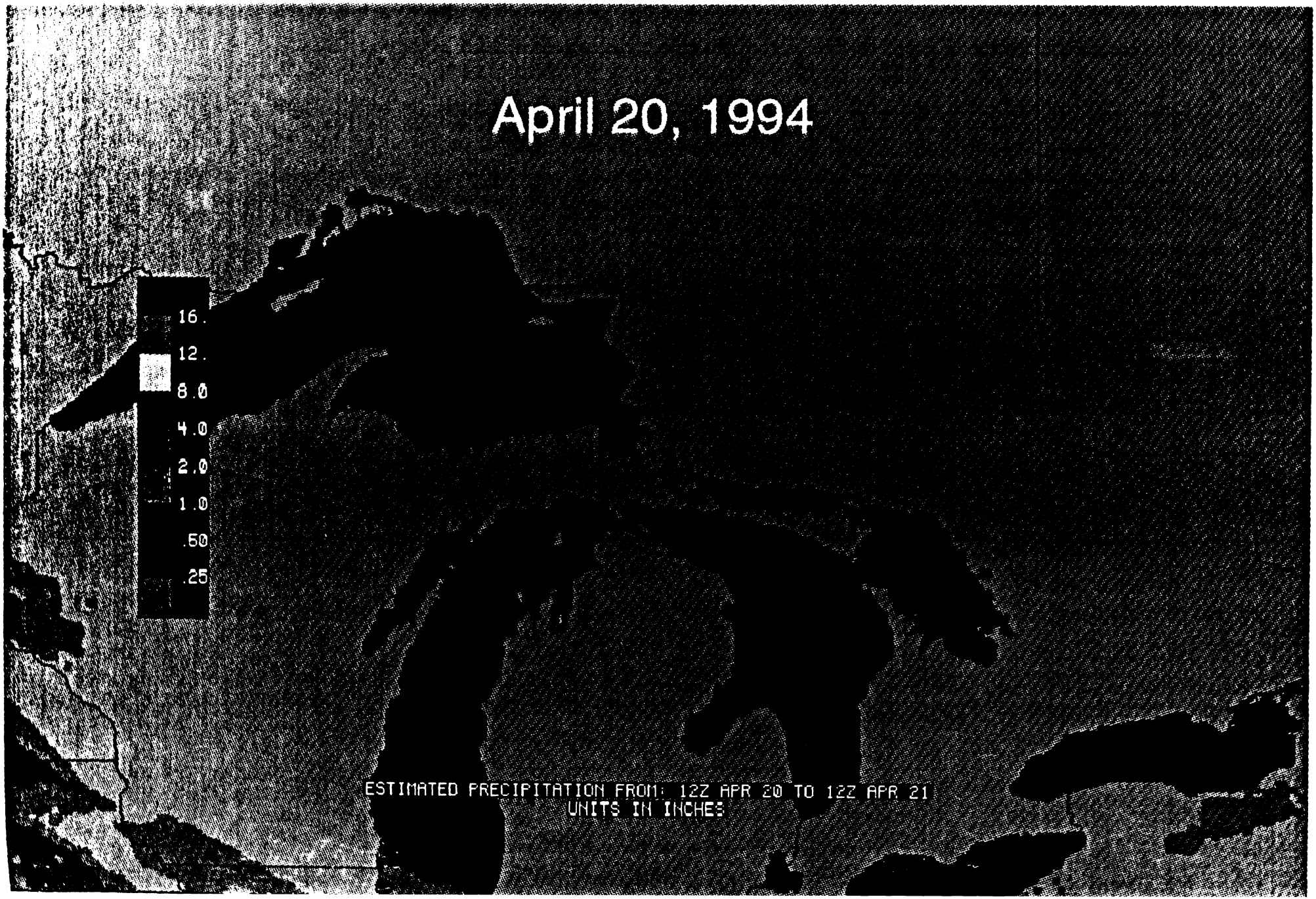
UNITS IN INCHES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ESTIMATED PRECIPITATION FROM: 12Z APR 20 TO 12Z APR 21
UNITS IN INCHES

H20