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MICROCLIMATIC WEATHER DATA FOR 1978 AND 1979 AT THE UNIVERSITY OF WISCONSIN–MILWAUKEE FIELD STATION

INTRODUCTION

The UWM Field Station has measured precipitation, temperature, relative humidity, wind direction and speed, and barometric pressure continuously since December 29, 1969. These data were recorded at three weather stations each located within a different vegetation type all within 0.8 km of each other. The main station is located near the Field Station laboratory building in an open field. This station measures all of the above parameters. The two satellite stations, one in a beech-maple forest and the other in a tamarack-white cedar bog, measure precipitation, temperature, and relative humidity only. This paper summarizes and compares the data collected at each station for the years 1978 and 1979. The results discussed are tentative since only two of the 11 years of data have been analyzed.

MATERIALS AND METHODS

Instrumentation

The instruments used to measure and record each meteorological parameter are summarized in Table l. The hygrothermographs are housed in white meteorological instrument shelters which stand approximately 1.2 m above the ground. The precipitation gauges have a collecting orifice of 20 cm and stand about 90 cm above the ground. The gauge at the field weather station is equipped with Alter-type wind shields. The microbarograph is housed in the Field Station laboratory building where measurment errors due to temperature fluctuations are minimized. The anemometer and wind vane are between 6 and 7 m high. Continuous measurements of wind direction and speed are recorded with an Esterline-Angus analogue event chart recorder.

TABLE 1. Meteorological instrumentation

Parameter	Instrument[1]	Accuracy[2]
Temperature	Hygrothermograph[a,b,c]	± 0.5°C
Relative humidity	Hygrothermograph [a,b,c]	± 1% between 20 & 80% ± 3% at extremes
Precipitation	Weighing rain gauge[a]	± 1 mm
Barometric pressure	Microbarograph [a]	± 0.7 mb range: 965 to 1050 mb
Wind direction	Wind vane [d]	No data
Wind speed	Anemometer[e]	No data

1 Manufacturer: [a] Belfort Instrument Co., [b] Weather Measure Corp., [c] Bendix Corp., [d] Science Associates, [e] Electric Speed Indicator Co.

2 Accuracies obtained from the manufacturer's instrument manual and converted to metric units.

DATA ANALYSIS

The recording charts were changed every 14-17 days for the analogue event chart recorder and weekly for the remaining instruments. Clock failure occurred infrequently in the recording precipitation gauges. The pens continued to write and thus the charts recorded total precipitation for the week, but not when the rainfall occurred. For these periods the intensity and time of rainfall was interpreted from the other functioning gauges. All measurements were coded for three-hour intervals beginning at midnight for subsequent key punching and computer analysis. The data were summarized by using routines of the Statistical Package for the Social Sciences (Nie et al., 1975), and the results converted to metric units.

RESULTS AND DISCUSSION

Temperatures differ the most among the three stations during the growing season when the effect of vegetation on microclimate is the greatest (Figure 1). The field weather station is situated on a mown lawn and is never shaded. The bog weather station is somewhat shaded all year because of evergreen white cedars. The most shade occurs during the summer when the deciduous tamaracks and paper birch are in leaf. Deciduous trees and shrubs of the beech-maple forest influence the woods' microclimate most during the summer months. Insolation, evapotranspiration and air movement are all influenced by vegetation and in turn, affect recorded temperatures and relative humidities.

Temperatures in the bog are cooler than in the field during the spring and early summer months (April through July), and in most cases, equal to or warmer than temperatures in the field during late summer and early fall (Figure 1). This temperature difference may be the result of the large heat capacity of water in the saturated bog environment. Remaining data should be examined to confirm this effect. There were no apparent differences among the three stations in the extreme temperature values (Table 2).

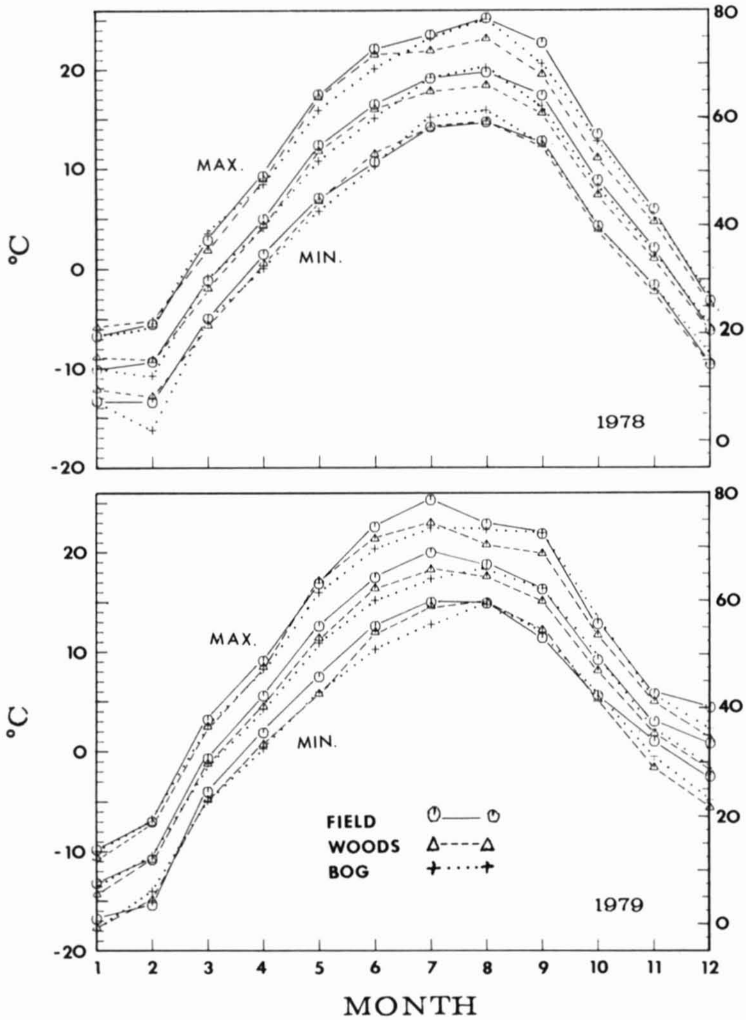

Figure 1. Average monthly temperatures for 1978 and 1979. Also shown are mean monthly maximum and minimum temperatures.

Total yearly precipitation recorded at the upland field weather station was 905 mm for 1978 and 779 mm for 1979 (Table 2). This compares with 874 mm for 1978 and 805 mm for 1979 at West Bend, Wisconsin 8 km to the west of the Field Station (National Oceanic and Atmospheric Administration, 1978 and 1979). The wettest month at the Field Station was June, 1978 with 164 mm of precipitation and the driest was September, 1979 with 3 mm.

A two way analysis of variance was performed to test for differences in total monthly precipitation among the three weather stations. Both months ($F=66.2$, $p<.001$) and stations ($F=19.3$, $p<.001$) were found to vary

TABLE 2. Precipitation and extreme temperature summary for 1978 and 1979.

MONTH	Station[1]	Precipitation (mm) 1978 Total	1978 Most in 24 hr.	1979 Total	1979 Most in 24 hr.	Temperature extremes (°C) 1978 High	1978 Low	1979 High	1979 Low
JAN	F	29*	14*	65	23	2	-21	-1	-29
	W	26	13	52	13	4	-19	-1	-29
	B	18*	10*	57	22	3	-21	-2	-31
FEB	F	5*	3*	22	12	1	-19	4	-27
	W	7	3	22	11	0	-17	4	-27
	B	4	1	19	8	2	-24	4	-27
MAR	F	7	5	104	27	20	-17	14	-17
	W	11	5	86	22	21	-18	13	-17
	B	10	5	66*	19*	22	-19	12	-16
APR	F	51*	25*	99	30	20	-4	22	-8
	W	76	23	75	23	20	-2	22	-11
	B	50	17	59	20	19	-4	21	-10
MAY	F	103*	62*	62	36	30	-4	29	3
	W	84*	47*	53	29	28	-4	29	-1
	B	75*	47*	58	38	27	-4	27	-1
JUN	F	164*	48*	58	20	30	4	30	3
	W	160*	37*	65	26	29	4	28	7
	B	120*	34*	62*	26*	28	3	28	2
JUL	F	113	54	59	27	29	8	31	8
	W	106	52	70	30	28	9	27	9
	B	94	51	41*	32*	30	10	26	7
AUG	F	110	66	131	54	30	9	31	6
	W	123	75	121	52	28	9	29	8
	B	103	66	119	47	30	11	31	7
SEP	F	141	39	3	1	32	3	28	4
	W	139	41	1	1	29	6	26	6
	B	130	41	2	1	30	3	28	4
OCT	F	45	10	53*	18*	24	-2	26	-4
	W	48*	14*	44*	18*	20	-1	25	-4
	B	33	7	27	11	23	-1	26	-2
NOV	F	69	29	67	29	23	-14	16	-11
	W	56	17	46	15	20	-14	18	-10
	B	48	13	41	13	22	-13	19	-11
DEC	F	68	19	56	41	3	-23	12	-16
	W	63	14	45	19	3	-21	10	-17
	B	55	16	38	26	3	-21	10	-19

[1] Station: F = Field, W = Woods, and B = Bog

* An asterisk indicates a rain gauge clock malfunction sometime during the month.

significantly in total precipitation. This variation among stations was caused by a consistently lower amount of rainfall collected at the bog site (Table 2). The dense canopy of trees at the bog site probably intercepted precipitation and prevented it from reaching the rain gauge.

Relative humidity values at 2400 hours (midnight) are close or equal to 100% during the growing season and between 80 and 100% when foliage is not present. This trend also occurs for relative humidity values at 0600 hours (Figures 2 and 3). Values at 1200 and 1800 hours appear to fluctuate with monthly precipitation (Figures 2 and 3). The effect of precipitation was less apparent on night relative humidity values because temperature approached the dew point during the dark hours.

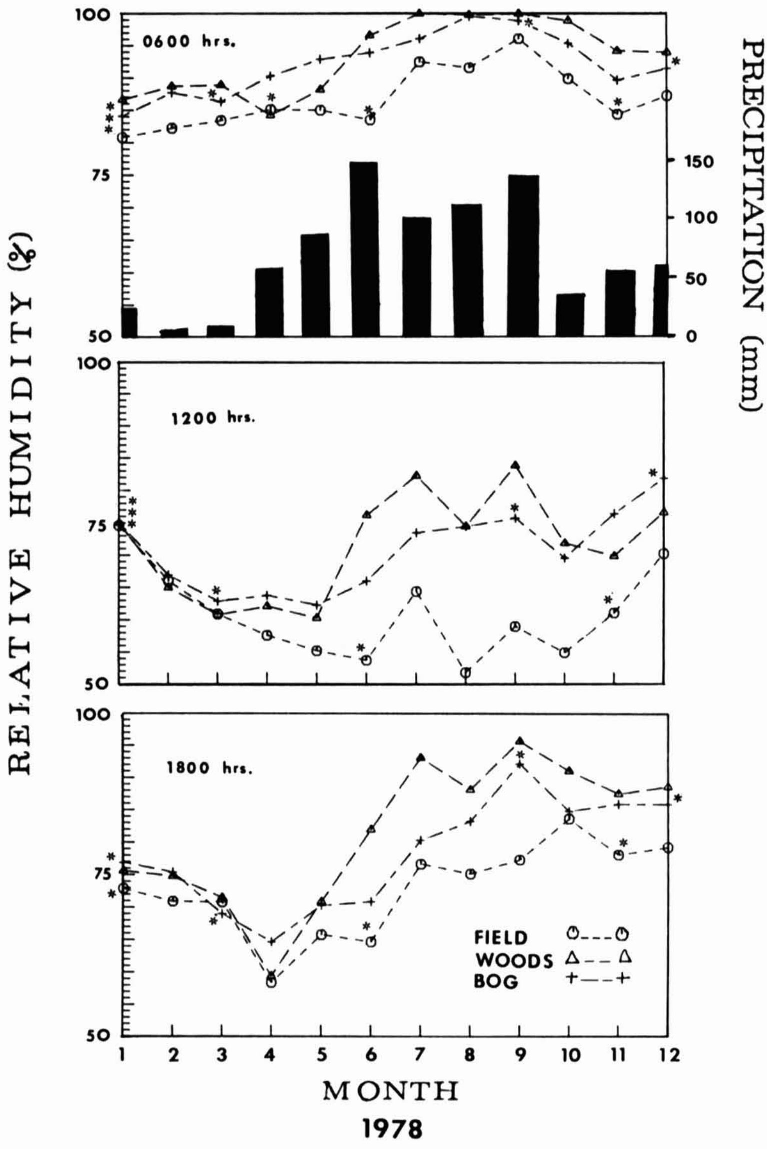

Figure 2. Mean monthly relative humidity at 0600, 1200 and 1800 hours for 1978. An asterisk (*) denotes months with more than two missing data values. The bar graph shows the average monthly precipitation for the three weather stations.

The greatest difference in relative humidity between stations occurred during the months when foliage was present. In most cases, the field weather station recorded the lowest values and the woods weather station the highest. Greater evapotranspiration, decreased air movement, and shading all may have contributed to a higher relative humidity in the woods. Because of the presence of standing water and saturated soil, we expected the bog station to

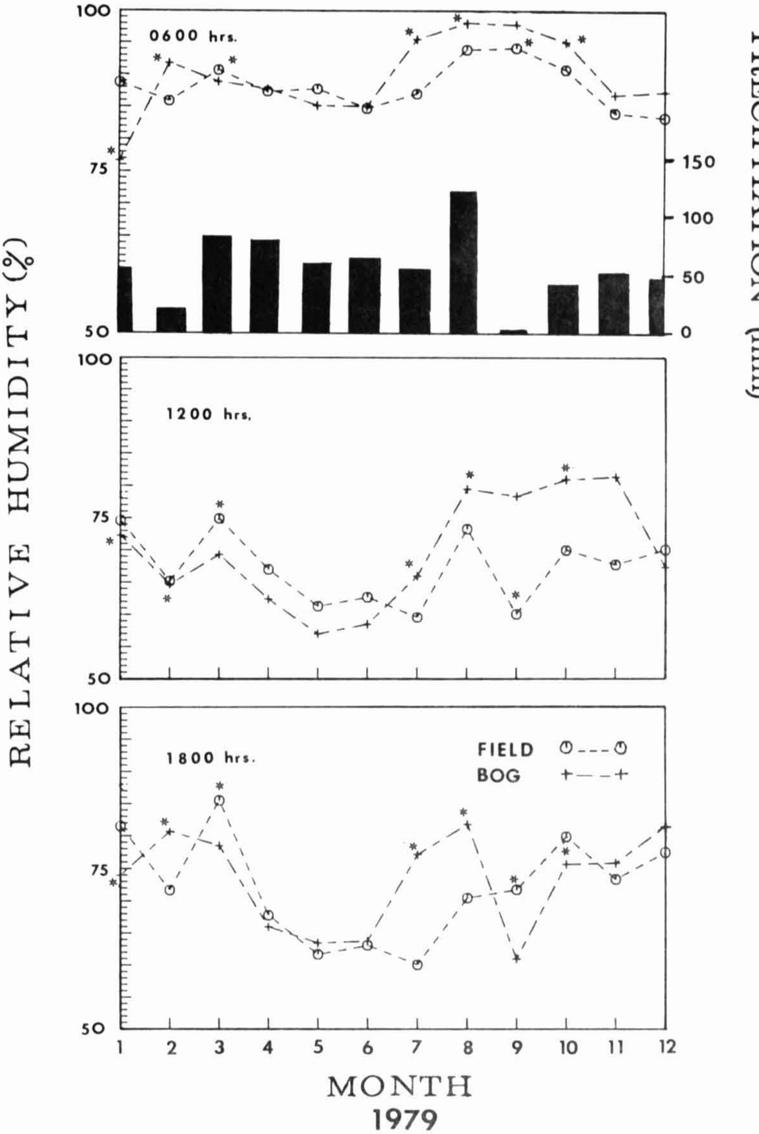

Figure 3. Mean monthly relative humidity at 0600, 1200 and 1800 hours for 1979. The woods weather station is not shown because of instrument miscalibration. An asterisk (*) denotes months with more than two missing data values. The bar graph shows the average monthly precipitation for the three weather stations.

have the highest relative humidities. However, the lower transpiration rates of the more sclerophilous bog vegetation may have caused lower relative humidity values than the upland woods.

Winds from the northwest predominate during the winter months (Figure 4), but change to northeasterly during the spring. Summer winds are

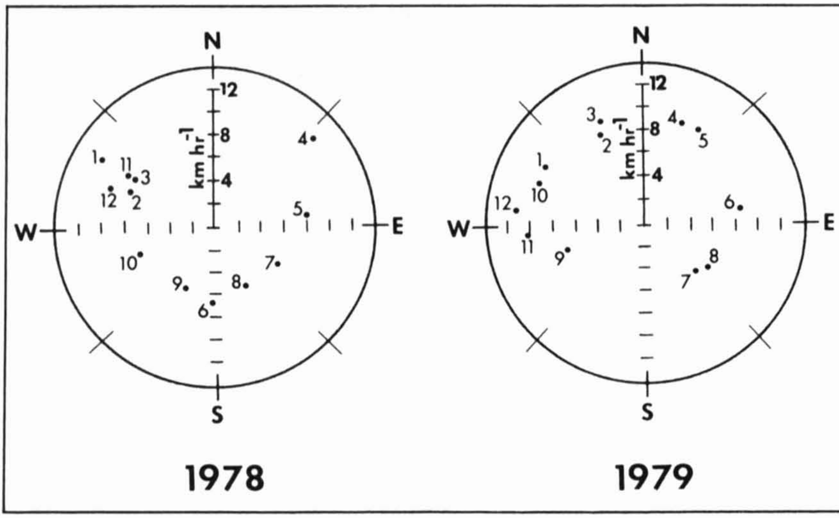

Figure 4. Mean monthly wind speed and direction for 1978 and 1979. Months are numbered consecutively from January. The distance a month is from the origin indicates the mean monthly wind speed.

mainly southeasterly and in the autumn from the southwest. Thus, there appears to be a yearly progression of wind direction around the compass. The months with the slowest wind speeds are July, August and September, and the fastest wind speeds occur in November, December and January.

Measurements at the two satellite stations were discontinued January 4, 1981, because eleven years of data have been collected to describe microclimatic differences between the stations and because of the additional effort involved in maintaining three stations simultaneously. The preliminary results reported in this paper suggest that further analysis will reveal a number of interesting micro-climatic differences between the three vegetation types. Currently the remaining years of weather data are being checked for coding and key punching errors. Complete English and metric summaries of the weather data will be available at the UWM Field Station.

ACKNOWLEDGMENTS

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