Not for publication

LIMITATIONS OF A PLASTIC HYGROTHERMOGRAPH SHELTER

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INTERNAL REPORT BC-3

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It is known that unventilated instrument shelters can overheat on calm days when exposed to solar radiation, and cause a distortion of the temperature and humidity records. Overheating, coupled with the thermal lag of the shelter, may cause the occurrence of the maximum air temperature to lag behind the actual time. After the occurrence of maximum air temperature, the overheated shelter causes a slower decline in the temperature than the true rate outside it.

Qualitatively these shortcomings have been recognized to apply to the plastic hygrothermograph shelter (Muraro 1962), but no attempt has yet been made to assess the errors quantitatively. The objective of this paper is to examine the magnitude of errors that may arise from exposing the plastic shelter to insolation on open sites.

From the author's observations during the 1965 field season, and judging by the results of similar studies (Anon. 1964; MacHattie 1965), it is known that temperatures in the plastic shelter can be 1° F. higher between noon and 1:00 p.m. and 2° F. higher between 1:30 and 4:30 p.m. than true air temperature. Further, the thermal lag of the screen causes a slower decline in the temperature past the occurrence of the maximum with temperatures 3° F. higher around 5:00 p.m. and 2° F. and 1° F. higher at 6:00 and 7:00 p.m., respectively, than outside the shelter. These errors are applicable to clear, calm, mid-summer days on an open site over logging slash at the standard 48 inch level.

In Table 1 temperature and relative humidity records of a calibrated hygrothermograph are given for two clear afternoons in August. The plastic shelter was located on an open site near Enderby, B. C., above

logging slash. Vapour pressures were obtained from meteorological tables. The temperatures were corrected in proportion to the assumed errors, and the relative humidity values changed with the aid of constant vapour pressure.

It appears that a possible temperature error of +1 to +3° F. may cause a -1 to -4% error in the measurement of relative humidity, and a +0.8 to +3.8 mb. error in the estimate of vapour pressure deficit. These values do not include the errors normally expected due to the performance of calibrated hygrothermographs, i.e., ± 0.5 to ± 1° F. for air temperature, and ± 2 to ± 5% for relative humidity.

The overheating of the plastic shelter by 2-3° F., and the resulting 1-2 hr. thermal lag under the above-described conditions are believed to be conservative estimates. The resulting errors in relative humidity and temperature measurements are far from being negligible for scientific research, being three to five times greater than the tolerated limits dictated often by the choice of instruments. There are occasions when the changes in the temperature and relative humidity are followed only for relatively short periods, e.g., when prescribed fires are ignited in the afternoons. For the small range of values, the relative errors may even be greater (see Table 1) and lie between +6.2 and +21.4% for air temperature, -4.7 and -16.6% for relative humidity, and +5.3 and +25.3% for the estimate of the vapour pressure deficit.

With the recent appearance of a new, portable type of the standard Stevenson shelter (Day 1965), the plastic shelters no longer offer any advantage over others that conform to W.M.O. specifications (Anon. 1961). It is concluded that plastic shelters should not be employed on open sites

in scientific studies where temperature errors in excess of 1° F. are not tolerated. However, located under natural or artificial shade, the plastic shelters are acceptable tools of scientific research.

References

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Table 1. Hygrothermograph records obtained under a plastic shelter over logging slash on two clear days near Enderby, B. C., and errors due to the overheating and thermal lag of the shelter

Date	Hour	Temperature (%)	Rel. Hum. (%)	Temp. Error (°F)	Temp. Error (%)		R. H. Error (%)		Vapour Pres. Deficit Error (%)	
					1*	2**	1*	2**	1*	2**
Aug. 15, 1965	1200	74	42	+ 1	+ 1.3	+ 7.1	- 2.4	- 4.7	+ 6.0	+ 7.6
	1300	75	39	+ 1	+ 1.3	+ 7.1	- 2.6	- 4.7	+ 5.6	+ 7.6
	1400	76	34	+ 2	+ 2.6	+14.2	- 5.8	- 9.5	+ 9.9	+15.2
	1500	77	28	+ 2	+ 2.6	+14.2	- 7.1	- 9.5	+ 9.2	+16.0
	1600	78	28	+ 2	+ 2.6	+14.2	- 7.1	- 9.5	+ 8.9	+16.0
	1700	78	29	+ 3	+ 3.8	+21.4	-10.3	-14.3	+13.5	+23.6
	1800	77	32	+ 2	+ 2.6	+14.2	- 6.2	- 9.5	+ 9.8	+16.0
	1900	64	49	+ 1	+ 1.6	+ 7.1	- 2.0	- 4.7	+ 6.8	+ 5.3
Aug. 19, 1965	1200	77	42	+ 1	+ 1.3	+ 6.2	- 2.4	- 5.5	+ 5.9	+ 7.3
	1300	80	42	+ 1	+ 1.2	+ 6.2	- 2.4	- 5.5	+ 5.4	+ 7.3
	1400	83	37	+ 2	+ 2.4	+12.5	- 5.4	-11.1	+10.7	+17.3
	1500	84	36	+ 2	+ 2.4	+12.5	- 5.5	-11.1	+ 9.7	+16.6
	1600	85	35	+ 2	+ 2.3	+12.5	- 5.7	-11.1	+ 8.9	+16.0
	1700	86	35	+ 3	+ 3.5	+18.7	- 8.6	-16.6	+13.7	+25.3
	1800	84	38	+ 2	+ 2.4	+12.5	- 5.3	-11.1	+10.0	+16.6
	1900	70	53	+ 1	+ 1.4	+ 6.2	- 1.8	- 5.5	+ 6.9	+ 5.3

* Based on the uncorrected values of the parameter.

** Based on the range of uncorrected values for the given afternoon.