Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNCIL

NERC FSF
Instrument Evaluation Report

Preliminary Evaluation of Microtops II Sun-photometer

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Introduction

This report summarises the results of initial tests with the Microtops II Sun-photometer, which aimed to establish an optimum mode of operation with the default instrument sampling. In the default set-up, the Microtops II utilises a signal processing system to minimise sun-targeting errors. Each scan consists of a number of samples, the number of samples being termed the 'scan length'. Of these, only a fixed number are averaged to produce the signal value for the scan. These are selected based on a signal strength factor, which is calculated for each sample, based on the signal for the UV channel. The average signal is then calculated from the specified number of samples with the highest ranking signal strength factors.

In the default settings, the scan length is set to 32 and the number of top samples to be averaged is set to 4. The manufacturers report this as suitable for most measurement situations, taking approximately 10 seconds to complete, with a rate of over 3 samples per second.

The default settings were used to compare signal and signal variability of data collected in several different operating modes.

1. Mode of operation

Five different operating modes were examined:

A. Unit supported in case, on ground
B. Unit supported in case, case handheld resting on lap while seated
C. Unit supported in case, case handheld while standing
D. Unit handheld, resting on lap while seated
E. Unit handheld while standing

With modes A to C the unit was securely wedged at the appropriate angle with the foam lining of the case.

Ten (10) scans were made in each mode. Data were collected near solar noon on 1 November 2001. Sky conditions were very clear (assessed by visual inspection through 2 pairs of UV protected sunglasses). The 10 measurements in each mode took approximately 4 minutes to collect. Unfortunately, there was no independent measure of irradiance variability during the period of data collection. For all the measurements, effort was made to ensure the Sun target remained in the central bulls-eye throughout the scan.

Figures 1 to 5 show the mean signal for each channel with error bars. Table 1 summarises the coefficient of variation for each method. If it is assumed that variation in irradiance remains unchanged throughout the measurement period, these values provide an estimate of the relative variability associated with each method

	A1	B	C	D	E	A2
440nm	0.8828	0.5540	0.7159	1.0484	1.1507	0.8876

675nm	0.5074	0.4394	0.4481	0.6932	0.7092	0.5183
870nm	0.5491	0.3584	0.4151	0.6859	0.6498	0.5191
936nm	0.9248	0.4881	0.8942	1.1113	1.0855	0.9136
1020nm	0.4344	0.4115	0.4333	0.5437	0.6400	0.4678

The unit is designed to be hand-held. These results indicate that hand-holding the unit allowed minor adjustments between measurements much more easily than when the unit was on the ground, supported in the case. From a practical point of view, maintaining the position for 10 seconds is easier seated than standing. This is consistent with the lowest variance being associated with Method B (case-supported, hand-held while seated) which appears to offer a slight advantage in terms of reduced signal variance.

However, it should be noted that these values should be interpreted with caution. For example, the 936nm variance, which is higher for methods D and E, might indicate that water vapour was varying more at the time of these measurements.

Figure 1

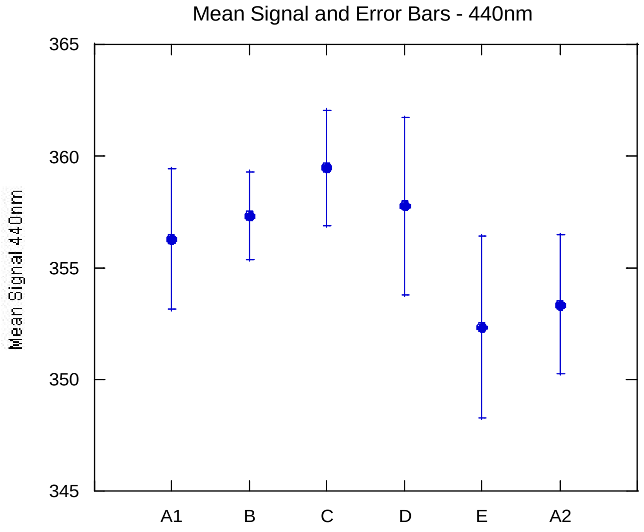


Figure 2

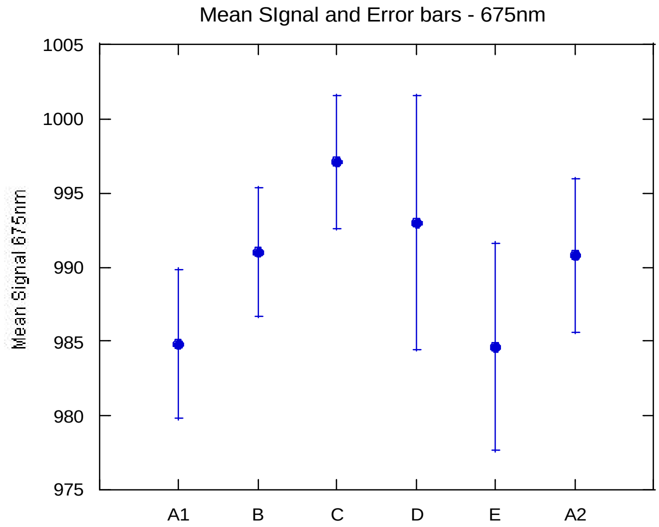


Figure 3

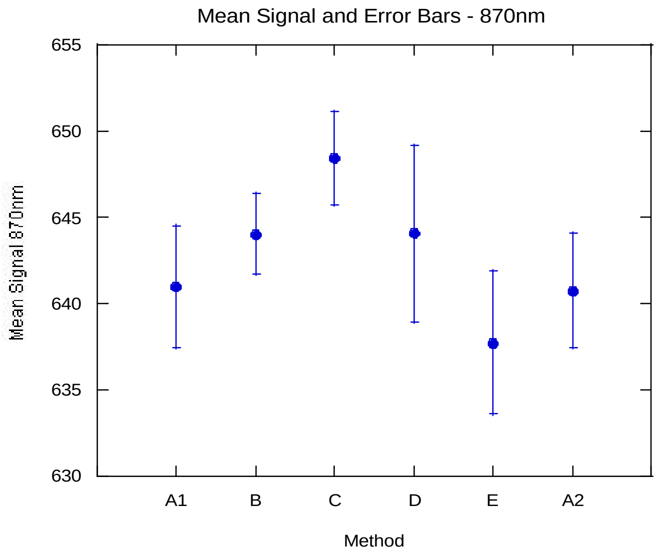


Figure 4

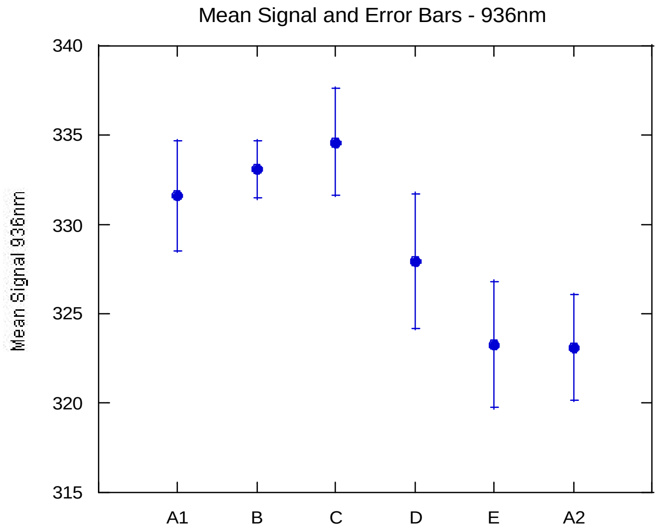
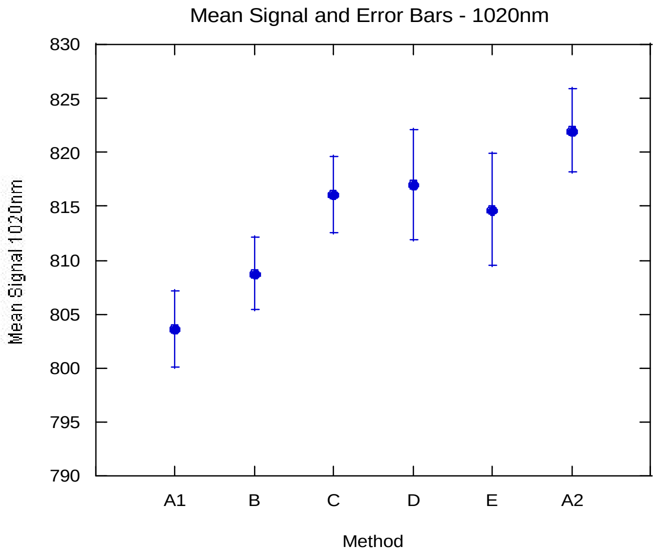


Figure 5



2. Systematic positioning errors

Systematic targeting errors can occur if the Sun-spot is not centralised in the Target. A likely cause of this is if the operator views the target obliquely rather than from the orthogonal.

The effect of the Sun-spot being not centrally located was examined by taking a rapid sequence of scans with specific targeting error. Four scans were repeated for each of the following positions (see Figure 6):

W – straddling first contour
X – in first ring
Y – straddling second contour
Z – in second ring

Multiple scans were made in the C position – centralised on Sun-target – before the off-target scans, during the sequence and at the end of the sequence. These proved to be very stable, indicating

Figure 6 Errors in Sun-target positioning – measurement zones

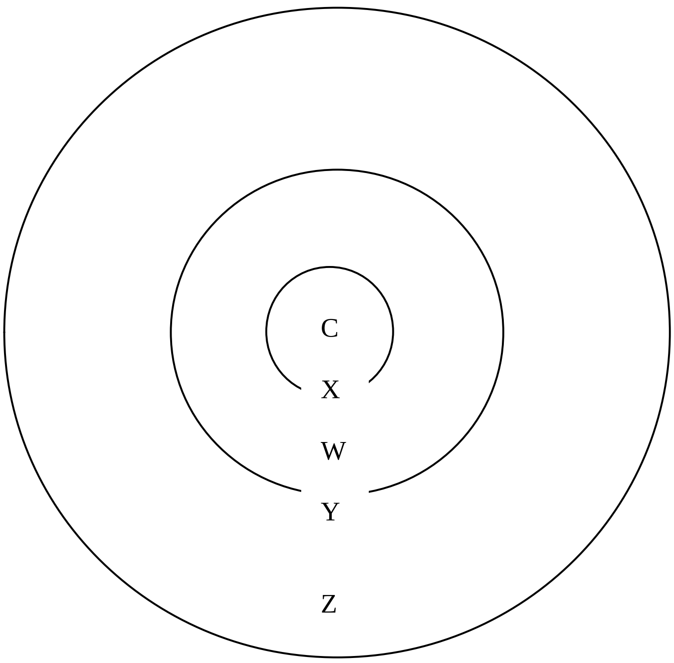


Figure 7 to 11 compare the irradiance in each band for each Sun-spot location. The signal reduction with position off the target was systematic and similar for all bands. In zone X the signal approximated 90% of that in the Central zone. In zones W and Y the signal approximated 60% and 25% of the Central value respectively. In zone Z the signal was barely 3% of the Central value.

Figure 7

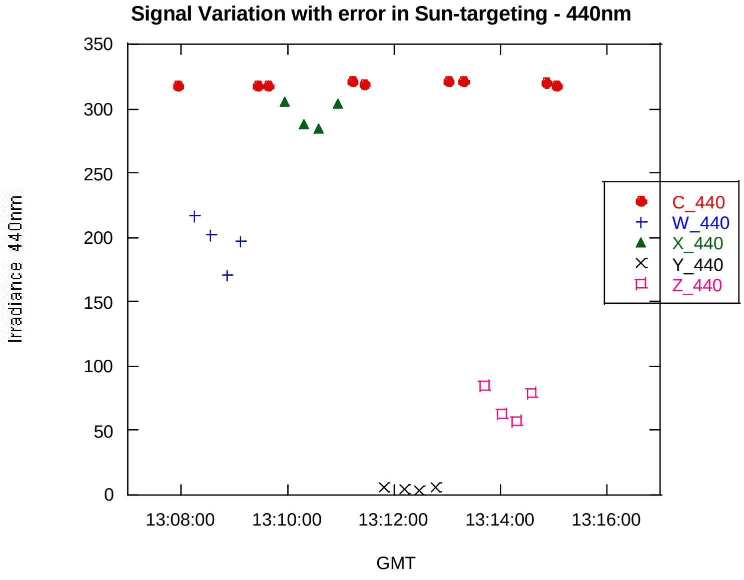


Figure 8

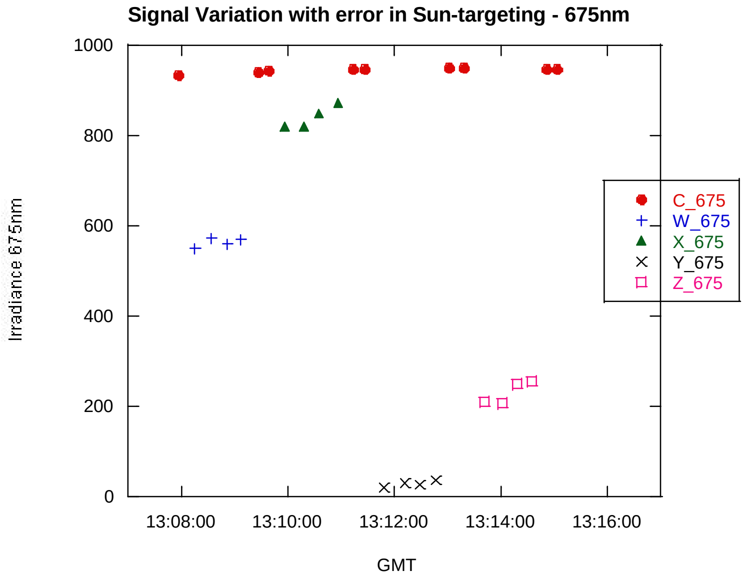


Figure 9

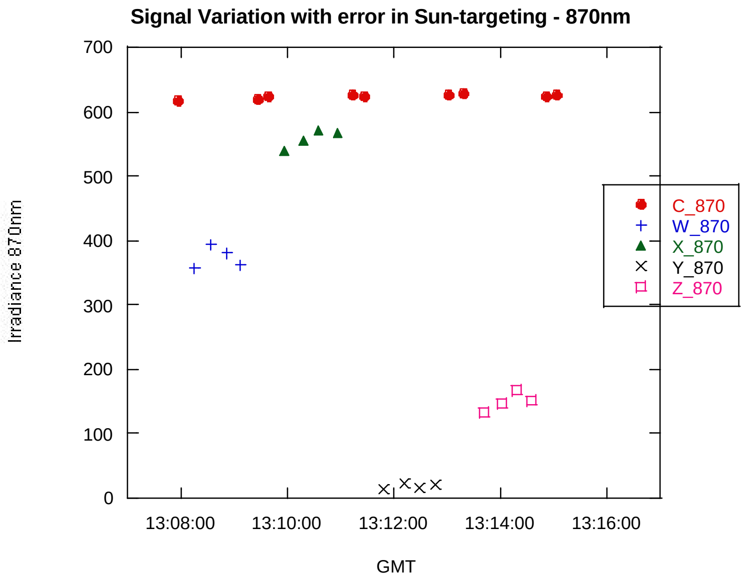


Figure 10

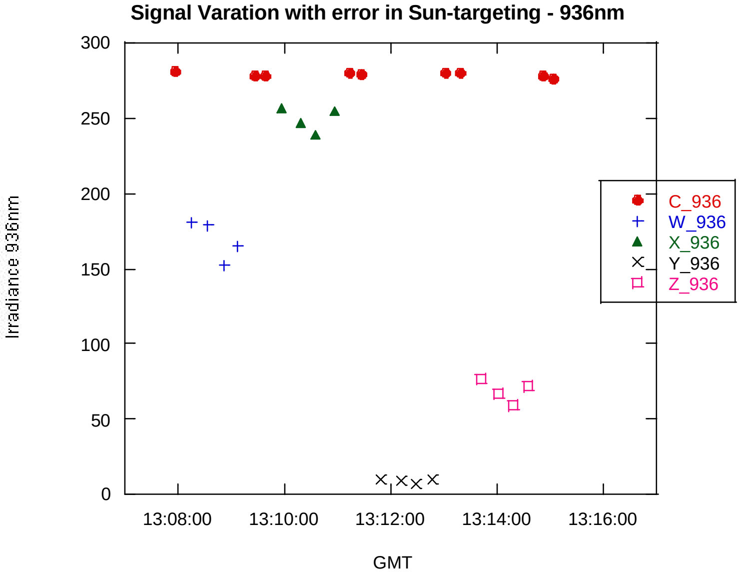
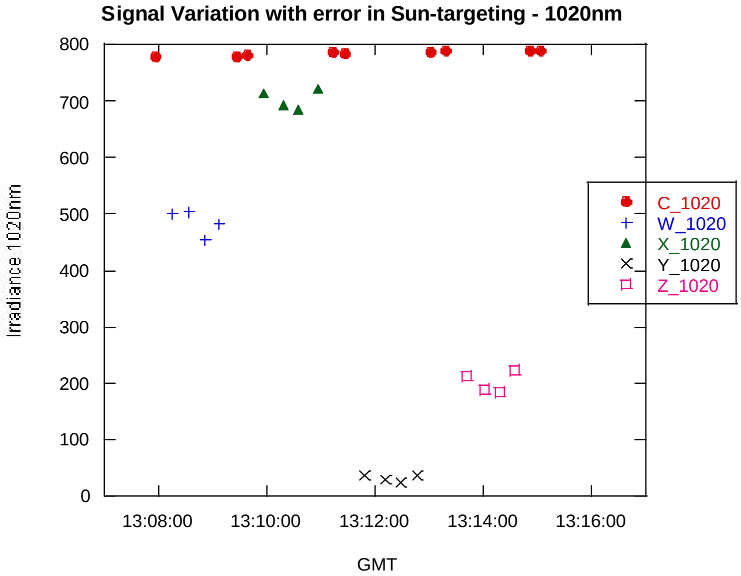


Figure11



Conclusions

1. There was little difference between the variability of measurements collected in several modes of operation, probably because of the default sampling and signal processing by the Microtops, which aims to minimise Sun-targeting errors. The operator found it easier to maintain a good position on the target while seated. The lowest variance of the data is associated with Method B, where the sensor is supported in the case, which is hand-held while the operator is seated.

2. Disregarding carelessness, Sun-target positioning errors are most likely to arise if the Sun-target is viewed obliquely rather than orthogonally. The signal was found to reduce systematically as targeting deviated from central, with a reduction by 10% once the Sun-spot appears across boundary of the central bulls-eye.