RC2: 'Review of "Shortwave Array Spectroradiometer-Hemispheric (SAS-He): Design and Evaluation"

We highly appreciate your comments on our manuscript. We hope that you will find our responses and the corresponding revisions for the original manuscript satisfactory. Please find below your comments/suggestions (blue color) and our responses (red color).

This is a great manuscript to read, however there are a few minor comments to address, mostly on some clarification of some points (see list below). After these minor comments are addressed, it is recommended for publication in AMT.

General Comments:

1. The direct to diffuse ratio is both used for quantifying the non-linearity of the spectrometers and the comparison to MFRSR. It is not evident if the subset of data is used is the same for non-linearity correction and comparison to MFRSR, and if there is a circularity in these comparisons.

In fact, there is circularity built in, in that we require the direct-diffuse ratio to agree, and we obtain this agreement by applying the non-linearity correction derived from the initial disagreement between the MFRSR and SASHe measurements. Our argument that this approach is valid because it appears to be independent of wavelength and of deployment (both the TRACER and EPCAPE show essentially the same correction).

Specific Comments:

1. Line 24-25 (repeated in the summary): How does the uncertainty of the cimel sunphotometer translate to the uncertainty metric from this method 0.01-0.02 root mean square error, may not exactly equate to the accuracy uncertainty. Some refinement in this statement to differentiate uncertainty in accuracy and root mean square.

This statement has been refined (lines 24-25), the corresponding clarifications (lines 312-314, 390-391) and reference (Shinozuka et al., 2013) have been added.

2. Line 60-61: How does the SWS influence the development of the SAS-He? Was it at all influence? If so then a citation might be adequate here.

No real influence from the SWS, but the 4STAR was an influence. The corresponding reference (Dunagan et al., 2013) has been added.

3. Line 88: if it is a single core fiber, how does the coupling work to split exactly 50/50 in the Y fiber optic?

It is only a nominal 50/50 split, but the two spectrometers are independently calibrated with Langleys so the ratio is almost immaterial.

4. Line 93: Wouldn't a celsius scale be more appropriate to highlight the stability of the thermal control?

The thermal control used allows either +/- 1 C or +/- 1 F. Using F achieves 5/9 of the resolution of C.

5. Spectral Registration: How often is this procedure run? since 3 campaigns are shown, has this been done only once, or is there a time series of spectral calibration to ensure spectrometer stability?

It has been measured several times, once or twice per campaign, with no changes by more than a pixel and nothing systematic observed over time.

6. Spectral Resolution: How was this measured?

Not measured, vendor-provided nominal resolution for our purchased spectrometer configuration.

7. cosine correction: How far off from cosine was the lab measurements returned?, and is it spectrally neutral? While most of this can be corrected, if substantial, it would indicate that sampling is uneven, so there is increased error in the hemispherical measurements.

We've provided a new figure (Figure 3) showing the cosine correction. It is spectrally neutral.

8. Spectrometer non-linearity correction: There seems to be the whole range of potential non-linearity correction factors at low direct to diffuse ratios (vertical color range in figure 3a) Does this mean that the correction is limited in efficacity at the lowest end of the ratio? There is no mention that there are limits to the correction factor at low ratios. This seems potentially problematic to accurate measurements.

We are inclined to believe the spread in the nonlinearity factor toward the low end is driven by statistics and the finite digital resolution of the A/D counters. Even though the spread appears large, recall that this is a density plot so the correction factor is actually pretty robust and quite reproducible to within a few percent at worst.

9. Line 196: degree Celsius or Fahrenheit?

Fahrenheit

10. Line 198: How much variation is observed in the 30 second dark measurements?

They are quite stable except for occasional partial shutter operation. The processing software identifies and reject spectra where the shutter was not either entirely closed (for darks) or entirely open (for "lights").

11. Line 199: What is the temperature of the minimum in temperature sensitivity?

It was 29 F, but we opt to operate slightly warmer (35F) to reduce the potential of condensation/freezing issues.

12. Figure 5: What is the standard deviation from the fit of the langley calibration presented here? And the resulting impact to the expected accuracy in AOD?

This is a single Langley, not a compilation of Langleys (as is used for the 4STAR). In analog to the MFRSR we apply an interquartile filter to Io values over a span of several weeks, and then apply a sliding Gaussian-weighted averaging filter to determine a daily Io. The daily Io values are stable to within a few tenths of a percent per day, which effects OD at less than 0.01. Absolute accuracy is very difficult to determine which is why we are comparing to collocated measurements.

13. Figure 6: How about the wavelengths near 1220 nm for AOD?

We agree that the wavelengths near 1220 nm should be suitable for the AOD measurements due to small gaseous absorption. However, AODs at these wavelengths are not provided by the reference instruments (both MFRSR and CSPHOT) considered in our paper. Thus, we use only AOD offered by the reference instruments.

14. Line 299: Is 'as' missing for 'such as'?

Done (line 348).