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Atmospheric Measurement Techniques Discussions

Interactive comment on "The instrument constant of sky radiometer (POM-02), Part I: Calibration constant" *by* Akihiro Uchiyama et al.

Anonymous Referee #1

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The instrument constant of sky radiometer (POM-02), Part I: Calibration constant

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Review For Atmospheric Measurement Techniques

General Comments:

This paper overall is a useful contribution to the literature, as it includes discussion of several issues that are often overlooked in sunphotometry, such as the temperature dependence of the detectors. However in order to provide a complete assessment of the uncertainties and issues involved in calibrating sunphotometers, additional information needs to provided and discussed before final publication. One aspect that is lacking is a description of the filters utilized in the POM-02 instruments, such as the bandpass

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width of the ion-assisted deposition interference filters for each wavelength, the filter transmittance values and the filter blocking to exclude out-of-bandpass energy. Filter issues such as insufficient blocking can also potentially contribute to calibration uncertainty. Some important information about Langley calibrations done at the Mauna Loa Observatory (MLO) is missing, such as the well-known fact that only morning Langleys should be used for calibration due to unstable conditions in the afternoon as a result of vertical growth of the marine boundary layer to the observatory altitude. References describing the characteristics of the MLO site specifically as related to the Langley calibration method should be added to the manuscript (see Shaw, 1979 JAS; Shaw, 1983 BAMS; Perry et al., 1999 JGR). When discussing the calibration transfer of Vo from a reference instrument to another one in Section 4.2, it is critical to emphasize the importance of the AOD stability during the interval of simultaneous measurements as AOD temporal variability can incur additional uncertainty in Vo transfer. Additional information needs to be included such as how long a time interval was utilized and the time matching criteria used (how many seconds and how many observations matched) for the inter-comparison measurements. Additionally some discussion on how you account for small differences in wavelengths between compared instruments (should use wavelength interpolations) needs to added to the text. Some mention should be made of the fact that near solar noon time intervals are typically the best for calibration transfer since optical airmass (m) changes most slowly at this time and therefore inexact time matching between the instrument measurements is minimized. Another advantage of the use of the solar noon time interval is that if there are differences in filter blocking between instruments then Vo transfers made at the smallest optical airmass are reduced by a factor of 1/m at the larger airmasses. Also, there is larger uncertainty in the computation of optical airmass at large values of optical airmass (see Russell et al., 1993; JGR). I recommend publication of this manuscript in AMT but only after significant revisions that address my general comments, and also after appropriate changes are made to address the specific comments listed below.

Specific comments:

Abstract, Line 15: Please add ‘optical properties of’ before the word ‘aerosols’

Abstract, Line 23: Please mention that the normal Langley method is performed at Mauna Loa Observatory here in the abstract as this is very important information.

Line 111: Remove ‘Mt.’ as Mauna Loa is never referred to as Mt.

Line 122-123: ‘using special equipment’ to measure temperature dependence. Please provide much more information on this equipment and on how the measurements are taken with this equipment.

Line 144: Please define ‘turret’ here, as it is not a commonly used term. I assume it is the rotating filter wheel that holds the individual filters?

Line 156-157: The nomenclature that you have utilized for wavelength regions is poor and not very specific. Note that visible is typically defined as 400 – 700 nm, near-infrared (NIR) as 700 – 1000 nm and shortwave infrared (SWIR) as 1000 - 2500 nm.

Line 181-182: Please give references for the ‘normal Langley method’ that you refer to here.

Line 187-188: It is well known that afternoon Langley plots at Mauna Loa are much more variable due to marine boundary layer vertical growth. Please note this fact here. It would have been much more robust to use only morning Langleys as the AERONET project does.

Line 194-196: This statement is too general, as some near-infrared channels (such as 870 nm) do not have water vapor absorption.

Line 204-206: You should note that for 380 to 1020 nm the SD/Vo of $\sim$0.2 to 0.5%, very similar to the repeatability values of Vo for AERONET as given in Holben et al. (1998).

Line 206-207: Need to specify how the weighting is done to compute the weighted mean you refer to here.

Line 224-231: Please specify here or in the later section on this topic (section 7) how important it is to account to the vertical profile of water vapor. What is the percentage difference if just an average vertical profile is utilized rather than a specific profile for that date and location?

Line 247-248: What are the channels (give wavelengths) that had annual changes of <1% from 2009 to 2013?

Line 291-294: Please show the monthly mean AOD over the annual cycle and/or add this information to the discussion.

Line 298-300: Please be clear here, are you talking about the difference between the IML and the inter-calibration Vo values?

Line 307-308: Please note that these maximum differences are highly dependent on wavelength.

Line 311-320: Do you have any ideas what may cause the seasonal trends in IML errors? Temperature is accounted for, and AOD is higher in summer when errors are smaller. Possibly optical airmass differences (larger m in winter) in conjunction with filter blocking differences may be bigger factors in winter. Some discussion of possible reasons for the seasonality of IML errors should be added to the text.

Line 395-396: Is this 2% uncertainty based on one standard deviation uncertainty?

Line 400: What is the fixed value that is assumed for the refractive index? Are both real and imaginary parts assumed?

Line 441 – 442: Please give the wavelength ranges here rather than just channel numbers so that the reader does not have to keep referring to the Table when reading the text.

Line 508: Please clarify how you computed the percentage differences in this sentence. Describe more completely what you are talking about here.

Line 525-528: Please note that both AOD and columnar water vapor need to be stable over the full Langley airmass range of measurements. It is very risky to use only one ‘stable and fine day’ since repeatability cannot be determined and therefore uncertainty cannot be assessed.

Line 531: Please replace ‘near-infrared’ with ‘shortwave infrared’.

Line 680-681: Please state the wavelength of this channel that has the maximum error.

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