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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Can AERONET data be used to accurately model the monochromatic beam and circumsolar irradiances under cloud-free conditions in desert environment?" *by* Y. Eissa et al.

**Anonymous Referee #5**

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Review for Atmospheric Measurement Techniques

Title: Can AERONET data be used to accurately model the monochromatic beam and circumsolar irradiances under cloud-free conditions in desert environment?

Authors: Y. Eissa, P. Blanc, L. Wald, and H. Ghedira

General Comments:

The authors of this study have utilized AERONET measured spectral AOD and sky



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radiances extensively in this study. Unfortunately they have incorrectly analyzed much of this data due to misinterpretation of the data itself.

First, it is suggested that the AERONET measured AOD is biased by ~0.01 too high as a result of inter-comparison with the SAM measured AOD. This conclusion itself is problematic since the SAM instrument has an AOD uncertainty of 0.03 as compared to 0.01 for AERONET, so how could the less accurate SAM data possibly be used to determine a bias of 0.01 in AERONET data? The authors suggest that the diffuse radiation forward scattered into the AERONET instrument FOV is the reason for the low bias in AERONET measured AOD. However Figure 2 shows this relatively small bias is largest for low AOD and then decreases as AOD increases. This is exactly the opposite trend that would be expected if diffuse radiation in the FOV were the real reason for the bias. Surprisingly the paper of Sinyuk et al. (2012; GRL), which describes this bias (due to diffuse in the FOV) in detail for AERONET data, is not cited in the present paper. See Figure 3 in Sinyuk et al. (2012), where it is shown that the diffuse effect on measured AOD for AERONET instruments is only 0.003 or less for AOD < 0.8 at 675 nm, for the case of coarse mode dominated aerosol with Angstrom Exponent of 0.24. Additionally, the diffuse circumsolar effect on AOD is much greater for coarse mode particles with strong forward scattering (again, see Sinyuk et al. (2012)), and the aerosol in the UAE region are often mixtures of fine mode aerosol (from petroleum industry emissions) and coarse mode desert dust aerosol (see Eck et al. (2008; JGR)), therefore the effect may vary from day-to-day or seasonally as the relative fine-coarse mode percentage mixture varies. The authors are encouraged to analyze the data as a function of Angstrom Exponent in future analyses for the UAE region.

An even more problematic interpretation of the AERONET data involves the sky radiances from the almucantar scans. The authors have analyzed the data as though the measurements were made in scattering angle increments, whereas in reality the measurements were acquired in fixed increments of relative azimuth angle from the sun. Therefore there are significant errors in the way these data were utilized in the study,



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which vary in magnitude as a function of solar zenith angle. Additionally, it is noted that for retrieval data input, AERONET averages the sky radiances acquired in the almucantar scans at 'equal' azimuth angles from both sides of the scan to minimize any effects of small pointing errors, see Torres et al. (2014; ACP). If these sky radiance data in the current paper are re-analyzed with the correct angles, then it is suggested that the authors also average the data from both sides of the almucantar scan. Also note that the AERONET sky radiance data for scattering angles less than 3.2 degrees are contaminated by stray light and thus are not used as input to the AERONET retrievals (see Holben et al., 2006).

I recommend that this paper be re-considered for publication after substantial revisions to address the issues I have raised above and also in response to the specific comments below.

Specific Comments:

Page 7703, lines 10-12: Please note that the AERONET direct sun measurements of AOD in the visible and near-infrared wavelengths have an accuracy of 0.01 for overhead sun (optical airmass=1), Eck et al (1999; JGR).

Page 7704, line 5: For the AERONET retrievals of single scattering albedo (SSA), it should be mentioned that the uncertainty in SSA is $\sim$0.03 for AOD at 440 nm > 0.4 (see Table 4 in Dubovik et al. (2000).

Page 7705, line 11-12: However, in the UAE it should be noted that the SSA at 675 nm varies significantly as a function of Angstrom Exponent, see Eck et al. (2008; Figure 13).

Page 7705, line 15-19: Therefore you suggest here that you are accepting a 6% range in circumsolar diffuse irradiance as a result of variability in SSA alone. Discussion of this should be included in the text.

Page 7706, line 8: Therefore the bandpass of the SAM instrument at 670 nm is double



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the width of the AERONET at 675 nm. You should mention how ozone absorption was accounted for in the 670 nm SAM data. AERONET uses a monthly climatology of total column zone amounts determined from the TOMS satellite data. (also see Page 7709, lines 11-12, for a directly related sentence).

Page 7709, lines 17-22: For spectral interpolation of the AERONET data to 670 nm, it would be most accurate to use a 2nd order fit of AOD versus wavelength in logarithmic coordinates (see Eck et al., 1999), using the 440 nm, 500 nm, and 675 nm measurements of AOD from AERONET.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 7697, 2015.