

## ***Interactive comment on “Aerosol absorption retrieval at ultraviolet wavelengths in a complex environment” by Stelios Kazadzis et al.***

### **Anonymous Referee #1**

Received and published: 8 September 2016

Review for Atmospheric Measurement Techniques

Title: Aerosol absorption retrieval at ultraviolet wavelengths in a complex environment

Authors: S. Kazadzis, P. I. Raptis, N. Kouremeti, V. Amiridis, A. Arola, E. Gerasopoulos, G.L. Schuster

General Comments: This paper presents some interesting results regarding the spectral variation of single scattering albedo from the visible into the UV wavelength region in Athens, Greece. Given the location's proximity to the Saharan desert there is an interesting variety of aerosol types including urban-industrial, desert dust and various mixtures of these. However there are several errors and/or confusing aspects of the paper that require modification or elaboration. One is the interpretation of Figure 5. When the 15 degree solar zenith angle data point is excluded then there is an obvious

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trend of AERONET-UVMFR differences of AOD that range from  $\sim+0.02$  to  $-0.01$  as a function of solar zenith angle from 20 to 65 degrees, while the authors suggest there is no trend (page 12, lines 8-12). This suggests that the cosine response error in the UVMFR may not be fully accounted for, since the AERONET direct sun measurement of AOD with a narrow field of view does not have any solar zenith angle tendency. I also include several specific comments below that the author's need to address in order to correct or clarify some parts of the paper. One example is that Figure 13 as described in the text (page 22, lines 10-11) was missing from the review copy of this manuscript.

Specific Comments:

Page 2, lines 25-28: The authors suggest that AERONET almucantar retrievals are only for the visible (VIS) part of the spectrum. This is not true as the wavelengths that are input to the retrieval algorithm include two near-infrared wavelengths (870 and 1020 nm) in addition to two visible wavelengths (440 and 675 nm). Therefore the term "VIS-SSA" on line 28 is somewhat misleading.

Page 3, line 1: The word 'weaker' seems to be a poor choice of vocabulary here, perhaps 'difficult' would be better?

Page 3, line 5: Please include the fact that measurement accuracy is even more important here than measurement precision.

Page 3, line 5: Please note that the UV fraction of the energy in the total solar spectrum is very small and therefore it is not very important for radiative forcing estimates.

Page 3: Please include some mention in the introduction section of the satellite retrievals of SSA in the UV wavelengths as has been published in several papers by Omar Torres (GSFC). Include at least one Torres reference in this discussion.

Page 5, line 18: Please include "mid-visible" before SSA in this sentence.

Page 6, line 4: Note that aerosol SSA cannot be much lower than 0.2 due to particle diffraction effects.

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Page 6, line 15-17: Note that Eck et al. (2003) also applied this approach to VIS-NIR wavelengths.

Page 7, line 25: Change 'constructing company' to 'manufacturer'

Page 8, line 15-16: Please give references here for the range of SSA, particularly for values as low as 0.5. This lower limit seems extreme to me.

Page 9, line 28: Please include the reference of Smirnov et al. (2000) for the AERONET cloud screening.

Page 12, Figure 4: Figure 4 is hard to read due to extreme compression of the y-axis and very small font for labels. The figure is also confusing since it implies an AOD of 1.5 from the UVMFR when the Cimel would measure only 1.0. The plots therefore appear to be inconsistent with the linear fit equations which have a slope of very close to 1.0. Please explain this apparent discrepancy.

Page 12, line 9: Figure 4 should be Figure 5 here.

Page 13, Figure 5: I assume that the 15-degree solar zenith angle has less observations than the other bins in Figure 5. It would be useful to show the number of data points that are included in each SZA interval bin.

Page 13, line 6: Please be clear that AERONET uses satellite derived climatological values for both ozone and NO<sub>2</sub>.

Page 13, line 17-18: However, this plot (Figure 6 right panel) suggests a cutoff of <65 degrees SZA for retrievals due since sensitivity decreases rapidly as SZA increases.

Page 15, line 10-11: Please note here that you have also applied the SZA restriction of >50 degrees, as shown in Figure 10 (on page 18). Also please note that the uncertainty in SSA from AERONET increases rapidly as AOD decreases, with uncertainty of  $\sim 0.03$  at  $AOD(440\text{ nm})=0.5$ , see Dubovik et al. (2000; Table 4). Did you apply a minimum value of AOD to the AERONET and UVMFR retrievals of SSA shown in this paper?

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The errors in SSA for the UVMFR shown in Figure 7 become very large at low AOD.

Page 16, Figure 8 caption: Please change 'the visible range' to 'at 440 nm'.

Page 16, line 23-24: I suggest also plotting the monthly mean AOD values to see if there is a relationship to the SSA retrievals.

Page 17, line 18-20: These should not be called error bars if they denote variability of SSA in each month. These 1-sigma values are likely due to both variation in aerosol properties and retrieval uncertainty. Please add a sentence to clarify this.

Page 18, Figure 10: Figure 10 shows the annual average diurnal variability. How does the diurnal variation change seasonally?

Page 18, Line 15: Please specify in the text the magnitude here for "higher AOD". Do you mean  $>0.4$  at 440 nm?

Page 18, Line 15-17: This is a very confusing sentence about AERONET spectral dependence of SSA. Please rewrite or clarify this.

Page 18, Line 18: "at Washington" should be "near Washington, DC". Remember there is a Washington state on the west coast of the USA.

Page 20, Figure 12: Please use larger fonts for the labeling of Figure 12, it is currently very hard to read.

Page 20, Lines 9-11: What are the AOD levels for these low SSA cases with values  $<0.75$ ? Are these very low SSA values from L1.5 or L2 retrievals? Please include this information in the text.

Page 20, Lines 15-21: "Russel et al (2010)" should be "Russell et al (2010)"

Page 21, Lines 2: I think that Figure 11 should be Figure 12 here.

Page 21, Lines 8: I think that Figure 12 should be Figure 13 here.

Page 21, Figure 13: There is no fine and coarse mode information given in the figure

13 although the text suggests it does have this information. Why are the January and December months missing in Figure 13. The caption of this figure says “in the lower plot” when there is only one plot panel. It seems as though the authors did not include all final figures in this manuscript!

Page 22, Lines 1-4: Why only scattering and not extinction for the AE?

Page 22, Lines 10-11: The Figure showing the temporal variability of AAE is missing from the review manuscript. This suggests poor quality checking of the manuscript by the authors.

Page 23, Figure 14: I suggest adding a fourth category to this plot :  $AE > 1.2$  to see the spectral SSA variation of fine mode cases.

Page 24, Line 20: What is a satellite post-correction validation result? What do you mean by post-correction?

Page 25, Line 1-3: It does not make any sense to me to compare this data to retrievals made in Washington DC without any further explanation. There is very little dust aerosol in Washington DC and therefore it would be expected for these two sites to differ significantly.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-273, 2016.

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