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Atmospheric Measurement Techniques Discussions

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Interactive Comment

Interactive comment on "Aerosol absorption retrieval at ultraviolet wavelengths in a complex environment" *by* S. Kazadzis et al.

Anonymous Referee #1

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The paper "Aerosol absorption retrieval at ultraviolet wavelengths in a complex environment" presented by S. Kazadzis et al.

General comments This work explains the methodology followed to determine the single scattering albedo (SSA) of atmospheric aerosols at two UV wavelengths (332 and 368 nm) and discuss the retrieved SSA values in the Athens area. The method is based on known values of the AOD (aerosol extinction optical depth) and the ratio of direct to global irradiances measured by the UVMFR radiometer at these two wavelengths We must note, that to apply this methodology the authors needs very accurate direct and global absolute irradiances values, in order to obtain reliable SSA values, but also AOD values (which are not necessary taken from the UVMFR radiometer) for

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input in the RT model.

1. The authors need to calibrate the UVMFR spectral radiometer. Because of the polluted area of Athens, they cannot use the Langley technique to obtain the calibration constant (Vo, named ETC by the authors) at these two wavelengths. Therefore, they use the Beer law, needing the AOD values at the two UV wavelengths. To do that they make two important things: a) they take the AE(340-380) coefficient given by AERONET using the log-log plot of AOD at 340 and 380 nm, and by interpolation they obtain the AOD at the two UV wavelengths. Thus it can be consider that these two values are provided by AERONET data. This process gives rise to a high uncertainty in the new AOD values because the AE coefficient itself has a high uncertainty, but it may be a reasonable procedure. However, the authors must evaluate the uncertainty of these new AOD data, because the reference value of 0.02 of AERONET is neither applicable, nor reasonable. This value is under optimal calibration conditions and this is not the case in this paper.

b) The authors take the AOD values at 332 nm (same for 368 nm) and use the Beer law to obtain the Vo (ETC constant) calibration constant for this wavelength, and this, for all measurements data of the UVMFR. This way, they have the radiometer calibrated. However, taking this method the authors introduce a high uncertainty in the Vo values. Therefore it is necessary to assess the reliability of the Vo values and also evaluate the associated error. The two things are also necessary to determine the true error of UVMFR irradiance values.

The method followed by the authors to evaluate the reliability of the calibration (i.e. Vo values) based on the correlation between the AOD values of AERONET and UVMFT has no sense. They cannot compare the AOD retrieved by UVMFR with those given by Cimel because this is a circulatory or reverse method and it is evident that both set of AOD the data are the same. This is the reason of the excellent agreement commented by the authors (e.g. mean differences, residual values), which are in fact due to the reverse mathematical operation. They determine Vo from AOD and use the

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Vo to obtain the AOD, this has not sense! The author fall in “a vicious circle”. . . Because of the excellent correlation they obtain, they state that only a sole constant is needed during the entire period. Why the authors do not show the evolution of Vo during the period of measurements in order to observe their variability and evaluate their validity? In addition, they also need to analyze the behavior during the day (taking selected days of clear sky conditions and an AOD as much constant as possible during the day) in order to observe no dependence of Vo on SZA.

2. In addition to all the above discussion, the figures 2a,b showing the slopes of the AOD correlations are not correct, the values of 0.001 are not possible, the values must be 1 or very close to 1. Anyway, the authors cannot use this senseless method to validate the calibration procedure, and they do not demonstrate the confidence of the Vo values. Figure 2 and 3 are not applicable.

3. The authors do not need to determine the AOD from UVMFR, they should use instead the AOD given by AERONET for the retrieval of SSA. No matter, how good or bad Vo values are, and how good or bad SSA retrieved values are, there is no option to validate the confidence of the retrieved SSA values, though they look apparently reasonable. Beside, according to the Krotkov methodology using the ratios of irradiances, absolute calibration is not needed, and if the AOD data are taken from AERONET, the results are apparently correct but the uncertainties are not well calculated.

4. The observed diurnal pattern of SSA is a consequence of the same diurnal pattern of the AOD given in this case by AERONET. The authors must know that the error in the calibration constant is transmitted to the AOD as a diurnal cycle or SZA dependence. And this problem is very significant in the UV wavelengths. To address this problem see Cachorro et al., 2008a,b in JGR or Kreuser et al. in AMTD, 2012 papers. Figure 6 is very important to analyze AOD cycle, but this figure accounts for calibration cycle together with the diurnal variability due to atmospheric conditions, thus masking the calibration problem. Apart from this figure, I also recommend to analyze selected days during the measurement period. The values obtained with different colors have no

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sense because of the above discussion.

5. The authors cannot say that the error of SSA retrieval is 3% like in the method of Krotkov et al., 2005a,b, (also Bais et al., 2005 and Buchard et al., 2011 reported other error values) because this depends essentially on the error in irradiance values of their instrument. They must evaluate the true errors of the UVMFR irradiance measurements according their own procedure. It is not clear for the reviewer how the authors have obtained the results of figure 4. This must be explained in detail.

6. Finally, figure 10 establishes a change of tendency or different slope in SSA from visible to UV, giving a higher absorption in the UV than in visible for all aerosol data and for polluted aerosol. This is an important results but it is difficult to assess its validity, although some authors have obtained similar results (Krotkov et al., 2005a; Corr et al., 2011). However, in other studies such as Buchard et al., 2011, this wavelength dependence does not appear. Can de authors give some realistic explanation to this behavior?

Given all the above mentioned problems, the paper is not suitable for publication, needs a deep re-evaluation and some text must be rewritten. The authors must decide if they take AOD-AERONET values at the two UVMFR wavelengths, or if they want to calibrate the UVMFR to get reliable UVMFR-AOD, which are not really necessary to retrieve SSA values.

Minor relevant recommendations In the abstract the authors must replace the sentences of lines 1-3 because they properly do not use radiance measurements. They take the elaborated AOD product of AERONET and use these products with their measurements of UVMFR. Besides, they use the elaborated SSA-AERONET product to compare with their retrieved SSA. Many other methods are open if the authors would use directly the Cimel radiance data.

In figure 5, remove the lines for a better visualization. In figure 8, do not show as the limit for SSA the value 1.1 because the reader may think that this value is possible.

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Many paragraphs are very long. Please, make them shorter.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 6991, 2012.

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