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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol Single Scattering Albedo retrieved from ground-based measurements in the UV-visible" *by* V. Buchard et al.

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Answers to referee #1 comments, received and published on 23 August 2010, on the manuscript:

"Aerosol Single Scattering Albedo retrieved from ground-based measurements in the UV-visible"

General comments: This is a very interesting work towards the progress of retrieving aerosol absorbing properties by the use of spectroradiometric measurements. The authors present results of an already established methodology using global and diffuse

as well as aerosol optical depth measurements in order to use them as inputs in a radiative transfer model retrieving SSA. The authors use AERONET measurements in order to validate their results. I would suggest the publication of this work in Atmospheric Measurements and Techniques after taking into account the below mentioned comments.

Abstract :

page3180 – line 27 satellite.. change to satellites

Reply: The correction has been made.

Introduction: Some additional information could be included in the introduction based on the current status of aerosol absorption measurements from ground based radiation instruments. Two publications that have to be mentioned and discuss extensively such issues are the following: Corr, C. A., Krotkov, N., Madronich, S., Slusser, J. R., Holben, B.,Gao, W., Flynn, J., Lefer, B., and Kreidenweis, S. M.: Retrieval of aerosol single scattering albedo at ultraviolet wavelengths at the T1 site during MILAGRO, Atmos. Chem. Phys., 9, 5813–5827, doi:10.5194/acp-9-5813-2009, 2009

Bergstrom, R.W., Pilewskie, P., Russell, P. B., Redemann, J., Bond, T. C., Quinn, P. K., and Sierau, B.: Spectral absorption properties of atmospheric aerosols, Atmos. Chem. Phys., 7, 5937–5943, doi:10.5194/acp-7-5937-2007, 2007.

In addition current studies that present such SSA retrieval results are: Ialongo, I., Buchard, V., Brogniez, C., Casale, G. R., and Siani, A. M.: Aerosol Single Scattering Albedo retrieval in the UV range: an application to OMI satellite validation, Atmos. Chem. Phys., 10, 331–340, doi:10.5194/acp-10-331-2010, 2010 Kazadzis, S., Gröbner, J., Arola, A., and Amiridis, V.: The effect of the global UV irradiance measurement accuracy on the single scattering albedo retrieval, Atmos. Meas. Tech., 3, 1029-1037, doi:10.5194/amt-3-1029-2010, 2010.

Reply: Following the reviewer comment, the references of Corr et al, 2009 and

AMTD

3, C2249–C2254, 2010

Kazadzis et al, 2010 have been added in the introduction paragraph in the new manuscript. Ialongo et al. was already cited in our manuscript. We did not add Bergstrom et al. since this reference does not concern ground-based measurements.

Ground-based instrument: As measurements of global and direct irradiance differ by 15 minutes, please clarify if you apply any time or solar zenith angle fitting approach in order to match the timing of the global and the diffuse spectral irradiance measurement as such different can be crucial especially at high solar zenith angles.

Reply: The direct irradiance at a time T is retrieved by removing from the global measurement at this time T, the average of the two diffuse irradiances measured at T+15 minutes and T-15 minutes. This kind of technique introduces some errors depending on the aerosol content and on the variation of the SZA during the registration of the spectra. This error has been analyzed by Houet (2003), and is also detailed in Brogniez et al, 2008. In the processing, this error is corrected.

We have more detailed this part in the new manuscript in the paragraph "2.1 Ground-based instrument" p. 3182 l. 26.

"The difference between the global spectral irradiance and the mean of the two diffuse spectral irradiances, performed 15 min apart, enables to derive the direct spectral irradiance. The time lag introduces some errors depending on the aerosol content and on the variation of the SZA during the registration of the spectra. The error is estimated and corrected in the processing. "

SSA retrieval:

There is a discussion about the AOD retrieval based on Brogniez et al. 2008 paper. Could you include some discussion about issues such as how the shadow-disc used for diffuse measurements affects the retrieval? This can influence both the AOD retrieval (included in the RT model inputs) but also the absolute diffuse irradiance measurement. For example if the portion of the diffuse irradiance measured is underestimated, due

AMTD

3, C2249–C2254, 2010

to the dimensions of the shadowing disc compared with the diffuser dimensions (and this is AOD, wavelength and solar zenith angle dependent), there will be a systematic offset in the SSA retrieved values.

Reply: The shadow disc used to perform diffuse irradiance measurements introduces a bias leading to a measured diffuse irradiance slightly smaller than the true value. This bias has been analyzed and a correction of the diffuse irradiance is performed in the data processing. More details about this correction can be found in Houet, (2003) and Brogniez et al., 2008.

We have added a sentence to discuss about the bias introduced by the shadow-disc on the diffuse spectra and the correction made in the processing in the new manuscript in the paragraph "2.1 Ground-based instrument" p. 3182 l. 24.

"The use of a shadow-disc to hide the sun during the diffuse irradiance measurement leads to a measured value slightly smaller than the true value. To account for the bias, a mean correction is performed in the data processing by using radiative transfer computations (Houët, 2003)."

3183-28. concerning the asymmetry parameter and the surface albedo uncertainties: It is not clear how the authors have calculated the 0.01 variation of SSA.

Reply: As requested by the reviewer some info about the calculation of the 0.01 variation of SSA have been added (p. 3183 l. 27).

"Based on model calculations, the effects of g and the surface albedo variations on SSA retrieval have been studied. We found that the variation of g between 0.68 and 0.72 leads to a slight variation of the SSA value, about 0.01. The same conclusion was observed for a surface albedo value varying between 0.01 and 0.04. The resulting uncertainty for both effect is about 0.02 at 380 nm.

Figures 3 and 4. Since differences comparing sub figures a-c and b-d are difficult to be clearly seen by the reader I would suggest to merge plots 3a and 3c to one figure

AMTD

3, C2249–C2254, 2010

with axis limits (e.g. from 0.8 to 1) and also the 3b and 3d also in one, using different symbols for the new spectrum and the Thuillier. Similar changes can be introduced also in figure 4.

Reply: As suggested by the reviewer, figures 3 and 4 have been changed and moreover (following reviewer 2 suggestion) combined in one figure (figure 3).

Figure 5. My understanding is that there were diffuse measurements only in part of 2003 and then 2005 and 2006. I cannot see any reason to separate these periods except if there are technical/instrumental differences not mentioned in the text. However, the relationship of AERONET SSA uncertainty with low (<0.2) or high (>0.2) AOD can be used to separate the two plots. So if figure 5a includes only AOD<0.2 cases (for both periods) the dash (bisector) lines have to be drawn taking into account the AERONET uncertainty for this AOD levels. The same can be introduced for figure 5b (AOD>0.2, both periods).

Reply: Following the reviewer suggestion the figure 5 has been changed. The figure 5-a (now figure 4-a) shows comparisons of SSA retrieved by AERONET to our SSA retrievals considering only cases with an AOT < 0.2 for the years 2003, 2005 and 2006. The figure (b) concerns the cases with an AOT >= 0.2 for the same period.

Figure 6. The authors try to discuss seasonal variations of SSA at different wavelengths. The fact that there is lack of summer measurements for 2003 and only few measurements for wintertime for 2006 makes the interpretation of the plot and the discussion difficult for the reader. I would suggest to include all analysis data of figure 6 in one plot in order to show the seasonal patterns that are also obvious in figure 5. What we figure out from figures 5 and 6 is that a. for low AOD's there is a big spectral dependence of SSA b. There is higher SSA's at UV at low AOD's and lower SSA's at UV for high AOD's compared to the visible SSA's measured at the same time. c. Overall higher AOD's are linked with higher SSA's at all wavelengths. One figure that could possibly show more clear the above conclusions would be to plot 340 (figure a)

AMTD

3, C2249–C2254, 2010

and 440 (figure b) nm AOD (YY' Axis) versus SSA(XX' Axis) and discuss the above considerations.

Reply: We agree that there is a lack of measurements for both years but we choose to keep the two plots for the two years separately because the spectral variation of the SSA monthly mean may be different in 2003 and 2006 like it is the case in the month of September for example. Therefore it is difficult to derive a seasonal pattern.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3179, 2010.