

## ***Interactive comment on “Validation of UV-visible aerosol optical thickness retrieved from spectroradiometer measurements” by C. Brogniez et al.***

**C. Brogniez et al.**

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Answers to referee 2 comments

General comments:

The manuscript deals with the retrieval of aerosol optical depth, derived from spectral measurements in the UV-visible range. Although the used method is valid, the results are sufficient and the overall presentation is quite well structured, some parts of the paper should be clarified or extended. The overall impression is that some major revisions are needed before publication to ACP.

Reply: As requested by the reviewer some parts have been detailed (see following

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replies).

### Specific Comments:

1. Quantitative results, instead of expressions like "very large discrepancies" or "very satisfying agreement", should be added in the manuscript. These results should be clearly mentioned also in the abstract and conclusions paragraphs.

Reply: In many places we have completed that sort of expression with quantitative results.

- p. 3896 in the abstract line 10: "... show good agreement: in 2003-2005 at 440 nm the correlation coefficient, the slope and the intercept of the regression line are [0.97, 0.95, 0.025], in 2006 at 440, 380 and 340 nm they are [0.97, 1.00, -0.013], [0.97, 0.98, -0.007], and [0.98, 0.98, -0.002] respectively."

- p. 3903 lines 7-11: we have given the correlation coefficient, the slope and the intercept of the regression line for each period and wavelength.

- p. 3904 lines 13-14: "Both spectroradiometer retrievals are very close (differences generally smaller than 0.1 for coefficients larger than 1.3), whereas there are often large discrepancies with sunphotometer data, the spectroradiometer data lying at the limit or outside the uncertainty bars of sunphotometer data."

- p. 3904 line 20: "... Fig. 8 exhibits a poor agreement with a correlation coefficient equal to 0.71, and the slope and the intercept of the regression line equal to 1.23 and -0.157 respectively."

- p. 3905 in the conclusion line 9: "The comparisons show good agreement with high correlation coefficients ( $\geq 0.97$ ), slopes of the regression lines close to 1 and intercepts very small. Moreover for SZA smaller than  $65^\circ$ , the differences are generally smaller than the uncertainties on the spectroradiometer's AOT."

2. The authors could give more credit to related work in the introduction paragraph.

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Some references are included, but there is no discussion about the results presented at those studies. As a consequence, the direct comparison of results of this study and those from relevant publications cannot be easily made. It would be further recommended, that a short paragraph comparing the outcomes of this manuscript with those of previous studies could be added in the results paragraph.

Reply: According to the reviewer suggestion we have added in the introduction comments on the methodologies from related works.

p. 3897, line 16: "In the first technique the field of view of the instrument pointing to the sun is larger than the sun apparent diameter while in the second method the shadow disc hides an area larger than the solar disc. Therefore, both techniques introduce a bias in the direct irradiance and thus in the derived AOT. In both cases the bias has to be estimated and corrected."

We have also added a comment page 3902, line 6: "Compared to other spectroradiometers such as Brewers, whose largest measurement wavelength is 320 or 365 nm, the advantage of our spectroradiometer is that its spectral range is large enough to avoid extrapolation for comparison with AERONET/PHOTONS AOT at one or several wavelengths in the UV-visible".

3. The authors try to validate their results with measurements from AERONET. This method has been used also before (e.g. Kazadzis et al., *acp*, 2007 and references therein), so some relevant studies could be referenced and discussed in the introduction and results paragraphs.

Reply: We agree that Kazadzis et al., *acp*, 2007 is a good reference, it has been added. Some comments have been made (see previous reply).

We have not discussed deeper the results from other works because the aim of our paper is to show that our spectral AOT are consistent with sunphotometer measurements. We don't want to judge the comparison works of other teams using various

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instruments and methodologies.

4. page 3898, line 20: the STREAMER code was used to calculate the radiances for the shadow ring correction. Some information (or a relevant reference) about the input parameters that were used in model calculations and the performance of the method could be provided.

Reply: As requested by the reviewer some info about the input parameters have been added as well as the reference work (p. 3898).

"The input parameters are the temperature and pressure vertical profiles, the AOT, the SSA, and the SZA. Three aerosol models representative of Villeneuve d'Ascq conditions have been studied (Houët, 2003)."

5. Figure 2: The SHICRIVM algorithm should be capable to correct any wavelength shift. Such a large variation in the AOT spectrum could be attributed also to the insufficient estimation of the FWHM of spectral response or to the low resolution of the extraterrestrial spectrum. The reported smoothing over 2, 4 or 6 nm could be considered acceptable, but it is rather surprising that the retrieved aerosol optical depth is almost stable in the 400-440 nm spectral region.

Reply: For the correction of the wavelength misalignment we have tested the SHICRIVM algorithm and it leads also to these unexplained oscillations. The spectroradiometer slit function has been measured in lab with a laser at 2 wavelengths: 351.1 and 457.9 nm. The 2 slit functions are very close, so we use a mean slit function in the whole wavelength range. We agree that it can introduce oscillations but we don't have measurements of the slit function at many wavelengths in the 280-450 nm range. A stable AOT in the 400-440 nm spectral region is observed only in few spectra. If we replace the Thuillier ET with the ET spectrum used in SHICRIVM the AOT in this range are still larger.

6. page 3902, lines 7-16: some of the AERONET specifications, mentioned in the

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introduction paragraph (page 3897, lines 2-8) could be more easily fitted here.

Reply: We agree with the reviewer suggestion, so we have moved the sentence "The shortest wavelength measured ... and 340 nm after", from the introduction p. 3897 to p. 3902.

7. The method of cloud screening, used to determine the cloud-free spectral measurements, should be mentioned or referenced, since the one global and the two diffuse spectra are measured within half of an hour.

Reply: We agree that such info is useful, so we have added in the text a short explanation about that, p. 3899, line 13: "Clear sky conditions are selected by means of cloud screening performed using a YES UVB-1 radiometer, close to the spectroradiometer, delivering routine measurements with a 3-min period, enabling to detect any fast variability of the irradiance related to cloud presence. Moreover analyses performed on almucantar measurements in the AERONET/PHOTONS processing are also used to determine if clouds are present or not."

8. As the authors mentioned, there are large discrepancies of aerosol Angstrom exponent coefficient between the spectroradiometer retrievals and the sun photometer data. If the aerosol optical depth values in the visible region do not show any spectral dependence (see also comment 5), it would be worthwhile to calculate the exponent coefficient only in the 340-400 nm spectral region. Although the two wavelengths are not exactly the same with those of Aeronet, the differences could be decreased.

Reply : We don't agree with the reviewer suggestion. Fig. 8 shows no bias, that means that the Angstrom exponent from the spectroradiometer is either larger or smaller than that from Aeronet. Changing the wavelength 440 to 400 will decrease the denominator in Eq 5 whereas the numerator will not change much. That will lead to larger Angstrom exponents from the spectroradiometer. If they are compared to the unchanged exponents from AERONET it could appear a bias that cannot be reliable since the wavelengths pairs are no more identical. Moreover, as explained in reply to comment 5, the

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AOT spectral dependence is not always flat.

9. Page 3904, line 27 up to page 3905, line 2: figures 9 and 10 could be omitted; otherwise the discussion should be extended.

Reply: We agree with the reviewer that the discussion of the figures was too short. We have made an extended comment:

"As observed in Fig 9 there is a correlation between the AOT at 440 nm and  $\alpha_{A/P}$ : small AOT values are obtained for large  $\alpha_{A/P}$ , i.e. for small aerosols. Fig 10 shows that there is also a correlation between the AOT difference and  $\alpha_{A/P}$ : small AOT difference values are obtained for large  $\alpha_{A/P}$ , i.e. for small aerosols, confirming the AOT effect seen in Fig 5 (smaller AOT differences at small AOT). A similar behaviour is observed for the AOT differences at 340 and 380 nm (not shown). This phenomenon could be an effect of the increasing uncertainty on  $\alpha_{A/P}$  when the AOT are small, i.e. when the AOT relative uncertainties are large, it needs confirmation with additional measurements."

Technical corrections:

Page 3896, line 20: replace 'Forsters' with 'Forster'.

The correction has been made

There are some acronyms that should be explained (NIST, NPL etc).

We have explained the acronyms NIST, NPL, QASUME, FWHM, NCEP, NCAR.

Page 3898, line 19: replace 'so' with 'and'.

The correction has been made

Page 3899, line 17: please clarify the 'other absorbing species'.

We have replaced this expression with 'NO<sub>2</sub>'.

Page 3899, line 23: please provide 'the standard midlatitude atmosphere values' for

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the surface pressure.

We have given the values (1013 hPa in summer, 1018 hPa in winter).

Page 3902, lines 18-23: these sentences could be conjoined in one paragraph.

We agree. It has been done.

Page 3903, line 13: the phrase 'one can see that' could be deleted; the same for other relevant phrases throughout the manuscript (one can notice etc.)

According to the suggestion we have removed these sentences in some places: p. 3902 line 25, p. 3903 line 13, p. 3904 lines 13 and 23.

Page 3905, line 7: replace 440 with 340.

It is done.

Caption of table 1: replace 'several' with 'four'.

It is done.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3895, 2008.

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