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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Nine years of UV aerosol optical depth measurements at Thessaloniki, Greece" *by* S. Kazadzis et al.

S. Kazadzis et al.

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Response to ref. #3

General:

We would like to thank the reviewer for the useful comments and suggestions. Most of them have been taken into account. A change in the de-seasonalisation method and the calculation of trends lead to slight changes in the retrieved AOD trends. In addition the use of cloud flagging methodology to derive clear sky scans also for the Brewer MKII direct sun scans eliminated a (small) number of points that were included in the previous version of the manuscript mainly in figure 3. Figures 3, 4 and 8 are changed according to the reviewer's suggestions. All changes in the text according to the reviewer's suggestions are included in this response document together with the

reviewer's suggestions in order to help understanding easier the manuscript changes.

Comments

Page 545, line 3, The difference in percentage is about the same than what is given in the line 14 for the Brewer vs. Brewer comparison. Maybe similar statement, that is given in the lines 14-16, is relevant here as well. Or maybe one could speculate on some of the possible reasons that could partly explain: e.g. FOV of Cimel is 1.2 degrees and is larger for Brewer, so the diffuse light effect for the latter should be larger. Of course, exact reasons are difficult to estimate, since different calibration and procedures are involved too.

Response:

The difference is about the same as stated in the referee's correction. The sentence was changed to: "Comparison of the AOD derived by the two Brewer spectroradiometers shows that the single monochromator Brewer MKII overestimates by about 5% the AOD."

Concerning the FOV comment, two sentences were added: "One possible reason that could partly explain this difference is the difference in the field of view of the two instruments (Cimel is 1.2o and for the Brewer is ˜ 2o) so the diffuse light effect for the latter should be larger. Of course, exact reasons are difficult to estimate, since different calibration and procedures for AOD retrieval are involved too."

Page 545, lines 5-7, The meaning of this sentence can be guessed. However, the sentence could be clarified. Presumably the purpose was to use longest wavelength, since it is least affected by ozone.

Response:

The sentence was modified in order to be clarified: "Here we used the AOD at 320 nm, because although this wavelength is affected by ozone, it is the longest available wavelength in the Brewer MKII measurements."

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Page 545, line 25, MKIII is meant instead of MKII?

Response:

MKIII was meant instead of MKII and it was corrected.

Page 454, line 26, Related to the earlier comment on many possible reasons: maybe "the difference ... is due to" could be rather "the difference ... is PARTLY due to".

Response:

Suggestion was taken into account and the text was corrected accordingly.

Page 546, lines 4-6, These are for MKIII, it would be interesting to see these for MKII as well.

Response:

A sentence was added describing similar results for MKII instrument. “Similarly, for MKII the standard deviation was found to be 0.15 with minimum and maximum of 0.01 and 0.27 respectively.”

Page 547, around line 18, AOD seasonality in Figure 5 is discussed. Perhaps the slight seasonality in Ångström exponent could be mentioned too.

Response:

Additional text was added at page 547 discussing the Angstrom exponent α seasonality: “In addition, a slight seasonality can be observed in the Angstrom exponent, α, monthly means. A summer maximum of 1.6 was found in July and August and a winter minimum of 1.2 in December. This is an indication of the presence of larger aerosol particles during the summer months. However, these variations are well within the 1σ standard deviation, as shown in the lower panel of figure 5”

Page 550, line 15 onward, This paragraph is not easy to follow. It is said that "there has been a significant increase in the pollution load ..." and "..the decrease is ... for PM10

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concentrations". The impression that can be drawn is the there has been increase in the number of vehicles on the one hand, on the other hand "positive development due to a series of measures..." counteracting. Maybe this is a wrong conclusion, so please clarify this paragraph.

Response:

The paragraph was not clearly written and lead to erroneous conclusions as all the reviewers report. The correct conclusion that had to be written is that there has not been a significant increase in the pollution load but on the fleet of vehicles. So the correct sentence had to be “This remark is of high importance, since during the period 1989-2003 there has been a significant increase in the fleet of the vehicles.” Also, the phrase “this positive development” that existed in the manuscript can be mixed with the positive and negative trends that are discussed in the same paragraph so it was eliminated. Summarizing, however there has been an increase on the vehicle fleet, the series of measures that have taken, lead to the negative PM10 and other pollutant’s trends.

Page 550, related to the figure 8, the scatter-plot of PM10 vs. AOD would be interesting. These type of comparisons exist for AOD retrieved from satellite data, while less using ground-based AOD measurements. Obviously, the correlation depends mainly on the actual variability in vertical profiles.

Response:

The scatter plot of the PM10 and AOD values have been produced but not shown in the paper. As it appears there is a weak correlation between the deseasonalized data of AOD and PM10, suggesting that a small part of the observed negative change in the AOD column can be attributed to aerosol change near the surface which can be described by the PM10 measurements. But still the seasonal aerosol vertical profiles that are measured with the LIDAR and referenced in this work (Amiridis et al., 2005) are more appropriate to describe the exact characteristics of the seasonal behavior of

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the height distribution of the aerosols.

In addition, we have used the daily PM10 data from the closest to the Brewer site ground station, and we produced a scatter plot by selecting only the common days of measurements (daily means). The poor correlation (R squared ˜0.35) is the result of the contribution of the aerosols that are present in higher altitudes, in some cases, and in addition the fact that PM10 stations are directly affected by local and short term emissions of heavy traffic or other ground level emissions. On the other hand, the location of the Brewer site (60 m above surface) is high enough that the instrument is not able to measure completely these local aerosol contributions. For these reasons we believe that this scattered plot does not provide more information (from those presented in Amiridis et al., 2005) concerning the variability in the vertical AOD profiles.

Technical comments:

Response:

Equation 1: more common is to have the exponent, a, as _. It would clarify the text as well, when it cannot be mixed with an indefinite article. Also, Ångström instead of Angström. Exponent α was corrected and also Ångström instead of Angström was used throughout the text

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