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Interactive comment on "Retrieval of aerosol optical depth in the visible range with a Brewer spectrophotometer in Athens" *by* H. Diémoz et al.

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The authors are very grateful to the anonymous referee for the insightful and thorough revision of their paper. A point-by-point list of responses is written further below.

Comment #1: Page 9, line 5-6: You mention a trend in the difference between AODs from the Brewer and the Cimel of 0.003 per year. Please specify whether the trend is statistically significant. If it is not, I would not mention this as it has no added value here. If it is significant, can you explain what causes this trend (i.e. changes in the Brewer AOD or in the Cimel AOD)?

Answer #1: we have tested the statistical significance of the trend by using the

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Student's t-test and the non-parametric Mann-Kendall trend test. Even though the trend of 0.003 per year is small, it appears to be statistically significant. Section 4.2 was therefore modified as follows:

"... The resulting ETCs differ by only 0.01 compared to the calibration constants obtained during the intensive campaign (Sect. 4.1). However, the standard deviation ... due to a slight overcorrection for the polarisation or for the Brewer temperature (Sect. 5.1). *Finally, there does not seem to be a trend in the ETCs, however a modest drop after 2011 can be noticed. Although this variation occurs just after a calibration period of the Cimel, the strict quality controls by AERONET would rather favour the hypothesis of a change of the sensitivity in the Brewer instrument. The effect is of the order of 0.05 at airmass 1, and therefore lower at larger airmasses (cf. later in this section).*

The resulting AOD dataset ... at different midlatitude locations (e.g., Cheymol and De Backer, 2003). *The average trend of the differences between the AODs measured by the Brewer and the Cimel in the period 2008–2013 is 0.003 year^{-1}. Even though the trend is small, it appears to be statistically significant. Trials with the Student's t-test (Student, 1908) and the non-parametric Mann-Kendall trend test (Mann, 1945; Kendall, 1938) all gave statistically significant results (Student's t-test: t-value = 4.31471, p-value < 0.0001, N=924; Mann-Kendall test: τ statistics = 0.124, 2-sided p-value < 2.22e-16). The trend is likely to be the consequence of the Brewer radiometric instability which has already been described previously in this section.*"

The updated text additionally answers **referee's comment #6**.

The conclusions were also updated by including a reference to this result: "Several effects have been found to impact the AOD estimates, such as changes in sensitivity of

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about 0.3%/°C due to variations of the Brewer internal temperature, *slight radiometric instabilities*, ...".

Comment #2: Page 10, line 6: Why must the average AOD during the day be lower than 0.4? How did you decide to use this value?

Answer #2: the following sentence was added to the manuscript: "... and lower than 0.4. *This upper limit was chosen to exclude days with very high aerosol loads or contaminated by clouds from the Langley extrapolation. The value of 0.4 corresponds to the 90th percentile of the AERONET AOD series at 440 nm*".

Comment #3: Page 14, line 21: What is the "Chauvenet" criterion? Please explain or add a reference.

Answer #3: the text was modified as follows: "Otherwise, *single measurements are removed when the corresponding AOD or* Angstrom exponent (calculated from *the* data through all slits except slit 2) *falls* outside the daily mean plus or minus three standard deviations".

Comment #4: Page 16, lines 12-14: I am not quite sure if you should include this as the link between the PCA mode and PWV seems very weak. Also, as it is mode 6, I guess its added value in explaining the observed variation is very small?

Answer #4: we agreed to remove the plot in Fig. 17, however we consider it of interest to leave a mention in the text about the correlation between one component of the

C3

PCA and the PWV, since this link is expected from the theory. Therefore, the text was modified as follows: "A weak link can again be noticed between the last component of the PCA and the total precipitable water vapour (PWV) measured by the Cimel at 940 nm *(not shown), as expected from the theory. Although only a* modest correlation is found between both variables ($\rho = \rho_s = 0.30$), *we believe that it is worth reporting that* the scores slightly increase as a function of the water vapour amount".

Comment #5: Page 16, line 28: Can you please explain what you mean with the following sentence? 'For the same reason, the effects of finite bandwidth due to the breakdown of Bounguer-Lambert-Beer law do not relevantly affect AOD measurements in the visible range.'

Answer #5: the text was modified as follows: "... of the solar spectrum *measured at ground* in this region. For the same reason, the effects of *using the Bouguer-Lambert-Beer law (rigorously defined for monochromatic radiation only) together with finite-bandwidth irradiances (e.g., Slusser et al., 2000)* do not relevantly affect AOD measurements in the visible range".

Comment #6: Figure 5: There does not seem to be a trend in the ETC, however there does seem to be a drop in the ETC after 2011 (after a period without ETC values). Was this a calibration period of the CIMEL? Can this cause a change in ETC?

Answer #6: please, cf. **answer #1**.

Comments #7–#12: Page 2, line 32: ' about 80 MkIV Brewer spectrophotometer ...' → spectrophotometers; Page 5, line 22: 'which 170 nearly simultaneous (i.e.

within +/- 1 minutes) to the Cimel' → Replace with 'which 170 nearly simulta-
neously (i.e. within +/- 1 minute) with the Cimel'; Page 6, line 3: 'as similar as'
→ Replace with 'similar to'; Page 6, line 10: 'consisting in the subtraction' →
Replace with 'consisting of'; Page 6, line 28: 'Alternatively, pressure measured
at' → Replace with 'Alternatively, the pressure measured at'; Page 9, line 27:
'This criteria' → Replace with 'criterion'.

Answers #7–#12: the text was modified according to the referee's comments.

**Comment #13: Page 11, line 14 and Page 11, line 26: 'is to ascribe to' → Replace
with 'is to be ascribed to' or 'can be ascribed to' (depending on how certain you
are that the described effect is the reason for what you observe)**

Answer #13: the text now reads "*is to be ascribed to*".

**Comments #14–#20: Page 14, line 18: 'were loosen' → Replace with 'were
loosened'; Page 14, line 28: 'each neutral density filters' → Replace with 'filter';
Page 16, line 4: 'consisting in' → Replace with 'consisting of'; Page 16, line 13:
'only modest correlation is found' → Replace with 'only a modest correlation
is found'; Page 16, line 28: 'Bounguer-Lambert-Beer law' → Replace with
'Bouguer-Lambert-Beer law'; Figure 2, caption X-axis: T (C) → Replace with
'T ($^\circ$C)'; Figure 10, caption: 'on extraterrestrial constant' → Replace with 'on
extraterrestrial constants'**

Answers #14–#20: the text was modified according to the referee's comments.