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Comment

## ***Interactive comment on “Improvements to the OMI near UV aerosol algorithm using A-train CALIOP and AIRS observations” by O. Torres et al.***

**Anonymous Referee #1**

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### **Review of: Improvements to the OMI near UV aerosol algorithm using A-train CALIOP and AIRS observations**

by O. Torres et al.

The manuscript describes the most recent improvements to the OMAERUV aerosol retrieval algorithm from OMI data. The retrieval now includes a priori information on collocated CO concentrations (from the AIRS instrument) and on aerosol layer height (from a custom-made CALIOP climatology). A comparison with sun-photometer measurements at five AERONET sites shows that the performance of OMAERUV has become better in result.

This manuscript presents a novel and interesting approach, but the methods applied

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are not always well described and in some cases are not substantiated by evidence. The case presented in Fig.3, for example, does not in itself provide enough evidence for the presence of carbonaceous aerosols (as the authors say); more independent data is needed to show that what is seen is not merely a CO plume over (or within) a layer of desert dust. Similarly, an interesting "saturation effect" that occurs with CALIOP 532 nm backscatter data of a thick biomass burning plume is described in the manuscript, but there is no reference to previous work on this matter, and only a single example profile is shown where the effect occurs. Another important point is the missing comparison of the obtained CALIOP aerosol height climatology with similar, published work by Winker and co-workers (ACP 2013). The climatology presented in this manuscript is markedly different from that shown in Winker's paper and this merits attention (despite the fact that Winker's climatology contains all aerosol types, in contrast to Torres' climatology, one would expect a great degree of agreement — particularly because the same CALIOP data is used in both cases).

I recommend this manuscript for publication in AMT, but only after a revision addressing the points mentioned above and the minor comments listed below and in the annotated manuscript (see supplementary material).

#### Minor comments

p.5625, l.20 — How is A388 calculated? Is it the clear-sky reflectance corresponding to the albedo at 388 nm from the database?

p.5626, ll.2-3 — The so-called COI is not a dimensionless quantity! It is simply the CO column multiplied by a factor to make the number easier to handle. Please do not call it "normalized" (p.5625, l.26) unless you normalize it, e.g. using a reference or a background value.

p. 5626, l.11 — On what are these thresholds based?

p. 5626, l.21ff — Why is there a difference between the retrieval methods over land

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and ocean?

p. 5627, II.6-7 — Why is CALIOP input not used for SF aerosols?

p. 5627, II.12-15 — Why is the aerosol layer height assumed to be so much higher at high latitudes than at the equator? Is this because there are less, but more intense (forest) fires at high latitudes and more, lower-intensity (agricultural, household) fires at lower latitudes? Do the numbers come from a climate model?

p. 5628, II.18-19 — But what about other sources of CO? And the high and seasonally variable background value?

p. 5629, I.5 — What does the sensitivity profile (averaging kernel) of AIRS look like? E.g., how sensitive is it to the lower troposphere?

p. 5629, I.8 — CO retrievals may be performed for pixels with up to 80% cloud cover, but OMAERUV performs retrievals only for clear sky! How do you account for this difference?

p. 5630, II.12-17 and Fig.3 — This is not a good example to plead your case. It is obvious from Fig. 3 that there are a lot of absorbing aerosols around and that there is a plume of CO as well. But the co-existence of enhanced CO values with high AI in this case does not tell us if there are smoke aerosols present - this may just be a plume of CO over (in?) a layer of desert dust. Evidence for carbonaceous aerosols on this day can only come from measurements on previous and later days showing an isolated plume (not surrounded by desert dust) of smoke aerosols.

p. 5631, Sect. 4 — CALIOP is actually pretty good at discriminating between dust and other aerosols, so if you're using profile information from CALIOP, why not use their classification, too? If only to separate dust from other types.

p. 5632, I.22 — The cited paper does not contain a description of a cloud-screening procedure.

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p. 5632, ll.23-26 — If you re-grid CALIOP data to match with OMI pixels anyway, why not just use the OMAERUV cloud screening procedure on both OMI and re-gridded CALIOP data? That seems to be most consistent.

p. 5633, ll.1-9 — This, if found to be generally true, is a very important finding for all users of CALIOP data! But is there more evidence, either in literature or from your own studies, for this effect? How often does it occur, in other words, is it a significant, general problem? What are possible reasons for this phenomenon?

p. 5635ff, Sect. 4.4 — This is a similar approach to that taken by Winker and co-workers in compiling a 3D aerosol climatology from CALIOP (ACP 13, 3345-3361, 2013). It would be good to mention the paper and explain why your results look so different from those shown in Fig.9 in the cited paper.

p. 5637, Sect. 5 — Please shortly describe the AERONET network and add the appropriate reference (Holben et al., 1998). Mention the collocation criteria, even if they are given in the references mentioned in ll. 15-16.

p.5638, ll.18-22: These are very nice results! Please elaborate: what are the aerosols in the North? I would have guessed that they are desert dust, but that cannot be the case if they have  $SSA = 1$ .

p. 5639, l.2 — The "near-simultaneity" of the A-Train measurements is not really a fair argument in this case, as you use a monthly CALIOP climatology.

pp.5646-5652 — Please check the resolution of the figures; they don't appear so nice on my pdf viewer (Acrobat). And make all table and figure captions more descriptive, as it is they are not understandable without the accompanying text.

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