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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Retrieval of aerosol single scattering albedo at ultraviolet wavelengths at the T1 site during MILAGRO" *by* C. A. Corr et al.

C. A. Corr et al.

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We thank the reviewers for their thoughtful comments and suggestions and have addressed each reviewer's comments below. Reviewers 1 and 2 comments will be denoted by 'RC1' and 'RC2', respectively, with the author comments denoted by 'AC.'

RC1: Table 1 should be simplified with necessary explanations moved to footnotes. Columns 6 and 7 should be modified to make the results easy to find. Perhaps extra columns could be added to separate the results from the method explanations. Remove wavelength designations from column 8 and give only results that correspond to wavelengths listed in column 4.

AC: Done.

RC1: The color blue used in the Figures did not reproduce well and is difficult to distin-

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guish from black. The use of a brighter color would better define the Figures. Also the symbols used to label the plot axes should be larger and more descriptive [e.g. "Single Scattering Albedo (ω)" instead of just "ω"] with full descriptions in the Figure captions.

AC: Axes labels were made larger. The color blue was changed in a few plots but not in all as the blue appeared light enough and thus was distinguishable from black.

RC1: Figure 1: The title on the plot is unnecessary and should be covered in the Figure caption. Better define the numbers scattered throughout the Figure in the Figure caption. i.e. Lin-Quad=-0.002; Air mass = 3.778; __ = 0.01; etc. Can some of these be omitted from the plot and explained in the caption only?

AC: All in-figure text was removed and explained in the figure caption. The title was also removed.

RC1: Figure 2: Explain the graph inset (ln Vo, _, and last number column) in Figure caption and also in text. What is meant by the statement in the caption "The RMS difference between AERONET and UV-MFRSR _ (0.004) is shown to the right"? Explain this relationship in the text.

AC: A more thorough explanation of the graph inset can now be found in the figure caption. A description of the highlighted statement can be found on pages 4980 and 4981 of the text as well as in the figure caption.

RC1: Figure 3: It appears that the x axis is miss-labeled since the Figure caption says that it is for a fixed value of g. Omit the plot title as it is explained in the caption.

AC1: The wrong figure was inadvertently inserted for Figure 3. The incorrect figure, which shows DDR as a function of single scattering albedo and asymmetry parameter has been replaced with the correct figure which shows DDR as a function of single scattering albedo and asymmetry parameter.

RC1: Figure 4 is very difficult to read. Hopefully this will improve when the Figure becomes larger. Use a brighter color than blue to distinguish Level 1 from Level 2.

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AC: The blue was replaced with red. While the figure was reposted in a different format, it is uncertain that the quality has improved. We hope too that the figure will improve when made larger in the final version.

RC1: Page 4984, ln 5: It is assumed that the reference here to Fig 7 is for Fast et al. Fig 7 and not the Fig in the current manuscript. It may be less confusing to omit all Figure numbers except for those in the current manuscript and explain the results reported by Fast et al. in less specific terms.

AC: Done.

RC1: Figure 6: Omit plot titles (0319). It is difficult to tell which of the 3 plots the caption is referring to. Better discriminate between top left and top right plots in the Figure caption. What is meant by "middle" in the Figure caption? Does this refer to the lower plot? This could also be further explained in the text. Perhaps this Figure could be better presented if the first plot (AERONET_) were omitted since it is not covered in the text. If the authors feel that this information is necessary to fully understand the manuscript then maybe it should be presented as a separate Figure and explained fully in the text.

AC: The plot titles for figure 6 were removed and the figure caption fixed to refer to the correct plots. The AERONET aerosol optical depth plot is referred to on page 4984 and will therefore remain part of Figure 6.

RC1: Figure 10: Omit the insets in the Figure (ω= ; τ= ;) as they are explained in the caption,and correct these values in the Figure caption as they appear to be reversed from those in the Figure. Omit Figure inset "SAFS" and explain the acronym in the Figure caption.

AC: Done.

RC1: Page 4989, ln 18: The sentence beginning "In contrast..." is very difficult to follow. Please clarify.

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AC: Done.

RC2: The use of an NO_2 climatology instead of local simultaneous measurements of NO_2 is a severe limitation on the reliability of the single scattering albedo data. The authors should discuss this limitation, especially for such a polluted region as surrounds Mexico City. In the absence of NO_2 data, the SSA values are likely to be incorrect.

AC: We agree that this is a potential source of error in our retrieval that deserves discussion in our manuscript. To address this issue the following text has been added to the "retrieval techniques" section of the paper:

"It should be noted that error may also be introduced in the retrieval of ω with the assumption of a fixed NO_2 column concentration such as that used in this work's retrievals. Studies have shown that the use of the climatological NO_2 value will result in an underestimation of ω during high pollution episodes (Krotkov et al. 2005c). While the fixed NO_2 value of $\sim$0.4DU (1.1x10^{16} molecules/cm^2) used in all ω retrievals is consistent with that used in the AERONET inversions as well as with the background NO_2 value observed at the T1 site during MILAGRO (Johansson et al., 2009), such a value may not be representative of short-lived pollution plumes that passed over the T1 site during MILAGRO. It can be shown that the error in retrieved $\Delta\omega$ is determined by the ratio of NO_2 and aerosol extinction optical thickness at particular wavelength: $\Delta\omega/\omega \sim \Delta\tau_{NO2}/\tau$ (7)

Use of background NO_2 concentration when actual $NO_2\sim$2DU (5x10^{16} molecule/cm^2) under conditions with low aerosol loading ($\Delta\tau_{NO2}/\tau\sim$0.2, $\Delta\tau_{NO2}\sim$0.03 and $\tau\sim$0.15 at 368nm) results in significant underestimation of the retrieved ω at least 12% and 7% at 368nm and 332nm (Krotkov et al. 2005c). Accounting for τ spectral dependence in Eq. (7) the NO_2 error is even larger at 440nm (τ_{NO2} being approximately the same at 368nm and 440nm, but $\tau(368)>\tau(440)$). Therefore, under low aerosol loading conditions the NO_2 error can change significantly not only the absolute value of ω, but also ω spectral dependence. However, the error becomes practically negligible for aerosol

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laden pollution plumes when the ratio $\Delta\tau_{NO2}/\tau$ is small."

RC2: Before publishing this paper, the figures need to be improved. Each of the figures needs to use larger text as labels so that they can be clearly read. This is especially true for figures 5,6,8, and 9. Figure 2 is confusing at best with far too much information in one plot.

AC: The labels on all plots have been enlarged as requested. Because of its relevance to the discussion on V0, we wish to keep figure 2 in the manuscript. It is hoped that the above mentioned edits to figure 2's caption will make the figure easier to understand.

In addition to the changes mentioned above, an addition to the acknowledgments sections was made acknowledging the death of our colleague and operator of the T1 AERONET site, Mr. Wayne Newcomb, in December 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 4971, 2009.