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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simultaneous retrieval of aerosol and surface optical properties from combined airborne- and ground-based direct and diffuse radiometric measurements" *by* C. K. Gatebe et al.

C. K. Gatebe et al.

charles.k.gatebe@nasa.gov

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Dear Editor,

We have carefully considered referees comments' (reproduced below) and found them useful. We feel that the revisions done during the initial review adequately addresses some of the concerns. It is not possible to implement some of the suggestions such as error sensitivity analysis. That is too complex, involves a lot of effort and would constitute another independent study. So we took no further action.

Our detailed responses are found below interspersed with each of the referees' comments.

Referee #1: A. A. Kokhanovsky This is a very interesting paper. I have only one comment related to Figs. 7 and 8. It is known that the retrieval of complex refractive index (e. g., the imaginary part) is a very difficult task, which requires polarization measurements and even then it is not always possible. I think, authors need to look back in both figures and check, if their measurement set-up is adequate to get the parameters presented in Figs. 7 and 8. Simulations with synthetic data (with account for measurement errors, cloud contamination, and unknown surface albedo) are needed to prove the concept. It looks like the values of single scattering albedo are underestimated in some cases (e.g., below 0.5). For the case of Mexico city, the single scattering albedo in lower atmospheric layers is higher as compared to the upper troposphere, which is usually not the case. Sections 4.2.2 and 4.2.3 must be expanded and the error analysis must be performed.

The figures in question, Figure 7 and 8, refer to aerosol single scattering albedo and complex index of refraction, respectively, retrieved from combined CAR and AERONET measurements over four sites: Mongu, Zambia, Mexico City, Mexico, SGP Central Facility, Oklahoma, and Elson Lagoon, Barrow, Alaska. The issue raised by Dr. Kokhanosky about the low values of the single scattering albedo was addressed earlier during the initial submission, where we did revise section 4.2 as recommended. Also, as noted in that section, some of the retrievals are when the aerosol optical thickness is far less than 0.4, which is often assumed to be a rough cut-off for single scattering albedo retrievals for sunphotometer retrievals, and often leads to degraded accuracy due to insufficient signal-to-noise. In our case, this is especially true for above the aircraft when the optical thickness is quite low. No doubt, this kind of quantitative assessment would help one interpret the meaning and significance of the results, but involves complex analysis and require a lot of time to implement. It clearly does constitute an independent study and will have to be carried out in future. The lack of error

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analysis does not diminish the importance of our results. It took several years to get to this point.

Referee #2: Anonymous The paper is very interesting and new scientific information can be expected from applying the described joint inversion scheme for optical properties of aerosols. While aerosol size distribution is discussed in detail, there is much less discussion on the results for the single scattering albedo and refractive index. More comparison to AERONET results would better illustrate the potential of the synergy of CAR/radiometer retrieval. Adding first results from the announced sensitivity study and error analysis would be very beneficial.

We agree that including error analysis on the inversion products would be a big plus. However, as stated in our response to the first reviewer, this kind of analysis is complex and requires a lot of time and effort, and outside the scope of this study. We took no further action in sections 4.2.2 and 4.2.3. This is because the sections were extended during the first initial review.

On the question of making more comparisons to AERONET, we would like to point out that since the new algorithm is an extension of the AERONET algorithm as described in the paper, we feel it's more meaningful to compare joint retrieval products to independent approaches, but they are rather difficult to find. No action was taken.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 26491, 2009.