Atmospheric Chemistry and Physics Discussions

Interactive
Comment

Interactive comment on "Aerosol single-scattering albedo and asymmetry parameter from MFRSR observations during the ARM Aerosol IOP 2003" *by* E. I. Kassianov et al.

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The paper by Kassianov et al. describes a technique for the simultaneous retrieval of the intensive aerosol optical properties single scattering albedo w0, and asymmetry factor, g. Some parameters have to be assumed for the retrieval: variances of the bimodal size distribution, real part of the refractive index, surface albedo. The methodology used is an updated version of the one presented by Kassianov et al. (2005). The retrieved optical properties have been compared with the results of surface and aircraft measurements and the AERONET retrievals: the conclusion is that the method performs well under various aerosol conditions.

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The paper does not provide all the information needed for the reader to understand the methodology. Most of those information are probably included in the two recent papers (Michalsky et al., 2006 and Ricchiazzi et al., 2006) and in the one by Kassianov et al. (2005) cited in the manuscript, but they should also be included in this work in order to make it clearer. Moreover, the methodology is refutable if not supported by more specific motivations. This aspect will be cleared in the "Specific comments" part.

Overall, my opinion is that the paper requires a deep review.

The methodology is not exhaustively described, as well as the part related to the instruments deployed at the SGP ARM site and the cases selected for the analysis should be more deeply described. For example, from the first lines, the reader comes to know that an aerosol lidar was operated at the site and that an aircraft performed some flights during the aerosol IOP. A list of all the available instruments useful for this study may be helpful.

The IOP lasted ran from 5 to 31 May 2003 by the aircraft collected data only for 15 days: specify the time interval.

The cases selected for the analysis are 8, from 7 different days, and reported in table 1. Some days are described in the text (lines 25-27 on page 13370 and lines 1-4 on page 13371): they are 9, 12, 27 and 28 May. What about the other days? Maybe a more complete description of the 8 cases, with time behavior of aerosol optical depth,tau, and Angstrom exponent may be helpful.

Scattering and absorption coefficients are measured both at the surface and during flights by nephelometer and PSAP. Are the two nephelometers and the two PSAPs the same model? Where the two couples of instruments inter-calibrated prior and after the campaign? What are the uncertainties on w0 and g derived from these measurements?

The manuscript is completely missing statements on data retrieval methods and uncertainties in the derived tau. For instance calibration of both MFRSR and NIMFR,

Rayleigh correction and gas absorption (ozone, water vapor). How is the Angstrom exponent cited on line 2, page 13371, calculated? Are the tau values from MFRSR or NIMFR used? Using only two channels (for example 415 and 870 nm) or from a fit using the optical depth at all channels?

On page 13372, lines 7-10, the reference from Michalsky et al. (2006) is cited for the agreement of CIMEL and NIMFR derived tau. The comparison of coincident MFRSR, CIMEL and NIMFR derived tau at ARM site would be essential in this respect, particularly because in the retrieval aerosol optical depth from NIMFR and DDR from MFRSR are used. What are the biases among the three datasets?

In lines 9-10 the authors say that tau values obtained from the NIMFR are used in the study. This is a key question. Is it a typing error? Otherwise, why didn't they use the MFRSR optical depths? Why using two different instruments, with the consequent differences in calibration and measurements, when only one instrument is able to provide all the measurements needed for the retrieval of w0 and g?

Figure 2 shows the comparison of spectral tau from MFRSR and from Mie calculations. I would like to see the error bars added. In order to maintain the consistency of the method they should also present tau values from NIMFR.

Size distribution and complex refractive index are not independent. Which complex refractive index is assumed in the retrieval of Nf, Rf, Nc, Rc? What are the lower and upper limits of the 5 parameters (Nf, Rf, Nc, Rc, imaginary part of the refractive index) that are varied in the build-up of the look-up tables?

On page 13373, lines 15-17 the authors say that the imaginary part of the refractive index is estimated from the MFRSR DDR, instead of diffuse irradiance alone, as was done with the previous method. Please specify which wavelengths are used for the retrieval of the refractive index.

Please, add some more information about the correction applied to the forward-

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scattered radiation.

The method to retrieve w0 from direct-to-diffuse ratio (DDR) was first outlined by Herman et al. (1975); I suggest to cite this reference in the Introduction, line 24, page 13369. Herman, B. M., Browning, R. S., and DeLuisi, J. J.: Determination of the effective imaginary term of the complex refractive index of atmospheric dust by remote sensing: the diffuse-to-direct radiation method, J. Atmos. Sci., 32, 918-925, 1975.

I would change the title of section 2 from "Approach" to "Methodology" and I would add in this section the first part of section 3 (Optical properties), lines from 22 to 26 of page 13373 and from 1 to 6 of page 13374.

I would like to have an idea of the uncertainties on w0 and g both from surface and aircraft measurements and from AERONET and MFRSR retrievals. They could be added in the histograms of figures 3 and 4.

Page 13376. Specify that the direct and diffuse irradiance are broadband (which is stated only in the abstract) and add error bars on both measured and modeled irradiances in figure 5.

Page 13369, line 21: change "values" with "quantities".

Page 13369, line 29: I would say "Since g is highly variable in space and time".

Page 13372, line 19: change "describing" with "described".

Page 13375, line 21: add "is" after "that".

Page 13375, line 22: a space is missing after "experiment".

Page 13380, line 21: Geophys. Res. Lett., 33, L24817, doi:10.1029/2006GL027869.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 13367, 2006.

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