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Atmospheric Chemistry and Physics Discussions



# *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.

**Anonymous Referee #1**

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This paper is a continuation of Kassianov et al., 2005 (hereafter K05), but with the following changes:

1) The paper assumes 2-mode log-normal size distribution other than 3-mode in K05.

2) This paper now retrieves the imaginary part of refractive index by using diffuse/direct flux ratio other than diffuse flux alone as in K05.

3) This paper now retrieves (Nf, Rf) for fine mode aerosol and (Nc, Rc) for coarse mode aerosol, while K05 retrieves N and R for overall size distribution.

4) The revised method is applied to the data collected in ARM SGP site, and the re-

trieved W and g are compared against the other independent measurement. The retrieved parameters are also used in the radiative transfer closure experiment.

Similar work has been done extensively in the past studies (e.g., King et al., 1978, J. Atmos. Sci.), Nakajima et al., 1996, J. Appl. Meteor.; Dubovik et al., 2002, JGR ; Kim et al., 2004, JGR). The important parameters involved in the retrieval entail aerosol size distribution, refractive index, and surface albedo. The measurement usually can not provide sufficient information to retrieve all these parameters. Hence, assumptions have to be made on one or several of these parameters in order to retrieve the other parameters. In this paper, assumption on surface reflectance, real part refractive index and the variance of size distribution are assumed. The asymmetry parameter is a derived quantity, not a directly retrieved value.

In this context, I am confused about the motivation and the value of this paper. I suggested authors to highlight the new idea or technique in the current method. Other major concerns are listed in below:

1) The method is not well described. In fact, I have to first read K05 paper, which gives me confusion also. In K05, 3-mode size distribution is assumed. I don't see how two parameters N and R can constrain the 3-mode size distribution? In total there are 9 unknowns (number, mean radius and variance of each mode). Even the variance and mean radius of each mode are fixed, we still have 3 unknowns. Please clarify! I probably miss something in the paper.

2) In the current method, there are 4 unknowns for the size distribution, why the look-up speed is increased by a factor of 10? K05 paper only has two unknowns (N, R) for the size distribution.

3) Is your retrieval sensitive to the variance assumed? Some sensitivity analysis seems necessary. See Kim et al (2004, JGR, doi:10.1029/2003JD003387, Aerosol optical properties over east Asia determined from ground-based sky radiation measurements.)



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4) Hansen and Travis (1974) showed that it is more useful to describe the different size distributions in terms of effective radius and effective variance. The different combination of Nf, Rf, Nc and Rc can give the same reff and veff, and hence the same agreement between the calculated and the observed spectral optical thickness. How do you avoid multiple solutions in the retrieval? There are many size distribution data available in the ARM site (see ARM special issue in JGR 2006), why in this paper, there are no comparison between your retrieved size distributions with those in situ observations?

Minor concerns;

Page 13370, line 25. "One of these layers has high absorption (maybe smoke)." In the ARM IOP special issue in JGR 2006, several papers have indicated there were Central America smoke transported to the ARM in May 9-May 12(e.g., Wang et al., 2006, JGR, doi:10.1029/2005JD006416; Gasparini et al., 2006; doi:10.1029/2004JD005448). Cite these references to avoid "maybe".

Also page 13370, line 27, “another has less absorption (maybe dust)”. Again, I encourage authors to read the ARM special issue in JGR to gain a better knowledge on the aerosol events and aerosol properties during IOP 2003. It will also help you to explain your retrieval results, in particular, the variability of single scattering albedo and g.

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



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