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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol optical depth and fine-mode fraction retrieval over East Asia using multi-angular total and polarized remote sensing" *by* T. Cheng et al.

Anonymous Referee #1

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"Aerosol optical depth and fine-mode fraction retrieval over East Asia using multi-angular total and polarized remote sensing"

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This paper discusses a new aerosol retrieval algorithm from multi-angular total and polarized measurements. The algorithm uses the lookup tables (LUT), calculated for bi-modal log-normal mixtures of 6 fine and 6 coarse aerosol models. The algorithm fits total and polarized radiances at 3 wavelengths and retrieves aerosol optical depth (AOD) and fine-mode fraction (FMF). The algorithm is tuned for applying to PARASOL

data over East Asia. With that purpose the aerosol models are chosen by applying the cluster analysis to AERONET retrievals over East Asia. The algorithm has been applied to PARASOL data and the results were successfully validated by comparisons with AERONET observations. The paper is clear and well written. The results are well explained and illustrated. At the same time, the paper seems to be too descriptive. In depth discussion of the method accuracy, potential limitation and possible perspective future improvements is missing. Therefore, I recommend the publication of this paper in Atmospheric Measurement Techniques "after a minor revision". I have outlined below the comments for the authors consideration.

Comments:

MAIN ISSUE. The authors provide clear technical description of the algorithm, however they do not provide any discussion why this particular design of the algorithm was chosen, what are limitations and accuracy, what are the alternatives and perspectives. I suggest including such discussion. Below I outline some specific comments.

- Eq.(1) is based on an approximation. It is fully valid in single scattering approximation only. Wang and Gordon (1994) showed that this approximation introduces an error that does not exceed 4% for optically thin situation (optical thickness is up to 0.4). However, over East Asia high aerosol loading events are frequent with TAU=1.0 and even much higher. Evidently, this approximation may introduce much quite significant error. Ref: Wang, M., and H.R. Gordon, Radiance reflected from the ocean-atmosphere system : Synthesis from individual components of the aerosols size distribution, Appl. Opt., 33. 7088-7095, 1994.

- Eq.(2) defines the residual term. This definition is very simple. It does not account for possible differences in accuracies of observations in different spectral channels and different observation angles. This definition increases the importance of fitting observations with higher magnitudes. Correspondingly, such definition of residual may bias algorithm towards total reflectance, because the magnitudes of total reflectance

are generally much higher magnitudes than polarized radiances. Is this definition of the residual is optimal?

- The algorithm uses only 3 spectral channels of PARASOL, why other spectral channels are not used?

- The authors state that coarse mode aerosol was assumed as mixture of spheroids and the optical properties were calculated T-matrix code. I wonder if the authors really used T-matrix code. If so, it would be useful if they indicate which shape distribution was used for the spheroid mixture and how the optical properties of particles with radii of 2 microns are larger were accounted (T-matrix code may have problems with convergence here). If the authors simply used an approach employed in AERONET retrieval, that should be stated with appropriate reference.

- Page 5691, paragraph 15. The authors state remaining uncertainties in estimates of DFR. I suggest adding more recent references, for example, the paper by J. Hansen recently appeared in ACPD.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 5689, 2011.