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Atmospheric Measurement Techniques Discussions

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Interactive Comment

Interactive comment on "Multiple scattering in a dense aerosol atmosphere" *by* S. Mukai et al.

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Q1:

This paper is of interesting content. However, I am not sure what this paper is really about: 1) a new radiative transfer solver based on MSOS or 2) a new retrieval?

If 1) is the case, it should be stressed more clearly what is new compared to existing models, and accuracy tests should performed in comparison with independent community models, e.g. DISORT or Monte Carlo, from which is assumed that they are exact. Then dense aerosol layers could be considered under different scenarios to discuss multiple scattering effects as announced by the title. All this is not included in the present version of the paper. The application in some retrieval is not of interest here.

If 2) is the case, what is new in this regard? The fine mode fraction is the only parameter to be independent. Size distribution and complex refractive index data from AERONET are applied. Thus, the presented retrieval is not really a retrieval and also not independent. On the other hand, Fig. 1 indicates that, e.g., the complex refractive index can be derived by the authors' retrieval. Why not comparing their products to AERONET?

A1:

This manuscript intends to develop an efficient algorithm to retrieve aerosol characteristics in aerosol events. Therefore, the answer is 2) for your first question.

A flow diagram for aerosol retrieval in general from satellite data is shown in Fig 1. It is known that optical thickness of the atmosphere increases during aerosol events, where incident solar radiation experiences multiple interactions with aerosols due to the dense radiation field. And hence, efficient algorithms are required for calculating the multiple scattering processes in an optically thick atmosphere model. The MSOS, which is available for calculation of the radiation field reflected from the semi-infinite atmosphere, is a required method to solve our present problem. It is shown in this work, the MSOS is available for a simulation scheme in the dense radiation field being used to retrieve aerosol properties in the event with the high optical thickness. Finally our algorithms are practically applied for the biomass burning aerosol event over the Amazon using Aqua/MODIS data.

Regarding the satellite remote sensing aspect in general for the retrieval of aerosol characteristics, much wide variety of aerosol parameters should be required (Mukai et al, 1992) in order to accomplish accuracy and reliability of our retrieval method. In this work, however, an efficient and practical algorithm to retrieve biomass burning aerosols is desired. Therefore, intrinsic parameters with except to size or refractive index of aerosols are considered alone.

AMTD

5, C487–C491, 2012

Interactive Comment

Q2:

Is f not retrieved by AERONET, too? The various aerosol types in Table 1 should also be campaigned by characteristic mean values of f. How fit the retrieved f to the latter values, in particular to the case of category 2?

Why comparing the 'polluted marine' case with the retrieval case of f = 0.185 and the 'biomass burning' case with f = 0.31 in Fig. 4 to state in the main text that it would be '?

A2:

Our retrieval process of biomass burning aerosols from the forest fire is based on comparison between satellite data and the reflectance calculated using the MSOS. The results of the MSOS are independent of the AERONET data. Thus, Fig 3 indicates the comparison of satellite data with AERONET data.

Why using a mixed aerosol type in the retrieval, while a specific biomass burning event was considered?

A3: In the practical application, the refractive indices of the biomass burning is not clearly, because the aerosol parameters such as size distribution and complex refractive indices are varied by the burning process and/or the aging of particles. Thus we use aerosol model from AERONET data based on practical measurements as the initial value of the retrieval.

Q4:

Why not considering satellite reflectances directly above the AERONET sites A and B?

AMTD

5, C487–C491, 2012

With regard to Fig. 2 I have the impression that the coloured boxes indicate the area to which the satellite measurements refer? Then it would be mandatory to use data directly above or closest to A and B.

A4: Since the values of the satellite data over the AERONET site-A and-B are too low to represent the biomass burning events.

Q5:

Why is k(0:46μm) varied and not one of the other three parameters? A change in the AERONET-retrieved refractive index and a simultaneous application of the AERONET size distribution data would lead to inconsistency with respect to the sun photometer measurements which are the basis to derive the AERONET products. Of course, AERONET products might not provide the only set of aerosol parameters to match these measurements, however, the authors changed only k(0.46μm).

A5:

Because it is shown from the AERONET data that the carbonaceous aerosols strongly absorb the short wavelength radiation (Eck et al, 1999), and the 0.46 μm band is the shortest wavelength channel of the MODIS.

Q6:

Why not applying the size distribution data for the particular case of 21 in September of 2005?

A6:

Because, the AERONET data indicate high optical thickness on 21 September 2005 at

AMTD

5, C487–C491, 2012

the Brazil, and the MODIS data shows the characteristics of the carbonaceous aerosol, which the plumes become trancemissive in the long wavelength.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 881, 2012.

AMTD

5, C487–C491, 2012

Interactive Comment