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Interactive Comment

Interactive comment on "Dust events in Beijing, China (2004–2006): comparison of ground-based measurements with columnar integrated observations" *by* Z. J. Wu et al.

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Response to the reviewer 2:

This paper generally well describes the physical and optical characteristics of dust events observed at Beijing, China during the springtime of 2004-2006. Both ground-based measurements of particle size distribution and column-integrated aerosol optical properties (including Angstrom exponent, AOD, refractive index, etc.) retrieved from AERONET were analyzed. Some meteorological data (including sounding) and TOMS

AI with aerosol mass concentration data also used. Following comments need to be more clearly addressed:

Synoptic scale view of dust events needs to be considered in the dust event categorization and characterization of optical properties. In this paper authors are mainly concentrated on the measurement data at Beijing, except for TOMS AI and back trajectories. Spatial and temporal evolution of each dust events from source regions to Beijing would be also important to understand aerosol optical properties of two dust types categorized in this study. More quantified evidence to support authors' categorization and findings would be required. (in section 3.4.2) Authors mentioned the extinction contribution by urban aerosols between type 1 and 2. But it is possible if authors carry out optical closure study (i.e., physic-chemical apportionment study of aerosol light extinction with size and components) for fine and coarse mode aerosols. In the retrieval of the aerosol volume size distribution, the cause of discrepancy between AERONET and TDMPS measurements needs to be discussed with more detailed explanation. More new and unique findings from the study needs to be provided.

Response:

The authors think that the categorization of dust events based on the particle number size distributions and local meteorological parameters has already been very clear. The optical parameters provided by AERONET support this categorization. If the discussions on synoptic scale view of dust events are involved into the categorization, the paper will be too much complicated. Moreover, the brief explanation is not enough for clearly presenting the synoptic scale characterizations of 18 dust events. More texts could lead to a tedious manuscript.

In order to study the spatial and temporal evolution of dust events, we need multi monitoring sites at different locations along the track of the dust storms. However, there

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is only one observation site at which particle number size distribution data are available in this study. The AERONET data are possibly one option to do this. But, most of AERONET sites upstream Beijing including Asia1 (2007), HAMI (2003), Dunhuang (2001), Lanzhou_city (2008), Yulin (2001-2002), and Inner_Mongolia (2001) only have short-period dataset. There is one AERONET site (Dalanzadgad) in Mongolia with long-term observations. But it is not enough to perform studies on spatial evolution of dust events.

The physic-chemical apportionment of aerosol light extinction is good way to gain insight into the particle optical properties in the urban atmosphere during dust events. Unfortunately, the chemical compositions for dust particles are not available.

Concerning the discrepancy between AERONET and TDMPS measurements, two reasons are stressed here. One is the different methods to obtain the data between AERONET volume distributions and TDMPS ones. The expected accuracy of AERONET particle volume size distributions is 15-25% for particles larger than 0.5 μm in radius (Dubovik and King, 2000; Dubovik et al., 2000) including the coarse mode and dust aerosols. This may result in the discrepancy. Another reason is the vertical distributions of aerosol particles are not homogenous. Iwasaka et al. (2004) measured the particle vertical distributions using the balloon-borne measurements with an optical particle counter (OPC) at Dunhuang, China. They found that the particle size and concentration had noticeable peaks in super micron size range not only in the boundary mixing layer but also in the free troposphere and Super-micron particle concentration largely decreased in the mid tropopause (from 5 to 10 km; above sea level, a. s. l.). Because the AERONET volume distributions reflect the columnar integrated properties, the non-even vertical distributions may lead to the difference in columnar volume distributions and ground-based measurement. A little bit more discussions will be added into the MS.

The authors would like to thank for these constructive suggestions from the referee. But, most of them can not be performed in this study due to the limitation of dataset

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and article length. These points will be considered in the future studies.

Modification in the MS:

The discrepancy may originate from the different accuracy of the methods to obtain the data between AERONET volume distributions and TDMPS ones. The expected accuracy of AERONET particle volume size distributions, which is 15-25 % for dust particles larger than 0.5 μm in radius (Dubovik and King, 2000; Dubovik et al., 2000), is lower than those of TDMPS and APS. Another possible reason is the vertical distributions of aerosol particles are not homogenous during dust events. Iwasaka et al. (2004) measured the particle vertical distributions using the balloon-borne measurements with an optical particle counter (OPC) at Dunhuang, China. They found that the particle size and concentration had noticeable peaks in super micron size range not only in the boundary mixing layer but also in the free troposphere and Super-micron particle concentration largely decreased in the mid tropopause (from 5 to 10 km; above sea level). Because the AERONET volume distributions reflect the columnar integrated properties, the inhomogeneous vertical distributions may lead to the difference in columnar volume distributions and ground-based measurement.

Reference:

O. Dubovik and M.D. King, A flexible inversion algorithm for retrieval of aerosol optical properties from Sun and sky radiance measurements, Journal of Geophysical Research-Atmospheres 105(2000), pp. 20673-20696.

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