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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optical properties of atmospheric fine particles near Beijing during the HOPE-J^{3}A Campaign" *by* X. Xu et al.

Anonymous Referee #2

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The authors describe field measurements during November 2014 - January 2015 in the North China Plain. They measure aerosol extinction, scattering, and absorption, together with size distribution and composition. They examine the aerosol optical properties in detail over two days with different pollution levels. The cavity-enhanced albedometer is a unique and interesting instrument. However, some important questions need to be addressed before publication.

Major Comments

1. The repeatability of the cavity-enhanced albedometer is mentioned, but its accuracy is not discussed. The following questions should be addressed:

- How has the cavity-enhanced albedometer been validated? How well did the mea-

surement agree with Mie calculations for standard aerosol particles (PSL, ammonium sulfate)?

- How does the truncated fraction of total scattering vary with particle diameter, and what error does that introduce?

- What was the precision of the mirror reflectivity and scaling factor measurements?

- Define the "scaling factor (K')".

- Add an error budget for the cavity-enhanced albedometer and give the total uncertainty. The error budget would include uncertainty in temperature, pressure, Rayleigh scattering of calibration gases, truncation angle, aerosol sampling losses, and possibly other factors.

2. The introduction is well-organized and well-written in five paragraphs. In contrast, Section 4 (Results and discussion) and Section 5 (Conclusions) are long and contain too much detail. The paper would be strengthened if the authors edited sections 4 and 5 to shorten their discussion to the most important points and eliminate repetition.

3. The authors use the IMPROVE algorithm (Pitchford et al 2007) for comparison to their measurements. The IMPROVE algorithm predicts optical extinction at 550 nm, and is not directly comparable to measurements at 470 nm. I do not understand how the authors correct for this. They state (pg. 33686, lines 14-18): "One point should be kept in mind that the above discussion of the IMPROVE algorithm was suitable for the reconstruction of atmospheric aerosol extinction at lambda = 550nm. In this study, the optical properties of PM1.0 were measured at lambda = 470nm. The IMPROVE algorithm need further improve to well represent the chemical apportionment of light extinction for PM1.0 particles."

4. The IMPROVE algorithm is a simplified prediction of extinction that is intended to be used when no size distribution measurement is available. The authors have the necessary information to directly calculate aerosol extinction, scattering, and absorp-

tion using Mie theory. The Mie calculation assumes that the aerosol are spherical and well-mixed, but it would be more accurate than the IMPROVE algorithm. The approach would be to use the the AIM or ISORROPIA model to determine salt concentrations from the measured ion concentration. The salt concentrations, their density and refractive index values from literature (see values in Hand and Kreidenweis, 2002, AST), and the measured size distribution would then be used with Mie theory to directly calculate aerosol absorption, scattering, and extinction.

5. The authors have data on aerosol optical properties and size distribution with high time resolution. In contrast, the filter composition was measured every 12 h and the classifications of "clear", slightly polluted", and "polluted" are based on a 24 h government definition. Interpreting the high time resolution data within simplistic 24 h classifications and only looking at a few days means that it is difficult to draw conclusions. Are any high time resolution gas-phase measurements available? This would open two analysis possibilities: 1) Individual air quality index could be calculated at higher time resolution (using SO2, NO2, O3, CO measurements); or 2) The aerosol optical properties could be correlated with tracer species to identify the likely sources.

Other Comments

How often was the particle size distribution measured?

Pg. 33679, line 4: Change "higher than 500 ug m-3" to "higher than 500 ug m-3 for Beijing"

Pg. 33680, line 18: Add reference for MODIS data.

Pg. 33680, lines 23-24: "The inlet consisted of a PM1.0 ambient size cut (SF-PM1.0, 1.0m3 $h-1$, Seven Leekel Ingenieurburo GmbH), allowing only particles with an aerodynamic diameter smaller than 1 μm to enter the sampling line." Is this correct or does the inlet have a 50% cut-point at 1.0 um?

Pg. 33683, line 17: Add a definition of the Ambient Air Quality Index 633-2012. My un-

derstanding is that it is the highest of six pollutant values, but only PM2.5 is mentioned here.

Pg. 33684, lines 13-14: "The CRI is one of the intensive optical properties of atmospheric aerosols, and determined by the aerosols' size, shape, mixing state and chemical composition." CRI depends only on chemical composition of a material. It does not change with size or shape or mixing state.

Pg. 33685, lines 10-12: "Projections of the contour lines (with a contour value of 2.298) on the n and k plane gave the standard errors n and k, respectively (Dinar et al., 2008; Zhao et al., 2014)." This statement is unclear.

Pg. 33689, lines 14-19: It is very difficult to match the back trajectories to the periods of interest. Change Fig. 4 to show back trajectories for the highlighted periods.

Pg. 33693, lines 13-27: This general discussion is common to all of the six periods. It should be moved to Section 4.1.

Change "Seven Leekel" to "Sven Leckel" throughout.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 33675, 2015.