Wang et al.: Optical and microphysical properties of natural mineral dust and anthropogenic soil dust near dust source regions over Northwestern China, Atmos. Chem. Phys. Discuss., doi.org/10.5194/acp-2017-686, 2017

REVIEW

GENERAL

The paper presents measurements, results and analyses of optical properties and size distributions of surface layer aerosols in Northwestern China. Mineral dust affects air quality and climate over very large areas and they can be observed very far from their sources. In observations far from the sources the aerosol is typically aged and mixed with other particles. Therefore it is very valuable that measurements are conducted also near the sources. This manuscript presents measurements very close to or essentially at the source and is valuable as such. One of the weaknesses of the work is that particle size range of the optical measurements was limited to 2.5 µm. In dust storms there are often larger particles like the authors' own APS measurements show. But now the data are here and also they yield good information. The authors could use the full extent of the data to obtain also more information as I will suggest below.

I can recommed publishing the paper in ACP, but I did find something to be revised.

DETAILED COMMENTS

There is no text on the calibration of any of the instruments. In dusty conditions such as the sites where the measurements were conducted, instruments get quickly dirty and calibrations change. How did you deal with this? Write about calibrations, flow checks etc.

In addition to calibrations, also data processing needs some revision.

The nephelometer suffers from a problem called truncation which leads to underestimation of scattering. The error is the larger the larger the particles are. Read and cite Anderson and Ogren: Aerosol Sci. Tech., 29, 57–69, 1998 and Müller et al.: Aerosol Sci. Tech., 43, 581–586, 2009 and use their algorithms to correct the scattering. The corrected scattering coefficients will be larger than the ones presented now. And so will the corrected single scattering albedos also be.

The nephelometer used in the campaign also measures backscatter coefficient. Why is there nothing about that in the whole manuscript? It would be a valuable addition to the paper. If the instrument was working I strongly recommend presenting and discussing also backscatter coefficients and backscatter fractions at 3 wavelengths, both in figs and tables.

There was the APS. Why was that not utilized more? I have some suggestions, not requirements. First, calculating integrated volume concentrations for PM2.5 would yield some quality control when compared with the TEOM. And if they correlate well, they would together yield an estimate of the dust particle density, at least in such cases when particles were dominated by supermicron particles. That would be valuable.

Second: estimation of scattering coefficient would not be difficult either. If you don't have a Mie code, you can find them in the internet, calculate scattering efficiencies for the size channels of the APS and then calculate scattering coefficient of each size and finally integrate over the size range. An important question would be, for instance, how large a fraction of scattering did you not get measured because of the impactors in front of the nephelometers? Sure, the particles were not spherical and Mie theory not accurate but it would yield an estimate.

Third: the APS data could also be used for calculating some weighted mean diameter, e.g., volume-weighted mean diameter VMD of the size distribution and compare that with the Åsp. That would be valuable since satellite-derived products use wavelength dependency for estimating size.

There was also an SP2 in the campaign, at least according to Fig 3. Why was it and its data not discussed at all? It would potentially yield also interesting and important results. Comparison with MAAP in different cases for instance. The MAAP measures light absorption which may also be due to absorbing mineral aerosols, not just BC.

P6, L5 – What is Hexi corridor? Not well-known for non-Chinese.

P7, L3- Define or explain floating dust.

P8, L3-4, The detection limits of the scattering coefficients were obviously taken from the Table 4 of Anderson et al., 1996 for 300 min averaging time. But in that table there is not the multiplication by 10. So, the detection limit oftotal scattering at 450 nm is 0.44 Mm-1, not 0.44 x 10 Mm-1 like the authors claim on L3.

P8,L7: MAAP wavelength: the MAAP manual claims it is 670 nm but Müller et al. Atmos. Meas. Tech., 4, 245–268, 2011 measured it to be 637 nm. You should reprocess the data. First correct scattering for truncation, then use MAAP data for calculating SSA. But, instead of assuming the wavelength dependence of absorption, use the wavelength dependency (Åsp) of truncation-corrected scattering and interpolate the scattering to 637 nm and present SSA at 637 nm. This way you avoid assumptions. The point is that the wavelength dependency and Ångström exponent of absorption by absorbing mineral dust may significantly differ from 1.

In Fig 1, show

- Hexi corridor – not well-known for most readers of ACP
- show a kilometer scale also in the upper panel
- use and show sub-panel letters a – d. Also for the upper panel.