Review of MS acp-2017-5 by L. Caponi et al.

GENERAL COMMENT

The manuscript presents important results from a carefully designed and conducted study on the light-absorbing properties of mineral dust from various origins. Dust samples collected at the different source regions have been re-suspended in an aerosol chamber and characterized with respect to microphysical, optical and chemical properties by state of the art methods. The study provides urgently needed knowledge on the multi-spectral light absorbing properties of mineral dust and for sure deserves publication in ACP. The manuscript is well structured, the methods are described in necessary detail and the referenced literature reflects the current state of knowledge. I recommend publication after the following minor revisions have been considered.

SPECIFIC REMARKS

1. In the experimental protocol section, the potential impact of gravitational settling on the re-suspended fraction of the dust samples is mentioned. Given the instrumentation list, the size distributions of the airborne dust samples were monitored during the runs of the experiments. It appears obvious to control the change of the size distribution during the experiment time in the chamber. Since the mass concentration in the chamber decreased very rapidly after injection, whereas the chemical composition of the dust samples was determined from bulk samples, it would be important to know if the airborne fraction sampled for the determination of optical properties features the same chemical properties as the bulk samples. At least a discussion of this potential source of uncertainties should be presented, along with a plot showing the change of the size distributions during the experiment time. The current analysis starts from the assumption that the dust bulk properties represent also the properties of the sampled airborne fractions. However, is this really justified?

2. In section 3.2, the variability of dust optical properties with particle size is discussed. The authors found no statistically significant size-dependence of the absorption Ångström exponent (AAE), whereas the absolute values of the mass absorption efficiencies (MAE) show large differences between the $PM_{2.5}$ and PM_{10} fractions with larger values for the fine mode fraction. These findings imply that the relative chemical composition with respect to light-absorbing compounds does not change between the size fractions (similar AAE values), whereas the differences between the MAC values indicate that coarse mode particles contain more non-absorbing matter than fine mode particles (higher MAE values for smaller particles). This however, this is in contrast to the assumption that the chemical composition is uniformly distributed across the particle size distribution. Here, a detailed discussion is requested.

3. In section 4, it is discussed that the potential impact of light absorption by mineral dust may play an important role even after long range transport. Cited studies all refer to observations in China. However, there is another detailed study on this effect available for the pollution plume of Dakar mixing with mineral dust which also includes the variation of the AAE during mixing (Petzold et al., 2011). The authors may consider including this study.

MINOR COMMENTS

1. The list of references contains various references which are not cited in the manuscript. This should be checked, I found the following but there may be more:

Anderson et al., 1998, Andrews et al., 2006, Arnott et al., 2005, Collaud Coen et al., 2010, Petzold et al., 2013.

2. Line 56: The sentence seems to be incomplete.

3. Line 97 – 98: The basic unit of mass concentrations is g m^{-3}. Using this unit, then the unit of the combined property MAE is m^2 g^{-1} as stated. In its current version this link is not clearly visible.

4. Line 102: The sentence seems to be incomplete.

5. Line 163: A reference for the uncertainty of the MWAA is required.

6. Line 912: Please check for correct reference, there is no reference Petzold et al. (2008) is the list of references.

7. In Figure 4, regression lines may be shown as full line to improve their visibility.

TYPOS

1. Line 108: It should read: “absorption Ångström exponent”.

2. Line 138: Skip “with”.

3. Line 165: It should read “deposited on a filter …”.

4. Line 245: It should read: “the uncertainty of values …”.

5. Line 253: Skip “by”.

6. Line 338: It should read: “$PM_{2.5}$ fraction”.

7. Line 426 – 427: I assume the Figures 4 are referenced here.

REFERENCES

Petzold, A., Veira, A., Mund, S., Esselborn, M., Kiemle, C., Weinzierl, B., Hamburger, T., Ehret, G., Lieke, K., and Kandler, K.: Mixing of mineral dust with urban pollution aerosol over Dakar (Senegal): impact on dust physico-chemical and radiative properties, Tellus, 63B, 619-634, doi: 10.1111/j.1600-0889.2011.00547.x, 2011.