

Interactive comment on “Optical properties and mineralogical composition of different Saharan mineral dust samples: a laboratory study” by C. Linke et al.

C. Linke et al.

Received and published: 7 July 2006

Answer to the comments of Referee 2:

We acknowledge the comments and suggestions for an improvement of the paper.

Specific comments:

The reviewer refers to the effect of cutting off the large size aerosols. The reason for limiting our experiments to the small particle fraction was to avoid significant particle losses by sedimentation in the horizontal sampling lines and especially the long horizontal flow tube of LOPES (length 3.5 m). In this way we minimized systematic errors in the calculation of the mass specific optical cross sections. In section 2.1 we added

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the following paragraph:

“Both the brush disperser and the dispersion nozzle were operated with dry and particle-free synthetic air. The dispersion pressure of the nozzle was 1.5 bar. The impactor stages with a cut-off $d_{(50)}$ of $1.2 \mu\text{m}$ (aerodynamic diameter) limited the size range of particles entering the NAUA chamber. Thus particle losses by sedimentation in the horizontal sampling lines and the long horizontal flow tube of LOPES were minimised resulting in a low systematic error of less than 5 % in the deduced specific optical cross sections.”

For a clearer illustration of our experiments we added a figure (Figure 2) showing representative APS size distributions of the four investigated dust samples. The impactor cut off size of $1.2 \mu\text{m}$ (aerodynamic diameter) limits the particle fraction entering the chamber. Our mass determination results from APS measurements which were directly sampled from the chamber and which cover the whole size range of the APS (i.e. $0.5 \mu\text{m}$ to $10 \mu\text{m}$).

We agree with the referee that it is reasonable to point out the use of the nephelometer in more detail. We therefore added the following description to section 2.1:

“The scattering coefficients at 450, 550 and 700 nm were measured with a commercial integrating nephelometer (TSI; 3653). The instrument was calibrated by CO_2 and filtered air. The nephelometer was operated at a flow rate of 5 L/min.

From extinction and scattering measurements the absorption coefficients can be calculated by the difference method (DM):

$$b_{abs} = b_{ext} - b_{sca}$$

Necessary nephelometer corrections are reasonable for moderately absorbing aerosols like biomass burning smoke with SSAs up to 0.7 (Schnaiter et al., 20053). For aerosols with higher SSA values the uncertainties in the calculated absorption coefficient increase due an increasing importance of the nephelometer and LOPES measurement errors.

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With regard to typical mineral dust aerosols with particle sizes above $0.5 \mu\text{m}$, broad distributions and non-spherical particle shapes, the nephelometer turned out to be not applicable for precise measurements of the scattering coefficient, necessary to deduce the absorption coefficient by applying the DM. Closer examination of similar sized, non-absorbing quartz glass beads and non-spherical quartz glass particles indicates that the nephelometer correction depends not only on particle size but also on particle shape. Therefore, we used the DM only in case of highly absorbing soot to validate the direct absorption measurements by the photo-acoustic absorption spectrometer.”

We do not agree with the referee that conglomerates were an artefact of our aeration process. Fine mineral particles are present in the atmosphere as aggregates as well. Aggregation is also a consequence of the diversity in mineralogical composition and the amount of weathered surfaces (Reid et al., *J. Geophys.* 108(D19).8591, doi 10.1029/2002JD002935, 2003). In this respect we added a new figure (Figure 8) showing a SEM micrograph of the Morocco sample. The inserted magnified image of a dust agglomerate gives an impression of the diversity of the dust samples in terms of size, shape and surface structure, which may be representative for naturally mixed dust aerosol.

The referee suggests a further discussion of our measured hematite extinction. We inserted the following paragraph in Section 5:

“The hematite sample consists of a narrow sized distribution of pseudo-cubic hematite particles (Sugimoto et al., 1993). The hematite spectrum shows a Mie-type resonance structure around 600 nm, but this does not affect the general absorption-induced flat spectral behaviour in the wavelength range below 600 nm, which is obviously a specific spectral feature of hematite.”

Page 2922 or 2905 line 19:

The basic idea of Fig. 9 was to compare the wavelength-dependences of the mineral dust samples. The extinction spectra were acquired at different times during the experiments, while the given particle concentrations in Table 1 refer to the particle con-

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centration at the beginning of the experiment. We replaced Fig. 9, now showing the mass-specific extinction spectra.

Details: Abstract: All absorption cross sections were measured with the PAS

Pg 2901 lines 15-25: The soot was polydisperse

Pg 2902 line 15: The PAS was only available in the second set of experiments. That was the only reason for the two sets of experiments

Page 2902 lines 20-25: We thought of contamination of the sample Cairo 3 too, but we could not detect significant higher concentrations of elemental and organic carbon.

Page 2903 line 3: We inserted: "The other fractions were removed."

Page 2904 line 12: Commonly by this kind of tempering process the carbonates were removed, to refer all measured elements to oxides.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 2897, 2006.

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