

## Interactive comment on “Aerosol classification by airborne high spectral resolution lidar observations” by S. Groß et al.

M. Tesche

*We thank Matthias Tesche for his fruitful comments and suggestions that helped us to improve the paper. The answers to the comments are given in a direct response (bold, italic).*

I have a few comments that mainly concern what is classified as Biomass burning aerosol (Africa) or African biomass burning (fresh) in the text.

I do not think it is an intuitive decision to separate between mixed Saharan dust and African biomass-burning aerosol mixtures. In fact, I don't see a difference between the two (except for the amount of dust in the mixture) and would widen the mixed Saharan dust type to include measurements with PDR > 10% as well. You show in Figure 6 that what you call African biomass burning (fresh) actually is a mixture of Saharan dust and dust-free smoke. Also, it is discussed in Section 3.4 that African biomass burning (fresh) is a mixture of dust and biomass-burning aerosol. You could introduce different stages of mixed Saharan dust that refer to the amount of dust in the mixture, e.g., high, medium, and low. Or you could flag the dust mixtures according to the other aerosol type(s) contributing to the mixture. Using a single mixed Saharan dust class (with subtypes for the mixing state of dust) would also eliminate the strange thin layer of fresh African biomass-burning aerosol on top of the dust mixture in the SAMUM-2 example in Figure 9 (as an artefact of the transition to aerosol-free air).

***We named this cluster ‘African biomass burning aerosols’ to stay consistent with former publications from the SAMUM community. Furthermore we want to separate the cluster dominated by Saharan dust with minor contributions of other aerosol types from the cluster of African biomass burning aerosols mixed with dust. We agree that the notation as ‘African biomass burning (fresh)’ is misleading and changed the notation to ‘African biomass burning mixtures’.***

Note that pure biomass-burning smoke has a much lower PDR than 10-15% (as you also show in Table 6). This should be clearly stated in the text. African biomass burning (fresh) implies that the values in your classification scheme are valid for entire Africa. If you want to avoid confusion with biomass-burning aerosol from central or southern Africa (which originates south of the ITCZ and never got in contact with dust-laden Saharan air), you should merge the African biomass burning (fresh) type with the mixed Saharan dust type or refer to it in a more correct way as wintertime southern West-African dust-laden biomass burning (fresh). You probably agree that the latter would be an awkward class.

***See comment above.***

Minor Comments

You have a brief discussion on ice particles and volcanic ash aerosol. The two species are also included in your flowchart in Figure 8. Why is it that the cirrus clouds from the LACE 98 case (at 8 km height in Figure 4) are not classified as ice in Figure 9a. Or is the figure just missing the label for ice?

***The discrimination of the different aerosol types for Figure 9 is based only on our own measurement results (Saharan dust, mixed Saharan dust, African biomass burning mixture, Canadian biomass burning aerosol, anthropogenic pollution, and marine aerosol). This point was clarified in Figure 9 by adding the following sentence to the figure caption: "As the discrimination of the different aerosol types shown in this Figure is based only on our own measurement results (Saharan dust, mixed Saharan dust, African biomass burning mixture, Canadian biomass burning aerosol, anthropogenic pollution, and marine aerosol) a classification for ice is missing; therefore the cirrus clouds in the LACE98 case are misinterpreted."***

Some more general questions follow from the last point. What is happening with clouds in the classification scheme? How do you get the white areas on the right side of the EUCAARI example in Figure 9?

***The white areas are caused by overload of the data acquisition.***

You could add some discussion on the reliability of the classification scheme. For instance, there is a Canadian biomass-burning layer in the SAMUM-2 example in Figure 9. In this context it would also be nice to see some discussion with respect to the classification scheme presented by Burton et al., 2012.

***The reliability of the classification scheme is very sensitive to the accuracy of the measurements of the optical properties used as input for the classification. In addition, the classification is more confident for some aerosol types (e.g. Saharan dust) than it is for others. We have expanded the discussion about the reliability of the classification scheme, and we have also included the results of Burton et al., 2012.***

Page 25992, line 17: Note that the backscatter ratio refers to the ratio of the total to the molecular backscatter coefficient. The displays in Figure 4 are correct but your definition at this point in the text is wrong.

***We have corrected the typing mistake.***

Page 25998, line 9: You mention that lidar ratios during the winter campaign of SAMUM-2 were found to be higher than the ones measured during SAMUM-1. I think it is worthwhile mentioning in the text (the values are included in Table 4) that no difference of the mean dust lidar ratio was found between measurements of SAMUM-1 and the summer campaign of SAMUM-2, when the overall transport pattern are much more similar than in a comparison of measurements conducted in summer and winter.

***We agree that the mean lidar ratios are more similar when comparing summer time measurements to summer time measurements, as different activation source regions during summer and winter time might be the cause for those differences in the lidar ratio. Nevertheless, we think it is important to show the full range of results.***