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

Anonymous Referee #3

We would like to thank the anonymous reviewer the useful comments and suggestions which help to improve the clarity and scientific quality of this paper. The answers to the comments are given in a direct response (bold, italic).

The paper demonstrates the utility of HSRL lidar observations for aerosol classification. In connection with other data sets – such as the quoted Burton et al. (2012) – it provides a very valuable data set, in particular, it could be instrumental for the classification of aerosols observed by space-borne HSRL instruments. In particular, these data have strong potential in the interpretation of future HSRL satellite observations of missions such as EarthCARE, albeit the latter operates at a different laser wavelength.
We are aware that EarthCARE operates at a different laser wavelength then our system. We clarified this point in the manuscript.

From section 2.5, it is understand that the back-trajectory calculations have been used to identify aerosol source regions, i.e., related the observed aerosol intensive quantities to the respective source regions. Quoting past publications, the authors assume that characteristic values (i.e. the observed intensive quantities) can be attributed to different (meaning, specific?) aerosol types and, subsequently, present their aerosol typing scheme in section 3.2. The authors should clarify explicitly whether the backtrajectory calculations are the only tool that attributes the observed intensive quantities to the aerosol source and expand the discussion on why aerosol source could be assumed here equivalent to aerosol type. (Fig 3 suggest age of the observed air of 5 or 7 days.)
Back-trajectory calculations have not been the only tool to identify different aerosol types. Independent in-situ measurements were also used to identify individual type. We revised Section 4.2 and describe the procedure of aerosol type classification with more detail.

The mixing lines in Fig. 6 are a good warning that mixed situations (in this case Canadian – Sahara) could get confused with a different type (African) and that caution is required when relying only on the proposed aerosol type identification scheme alone. This warning and the possibly required more rigorous use of back-trajectory calculation for HSRL data processing should perhaps be more thoroughly discussed and clearly stated. This aspect could be highly relevant for operational satellite data evaluation.
We agree with this comment. To emphasize this point we revised the text and discuss these possible ambiguities with more detail.

Microphysical properties (3.4, Fig. 7). The particle size distribution is interesting to see, but I understand these results from in-situ observations? What is the detection limit (in terms of particle size) at 532nm? What is the relevance of Fig. 7 (of the small end of the particle size distribution) for aerosol classification by lidar?
Indeed, particle size distributions originate form in-situ observations. The detection limit of applied particle spectrometers in terms of particle size is 100 nm in diameter. As a rule of thumb particles larger than 100 nm in diameter are considered optically active, while

particles smaller than 100 nm do not contribute to the lidar signal. However, we intended to show full size distributions from our observations.

Overall, the paper would provide highly useful data sets and would be a very welcome and needed publication.

A quantitative comparison to / verification with Burton et al. observations could be considered as a future activity.
We included the results from Burton et al. in our discussion.