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

Anonymous Referee #1

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 presents a large airborne HSRL dataset gathered by well-known experimental campaigns and processed in order to provide an aerosol classification scheme. The paper makes a great contribution to the aerosol community as well as to the efforts for the development of a consolidated reference aerosol model focused on space-borne lidar applications. Beyond the advanced instrumentation and methods used in this study, the paper is well written and the results are clearly presented. Important information regarding the lidar and particle depolarization ratio is presented, contributing to the scientific discussion regarding the variation of these intensive parameters for different aerosol types.
I suggest that the paper should be accepted for publication in ACP, after the authors address the following minor questions/comments:

25993 – line 14: two aerosol specific properties independent from aerosol load, so called intensive properties
We changed the sentence.

Paragraph 4.2: Some minor objections on this paragraph:
1. The aerosol type has been identified by back-trajectories and independent in-situ data collected during the campaigns. Then, the examined δp and Sp showed a classified behavior for the aerosol types defined.
We modified Paragraph 4.2 according to the reviewer's comments.
2. The "classification scheme" term is inserted without justification. The authors could say here that "Altogether, our aerosol dataset" and not "our classification scheme".
We changed that.
3. As a last sentence in this paragraph, the authors could state that "Based on the presented dataset, an aerosol classification scheme has been developed: : :. based on threshold values : : :.." and finally that: "Our final classification scheme is presented in Figure 8" In my opinion this is a very important paragraph and should be written clearly in order to pass the message to the reader.
We modified this Paragraph according to the reviewer's suggestions.

Conclusion section: Please rephrase the sentence "The presented approach can also be applied to satellite instruments" to "Part of the presented approach can be utilized by current and future lidar missions for aerosol classification purposes". My concern in that point is that the presented classification scheme cannot be fully applied for example to EarthCARE (which is the mission that the authors concentrate to directly afterwards), since the color ratio (included in the classification scheme of Fig. 8) is not a quantity that EarthCARE instrument will provide. However, I strongly believe that the results presented will be useful for all space missions including ESA missions, CALIPSO and future NASA CATS. I

suggest that the authors should re-write the conclusion section by addressing their work to other missions as well.

It is correct that the Color Ratio will not be provided from EarthCARE. We considered this comment and modified the conclusion.

Missing references: In paragraph 4.1.1. the recently published paper of Shuster et al. should be referenced regarding the lidar ratio variation in respect to absorption and mineralogy. Moreover, the reference of Balis et al. should be included when attributing the lidar ratio variation to aging of the dust particles during transport. In paragraph 4.1.3., the analysis of Amiridis et al. is missing, where large variation of lidar ratios was found for aged and fresh smoke.

Schuster, G. L., Vaughan, M., MacDonnell, D., Su, W., Winker, D., Dubovik, O., Lapyonok, T., and Trepte, C.: Comparison of CALIPSO aerosol optical depth retrievals to AERONET measurements, and climatology for the lidar ratio of dust, Atmos. Chem. Phys., 12, 7431-7452, doi:10.5194/acp-12-7431-2012, 2012

We included the paper by Schuster et al. in the Introduction and in Section 4.1.3.

Balis D., V. Amiridis, S. Nickovic, A. Papayannis, and C. Zerefos, Optical properties of Saharan dust layers as detected by a Raman lidar at Thessaloniki, Greece, Geophysical Research Letters, 31, L13104, doi:10.1029/2004GL019881, 2004.

Amiridis, V., D. S. Balis, E. Giannakaki, A. Stohl, S. Kazadzis, M. E. Koukouli, and P. Zanis, Optical characteristics of biomass burning aerosols over Southeastern Europe determined from UV-Raman lidar measurements, Atmospheric Chemistry and Physics, 9, 2431-2440, 2009

Since our study is focused only on measurements at 532 nm we did not include results of Balis et al., and Amiridis et al. in the discussion, as both show results at 355 nm.