Interactive comment on "Characterization of long-range transported Saharan dust at the Caribbean by dual-wavelength depolarization Raman lidar measurements" by S. Groß et al.

Anonymous Referee #1
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We thank this Reviewer for his careful reading of the manuscript and for his suggestions to help us improve the paper.

The answers are given in a direct response (bold, italic).

The paper by Groß and Co-authors presents optical properties of Saharan dust layers over Barbados that have been derived from lidar observations conducted in the framework of SALTRACE, the follow-up to the highly successful SAMUM campaigns. The authors show that lidar-derived intensive properties of Saharan dust at the Carribean show negligible difference to observations closer to the source regions and in Central Europe. The paper presents solid findings that are of interest to the readers of ACP. However, I suggest major revisions before publication because I believe that the findings could be presented more concisely if the paper was freed of unnecessary ballast.

Major points:

- I suggest significant restructuring of the paper. The presentation of four case studies is excessive and should be revised. Additional cases do not provide additional information - particularly as the observed properties don't vary much. I suggest to stick to one or (at most!) two case studies.

We decided not to reduce our results to just one or two case studies. One main topic of our study is if different dust mobilization mechanisms, found for the SALTRACE period and are discussed in the text, have an impact on the optical properties of long-range transported Saharan dust. For the four case studies we found no significant differences in the optical properties measured by lidar at Barbados.

- The number of figures exceeds what I would consider reasonable for the amount of text. For instance, Figure 1 is redundant as it doesn't help in understanding the measurement capabilities of POLIS. It is also unnecessary to present identical information multiple times. For instance, basically the same statistics are provided in Table 1 and Figures 13, 14, and 15. In the same way Table 2 overlaps with what is presented in Figures 14 and 15. Please decide on presenting your findings either as figure or as table and omit what is not needed from the paper.

The large number of figures results from the number of case studies we discuss in this work. But we agree with this referee that there is some potential to tighten the information. For this reason we removed Figure 1 and 13. However we want to keep Figures 14 and 15 additionally to the information provided in Tables 1 and 2.

- You might make better use of the information in Figures 3 and 4 by combining trajectories and source regions for individual cases in a single figure for the example case you decide to present in the revised paper. The discussion of the measurement period (e.g. discussion of Figure 2) could still include which source regions have been active during which part of the campaign.

We also thought about this but finally decided to present the results in a more compact way and keep the current presentation of the data; especially as a different presentation of the data would result in 2 additional figures.

- Why do the profiles of lidar ratio and PLDR not cover lower heights when statistical information on the parameters at these heights is given later in Table 1 and in Figures 13 and 16?

We included the lower height ranges in the profiles.

- It is incredible to see that the optical properties of Saharan dust remain unchanged after thousands of kilometers of transport. Can you speculate about possible aging and transport effects (mentioned on page 19339,lines 20-24) based on the data presented in the paper? Regarding the argument made there (effect of transport path): Are the source regions for the measurements at Munich similar to those active during SAMUM and SALTRACE?

We agree with this referee that it is astonishing to find almost unchanged optical properties for long-range and fresh Saharan dust. We are still working on this topic and do not want to make hasty speculations so far. Furthermore, similar dust source regions were active for the Munich dust event and our measurements at Barbados.

Minor points:

- the city in affiliation 3 should be Valladolid

This was a typo. We changed it.

- I think the title does not properly reflect the content of the paper. The authors do not present a complete characterization of the observed dust layers (i.e. including microphysical and chemical properties of the particles). They focus on optical properties only. I therefore suggest revising the title. What about "Optical properties of Saharan dust over Barbados as measured with dual-wavelengths depolarization Raman lidar"

We followed this reviewer's suggestion and changed the title accordingly.

- Please don't use acronyms without proper introduction, e.g. AOD and SALTRACE in the Abstract.

We changed that.

- Always give the wavelength when discussion AODs or AEs.

We added the wavelength to all discussions of AOD and AE.

- p19326,l4 and p19326,l13: "at the end of its way across the Atlantic" is kind of misleading. Who says that the dust isn't transported any further west? I suggest changing this to after transport across the Atlantic

We changed that.

- p19327,l5/6: sentence is redundant

We removed this sentence.

- p19327,l8: please provide original references to HSRL

We changed the references.

- p19327,l13: note that CATS, currently flying on the ISS, is equipped with a HSRL channel at 532nm

We included CATS in the introduction.

- p19330,l11: What is meant with "high accuracy"?

This is redundant; we removed it at this point.

- Section 2.3 Data evaluation should be called Data analysis

We changed that.

- p19330,l25: Raman channels "during daytime"

We added "during daytime".

- p19331,l2: validated by "assessing the temporal evolution of the range-corrected signal" over the smoothing period

We changed that.

- p19331,l4 and later: please give smoothing lengths in meter, range bins should be in parentheses

We changed that.

- p19331,l9: What makes this method highly accurate? You cannot just state this.

The high accuracy of this method is demonstrated in the referenced publication. However, to avoid misunderstandings we removed "highly accurate" at this point.

- p19333,l8-13 and l17-22: Shouldn't this be part of Section 2?

We moved these paragraphs to Section 2.

- p19335,l1-4 (and the other case studies): Why is this not shown as profiles in Fig. 6 (8, 10, 12)?

We included the PLDR of the lowermost layer in Fig. 6, 8, 10, 12.

- p19340,l26: What are the threshold values for those aerosol types in the EarthCARE classification scheme? It might be worthwhile to add those to Figure 16. This would be useful

information when getting to the end of this paragraph: "Thus, this threshold has to be adapted..."

We did not add the threshold in Figure 16, but we added the values in the text.

- p19341,l20: closely related? what does this mean?

We changed "closely related with former measurements" to "follow up former measurements".