Anonymous Referee #3

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).

General comments

The paper presents a case study related to SALTRACE campaign addressed to the characterization of the boundary layer with the presence of a mix of aerosol (dust and maritime) in the Caribbean area during a Saharan dust transport. It deals with a very interesting topic for the scientific community involved in atmospheric research because it provides information that can be merged with other results coming from other papers produced for the same campaign, obtaining a large and exhaustive overview and interpretation of the atmospheric observations in a particular site and in several kinds of conditions. This gives the paper a value even if it is not particularly original.

The paper seems to be written with no sufficient detail in the discussions and justifications. Improvement and more care should be requested in English language, being present several English grammar typos errors.

We changed the manuscript considering the suggestions of this Reviewer. We modified the Summary and included a Section to discuss the results. We also checked on grammar typos errors.

Specific comments

Some general considerations

In order to give the paper more completeness and to allow a better understanding of the observations, the authors should link (and cite) a previous paper: "S. Groß, V. Freudenthaler, K. Schepanski, C. Toledano, A. Schäfler, A. Ansmann, and B. Weinzierl, Optical properties of long-range transported Saharan dust over Barbados as measured by dual-wavelength depolarization Raman lidar measurements, Atmos. Chem. Phys., 15, 11067–11080, 2015, www.atmos-chem-phys.net/15/11067/2015/, doi:10.5194/acp-15-11067-2015", where most of the authors are the same, the lidar system is the same and also the measurement period is the same. In the present paper the authors address the study to a different day, characterized by a dominance of marine aerosols.

As suggested by this reviewer we linked and cited the previous paper in this work.

There are several references to papers in preparation for the same special issue. In my opinion, this is possible if some aspects presented will be furtherly analyzed and discussed in those, but this is strange if the results of those papers are used (e.g. Groß et al 2015, Haarig et al., Marinou et al.) before the corresponding peer review processes. In principle, the results or conclusions of those papers could also be rejected. This paper should have its own self-consistence and therefore the results of those other papers should be introduced in a different way, otherwise the paper should be accepted after the others will be accepted for publication.

We agree that the paper has to be self-consistent and thus we replaced the papers in preparation by peer-reviewed published papers

where a link to former or other work is needed. However we kept the announcement that papers dealing with the same topic are in preparation for this special issue.

In detail

Page 2, Lines 11-12: The authors write: “This strong increase at the top of the cloud-topped or cloud-less CMBL is to our opinion a clearly sign for an efficient...” The conclusion should be better discussed by the authors.

We believe that the high values in the particle linear depolarization ratio in the layer below the well-defined Saharan Air Layer is already an indication that dust removal processes started to mix the dust out of the SAL down to the ground. We added this to the text.

Page 3, Line 6: The authors justify the assumption about the two component mixture of marine aerosols and mineral dust with “coordinated in-situ measurements”. Which kind of measurements?

For this assumption we used airborne in-situ measurements of microphysical and chemical composition of the observed aerosols. We added this in the text.

Section 2.1. The authors assume several values for linear depolarization ratio for dust and marine aerosols, lidar ratio. Did they try to have support from direct measurements to these assumptions? For example, in my opinion, with reference to the paper I cited before (Point 1), why in this paper the authors do not use a similar optical characterization?

This reviewer is right that we should link the previous paper to this work to justify our assumptions of the used values for the linear

depolarization ratio of dust and marine aerosols. We measured these values during the SALTRACE campaign and the values are described in detail in Groß et al., 2015. We now refer to this optical haracterization of the different aerosol types to make clear that the values used for the type separation are based on direct measurements at Barbados.

Section 2.2: It is not clear to me how, from the reference ensemble of Gesteiger et al (2011) at 532 nm, the value 0.68x10-6m is obtained. But, in general, this is applicable also to the several values of v/alpha. The assumptions are introduced in a very fast way, without justifications. I think, a discussion, even if minimum, should be given to give the paper a self-consistence.

The v/alpha value is calculated for the reference ensemble by first calculating the volume of the mixture and then the extinction coefficient of the mixture as described by Gasteiger et al.

Page 4, Line 15: Did the authors tried a comparison using Raman measurements? According to the paper I cited at the beginning (Point 1), POLIS is also equipped with Raman channels. How the backscatter in fig 2a are calculated? Why Raman measurements have been not used to characterize the layers like in the previous paper (see Point 1)?

POLIS is indeed equipped with Raman channels and we used these measurements for the optical characterization of the different aerosols and aerosols layers as was shown in the previous paper mentioned by this reviewer (Point 1). We also characterized the intensive optical lidar properties in the boundary layer as shown in Fig. 5 (now Fig. 4) and Table 1. The shown case study was performed during daytime where no Raman measurements were performed. As the aerosol type separation is based on depolarization measurements, the backscatter

value and depolarization ratio measurements are the most important values. We derived them with the Fernald/Klett algorithm as is now described in the 'Instrumentation and Method' section. We chose this case study as the measurements were performed during aircraft overflights over the ground-based station and the date was chosen as one of the 'golden cases.' Thus this case study might be useful for further analyzes. We tried to better link to the previous study.

Page 9, Table 1: It is not clear to me the case 24 June – 10 July. What does this indication mean: dust and marine (marine dominated), but without marine cases.

'dust and marine (marine dominated)' refers to a mixture of dust and marine aerosols which optical properties dominated by the marine aerosols in this mixture.

Page 10, Line 2: Which is the distance between the measurement site and the Ragged Point? Is this comparison significant?

The distance between Ragged Point and the lidar measurement site is about 40 km. To check the significance of comparisons between both sites we looked on aircraft in-situ and sunphotometer measurements of total AOD and Angström Exponent.

Page 10, Line 8: Which is the meaning of the factor 1.25? How is it obtained?

For the derivation of this correction factor we use the OPAC desert mixture and calculate the aerosol volume of this mixture for upper cut-off radii of 5 and 10 micrometer. We calculate the ratio between both volumes, assuming that a cut-off radius of 10 micrometer is valid for dust reaching Barbados and a cut-off radius of 5 micrometer is valid

for the instrument. This factor is about 1.25 and is applied to the PM10 measurements to calculate the ambient dust volume. However, as the uncertainty about the size distribution of dust after long-range transport is large, we consider an uncertainty of +-0.25 which also covers the case that no aerosol with r > 5 micrometer reaches Barbados.

Page 10, Lines 9 and 10: What does it mean "we assume an uncertainty of. . .". How this estimation has been obtained?

See previous comment.

Page 10: The comment to the results of Fig. 6 is really very short. In general, these should be better discussed.

We extended the discussion.

Page 11, Summary: I image that the conclusions are referred to the 10 July case study. The authors does not report this. Moreover, I do not see correspondence between the values reported for PLDR in the Summary and those reported in table 1. Again, in the last line, which is the distance from the eastern part of the island? In general, the summary should be more clear and should give the idea of the importance of the reached goals.

We completely modified the summary to make it more clear and to give and idea of the reached goals.

Technical corrections

Page 1, Line 5: change "information of the CMBL" into "information on the CMBL"

We changed that.

Page 2, Line 21: change “information of the boundary layer” into “information on the boundary layer”

We changed that.

Page 2, Line 24: change “ground-base” into “ground-based”

We changed that.

Page 2, Line 26: change “located at the area” into “located in the area”.

We corrected that.

Page 3 Lines 6-8: Specify that the content of the sentence has been demonstrated when aerosols are transported across the Atlantic in summertime, otherwise it seems valid in general.

We tried to limit the validity of this statement by mentioning that it is valid for this study. However we agree with this Reviewer that a wrong assumption of general validity has to be avoided. Therefore we modified the text to make clear that this two-type assumption is only valid during dust long-range transport across the Atlantic Ocean as it was found for this study.

Page 7, Lines 3 and 5: change “on top the CMBL” into “on top of the CMBL”. Page 7, Line 3: change “found, that” into “found that”. Remove the comma.

We corrected that.

Page 8, Line 9: the authors write “AOD >= 0.4 nm”. They missed the wavelength between “0.4” and “nm”

We corrected that.