Anonymous Referee #1

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 et al. investigates the contribution of Saharan dust to the boundary layer over Barbados as observed during SALTRACE. The paper is of interest to the scientific community but major revisions are necessary before further consideration for publication in ACP.

Major points:

A description of the used instrumentation is completely missing in the text. Section 2 should be revised to Instruments and Methods. There should be at least a table that provides an overview of the used instrumentation. The authors only mention auxiliary measurements with sun photometer and in situ measurements when they are already discussing results in Section 3.

We added a description of all used instrumentation and methods in Section 2.

It is not acceptable to use papers in preparation as references. Nothing is known about the status of these papers

We removed the papers in preparation as references but we kept the announcement that papers dealing with the same topic are in preparation.

The authors should consider restructuring the paper. It seems more straight-forward to first discuss the measured optical properties and later describe the subsequently retrieved parameters. This means that all optical properties should be addressed before Figure 4 is discussed.

We agree with this reviewer that a restructuring of the paper would be more straight-forward and followed his suggestion to first discuss the optical properties and then the subsequently retrieved parameters.

Greater care is necessary with respect to the investigated height range. The authors loosely vary between the terms convective marine boundary layer, convective boundary layer and just boundary layer. Are these meant to be the same things? Later they also discuss the transition layer and the Saharan air layer. It might be worthwhile to properly define all these layers in the example provided in Figure 2.

We are more consistent now.

Please make sure that the same tense is used throughout the paper.

We revised the paper to check the tense.

Statements of good and very good agreement need to be quantified.

We replaced these statements by more precise statements.

Minor points:

• Check the co-authors' affiliations. I believe it's Leibniz Institute.

We changed that.

• p1,l13: 80% seems like a normal value for RH in marine environment.

Indeed, 80% is a normal value for RH in marine environment. We mentioned that value as it justifies the use of optical properties for moist sea salt. We removed this statement in the abstract but mention this in the text.

• p1,l20: Are the measurements just used to support modelling efforts or rather to validate them?

Indeed, the measurements are also used to validate modelling efforts. We changed the text accordingly.

• p2,l11: Please elaborate on the point of efficient downward mixing.

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.

p3,Section 2.2: More background is needed on how the conversion factors have been obtained. Did you apply any constraints for retrieving marine conversion factors from AERONET measurements at Barbados? Why are the factors almost identical for marine aerosol and mineral dust?

We provide now more information how the conversion factors are calculated.

To the question of the almost identical values: For large particles the aerosol extinction coefficient is mainly dominated by the size of the particles. As both, marine aerosols and mineral dust, are large particle types in the same size range also their conversion factor from extinction to volume should be almost the same.

• p4,l4: Does this mean that you use the gradient method to find the top height of the CMBL? Do you use the first gradient or the strongest gradient? Please provide more information.

The gradient method was applied to derive the top height of the CMBL which was defined as height range of the strongest gradient. Furthermore we used the change of the change of the intensive optical properties to strengthen our result. We changed the text to be more precise there.

• p4,Section 3.2: More details are needed regarding the analysis of the lidar measurements. You could provide those in an Instruments section: What is the averaging time of the lidar measurements? Were the lidar measurements performed during day or night? How did you analyze the data? Which lidar ratio has been used to derive the backscatter profiles?

We added a subsection in the 'Instrumentation and Method' section to describe the lidar system, analyzes of the data and specific information on the used data.

• p5,l12: Could the differences in lidar and sounding be the result of the two hours time delay between the two?

We do not believe that the missing capping inversion in the radiosonde at the CMBL top height derived from the gradient method is due to a two hour shift between both measurements. We

rather think that there was no strong capping inversion on that day. This would also explain the little difference in the intensive lidar quantities below the CMBL top height and above.

• p6,Figure 3: What is the general time difference between the lidar measurements and the soundings?

Typically the soundings were launched during the lidar measurement sessions, thus no or only little time difference is found in general. We added a subsection in the section 'Instruments and Method' which includes this information.

• p7,l3: Please elaborate what is meant with intensive lidar quantities for the unfamiliar reader.

Intensive lidar quantities are only dependent on the type of the observed aerosol or aerosol mixture. The intensive lidar quantities are not dependent on the amount of aerosols. We added a description in the text.

• p7,l12: I don't believe that this paper is the best reference on sea spray production.

We use this paper here as the authors conducted an empirical study of the relation between sea salt production and wind speed. We use their thresholds in this study.

• p8,Figure 5: Add mean/median/sd to the figure. Improve the scale in lidar ratio, i.e. 0 to 50 sr.

We show now mean, stdev, median and error of the mean in this figure and improved the lidar ratio scale from 0 to 50 sr.

• p10,l10: More details are needed for the in situ measurements used in the closure study. Which instruments are involved? How have those measurements been transformed to mass concentration? What is meant with "match in time"? Such criteria need to be provided in the paper.

We added a subsection in the 'Instrumentation and Method' section to provide information on the in-situ measurements and their analysis.