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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Saharan dust contribution to the Caribbean summertime boundary layer – A lidar study during SALTRACE" *by* Silke Groß et al.

Anonymous Referee #2

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The authors describe a case study of Saharan dust observed over the Caribbean with a dual wavelength lidar. In their paper, the authors describe time series of LIDAR (CIMEL and POLIS) measurements to highlight a study case (10 July 2013) and vertical profiles of this study case. They also provide a closure study based on the comparison of LIDAR retrieved parameters and in-situ measurements. This manuscript is of interest for the scientific community but need major revisions before submission to ACP.

MAJOR COMMENTS :

1. The scientific objectives of the study are limited to "provide detailed BL characterization as part of the vertical aerosol structure over Barbados during SALTRACE" as it play a significant role in the synergy between ground based, airborne and column

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integrated measurements. Could you state clearly how your results will help to link all these measurements? Could you also state if and how those results may be applied to different measurement campaign?

2. This paper is referring to LIDAR (POLIS and CIMEL), in-situ and radio-soundings measurements. There is no description of the used instruments, which is mandatory. Also every all the algorithms to correct the data, if existing, must be described in one specific section.

3. Figure 4 : From the dust mass concentration shown in this figure, one can see that the variability is not important from day to day. The dust mass concentration is on average 40ug/cm3. Two outliers can be distinguished at 70and 100ug/cm3. That would have been really interesting to show the lidar profile for these two cases when dust are obviously mixed with sea salt.

Looking closely to the values for the study case (10/07/2013) the values are always below 40ug/cm3 and increasing throughout the day. Now from the profiles shown in Figure 2 the average mass concentration of dust within the CMBL is about 110ug/cm-3. This strong difference makes questionable the quality of the data used in Figure 2 or in Figure 4.

MINOR COMMENTS :

1. Could you provide a map to show the location where SALTRACE took place ?

2. Although, Denjean et al 2015 found (based on model results) that optical properties of one dust plume particles were not modified during their transport over Atlantic, many studies have shown differences in the dust size distributions, in the dust morphology, and also on the dust optical properties including dust polarization (Bréon et al. 2013). Why you are stating that here ? Is it related to your choice of a mean depolarization ratio of 0.30 ? If yes then you should lead the reader into it cause I don't see the point here. Also, Burton et al. (2015), using HSRL measurements, highlight a dust

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particulate depolarization ratio of 0.32 over the Caribbean islands. You should spend more energy on why you choose 0.30.

3. P3, L8 Remains not remaines

4. Dust volume and mass conversion: You use a conversion factor of 0.65.10-6 m. According to previous studies large aerosols do not reach the Caribbean coast (Maring et al. 2003). So this factor should not remain the same over the dust source and after few days of transport. Could you precise if the Gasteiger study was referring to fresh or aged dust ? Moreover it appears difficult to compare a factor obtained from measurements over the source (SAMUM) to a factor obtained after transport (SALTRACE). How did you calculate this factor ? It seems that you use the aerosol volume from AERONET measurements (integrated over the column) and an extinction coefficient from the LIDAR (at which altitude ?). What are the errors associated with this coefficient (AERONET volume errors + Lidar ratio errors + density errors)? Did you perform a closure with the AOD from AERONET and the AOD from your LIDAR data ?

This factor is depending on the altitude, right ? Bigger SS at the surface, dust mixed with SS and pure dust over those layers.

5. You choose to use a density of 2.5g/cm3 assuming that dust are mixed with sulphate. Earlier you state that dust chemistry was not changing during the transport. If there is any sulphate on a dust particle, even a little bit, then the dust becomes hygroscopic (Roberts et al., 2001) and the optical properties are not the same than pure dust. You need to clarify this point

6. You need to show the data that provide you enough information to chose 0.65 .10-6 m for dust and 0.66 .10-6 m for sea salt particles.

7. Could you provide the extinction profile retrieved for the 10 July 2013 study case ?

8. P6 L4 You say that dust particles contribute to 100% of the total aerosol volume so why is there no pure dust in Table 2 ?

9. From what I understand, you used the wind speed to say that SS can be generated at the surface, the wind directions to say that wind are mainly coming from East / North-East, and the relative humidity is always larger than 60% and in average 80%. Does that need to be plotted ?

10. What can we learn based on your CMBL height retrievals ? You say that some cases are not well retrieved by the LIDAR and you say why. Is there a solution to avoid those mistakes with this kind of LIDAR ?

11. Figure 5 : Could you change the scale of the Lidar ratio plot ? The values are between 15-35 and your scale is between 0-100. What are the green and blue dots represent?

12. Section 3.6 : What kind of in-situ measurement did you use ?

- The correction you apply to these unknown in situ data is based on OPAC desert mixture and assuming 10um particles reach the barbadoes. What is this correction about? You cannot use a correction factor that please you without explaining the reader what you exactly did. - You are only looking to data that 'match in time'. What does that mean ? Is it a window of an hour, 10 minutes? - This closure doesn't conveniently take into account the larger values of dust concentration. In the figure caption remove the second 'dust'

13. The summary is not giving any conclusions or any clue to better improve the relation between ground base and remote sensing measurements. You should be careful in the summary and say that you were able with this case to link ground based measurements to remote sensing measurement but that for other cases it might not be as easy to achieve. You also need to tell the reader why you were able to do it (mixing condition with the BL, Just two type of particles etc. . .)

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