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Review Chazette et al. , Mesoscales patio-temporal variability of airborne lidar-derived aerosol properties in the Barbados region during EUREC4A'

Anonymous Referee #2

Referee comment on "Mesoscale spatio-temporal variability of airborne lidar-derived aerosol properties in the Barbados region during EUREC^{4}A" by Patrick Chazette et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-706-RC2, 2021

The manuscript by Chazette et al. is dealing with the aerosol load in the Barbados region during a measurement campaign in January/February 2020. This season is not known for major dust transport towards the Caribbean. Thus, the results in this manuscript, showing wintertime dust transport, are very interesting. The manuscript is well in the focus of ACP and should be published after mainly minor revisions.

General comments:

In the introduction and the discussion findings of the approx. last 10 years on Saharan dust are completely missing. Large research projects and campaigns were conducted focusing on the beginning of dust transport (e.g. SAMUM – which focuses also on wintertime conditions), as well as after long-range transport towards the Caribbean (e.g. SALTRACE, NARVAL-II). A large number of studies were published using data from these studies that should and could be connected to the findings of this manuscript. Those studies were also dealing with wintertime dust transport, mixtures of dust and biomass burning aerosols, downward mixing of dust, and on the relation of Saharan dust layers and relative humidity. Those studies should be mentioned in the introduction and discussed in relation to the findings described in this manuscript.

Specific comments:

In the abstract information on what characterized the two distinct periods with significant aerosol content should be given. How is the heterogeneity connected to the highly variable relative humidity field?

Introduction: A differentiation between summertime and wintertime transport should be made. The main dust transport towards the Caribbean is happening in summertime (which is also mentioned in the manuscript). The Saharan Air Layer seems to be quite undisturbed close to the source and during long-range transport during the summertime transport. A number of publications (e.g. Weinzierl; Haarig; Groß; Gutleben; …) described the summertime dust transport to the Caribbean. In contrast, during wintertime the dust is located at lower altitudes and frequently mixed with biomass burning aerosols (e.g. SAMUM-II related publications: Ansmann; Tesche; Groß; …). Additionally, biomass burning might be transported to the Caribbean from the South American continent (Haarig).

Calibration of the lidar signal: How stable is the system constant when pressure and temperature change during flights? How do system settings affect the system constant?

Observation periods: The detailed information on the different observation periods should be given together to get a better overview of the different aerosol situations. The different observation periods should be described in a bit more detail. Which aerosols / mixtures were the dominant one? Or why were these periods chosen for a detailed description?

Is the vertical profile derived from the ascends and descends? Can you give a bit more information?

Page 6, line 31: Do you mean vertically homogenously distributed? I do not see it for horizontally…

Page 7, lines 8ff: How do you link the horizontal relative humidity filed to the particle's horizontal heterogeneity? Might it also be the other way around? As described in Gutleben et al., 2020, Saharan dust transport is associated with transport of embedded water vapor. To link relative humidity and aerosol heterogeneity one needs to have information about the water vapor / relative humidity field, and on the type of particle. To better describe the vertical distribution and the connection to possible convective processes a consideration of the atmospheric stability would be helpful (e.g. inversions, stability).

Page 11, lines 14ff: To connect changes in relative humidity to changes in the optical properties, information on the relative humidity distribution is needed. Furthermore, e.g. dust aerosols are not hydrophil. Thus, relative humidity should not affect the intensive

optical properties. What about biomass burning aerosols? What kind of mixtures do you consider?

Figure 5: Capture is missing the date information.