Response to Reviewer CC:

Section 2.1 ALADIN/Aeolus:

Indicate which L2A baseline (i.e. baseline 10 or 11 referring to the L2Ap v3.10 or v3.11) has been used for processing might be useful for traceability (e.g. new radiometric correction being included in v3.11 using telescope temperatures oscillations).

AR: Thank you for your suggestion. For L2A products and L2C products from Aeolus, we both use baseline 10 data (referring to the L2Ap v3.10). In the revised manuscript, the corresponding explanation is supplemented as following:

"In this study, the Level 2A (baseline 10 referring to the L2Ap v3.10) aerosol optical properties and Level 2C (baseline 10 referring to the L2Ap v3.10) wind vectors are used."

Section 4.1 Measurement case with CALIOP, ALADIN, ECMWF and HYSPLIT:

The differcences between Aeolus/ALADIN and CALIPSO/CALIOP instrumentation principle and geometry could be highlighted (i.e. ALADIN poiting 35° offset from nadir with the ground) as the time gap between acquisitions (e.g. for intercompaison cross-section 3 on June 19, 2020 showed in Figure 5 Aeolus hovered the West of Cape Verde from 08:00 to 08:30 UTC four hours later than CALIOP from 04:07 to 04/20 UTC). It is fair to assume that the particles distribution within the plume might have evolved during the time offset, hence a limit of the data intercomparison.

AR: Thanks. Since the instrumentation principle and geometry of Aeolus/ALADIN and CALIPSO/CALIOP is different and the orbits of Aeolus/ALADIN and CALIPSO/CALIOP are not coincide, there are always space gaps and time gaps (around 4 hours) between the closest two scanning tracks of Aeolus and CALIPSO. Although the existence of the space gaps and time gaps of two satellites scanning tracks, it is considered that the optical properties of the dust plumes between two satellites scanning tracks are almost unchanged.

In our study, the closest CALIPSO scanning tracks to those of Aeolus, are about 4 hours ahead of Aeolus. Based on the transport directions of dust events modelled with HYSPLIT, the tracks of Aeolus should be always downwind of the tracks of CALIPSO. When the tracks of Aeolus and CALIPSO are selected, the distances between the tracks can be calculated. Assuming that the wind speed between CALIPSO scanning tracks and Aeolus scanning tracks is in the range of $5m{\cdot}s^{-1}$ to $15m{\cdot}s^{-1}$, the corresponding transport distances of the dust plumes are in the range of 72km to 216km.

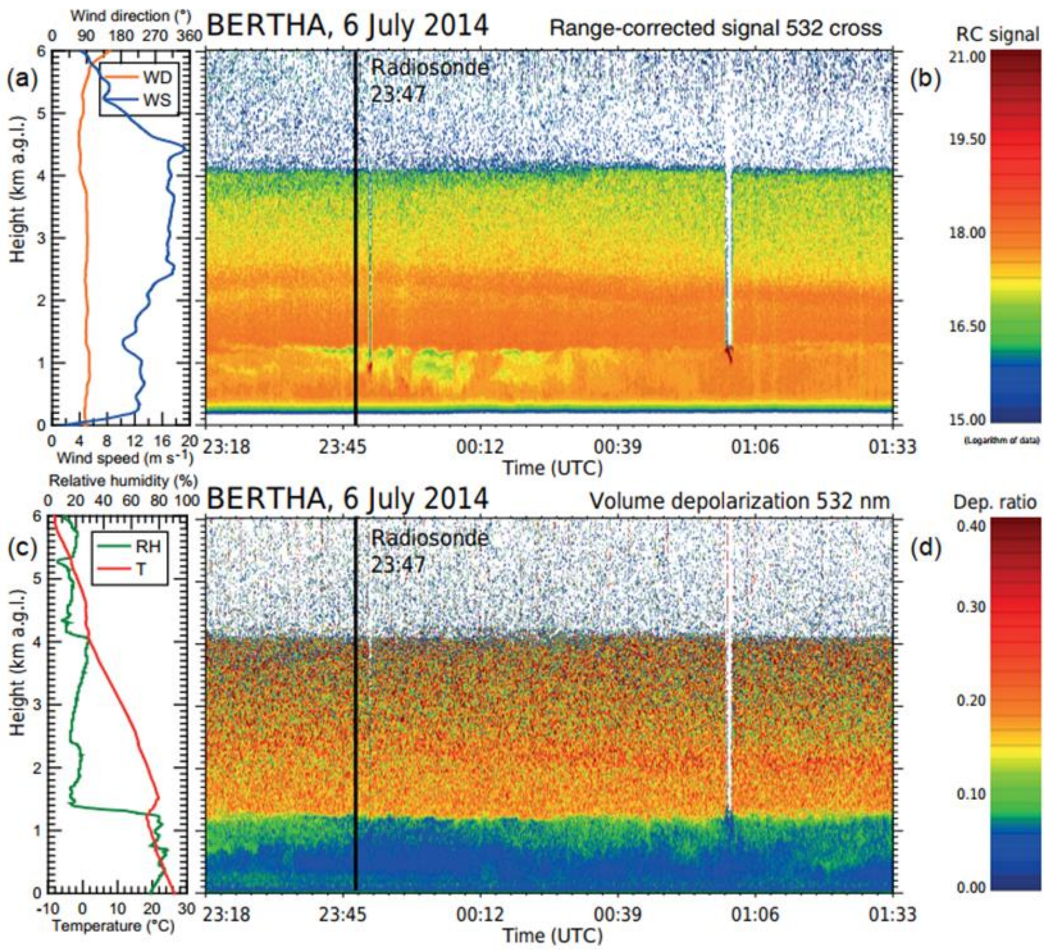

Figure 1. Saharan air layer (from 1.2 to 4.2 km height) above the marine boundary layer. Panel (b) shows the range-corrected cross-polarized backscatter signal at 532 nm with temporal resolution of 30 s and vertical resolution of 7.5 m, respectively. Panel (d) shows the volume linear depolarization ratio at 532 nm. The radiosonde profiles of wind speed (WS) and wind direction (WD) are shown in panel (a), the profiles of relative humidity (RH) and temperature (T) in panel (c). The lidar observation was performed on 6 July 2014, 23:18–01:33 UTC. The radiosonde was launched at

23:47 UTC (indicated by a black vertical line). [Figure 11 from Haarig et al. (2017).]

Figure 1 shows the wind direction, wind speed, relative humidity and temperature measured by radiosonde, as well as the range-corrected cross-polarized Sahara dust backscatter signal at 532 nm and the Sahara dust volume linear depolarization ratio at 532 nm measured by BERTHA (Backscatter Extinction lidar-Ratio Temperature Humidity profiling Apparatus) at Barbados, which is located in Eastern Caribbean (Haarig et al., 2017). It can be seen from Figure 1 that even after long-range transportation, the optical properties (volume linear depolarization ratio at 532 nm) of the dust layer maintain stable in about 2 hours. Therefore, in our work, we think that during the short-time (~4 hours) transportation of Sahara dust plume, dust optical properties maintain almost unchanged.

Consequently, in our study, if the distances between two satellites scanning tracks are less than 200 km and the tracks of Aeolus are downwind of the tracks of CALIPSO, it is reasonable to state that the dust plumes captured by CALIPSO are transported towards the Aeolus scanning regions in around 4 hours, hence the following procedures could be continued. From the measurement cases provided by the paper mentioned above, the optical properties of Sahara dust within short-time (e.g., 2h, 4h…) seems to be stable. Hence, we insist that the combination of the optical properties provided by CALIPSO and Aeolus, with 4 hours difference, is applicable/reasonable to calculate the volume concentration and mass concentration.

To make it clear to the reader, we also add the similar explanations in the Section 3 of the revised manuscript as following:

"Assuming the wind speed between CALIPSO scanning tracks and Aeolus scanning tracks is in the range of 5 $m \cdot s^{-1}$ to 15 $m \cdot s^{-1}$, the transport distances of the dust plumes are in the range of 72km to 216km. Besides, during the short-time transportation of Sahara dust plume, dust optical properties maintain almost unchanged (Haarig et al., 2017). Consequently, in our study, if the distances between two satellites scanning tracks are less than 200 km and the tracks of Aeolus are downwind of the tracks of CALIPSO, it is reasonable to state that the dust plumes captured by CALIPSO are transported towards the Aeolus scanning regions in around 4 hours, hence the following procedures could be continued.”

Reference:

Haarig, M., Ansmann, A., Althausen, D., Klepel, A., Groß, S., Freudenthaler, V., Toledano, C., Mamouri, R.-E., Farrell, D. A., Prescod, D. A., Marinou, E., Burton, S. P., Gasteiger, J., Engelmann, R., and Baars, H.: Triple-wavelength depolarization-ratio profiling of Saharan dust over Barbados during SALTRACE in 2013 and 2014, Atmos. Chem. Phys., 17, 10767–10794, https://doi.org/10.5194/acp-17-10767-2017, 2017.