Authors' response (in blue) to the Reviewer #1's comments (in black):

The authors thank Reviewer #1 for their comments and suggestions that definitely improved the manuscript. Required changes and modifications have been introduced in the text of the revised version of the manuscript by using the Word Track Changes tools.

In general, the title has been modified, and following some reviewer #2's suggestions, Sections 2.4.2 and 3.4 have been removed and the proposed changes as indicated in the Supplement by the reviewer #2 have been implemented as well. New references have been added and Figures 5 and 6 have been simplified, as well.

Next, the authors respond to the particular comments of the reviewer #1.

- Reviewer 1

Authors compare MPL data with measurements of Raman lidars, to evaluate the overlap function and estimate it's influence on backscattering coefficient and depolarization ratio. This is useful technical study, which, by my opinion, can be published in AMT after minor revision.

I have just technical comments

R1C1. Ln.143. "Those two polarized signals are semi-simultaneously detected by alternatively switching in the basis of 50%/50% the LRC polarization mode (LCR switching time of 133 μs) within every integrating minute." Unclear. Switching occurs every minute or every pulse?

Authors' response: The MPL system switches the polarization state every 250 pulses (but just 249 pulses are collected since one of the pulses is discarded during the ~100 μS it takes to switch). Therefore, the sentence is conservatively right, but in order to avoid the confusion, the corresponding text has been modified in the revised version of the manuscript as follows:

Page 5, lines 160-162: "Those two polarized signals are semi-simultaneously detected by alternatively switching in the basis of 50%/50% the LRC polarization mode within every integrating minute. Note that the P-MPL pulse frequency is 2500 Hz, and the polarization state is switched every 250 pulses, but just 249 pulses are collected since one of the pulses is discarded during the LCR switching time (~100 μs)."

R1C2. Ln.259. "and 25 sr for ND components". Why so small value? For example, for smoke it can be 70 sr.

Authors' response: That's true. However, a minor contribution of non-dust (ND) aerosols under dusty conditions is expected in comparison with the predominance of dust particles. Besides, smoke particles were not identified for the selected cases as shown

in the manuscript. The choice of 25 sr is just a conservative low value, which is assumed for the lidar ratio of ND aerosols by considering their small contribution, mainly within the dust layers.

R1C3. Eq.5,6. I am confused. To calculate extinction profile assumptions about lidar ratios for all three components are made. Is it still more accurate than just apply Klett solution?

Authors' response: For elastic lidars, an a-priori particle lidar ratio must be assumed. By using the KF algorithm in constraint with an ancillary value of AOD (i.e., AERONET AOD), an effective lidar ratio is obtained, which is a height-constant parameter. Hence, the height-resolved extinction coefficient is just obtained by multiplying the height-resolved backscatter coefficient and that effective lidar ratio; the AOD is calculated by integrating the extinction coefficient in height. Actually, the lidar ratio is not constant with the height as it is dependent on the aerosol type detected along the atmosphere, and therefore the extinction profile can differ in dependence on the aerosol mixing state of the atmosphere. In this work, the total extinction profile is obtained by summing the separated extinction coefficient profiles of each of the particle components, which the specific lidar ratio is indeed accurately known for. Therefore, in our case, we consider this is an improved result in the retrieval of a 'more accurate' extinction coefficient profile from elastic P-MPL lidar measurements, where a vertical lidar ratio, to some extent, has been intrinsically applied.

However, in the revised version of the manuscript, Sections 2.4.2 and 3.4, regarding the determination of the extinction profile, have been removed, as suggested by the reviewer #2.

R1C4. Ln.333. "The P-MPL VLDR is calculated using Eq. 8" I don't see Eq.8.

Authors' response: Eq. 8 of the original manuscript (page 12, line 366) is the renumbered Eq. 7 in its revised version (page 13, line 401). However, for avoiding any confusion, the text has been modified in the revised version as follows:

Page 14, line 405: "… where $\delta_{MPL}^{V}{}^{corr}$ is the corrected P-MPL VLDR profile, and δ_{MPL}^{V} is that VLDR as obtained from Eq. 2".

R1C5. Ln.364. "Therefore, the P-MPL VLDR must be also corrected by that offset using. . ." But in calculation of VDR from Polly data, the calibration coefficient is used. Can corresponding uncertainty contribute to this offset?

Authors' response: The calibration parameters of the continuously operated Polly lidar are automatically checked on a daily basis, and the calibration parameters are stored as time series (over months) to identify biases and miss-alignment and do corrections and

improve alignment. Hence, we assume no bias (in the Polly depolarization ratio) when all calibration parameters show good performance of the lidar over days, weeks, and months, as is the case here.

R1C6. Ln 377. "see Eqs. 4 and 9. . ." I don't see Eq.9.

Authors' response: Right. It was a mistake. Eq. 9 is actually the Eq. 8 (renumbered Eq. 7). This has been corrected in the revised version of the manuscript (page 13, line 404).

R1C7. Fig.5. I didn't understand what is difference between (a,b) and (c,d). Are (c,d) plots necessary? The same about Fig.6.

Authors' response: Plots in (c) and (d) are a 'zoom' of those (a) and (b); maybe they give a redundancy of results. Then, we will leave only plots (a) and (b) of both Figs. 5 and 6 in the revised version of the manuscript.

R1C8. Fig.8. I don't quite understand why authors decompose extinction for three components. Looks like goal of the paper is to correct the overlap function.

Authors' response: Indeed, the main goal is to experimentally assess the P-MPL system, including the determination of an overlap function for the P-MPL and the evaluation of its volume linear depolarization ratio (VLDR), in addition to study the effect in the lidar-derived aerosol optical properties, like the particle backscatter coefficient (PBC) and the particle linear depolarization ratio (PLDR). However, we considered consistent to extent that study to the other interrelated variables as the height-resolved extinction coefficient. In particular for elastic lidars as the P-MPL, it is relevant to estimate the extinction profile. Therefore, an alternative methodology to derive the extinction was also introduced in this work, which is based on the firstly separated three components (particularly, in dust mixtures), and then the total extinction is basically obtained by summing them, as described in Sect. 2.4.2.

However, in the revised version of the manuscript, Sections 2.4.2 and 3.4, regarding the determination of the extinction profile, have been removed (see **R1C3**), as suggested by the reviewer #2.