

## Response to Referee #2

First, we are very grateful to the Referee for accurate reading of manuscript and useful suggestions.

*This manuscript is very well written, with the quality of the text being one of the positive aspects to highlight. The analysis carried out deepened the study of the aerosol biomass burning (BBA) transported over long distances including entrainment in the PBL. Based on the studies that highlight the advantage of measuring the total fluorescence spectrum, the authors use several discrete channels and obtain the spectral properties using the width of the transmission band. By using five different wavelengths, they can evaluate their performance. According to the results obtained, a current Raman lidar equipment can be significantly improved for aerosol typing by including only two fluorescence channels. This greatly contributes to current knowledge and allows using the contrasted data for future research and further advancing the characterization of atmospheric particles.*

*On the other hand, something that made me think was that the analysis was only carried out in the PBL, FT and UTLS. Furthermore, considering 8 to 12 km as UTLS. Perhaps 8km would not be considered as upper troposphere and 12km as low stratosphere either. This is something that should be considered and more appropriate language should be used or why it is treated this way should be explained.*

Yes, similar comment was provided also by Referee 1. In the revised manuscript for these height ranges we use “Lower Free Troposphere (LFT) and “Middle and Upper Troposphere (MUT)”.

*Additionally, there are several points that could be interesting to include with the aim to have a more consistent work. As it happens, it could be included the analysis of the particle depolarization ratio once smoke and urban particles are classified.*

We agree, that depolarization measurements are important. Unfortunately, at the current configuration of the lidar, these measurements are not available.

*Be that as it may, something that undoubtedly devalues the work is the quality of the figures. Its size and the size of the axes and legends, the half-titles in some cases or the lack of units in the figure itself (Figure 1 right), the letter that differentiates one subfigure from another such as a, b, c cannot be seen (Figure 2), the height range of the graphs of the same event differ from each other (Figures 5 and 6), the meaning of the different colours of the data series is not explained (Figure 7).*

In the revised manuscript the figures are modified, following recommendations of Referee #1 and #2.

*Another issue to point out is the fact that many are times that average period to study and plot is not indicated.*

In the process of revision we modified the plots. The information about averaging period is provided in the captions. We did not indicate it on certain plots, not to overload the figures.

Some specific details can be found below:

*Page 1 line 16: How long are the 40 smoke episodes? Are they all equally representative? How many hours of measurement does each of them include? The lidar measures 24/7?*

The lidar was operated in the night time only. Duration of the measurements varied from 5 to 8 hours, depending on season. Corresponding comments is added to the manuscript.

*Page 2 line 45-48: It would be advisable to explain in detail that hygroscopic growth decreases the fluorescence capacity but does not affect the fluorescence spectrum.*

Particle hygroscopic growth leads to an increase in the backscattering coefficient, which in turn reduces the fluorescence capacity. However, how it was demonstrated by Veselovskii et al. (2023) and in current manuscript, the ratios of fluorescence backscattering in different channels do not depend on RH. Thus, the spectrum is not effected by hygroscopic growth. We added this comment to manuscript.

*Page 10 line 23: The text points that despite standard deviations, all measurement sessions reveal that the fluorescence backscattering gradually decreases with wavelength but Figure 8a fails to show that.*

Fluorescence backscattering gradually decreases with wavelength within the PBL. Corresponding comment is added to the manuscript.

*Page 14 Figure 12: The word “Backscattering” in the upper left subfigure should be corrected.*

Sorry, corrected.

*Page 16 line 322: Perhaps the average interval established to obtain the properties of aerosol particles is too long in time considering the extent and detail of the analysis of the events.*

Yes, but both urban and smoke layers are quite stable, so we think that this averaging well represents the mean values. The details of spatio-temporal variations of elastic and fluorescence backscattering are given by the curtain plots.

On balance, this paper represents a major advance in Raman and fluorescence-based lidar techniques, but the presentation of the work needs to be revised to maintain the high quality of the scientific content.