Response to Referee 3

We would like to thank the Reviewer for reading the manuscript and for useful suggestions. Below, we provide response to the comments.

The authors have developed the partitioning method of smoke, urban, and dust aerosols based on Mie-Raman-fluorescence lidar measurements and have shown excellent performance. Classification of aerosol types and quantification of their respective components is very important in atmospheric environment and climate change. In particular, the partitioning of smoke and urban aerosols is a significant contribution to remote sensing methods. The methods, results, and suggestions are reasonable and clearly described. I recommend that this paper can be published with some minor modifications.

Specific comments

Lines 143-144: How did you introduce the non-negativity constraint to the least squares method?

The non-negativity constraint was implemented as follows. First, the LSQ problem was being solved in 3D space without non-negativity restrictions. If the solution was non-negative, it was taken for the final result. Otherwise, the LSQ problem was being solved on three 2D planes ($\eta_s=0$), ($\eta_d=0$), ($\eta_u=0$). If non-negative solution(s) were found, one of them having the least discrepancy was taken for the final result. Otherwise, the process was repeated for 1D lines ($\eta_s=0$, $\eta_d=0$), ($\eta_s=0$, $\eta_u=0$), ($\eta_d=0$, $\eta_u=0$). If no non-negative solution(s) were found on this last stage, the final solution was (0,0,0).

However, we would not like to put all these details in the manuscript. It will look to "mathematical". In the revised manuscript, we tried to simplify description of LSQ solving, to make it easier for reader.

Lines 154-156 and 162-163: The partitioning method would be helpful for atmospheric environment monitoring and data assimilation. The calculations of the ATS method for the four triplets seem time consuming. Is the method applicable to the quasi-real-time analysis?

Yes, the ATS method is time consuming. To analyze the night measurement session (Fig.9) it takes about 40 min for standard notebook computer. However, when only 3 aerosol types are considered, computation time is about 8 min, so quasi-real-time analysis is possible. We do not provide these numbers in the manuscript, because the computation time depends on the parameters of computer used.

Lines 177-129: What are the ranges of fluorescence capacities and depolarization ratios for smoke, pollen, urban, and dust aerosols above 60 % relative humidity? If several studies exist, their ranges should be noted for reference.

Decrease of the fluorescence capacity and the particle depolarization ratio in the process of hygroscopic growth was demonstrated in recent publication of Veselovskii et al. (2024) in Fig.6. The G_F decreases from 1.2×10^{-4} to 0.1×10^{-4}, while δ_{532} from 9% to 3% when RH increases up to 90%. We should mention, that the hygroscopic growth does not affect the spectrum of fluorescence. Therefore, the use of two or more fluorescence channels allows particle identification even at high RH. The comment and reference is added to the manuscript.

Table 1: Why is the fluorescence capacities of smoke and pollen so large? A brief explanation is in the best interest of the reader.

High fluorescence capacity of smoke is due to the presence of organic carbon. Biological materials are responsible for strong fluorescence of pollen. Added to the text.