Response to Reviewer 2

First of all, we would like to thank the Reviewer for reading the manuscript and useful comments.

This paper presents the potentiality of fluorescence measurements in Mie-Raman lidar systems to obtain aerosol type, with focus in biomass, dust, anthropogenic pollution and aerosols. The paper is well structured and discussions are appropriate. In general I am excited about the potential of fluorescence technique for aerosol profile characterizations. However, I agree with previous referee that authors claim the development of an algorithm and that is not straightforward from the paper. Indeed it seems an introduction with different study-cases. So my concerns prior the publication in AMT are:

- There is no mention to the physical principle of fluorescence and if fluorescence can be modeled for different aerosol particles. Maybe these models are not well developed. But if they exist, why not using them for training the model? If not, the authors should clarify this point. In summary, I miss a theoretical background for fluorescence
- The selections of the study cases are excellent, but I miss an overall conclusion that includes all your data. Why not presenting a plot that includes all data and even statistical analyses?

Minor comments

I agree with most of the comments raised by referee 1. I just would like to insist that backward-trajectories and other types of measurements (satellite, in-situ, models) would enrich the discussions. I really miss this information for the cases of Fig 1 and for the pure dust case. Also, the mention to SILAM must be clarified.

In the process of revision, the manuscript was significantly modified. We added a table, containing the particle intensive parameters for the cases considered (lidar ratios at 355 and 532 nm; depolarization ratios at 355, 532 and 1064 nm; and the backscattering and extinction Angstrom exponents). Another table provides the range of variation of particle intensive properties from different typing algorithms for the urban, smoke and dust particles. The table contains also the range of parameters variation for episodes from current study for the same aerosol types. The back-trajectory analysis is included, when the cases are analyzed. In Appendix we added four maps with SILAM pollen index, for the episodes where the presence of the pollen was revealed. Sections 3 and 4 were significantly extended and we hope, that all this improved the manuscript. Details of the manuscript revision are given in our extended response to Reviewer 1.

Reviewer is right, that at this stage we did not analyzed the fluorescence mechanisms. And this should be done at the next step of our research. We plan to increase the number of fluorescence channels, and choose of corresponding spectral intervals will demand this kind of analysis.

Statistical analysis of our observation over Lille is not done yet, but this is definitely one of our goals. And in this manuscript we tried to demonstrate that for different aerosol episode, the depolarization – fluorescence diagram allows to identify the particle type, and it also provides information about the aerosol mixture composition.