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Comment on acp-2021-980

Anonymous Referee #2

Referee comment on "Pollen observations at four EARLINET stations during the ACTRIS-COVID-19 campaign" by Xiaoxia Shang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-980-RC2, 2022

The paper reports a study on the discrimination of pollen based on observations from four lidar of similar setup, performance and data processing. The lidar oberved pollen-laden atmospheres and provided colour and depolarization ratios. The presence of pollen, and the absence of dust which would hamper the detection and discrimination methodology, have been confirmed by models from dust and pollen distribution over europe and, when and where available, by direct in situ pollen detection and characterization. The study continues and extends previous works by some of the same authors. It is interesting and certainly deserves to be published after a suitable revision, also in view of the fact that the proposed method finds application not only to discriminate different pollen but whenever external mixtures of two aerosol are present, under the condition that both DRs and BAEs of the two aerosol types should be different.

The conditions under which the method is applicable are rather stringent and I don't know how frequently they can be encountered in reality. This is probably the main flaw of the article, not having discussed how extensible the method and its results are in general, beyond the single case studies presented here, which essentially validate the products of two models on dust transport and presence of pollen, which are initially used to select case studies.

More specifically, how good is the hypothesis of a characteristic depolarization and angstrom coefficient of a given pollen species, independent of the pollen aging phenomena and of the current relative humidity conditions at the time of observation, given the natural hygroscopicity of the pollen?

I believe, on the contrary, a variability of the optical characteristics of pollen is probable, depending on the present state and their specific history in the atmosphere. Likewise, apart from some particular stations (the authors cite Leipzig among them) it is possible that also the optical characteristics of the background aerosol are not constant to the degree required by the authors to apply their method. Given these drawbacks how the results here reported can be generalized?

I encourage the authors to better explore the effect this crucial aspect on their hypotheses

and results, exploring the dependence of the results on RH at the time of observation and perhaps also - if deducible - on the time elapsed since pollen was released into the atmosphere.

Some more specific point the authors may wish to make clearer are the following:

line 172 until the end of the paragraph: I found the description of the simulation results quite confusing, especially panel d in figure 1, and the caption doesn't help. In particular, it is stated in the text that the dashed lines in panel b - which appear to be straight - descend from Eq. (7) - which does not look like a straight line.

In table 2 they talk about "bins" without having defined them either in spatial or temporal terms. Moreover, it is not clear how the averages of the optical parameters shown in the table were calculated.

232 "Note that if there are many profiles, it is possible to use the mean values of pollen layers instead of each bin." Yes but what does it mean? Is this related to the squares reported in fig.2? The authors should dwell more on the description of their dataset and procedures of data processing.

236 What does "good dataset" mean?

240 "the depolarization ratio of the background particles can be reasonably estimated or assumed" Please refer to what I considered before: to what extent the assumption on the depolarization ratio of the background particles on a given day can be used to infer the characteristic pollen depolarization? how the uncertainties on such assumption influence the result?

242 "the BAE of pure pollen can be assumed to be 0, as pollen grains are quite large particles" would this probably be the case if the pollen were transparent, but aren't they colored instead? Are the authors able to give an estimate of the angstrom coefficient of the pollens, from their dataset? This might be done by extrapolation, starting from the measured total angstrom coefficient and from the variability of the background aerosol relative contribution to it, given that it could be be assumed the value of the background aerosol angstrom coefficient (known from previous measurements?).

358 "This study shows that automatically retrieved lidar data profiles (using SCC) are suitable for pollen characterizations. The
proposed methodology demonstrated a first step towards automated pollen detection in lidar networks." I hope I have brought the authors aware of possible problems related to

their assumptions and their method, and have suggested to them how to expand the work to address these issues, which appear to me critical. I believe that the conclusion should be rewritten by better highlighting the limits of applicability of the method, which in my opinion, at least in the present state, can only provide indirect confirmation to the predictions of the dust and pollen models, rather than proposing itself as an independent method for the their detection and characterization.