

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-990

Anonymous Referee #3

Referee comment on "Measurement report: Spectral and statistical analysis of aerosol hygroscopic growth from multi-wavelength lidar measurements in Barcelona, Spain" by Michaël Sicard et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-990-RC1>, 2022

This paper deals with a statistical analysis of aerosol hygroscopicity determined with the combination of multiwavelength measurements and radiosondes. The topic is of great interest to advance in the water vapor uptake by atmospheric aerosols particles and thus advance in understanding the role of aerosols as potential cloud condensation nuclei. Of particular interest is the analysis of aerosol hygroscopicity below clouds and for clean skies. Therefore, the study topic is of interest for Atmospheric Chemistry and Physics goals.

To my knowledge, this is one of the first papers that use a long-term database for statistical analyses which implicitly is a novelty. The database of multiwavelength Raman and micropulse lidars plus radiosondes is unique. The paper is well structured and references are updated. Results are unique. The paper has the potential of becoming a reference study for future statistical analyses that involved more ACTRIS stations and similar infrastructures worldwide. However, because of the expectation, I have some concerns that must be addressed before its final publication in Atmospheric Chemistry and Physics.

- Although there are no needs for given specific details about your lidar systems, I would like to know if your Raman lidar measurements used are also for daytime. If so, how does it affect the temporal resolution? Also, it is needed to specify which type of radiosondes used and if data are publicly available.
- The methodology proposed for determining aerosol hygroscopicity parameters from lidars measurements is not new. The authors give some recent references but I would go the original papers that explain why the specific thermodynamic conditions must be fulfilled and give a short overview in the paper. But what is not clear to me is the novelty introduced by the authors in using RH_{ref} . Moreover, I miss an error analysis in $f(RH)$ and γ because determining their uncertainty is essential for a discussion of similarities and differences between seasons and between different sites.
- The authors make a great discussion comparing their results with other stations. But

they refer many times to chemical properties of aerosols in Barcelona. To me, that should be accompanied with data. I understand that most of your chemical data are from ground-measurements and lidar measurements refer to different altitudes. But having a study case with well-mixed conditions and chemical properties from the surface would help the discussion.

- I get lost with the statistical comparison. The databases for spectral analyses and climatological analyses seem different. That needs a clarification

MINOR COMMENTS

- The time period when data were acquired is not mentioned. That must be clarified
- Line 46: The statement that aerosol hygroscopicity depends on chemical composition need reference. The same for the discussion of deliquescence and cristalization.
- Line 60: Reference needed for measurements of hygroscopicity with tandem nephelometers
- Line 76: I agreed that multispectral lidar measurements are fundamental for aerosol hygroscopic growth study. But this technique has limitations. Please clarify.
- Line 97: Details or reference are needed for your algorithm for MPLNET data
- Lines 140:144: Did you carry out backward-trajectories analyses for stdudy each case?
- Line 167: I do not understand the statement ` it is the first time a conversion f_{min} to f_{ref} is proposed
- Figure 3: Are the data those of Figure 1?
- Line 229: I do not understand the expression `en passant`. Generally I would recommend double-checking English grammar.
- Line 277: Do you expect marine aerosols above 2 km? Please clarify
- Line 313: Please clarify the statement `our findings suggest that hygroscopic layers near the top or slightly above the PBL`.
- Table 3: Why the analyses are only done at 532 nm?
- Lines 355-356: Why as the aerosol size grows, its potential to keep growing are reduced compared to a drier aerosol?