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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of aerosol properties from ceilometer and photometer measurements: long-term evaluation with in-situ data and statistical analysis at Montsec (southern Pyrenees)" *by* Gloria Titos et al.

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We thank all the reviewers for their comments and suggestions that have helped to improve the quality of the manuscript. A point by point response to Prof. Gross is included below. Changes in the manuscript are noted between quotation marks. The new version of the manuscript with the changes tracked is included in a separate file.

Barry Gross (Referee) Comment: This paper entitled "Retrieval of aerosol properties from ceilometer and photometer measurements: long-term evaluation with in-situ data

and statistical analysis at Montsec (southern Pyrenees)" provides a very detailed statistical assessment of a fairly recent algorithmic approach entitled GRASP (Generalized Retrieval of Aerosol and Surface Properties) to optimize the vertical retrieval of aerosol properties by merging vertical profile data with constraining column data from a sun/sky photometer. The novelty of the statistical comparison is that it is done using insitu data obtained from the Montsec Observatory which is _ 750 meters above the ceilometer profiling instrument which allows the authors to study the retrieval performance above the critical overlap region which even with correction generally leads to significant biases that would be enhanced by the multi-instrument retrieval. Another novelty of the paper is the long duration of the study (3 years) which allows the authors to study the effects of different meteorology and aerosol sources on the results. Based on the authors literature background, this is a significant improvement over existing algorithm retrieval validations which were limited to short duration air craft campaigns. Besides quantifying the retrieval characteristics and identifying conditions in which the retrieval performances is degraded (fine mode dominated), the authors are able to build a very useful profile climatology of vertical aerosol properties filtered by climatology (RH) and source locations In summary, the paper illustrates convincingly the usefulness of the GRASP algorithm in optimally analyzing combined Ceilometer / Sky Radiometer data. The fact that a much cheaper ceilometer is used instead of more costly and sophisticated Lidars is very useful since it opens up the possibility of developing a much larger network of such instrument sites. Suggestions: One suggestion that comes to mind would be to illustrate the importance of the radiometer (i.e radiance constraints) on the retrieval properties. In particular, prior algorithms that combine lidar (or ceilometers) with only total column Aerosol Optical Depth at multiple wavelengths from a sunphotometer has been used to retrieve vertical aerosol profiles. The sun photometer AOD measurements may provide an even cheaper alternative to an instrument site. Therefore, it would be very helpful to the community if some comparison between the different algorithms could be made to see how much improvement there is in the AERONET Radiometer data as compared to just sunphotometer AOD constraints on this very nice

and rich data set.

Answer: We thank Prof. Gross for his positive comments on this manuscript. The GRASP retrieval using only AOD and ceilometer signal is an interesting suggestion that looks very promising since sky radiance measurements are scarcer than AOD measurements. In line with this comment, Torres et al. (2017) explored the use of multi-wavelength AOD measurements to retrieve column integrated size aerosol properties. The versatility of GRASP algorithm is promoting the use of different set of data as inputs such as sky radiances from sky cameras combined with lunar photometers (Román et al., 2017) or scattering measurements from polar nephelometers to retrieve aerosol optical and microphysical properties (Espinosa et al., 2017). In this study we focus on the evaluation of the inversion scheme proposed by Román et al. (2018) that uses sun/sky photometer and includes the RCS from ceilometer as novelty. We are currently exploring other inversion strategies and we will consider the use of only AOD as suggested by the reviewer. However, we feel that this would be out of the scope of the present manuscript in which the main objective is to evaluate the GRASPpac inversion strategy.

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Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2018-431/amt-2018-431-AC1-supplement.pdf

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