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Interactive comment on "Advanced characterization of aerosol properties from measurements of spectral optical depth using the GRASP algorithm" *by* B. Torres et al.

Anonymous Referee #1

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The paper deals with the retrieval of aerosol microphysical properties from spectral aerosol optical depth (AOD) using the Generalized Retrieval of Aerosol and Surface Properties (GRASP) algorithm. The main objectives of the paper are well described and discussed. GRASP is becoming a very powerful tool for aerosol characterization from remote sensing measurements and the inclusion of this new capability is of great interest for the scientific community. There are very large databases of spectral AODs alone compared with the classical inversion that also requires sky-radiances measurements. The accuracy and errors in the retrievals are well presented, and it is shown how the final products are below 20% uncertainty. The inclusion of AOD measurements at 1640 nm is very interesting and actually allows retrievals of coarse

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Discussion paper

mode with good accuracy. This point should be pointed out more as an improvement to previous developments. The applicability to nighttime photometric measurements is great an interestingly presented as such measurements can only provide AODs. Nighttime measurements are expecting to increase with the recent developments in moon photometry. Therefore, the research presented in the article is recommended to be published in Atmospheric Measurement Techniques.

However, in my opinion, the paper needs improvements before its final publication. Although is generally well structured, the writing can be improved as there are many unnecessary discussion (e.g. in page 7, lines 20-30 about the multi-pixel capabilities of GRASP seem out of context) and repetitions. Also, there are many editing errors and English misspellings. My major scientific concerns are:

As commented, the use of 1640 nm provides very good retrievals of coarse mode. However, many AERONET measurements do not include this filter. A discussion (extra analyzed if required) about the use of the classical spectral range of measurements 380-1020 nm need to be included. I also agree with the editor that the analysis should be extended to lower and higher AOD values.

It is not clear to me which approach you eventually use about spherical/non-spherical particles. Is it critical for the retrieval?

I also have minor concerns that could be useful to improve the manuscript.

The final products of the approach presented are the parameters of a log-normal bimodal size distribution. If I am right, you need to retrieve first the size distribution. So I do not understand well what the improvement instead of using 22 bins is. Please clarify.

The authors show the dependence of size distribution with refractive index, but such dependences are within the error claimed. However, it is not clear to me how they select the input refractive index for experimental measurements.

It is not clear to me how you obtained refractive indexes of Table 1. If you used AERONET sky-radiance inversion, how did you obtain values in 340 and 380 nm.

Figure 2 does not show something new and could be removed. Also, section 3.5.1. 'Pre-analysis with the forward code' can be shortened as it is well known by the scientific community.

In my opinion, Appendixes can be skipped and references are enough.

The authors reference many times the results of Dubovik et al., (2002). Why not including a table that summarizes the main results used in the current manuscript? Page 16 lines 14-15. Please add a reference.

Section 3.4 Simulation of aerosol optical depth errors. For wavelengths below 400 nm AERONET instruments have errors of 0.02. Also, moon photometers might have errors of 0.02 or even higher. I suggest adding a brief discussion about the effects of these larger errors.

Section 3.5.2. I miss a general conclusion or a table that summarizes the conclusions. What are the final results adding all the errors you computed?

The variables in Table 3 are confusing. Please choose another way to remark that are differences between model and retrieved parameters.

Figure 10: Please make the points corresponding to experimental measurements bigger. In their current shape they are difficult to see. The same happens in Figure 11.

Why not showing temporal evolution of radius and volume concentrations retrieved in Figures 10 and 11?

Why did you not say anything about your applications to experimental measurements in the conclusions section?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-334, 2016.