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# ***Interactive comment on “Retrieval of aerosol single scattering albedo and polarized phase function from polarized sun-photometer measurements for Zanjan atmosphere” by A. Bayat et al.***

## **Anonymous Referee #1**

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General Comments This study retrieves some aerosol optical properties over Zanjan, northwestern Iran, giving extra emphasis on aerosol polarized phase functions and single scattering albedo (SSA) by examining their dependence on Angstrom exponent and refractive index in the atmosphere. The results of the study are clear and the figures of high quality, however, the discussion is rather poor and the objective of the paper is not well established. These are the main drawbacks, along with the absence of a conclusion section, that do not allow the publication of the manuscript in AMT without strong revisions in the text and results/discussion sections mainly. The authors must highlight

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the innovation of their research in a more clear way as well as the methodology approach, i.e. what analysis do they follow in order to justify their method for identification of different aerosol types. From the figures, I can see that the  $qa(\max)$  from the author's new approach, in combination with AOD, SSA and  $\alpha$  can be used for identifying different aerosol types over this arid environment. Specific comments 1. The authors may be more informative in the abstract section about the instrumentation that they used and the significance and/or applicability of their method to aerosol scattering studies. 2. In the introduction section a paragraph describing the phase function properties, the usefulness of its use for aerosol studies, as well as the other aerosol properties used in the current analysis would be useful. The instruments and the experimental procedure, briefly described in the introduction, must be discussed more analytically (also including references) in the next section (Instrument, analysis and method), or even separating them further. However, the data recording cannot be discussed together with the results. According to my opinion, this structure will benefit the manuscript. 3. The differences between SPM and SPP instruments are not so clear. Are they used for different retrievals and which are these? This part of the manuscript needs better clarification especially for the readers who have not used these techniques. 4. About the methodology section, although it seems to be clear enough, I'm not able to provide specific comments and/or to be critical in some issues, since I'm not so familiar with this approach. 5. There is no discussion about the method for the  $\alpha$  retrievals (I suppose that the authors use the least squares method) as well as typical errors in the calculation of  $\alpha$  occurred due to curvature of the  $\ln AOD$  vs  $\ln \lambda$  plot. Why the authors plot the AOD at 870 nm and not that at 500 nm, which is more commonly used? I suppose because AOD870 has a better response on dust changes, but this has to be mentioned. 6. The annual variability of the aerosol characteristics is rather poorly discussed. The authors are mainly based on citing the previous results obtained over Zanzan. In that case, which is the scope and the innovation of the current analysis? Furthermore, a clear seasonal pattern is observed, which has to be discussed thoroughly. The seasonality of the aerosol properties and types must be also taken into

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consideration when discussing the results of the next figures also. 7. How significant is the nearly constant anthropogenic aerosol background? What's about its contribution to the total AOD? Can be estimated via the current methods? I think that the authors have not been involved with such an analysis and this statement seems to be fairly justified. 8. The agreement in the SSA retrievals between the almucantar AERONET method and the current one cannot be seen via Fig. 1. A new graph correlating them, even for different values of AOD and  $\alpha$ , seems to be necessary. Also, the bias and the significance of the correlation need to be examined and provided in the analysis. 9. Authors provide a combination of scatter plots between  $qa(\max)$ , AOD, SSA,  $\alpha$  without a clear objective of what they are looking for, i.e. which is their objective in their current research. Although the figures are of high quality and informative, the discussion of the results is rather poor. Authors just discuss some positive or negative correlations between the examined parameters, which are obvious to anybody. However, they do not provide explanations about the physical meaning of these correlations and the type of aerosols that dominate the Zanjan atmosphere, but they only refer to previous works. The critical for the current analysis is to discuss the physical meaning of the correlations shown in the graphs with the aerosol field over Zanjan. In case that this is the main objective of the work, it must be underlined from the beginning. Furthermore, there is no connection between the current results and other studies dealing with identification of aerosol types. All the above are the main drawback of the work; otherwise it's an interesting study providing new methods for discrimination of aerosol types over an arid environment. 10. In Figure 7, the three curves for different values of refractive index are very close to each other for low values of  $\alpha$ . So, the statement that for lower  $\alpha$  the data points match more the m3 (dust) curve is not so valid. I can see several "dust points" above the m1 (anthropogenic) curve, the reason is clearly explained, and far away from the "dust" curve. These discussions must be more coincident to the results. 11. A separate conclusion section is absolutely necessary, highlighting the scope and achievements of the current work. It is surprisingly that Conclusions are absent from a scientific article.

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