

Interactive comment on “Retrieval of atmospheric optical parameters from ground-based sun-photometer measurements for Zanjan, Iran” by A. Bayat et al.

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The authors would like to express their gratitude to the referee for valuable comments and questions. We have tried to answer all the questions and apply all the comments into the manuscript.

All the changes have been addressed by the page number, P, the column (C1 for left and C2 for right), and the line number, L.

Answer to the questions and comments:

C2008

Question 1. The measured and computed results should be accompanied by a measurement error. This will enable the authors to quantify their conclusions (significant or not). Specifically the Angstrom parameters are very sensitive to AOD measurement errors and therefore quantitative conclusions on particle size distribution should be drawn with care.

The comment has been applied to the manuscript and errors on AOD measurements and Angstrom exponent are discussed in P3C2L7-L20. It is well discussed by Holben et al. (1998) the resolution on AOD measurements is 0.01-0.02 for AERONET calibrated instruments. For the Langley plots that we have used during the second year of the measurements, we almost have the same resolution. The resolution on α , α_1 , and α_2 values is proportional to $\frac{\Delta r_i}{r_i}$ and implicitly dependent on the air mass (Eck et al., 1999). Therefore at small AOD values (i.e. about few percents) the uncertainties on α , α_1 , and α_2 considerably increases (Eck et al., 1999). Errors resulting from incorrect determination of the filter wavelengths errors are neglected in this work.

Question 2. Information on cloud screening method and number of cloud-free days used per month is needed. During months with much rain (and thus clouds), cloud-free days may usually occur directly after rain. This may lead to underestimation of monthly mean AOD and thus influence conclusions. Figure 1 is added to the manuscript, showing the number of cloud screened data recorded in each month during the measurement period.

P2C2L23-L24, have been added to the manuscript to discuss the cloud screening algorithm used in this work. We have used the standard AERONET algorithm Smirnov et al. 2000 for this purpose.

P2C1L18-L28 is a short review on the number of raw and cloud-screened AOD observations.

Also it should be mentioned that Zanjan is located in a dry region with average annual precipitation of less than 300 mm. The area does not experience many rainy days

C2009

during the year and so we do not believe this can have a considerable effect on the recorded monthly average AOD but we are going to check it in our next works.

Question 3. Some minor comments: 3) The optical thickness due to ozone absorption (Chappuisband) at the 670 nm channel is approximately 0.01 at 300 Dobson Units. This should be accounted for.

Thank you very much for this comment. The ozone optical depths are subtracted from the measured optical depths to retrieve more exact AODs. The comment has been applied to equation (2) and discussed in P2C2L15-L19. Applying the ozone effects, Figures 5, 6 and Table 2 have changed in this version.

Question 4. Some more information about what is called "a dust event" would be welcome (duration, intensity etc.). Are higher values of AOD in dust-event period only due to dust events or is the background value of AOD also higher at that time?

Table 1 is added to the manuscript showing two typical dust events observed on 22 Jun 2008 and 3 July 2008. The table contains daily averaged AOD values extracted from MODIS Deep Blue recordings at 550 nm and IASBS site measurements at 440 nm as well as the horizontal visibility data reported by the Zanjan Met. Office for the mentioned dates. As it can be seen the events duration are almost about one day and this is the typical duration of the dust events that are happening in this region. These discussions are appeared in P4C1L8- L16. Also referring to Fig 2 some background on AOD can be observed in late spring and summer. This is discussed in P3C2L33-L35.

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