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Atmospheric Measurement Techniques Discussions

Interactive comment on "Columnar aerosol size distribution function obtained by inversion of spectral optical depth measurements for the Zanjan, Iran" *by* A. Masoumi et al.

A. Masoumi et al.

masoumi@iasbs.ac.ir

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

In this new version we made some general changes that are listed in the following. 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. We also worked on the English writing of the manuscript.

General scientific revisions in the current version

1. We applied the Langley plot calibration method in the most appropriate possible conditions and used the cloud screening algorithm that suggested by AERONET. Also the ozone optical depths are subtracted from the measured optical depths to retrieve more exact AODs. Therefore, the AOD and Angstrom exponent values are changed slightly without basic effects on the conclusions of the manuscript.

2. As it appeared in P2C1L4-7, the separation point of the fine and coarse mode aerosols is shifted from r = 1 μm in the previous version to r = 0.75 μm in the current version, in agreement with the Version 2 AERONET inversion products that supposed a variable boundary between $\sim$ 0.5 μm to 1.0 μm for this parameter (http://aeronet.gsfc.nasa.gov/new_web/Documents/Inversion_products_V2.pdf).

3. We changed Eq. 8 in a manner that equal coarse radius intervals (Δr) are substituted by equal coarse logarithmic radius intervals (Δlogr) (P2C2L32). Also we supposed aerosols are spheres with radii between $\sim$0.15 μm and 3 μm (King et. al, 1978) (P2C2L4). Therefore, the radii of 0.25, 0.5, 1, and 2 μm are the midpoints of four coarse logarithm radius intervals in the revised manuscript (P3C1L39).

4. We applied the complex refractive index values suggested by Dubovik et al., 2002 for dust and urban-industrial aerosols at four different wavelength channels for the coarse and fine mode aerosols, respectively. These changes are appeared in Table 1.

Applying all above changes, Figures 1, 2, 3, 4, 6, 7, and 9 and Table 2 have been changed respect to the previous version but the main conclusions of the work concerning the observation of the aerosols in different seasons of the year are almost remained unchanged.

Answer to the questions and comments:

1) The authors state that they can only retrieve n(r) for four size bins, since there are only AOT measurements at four wavelengths. This would be true if the least squares

method would be used for the inversion. The constrained linear inversion technique on the other hand is dedicated to "solve" ill-posed or underdetermined problems. For the latter method a finer radius grid would be more suitable, because then the method would retrieve those signatures of the size distribution about which information is contained in the measurement (indicated by the averaging kernel of the retrieval). So, the authors should make a clear choice between using the least-squares method with 4 radius bins (which should be carefully selected and the choice should be motivated), or using a constrained inversion technique with a finer radius grid. Another option would be to use a Truncated Singular Value Decomposition (TSVD) method.

In this work (Eq. 10-12), we used the constrained linear inversion technique presented by King et al., 1978 and King, 1982. The technique also well discussed by Liou, K. N., 2002 (Academic Press, USA, 2002, Pages: 350-358). In this technique the number of wavelength channels (i) that the AOD has been measured on each channel, determines how fine should be the grid over the radius intervals (j) or in other words $i \geq j$ (Liou, K. N., 2002, page: 355). Therefore, it is not clear for us how we can consider a grid finer than this. We removed P2C2L27-29 and Eq. 10 from the previous version of the manuscript to make clear that we just used the constrained linear inversion technique.

2) For the inversion a fixed value of the refractive index of 1.45 (no imaginary part?) has been used. In reality the real part of the refractive index may vary roughly between 1.33 and 1.6, and the imaginary part between virtually zero and $\sim$0.3 for strongly absorbing aerosols. These variations in refractive index may severely hamper the accuracy of the retrieved size distribution.

Please refer to general revisions No. 4. We have to add that the considered values for aerosol refractive indices in Table 1 also are in agreement with reported AERONET values for our station during 2010 but we do not believe this should be referred in the current manuscript when all the measurements have been done during 2006-2008.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 2367, 2010.