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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.

Anonymous Referee #1

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The paper describes an algorithm to derive the columnar aerosol size distribution from aerosol optical thickness measurements at 4 wavelengths. The algorithm has been applied to sunphotometer measurements taken in Zanjan, Iran. To my opinion the paper is not suited for publication in AMT in it's present form. The information provided in the paper is already available for many AERONET stations around the world. Providing this information for one station outside the AERONET network does not provide sufficient material for publication in AMT. Furthermore, I have 2 serious caveats about the proposed inversion methodology to obtain the aerosol size distribution:

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.

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.

Because of points 1 and 2 above, I believe the retrieved size distributions are only a qualitative indication of aerosol size and provide similar information as the Angstrom exponent (as confirmed by the results of the authors). The paper may become acceptable for publication if the inversion methodology is significantly revised (see point 1 above) and a detailed sensitivity study (including the sensitivity to refractive index) and error analysis are included. Also, in a possible revised paper it would be necessary to apply the revised algorithm to measurements of some AERONET stations and compare it with the size distributions obtained from inversion of diffuse sky measurements (Dubovik and King, JGR, 2000). This would give an important quality check.

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