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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.

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First of all, we are grateful to the anonymous referee #3 for his/her comments/suggestions.

Critical comments

1)*Some explanations are required about the choice of constant refractive index of 1.45. Conduct the sensitivity study and evaluate uncertainties of derived results using other reported values of refractive index with non-zero imaginary part. It is commonly* *recognized that aerosol and dust particle in the region under investigation may have a non-zero imaginary part of the refractive index.*

We used the method of Ref. (King et al., 1978) that supposed aerosols as spheres with refractive index ($m' = 1.45 - 0i$). We now agree with you about using a precise aerosol refractive index and apply it. The detailed report is presented in here. Aerosols of our region are divided to urban-industrial and dust aerosols. First type is fine and we can suppose that as aerosols with radii smaller than 1 micron (submicron). The refractive index of them at 4 wavelengths 440, 670, 870 and 1020 nm are almost the same and are:
$m' = 1.40 - 0.02i.$
Dust aerosols commonly have radii $>$ 1 micron and refractive index of them is supposed as:
$m'(\lambda = 440nm) = 1.60 - 0.0030i; m'(\lambda = 670nm) = 1.60 - 0.0015i;$
$m'(\lambda = 870nm) = 1.60 - 0.0010i; m'(\lambda = 1020nm) = 1.60 - 0.0010i;$
We use now both previous and new assumptions of refractive index in our method. We retrieve ASD from both them and compare them with AERONET method conclusions for some days of this year for our station (IASBS station). For example, we exhibit 3 days results in here.

1. 7 Jan 2010. A day with minimum amount of AOD (τ_a (440nm) = 0.054) and large amount of Angstrom exponent (α = 1.77). The Fig. 1 and Fig. 2 are presented here. The only basic difference between old and new refractive indices is seen at very coarse aerosols that increase for new amount of refractive index. Dust aerosols radii often are bigger than 1.9 micron (Ref: Dubovik et al., Journal of the atmospheric sciences, 59, 590-608, 2002) and results of method with new refractive indices confirm it. Also the supermicron aerosols volume concentration is increased slightly from 21% to 22% and other results of our method are almost unchanged.

2. 24 June 2010. A very dusty day with large amount of AOD (τ_a (440nm) = 1.451) and minimum amount of Angstrom exponent (α = 0.04). The Fig. 3 and Fig. 4 are presented here.
We see that for our method with new refractive index, amount of coarse aerosols is decreased, but amount of very coarse ones is increased instead. Also the supermicron aerosols volume concentration is increased slightly from 95% to 97% and other results of our method are almost unchanged.

3. 16 April 2010. A day with AOD (τ_a (440nm) = 0.113) and Angstrom exponent (α = 0.75). The Fig. 5 and Fig. 6 are presented here.
The only basic difference between old and new refractive indices is seen at very coarse aerosols that increase for new amount of refractive index. Also the supermicron aerosols volume concentration is increased slightly from 67% to 69% and other results of our method are almost unchanged.

Finally, we see that general behavior of ASD at our method is similar to AERONET method results especially for fine and coarse aerosols. But our method results are semi-quantitative and its accuracy is less than new methods. On the other hand, applying accurate refractive index in our method doesn't have considerable changes in results and only move boundary of fine and coarse modes from $\alpha \sim$ 1.2 to $\alpha \sim$ 1.3. We will add a section to revised paper and discuss effect of change of aerosol refractive index in it.

2)*Provide better review of standard methods for aerosol retrievals from the ground sunphotometer observations and available results for the regions with similar atmospheric conditions and climatology.*

We will add a paragraph to a section Method of revised paper and discuss other techniques in it. We also add a section to revised paper and will show our method and AERONET method results in it for our region.

3)*It would be beneficial to compare results of this work with available satellite retrievals from MODIS, MISR and SEVIRI (Meteosat).*

We used an output of NOAA ARL (Aerosol Resource Laboratory) HYSPLIT model (for example see Fig. 7.). We will add figures of MODIS results in section 4 (Discussion) of revised paper. These figures confirm our opinion about the main dust source of our region.

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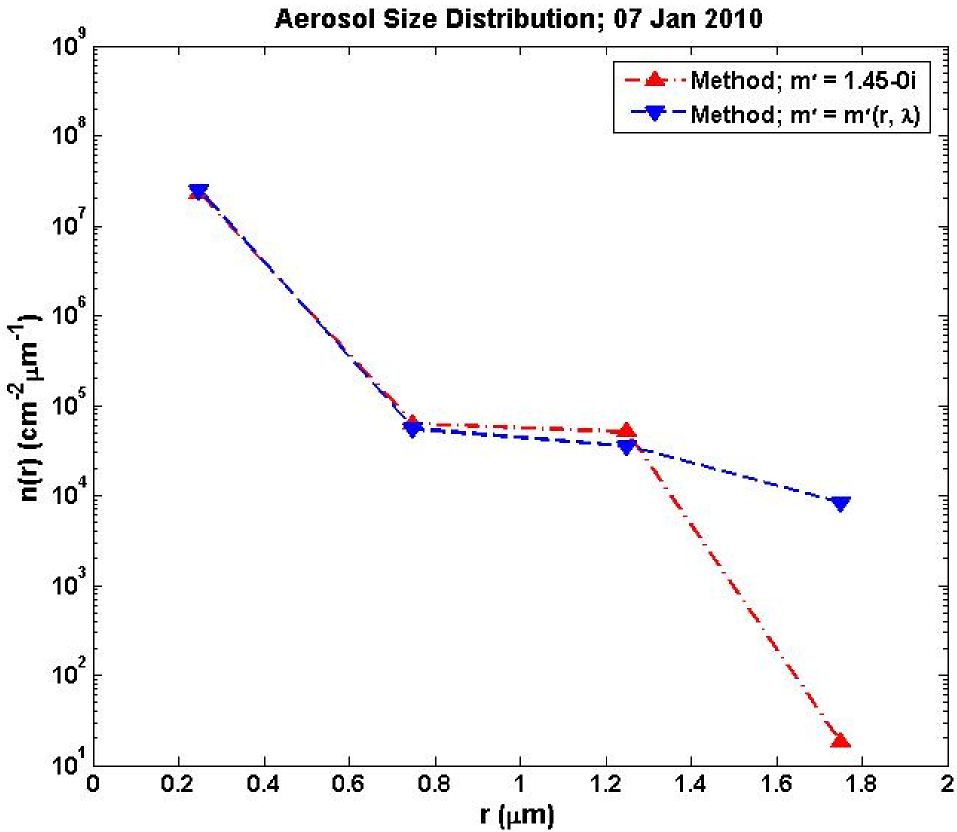

Fig. 1. Daily-averaged aerosol size distribution (1/cm2 micron) for 7 January 2010 for Zanjan, Iran. Our method is employed with old and new refractive indices respectively.

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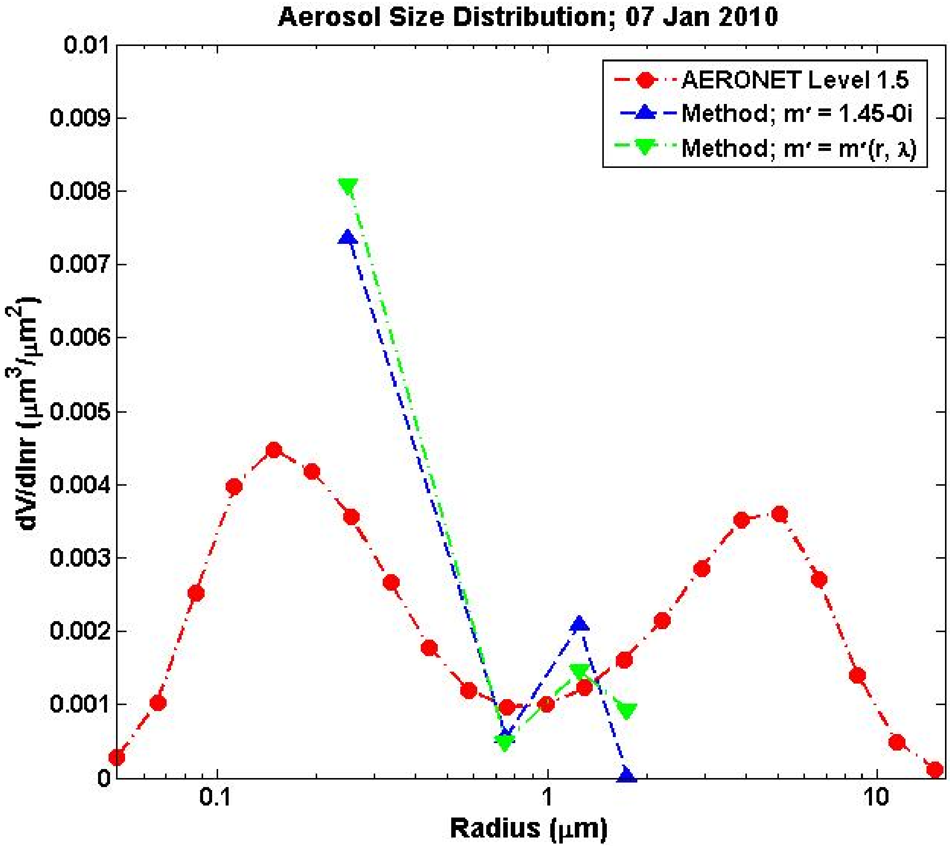

Fig. 2. Daily-averaged aerosol size distribution (micron3 / micron2) for 7 January 2010 for Zanjan, Iran. AERONET and our method with old and new refractive indices are employed respectively.

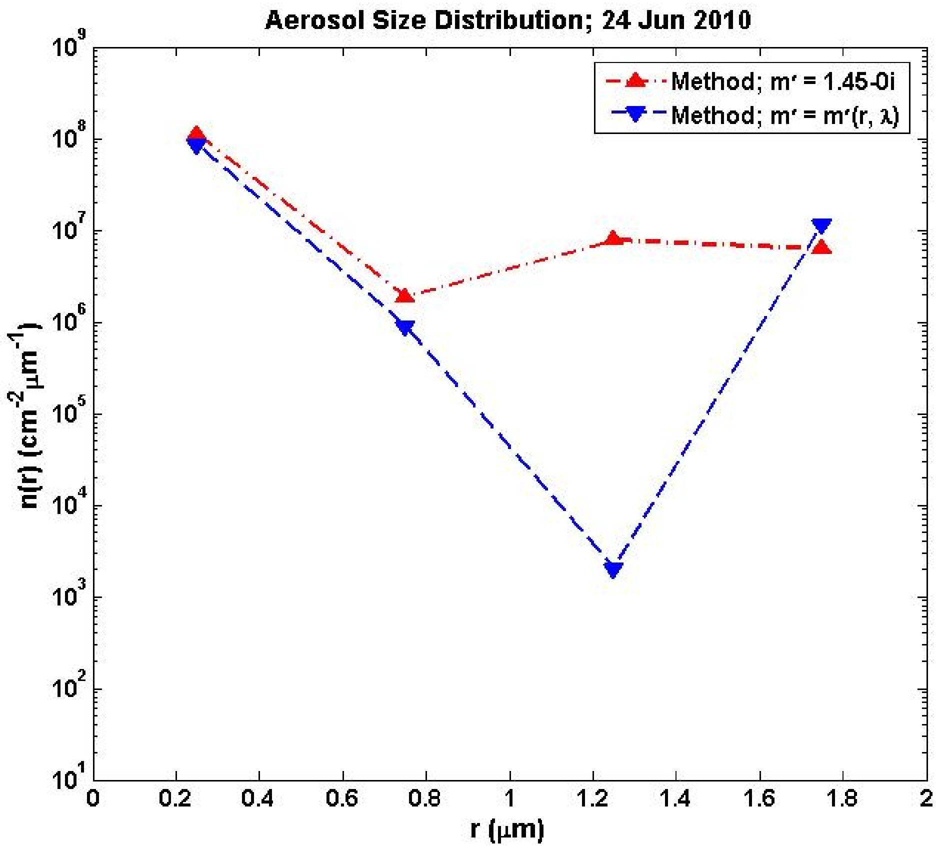

Fig. 3. Daily-averaged aerosol size distribution (1/cm2 micron) for 24 June 2010 for Zanjan, Iran. Our method is employed with old and new refractive indices respectively.

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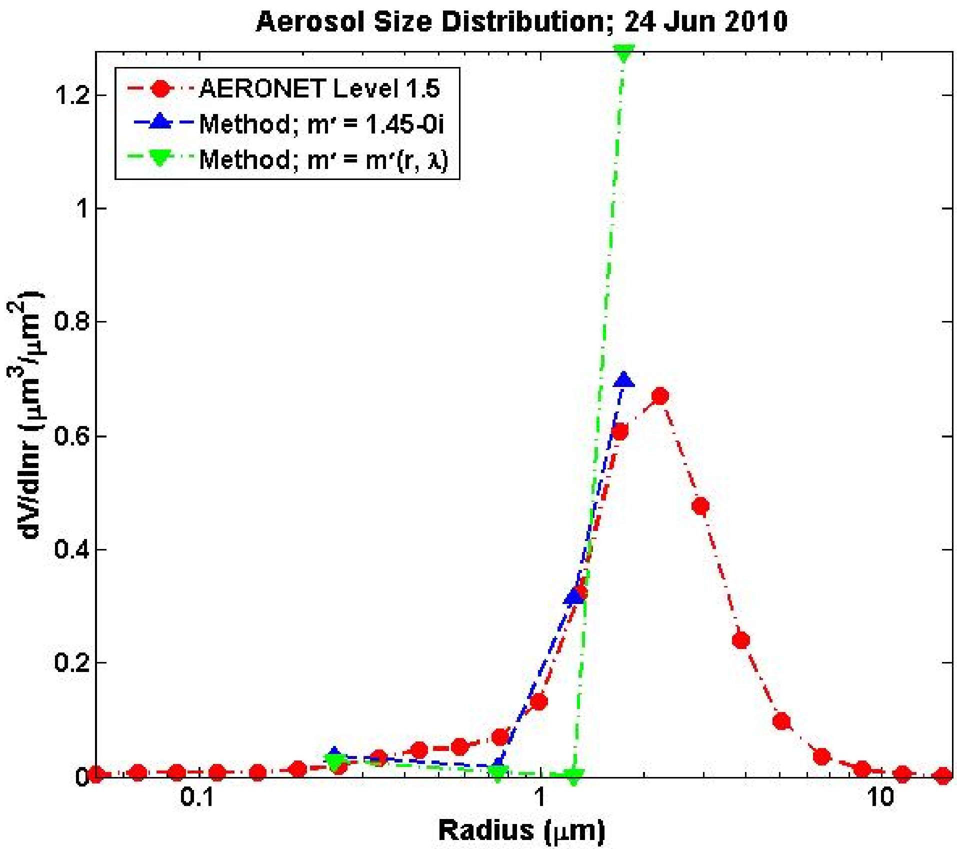

Fig. 4. Daily-averaged aerosol size distribution (micron3 / micron2) for 24 June 2010 for Zanjan, Iran. AERONET and our method with old and new refractive indices are employed respectively.

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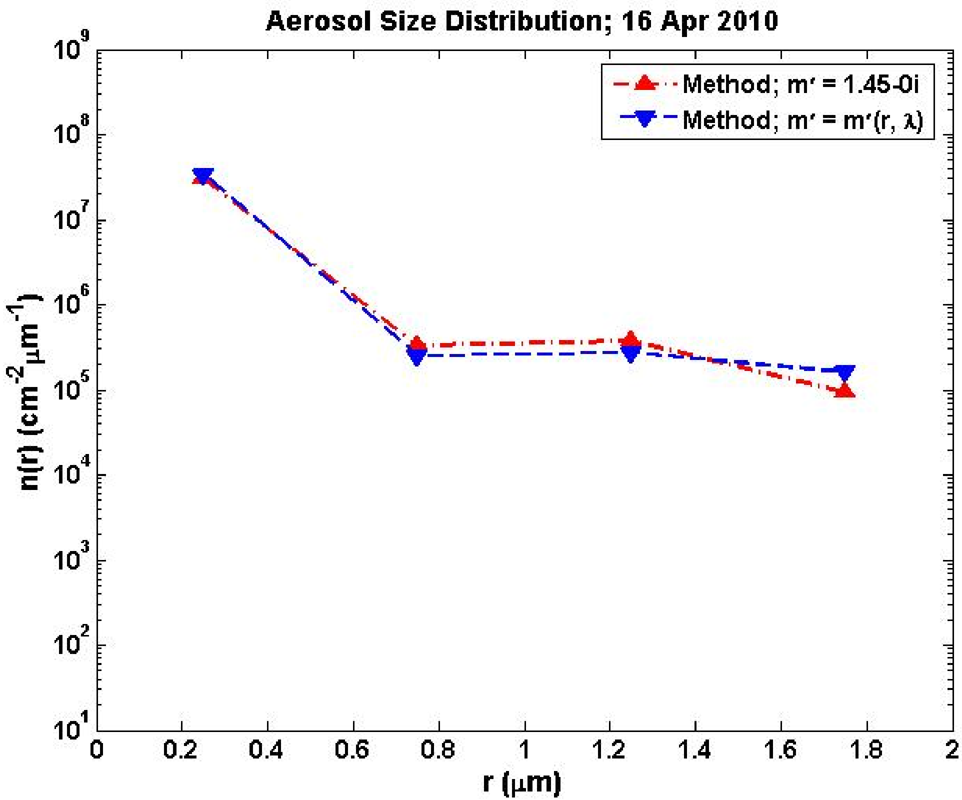

Fig. 5. Daily-averaged aerosol size distribution (1/cm2 micron) for 16 April 2010 for Zanjan, Iran. Our method is employed with old and new refractive indices respectively.

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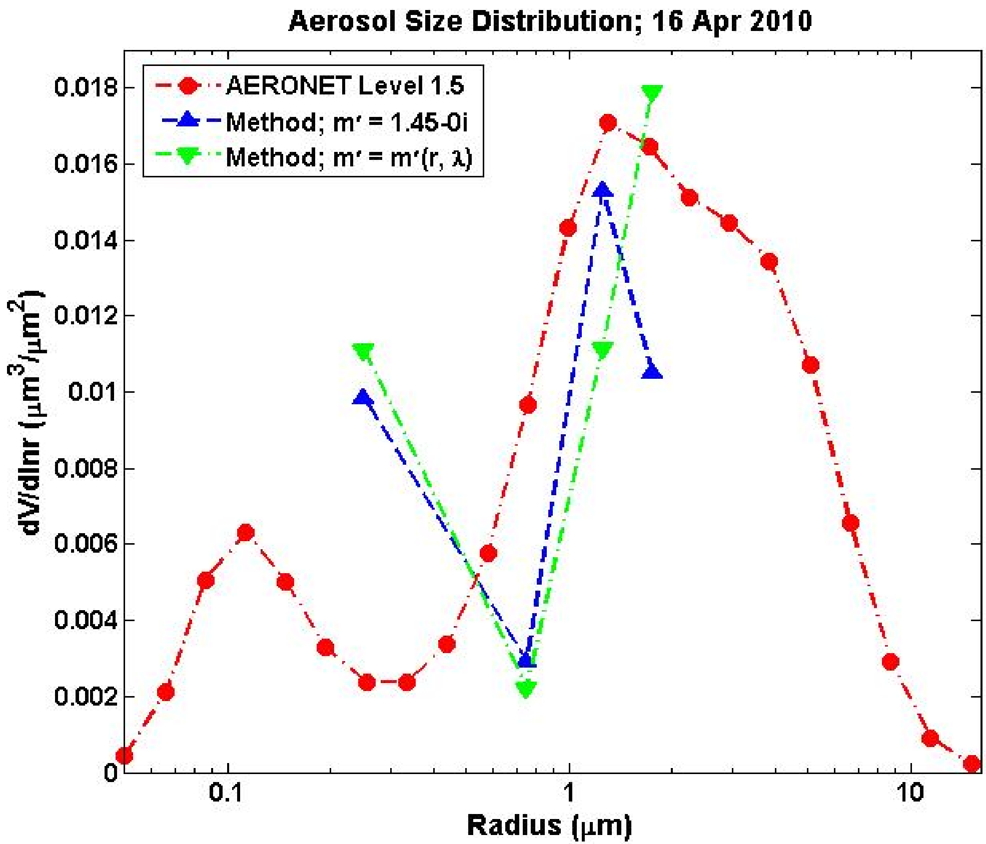

Fig. 6. Daily-averaged aerosol size distribution (1/cm2 micron) for 16 April 2010 for Zanjan, Iran. AERONET and our method with old and new refractive indices are employed respectively.

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