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Atmospheric Measurement Techniques Discussions

Interactive comment on "Method to measure the size-resolved real part of aerosol refractive index" *by* G. Zhao et al.

Anonymous Referee #1

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In this manuscript, the authors introduced a method to retrieve the real part of refractive index (RRI) of ambient aerosols from the measurements of the scattering intensities of size-selected aerosol particles by the combination of the differential mobility analyzer (DMA) and the single particle soot photometer (SP2). The authors pointed out that retrieval of the size-resolved RRI of ambient aerosols is the innovation of this paper in comparison with the measurements of the total equivalent aerosol RRI or aerosol RRI at a given diameter in previous studies. It is a meaningful topic to measure the real part of the complex refractive index of ambient aerosol particles. However, there are still some important issues should be considered before it is publishable.

1. The authors pointed out that "there might be significant variations in the aerosol RRI for aerosols of different diameter because the aerosol RRI is highly related to the

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Discussion paper

aerosol density and chemical components. . .information of the size-resolved aerosol RRI can help to study the chemical information and the aging process of aerosols among different diameters". However, the results of the size-resolved RRI of the ambient aerosols do not show significant variations among different diameters. The authors should give explanations.

2. The size-resolved aerosol RRI is retrieved based on the Mie scattering theory at a given particle diameter. What is the effect of the imaginary part of the complex refractive index on the retrieval?

3. The impact of non-sphericity of ambient aerosols on the light scattering cannot be neglected, especially for dry particles. The authors should also discuss the uncertainties introduced by the sphericity assumption based on the Mie theory.

More specific comments:

1. Some details of the method to retrieval real part of the refractive index based on the Mie scattering theory should be added.

2. Lines 57-58: the authors pointed out that "Up to now, there is no information in the literature of the size-resolved ambient aerosol RRI over the diameter range between 200nm and 500nm. . .". However, the individual particle analysis combining scanning and transmission electron microscopy (SEM and TEM) have been widely used to derive size-resolved information of the complex refractive index of atmospheric aerosol particles (e.g., in the size range from 100 nm up to 50 μm in diameter) (Ebert et al.,2002, 2004; Kandler et al., 2007).

Ebert, M., et al., 2002. Complex refractive index of aerosols during LACE 98 as derived from the analysis of individual particles. Journal of Geophysical Research 107 (D21), 8121.

Ebert, M., Weinbruch, S., Hoffmann, P., Ortner, H.M., 2004.The chemical composition and complex refractive index ofrural and urban influenced aerosols determined by

individual particle analysis. Atmospheric Environment 38, 6531–6545.

Kandler K, Benker N, Bundke U, et al. 2007. Chemical composition and complex refractive index of Saharan Mineral Dust at Izaña, Tenerife (Spain) derived by electron microscopy. Atmospheric Environment 41(37), 8058-8074.

3. Section 4.1: The field measurements were carried out at the AERONET BEIJING_PKU station. The results should be compared with the AERONET retrievals considering that the size-resolved RRI of the ambient aerosols doesn't show significant variation among different diameters.

4. Lines 232-233: "For most ambient aerosols, the RRI ranges from 1.4 to 1.5 . . .". Some researches have reported the values around 1.53∼1.57 for the RRI of most of dry components of atmospheric aerosols, and higher values for RRI of black carbon (BC) component (Xie et al., 2017). The authors should demonstrate their results with other measurements.

Xie Y S, Li Z Q, Zhang Y X, et al.,2017. Estimation of atmospheric aerosol composition from ground-based remote sensing measurements of Sun-sky radiometer. Journal of Geophysical Research Atmospheres122(1),498-518.

Typos/Grammar:

1. Line 12 and some other lines in the text: a space should be placed between the number and the unit.

2. Lines 27-29 and some other lines in the text: it is better to use the past tense in review of the literature.

3. Line 29: please rewrite the sentence "Valenzuela et al. (2018) also reports an uncertainty of 7% with the uncertainties of RRI of 0.1 in RRI."

4. Line 58: "the diameter range between 200nm and 500nm where the aerosol scattering coefficients contributes to. . .". "contributes" should be "contribute".

5. Line 64 and some other lines in the text: “for aerosol of different diameter” should be “for aerosol of different diameters”

6. Line 90: “PNSD” first appears in Section 2.1, but it has not been defined.

7. Lines 99-100 and some other places in the text: the physical quantities “V” and “Zp” should be set in italic in consistent with the equation.

8. Line 102: “L” in Eq. (2) has not been defined.

9. Lines 113 and 140: please distinguish the two “C” in Eqs. (5) and (6).

10. Lines 150 and 155: “equation (6)” and “equation 6” should be in a uniform format.

11. Line 156: “as that described in section 2.2.1”. There is no section 2.2.1 in the manuscript.

12. Line 177: “PH0” first appears in Section 3.2, but it has not been defined.

13. Line 184: “Dp$\sim$ ” first appears in Section 3.2, but it has not been defined.

14. Lines 175, 180, 184-185: “fig.2” should be changed into “fig.3”.

15. Line 221: “SP” should be “SP2”.

16. Line 251: “This instrument is employed at a field measurement at the AERONET PKU stating. . .”, please rewrite this sentence.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2018-399/amt-2018-399-RC1-supplement.pdf

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