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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optically effective complex refractive index of coated black carbon aerosols: from numerical aspects" *by* Xiaolin Zhang and Mao Mao

Anonymous Referee #1

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Comments: The work by Zhang et al. investigated optically effective complex refractive index of coated BC by the multiple-sphere T-matrix method. They investigated the optically effective ACRI of polydisperse coated BC aggregates retrieved from their accurate scattering and absorption properties on different shell/core ratio, and compared with VWA and EMT. Besides, they propose a new ACRI parameterization for fully coated BC with Dp/Dc $\geq$ 2.0 in coarse mode. The paper is overall well written. I suggested its publication in Atmospheric Chemistry and Physics after addressing the following issues: In line 8-10, the author said that "the simple spherical coatings on BC particles have similar effects on scattering and absorption properties to those with more complicated coating structures". But I didn't find the same conclusion from the

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Discussion paper

cited paper by Dong et al., [2015] and Liu et al., [2016], and in my opinion this point may be not true in reality. Please carefully reread these two papers. In line 19-21, more description about fractal dimension should be added, for example, wang et al., [2017] get a fractal dimension about 2.2 for aged BC aggregates. The size of BC in figure 2-5, 7 is not mentioned throughout the manuscript. This information should be added in Methods Section. In Methods Section, the method calculating the ACRIs of concentric coated BC aggregates with different particle size distributions are not mentioned. Although the author briefly introduced the method in Section 3.2, detailed methods and parameteres should be added in Methods Section. The sketch maps of geometry of coated black carbon of two off-center core-shell structures should also be shown in the manuscript or supplementary information section. In Section 3.3, the author needs to descript the exact size of BC aggregates. Besides, did you calculated different size and fractal dimension of BC aggregates using your new assumed parameterization of ACRI? Does this method always perform better? This should be illustrated. In section 3.4, Due to aged BC particles having complicated coating morphologies in ambient air. Seemly, individual particle analysis provide very good coating morphologies (Wang et al., ESTL, 2017, Adachi et al., JGR, 2008; Li et al., 2016, JGR)

References: Dong, J., J. Zhao, and L. H. Liu (2015), Morphological effects on the radiative properties of soot aerosols in different internally mixing states with sulfate, Journal of Quantitative Spectroscopy and Radiative Transfer, 165, 43-55, doi:10.1016/j.jqsrt.2015.06.025. Liu, F., J. Yon, and A. Bescond (2016), On the radiative properties of soot aggregates – Part 2: Effects of coating, Journal of Quantitative Spectroscopy and Radiative Transfer, 172, 134-145, doi:https://doi.org/10.1016/j.jqsrt.2015.08.005. Wang, Y., F. Liu, C. He, L. Bi, T. Cheng, Z. Wang, H. Zhang, X. Zhang, Z. Shi, and W. Li (2017), Fractal Dimensions and Mixing Structures of Soot Particles during Atmospheric Processing, Environmental Science & Technology Letters, 4(11), 487-493, doi:10.1021/acs.estlett.7b00418.

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