

Interactive comment on “Estimation of aerosol complex refractive indices for both fine and coarse modes simultaneously based on AERONET remote sensing products” by Ying Zhang et al.

Anonymous Referee #4

Received and published: 6 June 2017

The Authors present a method for the separate estimation of the aerosol refractive index from AERONET data. First they fit AERONET aerosol size distribution to a multimodal log-normal distribution, then they group the modes of the fitted log-normal distribution into a “fine” and a “coarse” mode, and then they proceed to the estimate of the refractive index of each mode by an iterative fitting AERONET total and absorption AOTs to Mie forward calculations. The proposed method looks fine to me. The steps of the procedure are well identified, the underlying assumptions are clearly stated and so are the limitations of the method (e.g., not taking the possibility of nonspherical particles into account). The validation on synthetic data, instead, looks a bit shallow, because the Authors only test three configurations, in which three realistic fine mode

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aerosol types (water-soluble, biomass burning and dust) are combined with a “default” coarse mode with refractive index $1.53+i0.008$: in this section I would have been curious to see tests with more combinations of aerosol parameters. Anyway, in the last section of the paper the Authors also make the effort of applying their method to real AERONET measurements taken at Beijing, and they show that their separate retrieval allows a reasonable physical interpretation (which is probably the best possible “validation” of a refractive index retrieval, given that independent correlative measurements of this parameter are very difficult to obtain. and even an objective definition of the refractive index of a mixture of aerosol components is problematic in itself). Furthermore, the Authors show that their multicomponent refractive index retrievals fit AERONET AOTs quite well. In view of this, I think this paper can be published with minor revisions. I would recommend, though, a proofreading by a native English speaker, because the quality of the written English looks below par in some parts of the manuscript. Below are some suggestions for the modification of some unclear statements, and some other minor comments.

MINOR COMMENTS

- P1, L4-5. I would suggest to change “. . . based on AERONET aerosol products, including” etc., with “. . . based on AERONET volume particle size distribution” etc.
- P1, L5-6. The sentence “The method . . . simultaneously” is a bit unclear. Consider removing it or rephrasing with something like “The method consists of two steps. First a multimodal log-normal distribution that best approximates the AERONET VPSD is found. Then the fine and coarse mode CRIs are found by iterative fitting of AERONET AODs to Mie calculations.”
- P2, L8-9. I do not understand what the last two sentences mean. Especially the last one (“Raul and Chazette etc.”).

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- P2, L17. Change “There are only few studies ... attempted...” to “Only a few studies ... attempted...”. Furthermore, Wu et al. (2015) does not describe retrieval from ground-based measurements. It describes retrievals from airborne measurements.
- P3, L12. σ_i is the “geometric standard deviation” (not the ordinary one) of r for each mode. As an alternative, if you prefer not introducing the concept of geometric standard deviation, you can say that “ $\ln \sigma_i$ is the standard deviation of $\ln r$ for each mode”.
- P5, L1. Cite:
J. A. Nelder, and R. Mead (1965), “A simplex method for function minimization”.
Comp. J., 7, 308-313, doi: 10.1093/comjnl/7.4.308
- P9, L1. What does “In a meaning of band average” mean?
- P10, L16-17. I do not understand the meaning of the last sentence: “Either sensitivity on τ or τ_a will be able to support the estimation of related sub-CRI parameters”.

TECHNICAL CORRECTIONS

- P2, L16. Consider moving “inventories” before the parenthesis.
- P2, L17. P2, L17. “knowledge of ... are essential” -> “... is essential ...”
- P3, L21. “subsequence” -> “subsequent”
- P5, L26, “an” -> “a”
- P5, L28. “achieves” -> is achieved. “If yes” -> “If so”

- P9, L5. “preform” -> “perform”. “access” -> “assess” ?
- P9, L18. “imagery” -> “imaginary”
- P10, L16. “Another saying” -> “In other words”
- P11, L2-3. “relative” -> “relatively”, “presents” -> “present”, “high” -> “higher”, “in the case” -> “for this case” ?
- P11, L4. “sensibilities” -> “sensitivities”
- P12, L13. “... the hygroscopicity ... are significantly increased” -> “... is significantly increased”
- P12, L15-16. Consider removing the parentheses from “(k_f and k_c)”, and from “($k_{f,440}$ and $k_{c,440}$)”.
- P14, L5. What does “online” mean in this sentence?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-5, 2017.

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