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Atmospheric Measurement Techniques Discussions

Interactive comment on "$3+2+\mathrm{X}$: What is the most useful depolarization input for retrieving microphysical properties of non-spherical particles from lidar measurements by assuming spheroidal particle shapes?" *by* Matthias Tesche et al.

Anonymous Referee #2

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Authors present results, related to inversion of lidar observations, containing three depolarization ratios to the particle microphysics. This is interesting and important study. Paper is clearly written, contains new results and can be recommended for publication. Still I think that the manuscript will become better if authors address several important points. 1. Authors use the spheroids model to mimic the scattering properties of dust or other non-spherical particles. Thus, the analysis presented is valid only for this model. By my opinion, the manuscript should start with consideration, how well the spheroid

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model describes depolarizing properties of real aerosols. I would suggest to compare available in literature depolarization measurements with model predictions. Some information can be found in: Miffre et al., Journal of Quantitative Spectroscopy & Radiative Transfer 169 (2016) 79–90 Mamouri et al., Atmos. Meas. Tech., 10, 3403–3427, 2017 (this one is cited by authors) The issues related to modeling of the smoke depolarization ratio are discussed also in Mishchenko et al., Appl Opt 55, No. 35, 2016. 2. For convenience of results discussion, I would suggest to add in the beginning a kind of a table (or figure), showing depolarization ratios, predicted by spheroid model for realistic PSD of dust for pure spheroids and for spheroids fraction 40%, 60%....It will help in the analysis of results. It is important to show depolarizations for different values of the imaginary part (mI). From my knowledge even pure spheroids have difficulty in reproducing high depolarization ratios, especially for high mI. 3. Authors assume spectrally independent the particle refractive index. In reality, in dust the imaginary part of the refractive index increases in UV, leading to fast decrease of depolarization ratio. This should be discussed.

Technical comments. p.5 ln 27 “This case represents nearly pure dust conditions. . .” It is worth to mention that this is long-transported dust, which can be modified during transportation. p.6.ln.6 The inversion of all input data sets shows a decrease of effective radius with height” Why? If Angstrom and depolarization are stable. . . p.6. ln 12 “In fact, non-spherical particle fractions were never found to exceed 40% when using the traditional 3+2 input” Inverse problem for 3+2 set is strongly underdetermined, so retrieved spheroid fraction is un-trustable. This is why usually 100% of spheroids is assumed. p.6 ln9 “The high values of _532 lead to a dust fraction above 80% “ Here the table with predicted depolarizations would be useful. What discrepancy did you obtain in retrievals? Fig.2. Why not to show retrieved real and imaginary parts? Error bars should be added.

p.11 ln.18 ” The most realistic non-spherical fractions is found when using depolarization information at 355 nm.” Have you any explanation for this?

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