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 #3

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This work is valuable since it discusses the most useful depolarization input for retrieving dust properties from lidar measurements using the spheroid model of Dubovik et al. (2006). The Dubovik model was generated for retrieving dust microphysical properties with passive remote sensing, but it has been extensively used for dust retrievals with lidars. A discussion relevant on the Dubovik model capabilities and limitations for dust retrievals using lidar measurements is missing from the literature. Although the work in discussion does not extensively do this, it opens a discussion for the most useful input

in terms of depolarization at 355, 532 and 1064 nm.

Unfortunately the paper is very confusing since the authors present their results as if they consider a universal spheroid model. The spheroid model of Dubovik et al. (2006) cannot be considered as a universal spheroid model, due to the assumption used for the aspect ratio distribution and the mixture of prolate and oblate spheroids. This is discussed in Dubovik et al. (2006), showing that the values of P22/P11 (i.e. the phase matrix elements relevant to depolarization) can be different for different aspect ratio distributions (see Fig. 12 in Dubovik et al. (2006); the values at 180 degrees are not shown but from the scattering angles up to ~170 degrees the tendency is clear). Dubovik et al. state in page 15 of their paper that: "Figure 12 illustrates the phase matrices simulated for desert dust aerosol using an ensemble of spheroids differing only by their axis ratio distributions. .... Some differences can be seen for ... P22/P11, however they are likely to be insignificant for passive remote sensing applications."

This is most probably the reason the results of the work in discussion are different from results shown in Gasteiger and Freudenthaler (2014), who assumed the spheroidal shape for non-spherical particles, but assumed different aspect ratios and mixture of prolate and oblate particles, than the Dubovik model.

In conclusion, although the work in discussion can be a valuable tool for dust lidar retrievals, it should undergo major revisions before it is published in AMT. Specifically, the authors should shift its objective to discuss what their results are actually about, starting with changing the title to something similar to: "What are the most useful depolarization input for retrieving the microphysical properties of dust particles from lidar measurements using the spheroid model of Dubovik et al. (2006)". Please revise the whole manuscript accordingly.

Last, please note that the focus of the work is on dust particles and not on "non-spherical particles" in general. Moreover (a) change the retrieved "non-spherical fraction" to "spheroid fraction" throughout the document, (b) include plots of the retrieved

real and imaginary part of the refractive index in the results section and (c) provide a more extensive discussion on the effect of the assumption of spectrally-independent refractive index used in the analysis.

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