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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of the spectral dependence of particle depolarization ratio of aerosols using NASA Langley airborne High Spectral Resolution Lidar" *by* S. P. Burton et al.

Anonymous Referee #2

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General comments:

The discussion paper of Burton et al. presents very interesting measurements of the linear depolarization ratio at three wavelengths for cases with long-range transported Saharan aerosols, with locally-generated desert aerosols, and with transported smoke aerosols. The measured data is discussed in context of existing literature. The paper is well-structured and overall well-written. It is a valuable contribution and should be published in ACP after some minor corrections.

Specific comments:

1) For someone starting to read this paper, it remains unclear for a long time which depolarization ratio (linear or circular?) is meant. Please explicitly write "linear depolarization ratio" in the title, the abstact, the main text (at least once per section), and the figure captions.

2) The abstract (p24753 l18) says "... is inferred to be ...": In my view, "coated soot aggregates" are one possible explanation for the smoke measurements, but there are certainly other types of soot-like particles that would explain these measurements. Thus, I suggest to write "... can be explained ..." or something similar.

3) Eq. 2: The definition of beta_parallel and beta_perpendicular is unclear. The text calls them "signal", but beta usually is the backscatter coefficient.

4) Fig. 4 at about 150km distance on track and 4km altitude: The linear depolarization ratio increases from <0.1 at 355nm to ∼0.2 at 532nm and ∼0.25 at 1064nm. As this wavelength dependence is quite uncommon, I wonder if these numbers are real aerosol properties or just a measurement artefact. Can you comment on this?

5) "pure dust", "pure Saharan dust" in several places of the paper: Though these terms have been used in the literature, they are, strictly speaking, wrong. Dust particles are solid particles, but desert aerosols usually contain also a non-negligible number of small spherical particles that are no dust particles. This was shown in measurements during field campaigns, for example SAMUM. The "desert mixture" of the aerosol database OPAC also contains small spherical particles. They are very important for the depolarization ratio at 355nm and thus the spectral dependence of the depolarization ratio. The spectral dependence of the depolarization ratio presented in Sect. 3 shows that such non-dust particles were present in both measured "dust" cases. Thus, I suggest to write "pure desert aerosol", "pure Saharan aerosol", "dust-containing aerosol", or something similar, but not "pure dust".

6) More generally, I like to encourage the authors to replace "dust", where appropriate, by "desert aerosol", "Saharan aerosol", "dust-containing aerosol", "dust-dominated aerosol", etc., throughout the paper, to take into account that the measured aerosols contain also non-dust particles as discussed in comment 5. I admit that this is not always considered in the literature, nonetheless the suggested naming would be more precise.

7) p24767 l16ff.: Does the incomplete geometrical overlap not increase the uncertainties of the depolarization measurements?

8) p24770 l24 and Fig. 15: Please mention how the size of the soot aggregates is defined? Volume-equivalent, maximum dimension, or?

I find the technical details of the system and the error analysis well-described. However, since I am not so familiar with all the effects that can happen in the optics and the electronics of such an advanced lidar system, I hope that other reviewers are more familiar with this topic.

Technical corrections:

A) p24756 l8: "6-km" –> "6 km"

B) p24762 l18: "The particle depolarization spectral dependence..." –> "The spectral dependence of the particle depolarization ..."

C) Fig. 3 caption: "Aerosol backscatter and extinction curtains ..." –> "Curtains of aerosol backscatter and extinction coefficients ..."

D) Fig. 6 and 12 caption: "backscatter" –> "backscatter coefficient"

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 24751, 2015.