We would like to thank the referee for the constructive comments. Below are referee comments in **bold**, followed by our reply.

In their manuscript the authors describe a new method to derive the particle linear depolarizatio ratio for HALO photonics lidar systems. The particle linear depolarization ratio is a very important property to distighuish different aerosol types. Thus, an additional method to derive this important property is of high significance. The manuscript is very well written and easy to follow. The technique and the results are very well presented. I suggest publication after some minor revisions.

Comments:

The authors present a new method to derive the particle linear depolarization ratio at a quite long lidar wavelength. Can the new method / the particle linear depolarization derived from the 1565 nm measurements be used stand alone for aerosol typing, or is its main purpose an extension of existing classification schemes to provide additional information for a more robust classification.

Most aerosol typing algorithms are based on a combination of depolarization ratio and other parameters such as lidar ratio or Ångström exponent, as e.g. marine and polluted air masses can have very similar depolarization ratio (e.g. Illingworth et al., 2015; Baars et al., 2016). Thus, we see the new wavelength mostly as an extension of the current suite of measurements. However, if there is prior knowledge of prevailing aerosols (e.g. volcanic ash transport) also stand-alone measurements can provide useful aerosol typing.

We have added following paragraph in the conclusions on line 334:

"For aerosol typing, adding particle linear depolarization ratio at 1565 nm to shorter wavelengths can help to distinguish biomass burning aerosols from dust, as much stronger spectral dependency has been observed for elevated biomass burning aerosols than for dust (e.g. Haarig et al., 2017, 2018; Hu et al., 2019). In case there is prior knowledge of prevailing aerosols, such as transport of volcanic ash, even stand-alone particle linear depolarization ratio measurements with Halo Doppler lidars can probably provide useful information for aerosol typing."

Can the authors give a few more words on the calibration of the two signals / on the uncertainties resulting from their kind of calibration? The mean values of the two systems do not show a significant difference; does it represent a universial characteristic of the HALO Photonics systems? How often should the calibration be performed?

We have added a more detailed discussion on the calibration in response to Reviewer 1. In our experience from seven different Halo Photonics systems in Finland the bleed-through is typically less than 0.02. However, one of the XR systems has considerably higher bleed-through, though that can be partially attributed to higher uncertainty in the background noise level for XR systems (see Vakkari et al., 2019).

As the optical path is made of fibre-optic components, we do not expect significant temporal variation in the bleed-through. Continuous measurements in Finland have also shown that the bleed-through remains constant for several years at least. However, we recommend to check the bleed-through monthly or after an instrument is moved to be sure.

We have added following on line 146:

"The mean cloud base δ* observed for these two systems in Fig. 3 are well in line with our experience with these and five other Stream Line and Stream Line XR systems in Finland, where cloud base δ* typically ranges from 0.01 to 0.02."

And on line 149:

"This is also our experience with Halo systems in Finland since 2016, but we recommend to check the bleed-through monthly or after an instrument is moved to a new location."

The authors show an important comparison of their results compared to former measurements. Especially with regard to the longer wavelength, a comparison with results from optical modelling would be interesting and is missing in this manuscript.

We have added a new figure in Section 4 including spectral dependency of depolarization ratio modelled by MOPSMAP (Gasteiger and Wiegner, 2018) for desert dust aerosol and an Aeronet inversion up to 1640 nm by Toledano et al. (2019). Here, we would like to keep the manuscript focused on measurements and decided to leave more detailed model comparison for future studies.

The new figure and related discussion added on line 309 are:

"Spectral dependency of depolarization ratio modelled with MOPSMAP (Gasteiger and Wiegner, 2018) for desert dust aerosol from OPAC database (Koepke et al., 2015) agrees reasonably well with the Saharan dust case on 21 April 2017 in this study (Fig. 17). On the other hand, the sun photometer based retrieval by Toledano et al. (2019) for long-range transported Saharan dust over Barbados indicates a little lower depolarization ratio of 0.19 at 1640 nm compared to this study at 1565 nm (Fig. 17). The lower depolarization ratio at 1640 nm over Barbados is reasonable considering the much longer transport compared to this study."

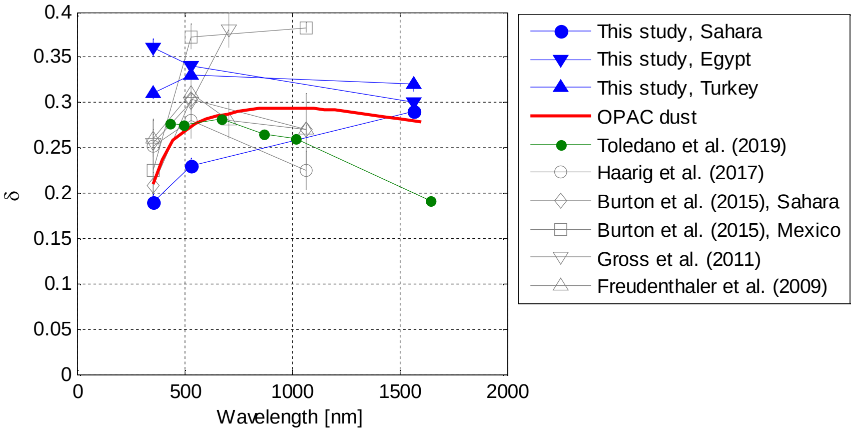

Figure 1: Particle linear depolarization ratio as function of wavelength for dust observations in Table 2. Additionally, spectral dependency modelled with MOPSMAP based on OPAC database for desert dust (Koepke et al., 2015; Gasteiger and Wiegner, 2018) and Aeronet inversion by Toledano et al. (2019) are included.

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