

Interactive comment on “Dry versus wet marine particle optical properties: RH dependence of depolarization ratio, backscatter and extinction from multiwavelength lidar measurements during SALTRACE” by Moritz Haarig et al.

Anonymous Referee #1

Received and published: 27 June 2017

This is an important paper that utilizes the three-wavelength polarization Raman lidar BERTHA, measuring the PLDR together with the relative humidity, to show an interesting phase shift of sea salt aerosols, from spherical to cubic like (under changing RH conditions). If indeed the measurement were done under clear marine conditions, this would have important implication for aerosol classification in remote sensing application. The authors did a careful work, with the measurements and the optical modeling as well as with the comparison and the use of other available instrumentation (radiosonde and AERONET). However, the writing needs to be

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improved. It is recommended that the manuscript be accepted for publication after some minor revisions (detailed below)

General comments:

*The authors state in P9 line 13-14: "Overall we are very confident, that only pure marine aerosol was present in our measurements and no other aerosol type interfered with our measurements". The authors also show in figure 6 left panel a small cross over wet Sahara, as well as showing in figure 2 Images of dry atmospheric sea salt particles surrounded by **Saharan dust particles**. (Mentioning that these samples were taken in the dust layer 2–4 km). The reviewer agrees with the authors that it is likely that most of the aerosols are indeed sea salt. Especially if the authors claim to have ensemble trajectories below 2000m which passed only over the ocean. Nevertheless, what evidence do the authors provide for claiming there is no dust entrainment to the marine aerosol layer? In other words, how do the authors completely rule out the existence of Saharan dust, affecting their measurements? Groß et al., 2013, table 3 (1) provides the linear depolarization ratio and the LIDAR ratio, calculated for selected mixing ratios of marine aerosol and Saharan dust at 532nm. These values could be in agreement with the measurement presented in this manuscript, for example Groß et al., 2013 shows, that for 20% Saharan Dust (SD) contribution the LIDAR ratio is 21 ± 5 (and 24 ± 6 for 40% SD) and the linear depolarization ratio is 5 ± 2 (and 8 ± 3 for 40% SD).). The authors also present very low Ångström Exponent in this work, and even mention in P10 line 17 "The drying process may occur within the marine aerosol layer or on top of it, where dry air from the free troposphere is mixed in". Is clear separation from a potential dust influence possible in this case? If not, could you add several lines in the manuscript discussing this option?

* P8 line 17-18: "...Then a fast decrease of the relative humidity... was found at the

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trade wind inversion between 1850 and 2150 m. This feature was observed for most of the measurements under clean marine conditions in February 2014".

Do the authors observe the same depolarization ratio in these cases? Why only the 23 and 24 Feb are presented in this manuscript?

* Section 5 : Could you please provide a short explanation to why the modeled lidar ratios are smaller than the measured ones. Also, could you provide a justification for the assumption that dry marine particles are halved compared to the Aeronet (assumed wet) measured size. Based on your measured backscatter values.

*Please go over the manuscript and improve the writing. There are many small grammar/language mistakes, many of the sentences are missing punctuation marks (mainly commas), hence there are difficult to follow. Some examples: (the incorrect form is marked in Bold)

*P2 line 10-11 : "Aerosol classification from active remote sensing (Burton et al., 2012; Groß et al., 2013) based on the depolarization ratio **will get trouble** if dried marine aerosol with a high depolarization ratio is present"

*P2 line 28-29: "Combined with regularly available temperature profiles from radiosondes or models **we even have RH** together with the depolarization"

*P3 line 4: "The relative humidity ranged from 40% **till** more than 80%"

*P3 line 19: . . . "in a wide size range from **some** nanometer".

Example for a sentence missing punctuation marks:

*P3 line10-11: "At the beginning we will give an introduction to sea salt aerosol under dry and humid conditions and show examples of sea salt particles collected above Barbados".

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Specific minor Comments:

P4 line 10: Please add a sentence about the methodology used for this result.

Figure 2: It hard to see what the green arrows are pointing at

P6 Line 12: Please add the wavelengths

P10 Line 19-20: "There the increase in depolarization is less pronounced as in the case, where the dried marine aerosol was 20 found within the MAL (24 Feb 2014)" could you please clarify this sentence.

Technical correction:

P13 Line 14: Please correct Tab 1 to Table 1

Figure 12: Please add figure legend

(1) Groß, S., Esselborn, M., Weinzierl, B., Wirth, M., Fix, A., and Petzold, A.: Aerosol classification by airborne high spectral resolution lidar observations, Atmospheric Chemistry and Physics, 13, 2487–2505, doi:10.5194/acp-13-2487-2013, 2013.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-545>, 2017.

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