

Interactive comment on “Ship-borne aerosol profiling with lidar over the Atlantic Ocean: From pure marine conditions to complex dust-smoke mixtures” by Stephanie Bohlmann et al.

Anonymous Referee #2

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The paper by Bohlmann et al. provides results of ship-based lidar measurements conducted during two recent cruises with the R/V Polarstern. This is certainly a unique data set and the paper is suitable for publication in ACP. However, I recommend major revision following the suggestions below before publication of this paper.

Major points

- The paper focusses on two research cruises, P95 and P98, but reference is also made to previous cruises in Table 1 and Figure 1. I suggest to remove this information as no data from these cruises is presented. In turn, it raises the question why not all cruises with the new setup of PollyXT (PollyXT-OCEANET?) have

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been presented here. In this context, I am also missing proper reference to the previous cruises presented by Kanitz (2011, 2013, 2014) or in fact the wider literature in the discussion of the data. Please refer to the peer-reviewed papers rather than the PhD thesis of Kanitz (2012).

- The structure of the paper should be revised. Section 2.2 (overview) should mark the beginning of the results section. After that, Section 3 could be split in case studies (3.1) and statistical analysis (3.2). The description of the data analysis (p6, 14-11) should be moved to Section 2 (instruments and methods) together with some more details on the data analysis and error calculation (same as in Baars et al. (2016) or Engelmann et al. (2016)?) as well as the procedure for selecting the data for the statistical analysis (i.e., what are the requirements for a measurement to be suitable for full analysis in Figs. 14-16?). Also, why is GDAS1 being used in the analysis when there are soundings from Polarstern available?
- The description and discussion in Sections 4.1 and 4.2 should be combined and shortened. Maybe the mean values for the different layers and wavelengths can be presented in a table? Also, please consider the use of histograms to present the data set (if there's enough data points). The reference to previous relevant publications on the observations of different aerosol types and aerosol classification schemes needs to be improved.
- The authors state throughout the paper that parameters are significantly different. Have any significance tests been conducted to warrant these statements? Please be accurate in your wording. The same holds for the use of "good agreement".
- The enhanced depolarisation ratio of dried marine aerosol is an important finding of this paper that should be better highlighted. Maybe discuss the implications for aerosol mistyping in satellite lidar retrievals more thoroughly? You recommend to use information on relative humidity for aerosol classification over the ocean. Why has this idea not been explored further in this paper?

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Minor points

- p2, l8-13: What about satellite observations?
- p3, l1-4: Pretty much the same has been stated in the previous sentences.
- p3, l32: Please note that the exponent and the particle linear depolarisation ratio are qualitative measures that provide relative information, i.e. an increase in the particle linear depolarisation ratio refers to particles being "more non-spherical" than before rather than an increase in non-spherical shape (or clarify what is meant here).
- p5, l31: An AOT of 0.1 at 500 nm seems rather high compared with the baseline value of 0.05 suggested by Kaufman (2001). Please comment.
- p6, l28: Zieger et al. (2017) might be a better reference regarding the composition and deliquescence of sea salt aerosols.
- p7, l5-8: Note that the aerosol layer above the MBL shows much lower beta and alpha, i.e. exponents are the ratio of small numbers.
- p8, l32: What are the times of the SPM measurements?
- p9, l18: exponents of 1.6 indicate small particles.
- p10, l6: What criteria have been applied to select the measurement period for analysis (see major comment 2)?
- p10, l14-16: Move to figure caption.
- p12, l12: Where does this information come from? Is it the cloud cover along the ship's track or over the entire hemisphere?

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- p13, l6-23: Just provide the conclusion of this investigation in a short statement. If there's no added value in Figure 16, it should be omitted.
- Figure 1: This figure could be omitted. If you decide to keep it, remove the tracks of cruises that are not being referred to in this work.
- Figures 2 and 3: Are the values from the Microtops daily means? The white bars are barely visible. Please explore other options for marking the case studies.
- Figure 4: Plot only to 1 km height and mark time period shown in Figure 5. reduce
- Figures 6, 7 and 8: Omit but leave the description of the origin of the observed air masses in the text.
- Figure 9: Plot only to 5 km height. Add explanation of the white bars to the caption.
- Figure 11: Plot only to 4 km height. Add explanation of the white bars to the caption.
- Figure 13: Omit or combine in one panel. Not all trajectories have to be shown in their entirety.
- Figure 14: Please explore if part of this data set might be better presented in the form of histograms.
- Figure 15: How do these findings compare with Burton et al. (2012) or Gross et al. (2015)?
- Figure 16: Omit.
- Table 1: Omit. The relevant information is already provided in the text.

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