Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-434-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Application of the shipborne remote sensing supersite OCEANET for profiling of Arctic aerosols and clouds during Polarstern cruise PS106" *by* H. J. Griesche et al.

Anonymous Referee #1

Received and published: 16 January 2020

General comments This paper presents the instruments deployed on the icebreaker Polarstern and close by on a temporary ice-camp and results obtained during a summer cruise performed in the frame of the AC3 German project in 2017. Several remote sensing equipment, including a motion-stabilized 35-GHz cloud radar were deployed and combined with meteorological observations in high Arctic. This experiment concurred to a very important goal on a better documentation and understanding of Arctic change, through the presentation of a campaign and results obtained to better document Arctic cloud forcing. After introducing the context, this paper first gives a general description of the instrumentation deployed on board the ice-breaker Polarstern and on the ice camp, technical challenges, new developments, analysis methods and results

Printer-friendly version

Discussion paper

obtained during the campaign. It finally focuses on case studies. Two main points are highlighted in the paper which are 1) the first involvement of the cloud radar Mira-35 and the development of a motion stabilization system to ensure stable observations. Corrections and results obtained from vertical wind spectra to derive on the turbulent kinetic energy eddy dissipation rate (EDR) are presented; 2) the focus on low-level clouds and the presence of fog from synergies of lidar and radar within Cloudnet, and the retrieval of radiative cloud properties.

The topic is of importance to the community. The paper is clearly written, and presented in a very comprehensive way. The context of the paper is well introduced although additional general information should be given on existing surface based observations. The two main points presented also need some additional information and discussion. The paper is worth publishing after minor revisions are made. They are addressed here below.

Detailed comments Page 2, line 27 : “decline of the Arctic sea ice” precision to be added on period of the year (summer ?) or ice type (multi-year sea-ice) ?

Page 2, line 45-47 : Arctic observations refer to aircraft and shipborne measurements, but Arctic ground-based stations should be discussed (IASOA network, Uttal et aL, BAMS 2016 DOI:10.1175/BAMS-D-14-00145.1) in which remote sensing instruments are implemented at Barrow (Dong et al., 2010, doi:10.1029/2009JD013489, Eureka (Blanchard et al., JAMC 2014 doi: 10.1175/JAMC-D-14-0021.1) for example. Drifting buoys have also recently been equipped in the high Arctic with lidar in the frame of the IAOOS project (DiBiagio et al., JGR 2018, doi: 10.1002/2017JD027530 ; Mariage et al., Opt. Exp. 2016, doi: 10.1364/OE.25.000A73).

Page 2, line 54, replace by a more recent reference Winker et al., BAMS, 2010, doi:10.1175/2010BAMS3009.1.

Page 4, line 88 : Figure 1 legend : mark days also on the track in the upper figure

Page 4, line 94 : mention if Polar measurements have already been performed ?

Page 5, lines 103 and 104 : 532 instead of 512 ?

Page 5, line 110: “allow to determine the shape” this is too strong a statement. As the authors write further in the text, it allows to discriminate shape between spherical and non-spherical particles, but several shapes can give the same depolarization ratio

Page 6, lines 125-26 : the authors “do think that the atmospheric conditions in summer in the Arctic are comparable to those in winter in the Netherlands ”. I don’t think so. Surface temperature are close to zero over ice and surface-atmosphere interactions are different

Page 7, Table 1 : Add information on the auxiliary measurements (tethered balloon, sonic anemometer, pyranometers, ...)

Page 8, Figure 3 legend : extend period limits on the vertical with dotted lines

Page 10, Figure 5 : put the histograms outside the figure so to better see the full 2D plot

Page 10, line 194 to 246 : Extend discussion on error induced by the correction. What is the expected in terms of residual contribution ? What bias is to be considered in the sigma correction, and error induced as an additional error. This can be discussed from the spectrum shape, errors and confidence in the limits of analysis to be used. Present/discuss more in detail the corrected spectrum in section versus non-corrected one and versus the sonic anemometer one.

Page 11, line 230 : typo vertical

Page 12, Figure 6 shows linearized fit from sonic only, what would be the one from corrected spectrum ? Discuss values retrieved from the range of the fit identified from the residual errors and confidence in the correction.

Page 12, Figure 6 legend : refers to values of EDR, but hypotheses for deriving EDR

from radar should be more discussed (see above).

Page 12, line 251 : Iacono et al., 2208, is not a general reference for RRTMG. This ref is to be replaced by a more appropriate one.

Page 13, line 288 : It is OK here, but more generally for Arctic louds I am not sure of that, as for supercooled precipitating clouds

Page 14, line 310 : a strong attenuation

Page 14, line 318 : I would suggest to use scattering ratio Sr as well, which would further allow to discuss fog issue using lidar measurements only assuming a threshold in Sr

Page 15, line 348 : I would suggest to extend presentation here and discuss meteorological context change to introduce cases studies and overall meteorological patterns observed leading to the various cases analyzed. I would suggest to move Figure 11 here and briefly discuss more general transport evolution over the period studied (not necessarily adding a figure).

Page 20, Figure 10 : I would suggest to present lidar scattering ratio instead of backscattering coefficient (to better support aerosol/fog/cloud discrimination).

Page 23, and 24 : Synergies between the remote sensing instruments and auxiliary observations from aboard Polarstern were analyzed by means of Cloudnet classification procedure. This procedure is shown to induce caveats because of limitations in the radar range measurements. More discussions on the way this could be mitigated using lidar measurements should be included.

Page 23, lines 429-432 : PollyXT “Though detected fog almost continuously during the case study, . . .”. How is this done ? Explain in the text how this can be translated in an additional information below 165 m in a quantitative way from scattering ratio.

Page 24, Figure 15 : Blue color below 165 m shows occurrence of clear air <165m. It is

thus misleading as no information is available from Cloudnet. Should be another color corresponding to unknown (white?) instead of blue below 165 m in Fig 15. Could be replaced by dots corresponding to fog color on a white background from the discussion on fog detection by lidar only.

Page 24 line 435 : “above the fog layer” meaning well above !

Page 28, lines 509-510 : Yes, frequently observed from surface-based IAOOS observations as reported in Mariage et al., 2016

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-434, 2019.

Printer-friendly version

Discussion paper