Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-434-RC2, 2020

Atmospheric Measurement Techniques Discussions

Open Access

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 #2

Received and published: 21 January 2020

The authors describe the deployment of the Oceanet remote-sensing container during a cruise to the Arctic. Right now it is not clear if the authors want to present technical development or research findings. The authors briefly describe a new motion stabilisation platform and a new data processing method for fog detection. However, they fail to provide a validation that those are working. The remainder of the paper is dedicated to case studies. The paper is of interest to the community but needs major revisions. First of all, the authors need to make up their mind if this should be a paper for AMT or ACP. There are further major items that need to be addressed before it can be considered for publication:

Printer-friendly version

Discussion paper

- [Abstract] The Abstract appears to be more of an introduction than a concise summary of the paper. Key points of the article are missing. Please rewrite the Abstract.

- [MWR retrieval] One of the major issues with this work is related to the analysis of the microwave radiometer measurements. I do not agree with the assumption that atmospheric conditions in the Arctic are comparable with those during winter in the Netherlands. In the Netherlands the minimum temperature rarely reaches 0°C; also radiative balance is not comparable. The analysis needs to be repeated with a customised Arctic retrieval. Radiosonde data can be obtained from several research cruises in the Arctic since 1990 and are also available from research stations around the Arctic.

- [Motion stabilisation] The authors should provide proof that the roll and pitch was actively levelled out for the motion-stabilised radar measurement. Please provide a time series of roll angles for the ship and radar during roughest sea and the probability distribution of radar roll angle for at least a 1 h period with greatest ship roll. Further information on the measurement conditions is needed to assess the performance of the motion stabilisation platform. What was the maximum roll angle? What was the ship's mean horizontal velocity when underway? What was the wave-induced velocity perturbation in open water?

- [Eddy dissipation rate] The validation of eddy dissipation rate is not convincing. At what height was the tethered balloon located? Below a cloud or within a cloud? What are the reasons for the over- and underestimation? Also, it would be good to have more than two comparisons cases between the Radar and the measurements with the tethered balloon or to provide justification why this is not done. Please also provide the ÉŻ values from tethered balloon and radar for both cases.

- [Cloudnet and cloud definition] There are several issues related to the Cloudnet retrieval. Right now it is often unclear what has been done. For instance, the description of the classification mask (Page 13, line 261) does not agree with the shown Cloudnet target classification in Figure 9a. Please provide more details on Cloudnet in general and on the classification mask and the target classification for readers that are not familiar with the method. Further, it is not clear if the presented definition of liquid and mixed-phase clouds (page 12, second paragraph) is an official Cloudnet product such as the target classification or if it is a new data product developed by the authors. In that context, why not use the target classification as in comparable studies based on multi-sensor retrievals? In those, Arctic mixed phase clouds are defined when both liquid/supercooled water and ice particles are present and when ice particles are identified directly below liquid and mixed-phase regions (e.g. Shupe 2011, Mioche et al. 2015). For comparison of cloud statistics from different campaigns it is important to use the same definition as already used in the literature.

- [Fog detection] The information related to the fog detection is not adequate to evaluate if the proposed method works. Please make use of the visibility sensor aboard Polarstern to assess your findings as well as to test if your assumed SNR value of 40 can be used to reliably detect fog. Just as a reminder, fog is defined when the visibility is below 1 km. The visibility sensor can also be used to distinguish between fog and low clouds. In that regard, please compare the detected low cloud layers with the observation of the ceilometer aboard Polarstern. The first height bin is much lower than the first height bin of the Polly system. Also would it not be better to use the ceilometer for detection of fog and low cloud layers? First of all the first cloud layer is lower and the Ceilometer on Polarstern is a CL51 which reports the vertical visibility in case that the lowest height bins are obscured due to precipitation and/or fog?

Minor issues

- Line 88, Please also cite Ehrlich et al. (2019) for ACLOUD

- Line 122: It is not clear if only winter time radiosondes from De Bilt are used in the retrieval. Please clarify. But even better would be to revise the retrieval using actual Arctic measurements.

- Line 126: An Arctic retrieval based on ERA-Interim data should be compared to a retrieval based on Radiosonde data. Systematic errors in ERA-Interim data (e.g. Wesslén et al., 2014, for temperature bias) can have an influence on the MWR retrieval. Consider using ERA5 instead.

- line 153: Please provide the typical error range of the RS92 measurements

- line 270: Do you mean T or Td (dew point temperature here).

- line 344: Can you please verify if the mixing depth provided by GDAS1 is comparable to the observed mixing depth. It is known that models have problems to provide realistic mixing depth in the Arctic.

- line 354: Do you mean Figure 4.1.1? And the profiles are shown to a height of 2.5 km not 2.0 km.

- line 356: Since ice particles are below the liquid stratocumulus the cloud should be reclassified as mixed-phase cloud (see major comments).

- line 375: As observed by Shupe et al. (2013). Please add citation.

- The figures do not appear in the order they are discussed in the text. Please revise.

- Figure 6b is not necessary and should be omitted.

- Figure 15: Fog and low cloud should have different colours. Again use the visibility sensor to distinguish between fog and low clouds. Add visibility to the plot. Also add the observed backscatter from the CL51 as comparison as an extra plot next to it.

- Figure 17: How is fog height determined? That needs to be discussed in 3.3.3. Add visibility to the plot.

- line 500, e.g. Sotiropoulou et al. (2014) and (2016) considered low clouds from ceilometer/Halo and radar measurements.

- Line 762: Somag, the provided link does not work. Please provide an open link or add the information to the text.

Printer-friendly version

Discussion paper

- Figures 7, 10 (upper panel), and 13: Please use same scale for T and RH in all plots.

Ehrlich, A., Wendisch, M., Lüpkes, C., Buschmann, M., Bozem, H., Chechin, D., . . . Zanatta, M. (2019). A comprehensive in situ and remote sensing data set from the Arctic CLoud Observations Using airborne measurements during polar Day (ACLOUD) campaign. Earth System Science Data Discussions, 1–42. https://doi.org/10.5194/essd-2019-96

Wesslén, C., Tjernström, M., Bromwich, D. H., De Boer, G., Ekman, A. M. L., Bai, L. S., & Wang, S. H. (2014). The Arctic summer atmosphere: An evaluation of reanalyses using ASCOS data. Atmospheric Chemistry and Physics, 14(5), 2605–2624. https://doi.org/10.5194/acp-14-2605-2014

Shupe, M. D.: Clouds at Arctic Atmospheric Observatories, Part II: Thermodynamic phase characteristics, J. Appl. Meteor. Clim., 50, 645–661, doi:10.1175/2010JAMC2468.1, 2011.

Mioche, G., Jourdan, O., Ceccaldi, M., and Delanoë, J.: Variability of mixed-phase clouds in the Arctic with a focus on the Svalbard region: a study based on spaceborne active remote sensing, Atmos. Chem. Phys., 15, 2445–2461, https://doi.org/10.5194/acp-15-2445-2015, 2015.

Shupe, M. D., Persson, P. O. G., Brooks, I. M., Tjernström, M.,Sedlar, J., Mauritsen, T., Sjogren, S., and Leck, C.: Cloud and boundary layer interactions over the Arctic sea ice in late sum-mer, Atmos. Chem. Phys., 13, 9379–9399, doi:10.5194/acp-13-9379-2013, 2013.

Sotiropoulou, G., Sedlar, J., Tjernström, M., Shupe, M. D., Brooks, I. M., and Persson, P. O. G.: The thermodynamic structure of summer Arctic stratocumulus and the dynamic coupling to the surface, Atmos. Chem. Phys., 14, 12573–12592, https://doi.org/10.5194/acp-14-12573-2014, 2014.

Sotiropoulou, G., Tjernström, M., Sedlar, J., Achtert, P., Brooks, B. J., Brooks, I. M., Wolfe, D. (2016). Atmospheric conditions during the Arctic clouds in summer experiment (ACSE): Contrasting open water and sea ice surfaces during melt and freeze-up seasons. Journal of Climate, 29, 8721–8744

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