Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-1222-RC2, 2019

Atmospheric Chemistry and Physics Discussions

Open Access

Interactive comment on "Antarctic clouds, supercooled liquid water and mixed-phase investigated with DARDAR: geographical and seasonal variations" *by* Constantino Listowski et al.

Anonymous Referee #2

Received and published: 4 February 2019

Review of 'Antarctic clouds, supercooled liquid water and mixed-phase investigated with DARDAR: geographical and seasonal variations' by C. Listowski et al., submitted to ACPD

Listowski et al. use the merged satellite lidar-radar data product 'DARDAR' to characterise cloud phase and variability south of 60S (covering Antarctica and the surrounding oceans) and through the seasons. In doing so, Listowski et al. provide a thorough and comprehensive treatment of the data analyses, and, just as importantly, its limitations (especially with respect to radar ground clutter and lidar attenuation/extinction).

The subject matter addressed is currently highly topical given the known uncertainties with high southern latitude clouds (and radiation) fields in GCMs. The authors demonstrate the links to orography and oceanic-centred cyclones of the ice cloud distribution. Particularly interesting is the differences in seasonality of the MPC and USLW cloud fractions and the links which the authors draw to marine biological activity as a source of INPs, and the links to sea-ice.

This is an excellent manuscript of high interest to the ACP readership. I certainly recommend the publication of this manuscript by ACP following the authors' consideration of the following points as they prepare their revised manuscript.

Minor Comments (references given at the end)

1) There are so many acronyms in the text. I suggest a table in an Appendix listing them all to ease the reader's need to refer back or memorise them.

2) Figure 1: A gap in the contour (black and white) topography is evident south of 82S. No doubt this is due to the fact that CALIOP / CloudSat don't see south of here. However, you really ought to fill in the contour levels between here and the Pole.

3) Page 10, lines 14-16. The authors define low-level clouds as those between 0.5-3km above the surface; mid-level as 3-6km; and high-level clouds >6km. This strikes me as somewhat arbitrary, especially since no rationale for these altitude cutoffs is given. Do you have a convincing argument for choosing fixed levels? While in the tropics a fixed altitude cutoff may be appropriate (such as 4.5km for the fairly-constant freezing level at low latitudes, e.g. Protat et al., 2014, JAMC), in the extra-tropics it is better to work on pressure levels. I suggest the authors change these limits to match those from the ISCCP cloud low/mid/high definitions (Low cloud top pressure >680hPa; middle cloud top pressure>440 hPa etc.). This would facilitate more direct comparisons with previous studies, especially over the Southern Ocean, where pressure levels are regularly used (for example Haynes et al., JClim, 2011; Mason et al., JClim, 2014).

Printer-friendly version

Discussion paper

4) Regarding comparisons between surface-based instruments and satellite, this is, as the authors note, a challenge given different temporal / spatial sampling, and indeed, DARDAR curtains likely do not pass directly above the surface sites anyway. One additional option to make closer comparisons would be to spatially average DARDAR and temporally average the ceilometers. For example I found that in a recent Southern Ocean DARDAR/surface lidar study, DARDAR data were horizontally averaged based on typical wind speeds at cloud height (Alexander & Protat, JGR, 2018). I wonder whether applying something similar in Section 4.4.1 above Rothera & Halley would be of benefit, despite the simplicity of this averaging?

5) The authors note that ceilometers detect cloud base heights (page 28, line 5), specifically the Vaisala CBH (Section 3.3). It is known that these are not accurate CBHs in the polar regions, especially for ice (e.g. van Tricht et al., AMT, 2014). Some comment ought to be made about this additional source of uncertainty comparing ceilometer and DARDAR in Section 4.4.1 in the context of your minimum altitude cutoffs.

6) Figure 17: I think that it would be much clearer to interpret if you flipped the sea-ice scale

7) Finally, I suggest a careful, thorough re-read of the manuscript to correct several minor spelling and grammar issues.

References;

Haynes et al., 2011; Journal of Climate, ‘Major characteristics of Southern Ocean cloud regimes and their effects on the energy budget, doi:10.1175/2011JCLI4052.1

Mason et al., 2014; Journal of Climate,’ Characterizing observed midtopped cloud regimes associated with Southern Ocean shortwave radiation biases’, doi: 10.1175/JCLI-D-14-00139.1

Protat et al., 2014: J. Appl. Met. Clim, ‘Reconciling ground-based and space-based estimates of the frequency of occurrence and radiative effect of clouds around Darwin,

Printer-friendly version

Discussion paper

Australia’, doi: 10.1175/JAMC-D-13-072.1

Alexander & Protat, 2018; J. Geophy Res, ‘Cloud Properties Observed From the Surface and by Satellite at the Northern Edge of the Southern Ocean’, doi: 10.1002/2017JD026552

Van Tricht et al, 2014; Atmos Mes Tech, ‘An improved algorithm for polar cloud-base detection by ceilometer over the ice sheets’, doi: 10.5194/amt-7-1153-2014

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1222, 2018.