

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-433

Anonymous Referee #2

Referee comment on "Supercooled liquid water clouds observed over Dome C, Antarctica: temperature sensitivity and cloud radiative forcing" by Philippe Ricaud et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-433-RC2>, 2022

Review of „Supercooled liquid water clouds observed over Dome C, Antarctica: temperature sensitivity and surface radiation impact“ by Ricaud et al.

The authors investigate the radiative impact of SCLW clouds at Dome C. In general, the topic is very interesting and suitable for ACP and the paper is well written. However, I have some concerns regarding the methodology and recommend major revision.

Major comments:

Estimating clear sky surface radiation: Instead of averaging the observations of the complete day, the authors could fit a sinus function to the clear sky observations to account for the diurnal cycle. Likely, this would reduce the bias of up to 20 w/m² that can be seen in Fig. 4, top panel. Also, when using averaged observations instead of a radiative transfer model to estimate clear sky radiation, the authors should quantify the uncertainties caused by varying temperature and aerosol profiles among the elected clear sky days. A radiative transfer model would be required for this which leaves the question why such a model is not used in the first place.

Measurement errors: What are the typical measurement errors of the instruments and how do they impact the results of the study? Also, the sometime negative radiation balance should lead to near-surface temperature inversions that are hard to measure with microwave radiometers because the obtained temperature profiles are typically very smooth. How do these inversions impact the results?

Minor comments:

General: When discussing temperature, I recommend to be more specific. Is it surface or cloud temperature? Is it potential or regular temperature?

L94: Readability would improve if proper notation was used.

L236: What is the physical explanation why multiple normal distributions are required?

L254: I think the plots show the probability density, but not the probability density function which would be an analytical formula to describe the probability density.

L261: *joint* Gamma distributions ?

L265, L281: add unit to +/- 1.5, +/- 10

L267: liquid water *content*

L354: What variables would be how impacted by ice contaminated clouds?

L409ff: Would the mean Net SR be more interesting than the maximum?

L410: Please provide the mean cloud fraction value.