Comment on acp-2021-97
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Referee comment on "Ice and Mixed-Phase Cloud Statistics on Antarctic Plateau" by William Cossich et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-97-RC2, 2021

Review of ACP-2021-97: Ice and mixed-phase cloud statistics on Antarctic Plateau by Cossich et al.

This is a very interesting study of cloud type and frequencies of occurrence observed from MIR and FIR spectra over the Antarctic Plateau. The study is fairly well written and informative; I recommend acceptance after these comments have been considered by the authors.

Relatively minor questions:

1. It would be quite interesting to provide an analysis of the surface-based lidar measurements for cloud occurrence, thermodynamic phase, cloud heights and layers, even if the measurements are limited to a height of about 7km. The lidar analysis would be complementary to the REFIR-PAD analysis, if there was enough data collected.

2. I have two questions about the lidar data:
   a. does multiple scattering above a liquid layer or at the cloud top impact the interpretation of the results? There is some evidence for this in the upper panel of Figure 7.
   b. Is there evidence of ice particles falling through the base of the liquid layer? How often does this happen? This question arose when I read lines 290-296, and studied Figure 7 and related text.

3. In the paragraph beginning on line 437, I am puzzled by the lack of cloud fraction information in the winter (dark) months for the combined Terra and Aqua MODIS cloud product. If the information is available for the MODIS product from each of the Terra and Aqua platforms, there must be a problem with the combined data product. This seems to be something that the MODIS cloud team has to resolve. Suggest leaving out the combined Terra and Aqua data product until it has been resolved.

Other comments:
Title: “on Antarctic Plateau” —> “on the Antarctic Plateau”

Line 114: does 1928 refer to the number of REFIR-PAD spectra that are collocated with LiDAR measurements?

Line 126: I think there’s a problem with the reference “Sassen and yu Hsueh”. Should be Sassen and Hsueh.

Line 142: Radiosondes Vaisala RS92 —> Radiosondes (Vaisala RS92)

Line 176: are arranged —> are prepared

Line 188: generally small cloud —> generally low cloud

Line 199: that can be different —> which can be different

Line 228: “window wavenumbers, that results in a very”—> window wavenumbers, and the measurements can have very

Line 286: “if for the 8.3” —> if for 8.3

Line 302: (c) —> or (c)

Line 345: as TS —> for training

Lines 361-363: A third possibility is suggested by the authors but not included in the sentence: The temperature and mixed-phase cloud correlation could indicate that warm temperatures are favorable for mixed-phase clouds formation or that the presence of warm liquid clouds implies a stronger cloud forcing at the surface and, consequently, an increase in the temperature values near the ground. The third possibility is warm air advection of moisture. If the authors agree on this point, this third possibility should be included here and also in the Conclusion section.

Line 391: in correspondence of cloud sky conditions —> when clouds are present

Line 412: in presence of different —> for different

Lines 409-410: please mention where the winds from the NE originate to provide some potential insight as to the origination of the moist layer that is being advected over the Plateau.

Line 434: by both satellites platforms —> by both satellite platforms

Line 439-440: Thus —> For some reason... Note: the MODIS cloud mask should always have a result regardless of solar illumination because it includes infrared measurements.

Line 456: in case of —> in the case of

Line 460: In months in which —> In the months where

Line 460: CALIOP products in green —> CALIOP products as shown in green

Line 461: maximum of —> maximum in

Line 497: in presence of —> in the presence of
Potential explanations for this are that it could be due...

Reasons for this could include... Actually, this entire sentence is a bit awkward and should be reworked.

Line 512: classification → classifications
Line 515: set up → optimized
Line 525: sets in two → sets into two
Lines 545-547: could include warm air advection as a third option
Line 564: intense insolation → higher insolation
Line 565: CALIOP collocates the → CALIOP data indicates that the
Line 566: similarly to what derived → similar to what is derived
Line 572: a hourly → an hourly
Line 572: with maximum → with a maximum
Line 573: and minimum → and a minimum
Line 579: but it is reduced → but smaller