

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-215

Bryan A. Baum (Referee)

Referee comment on "Consistency test of precipitating ice cloud retrieval properties obtained from the observations of different instruments operating at Dome C (Antarctica)" by Gianluca Di Natale et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-215-RC1>, 2022

This is a very interesting paper that describes a unique set of instrumentation at a site in Antarctica that take data useful for studying ice clouds without supervision. The instrumentation consists of a Fourier transform spectroradiometer (REFIR-PAD), a depolarization lidar, and a micro-rain radar (MMR). From my own experience with satellite imager-based observations of ice clouds over polar regions, the retrievals are problematic and the issue is having some sort of ground truth with which to assess them. The methodology described in this article provides a very important step towards being able to provide a "truth" set for satellite-based comparisons, at least from my own limited perspective.

The paper would benefit from more work on the results section and revisions to some of the figures before publication. Suggestions for improving the grammar are provided in an uploaded edited version of the manuscript. Further suggestions are provided below for the authors to consider.

Major comment:

The data provided by the instrumentation at Dome-C could be very instrumental for improving the retrieval/description of precipitating ice cloud properties in the Antarctic. If there were retrievals at the time of polar-orbiting imager overpasses, the intercomparisons would be useful to a broad remote sensing community. The manuscript would be strengthened by making the case for how much data are needed and what might be necessary for increasing the quantity and reliability of the products. How much data are needed over how long a time period? Are results available every day? Is the data processing fully automated? Are the products available to the scientific community? What is the daily coverage? How would you improve the analysis given more data? In other words, make the case for what you are doing here and what would be gained by

continuing this data collection and analysis effort. There are four case studies provided - how many more cases are necessary for your goals? More clarity of the current and future effort and goals should be provided, given that this manuscript will be referred to in future work.

Minor comments:

The verb tenses change often in the manuscript - suggest aiming for as much consistency as possible.

Introduction, line 20: please define the term cloud effect and perhaps cloud forcing, which is used in line 54. That is, describe the components of the radiation budget in broad terms for the reader.

Line 150: The figure - be specific about which figure is being referred to here.

Figure 6: there are basically two figures set side-by-side in Figure 6, and the details are difficult to see in the left plot (panels a through d). Would it be possible to separate the two panels so that the details are easier to discern?

Lines 166-170: the description of realistic ice particles from this area (Dome-C) is quite interesting, and I would hope that the authors will consider expanding their interpretation of the observations from the ICE-CAMERA photographs, especially in precipitating conditions for the case study dates.

Figure 10: Despite reading multiple times through the discussion pertinent to the results in this figure, it is difficult for me to interpret the comparison between REFIR-PAD and MRR of the intercept (N_0) and the optical depth since the results are on a log-log scale. There is a very wide range of results especially in the OD. Are there conditions where the results might compare more closely? Would results collected over a long time period be used to improve the retrieval process? Some discussion would be helpful here.

Figure 12: For ease of interpretation for the reader, I think it would be helpful to break this figure into two different figures, one for each day. Perhaps consider making a 2-panel plot of the MRR reflectivity map above/below the lidar map for each day so that the figure is expanded to help interpretation. Another suggestion would be to draw a circle around the times when a supercooled liquid water cloud is present in the lidar map. My final suggestion would be to expand the discussion for each day to focus on results at different times through the day, i.e., describe the results in more detail. How does the MRR add information to the REFIR-PAD results?

Figure 13: As noted earlier, the ice particle habit observations by the camera are quite interesting. Unfortunately, this figure shows exceptionally small images for two different days. It is difficult to make out any detail because the images are so small. Please consider reworking these figures, perhaps making a separate figure for each day with fewer (but larger) ice particle images. It would also be of interest to discuss what habits are found for each of the case study dates, under the specific conditions of the day (temperature/humidity), and pointing to specific images. This is an important component of your analyses but these figures are not helpful.

Figure 15: same general comment as with Figure 12. Please consider separating this into two figures, one for each day. Furthermore, there is almost no interpretation of the results for these two days (21 and 23 April 2020) - the discussion should be expanded.

Figure 16: same general comments as for Figure 13. It is difficult to get any information from these images of the ice particles. But the images should be useful for supporting the analysis in Figure 15.

Please also note the supplement to this comment:

<https://amt.copernicus.org/preprints/amt-2022-215/amt-2022-215-RC1-supplement.pdf>