Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC1
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Comment on amt-2022-62

Anonymous Referee #1

Referee comment on "ICE-CAMERA: a flatbed scanner to study inland Antarctic polar precipitation" by Massimo Del Guasta, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-62-RC1, 2022

Review of AMT-2022-62:
ICE-CAMERA: a flatbed scanner to study
inland Antarctic polar precipitation.
authored by M. Del Guasta
April 4, 2022

Global discussion
This manuscript presents the design concept and some data applications of a smart measurement device: ICE-CAMERA. The instrument is able to operate in an extremely harsh environment, to collect autonomously precious data of hydrometeor type on the Antarctic plateau and to routinely perform a calibration/focus correction procedure. The operation of an unmanned device collecting this type of data in the environment of the Antarctic plateau is remarkable and the data themselves are unique and precious. The paper fits well the scope of AMT. I have a few major remarks and a certain number of other comments that should be taken into consideration before publication. My current recommendation is of major revision.

Major remarks
1. As mentioned, the topic fits well the scope of AMT. For this particular journal a higher level of detail on the instrument itself (see also minor remarks below) is needed. I believe that the author has both data or simulation tools available to better characterize the sampling uncertainties associated to ICE-CAMERA. I would like for example to see statistics on the number of particles collected according to the wind speed (I see data are available in Fig. 8) or according to humidity/ dew point which influences sublimation. The author provides interesting hints about sublimation time for individual particles in section
1.6.2. The author may apply similar techniques over a population of particles, for example assuming a PSD (particle size distribution) and repeat the simulations multiple times for multiple PSDs and other parameters (temperature for example). A first approximation could be

to use a constant PSD/snowfall intensity over the measurement period or to elaborate more realistic scenarios.

This is only an idea, and the evaluation could certainly be done in a different way but the objective is the following: by extending the simulation to a population of particles, something more could be said in terms of (theoretical) catching efficiency of the instrument, a key aspect for the readership of this journal.

2. It was not clear if the main focus of the paper is the instrument or the CNN-based classification. I recommend to clarify it. In either case the level of detail should be increased (see my other comments). My assumption was that the main target is the instrument so I did not comment in much detail about the CNN.

3. The literature overview and the current state of knowledge about ice crystal habits is not enough documented and detailed in the introduction and more in general in the text. See minor remarks below. I would like to see the instrument and its capabilities better put into the context of current state of research and the known research gaps.

4. Data access. The instrument is collecting data since 2014. So there are now 7 or 8 years of unique data collected at the Concordia station and not yet available. The data are the real added value of each innovative instrument. It is crucial in my opinion that as much data as as possible is made available, behind a DOI to allow for citation and recognition, at the time this paper will be published. I see it as a necessary complement to allow the readers to understand the quality and the scientific impact of the data produced by the instrument. Platforms as Zenodo, just to cite a common choice, are easy and user friendly and they allow to obtain a DOI and a citation for the dataset.

Minor remarks

1. In the introduction or somewhere in the text I would recommend to take the time to explain all the difficulties and possible failures associated to the long term operation of an instrument in such an environment. This is briefly mentioned through the text but I am convinced that the average reader would not get the idea of the actual and maybe less known challenges: breaking of rubber parts, (low) humidity issues in heated environments, etc.

2. L14-19, L22-24: some references should be added to backup these scientific statements.

3. L29: 90 um ☐ 90 μm. Same through the text

4. L34: change forms to shapes

5. L79: I believe the scanning principle should be briefly introduced before this point. Here we read after an entire scan, but we actually do not know yet what a scan exactly is, for this instrument.

6. Fig. 3: I found this schematics not really informative. I would recommend either to use pictures of the actual parts of the instrument (a qualitative but illustrative way) or to provide a higher detail electrical / communication schematics, even as Appendix material.

7. L139: what is the expected lifetime of the LEDs?

8. L162: add a reference or a statement about the expected maximum height of blowing snow in Concordia.

9. L177 (and related section):
• Could you show data evidence of partial sublimation bias in the collected images? A caveat that you mention also later on in the manuscript.
• The role of relative humidity should be discussed here. If relative humidity is higher, sublimation rate will be lower.

10. Fig 8: I see some clear patterns / clusters / populations in the data. I recommend to try to explain why such patterns appear. I suspect they are related to individual events/seasons, but they may be related to more interesting physical aspects or technical issues.
Also, I would try to produce similar scatterplots but including relative humidity, which should be routinely available in Concordia.

11. L294 (and related section): a flow-chart could help to present the processing steps rather than a bullet list. The text of this section should be edited to be descriptive rather than a simple enumeration of steps.

12. L331: how often does this situation occur?

13. L352: Why this approach end up to be unreliable for your instrument?

14. L363: does this imply that the images collected have to be resized? (down or upscaled?) Is the resolution of the instrument constant?

15. Fig 14: can spheroidal particles actually be supercooled liquid water? It would be good to have some size reference in this image.

16. L402: about trigonal plates. This statement here seems to be contradicted by the results of Fig. 17, and in fact this is highlighted in L471. I would either remove the statement here or remove this class from all the analysis of the paper.

17. L407: a good idea actually.

18. L560-561: I maybe missed it, but are there statistics on the total amount of data collected since the instrument is operational?

19. L565: I would recommend to clarify explicitly the content of the governmental policies mentioned here. Nowadays most of the institutions promote FAIR policies (https://www.go-fair.org/fair-principles/), so this Code and Data availability statement may be sounding strange for some readers. Secondly, only the CNN and a test dataset is mentioned here. The paper, as the title suggests, is not about the CNN but about the instrument. I would expect to see a data statement about access to the data collected so far by the instruments and maybe some link to relevant technical documentation of the instrument itself.

20. Plot quality: the quality of some plots seems very low (for example Fig. 5)