amt-2022-62
Review after revision 2

Fig. numbers, Sect.s, and Lines refer to amt-2022-62-ATC3.pdf

Comments to author:

I appreciate the corrections and modifications done to improve the manuscript. However, I still see several small issues, which, together, still result in some confusion, ambiguity, and potentially wrong information or statements.

Double window
In Fig.3 "double window" seems to refer to the double window interspace (what you call "double window space" or "double window inter-space").
In L. 193 "double window" has not been mentioned or defined earlier.

DS
There is a potential confusion because "DS" refers both to a surface (e.g. in Fig. 3 or when talking about the DS temperature Ts) as well as to the sandwich of three glass layers. When "DS" is defined (L.200) it refers to the sandwich of three glass layers. This "DS" or sandwich is also referred to as "heated glass" (e.g. Fig. 3 or L.231), "electrically-heated glass" (L.200), "heating-glass" (L.250).

Heating and thermal control

- Instead of providing the specific heating power of 1000 W m-2 (L. 200/201), I would provide the actual heating power (in W), or provide both.
- The "heated glass" is used to achieve sublimation (L. 202). It is unclear if the "DS temperature of (at least) 3 °C above air temperature" (L. 205) refers to ICE-CAMERA and if this is temperature controlled using the DS "heated glass". If yes, clarify in Sect.2.6. Do you consider 3 °C or 5 °C?
- What is a "ventilated resistance" (L. 230)?
- L. 231, *"eventually"* is the wrong word: *"disabling… during sublimation (see Sect. 2.7) when needed"*.
- L. 232: *"200W wired thermostat"*, I am unsure what the "wired" refers to.

Fig. 8
If you want to keep Fig. 8, then several points should be addressed:

- “air” and “air” should refer to the outside air and the air in the double window interspace, respectively; change labels accordingly. Consequently, “Tair” is not the same as “Tair”.
- Similarly, “Ts” is not the same as “Ts”, one is the DS temperature, the other Ts is the temperature on the inside surface of the sandwich of three glass layers (surface towards the double window interspace).
- Radiative and convective/wind effects only apply to “k2” of the outside air. For explaining the cooling in principle, it may be sufficient to consider the outside-air k2; i.e. you may remove k2 of the double-window interspace.

Explanation of sublimation and deposition periods

Consider rewriting L273-274 *(“Once the heater is turned off, and after a cooling time of 20 minutes, the DS temperature comes back warmer than the air by about dT = 5°C. The "sublimation period" is considered complete, and ice particles accumulate again on the DS, with no relevant sublimation ("deposition period" in Fig. 7).”)* more clearly, e.g:

“Once the heater is turned off, and after a cooling time of APPROXIMATELY 20 minutes, the DS temperature comes back TO BE warmer than the air by ONLY dT = 5°C. AT THIS POINT, THE "sublimation period" (OF APPROXIMATELY 30 MINUTES) is considered complete, and ice particles START ACCUMULATING again on the DS, with no relevant sublimation, I.E. THE "deposition period" STARTS.”

Note that Fig 7 refers to an indoor test, but the text above to general outdoor behaviour (or an outdoor test) not shown in any figure. Thus, be careful when referring to Fig.7 to do it in an adequate way.
Note also that in Fig 7, “deposition” and “sublimation” do not bear a physical meaning.

Re: C) L 274-292 Adhesion of ice on DS

The two examples you provide in the explanations in L.291-295 give adhesion speeds (particles below these limits adhere) that are smaller than the settling speeds. Yet, you claim that this is sufficient to explain adhesion of these smaller particles. My interpretation of these explanations is that particles settle at speeds faster than adhesion speeds and therefore should not adhere (without considering other effects).
Perhaps I am missing something or mis-interpret. In any case, it would be good to improve clarity.
In L.291, “*decreases with particle diameter*” leaves me wondering if you mean “*decreases with DECREASING particle diameter*”.
The *“<<big>>”* in L. 298 should perhaps better be called *“large”*.

Diameters

L.460 “Particles below 3600 µm2 in bounding-box surface, 73 pixels minimum size (equivalent to approximately D<60µm)”:

- “D” is ambiguous, use Ds or Df (assuming a spherical particle, I think you want to refer to Ds, which would be equal to Feret width and Feret length);
- “73 pixels minimum size”: I would avoid “size” as you seem to refer to an area of 73 pixels;
- It is unclear what the limit for processing is, 3600um2 bounding box or 73 pixels area?

L. 449 In one occasion you use “Feret size”: should be Feret width and length?

L420-422 define Df and Ds, where Df is the “Feret-box surface-equivalent diameter”. Later , in L.715 you talk about “the bounding box equivalent diameter (Df)”; I would be consistent.

L.716-717 “For comparison, a round particle is expected to have a ratio of Ds/Df=0.78.”: SHOULD BE (accord. to def. in L420-422) sqrt(pi/4), approx. 0.89, and not 0.78!?

Overlapping particles
Sect 4.1.4, 3): Could these artificially created copies of the “same segmented image” be detected and thus avoided as an issue?

Positive bias of confusion matrices
L. 545-550: The text modified in response to my previous review is unclear and leaves my comment not properly discussed. It is unclear what “This process has been repeated three times recursively…” means exactly. Is the enlarged training datatset used to create a new CNN, which is then used to classify the previously discarded images (wrongly classified by previous CNN version)? It seems that this enlarged “image training data set” is used for consecutive training and testing. Data used for testing should be independent from training, but here it seems that the test data (or a large part of them) were part of training the CNN (or classified by a previous version). I see the risk of introducing a positive bias by effectively preventing (to a large extent) data that may be classified wrongly by the trained CNN because wrongly classified particles are excluded in this process of enlarging the training and test dataset. I don’t see how *“these images should be considered as ordinary, supervised training images”* adequately discusses this.

Discussion about importance of sublimation (Re comment on L624/5, 632/633 in previous review)
L647-649, “This result suggests that sublimation on the DS during the deposition period is less important than the natural variability of precipitation intensity in determining the number of particles detected during the acquisition.”: I am not sure that you can draw a conclusion like this based on the evidence you are mentioning. In addition, the following sentence, which should confirm this, is confusing as you seem to refer to lower (colder temperatures) as “temperatures above the median” and warmer temperatures as “in the lower temperature range”.

Also L 654-655 suggests that “sublimation does not affect dramatically the number of particles”. Again, this cannot be concluded from the results. Contrarily, one must expect that sublimation affects the number of particles (see Fig.9b in Sect 3.2) for smaller particles and at warmer temperatures.
Similarly, the statement in L 691-692 cannot be concluded from the measurements. The resulting size distribution in Fig. 23 may very well be affected by sublimation (and would have been different, with larger and/or more particles, without sublimation). If plates were observed at -50degC or warmer (temperature information is missing in the discussion) then the observed plates may be deposited at the end of the deposition period, shortly before the scan. Particles deposited earlier would have been completely sublimated if less than 200um in size (see Sect 3.2).
Likely, the discussion cannot be improved to support the author’s claims. Rather, it should be acknowledged that sublimation cannot be excluded or quantified easily. In addition to particles potentially disappearing due to sublimation (L731-732), particles may also appear smaller than their size during precipitation and when deposited. Statements such as in L738 (“apparently without dramatic losses of small particles for sublimation”) cannot be deduced from the presented observations.

Other issues:

Resolution of the ICE-CAMERA
Your clarifications refer to the pixel size in the scanned image, but not to the optical resolution. Can anything be said about the optical resolution? (What are
the smallest details/features that can be seen on the images?)

Use of “adverse”
L 307, “The adverse effect is an accelerated natural sublimation of deposited particles.” As in the previous review, I have a problem with this sentence and think it is bad language and therefore difficult to follow.

Section numbering
Sect. 4.1.1 is missing?

Eventually
L 628, “eventually” is the wrong word.

Data set or dataset
You use “data set”, data-set”, and “dataset”. In one place also “data store”, unclear if you mean dataset there or something else.