Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-412-AC2, 2017

Atmospheric Measurement Techniques Discussions

Interactive comment on "Automation and Heat Transfer Characterization of Immersion Mode Spectroscopy for Analysis of Ice Nucleating Particles" *by* Charlotte M. Beall et al.

Charlotte M. Beall et al.

cbeall@ucsd.edu

Received and published: 11 May 2017

amt-2016-412 Automation and Heat Transfer Characterization of Immersion Mode Spectroscopy for Analysis of Ice Nucleating Particles Charlotte Beall, Dale Stokes, Thomas Hill, Paul DeMott, Jesse DeWald, and Kimberly Prather

We thank the reviewers for providing feedback on the manuscript and include our responses below.

Responses to Referee 1, Report 1

P. 2, l. 2: I wonder what is meant by "the homogeneous freezing RH of aqueous solution droplet" ? Isn't the RH irrelevant, if you consider homogeneous freezing of

liquid water ?

Yes, thank you, this is true for immersion mode ice nucleation, but we intend to define INPs in general before narrowing the discussion to immersion mode INPs only. In deposition ice nucleation studies, RH is an important factor.

P. 5, L. 29: I do not understand why the intensity of light reflected back to the camera decreases when droplets freeze, as frozen drops become opaque and lighter than clear liquid drops, scattering more light towards the camera and leaving less for absorption at the dark background of the well block ? Please clarify

Whether the intensity increases or decreases with freezing depends on the color of the substrate, so we added absolute value bars. That way it applies whether the materials that show through the sample volumes are dark or light.

The following change was made and reflected in both P5, L33 and Fig. 3 so that both are consistent with Fig. 4. $|I(ti) - I(ti\text{-}1)| > \eta$

P. 9, : A statement is required on how the equations (4) and (5) were derived, or where they are taken from.

A citation for equation (4) was added: Churchill and Chu, 1975.

Technical corrections: Explain the acronym AIS upon first use: at present AIS occurs many times (e. g. in the abstract, and elsewhere) before it is first defined on page 5 L.1

Thank you. AIS is defined in the abstract upon first use now, and on P3 L32.

P. 2, L.13, insert "to" (identify drivers . . .)

P.2, L.13 now reads "..are needed to identify drivers. . ."

P. 2, L. 24 and many other places: check the references in brackets: often names of authors are put in brackets, although the names are part of the sentence. An Example:

“In (Hiranuma et al. , 2015), 17 online and offline . . . “

It appears that this bracket is standard formatting in AMT? From the website: “In general, in-text citations can be displayed as "[. . .] Smith (2009) [. . .]", or "[. . .] (Smith, 2009) [. . .]".”

http://www.atmospheric-measurement-techniques.net/for_authors/manuscript_preparation.h

P. 3, L3: remove droplet assay

Thank you. P.3, L3 “droplet assay” has been removed.

P.3, L. 3: Upon introducing the ice spectrometer the text refers to a paper by Hill et al. (2016) that is not in the reference list. Or do you mean Hill (2014)?

Yes, correct. The reference should read Hill et al., 2014. P.3, L.3 now reads (Hill et al., 2014).

Please clarify. P.3, L. 10: How can 50μl of water be filled into a 1.2μl well ? Please check the numbers.

P.3, L.10 corrected and now reads “. . .small aliquots of water, typically around 50 μL each, are distributed in 1.2 mL wells. . .”

P.3, L.19: introduce the acronym FRIDGE after “Frankfurt Ice Nuclei Deposition Freezing Experiment.”

P.3, L.19 now reads “. . .the Frankfurt Ice Nuclei Deposition FreezinG Experiment (FRIDGE). . .”

P. 4, L. 23: Remove “Automated” in header of chapter 2.2

The header of chapter 2.2 is now “Physical Design of the Ice Spectrometer.”

P. 5, L. 12: I presume that it’s not room air but heat that leaks into the nitrogen flow ? If so, then write something like “”. . . room air heat leaks into . . .”.

Yes, actually, if flow rates are too low, we believe room air does leak into the system because it is not perfectly insulated. The acrylic lid for example, is not sealed, so if the flow of nitrogen is low, room air could seep in underneath the lid.

P.5, L. 32: "are" instead of "is" in: “time, freezing temperature, and location of the well are recorded . . .”

P.5, L. 32: now reads “. . .time, freezing temperature, and location of the well are recorded.”

P. 8, L2: In Fig. 5 nothing is highlighted in yellow, as stated in line 2 and on P. 9, L. 16 . Please check.

Thank you, the measurements were updated in response to the other reviewer, so there is no longer a yellow highlighted feature in the manuscript.

Figure 5: In my copy the labels of all 4 axes as well as the legend and text in the insert have some strange characters (?). Please check.

This is another problem due to the pdf conversion. I will make sure that the characters convert correctly.

Reference:

Thank you, the updated reference of (Hiranuma et al., 2015) was added.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/amt-2016-412/amt-2016-412-AC2-supplement.pdf

---

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-412, 2017.

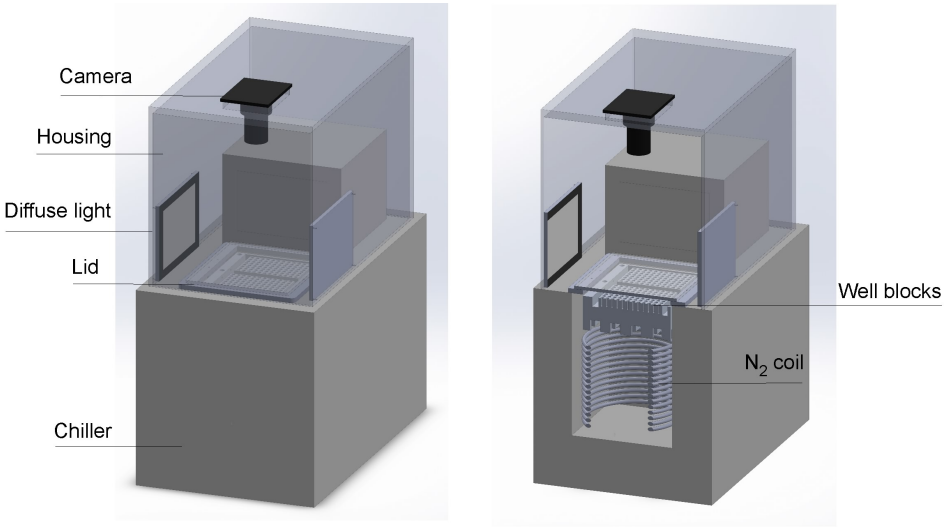

Fig. 1. Schematic of Automated Ice Spectrometer (AIS) showing primary components as indicated by labels.

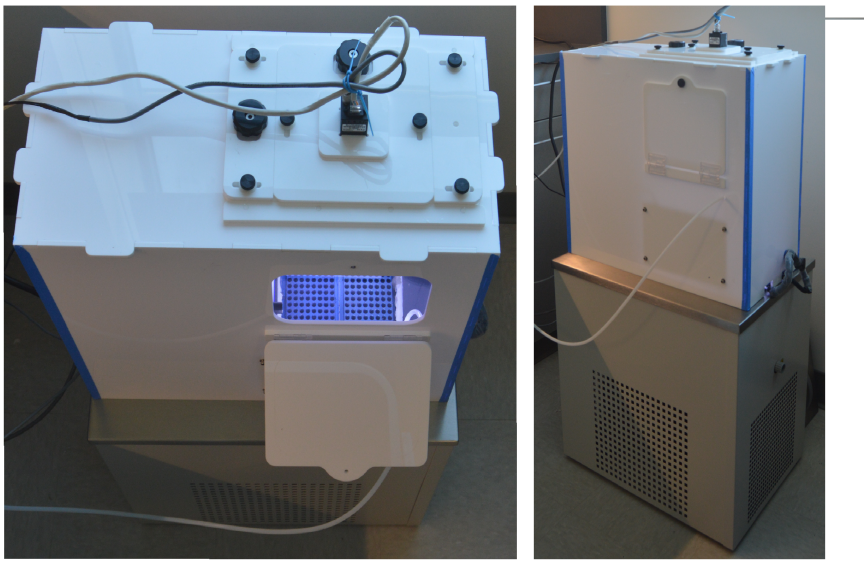

Fig. 2. Photo of current Automated Ice Spectrometer system

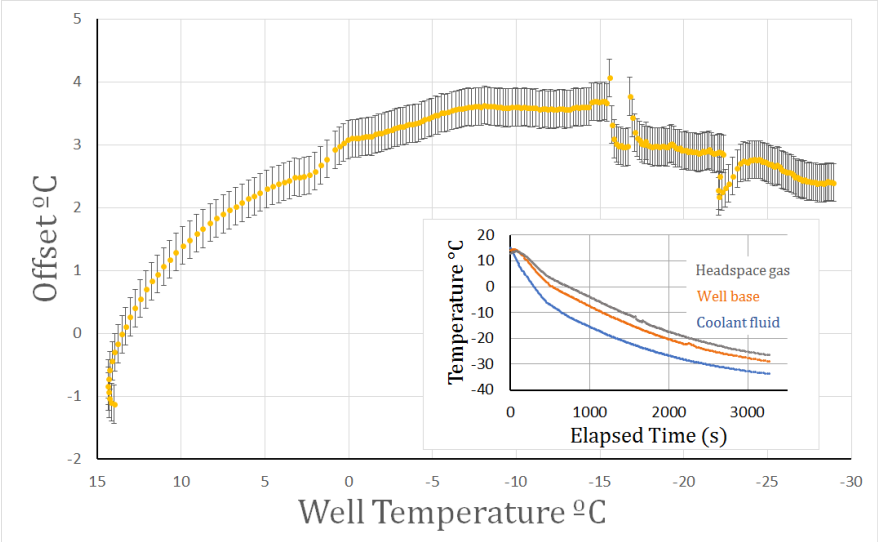

Fig. 3. Graph of well temperature vs. temperature offset measured between the base of the well and the air above the well as measured with a thermistor probe (orange filled circles).

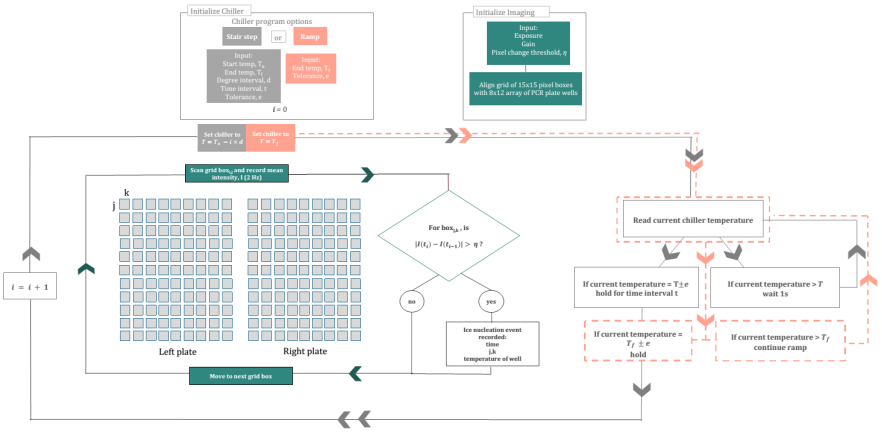

Fig. 4. Flow chart describing algorithm for detection of freezing events using camera, lights to leverage optical properties of phase change from water to ice.

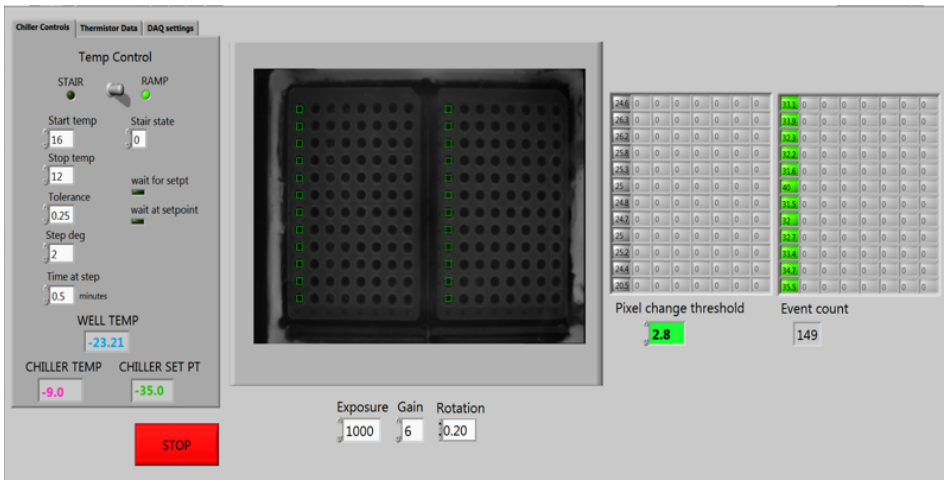

Fig. 5. A screenshot of the AIS user computer interface.

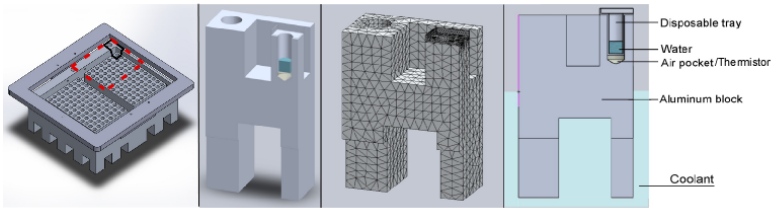

Fig. 6. Schematic of cut in well block made for heat transfer simulation and mesh applied.

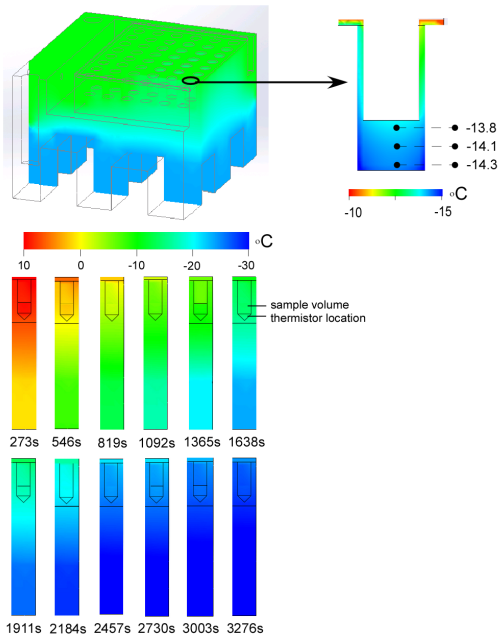

Fig. 7. Graphical time series of the heat transfer simulation. Top shows isometric view of the well block (top left quarter) at t = 1638 s.

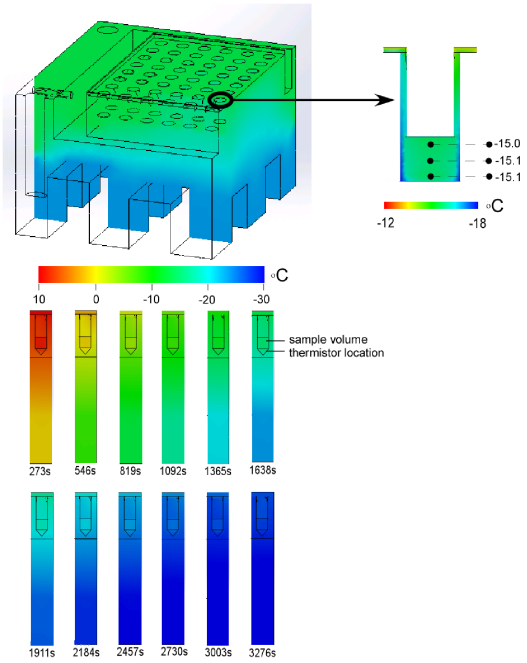

Fig. 8. Graphical time series of the heat transfer simulation.

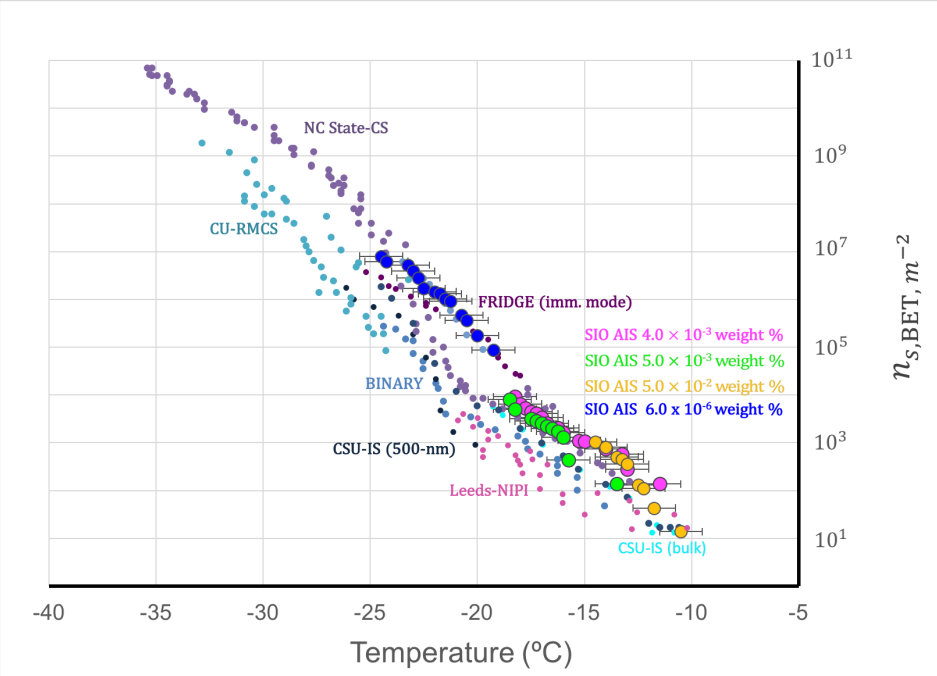

Fig. 9. Immersion freezing spectra of illite NX particles in terms of ns,BET (T) for comparison of SIO AIS against six other immersion mode techniques reported (see Hiranuma et al., 2015).