Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
https://doi.org/10.5194/amt-2022-141-RC2, 2022

Comment on amt-2022-141

Anonymous Referee #2

Referee comment on "A universally applicable method of calculating confidence bands for ice nucleation spectra derived from droplet freezing experiments" by William D. Fahy et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-141-RC2, 2022

"A universally applicable method of calculating confidence bands for ice nucleation spectra derived from droplet freezing experiments" by Fahy et al.

General comments:

This manuscript evaluates the potential of two types of bootstrapping methods for quantifying confidence intervals of droplet freezing experiments. Therefore, this manuscript may contribute to a more consistent interpretation of results from droplet freezing studies. The authors have also provided a very thorough documentation of their coding efforts through a publicly available Github repository.

However, I have major concerns regarding the discussion of limitations and requirements associated with the bootstrapping methods evaluated in this paper. These aspects (e.g., sample size requirements) need to be discussed in much more detail, e.g., as in figure S3 which should be moved to the main text. A more detailed discussion would also ensure that these methods are used „properly" as mentioned in the abstract. I would also recommend a stronger focus on the bootstrapping methods, instead of an in-depth discussion of binning and interpolation methods, to make the manuscript more concise and less verbose.

I therefore recommend the manuscript for publication after major revisions.

Specific comments:

p.2, l. 58: HPLC is not defined - please make sure that abbreviations are defined consistently across the manuscript.

p.3, Fig. 1: The naming convention is slightly confusing - maybe remove duplicate mentioning of „unnamed FUE" and „water aged FUE" in the legend? Also, the color scheme is not color-blind friendly and differences between samples are hard to see. How many runs were included per sample?

p.3, l.75ff: I don't see the advantage of representing the droplet freezing data as ns values within the context of this study. However, if applied, the concept of ice-active site densities needs to be introduced explicitly - it is unclear how ns is derived and which specific surface area values are used.

p.4, l.88f: What does „many" droplets mean exactly? Throughout the manuscript, a stronger emphasis should be on a discussion of the impacts that sampling size has (i.e., in the original observed data, the re-sampled data etc.)

p.5, l. 36: I would debate whether the contact angle approach with its many underlying assumptions (e.g., using bulk properties for describing microscopic nucleation processes) is strictly speaking „physically-based" - maybe rephrase?

p.6, l. 63: „high/warm" instead of „low" temperature?

p.7, Fig.2d: Why does the interpolated data (unaged FUE) stop at -12 degC?

p.8, l.75ff: Many of these approximations are only valid for „larger" droplet ensembles - this limitation should be mentioned to emphasize in which situations (i.e., for which experimental setups) we need more flexible statistical approaches. Also, as many readers might be more familiar with t-intervals than Z-intervals, a short explanation of the differences would be great.

p.13, l.40: The chosen sample sizes (e.g., n=91) seem to be arbitrary - please comment.

p.14, l.56: Replace „per degree Celsius measured" with „per Kelvin".