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Atmospheric Measurement Techniques Discussions

Interactive comment on "Re-evaluating the Frankfurt isothermal static diffusion chamber for ice nucleation" *by* J. Schrod et al.

Anonymous Referee #2

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I am supportive of publication of the paper, but I have some mixed feelings about it. My primary criterion for papers describing instrumentation is "Is there enough information here for someone to evaluate the data coming from this instrument?". By that criterion, this paper should be published, since the information presented here is critically important for evaluating the published data from the FRIDGE thus far and for reliable interpretation of the data gathered in the future.

But that is partially the source of my uneasiness. On page 12530, lines 9-12, the authors state,

> Unfortunately, the full extent of the error is variable and depends upon the sampled aerosol, meaning that the entirety of data collected from the stated

> time period and reported in the cited publications must be invalidated. Likewise, any conclusions and proposed hypotheses based on INP counted by FRIDGE from those cited publications must be re-examined.

The first sentence is a very strong statement. Have those papers been retracted or withdrawn? This seems quite a result to place in a section with the rather innocuous title of **Image Analysis**.

I admire the authors' honesty. That said, if that data is, in fact, invalidated (which I take to mean as useless), then one sentence in the third section of a follow-up paper on the instrument is not the only place it needs to be stated.

Specific Comments

On pg. 12526, lines 19-21, the authors state, "Thus INP are the low temperature analog to cloud condensation nuclei (CCN), which assist the nucleation of liquid droplets in the atmosphere." CCN and INP are alike in that both catalyze a phase transition. However, the vapor-liquid phase transition is generally not nucleated, because of the presence of soluble material. In that case, the CCN take up water continuously and the resulting haze droplet is in equilibrium with the water vapor in air. Such is not the case for ice nucleating particles. (See Mirabel et al. (2000) for a discussion of activation vs. nucleation.)

pg. 12529: "programed" is misspelled.

I am not convinced that comparing the concentration of ice nucleating particles as determined with the FRIDGE to DeMott et al.'s parameterization is really valid here. Though the parameterization is based on the number of aerosol particles with diameters greater than 0.5 μm, it is also based measurements with the CFDC which is

usually operated with an impactor that cuts out particles larger than approximately 1 μm diameter. If Figure 8 in the paper is correct, the FRIDGE samples particles in the size range of 1 or 2 μm. This mismatch in size could really bias the comparison – for two reasons. The first is that if the probability of serving as an ice nucleating particle scales with surface area, then the larger particles will be more effective simply because of the greater surface area. There's also a suggestion that larger particles are more effective INP even once you account for their greater surface area (see Mason et al.)

The ability to measure the ice nucleating ability of such larger particles is one of the strengths of FRIDGE. It is a complement to the CFDC. We need measurements of those larger particles as this from the Abstract of Mason et al. states "...these findings strongly suggest that supermicron and coarse mode aerosol particles are a significant component of the ice nuclei population in many different ground-level environments."

References

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Mason, R.H., Si, M., Chou, C., Irish, V.E., Dickie, R., Elizondo, P., Wong, R., Brintnell, M., Elsasser, M., Lassar, W.M., Pierce, K.M., Leaitch, W.R., MacDonald, A.M., Platt, A., Toom-Sauntry, D., Sarda-Estève, R., Schiller, C.L., Suski, K.J., Hill, T.C.J., Abbatt, J.P.D., Huffman, J.A., DeMott, P.J., Bertram, A.K., 2015. Size-resolved measurements of ice nucleating particles at six locations in North America and one in Europe. Atmos. Chem. Phys. Discuss. 15, 20521–20559. doi:10.5194/acpd-15-20521-2015

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 12525, 2015.