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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterization and first results of an ice nucleating particle measurement system based on counterflow virtual impactor technique" *by* L. P. Schenk et al.

Anonymous Referee #3

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The authors describe an attempt to couple an ice nucleus counter, the FINCH, to various instruments downstream of it, using a pumped counter flow virtual impactor (pumped CVI), to separate ice particles from the interstitials.

I have mixed feelings about this paper. It seems a fairly straightforward idea to couple an ice nucleus counter with a CVI in order to analyze the residuals of particles which activate as ice nuclei. Then again, the implementation of that idea is non-trivial, and deserves documentation in the peer reviewed literature. That said, you would like to see that the implementation of the idea really worked, and that's one of the weaknesses of this paper.

As I see it, there are three elements to this paper

- the performance of the Fast Ice Nucleation Chamber (FINCH)
- the performance of the PCVI
- the performance of the instruments coupled to the FINCH-PCVI system.

There seem to be some issues with the FINCH, particularly with the flow system. Those issues seem to be worked out, however. The purpose of this paper is not to evaluate the FINCH as an ice nucleus counter.

The PCVI is being used outside its documented range. The characterization of the performance of the PCVI is the most quantitative and well done aspect of the paper.

Downstream of the PCVI are the ALABAMA, CPC, or APS. If everything is working correctly, a comparison of the ice crystals counted by the FINCH and the ice crystal residuals counted by the OPC should be comparable. For deposition nucleation, this is the case. For saturation ratios above water saturation, the OPC counts exceed those recorded by the FINCH. Apparently, liquid droplets grow in the FINCH to the size where they are passed through the PCVI. In one way this is good news. The FINCH is performing as it should, discriminating between liquid and ice based on polarization, not just on size. However, if the FINCH is used as a way to activate particles as ice nuclei, and the size is the principal discriminator, as is the case for the PCVI, then the fact that particles activate as CCN within the FINCH is a serious drawback.

The authors make the case that only 1 in 3 particles is misclassified, but this is not a small error. In fact, I think an error of that size makes the data essentially unusable. What use is a size distribution of the activated residuals if one third of the particles are actually CCN, not IN? The authors also make no attempt to convince the reader that there's no systematic bias in the error. Is the fraction of CCN higher for smaller particles perhaps?

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Finally, the coupling of the FINCH with the mass spectrometer, ALABAMA, is little more than a statement of a proof of principle. The ALABAMA is analyzing particles passed through the PCVI, but there just aren't very many of them. I am left wondering why no lab data is presented here to show that this will work given enough particles. Trying it out in the field is commendable, but showing that it works in the lab first would be even better.

In summary the primary result of this paper seems to be that the idea of coupling the FINCH and downstream instruments via a pumped CVI will work in principal, but that in practice, there are still some difficulties. I'm not sure that is enough to warrant publication in AMT.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 10585, 2014.