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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 #1

Received and published: 18 November 2014

Review of Schenk et al. (2014) AMTD paper.

Authors report the technical details of an experimental setup, which was used to separate the INPs for further investigation. This setup was deployed at the high Alpine research center. Figures 1 to 6 show the experimental technique set up, performance and validation results, and other remaining figures (7 to 10) show the results obtained using this set up. Two results: INP concentration and sizes are particularly useful for cloud modeling community. Authors think that the mass spectra of INP (Figure 10) cannot be statistically evaluated, but the composition results can be used to demonstrate the proof-of-concept.

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Note that similar kind of experimental setup (ice chamber + PCVI + Mass Spec and other instrumentation) was used and shown by few previous studies: see Baustian et al. (2012) and references therein who had similar set up as here and was deployed at high mountain top research facility. This to me indicates that proof-of-concept to measure and characterize INPs at high top research facilities is already demonstrated. Question is what new things we can learn from the study that is reported here in this paper. I think this paper is missing novel things to stand on itself for publication. For publication, this paper needs to be revised and more results needs to be added. I have following suggestions to revise this paper further before it is accepted for publication.

General Comments:

Feasibilities studies were performed at the lab. No additional validation experiments were performed at the high alpine research center. Note that PCVI transmission efficiency (TE) is also a function of ambient pressure. One needs to adjust PCVI flow rates according to local pressure and temperature conditions to satisfy TE behavior. Figure 4 may not be accurate enough such that it cannot be used at JFJ research center. TE characteristics at JFJ center needs to be presented. It looks authors have used similar flow rates that are used in the lab at the JFJ. This is not perfect, PCVI may function, but not as expected. This needs to be acknowledged and discussed. Did you perform any CFD simulations to understand the effect of pressure and temperature on the performance.

Nothing is mentioned about the unwanted particle breakthrough via the PCVI. It is possible that in addition to sampling large ice crystals there is possibility that some aerosol particles of size smaller than cut size may pass through sampling port.

FINCH is operated at water-supersaturated conditions (Figure 6). How to do you ensure that Mass Spec is not sampling supercooled droplet residuals, but only ice crystal residuals, for INP characterization experiments. This is serious problem with FINCH and logically incorrect experimental methodology to study INPs.

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Related to above I'm not sure if you can grow ice crystals of sufficient size in FINCH that can overcome the counterflow within the PCVI. I think size distribution of only ice crystals that can be generated within FINCH need to be shown. If the maximum size of ice crystals that can be grown is 2 to 3 um using ambient aerosols (submicron size particles), then PCVI operation is not possible. Because the PCVI cut size is larger than 3 um.

Section 2.5 (SEM) can be removed. Results from SEM analysis are not used, and don't think deserve one section.

INP concentration over the whole campaign period should be shown if available. This result will be new. Currently, concentration during one day (Figure 8) is shown. Figure 6 shows that FINCH was operated over wide range of conditions, these FINCH results (INP concentrations) would be very useful.

Are there any previous studies who measured INP concentration at JFJ? If yes, those studies should be discussed and compared with the results (figure 8). Also, the ambient and INP size distributions should be discussed.

What is the importance of INP measurements and characterization at high Alpine research center. Nothing is discussed about this in the introduction section, except one line on page 10589. More discussion and strong motivation for this research is needed. Also, discuss previous high mountain top research facility studies.

I suggest a separate section or paragraph to be added focused on why only 7 particles were detected by mass spectrometer. Little is mentioned on page 10600 (top), but need more discussion. INP concentrations were in the range of 5 to 30 per liter, this is sufficiently okay for PCVI operation. If not why so.

Do the PCVI was thermally insulated? I think ice crystals will melt or shrink in size within the PCVI if it is not insulated. If the lab room temperature is below sub-zero degree C, then it should be okay, otherwise I suspect ice crystal melting within the

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PCVI. This will affect TE of particles.

Reference: Baustian, K. J., D. J. Cziczo, M. E. Wise, K. A. Pratt, G. Kulkarni, A. G. Hallar, and M. A. Tolbert (2012), Importance of aerosol composition, mixing state, and morphology for heterogeneous ice nucleation: A combined field and laboratory approach, *J. Geophys. Res.*, 117, D06217, doi:10.1029/2011JD016784.

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7, C3787–C3790, 2014

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