Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-348-RC2, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Agricultural harvesting emissions of ice nucleating particles" *by* Kaitlyn J. Suski et al.

Anonymous Referee #2

Received and published: 15 June 2018

In the submitted work Suski et al. present ice nucleating particle (INP) measurement data from emissions associate with harvesting wheat, soybean, and sorghum crops at two locations in the plains east of the Rocky Mountains. I find the manuscript well written and clear. The subject is certainly very interesting, especially given the intense agricultural activities in this region of the United States. I would recommend this manuscript for publication subject to the authors addressing a few minor points.

Furthermore, I suggest a few points that may be considered if future measurements of a similar nature are undertaken. Although, I understand the challenges of rigidly constrained ambient measurements I do agree with Anonymous Referee # 1 that the link to a clean ambient, "control" context is not clear cut. Similarly, the measurements raise a lot of open questions about links to landscape and agricultural evolution and

larger synoptic scales and beyond.

Minor Comments:

• It is a bit strange that the first figures referred to in the manuscript are actually in the supplement. Perhaps an initial figure that summarized a bit of the experimental parameters could/should be included? Perhaps a map with the sites located and/or a photo that would give the reader an impression of the landscape and/or emission plumes?

Notes on figures S1, S2:

S1: Could this plot be turned into a box plot with the added axes indicating distance, in addition to the lat/long currently indicated?

S2: It would be useful to also indicate the height above ground level of the collection (rain hat and concentrator) inlets? These numbers could also be added to the text.

• Page 3, line 9; I suggest that the wording be changed to, "Ice nucleating particle concentrations were measured *online* with the ....." to distinguish the CFDC measurements from the IS.

• Page 3, line 11; I suggest that, "coated with ice at different temperatures" be changed to, " coated with ice *and held* at different temperatures". I believe the ice coating is done with the walls at a single temperature.

• The use of the 2.4 μm impactor and 2.5 μm cyclone is mentioned with respect to the two INP measurement techniques. However, given the nature of the emissions one would expect a sizable number of large particles. The authors do not show any particle size distributions (perhaps would be a useful addition to the supplement) or to my reading comment about how many particles might be left unobserved given the size cutoffs. While the very largest particles likely sediment out quickly and thus may not readily affect clouds, what about particles closer to the cutoffs? A short discussion of this would benefit the manuscript.

• A justification of the concentration factor (CF) of 90 ± 3 that is used for all measurements is lacking. The authors argue that CF calculations are difficult but do not present a clear explanation of why the choice that is made is considered representative for all measurements. An additional sentence is needed.

• Page 5, lines 5-6: The parenthetical statement, “to ensure maintenance of activity of K-feldspar, if present" does not obviously follow from an addition of 2 mM KCl. Perhaps I am ignorant, but I would suggest a sentence of explanation would add clarity.

• For the chemical composition analysis using the SEM-EDX a 2.9 μm impactor is used after the CFDC. To my understanding that leaves a range of particles between 2.4 μm and 2.9 μm that may include INP that will not be collected for analysis. Can the authors comment on the impact of this gap? Is it likely to in anyway impact results? It might be helpful if they state the median or mean size to which the ice crystals grow when measured leaving the OPC. I guess once out of the controlled chamber the ice crystals will be evaporating and shrinking quickly, how small will they get before arriving at the impactor?

• Throughout the manuscript $n_{0.5\mu m}$ is used, expect in Figure 5 when n500 is used. The figure labels should be modified for consistency.

• A general comment on figures: I find the size distinction between No Concentrator and Concentrator data points difficult to distinguish. Although, likely the authors have tried many combinations I wonder if the difference could be slightly amplified?

• Figure 1: The light green of (a) makes the symbols more difficult to distinguish than the other color choices.

• In Figures 3 and 4: It would be helpful to state the number of particles that were analyzed to arrive at the pie charts. Are these numbers arrived at using a particle by particle analysis, or does the method allow some type of averaging over the entire sample? Please also address these points in the text.

• Figure 5: See n500 comment above.

General comments to be addressed now or in future work:

The current manuscript raises many open questions in my mind, some of which may be addressed, but likely many which cannot be given the current data set. I briefly summarize some of these, perhaps some of which the author’s could address or would be interested in incorporating as points of discussion. The most obvious question, is how do the measurements summarized here compare to conditions which would be found given other landscape contexts. Specifically, are there other measurements in the literature which would suggest how these observations might compare to a native landscape, which I assume was prairie? How about to other forms of agriculture? For example, this part of the US has seen a large homogenization of crops over the last half-century, how does that affect such emissions. Also, it is unclear exactly what kind of crops are being grown and harvesting is being done. For example are the crops “roundup ready", are the fields heavily treated with pesticides during the growing season? Also is the harvesting being done for silage or is just the main fruit/seed of the plant being harvested? How much residual vegetation is being left behind after the harvesting? For example are the corn fields cut completely to the base of the stalks or are only the ears of corn harvested and the stalks discarded onto the ground? These types of variables will significantly influence the amount of vegetation undergrowth, residual vegetation, and access to bare soil surface. One could envision an entire slate of field measurements to dig into some of these types of questions.

Finally, it remains unclear to me how relevant the ground based measurements are for cloud level processes. What is the anticipated spatial and temporal scale at which these emissions will remain relevant. Clear answers are beyond the scope of this manuscript, but perhaps there are existing modeling studies to which the authors could point.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-348,

2018.

C5