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Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessment of performance of the inter-arrival time algorithm to identify ice shattering artifacts in cloud particle probes measurements" *by* A. Korolev and P. R. Field

Anonymous Referee #2

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Review of "Assessment of performance of the inter-arrival time algorithm to identify ice shattering artifacts in cloud particle probes measurements." By A. Korolev and P. Field This paper goes into detail about the difficulties involved in removing shattered artifacts with post processing algorithms. The authors present several different complications that can hinder the algorithm and then demonstrate further issues that can occur by assessing the performance for the algorithm for the 2DC in three distinct cases during AIIE. They finish demonstrating that numerical simulations of an aircraft passing through natural high ice concentrations can also break the ITA. Overall, I think this

manuscript is well written and should be published in ACP after some minor comments I have about the paper are addressed. The conclusions of this paper have major implications for the processing of OAP data in ice clouds. My most major complaint is that there are sections of the paper that need to be made more quantitative in order to improve the presentation. Also, I think there are a couple of recommendations for future studies that this paper could mention.

My detailed comments are below.

Line 18, page 10251: It may help to define what the interarrival time of the probe is for a reader less familiar with OAP-2DCs.

Line 10, page 10252: "several" – 600? 700? I think something more specific than "several" is warranted.

Section 2.2. Bullet 2. I think it should be emphasized that this particular version of the ITA uses the minimum of $\varphi(\Delta t)$. Some other versions of the ITA that do not search for a minimum in $\varphi(\Delta t)$ are based off of a certain percentage of the mean interarrival time (i.e. Lawson 2011), or base the cutoff threshold as a multiple of the peak interarrival time in the shattered mode (Field et al. 2003) after fitting 2 Poisson modes to $\varphi(\Delta t)$. It may be interesting to discuss how your results in your paper apply to those particular versions of the ITA as well somewhere in the paper.

Section 3.4. Since entire-in processing helps mitigate the issue of classifying partially view ice particles as shattered artifacts, what implications would have for people processing optical array probe data using image reconstruction or center-in techniques to improve the sample area of the probe?

Section 3.5. Do you think there is any possibility that pattern recognition software might help to help recognize what a diffraction fringe looks like? A diffraction fringe would present itself as several smaller particles surrounding a large particle, all with low interarrival times, with the large particle somewhere in the middle of the train of

particles with low interarrival times. Therefore, I would expect there to be some sort of distinction between the two phenomena that could show up. Obviously, developing the algorithm is beyond the scope of the study, but it may be worth seeing if future studies could compare the size/interarrival time characteristics of diffraction fringes versus shattered artifacts and see if there is a clear distinction in the characteristics of the particles between the two. I think this should be a recommendation for future work to be listed by the authors.

Section 3.6: I think it would be beneficial to show an out of focus fragmented image as a figure in the paper.

Section 4.2.1. Line 20, page 10261. I think the wide (2+ orders of magnitude variability) in the cutoff should be explained as well. It is caused by the fact that the ITA has a tough time identifying the minimum between the modes?

Lines 6-10, page 10263: A more quantitative statement is needed here. What does it mean to agree "reasonably well?" I think it would be of a benefit to mention the values of the concentrations of particles in the given size ranges.

Line 25, page 10263: I would mention what the mean extinction and IWC are from the 2DC probes before and after corrections for this case to give a more quantitative estimate of the impact of the algorithm.

Line 6, page 10264: How much greater are the counts?

Line 8, page 10264: "most," Can you give a percentage here?

Line 28-29, page 10265: "small," How small? 10 particles?

Line 2, page 10267: I think you need to show these fits in Figure 13 as a curved line.

Line 30, page 10267: Few. 10? 20? How many are in the figure?

Line 23, page 10271: The relationship between the number of fragments viewed by the probe and the distance between the shattering volume and the sample volume makes

sense physically, but there is little work done to determine how strong this relationship actually is. I don't think the authors have the proper data to determine the strength of said relationship, so whether the "anticipated" statement on lines 29, 30 and line 1 of the next page is still up for grabs. I think it would be useful to mention that there needs to be future work done to see how strong this relationship is. Numerical flow modeling and lab tests of probes with differing Ssn and distance from sample volume to shattering surfaces have the potential to do this. These studies could potentially be useful not only for the correction of historical datasets, but also give the community recommendations of how to design probes in the future to best accommodate the ITA.

Line 7, page 10272: I think it's safe to say that the standard probe has a greater Ssh than the modified probe, but I would not argue that Ssh $\rightarrow$ 0. The modified probe tips still shatter ice particles and, as demonstrated by your results, these artifacts still enter the sample volume, so the modified probe must have a nonzero Ssh.

Conclusions. I think that a sixth bullet can be added here that highlights the main conclusions of the Monte Carlo simulations with the last sentence removed from Conclusion 5. This would better highlight the main points of the last part of the paper.

Technical corrections:

Line 18, 10251: "thought" should be "through."

Line 25, page 10253: "cut-off"

Line 7, page 10272: "anti-shattering"

Figure 13: I think you need to show the exponential fits as a curved line in this figure when the distributions are a good fit to the data. The fit coefficients to the relationships in Figure 13 should be shown as a table or an appendix.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 10249, 2014.