Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-265-RC2, 2020
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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterising optical array particle imaging probes: implications for small ice crystal observations" *by* Sebastian O'Shea et al.

Anonymous Referee #1

Received and published: 23 September 2020

Review of "Characterising optical array particle imaging probes: Implications for small ice crystal concentrations" by O'Shea et al.

Recommendation: Requires major revision after which its suitability for publication can be reassessed

The subject matter of this manuscript is timely and within the scope of AMT. It has been long recognized that there are significant uncertainties in the concentrations of small ice crystals that are measured by optical array probes due not only to the possibility of ice crystal shattering, but also because there is a small, poorly defined and dimensional-dependent depth of field. This paper attempts to improve upon the deter-

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mination of a probe's sample volume by using grayscale image analysis and co-location using stereoscopic imaging. Although the former has already been treated in the literature, the later is especially a novel contribution that deserves publication. Further, the manuscript is well written and the figures are of high quality. As such, it appears that the paper should eventually appear in AMT. However, as the conclusions of this study can be far-reaching, it is important that the technical details of the study have the highest quality. There are some overarching concerns about some of the analysis and some misinterpretations of previous studies that should be corrected before this paper is accepted.

First, the Korolev (2007) technique was never designed to work on non-spherical particles so the application of this technique to non-spherical particles is not appropriate here, even if prior studies have applied the technique to non-spherical particles.

Second, for the determination of the probe sample volume, there are optical reasons why the diameter in the direction of the photodiode array should be used in the consideration of the depth of field of the instrument. If this definition is not used, a proper depth of field dependence on particle habit/placement in the array cannot be derived.

Third, the paper exaggerates the implications of the study for the parameterizations or representations of small ice crystals. Most previous studies have specifically noted that there are large uncertainties in quantifying the contributions of particles with dimensions smaller than 150 micrometers due to small and poorly defined depths of field for small particles (going back to a study of Baumgardner and Korolev 1997 that has been cited many times). This study is not even referenced here! This study seems to be using a threshold size of 200 um rather than 150 um, so there is a bit of a difference here. But, the findings of the manuscript should be better placed in the context of other studies that have already been conducted as otherwise the implications of this study are overexaggerated.

I'm not sure that the data availability statement meets the threshold required by the

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journal. In general, the data should be available at a publicly accessible web site rather than only on request to the contact author. If this study is going to have far-reaching implications, these data should be more openly available for others to test their algorithms with. I'll leave it for the Chief Editor to decide if this statement is adequate.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-265, 2020.

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