Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-70-AC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "The Universal Cloud and Aerosol Sounding System (UCASS): a low-cost miniature optical particle counter for use in dropsonde or balloon-borne sounding systems" *by* Helen R. Smith et al.

Helen R. Smith et al.

h.smith20@herts.ac.uk

Received and published: 2 June 2019

responses are shown below reviwer comments

Major comments: 1) Calibration process is incomplete. The described calibrations using particles of known diameters can only determine the sensitivities of the instrument, but not counting efïňĄciencies (as a function of particle diameter). This is especially important for small particles (near the lower detection limit of 0.4 μm). Note that the inter-comparison results shown in Figs 16 and 17 are not sufïňĄcient to validate the

Printer-friendly version

Discussion paper

UCASS. This is because the particle mass concentration or liquid water content is only sensitive to large particles. The authors need to demonstrate the counting efïňĄciency by comparing the UCASS to a proven OPC or CN instrument.

response:The UCASS sensing area is defined optically, as described briefly in the paper. The hope with this is that the sensing area can be defined based on the fundamental geometry of the system, and therefore we do not have to rely on inter-comparisons with 'proven' instruments, which may have their own counting errors etc. The CDP was used for comparison because of the open geometry nature, meaning that it could be mounted alongside the UCASS and the results should be comparable. We have been unable to find an open path instrument to do the same comparisons for smaller sizes, but we do take your point and will try and take some comparative measurements in the lab. I will amend this in the revised manuscript.

2) It is a bit disturbing to see the wide (up to 1 order of magnitude) and inconsistent (between the low- and high-gain channels and between various sizes – note especially peaks of 0.753 and 3 μm PSLs and 11.58 μm soda lime) spreads of the instrument responses to PSL and other particles (Fig. 8). The authors seem to attribute it to calibration particles. But it is hard to believe the PSLs have such large spreads. If it is due to the real PSL spread, the authors ought to be able to reduce the spreads by using a DMA (at least for particles < 1 μm) and redo the calibration. If not due to the calibration material problem, then the authors need to provide an explanation.

response:The graph in question has the instrument response (amplitude displacement) on the x-axis. The instrument response does not correlate linearly with the particle size, so an order of magnitude in instrument response does not represent an order of magnitude in measured diameter. I will either alter this graph to show diameter rather than amplitude displacement, or add an additional graph to show this information. We had considered purchasing a DMA for experiments such as this, but they are only available for small size ranges (<5microns) and therefore cannot be used for a large number of our calibration particles, but we may look into this again. When taking size

calibrations, we check the size range against an APS and a TSI OPC to ensure we are producing particles in the correct size range. Perhaps in the absence of a DMA, we could show the measured size distributions by the UCASS alongside measurements from other instruments. Manufacturers also provide some statistical information for the calibration beads which can also be shown for comparison.

3) If the large spreads shown in Fig. 8 are due to an instrument problem (such as the imperfection of sensing area deïňĄnition/particle rejection as described in Fig. 4), then the size resolution of the instrument is not great. Detailed analysis is needed to show the true size resolution.

response: As mentioned in the above comment, fig.8 does not show measured particle size, but instrument response. Therefore the spread in measured size is not so wide. The suggestions made in response to the above comment will be used to comment on size resolution.

4) The description of the optical assembly is very difïňĄcult to understand. A better Fig. 2 should help.

response: The optical assembly will be updated to follow a common coordinate system as suggested by reviewer #1, this should make the optical assembly easier to understand.

Minor comments:

1) Fig. 1 is not well done. Appears to be hand drawn?

response:Fig.1 is an automatically generated technical drawing from 3d modelling spftware, I will attempt to export it again to solve the issue with the edges.

2) Fig. 16 needs to be improved. C2

response: Fig 16 will be redone

3) It is hard to get a clear understanding of the electronics design. A circuit diagram

should help (such as Fig 4. In Hill et al., J. of Atmos. And Ocean Tech., 2008).

response: We may add in some more description or a simplified diagram to help with the explanation of the electronics system. However we will not include a full circuit diagram as this is commercially sensitive.

4) A quick search for Alphasense mirror and First Sensor detector didn't yield any useful results. Please add web links or state that they special orders.

response: These are special orders, I will clarify this in the manuscript.

5) "f(x)" is not deïňĄned in Fig. 8.

response: This is a probability density function, I will clarify this in the manuscript.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-70, 2019.