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Atmospheric Measurement Techniques Discussions

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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.

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The manuscript describes a novel atmospheric particle spectrometer designed for use as part of a radiosonde / dropsonde system. The description and characterisation of the probe are comprehensive and require only minor improvements as described below. Field and laboratory based comparisons with more established particle measurement methods appear to show at least reasonable agreement, although the choice of particle mass for intercomparison appears at odds with the stated motivations for developing the system.

The manuscript is suitable for publication in AMT subject to some minor revisions. A large number of such changes are suggested, but these are all suggestions to improve an already good paper rather than requirements.

Major comments

Sections 3.1 and 3.2 show intercomparisons with a PCASP and a CDP respectively. The subject of this paper is an instrument which counts and sizes airborne particles, so it is confusing that the comparisons with other counting and sizing instruments is accomplished using data which has been converted to mass per unit volume. Especially given the motivations outlined in section 1 to improve understanding of aerosol radiative direct and indirect effects which are in large part controlled by particle number and surface area rather than mass. It can be difficult to compare three dimensional plots of size distribution as a function of time or height. However, it would be useful to see at least either a time series of particle number alongside the mass time series, or an averaged size distribution for UCASS and PCASP / UCASS and CDP in sections 3.1 and 3.2. This would improve confidence in the sample volume calculation outlined in section 2.5 as well as in the sizing accuracy of UCASS.

Minor comments

Section 2.1

Figure 2 uses a different but similar looking labeling system to figure 1. It might be worth numbering the parts in one of these diagrams, although this change is not essential. Figure 2 also appears to be less well drawn than the other figures in section 2.

It might be worth tidying it up.

Section 2.2

This section should possibly have some reference to dealing with coincidence errors or at least an estimate of the number concentration at which coincidence errors are likely to become significant.

Section 2.3

Line 3 on page 9 and subsequent parts of the paper contain references to 4095 bins of amplitude displacement. This is initially a bit confusing because in this context the output of a voltage converter as described is (very) often referred to as "Analogue to Digital Counts" or AD counts.

P9 L8 - It would be interesting to know why such a large range of particle time of flight is accepted.

P12 L10 Typo: none-turbulent should be non-turbulent. See also P14 L4 (none linearity), P19 L12 (none cloudy) and others.

Section 2.4.2

Presumably the sheath flow was added in order to accommodate the large volume of air flowing through the instrument. It would be useful to state this. It would also be interesting to know the length of the dryer column. A flow velocity of 5 m/s might not provide sufficient time to dry a flow containing PSLs using most conventional dryers.

On page 13 line 6 the authors discuss the use of PbP data to eliminate bin width related artefacts. They appear to be writing about exactly the same measures they describe in section 2.3 (page 9 line 3), but using completely different terminology. This is confusing. PbP pulse height recording is a more widely understood terminology than that used in section 2.3 so it would be useful to standardise to this.

Figure 8 has f(x) as the Y axis label. This is normalised counts, but is not defined in the text or the figure legend.

Figure 9 on page 15 shows an additional step in the probe calibration relating scattering cross section to instrument response. It is more usual to see the calibration mode diameters plotted on top of the Mie curves as presented in figure 10. It would be useful to see the calibration added to figure 10 as well as (or even instead of) figure 9.

Section 2.5

More description about how the angles of oscillation were calculated would be interesting. Also, on line 2 of page 18 the authors give an airspeed of 5.4 +- 0.3 m/s. Reading the values for +-5 degrees from figure 11 seems to show a range of around 4.5 to 5.6 m/s. The authors should show how the former figure was arrived at.

Section 3

Figure 14 would be much easier to interpret if panels a - c used the same Y scale.

Section 3.1.2

The explanation of the differences between the UCASS and PCASP measurements sounds a little speculative. It raises a question about why these data are being used for an intercomparison if their imperfect colocation means they are not comparable. The agreement between the probes seems OK, so this could be left out (subject to the major comment above being addressed).

P22 - Figure 16 appears to be at insufficiently high resolution or has been comresssed using an excessively "lossy" method. Can this be re-plotted?

Section 3.2

Change "figure ??" to figure 17 on the first line of page 23.

The discussion on page 23 of the time of flight rejection causing under counting contains a mistake. The short time of flight of fast moving particles is rejected on the basis that it looks like short duration electronic noise, not on the basis that it looks like a large aggregate particle. At least accordin to the reasoning in section 2.3 (page 9).

Section 4

Line 8 of page 25 mentions the use of an 8+ point sizing calibration. Was this type of calibration applied to all probes contributing data in section 3, or was this done once as an instrument characterisation exercise?

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Discussion paper