Review report

"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 H. R. Smith et al.

This paper describes a recently developed small-size optical particle counter for aerosol and cloud particle measurements for balloon and dropsonde applications and shows some field results in comparison with those from other particle instruments. The description of the instrument and calibration processes is basically comprehensive (though it seems there is a room for improvement), and the field results are very interesting and promising. I think the manuscript will be acceptable for publication in Atmospheric Measurement Techniques after considering the comments and suggestions below.

Major comments.

1. The instrument uses 658 nm laser light with an open-path configuration. Isn't there any influence of stray sunlight on the measurements? If not, is there any special measure for the daytime use?

2. The authors wrote at page 9 that Time-of-Flight (ToF) data is used to "reject" signals that may come from "a large body or agglomeration of particles." Does this mean that such particle signals are not on the record? There is alternative approach in that such signals (including ToF data) are also recorded, processed, but may be removed in the data analysis phase. Is there any reason to reject those at the onboard circuit? I ask this question because this treatment may miss cloud signals if particles are greater than 40 μm. For example, in Figure 14, at 5 km, there is another ~100 % relative humidity layer. It is not clear whether there was no cloud or there were clouds with particles much greater than 40 μm.

3. The description of the assembly, optical set-up, and sensing area is sometimes not easy to follow. I understand this because the instrument is three dimensional, but I have some ideas to improve this. I suggest the authors to (1) define the common x, y, and z axes for Figures 1 through 4, (2) show the axes explicitly in each of Figures 1 through 4, (3) avoid terminologies such as "width/depth", "left/right", "above/below" etc., but use the axis to specify the direction. Furthermore, please consider to use a common set of identifiers e.g., (a), (b), … in these four figures; for example, in Figure 2, (a)→(b1), (b)→(b2), (c)→(b3), (d)→(b4) (and keep Figure 1 as it is), and use e.g., (i), (ii), … instead of (a), (b), … in Figures 3 and 4. The mirror schematic in Figure 2 is very different from those in Figures 3 and 4, which made me confused at first. The

laser light schematic in red in Figures 2, 3, and 4 may be improved by making them more consistent across these figures, and add an explanation in caption Figure 5 about how the "major axis" and "minor axis" correspond to the laser light schematic in Figures 2 through 4. Finally, please add the dimension information to Figures 1 through 3 as much as possible, so that it becomes easier to read the text by referring to these figures.

Other comments.

Section 1 Introduction:

- I think MODIS and MISR are not lidars.
- There have been several particle instruments for balloon sounding. Some examples can be found in the Introduction of Fujiwara et al. (2016). Other instruments include LOAC (Renard et al., 2016) and POPS (Gao et al., 2016).
- I think that an OPC for dropsonde may be new. I assume that the dimension, shape, and configuration of the UCASS was determined so that it can be mounted in the dropsonde launcher. If so, please explicitly write the conditions under which an instrument can be used as a dropsonde. Also, the strength of the dropsonde over the balloon sonde system may be discussed (e.g., the former can be more easily targeted to a specific airmass including a specific cloud system).
- Because the examples of aerosol particle measurements shown in this paper are actually only for Saharan mineral dust, the role of mineral dust particles on the climate may be explicitly discussed.
- The mass of the instrument 280 g should be explicitly written here (near the term "lightweight"; and also in Section 2).

Section 2 Instrument Design, subsections 2.1 through 2.2:

- See the major comments.
- Why is the sensing area ("0.5 mm^2") an area, not a volume?
- It is helpful for the readers to summarize (e.g., to prepare a summary table for) the particle signal data (i.e., I_1, I_2, ToF, pulse height, etc.) and their relation with the criteria for data quality assurance (i.e., particle path inside/outside the sensing area, agglomeration of particles, etc.) Please also add the information how the numbers 0.4, 17, 1, and 40 μm for the particle size limits were actually determined.
- Figures 3 and 4 indicate that the detector only collect light reflected on the mirror. There is no contribution from the directly scattered light (i.e., around 120 deg.)?

Section 2.3 Electronics: Perhaps, the explanation of the "gain" i.e., "high gain version" and "low gain version" is first described here at page 8. In the current manuscript, the gain is mentioned first in the

Calibration section at page 13, and it is not very clear what the “gain” actually is.

Section 2.4.2 Calibration Measurements

- Have you used all the calibration particles for each of the two different gain versions? In Figure 8, the set of particles shown is different between the two. For example, what is the response of the high-gain version to soda-lime 37.36 μm particles?
- What were the ToF values for these experiments? How about the frequency distribution? Were the ToF values simply used onboard for removing agglomeration cases?

Section 2.5 Air flow Management:

- It looks strange that the air flow inside the instrument can be greater than the background air flow because the drag on the inside wall would reduce the air flow speed inside. Do you have some actual measurements showing this (see e.g., Appendix B of Fujiwara et al., 2016)?
- It is not clear why a double pendulum system would “inhibit the movement of UCASS”. Is that due to a rather heavy radiosonde located below that acts as a drag? A double pendulum system might even give chaotic motions (depending on the mass of the second object and the air drag). Furthermore, in general, the payload may also move along a circle or ellipse in the horizontal plane.
- Related to the above two comments, in Section 1 or 2.1, an explanation is necessary why the instrument shape has been designed like this, i.e., not symmetric along the air flow; this would give additional complication here.
- In the end, all these factors go to the uncertainty of the measurements. The term “Management” in the section title may not be appropriate; more appropriate would be something like, Evaluation of the measurement uncertainty due to air flow uncertainty?

Section 3.1.1 Dropsonde system

- The date information for the sounding in Fig. 14 is necessary. (See also the major comment on this sounding.)
- What about the results from the other 5 soundings?

Section 3.1.2 Upsonde system

- Description on the PCASP onboard the research aircraft is necessary.

References:

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