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Interactive comment on "Design and Field Campaign Validation of a Multirotor UAV and Optical Particle Counter" *by* Joseph Girdwood et al.

Anonymous Referee #2

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General Comments:

This paper is well written and makes a significant contribution to the field. The redesign of the OPC for flight onboard the custom-built SUA is very clever. The greatest contribution of this paper, however, is the rigor with which CFD-LPT simulations are used to evaluating a SUA sampling capabilities and instrument redesign. The authors also do an excellent job of outlining how the custom-built small-unmanned aircraft (SUA) is key to aerosol sampling using the open path optical particle counter (OPC).

As this SUA is a custom built platform, more details, perhaps in a table, on how to set up the CFD-LPT simulations would be helpful, so that future studies may easily emulate this rigorous theoretical framework for the evaluation of new SUA and instruments. Previous studies that have attempted to use CFD to validate SUA measurements should be cited and discussed briefly, stressing key differences or novel elements of the approach outlined here (e.g. McKinney et al. 2019 AMT).

It would be worth more carefully explaining the scientific value of using the SUA-UCASS-V2 instrument within the bottom 100 m of the boundary layer in particular, compared with other small, light-weight OPC (e.g. how near surface measurements of particles within a wide size range or measurements of liquid cloud water are particularly useful to give the reader an idea of the impact of these measurements and this technology).

The empirical tests, comparisons at high gain of smaller size diameter particles seems somewhat incomplete, particularly when compared with the rest of the paper. Due to the potential artifacts of the CAS at low aerosol sizes, it would be good to see the SUA-UCASS-V2 compared to a different OPC for aerosol sizes between 500 nm and 3.5 μm, such as POPS, which does not share the same artifacts as CAS either in flight (onboard a tethered balloon to avoid potential influence of aircraft flow), or even, in the lab. Also, could bins not have been reconfigured (either in post processing) or in a second test for a closer comparison in the 1-7 μm diameter size range, where much of the disagreement between redesigned SUA-UCASS-V2 and CAS instruments exist? There is also considerable disagreement between the OPC high gain (aerosol mode), low gain, and CAS within this size range. The suggestion that small particles could have been influenced by rotor airflow is perhaps too quickly dismissed. As briefly discussed,

Specific Comments:

Throughout change artefact to artifact

P1-L5 Consider rephrasing. It is not clear that the miniaturization of particle instruments hinders accurate and representative measurements, as much as that aerosols of various sizes may be impacted by the rotor airflow and the SUA's flight patterns during sampling.

P2-L9 Also cite Gao et al. 2016

P2-L22 spatial variation also?

P4 The authors provide two examples of studies that utilized fixed-wing SUA. Because so much of this paper centers on integrating the engineering design with measurement validation of a multi-rotor SUA, it would be better if the discussion could focus primarily on these studies (at least one more example would be good).

P5-L5 What is the endurance (min) of the UH-AeroSAM with a 3.2 kg payload? What does the current payload weigh, if it's not 3.2 kg, and what is the SUA's endurance with this payload?

P5-L13 Under what conditions is the inlet swapped? How do the two inlet configurations differ and why is it helpful or important?

P6-L15 Are raw data saved (and can they be reprocessed)? Are 16 bins the maximum number of bins?

Fig. 9. This figure is not particularly helpful and could be omitted. A diagram showing how the comparison was conducted might be more helpful.

Table 1. This table also seems unnecessary, seeing as all the information within is repeated in Fig. 10. Delete.

Fig 11b. Most of the data is clustered near the origin on this graph – consider a log/log plot here.

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