Characterizing the performance of a POPS miniaturized optical particle counter when operated on a quadcopter drone, by Liu et al.

Response to Reviewers

We would like to thank the reviewers for their comments on the manuscript. The reviewers raised some interesting and relevant points that we have addressed in our revised manuscript. Our responses are presented in red.

Second Referee

Overall Comments:

This manuscript investigated the performance of POPs on a drone and compared with aerosol microphysics measurements observed at the surface. This study provides a series of methods to quantify the uncertainties of the PNCs and PSD measured onboard a drone. The results from this study provide a good reference to the community when one wants to use the POPS or similar instruments to access aerosol profiling issues. The manuscript is well written in English and content structure. My comments are listed bellows:

Higher wind speed increased measurement error. The author explained that it is caused by the drone suffers from variations in pitch and yaw. It is not clear to the reviewer. If the wind direction is fixed during the flight, how the drone changes pitch and yaw frequently. My personal opinion is that the inlet flow rate of POPS is small, the high speed of horizontal wind causes the measurement uncertainty due to the insufficient inlet flow.

The wind direction is approximately fixed during each flight, but the speed is not. Also, due to the limitation of the power and control system, the drone is hard to keep stable under any violent gusts. But we agree the reviewer's opinion that the inlet flow rate cause uncertainties of the POPS. We added the table and text as follow (L290 – L303):

"The variability in the pitch, yaw and altitude of the drone also impacted the orientation of the inlet of the POPS, which ideally should be perpendicular to the horizontal plane. Variations in the orientation of the inlet led to uncertainties in the sample flow rate. Table 6 shows mean sample flow rates with standard deviation at G_NR, G_R, and FLY for all cases. It is clear that for G_NR, the mean flow rates were constant across all tests and the standard deviation in the flow rates were very low. Comparing with G_NR, the mean sample flow rate and the standard deviation were almost unchanged with for G_R. This shows that operating the rotors alone didn't impact the sample flow rate. However, while the mean flow rate during FLY was identical to G_NR, the standard deviations increased during the FLY stage, particularly for the tests under high windspeeds. The mean value of the standard deviation for low windspeed cases was 0.13, while for the high windspeed cases was 0.21 which may influence the accuracy of the POPS measurements."

We include the following table showing the mean and standard deviation of the sample flow rate

	Surface Wind Speed (m/s)	Sample flow rate (cm ^{3} /s)		
		G_NR	G_R	FLY
T1	0.5	3.04±0.04	3.03±0.04	n/a
T2	2.6	3.04±0.04	3.04±0.05	3.03±0.12
T3	5.7	3.03±0.04	3.03±0.06	3.03±0.20
T4	3.6	3.04±0.04	3.03±0.05	3.03±0.16
T5	6.7	3.02±0.04	3.02±0.04	3.00±0.26
T6	1.5	3.02±0.04	3.03±0.04	3.03±0.15
T7	1	3.03±0.03	3.03±0.05	3.03±0.17
T8	4.1	3.03±0.03	3.03±0.04	2.99±0.28
T9	7.7	3.03±0.04	3.03±0.05	3.02±0.21
T10	n/a	3.02±0.04	3.02±0.04	3.03±0.19
T11	n/a	3.02±0.04	3.02±0.04	3.03±0.22
T12	n/a	3.02±0.03	3.02±0.04	3.04±0.16
T13	n/a	3.02±0.04	3.03±0.04	3.03±0.23
T14	n/a	3.02±0.04	3.02±0.05	3.00±0.17

Table 6. Summary of the sample flow rates of each test flight at three stages. n/a = not applicable. The numbers denoted by ±x represent the standard deviation in the sample flow rates during the measurement time period.

Specific Comments:

In the abstract (line 59), the measurement errors induced from turbulence need to be carefully stated since the authors did not provide turbulence measurement data to support the conclusion.

Here we would like to point out that in our new analysis suggest that the impact of rotors are not significant for the performance of the POPS in our tests. The turbulence caused by rotors has been observed by previous studies (Wen et al., 2019).

Wen, S., Han, J., Ning, Z., Lan, Y., Yin, X., Zhang, J., Ge, Y., 2019. Numerical analysis and validation of spray distributions disturbed by quad-rotor drone wake at different flight speeds. Computers and Electronics in Agriculture 166, 105036.

Introduction: The first paragraph is too long and can be divided into three paragraphs.

We have shortened the instruction and separated it into three paragraphs.

Line 138: please check latlon format.

We rephrase the sentence as following:

"As part of the CLARIFY-2017 and LASIC campaign, the POPS was deployed at the ARM mobile site on Ascension Island located in the mid-Atlantic (7.96° S, 14.37° W) alongside an ARM operated SMPS."

Lines 157-160: not clear to reviewer, rewritten the sentence is needed.

This sentence was superfluous and we have removed it.

Line 278: T14 was marked as red in the table.

This mistake in Table 4 has been corrected.

Lines 250 and 351. The values from what kind of surface measurements should be specified.

We added text as following:

"The close to surface data were collected by the UAV-mounted POPS when the drone was 1-3 meters above the surface."

In Figure 3. The unusual spike values (bad data) may remove from the figure. X-axis label should be improved.

We would like to keep the spikes because they are not bad data. These peaks show the calibration of the instrument. Instead we explain this in the caption:-

"Spikes in the CO data occur at the beginning of each day when the instrument is in calibration mode"

In Figure 5: The dark blue line can be changed as green.

We would like to keep the color because they are friendlier for color blind people.

Table 5: All flights à all cases. The PNC MAD (%) might merge to the same raw of PNC RMSD(%).

Thanks for the suggestion. We choses to keep the MAD and RMSD separate because it provides a clearer analysis of where the errors originate.

Table 6 might present in two tables, same as tables 4&5.

We could, but we prefer to keep them as a single table (now Table 7) to keep the number of tables more manageable. We think that the information presented in the Table is clear enough.