RC1: Anonymous Referee #1

The authors describe a lightweight UAV system for measuring organic aerosol particles and present first vertical measurements from a rural area in southern Germany. The paper is well written and fits within the scope of AMT. However, there are some problems that need to be corrected before the manuscript can be published.

We thank the Anonymous Referee #1 for the supportive review and the constructive comments/suggestions that helped to improve our manuscript. We have carefully revised the manuscript accordingly. Below you will find our point-by-point responses. Reviewer comments and suggestions are written in black, responses in blue. Changes in the manuscript are marked with "".

Major comments

Introduction

Why does the paper only mention vertical profile measurements? UAVs are particularly suited for horizontal measurements, which supply the benefit of scanning areas and understanding emission sources (see literature).

Thank you for this comment. We have now added horizontal measurements to the introduction.

Line 54: "In addition to acquiring vertical profiles, the utilization of UAVs enables measurements to be taken in difficult-to-access areas, such as volcanic plumes, or over larger areas at the same height, helping to characterize emission sources (Karbach et al., 2022; Kuantama et al., 2019)."

Experimental procedures

Have you studied the turbulence of the rotor? Most groups working on aerosol sampling with UAVs use smog experiments to make turbulence visible. The position of your setup is given in the appendix. However, the pictures don't show the dimensions. Please add these dimensions to the pictures or provide a sketch with the dimensions. This is especially important for the distance between the instrument and the rotors. Since the results are very impressive and the effect of turbulence can obviously be neglected, the question is why. After all, the body of the UAV acts as a kind of shield and allows a shielding flow around the UAV? A colored smog test would show this.

Thank you for this comment. We have not conducted any studies for the turbulence of the rotors, as the experiments show no influence of those on the measured concentrations. A study by Crazzolara et al. (2019) (https://doi.org/10.5194/amt-12-1581-2019) for a larger UAV shows that because of the downwash, air mass from up to about 2 m above the UAV can also be collected. This has no significant influence on the trends shown in this study, as the difference between the measurement points is at least 120 m. In addition, we do not expect large concentration differences within a few meters, so mixing in this area should not significantly affect the measured results. A colored smoke test would provide a more comprehensive picture, but we do not think it is necessary in the context of this study. We have included this in the text and added the dimensions to the pictures.

Line 176: “A study by Crazzolara et al. (2019) investigated the airflow around a larger UAV than the one used in this study, using a colored smoke test. Their findings indicated that the air mass within a radius of up to two meters above the UAV can be affected by the downwash from the UAV. This phenomenon is therefore presumed to exert only a negligible influence on the measured concentrations in a mixed atmospheric boundary layer, as is the case with our results.”

Figure 1 shows a schematic of the filter holder. Again, the dimensions are missing. How long is the filter holder? What is the length and diameter of the pump? What is the diameter of the pump inlet? What is the distance from the filter to the pump inlet?

You are right. The dimensions are a relevant factor and should be included in the manuscript. We included them in the schematic of the filter holder (figure 1). The filter holder is approximately 6 cm. The pump measures 2 cm in length, 6.5 cm in diameter, and the inlet diameter is 2 cm. The distance between the filter and the pump inlet is 2.5 cm. The inlet diameter of the pump is now included in the text.

Line 69: “For aerosol sampling, a home-made 3D-printed filter holder (polylactic acid) was connected via a plug to an electric fan motor with an impeller (CDS-R540-QA012; DC 7.2 V; 70 W; inlet diameter 20 mm, SIP Cinderson Motor CO., LTD), which enables high gas flow rates.”

Have you determined the deposition characteristics of your filter holder? What are the diameters of the particles (size range) being filtered? Have you determined the total number of particles you are filtering per volume? What are the particle concentrations in number and mass?

We used the PallflexTM EmfabTM filters TX40HI20WW because they have an attested aerosol retention of 99.95 % for following ASTM D 2986-95A 0.3 µm (DOP) at 32 L/min/100 $cm^2$ of filter media. Therefore, we did not determine the deposition characteristics of the sampler system and assumed a nearly complete deposition of all present particles.

Other parameters that are missing are the down wash distribution, the rotor speed, and the weight of the sampling unit.

We assume that the downwash distribution does not have a significant effect on our measured concentrations, as mentioned in a previous comment. The rotor speed depends on different parameters like wind speed and air temperature, so it is not known. The total weight of the sampling unit is given in line 75 and in line 295, (sampler plus battery: 560 g).

Can you open and close the inlet to your filter assembly or can you turn the pump on and off during the flight to ensure that you are sampling only from the appropriate altitude?

Thank you for this comment. So far we cannot open or close the inlet or turn the pump on during flight. This is planned for future development of the filter system. Currently, we activate the pump on the ground before proceeding directly to the measuring point. This process takes approximately one minute for the 120 m sample and two minutes for the 500 m sample. This introduces some error, but we still collect most of the time at the appropriate altitude, so we don't consider the influence to be significant. We have specified this in the text.

Line 94: “The pump of the collector was activated on the ground, and the UAV was subsequently flown directly to the designated collection height. This process typically required between one and two minutes to complete.”

Electronic circuits and the schematic structure of the measuring unit are also missing. If software was used for the control system, this must also be specified in the appendix.

Thank you for this comment. Since the pump's motor was only connected to a battery by a plug, we don't think it's necessary to provide an electronic circuit. This is now more clearly stated in the

text. Figure 1 shows the schematic structure of the system. It was no software used to control the system.

Line 69: “For aerosol sampling, a home-made 3D-printed filter holder (polylactic acid) was connected to an electric fan motor with an impeller (CDS-R540-QA012; DC 7.2 V; 70 W; inlet diameter 20 mm, SIP Cinderson Motor CO., LTD), which enables high gas flow rates. The electric fan motor is directly plugged into the outlet ports of the battery.”

Results and Conclusions

The manuscript presents an impressive proof of concept. The results are robust and in line with expectations for the measurement situation. However, more information on the setup is needed to evaluate the errors.

Thank you for your supportive comment. We changed the text in accordance with the earlier comments. It now hopefully contains enough details to better evaluate possible errors.

Minor comment

“UAV” is the common term. You could use "UAV" instead of "drone".

Thank you for your comment. We have reviewed the manuscript and changed this accordingly. (Lines: 2, 13, 17, 53, 54, 56, 62, 75, 88, 89, 93, 94, 96, 98, 138, 156, 161, 162, 163, 174, 175, 176, 177, 178, 183, 188, 291, 295, 297, 297, 298, 299, 300, 319, 321 and 327. As well as in the supplement in lines: 3, 10, 12, 12, 13, 14, 15, 23, 57, 75, 80 and 84)