1 RC1: 'Comment on amt-2022-269', Anonymous Referee 2, 20 Oct 2022

Q1: Was any additional housing applied for the OPC to protect it against humidity or rain? Was it lying down on the roof of the building, or on any platform above the roof? If yes how much height above the roof surface? Can you present any photos of the devices set up?

A1: At the rooftop of the Faculty of Physics is located Radiation Transfer Laboratory where are conducted measurements of the optical and microphysical properties of atmospheric aerosols and clouds, as well as components of radiation fluxes and sensible and latent heat fluxes at the Earth's surface. Some devices, as Oxford Laser shadowgraph, are mounted just for a period of time, in this case for two months as the shadowgraph has a waterproof case. The OPC-N3 was mounted next to it just in the case of high probability of fog events without any protection. The picture of both devices mounted at Radiation Transfer Laboratory will be added. The Section "Data acquisition" was expanded by adding information about Radiation Transfer Laboratory.

Q2: In table 2, in the text it is written that OPC sampling was 10 s, then averaged up to 1 minute, in the table it is 1 minute sampling time, please make it consistent.

A2: Yes, I will correct in the table.

Q3: Equation 3, please check if all variables are explained, what is pix^2, is i here another variable or just index?

A3: Yes, We will add missing information. The Section "ShadowGraph" was extended and the Section "ShadowGraph depth-of-field" was rewritten to better explain all the parameters used.

Q4: Why there was double averaging applied? Why not straight average from 10s to 10 minutes? Please elaborate on how it would change if you would calculate it from 10 s, which was as far as I understood, basic sampling time.

A4: There is no difference in making an average first to 10s and next to 10 minutes, the standard deviation does not change. For clearer reading, it will be corrected that the average will be done right away to 10 minutes. In the Section "Scope of compliance between OPC-N3 and ShadowGraph" was added information why we used averaging to 1 hour.

Q5: How uncertainty would change if you also consider Poisson statistics which represents a random error in the measurements?

A5: We have performed measurements to consider how big the impact will have on uncertainty the Poisson statistics. In Fig. A and Fig B are shown the values of errors for OPC-N3 and for ShadowGraph. The x axis in both figures represents the value for which the uncertainty was calculated and the y axis the uncertainty value. The plot represents how big the impact on total uncertainty has Poisson statistics. Error derived from Poisson statistics gives a greater contribution to the overall uncertainty for cases where a small number of droplets were counted. In the revised manuscript, the contribution to the overall uncertainty from Poisson statistics will be taken into account.

Q6:What was the reason to do the 1 hour averaging? Why not 0.5h or 2 hours? It should be elaborated, how was it representative?

A6: ShadowGraph in one hour sample 1000 cm^3 of air. One run of Shadowgraph was 10 minutes. Making plots every hour allows for receiving a smooth droplet size distribution spectrum from this device. The minimum averaging time was chosen with a smooth spectrum to observe the dynamics of fog.

Q7: Is it 2:00:59 – 3:01:07 really an hour or a little bit more? I understand it is a minor issue, but it just looks strange.

A7: The ShadowGraph collects the data in intervals of 10 minutes, between one run and another, there is a small brake 1-2 seconds for writing the files. As there is a small interval between runs, therefore, the two runes from the first ten minutes of the instrument's operation at the hour do not fall out equally in time. Each plot was made by averaging data from 6 runs of ShadowGraph which gives one hour.

Q8: How it differs from other periods? Can authors present the temporal evolution of droplet size distribution for all sampling periods (at least in the appendix)? The authors should explain to the readers why the analyzed period and later case study in section 4.1 was better than the rest of the time series.

A8: The case of fog from 16-17 November 2020 was chosen for a longer description as it was was the longest period of fog event registered during this study. Other cases of duration between 50 minutes up to 230 minutes. As ShadowGraph samples a small amount of air, making a smooth DSD spectrum is possible from the data aggregated in one hour. For other cases of fog occurrence, it would give 1-3 plots, which wouldn't allow to show the evolution of the fog case. In Section "Case study" was added information why we choose to analyse only the case from November 16-17,2020 in detail.

Q9: Authors with good results applied the Refractive Index correction. Please elucidate if all data presented are based on RIOPC or RIwater because it is not clear to me. Can you present any figure on how the correction influenced the measurements (at least in the appendix)?

A9: During the study we have checked if making a correction of Refractive Index to the data obtained from OPC-N3 would improve the results. The obtained results are inconclusive if the correction improves the data. The RI correction shifts the droplets measured by OPC-N3 to higher values, this improves the LWC comparison. However, the spectra of ShadowGraph and OPC-N3 are

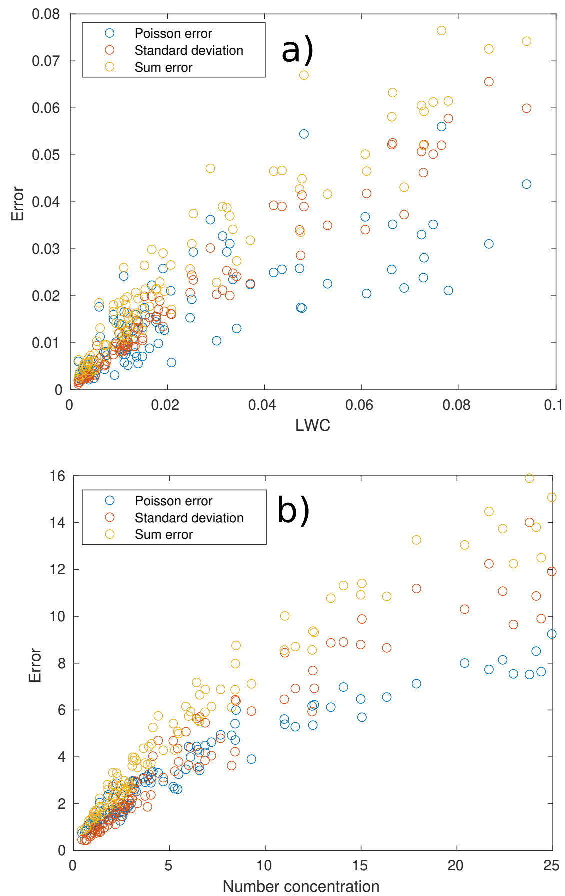

Figure 1: The figure shows the dependence of the error on the measured value from OPC-N3. Colors markthe contribution of the error from the Poisson statistics (blue) and the measurement uncertainty (orange), the total measurement error is shown in yellow. In Fig. a) the uncertainty was calculated for LWC on b) number concentration.

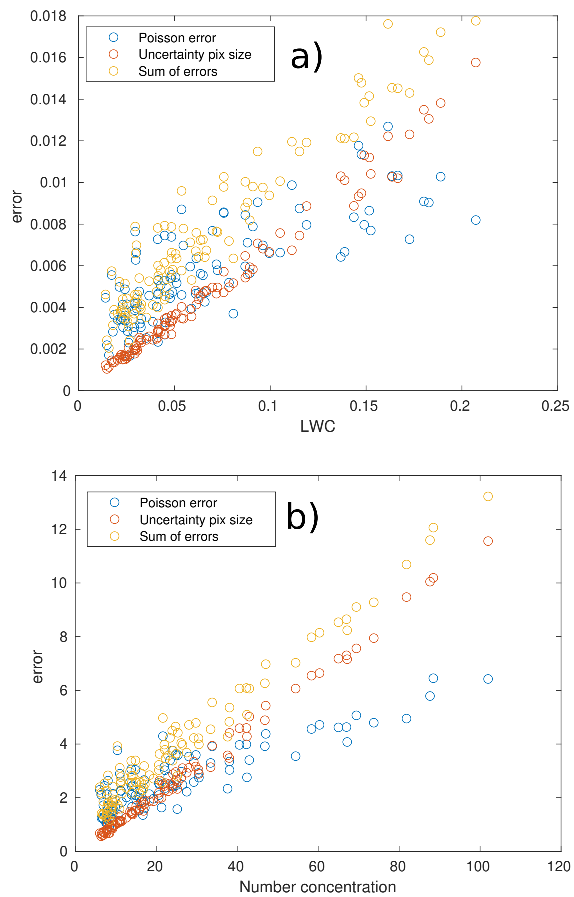

Figure 2: The figure shows the dependence of the error on the measured value from ShadowGraph. Colors markthe contribution of the error from the Poisson statistics (blue) and the measurement uncertainty (orange), the total measurement error is shown in yellow. In Fig. a) the uncertainty was calculated for LWC on b) number concentration.

less compatible. In the manual, it is not well described how OPC-N3 converts the light scattering to droplet radii. The procedure can be not straight forward Mie Theory. Therefore, applying the correction does not improve the data so well. In the whole article, the standard (assumed by the manufacturer RI_{OPC} was used). The appendix was added explaining the RI correction, the analysis for RI_{water} is shown.

Q10: Is it possible to apply any correction function for all factors influencing the OPC measurements (internal temperature, humidity, refractive index)??

A10: Internal temperature and humidity are not just shifted in comparison to ambient values, those factors are influenced, for example, by sun heating of the device. It can be seen from Figure 2 that internal temperature and humidity had a rapid change after sunrise. The refractive index correction is explained in the appendix which we added in the revised manuscript.

2 RC2: 'Comment on amt-2022-269', Anonymous Referee 1, 01 Dec 2022

Q1: General

A1: We suggest in the manuscript the usage of OPC-N3 as a drone device for fog measurements. However, as the main purpose of OPC-N3 is for PM measurements, our goal of this article was to show that OPC-N3 can be used to detect fog particles. This article focuses on the comparison of OPC-N3 with OLV. We have used OPC-N3 for making vertical profiles of fog, however, before it's publication we wanted to make the first article showing that OPC-N3 is possible to detect fog droplets.

Q2: Language and citations

A2: The referee suggested some changes of the sentence structure and additional citations which was done. Additionally, the text was sent to the language correction.

Q3: Article structure

A3: The referee suggested to change the article structure. The section "Instruments and methods can be divided into two separate sections. The proposition of the referee was to discuss the results as a case of light fog and heavy fog case. The article focuses on the calibration of OPC-N3 in all cases of fog measurements, and the calibration is done with the reference device OLV. During the measurements, only one case which is described in the manuscript, was longer than two hours and allowed for case analysing. Therefore, we would like to maintain the current structure of this paragraph. The conclusions were rewritten in the form of bullets for better reading as referee suggested. Instrumentation and Methods Section was divided into two sections, one describing "Instruments" and second one describing the "Methods".

Q4: Why OPC-N3 measurements wrong? Why OLV is seeing 3 times more Nc than OPC-N3?

A4: OPC-N3 is a cheap optical counter. The manufacturer does not provide clear information about: - processing of the data (how light scattering is changed to the radius of droplets); - how OPC-N3 is built inside; - how is measured, the sampling volume, and how this is affected by the speed of the fan. Without that information, it is hard to determine why OPC-N3 is detecting fewer droplets in comparison with OLV. We have come up with several possible scenarios in which the observations may be underestimated. Processing of the data - for example, assuming one RI for all particles - can lead to wrong droplet assignment to specific radii leading to lowering LWC. The fan speed forces the flow in OPC-N3 and changes in time. Therefore, the data are corrected by the manufacturer to take this effect into account, however there may be some bias which leads to a systematic lowering of the number concentration of droplets. The air is sucked into the OPC-N3 through a narrow inlet, inside we suppose the flow has no special path and expands throughout the whole device. This can affect the concentration of droplets in OPC-N3. Electronics inside OPC-N3 heats the surrounding which can lead to the arise of temperature and lowering humidity (see Section 2.4.2 and Fig. 2) and result in evaporation of droplets. In the "Conclusions" we have added several possibilities why the OPC-N3 measurements are underestimated.

Q5: Why OVL taken as reference?

A5: OVL is a high quality device which provides particle and droplet sizing measurements in real-time. It was used for droplet characterisation in clouds giving good results. OVL is waterproof, which allows for installation in our rooftop laboratory.

Q6: Why in table 3 the upper limit is different? Why has measurements more than 20 micron? Data available but company did not say?

A6: The manufacturer of OPC-N3 provides information that the upper limit of the last bin is 20 microns. Big droplets of radius 19 microns are rare, however, when the number of droplets is multiplied by its density, it can be seen that the spectrum of mass has an abrupt peak in the last bin of OPC-N3 (Figure 1 upper panel). By consulting with Alphasense, it was obtained information that indeed the last bin can count also bigger droplets, however, as usually OPC-N3 is used for PM calculations and such big aerosols are not often, for PM calculation the assumption of upper limit as 20 micros is sufficient. Therefore, the upper limit of the last bin of OPC-N3 was chosen arbitrary and it can measure droplets higher than 20 microns. That is why in Section 2.4.1 (Scope of compliance between OPC-N3 and ShadowGraph), based on data from ShadowGraph, we estimated that the last bin of OPC-N3 can calculate the droplets up to 25.02

microns.

Q7: Fig. 07: Why OPC-N3 measures more LWC than OLV

A7: The OPC-N3 vDSD is smaller than from OLV. The plots consist of two scales, the scale for OPC-N3 is on the right side - orange, and is in a lower range than the scale for OLV (left, blue scale).