Dear Editor,

Thank you for agreeing to consider a revision of our manuscript "The Aerosol Research Observation Station (AEROS)". We modified and revised the manuscript to address the editor and reviewer 2 comments and suggestions. We would like to thank the anonymous reviewers and many thanks to you for your time and efforts with this revision.

In line with the comments and suggestions, we revised the manuscript and made the requested additions and changes. Below are all the comments (in bold) followed by the replies. The parts that are in italic are corrections that are included in the revised version of the paper:

Sincerely,
Karin Ardon-Dryer

Comments to the author:
Thanks very much for your revisions in response to the reviewers, which I hope you agree have resulted in an improved manuscript. I'd like to see one more round of revisions, with further changes in response to the second round of comments. In addition, I have a few comments below that I'd like to see addressed. I will quickly review the revised manuscript without returning it to the reviewers.

Thanks for this nice contribution that highlights the need for improved coarse-mode on-line particle monitoring.

Line 16. What is meant by "provided a similar range (within a factor of three)"? Does this mean the instruments agree over their overlapping size ranges within a factor of three? Please be specific and quantitative.

Baes on the editor's comment we rewrote these sentences to explain them better
This article provides a description of AEROS as well as an intercomparison of the different instruments using laboratory and atmospheric particles. Instruments used in AEROS measured similar number concentration with an average difference of 2 ± 3 cm^{-1} (OPS and Grimm 11-D using similar particle size ranges) and similar mass concentration, with an average difference of 8 ± 3.6 µg m^{-3} for different PM sizes between the three instruments.

Line 17. What is meant by "show compatibility for comparison of number concentration and size distribution"? Compatibility could mean different things to different people. Please be specific with your terminology.

We change the sentence to clarify it
Grimm 11-D and OPS had similar number concentration and size distribution, using similar particle size range, and similar PM_{10} concentrations (mass of particles with an aerodynamic diameter of <10 µm).

Line 12. Please state the size range covered by these three sensors.

Changes were made to the sentence to reflect this comment.
The Aerosol Research Observation Station (AEROS) was designed to continuously measure these particles' mass concentrations (PM_1, $PM_{2.5}$, PM_4, and PM_{10}) and number concentrations (0.25 – 35.15 μm) using three optical particle sensors (Grimm 11-D, OPS, and DustTrak) to better understand the impact of dust events on local air quality.

Line 71. The sentence beginning "Therefore" is a run-on with two "therefores" and needs to be split into two sentences.

The sentence was split into two we also change the use of the word, therefore.
Therefore, routine, and long-term measurements are required for comprehensive monitoring of diverse pollution events in this region, including dust events (Tong et al., 2012; Mahowald et al., 2014). Hence, there is a need to monitor particle mass concentrations (of various PM sizes) and size distribution to understand how they change under distinct metrological and pollution conditions.

Line 95. "filter substrates".
Changes were made

Line 110. Please make it clear that each instrument has its own separate inlet in tube. What is the total flow rate through each of the tubes?

We added a sentence that will provide that information
Each inlet is connected to a different instrument, the flow in each inlet varies based on the instrument used (1.0 or 1.2 L min^{-1}).

Line 170. Please use consistent units of cm^-3 instead mixing with L^-1. It's not common practice to use the "#" symbol for number, just say "cm^-3", and nomenclature consistency is important given the international readership of AMT.

We apologize, we delete the use of L^{-1} to define particle concentrations, we also remove the sign # from the text and the figures.

Line 199. The dryers remove water from the particles by reducing the RH of the surrounding air. They do not impede hygroscopic growth.

Changes were made to the sentence to reflect this comment
The dryers remove water from the particles by reducing the relative humidity from the surrounding air, relative humidity after the dryer is low (24 ± 0.5%).

Line 2014. Change "measure" to "measures".
We change the word "measure" to "measures".
Line 220. "Diverse monodisperse" is an odd phrase. Perhaps "three monodisperse polystyrene sphere particle sizes"?

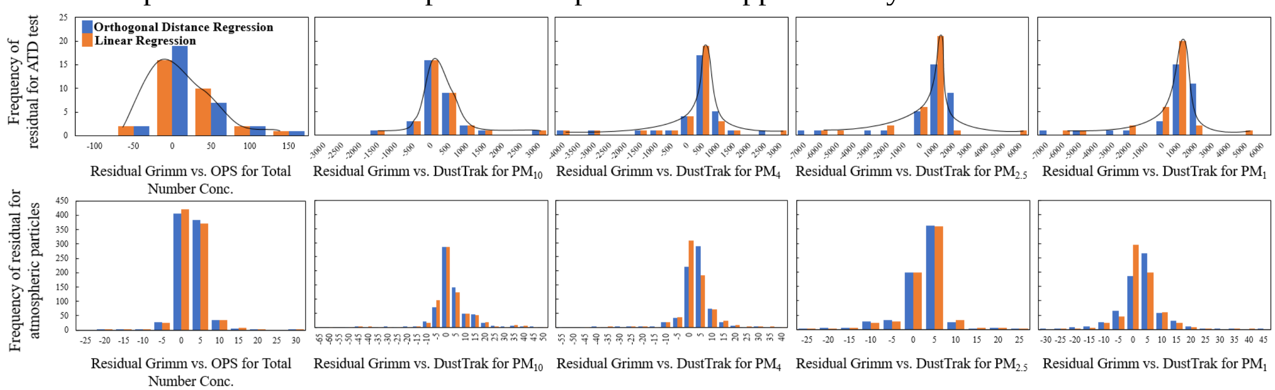
Changes were made as suggested by the editor.

Line 221-223. This is a run-on sentence. Please split into two sentences.
Changes were made as suggested by the editor.

Line 230. Change to "Brechtel".
Changes were made as suggested by the editor.

Lines 242-248. When there are uncertainties in both the x and y parameters, it is best to use a two-sided linear regression (e.g., orthogonal distance regression) to determine slope and intercept and associated errors. Were these regressions performed using standard least-squares linear regression? Is R^2 the square of the Pearson correlation coefficient? Would it be possible to repeat using ODR regression?

The analysis in the paper was based on regular regression based on standard least-squares linear regression, we add that information to the paper manuscript. We also calculated the Pearson correlation coefficient and added that information to the supplement. We believe our use of linear regression was fine since the residual for both laboratory and atmospheric comparison (see fig below in orange) were of normal distribution. Regardless as suggested by the editor, we perform a new analysis based on the orthogonal distance regression (ODR) and added information of slop and Intercepts to each of the comparisons as part of the supplementary section.



Comparison of residuals of linear regression (orange; black line highlights the distribution) and orthogonal distance regression (blue) showing residual distribution for both comparison of ATD (upper panner) and atmospheric particles (lower panel).

The following information was added to the revised manuscript

To evaluate the similarities and differences of the three instruments (or locations), a set of calculations and comparisons was performed using MATLAB and Excel. The evaluation and comparisons were based on R-squared (R^2), root-mean-square error (RMSE), and mean absolute error (MAE) values as well as the best fit information (including the slope and intercept), and Pearson correlation coefficient based on linear regression (standard least-squares linear regression). *Additional evaluation based on orthogonal distance regression was made using R.*

Full information on the statistics based on linear regression of each comparison including R^2, RMSE, and MAE, slope, intercepts, the number of parallel measurements, Pearson correlation *coefficient value as well as slop and intercepts based on orthogonal distance regression can be found in Table S1.*

Additional information of each composition including averaged and SD, median, mode, 10th, and 90th percentile values can be found in Table S2.

Table S1: Statistics for laboratory intercomparison of aerosol instrumentation using ATD particles based on linear regression

Variable	Instrument used		AVE ± SD		N	Based on linear regression							Based on ODR	
						R^2	RMSE	MAE	Slope	Inter	PCC	*P* values	Slope	Inter
Total Count	OPS	Grimm 11-D	441 ± 210	505 ± 243	31	0.97	43	29	1.1	3.6	0.984	1.0	1.2	-6.2
PM_{10}	Grimm 11-D	DustTrak	9401 ± 20065	6050 ± 12866	33	1	721	378	0.6	32	0.998	0.9	18.6	-2926
PM_4	Grimm 11-D	DustTrak	5092 ± 7983	2161 ± 5758	33	0.95	1214	7098	0.7	-1427	0.977	0.9	0.7	-1484
$PM_{2.5}$	Grimm 11-D	DustTrak	1904 ± 2325	1458 ± 5194	33	0.85	2005	11888	2.1	-2455	0.920	1.0	2.4	-3044
PM_1	Grimm 11-D	DustTrak	219 ± 296	1162 ± 5123	33	0.86	1894	1152	16	-2352	0.927	1.0	0.6	25.8

AVE± SD - Average ± standard deviation, N - Number of parallel measurements (min), RMSE - Root-mean-square error, MAE - Mean absolute error, Inter- Intercepts, PCC- a value of Pearson correlation coefficient, *P* values based on one-way ANOVA and ODR-orthogonal distance regression. Total Count in cm^{-3} and PM values in $\mu g\ m^{-3}$.

Table S2: Statistics of an intercomparison of AEROS instrumentation hourly measurements during March-May 2019

Variable	Instrument used		N	AVE ± SD		Median		Mode		Standard Error		10th percentile values		90th percentile values		PCC	ODR Slope	ODR Inter
Total Count	OPS	Grimm 11-D	892	22.7 ± 24.5	21.9 ± 23.8	14.4	13.8	NA	NA	0.8	0.8	5.1	4.7	51.4	50.0	0.989	1.0	0.2
PM_{10}	OPS	Grimm 11-D	867	11.5 ± 14.9	20.3 ± 23.8	7.8	14.9	NA	5.7	0.5	0.8	3.4	7.0	19.6	34.3	0.975	0.6	-1.1
PM_{10}	OPS	DustTrak	348	26.7 ± 84.9	21.2 ± 53.2	9.7	10.7	NA	6.7	4.6	2.9	4.3	6.0	26.6	23.0	0.889	0.6	5.3
PM_{10}	Grimm 11-D	DustTrak	671	26.3 ± 29.3	17.1 ± 17.1	18.6	12.0	4.1	5.0	1.1	0.7	6.3	4.1	45.4	33.9	0.786	0.5	3.6
PM_4	Grimm 11-D	DustTrak	671	17.1 ± 15.9	14.3 ± 14.8	13.3	9.2	7.5	2.0	0.6	0.6	4.9	3.3	29.6	29.8	0.853	0.9	-1.4
$PM_{2.5}$	Grimm 11-D	DustTrak	671	11.2 ± 9.3	13.6 ± 14.1	8.3	8.7	4.9	5.0	0.4	0.5	3.4	3.0	21.9	28.5	0.927	1.6	-4.0
PM_1	Grimm 11-D	DustTrak	671	7.7 ± 6.9	13.0 ± 13.4	4.8	8.3	1.5	2.0	0.3	0.5	1.7	3.0	17.1	27.4	0.863	2.1	-3.4

N - Number of parallel measurements (min), AVE± SD - Average ± standard deviation, PCC- a value of Pearson correlation coefficient. Total Count in cm^{-3} and PM values in $\mu g\ m^{-3}$. Slop and Inter (Intercepts) based on orthogonal distance regression (ODR).

Line 268. The peak in the smallest bin when using the 0.95 µm PSL is probably due to the surfactant the manufacturer adds to the PSL mix. This surfactant helps keep the spheres from clumping together during storage, and often produce a tail of small particles. So I wouldn't describe this as "contamination", but "an artifact likely caused by surfactant within the PSL solution".

We thank the editor for this information we were unaware of this issue, and we could not find such information on the PSL manufacture website. Per the editor's suggestion, we modify the sentence.

The following information was added to the revised manuscript:
We suspected that high concentrations of small particles detected in this PSL solution were due to an artifact caused by the surfactant used in the PSL solution. The surfactant is added by the manufacturer to help keep the spheres PSL from clumping together during storage but often can produce a tail of small particles.

Line 287. Change to "(R^2=0.97)". The minus sign is a little confusing.
Changes were made as suggested by the editor.

Lines 320-327. The standard deviations are larger than the mean values. This suggests that the probability distribution of the measurements is not normally distributed, and that means and standard deviations are not an appropriate way to statistically describe the data. If there is a long tail, a logarithmic transformation of the data might be appropriate. Alternatively, you could provide medians and 10th and 90th percentile values along with the mean and SD.

The distribution measured was not normally distributed, the value represented differences between values measured by the different instruments (e.g., Grimm 11-D compared to DustTrak). Per the editor's comment, we added a new table to the supplementary section that contains additional information including Median, Mode, Standard Error, 10th, and 90^{th} percentile values, PCC- a value of Pearson correlation coefficient, and Slop and Inter (Intercepts) based on orthogonal distance regression (ODR).

The following information was added to the revised manuscript:
Additional information of each composition including averaged and SD, median, mode, 10th, and 90th percentile values can be found in Table S2.

Table S2: Statistics of an intercomparison of AEROS instrumentation hourly measurements during March-May 2019

Variable	Instrument used		N	AVE ± SD		Median		Mode		Standard Error		10th percentile values		90th percentile values		PCC	ODR Slope	ODR Inter
Total Count	OPS	Grimm 11-D	892	22.7 ± 24.5	21.9 ± 23.8	14.4	13.8	NA	NA	0.8	0.8	5.1	4.7	51.4	50.0	0.989	1.0	0.2
PM_{10}	OPS	Grimm 11-D	867	11.5 ± 14.9	20.3 ± 23.8	7.8	14.9	NA	5.7	0.5	0.8	3.4	7.0	19.6	34.3	0.975	0.6	-1.1
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PM_{10}	Grimm 11-D	DustTrak	671	26.3 ± 29.3	17.1 ± 17.1	18.6	12.0	4.1	5.0	1.1	0.7	6.3	4.1	45.4	33.9	0.786	0.5	3.6
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N - Number of parallel measurements (min), AVE± SD - Average ± standard deviation, PCC- a value of Pearson correlation coefficient. Total Count in cm^{-3} and PM values in $\mu g\ m^{-3}$. Slop and Inter (Intercepts) based on orthogonal distance regression (ODR).

Fig. 5. "Concertation" typo in panel I.
Changes were made as suggested by the editor.

Fig. 7. It would be really interesting to see the number size distribution (panel C) converted to volume and plotted. There will be huge differences in the coarse mode (>1 µm), and volume is proportional to mass, which (in the form of PM10) is the main focus of this manuscript.

Changes were made as suggested by the editor volume size distribution for each of the three events were added to figure 7

The following information was added to the revised manuscript:

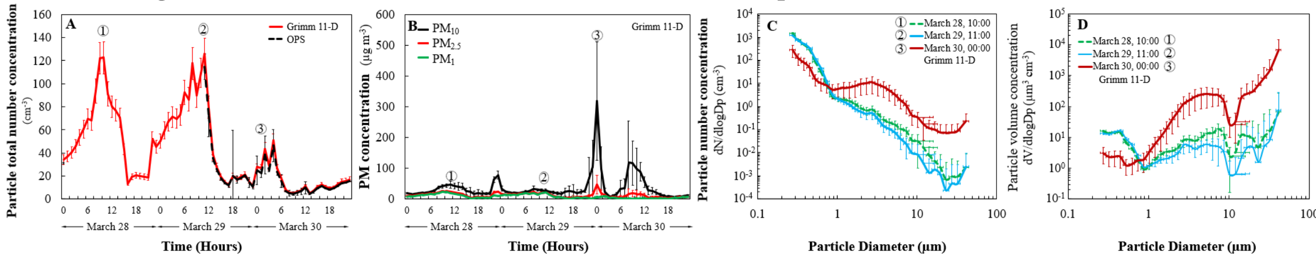

Figure 7. Measurements (hourly average) of total particle number concentration using OPS in black and Grimm 11-D, in red (A), measurements of PM mass concentration from Grimm 11-D (B), and particle number size distribution (C) and volume size distribution (D) of optical diameter using Grimm 11-D for March 28 - 30, 2019. The numbers on the plots represent different events (1 and 2 for the haze events and 3 for the dust event). Error bars represent SD values of hourly measurements.

Reviewer 2

The quality of the manuscript has improved but I still have a few questions and comments:
1) Line 170: The Grimm 11-D can measure number concentrations of up to 5 300 000 particles/L without coincidence losses (not 53 000 000 particles/L as stated in the text).

We check again using the most updated Grimm 11-D manual below (Portable Aerosol Spectrometer MODEL 11-D manual,2022), and the number concertation can reach 3.000.000 L^{-1}. We believe the 5 300 000 particles/L we wrote based on the comment and suggestion from reviewer 1comments was a mistake. The manual indicates the following *Number concentration 0 - 3.000.000 particle/Liter*, see image below. Reviewer 1 suggested this change based on information from the brochure (see image below), but we check again, and the number was changed in the manuscript accordingly to represent the correct number concertation up to 3,000 cm^{-3}.

Information from Manual   Number concentration   0 – 3.000.000 particel/Liter

Information from brochure

Particle number	0 … 5 300 000 particles/liter

The following information was added to the revised manuscript:
while number concentration can reach up to 3,000 cm^{-3}.

2) Maybe I have missed something but I still do not understand Figure 7. Figure 7C shows that the particle number concentration in the size bin 0.25-0.3 µm is as high as 1000 cm-3. So how can it be that the total number concentration in Figure 7A is one to two orders of magnitude lower? To calculate the total number concentration, shouldn't you calculate the cumulative counts in all size bins and then divide by the sampled volume? In Figure 7A, the concentration is sometimes as low as 5 cm-3. To achieve such low concentration in our lab (clean-room conditions), we need to filter the air. I cannot see how the concentration can be so low outdoors.

The reviewer might think we are using small particle sizes. The smallest particle detected by our instrument is 0.253 µm sizes. To explain the values measured from total count (Fig 7A) to concentration (dN/dlogDp) in Fig 7C we provide the following explanation. The calculation for $dN/dlogD_p$ is based on the eq. $dN/dlogDp = \frac{dN}{\log D_{P,u} - og D_{P,l}}$ where dN is the particle concentration Dp is the midpoint particle diameter $D_{p,u}$ is the upper channel diameter, and $D_{p,l}$ is the lower channel diameter. Therefore, if the particle concentration at the first size bin (0.253-0.298 µm) on March 28 at 10 am was 105.38 cm^{-3} calculation of $dN/dlogD_p$ for this bin size will be $\frac{105.38}{\log(0.298) - \log(0.253)} = 1482.3$

We believe when the reviewer refers to a clean room, he is referring to different particle sizes. In this case, the lowest particle number concentration was measured on March 30, with an hourly total number concentration of 5.2 ± 0.5 cm^{-3}. This day was a Saturday, and we expected such low concentration since very few cars normally enter the campus on weekend days. This area is relatively clean and the measurements we receive show that. These concentrations will vary per indoor/outdoor condition but most importantly it will be based on the particle sizes measured. We believe that if we used instruments that detect smaller particles (e.g., SMPS, CPC) our TOTAL concentration would have been much higher.

3) Depending on the meteorological conditions I suspect that the total particle number concentration can at times exceed the upper limit of the TSI OPS and Grimm 11-D (3'000 cm-3 and 5'300 cm-3, respectively).

We check again the most updated Grimm 11-D manual, and the concertation can reach number concentration up to 3.000.000 L^{-1}. It is possible to reach such a high concentration probably under very extreme pollution conditions, but from our experience so far, we have not experienced such behaviors. This area is rural and very clean overall (until we get a dust event). To emphasize it, in a recent work (Kelley et al., 2020) we analyzed the $PM_{2.5}$ values in this region over ~20 years and found that the daily values were below 10 µg m^{-3}

Have you considered adding a dilution unit upstream of these two instruments to avoid coincidence losses?

We have been considering that option, it's a budget issue, but overall, we believe a dilution method is not a must for AEROS as we have not reached that high total concentration yet, and most air quality in our region is low until we get a dust event.

Reference used in this document

Portable Aerosol Spectrometer MODEL 11-D manual,2022

Kelley, M. C., Brown, M. M., Fedler, C. B., and Ardon-Dryer, K.: Long-term Measurements of PM2.5 Concentrations in Lubbock, Texas, Aerosol Air Qual. Res., 20, 1306-1318, https://doi.org/10.4209/aaqr.2019.09.0469, 2020.