Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC3
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Comment on amt-2021-270

Anonymous Referee #2

Referee comment on "The Aerosol Research Observation Station (AEROS)" by Karin Ardon-Dryer et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-270-RC3, 2021

Review of Ardon-Dryer et al., “The Aerosol Research Observation Station”

This manuscript provides a description and instrument performance evaluation for a new aerosol research station established in Lubbock, TX. The addition of these measurements is an important contribution to understanding aerosol sources and characterizing their physical properties in the region. Because Lubbock is in an area that is exposed to major dust events, these data will also help characterize dust properties of the region, measurements that are currently lacking. The authors did a nice job of organizing and describing the aerosol station and instrumental design. However, I have concerns and questions regarding the comparisons between instruments. Because of the large differences observed, it would be helpful if a reference PM2.5 and/or PM10 monitor could be incorporated as part of the instrumental design. I recommend publication after addressing these questions in the comments below.

Comments

Line 8: Include “mass” before “particles”, as PM2.5 (or PM10) refers to the mass of particles with aerodynamic sizes less than a given size.

Line 11: include either “number” or “mass” concentration within “these particle concentrations”. Mostly likely this would be “number” given the measurements.

Line 13: Consider providing additional information regarding the “three instruments used”. Perhaps, ‘the three optical particle sizers used’.

Line 15: Add either “mass” or “number” with “similar concentration measurement”. Also, it would help to provide some quantifying information here besides “similar”. Within a factor of 10?, typical biaes?, etc.

Line 17: It would also be helpful to indicate how these different episodes are distinguished- in this case by size distribution (not composition for example).

Line 20: Similar to earlier comment, include “mass concentrations of” after “representing” particles to indicate that PM10 data refer to mass concentrations.

Line 35: Also, it might be complete to also include EPA’s Chemical Speciation Network in this description as it is also a long-term US aerosol monitoring network, similar to IMPROVE but located in urban/suburban settings.

Line 46: Include “are” before “gaining”

Line 103: Have any studies been performed to actually characterize the losses in the lines? Have losses been calculated based on theoretical calculations?

Line 119: Include “number” between “particle” and “concentration”

Line 122: Some work in SW Texas might help inform as to the range of refractive indices and densities in the region (Hand and Kreidenweis, Aerosol Sci and Tech, 36, 1012-1026, 2002) during pollution and dust events.

Line 131: Note that here and several places in the paper the units are in error. Mass units are ug/m3 and number concentration are #/cc or #/cm3. I suggest looking closely at all instances of units in the paper to confirm. With respect to number concentrations, I suggest choosing one notation and keeping with it for the entire paper.

Line 183: Include “number” before “concentration”

Line 195: What sizes of PSL are used for calibration? I think it is important to expand on these results if possible. The role of refractive index on reporting optical particle sizing data has been reported extensively in the literature and can significantly influence the results if a refractive index calibration isn't applied. Laboratory generated aerosol of known composition (ammonium sulfate, for example), in addition to Arizona test dust, can help provide uncertainties due to not accounting for varying refractive index.

Line 230: Here and throughout the manuscript, I have questions regarding how mass concentrations were calculated from the number concentration data. Was a constant density assumed? These instruments measure optical size, so converting the data to mass concentration would suggest the optical sizes were converted to aerodynamic sizes to get the PM size range reported? More details regarding these conversions is necessary. It would also be helpful to show these comparisons in linear-linear plots, because some significant biases appear to be observed between these instruments, even for this known calibration aerosol. It might useful to provide slopes and intercepts so that the multiplicative and additive artifacts can be identified. A ratio of the total number concentration of one instrument to the other would be helpful because these log-log plots makes it difficult to assess performance between instruments. How were error bars determined on the size distribution plots? What errors do they incorporate? Why do they not appear symmetric?

Line 263: Again, for Figure 4a and Figure 5 for mass comparisons, what density was used to convert number size distribution data to mass concentrations and how were optical sizes converted to aerodynamic sizes for the PM1, PM4, etc. comparisons?

Line 281: What two instruments are being compared with the two averages reported? Are these the AEROS instruments to the TCEQ?

Line 294: Figure 5I shows number concentrations but average mass concentrations are listed here? Also, what is the experimental uncertainty of these instruments (are these differences within experimental uncertainty?)

Line 301: Can the authors provide more discussion about how particles may be "interpreted slightly differently" regarding these comparisons? It seems that understanding how and why the instruments are interpreting particles differently, especially since these are both optical measurements, would be important to understanding future measurements.

Line 303: It would also be helpful to report intercepts from these linear regression as they are indicative of additive biases.

Figure 303: Can the authors comment on the two different apparent subsets of data for

the Figure I number concentrations? It appears 2 populations of data exist, one with fairly good agreement with 1:1 line and one with a multiplicative bias. Can the authors comment on why the shift? Was there a shift in calibration?

Line 319: Can the authors expand on the intention for these additional comparisons? Were they testing the role of RH, height above ground? How can these various impacts be separated in the comparison? Was RH measured (or considered from met data) for the instruments with no RH control?

Line 324: Wouldn't these particles (kicked up from sidewalk) generally be larger than accumulation mode particles measured less than 0.5 um?

Line 335: Can the authors expand regarding the "range of difference between the two instruments"? Is this with respect to the comparisons with ATD or experimental uncertainties?

Line 342: Can the authors comment regarding why the instruments outside the shed (Figure 6c) are consistently biased low for all size ranges? And the opposite is true for the Dusttrak at ground level? And can the authors comment on how error bars were calculated for these figure?

Line 354: Is this site also influenced by biomass smoke?

Line 358: How was visibility assessed?

Line 365: What did the TCEQ report for these periods?

Line 369: Emissions will also largely influence the differences between haze events China and Texas.

Line 405: Can the authors describe how error bars are calculated for number concentrations (figure 7c) and why they are not symmetric around the value?

Line 415: This adds to my confusion regarding how the authors converted their optical data to mass data?

References:

I don’t know how picky the journal will be, but some of the references don’t include DOI’s.

Figures

Figure 1: The map quality is quite poor. The words on the Figure are hard to read. Define “NWS station”, “TCEQ” and “HI” for reader who would have to flip back through the text. I assume the gray section of the tiny Texas map is the Southern High Plains? It would help to define. Also, label the instruments in the second photo.

Figure 2: Define “ATD” and “PRIZE” in the caption.

Figure 4: These figures are very difficult to read. Can they be created in color?

Figure 5: Typo for “slope” as “slop” in the figures.

Figure 7: Can these figures be created in color? They are quite hard to read. Figure B: What are the instruments used in this figure?