

## Referee #1

Review for Development and Application of a United States wide correction for PM2.5 data collected with the PurpleAir sensor

Overall, the paper is well written and clear, and the quality of the revised manuscript improved a lot. I have minor comments that hopefully you will be able to address.

[We thank the reviewer for their detailed final comments.](#)

Line 90 you state there were 14 states but then in line 109 you wrote there were 16, this is a bit confusing how did you start with 14 but end up with 16.

[This has been clarified:](#)

[Lines 91-92: From a download of all active AQS PM<sub>2.5</sub> sites and PurpleAir sensor locations on August 20, 2018, 42 unique sites were identified in 14 states \(data from additional states were available from sensors sent out by EPA and privately operated sensors\).](#)

Line 299 – you have double dot.

[This has been corrected.](#)

Line 401 no need to write full description of MBA or MAE again, you already define it in line 395

[Instead of linking the Figure number the whole caption was accidentally linked so this has been removed.](#)

## Referee #2

### GENERAL COMMENTS

I appreciate the authors' careful consideration of my previous comments! I've listed a few minor concerns below. All line numbers correspond to the revised manuscript.

[We thank the reviewer for another thoughtful and detailed review.](#)

### SPECIFIC COMMENTS

1. Lines 199–204: "...occasionally, an extremely high temperature (i.e., 2147483447) or an extremely low temperature (i.e., -224 or -223) was reported...Temperature values above 540 C (1000 F) were excluded before calculating daily averages..." All temperatures between -224 and 1000 F were included? Why not use stricter criteria for excluding erroneous temperature measurements? The results of a quick web search suggest that temperatures in the U.S. have historically ranged from -80 to 135 F. I suspect that many other groups will adopt the quality assurance criteria proposed here, so I think it's worth scrutinizing those criteria.

[This has been addressed in the text:](#)

Lines 205-208: Temperature values above 540°C (1000°F) were excluded before calculating daily averages since temperature errors were extreme and easily detected above this level. After excluding these values reasonable 24-hr averaged temperature values were generated (min= -25°C, max=44°C). Future work may wish to apply a narrower range of acceptable temperature ranges, accounting for typical ambient conditions and the potential for increased heat build-up inside sensors (discussed further in section 4.1).

2. Lines 521–522: “Applying this correction to our dataset results in an underestimate of PM<sub>2.5</sub> by 3 ug/m<sup>3</sup> (34%) on average...” Does this mean that MBE = -3 ug/m<sup>3</sup>? If so, can you please be more specific? This comment also applies to lines 529 and 534.

This has been clarified throughout this section.

Lines 526-527: Applying this correction to our dataset results in an underestimate of PM<sub>2.5</sub> by 3 μg m<sup>-3</sup> (MBE= -3 μg m<sup>-3</sup>, 34%) on average with more scatter as quantified by the RMSE (LRAPA= 4 μg m<sup>-3</sup>, US correction=3 μg m<sup>-3</sup>).

Lines 533-536: Applying this correction to our dataset results in an overestimate of PM<sub>2.5</sub> of 4 μg m<sup>-3</sup> (MBE= 4 μg m<sup>-3</sup>, 51%) with more scatter as quantified by the RMSE (AQ&U=6 μg m<sup>-3</sup>, U.S. correction=3 μg m<sup>-3</sup>).

Lines 539-541: Overall, applying this equation to our dataset results in a slight underestimate of PM<sub>2.5</sub> by 1 μg m<sup>-3</sup> (MBE= -1 μg m<sup>-3</sup>, 12%) on average with a similar scatter as measured by RMSE (both Woodsmoke and US correction =3 μg m<sup>-3</sup>).

3. Figures 5, 6, and S10: Were the corrected PurpleAir PM<sub>2.5</sub> values plotted in these figures calculated using the coefficients shown in Equation 10 (which were obtained using the full dataset), or were they calculated using one of the withholding methods? I’m assuming the former, but it’s not clear. Can the authors please clarify in the captions?

This has been clarified in the captions:

Figure 5. Error and ratio between corrected PurpleAir (PA) and FRM or FEM measurements are shown along with corrected PurpleAir PM<sub>2.5</sub> data (corrected using Eq. 10) as influenced by temperature, RH, and FRM or FEM PM<sub>2.5</sub> concentration. Colors indicate states, and black points indicate averages in 10 bins.

Figure 6. Scatterplot of the daily FEM or FRM PM<sub>2.5</sub> data with the PurpleAir data by U.S. region (see Figure 2) prior to any correction, after applying a linear correction, and after applying the final correction including RH. Data were corrected using the models built for the full dataset.

## TECHNICAL CORRECTIONS

1. Line 105: “cited” should be “sited”

corrected

2. Lines 263–264: I think this should just say “(Figure 2, Table 1)” but the entire Figure 2 caption seems to have been inserted by mistake.

Thanks for catching this. It has been removed.

3. Lines 272–274: Now that the manuscript has been reorganized, the inaccuracies associated with PurpleAir temperature and relative humidity measurements have not been discussed yet. The authors could revise this sentence to something like “There were limited data above 80% RH as measured by the PurpleAir sensor, which, as discussed in the following section, is known to consistently report RH lower than ambient.”

Thank you for this suggestion. We have updated the text

4. Line 302: “was” should be “were,” since it refers to “equations”

changed

5. Line 325: Delete the comma after “sensors”

removed

6. Lines 401–403: The entire Figure 4 caption seems to have been inserted by mistake.

removed

7. Line 480: Delete “Lastly,”. Sections 5.3.3 and 5.3.4 both start with “Lastly,”.

We have removed lastly from the beginning of section 5.3.3

8. Line 583: “Norther” should be “Northern”

corrected

9. Table S9 caption: Should “(as summarized in Table A5)” say “(as summarized in Table S8)”?

Yes, updated

10. Figure S2: Do the authors want to remove the x-axis label [`xlab(NULL)`] or add one that isn’t just their internal variable name?

Yes, we have removed the x-axis label.

Referee #3

It is unfortunate that the data set does not allow for a more in-depth investigation. It is also unfortunate that this was not addressed clearly earlier. My greatest complaint is – and has been since the first initial review – that this study, in its current form, does not make a significant scientific contribution to the field: there are already multiple studies investigating the effects of meteorological conditions on sensors, and many different correction equations have been presented. The notion that the correction equation presented here is similar to the ones presented previously makes this study less impactful in my opinion. The presented data processing technique is valuable, but it alone does not warrant for a full-length research article. Undoubtedly there will be readers who find this research useful, and there are many published studies, which are of much worse scientific quality than this study; it is understandable if this paper gets published. However, to stay consistent, I will stand by my previous decision and will not recommend its publication. The field of low-cost sensor studies is not particularly novel anymore,

and research, which describes the sensors on a general level without diving deep into their metrological features, for example, will not suffice.

We thank the reviewer for their time spent reviewing our manuscript. No past work looked at a broadly applicable correction across the U.S. and so we feel that it strengthens our work that our correction is similar to corrections built for specific areas. Although low-cost sensors are widely used, there is still not a broad understanding of how to effectively and efficiently quality control and correct sensor data in order to make this data useful across large regions and so we feel that this paper fills a critical research gap.

We have added one sentence in response in the conclusion:

Lines 547-549: Although no previous work had attempted a broadly applicable correction, the correction developed in this paper is similar to those developed for specific locations or sources (i.e. smoke) strengthening the confidence that this correction is applicable across the U.S. This national evaluation suggested that any corrections that are not strictly local probably need to include RH or other environmental factors to represent the wide range of conditions that can occur in the US.