Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC3
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Comment on amt-2021-154

Anonymous Referee #3

Referee comment on "Evaluation methods for low-cost particulate matter sensors" by Jeffrey K. Bean, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-154-RC3, 2021

This manuscript describes a co-location calibration of low-cost optical PM2.5 sensors. Overall the manuscript is topically relevant and well-written.

My major concern is that the Methods need more detail. The author does not reveal the brand of sensor used in this study, so a lot of the methods seem like a black box. For example, there needs to be some detail on the conversion of signal to PM concentration. Does the author simply rely on the factory calibration? Is there any compensation for humidity or other meteorological parameters?

A second important consideration is the range of PM concentrations shown in many of the figures. There seems to be a lot of emphasis on high concentrations (e.g., Fig 4), but I think it's more important to understand the performance of these sensors at typical ambient PM concentrations. Several examples are given in the specific comments below.

Comments:

Line 90 discusses the value of co-locating two sensors to catch instances of erroneous measurements from a single sensor. Some commercially available sensor packages, like the Purple Air, already do this.

What is the time resolution of Figure 1? Also, it seems strange that the R^2 generally decreases as the allowed difference shrinks. Is this perhaps because a small allowable absolute difference ends up scrubbing data from higher concentration events?

Line 187 - why was 70 ug/m^3 selected as the cutoff point?

The example in Figure 4 focuses on a very high concentration. Perhaps it would be more useful for readers to show this example for a more typical PM2.5 concentration.

The analysis in Figure 4 relies on a transform of the data to the 0.4 power. I assume that this is sensor-specific, and if someone wants to repeat this analysis they will need to find a transform that works for their sensor. Revealing the specific sensor used in this work would help others try to repeat the same transform.

I like Figure 5, but I wish I could see the typical ambient range (let's say up to 40 ug/m^3) better. I think that understanding the uncertainty for sensor measurements at typical ambient conditions is important, because in many cases these sensors will be deployed to examine neighborhood-level variations in PM concentration. Those variations can be small.

Line 225-226 note that in Fig 5, the daily average PM2.5 PI's can only be calculated for concentrations between 5 and 25 ug/m^3. This echoes my comments above - the performance of the sensors at low concentration is very important.

Figure 6 - I'm a little confused by exactly what is plotted in this figure. However it seems to me that the results are showing noise reduction via signal averaging. It's not clear to me why the R^2 is so low for the 1-day case (though errors are similar to, or slightly lower than, the 7- and 14-day cases).