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Atmospheric Measurement Techniques Discussions

Interactive comment on "Application of Low-Cost Fine Particulate Mass Monitors to Convert Satellite Aerosol Optical Depth Measurements to Surface Concentrations in North America and Africa" *by* Carl Malings et al.

Anonymous Referee #2

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The paper "Application of Low-Cost Fine Particulate Mass Monitors to Convert Satellite Aerosol Optical Depth Measurements to Surface Concentrations in North America and Africa" aims to examine the use of low-cost PM sensors as ground data sources for converting satellite AOD retrievals to surface PM2.5. Linear conversion factors relating satellite AOD to surface PM2.5 are calculated. In Pittsburgh, PA, the performance of the low-cost sensors is evaluated compared to traditional regulatory grade monitors, while in Africa, where traditional monitors are lacking, the ability of low-cost sensors to provide satellite AOD conversion factors is examined.

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Discussion paper

I am recommending the paper undergo major revisions.

General Comments

The majority of the results section focuses on the analysis for the Pittsburgh region. The goal of the paper is to assess the utility of low-cost sensors in deriving satellite AOD conversion factors, however, the results for Pittsburgh seem to suggest that ground monitor data overall performs poorly as a data source for the conversions over the region, at least in terms of correlations. As the authors note, this is likely due to the low concentrations being within the range of signal-to-noise in the sensors. This makes the results less meaningful, because it is difficult to determine whether the results are reflecting the ability of the low-cost sensors to be data sources for the satellite AOD conversion, or whether the results are just overwhelmed by the uncertainties in the measurements, and undermines the authors' conclusions that low-cost sensors perform just as well if not slightly better than the regulatory grade monitors in this region.

The analysis over Africa appears to be more promising, but much less time is spent discussing those results. The authors may be better suited by more prominently presenting the analysis over Africa. Low-cost sensor data would provide more benefit over regions such as Africa where the regulatory grade monitors are sparse; there already exist dense regulatory grade monitors over North America, so focusing more on the analysis over Africa would be of greater interest. Describing in detail the comparison of low-cost sensors and regulatory grade monitors in Pittsburgh would make sense if the results were meaningful, as they would provide a meaningful evaluation of the ability of the low-cost sensors to be used to convert satellite AOD in general, but in this case the results seem to suggest the method just doesn't work over Pittsburgh, and does little to provide confidence in the low-cost sensor only analysis over Africa.

Specific Comments

- Several of the figures are difficult to decipher. Figure 2 is difficult to read because the

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labels on the y-axis are clustered so close together. Figure 7 is extremely difficult to interpret, because it is hard to see the shades of red. Supplemental figures S6-S9 are very hard to follow and do not help to clarify the methods.

- In addition to Figure S5, the authors should have map plots for each region with the monitor locations over-laid, with a better indicator for the distance between monitors than just latitude and longitude. It is very difficult from Fig S5 to discern where the monitors are positioned throughout the cities, which would provide insight into the results. It is very difficult to tell which monitors are low-cost and which are regulatory without looking extremely closely.

- It is unclear how the satellite AOD and ground monitor data are being sampled; are the authors using pixels co-located to the ground monitor sites, or are they comparing a broader area of AOD to the ground monitor points? Also at which time-scales are the data points being sampled? At satellite-overpass time? This information would have important implications for the results.

- In several instances more "methods" type descriptions are mixed in with the results. Having all methods descriptions in the methods section would make the presentation of the results clearer.

Minor comments:

- Line 70: what is a "good" correlation? No range of values from the studies is given.

- Throughout the manuscript the authors refer to "satellite AOD measurements", when technically they are retrievals and not direct measurements.

- In the introduction the second paragraph on page 3 is confusing. It is structured as though they are discussing studies that use models combing satellite AOD with CTMs to estimate PM2.5, but then all of a sudden they are discussing satellite AOD and ground monitor PM2.5 agreement over Africa.

- When discussing the yearly/monthly conversion factors on page 11, it is unclear

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whether the monthly conversion factors are applied on a monthly basis, or if they are calculated on a monthly basis then applied on an annual basis: “the ‘monthly’ case, data from the previous month are used to develop conversion factors used in the current month; the median performance across months is presented”.

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