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Interactive comment on "Study of satellite retrieved aerosol optical depth spatial resolution effect on particulate matter concentration prediction" *by* J. Strandgren et al.

Anonymous Referee #2

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"Study of satellite retrieved aerosol optical depth spatial resolution effect on particulate matter concentration prediction" by Strandgren et al. addresses a potentially very useful application of satellite data for monitoring the particulate mass, PM2.5. This topic is of scientific significance, because the surface-level aerosol mass is relevant to the climate, regional air quality and human health and because the mass is costly to directly observe with high spatial and temporal resolution.

The relationship between satellite aerosol optical depth (AOD) data and ground-based PM2.5 measurements must be influenced by three factors: the measurement errors, the variability in aerosol loading within the satellite grid box, and the aerosol intensive properties. The magnitude of the first two factors varies with the spatial resolution of satellite data, as the authors point out in the introduction. Separating the three factors from each other would help determine the optimal satellite resolution for monitoring purposes.

The manuscript largely fails to do this. It matches the AOD product of the MODIS MAIAC retrieval scheme with near-coincident ground-based PM2.5 measurements and applies a linear regression between them. The variation in the regression results with the spatial resolution and coverage of the satellite data is reported but not effectively explained. The reader is left with few clues as to how the results are relevant to other places, time periods, aerosol types and meteorological conditions. For this reason, I recommend major revision.

The method of the linear regression, on which the entire manuscript hinges, should be presented in a clear way.

The lack of a description otherwise makes this reviewer believe that the standard least-squares fitting was employed. This method underestimates the slope when both x and y have an uncertainty and when the correlation coefficient is low. Importantly, for this effect to manifest itself the uncertainty in x does not have to be systematic; a random error is sufficient (Cantrell 2008). Therefore, a systematic bias in the slope by itself should not be taken as a proof of a systematic bias in x.

The observed slope systematically varies with the spatial resolution and coverage, as repeatedly pointed out in the manuscript, for example in the third paragraph of section 3.1. What can explain this? The authors speculate that this might "be due to the higher risk of cloud contamination" at coarser resolutions. The cloud contamination, which biases the AOD to higher values, can indeed be the explanation. But, so can any source of a random error in the AOD, and the aerosol horizontal variability for that matter, that varies with the spatial resolution and coverage. The regression analysis by itself does not reveal how influential the signal-to-noise ratio, the surface properties, the cloud contamination and the aerosol spatial heterogeneity are compared with each other.

Figure 6 is an effort to separate the impact of horizontal variability from other factors. It should be studied for all cases, not just two cities. Similarly, analysis should be made in order to isolate other factors such as the aerosol vertical variability (e.g., Figure 5), the intensive properties (Figure 4, 8 and 9), the surface properties and the singal-to-noise ratio.

Besides, it is not clear whether cloud contamination is likelier in the coarser resolutions. A satellite algorithm may have a better chance of identifying clouds with a greater number of subpixels. The aggregates of 1-km MAIAC products used in the study are not adequate for addressing this issue.

Minor comments. (The page and line refer to those of the printer-friendly version of the manuscript.) Page 25872, Line #3. What do you mean by “auxiliary data”? Page 25878, Line #14. This sentence essentially says “not significantly better but clearly better”. This is confusing. Clarify. Page 25879, Line #12. Heating does not remove any particle. It dries particles and reduces their mass and extinction. Rephrase the sentences. Page 25881, Line #8. This sentence should move to the beginning of the next paragraph. Page 25881, Line #24. Figure 7 seems to show standard deviation over time. But the context of this paragraph calls for a measure of the AOD variability over space. Revise. Page 25883, Line 26. Is there a reference for “very low fine mode fraction” in Los Angeles?

Reference Cantrell, C. A.: Technical Note: Review of methods for linear leastsquares fitting of data and application to atmospheric chemistry problems, Atmos. Chem. Phys., 8, 5477–5487, 2008, http://www.atmos-chem-phys.net/8/5477/2008/.

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