Responses to Anonymous Referee #2

The authors appreciate the comments and suggestions made by this reviewer. All of them have been considered and properly addressed in the revised manuscript.

This paper develops an empirical model approximating the relationship between urban parameters and aerosol data using Self Organizing Map (SOM) method. The developed model in combination with clustering technique was later used to identify the optimum number and locations of measurement sites. This covers an important issue related to the measurements of aerosol concentrations and can potentially have implications particularly related to exposure assessment. Despite the limitations of this study, it has adequate quality to be published in AMT after addressing the issues stated below.

Indeed, the main goal of this work was to evaluate the capability of SOM as a data-driven modeling method to approximate nonlinear relationships between urban parameters and air pollution data at ground level. The satisfying results predicting aerosol concentrations gave opportunity to interpolate concentrations in a complete gridded domain, and in combination with a clustering algorithm SOM was used to determine the optimum number and locations for monitoring sites to cover the different urban settings forming the studied neighborhood.

Although the approximated relationships can only be applied for the particular pollutants monitored in the selected neighborhood during the surveyed rush-hour, the methodology can be extended to other pollutants in a larger domain covering the whole diurnal course in future studies. The work described here has the unique purpose of testing SOM as a potential tool for the design of monitoring networks and forecasting potential concentration exposures at ground level.

General comments:

1) The measurements are limited both in spatial and temporal scale which can question the representativeness of the model and its application. This limitation should be stated more clearly in the manuscript.

As explained in the previous paragraph, the study presented here is a proof of concept. The manuscript states clearly the limitations imposed by the size and representativeness of the studied domain and timing of the measurements. The section with the results discussion includes a complete paragraph explaining these limitations. However, the revised manuscript highlights even more that this work is a proof of concept.

2) The measurements were taken at 1 and 10 second intervals, however, the rationale for using such a small interval needs to be elaborated specifically in relation to the response time of the instruments used. For instance, the manufacture claims a response time of around 9 seconds for TSI 3007 CPC (http://www.tsi.com/uploadedFiles/_Site_Root/Products/Literature/Spec_Sheets/3007_1930032.pdf). Even if we are optimistic enough to accept the manufacturer claim then how would

you justify using 1 sec measurements interval? Ideally you should have tested the response time of the instruments yourself and then used the intervals based on that considering the study design.

All monitors were set up for 1 sec measurements with the exception of the monitors for measuring active surface area and concentration of particles-bound polycyclic aromatic hydrocarbons, whose readings were at 10 sec intervals. Measurements at such frequencies give opportunity to catch sudden plumes which are expected to occur frequently at ground level in busy neighborhoods. The GPS was also set up for 1-sec readings, and an identification flag was assigned to each monitor's measurement using as reference the closest grid cell.

Indeed, the response time of each monitor is different. Their response depends basically on the measuring technology, and pump and inlet characteristics. To deal with the differences on the time stamps, in addition to synchronize the internal time of each monitor to a computer clock just before de measurement trials, the specific lag-time of each monitor was computed through cross-correlations against the sensor measuring size segregated mass-fraction concentration during the data post-processing. The Supplementary material provides details of the instruments preparation and data post-processing including the lag times estimation.

3) I believe the measurement uncertainty needs to be taken into account as well, particularly, in studies dealing with the comparison of measurements at different sites such as this one. Often the instrumental measurement uncertainty in practice is much higher than what is claimed by the manufacturers (For instance see: http://pubs.acs.org/doi/abs/10.1021/es400041r). The instruments should have been tested before and during the measurement campaign to come up with a realistic estimate of the uncertainty in the measurements. It would be great to include such data, if available, to your analysis and interpretation.

As explained in the Supplementary material prior to the measurement campaign, the individual response of each DustTrak Aerosol Monitor was evaluated to the properties of the particles in the tropical atmosphere of Singapore through gravimetric calibrations. Our instrumental resources did not allow us to conduct calibarions in-situ for the other monitors. However, prior to each day of measuements all instruments with removable parts were dismantled and re-assembled. On the measurement days upon arrival at the background site, zero calibration procedures for the Condensation Particle Counters and DustTrak monitors were carried out. Instruments were then set to log data for 10 min prior to the actual sampling. All instruments were placed side-by-side with inlets close together during these parallel measurement periods. Data from this parallel measurement were later used to correct the instruments at the background site to those used in the transects at street level.

The data post-processing included a proper filtering process and quality assurance, and depending on the monitor corrections by temperature, humidity and sensor sensitivity. The Supplementary material provides full details of the data post-processing and performed corrections.

It is also important to highlight that we follow a strict schedule for the maintinace service and factory calibration of the instruments. We follow the manufacturers recommendations to warrant as much as possible the proper performance of the monitors.

Table S1, also in the Supplementary material, provides information on the accuracy of each monitor. Those accuracies are much lower than the variability observed in the trials along the street and alleys of the monitored domain. Figure 1 in the main text illustrates this variability for $PM_{2.5}$ measurements during a trial.

4) The importance of this study could have been more clarified in the Introduction section by reviewing the literature and including studies related to the spatial variation of aerosol concentrations in urban area, particularly the ones related to the sites within close proximity. For example see the papers below Moore, Katharine, et al. "Intra-community variability in total particle number concentrations in the San Pedro Harbor area (Los Angeles, California)." Aerosol Science and Technology 43.6 (2009): 587-603. Salimi, Farhad, et al. "Spatial variation of particle number concentration in school microscale environments and its impact on exposure assessment."Environmental science & technology 47.10 (2013): 5251-5258.

This is an important point that was not considered in the original submission, but it has been included in the revised manuscript with the corresponding references.

5) Are you able to provide a general recommendation about the location of the measurement sites based on your study? It can be beneficial for the readers of the manuscript who plan to design a study.

The aim of the study was to test the capability of SOM as a data-driven modeling for helping to find representative locations for monitoring sites at ground level. The revised manuscript cites a few characteristics that need to be also considered when selecting a location. For a detailed guidance of all criteria that a location must fulfill to assure the proper monitoring, the readers are referred to the US-EPA handbook for air quality monitoring.

Specific comments:

6) Figure 1, what was the reason for selecting a single day? I recommend to illustrate the daily average and its 95% confidence interval for the whole measured data. It would give a more general trend.

The purpose of Fig. 1 is to illustrate the difference between the aerosol pollution above the urban canopy, at ground level along the streets and the data reported by the authorities for the region corresponding to the selected domain. Indeed, using bars and whiskers showing the average and the 95% confidence interval meets the figure's objective, but does not allow to appreciate the frequency and absolute magnitude of the spikes observed at ground level.

7) Page 3323, lines 14-16: Is it usually the case anywhere or you are talking specifically about Singapore? Please clarify!

It is usually the case everywhere and not only of Singapore. This has been clarified in the revised manuscript.

8) Page 3322, line 25: "monitoring" has been repeated twice, it is better to remove the second one.

This has been fixed in the revised manuscript.

9) Page 3324, line 14-15: I guess, the appropriate place of "," is after "ground level" not after parameters.

Right, the location of this comma was not correct, it has been fixed in the revised manuscript.

10) Page 3327, line 3: What does "ARIMA" stand for?

ARIMA stands for Autoregressive Integrated Moving Average. The manuscript has been revised accordingly.

11) Page 3327, line 7-9: this sentence needs to be re-written.

This and the previous sentence in the text were rewritten. Now they read: "In a recent study Nguyen et al. (2014) used low-resolution satellite images in combination with SVM to estimate aerosol concentration at ground level from urban surfaces with no need of *in-situ* measurements. However, they were not able of identifying the urban parameters influence on the aerosol concentration".