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Atmospheric Measurement Techniques Discussions

Interactive comment on "Mobile air monitoring data processing strategies and effects on spatial air pollution trends" *by* H. L. Brantley et al.

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We appreciate the valuable feedback by Referee #1. In response to comments by all of the referees, we have undertaken significant additional analyses to strengthen the background analysis section of the paper and also removed the time lag/alignment section that multiple referees commented as of lower importance. In the course of this additional analysis and considering referee comments, we decided to remove the overly complicated time series algorithm we developed ("flexible window") and have simplified the comparison to be between the location-based background and the time-series based background (spline of minimums).

The location-based approach of estimating background concentrations, i.e., using the

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median concentration measured in designated background areas (characterized by low traffic away from known sources) was applied to the eight mobile monitoring routes which included background areas. The time-series approach (spline of minimums) was also applied to these routes and the results were compared. In response to a comment by Reviewer #1, we further examined whether the spline of minimums approach could be used when the sampling vehicle did not pass through designated background areas by artificially removing measurements made in the background areas and re-calculating the background using the spline of minimums.

The original questions and comments are shown below, followed by our point-by-point responses. The revised manuscript has been attached as a supplement.

General Comments: This paper addresses an important issue that not been directly covered in the current literature. While the concept of mobile monitoring has been in regular practice for about a decade, the analysis and interpretation of the data have several challenges which require innovative and novel approaches, given the often high temporal and spatial resolution of such data sets. This paper is a good start to begin to explain and address these issues.

1. While it is likely outside the scope of this manuscript to address data interpretation, some mention of it would be useful. Since some of the data presented represent multiple days, a better discussion of meteorology would be particularly useful. It is mentioned briefly in section 3.3 that met varies on an hourly and daily basis, but this subject deserves a more in depth discussion. Some questions to consider: a. The range of SDs is resented in Table 4, but what does this mean for how data can be used? b. When processing the data how should differences in meteorology be considered?

Author response: The reviewer makes a very important point that we had overlooked in the manuscript. Additional discussion of meteorology was added to the revised manuscript including: “Several time-series based methods of estimating background were compared with the location-based method. One time-series based method is to

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calculate a single value for each sampling run to use to normalize the concentrations. However, in the present study over the course of a two hour sampling period, the baseline of the CO time series decreased from 400 ppb to 200 ppb (Fig 5). During this run the wind speed increased from a mean of 0.3 m/s during the first half hour to a mean of 0.7 m/s for the last half hour and the wind direction was fairly consistently from the southwest: mean wind direction was 217 deg and 249 deg during the first and last half hour, respectively. The decrease in background concentrations over the two hour time span is likely related to an increase in the atmospheric mixing height during the morning period, however further analysis would be required to fully explore the causes of background variation. ... The spline of minimums proved to be an effective method for routes spanning a range of distances and under a variety of meteorological conditions. The average wind speed measured during the runs with designated background areas ranged from 0.4 (m/s) to 1.3 (m/s). The wind direction ranged from fairly consistent to highly variable with an average standard deviation of wind direction (Yamartino, 1984) ranging from 30 deg to 86 deg. The effectiveness of the spline of minimums method at estimating the background concentrations for multiple pollutants across various routes and meteorological conditions will enable researchers to compare routes measured on different days. One of the difficulties in using the location-based method is determining whether the inclusion of a background section in the route is feasible given the study priorities. By using the spline of minimums method the analysis is simplified. To illustrate the possibility of comparing different routes sampled on different days, we compared PM2.5 concentrations measured on 4 different routes on 8 different days before and after the background was standardized by subtracting the estimates produced by the spline of minimums method from the measured concentrations."

2. The rolling median algorithm to calculate a "real-time" background, is shown here. This method assumes that the data reach some minimum over a certain time period. However, does calculating the background in this manner introduce bias if near sources? For example, we expect elevated pollutant levels near roadways (especially if downwind) wouldn't this method artificially increase background because the "min-

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imum" would be always affected by the roadside levels? It would also be useful to suggest a method of background correction for longer routes where the assumptions for a rolling median cannot be applied.

Author response: We thank the reviewer for this insight. To address this question in the revised background estimation section we compared the background estimates calculated using the spline of minimums after the designated backgrounds had been artificially removed with the background estimates from the spline of minimums of the complete time series and the location-based estimates of background. When all of the data was included, the spline of minimums method produced estimates of background that were similar but slightly lower than the location based method. When the background sections had been artificially removed the spline of minimums method produced estimated that were more evenly distributed around the location based estimated. (Figure 6 in the revised manuscript). While the spline of minimums method does assume that the data reach some minimum over a certain time period it was effectively applied to routes ranging in length from 5-18 km and could potentially be applied to longer routes.

3. Something else for the authors to consider-in the applications of mobile data described, removal of emissions events are critical. However, it should be noted that these emissions events are indeed important in terms of personal or localized exposure, which may be better characterized by the mean.

Author response: The reviewer makes a very good point. The following text was added "Studies focused on personal or localized exposure, however, may not want to remove the influence of the local exhaust plumes."

4. Figure 5. There is little discussion of this figure in the manuscript and no mention of the wind rose and its significance.

Author response: In the revised manuscript the original Figure 5 became Figure 3. This figure was revised to help the reader visualize the local exhaust plumes and the follow-

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ing discussion was added: “Figure 3 illustrates the potential of local exhaust plumes to affect the characterization of near-source spatial trends. Using the COV method (Hagler, 2012) for both CO and UFPs, several local exhaust plumes were identified (Fig. 3 b and c). Spatially aggregating the measurements without removing the influence of the plumes at 7:46 and 7:53 may erroneously lead to the conclusion that concentrations are generally greater along the transect than on the highway (Fig. 3).”

Editorial Comments: 1. Table 3. Suggest “Sample emission factors . . .” 2. Page 10452 Line20. Few=how many exactly?

Author response: Table 3 was removed based on comments from other reviewers. Added the text “Route B, which had the highest number of repetitions, was used to compare local exhaust plume detection and spatial and temporal smoothing methods. Eight of the twelve routes – those which had route sections that had very low traffic and were far from any known major source – were utilized to compare how background may be estimated using a purely time-series based approach versus a location based approach. The entire data set (12 routes) was utilized to estimate overall background contribution to the measured concentration of each pollutant. “

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/6/C4837/2014/amtd-6-C4837-2014-supplement.pdf

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10443, 2013.