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Atmospheric Measurement Techniques Discussions

Interactive comment on "Traffic-related air pollution near roadways: discerning local impacts from background" *by* Nathan Hilker et al.

Anonymous Referee #2

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This study provides three methods to quantify the contribution of local traffic emission to near road measurements and explored the effects of wind speeds and directions on near road pollution. The MS is well written and contains rich and interesting results. However, I worry that the background determined in the paper using method3 may not be a real background, but a characterization of the environment around the road. The authors need to give a clearer view on what they think it means. Below are some specific comments need a response before acceptance.

Specific comments:

1) The first paragraph in Introduction about exposure is not that relevant to the rest of the paper, so would better focus on the topic of traffic-related pollutants close to the road.

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2) In L174, why the calculated average difference is expected to converge the true average difference between sites? Are the differences between sites normally distributed? Is this convergence non-trivial and not simply a property of averages or central limit theory?

3) In L190, since the authors have realized the downwind and upwind scenarios may encompass different time frames and may influence the results, why not do some statistical tests? It seems important to the final outcomes.

4) In L238-274, the method3 was not explained properly.

Firstly, 'Time-series analysis' seems too general and may not be a good subtitle here and in the rest part of the MS. It often implies decomposition and forecasting.

Secondly, the authors talked about the frequency of signals very often in the first two paragraphs (L238-254) and allude to the wavelet decomposition algorithm used by Sabaliauskas (2014) as similar to their method. But I think this is not quite right and misleading. What I expected after the description is a frequency analysis, but method3 is approximately a 'moving minimum' baseline algorithm. As an example of signal processing and a spatial frequency domain in the road-environment can be seen in Xing and Brimblecombe (2019). Although wavelet analysis can also be used to exact baselines as shown by Liland et al. (2010), the underlying theory is different. There have been many baseline algorithms in Liland et al review (2010), method3 doesn't seem more accurate although it may be efficient. Besides, could the authors validate the extent to which the baselines derived using this algorithm represent the background?

Thirdly, many details about method3 were not shown in this paper but presented in Wang et al., 2018. I understand this is a method used in the published paper, but since this is a journal about measurement techniques, I think more details should be provided, especially the setting of the time window. Wang et al. (2018) used 8h, but is it appropriate here since a new station near a highway (NR-TOR-1) is added in this MS? As mentioned in L243-244, characteristics of emission sources determine the

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frequency of signals. Thus should the time window for a station near highway may need to be different from that near streets, intersections or bus stops, which have their own frequency components (probably higher)? In addition, would different pollutant species require a different setting of window, especially a secondary pollutant such as ozone?

5) In L380-384, I don't understand why method1 and method3 are better as they both provide lower difference values. In my opinion, method3 has more disadvantages than method2, because the outcomes highly depend on the choice of time window and it's hard to determine if the baselines represent a real background.

As I understand it, method2 only used part of the data and clearly gave the largest difference between roadside and background concentrations. While the other two methods used the data even when the roadside stations experience background concentrations (e.g. under upwind conditions). Literally, the output from method2 is not the average local concentration. So I don't agree with the statement that method2 overpredicts average local concentrations (L131 in supplementary information). If the aim of this MS is determining the averaged concentration difference, method2 should be revised, otherwise, the difference between method2 and method1&3 is just caused by the difference in the methods.

6) L410-412, it seems the increase of pollutant concentrations under downwind conditions compared to upwind conditions is a main finding in this MS (as also mentioned in abstract). Could the authors provide the factors for each station and pollutant species? Theoretically, this factor should be a function of distance between source and receptor, wind speed, eddy diffusivity etc. Is it possible to add some tests about this?

7) In L484, why is method3 accurate and robust? Is it because the outputs agreed with those derived from method1?

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