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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Air pollution near arterial roads: An experimental and modelling study" *by* José Ignacio Huertas Cardozo and Daniel Fernando Prato Sánchez

Anonymous Referee #1

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In this paper, the authors present measurements and modeling of air pollutant dispersion downwind of an arterial road. Measurements of TSP, PM10 and PM2.5 concentrations were collected at several downwind locations, along with traffic and meteorological variables. The authors also performed modeling of the dispersion of particulate and gaseous pollutants in a near-road environment using CFD modeling tool, and the simulated results were compared with their measurements. The authors claim that a unique curve (beta function) can describe the near-road dispersion of various air pollutants. While the topic is important because vehicle emissions undergo a rapid transformation in a near-road setting, which influences the physiochemical nature of pollutants and has implications for health and environmental effects and relevant for

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this journal, I thus do have some major concerns and comments about presentation, analysis, and discussions in this paper, which are outlined below:

General comment: The analysis and discussion in this paper are not comprehensive. Overall, this paper is not well written. The authors tried to do so many things in this article, but there is no good story. There are lots of sections and sub-sections where the reader cannot get the full picture. Discussions are limited in many cases, and many conclusions are not well substantiated by their analysis results. It seems like the authors are trying to include several aspects in this paper, but there is no comprehensive view. The QA/QC of data is not well documented. Specific comments are given in bellow.

Major comments: In this paper, the authors measured and modeled coarse (TSP, PM10, PM2.5) PM fractions downwind of two arterial roads. Many previous near-road studies have demonstrated that the traffic-emitted PM in a near-road setting is mostly dominated by ultrafine particles (< 100 nm), whereas coarse (TSP, PM10, PM2.5) PM is mainly dominated by regional/local background particles. The traffic-related pollutants (ultrafine particle, BC, NOx, CO, etc.) have strong near-road gradients, whereas near-road gradient of coarse PM is typically very mild (Karner et al., 2010). So one could have a strong concern that at which extent their measurements are relevant to traffic emissions? Although the authors performed their measurements at downwind of unpaved road, therefore, a large fraction of measured coarse PM are coming from the road dust. My concern is that how their measurements are relevant for a typical traffic emission/near-road perspective. For example, if someone wants to apply the knowledge from their paper in a typical near-road setting. Since the title of their paper says 'Air pollution near arterial roads'- thus, someone might expect the influence of traffic-related pollutants (combustion pollutants; ultrafine particle, BC, NOx, CO, etc.) at first, not that much about coarse PM. I think the author should have a strong justification on how their measurements fit in a context of typical traffic-emissions/near-road environment. If the coarse PM is critical for a traffic/near-road perspective under particular

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environment, then the authors should reframe their paper, its title and analysis- center around coarse PM (since they only have coarse PM measurements) and that particular environment. As it is, to me, their measurements and analysis do not represent a typical near-road/traffic-related pollutants scenario.

Other specific comments: 1) Background vs. roadway impact: How did the authors separate re-suspended PM from unpaved road vs. traffic emitted larger particles? This is important if exploring the influence of traffic emission is a primary goal of their study?

2) Method section: there should be a clear description of what they measured, what instruments they used, how did they maintain QA/QC and data quality, instrument response time, data averaging time, sampling frequency, etc. These are very important given the near-road environments are very dynamic, in general. The detail on these can put in the supplementary. A table should be given summarizing all the important aspects related to instrumentations and data quality. There is no details about their sampling, variability, measurement uncertainty, etc. Did they measure continuously? How many sample they collected at different locations and for how many days? There is no real mention (Fig) about their measured data and its variability. Also, based on their 24-hr filter sample, how did they tell anything about traffic influence since traffic is very dynamic? With their 24 hour filter sample, they essentially do not have any temporal information. For example, the influence of meteorology (boundary layer ariation), traffic (diurnal traffic variation).

3) PM size distribution and composition: It is very confusing that they frequently generalized PM without mentioning any size information. What they measured is road dust (PM10 and TSP). Traffic emitted particles are dominated by smaller particles (a majority of combustion particle). What traffic-related info they might get based on filter SEM analysis of coarse PM? They reported that changes in particle size distribution are negligible within $\sim$1 km from the road edge, which is very confusing and miss-leading. First, their measurements are mostly road-dust, not traffic particles, so there should not be any significant gradient for that. In reality, the size distribution of traffic-emitted

particle in a near-road environment is highly dynamic and changes very rapidly within a few hundred meters from the roadway (Zhang and Wexler, 2004). Several complex microphysical processes dictate that changes, such as dilution, evaporation, condensation, coagulation, etc. Since they only measured TSP, which is not that traffic-related. Therefore, their results would not tell the true nature of the typical traffic-related particle.

4) Traffic data (Page 4): how did they measure traffic data? Details should be given about measurement technique, data averaging time and data quality. Also, it is important to have some information about fuel use scenario (diesel vs. gasoline use). The reported traffic flow rate (20-50 veh./hr) looks very unreasonable to me, especially for an arterial road.

5) P4: There are a bunch of equations, but there is no description of what are they and what is the meaning of different symbols. There is a list of symbols at the end, but it's good to have the description of symbol along with equation. Also, how did they get inputs for estimating EF, which is not clear to me? Clarification is needed.

6) They reported that the non-dimensional concentration of all gas phase pollutants exhibits a unique profile (Figure 9.a) that can be represented by a beta function with parameters. This is something over-weighted (more generalized) to me. Can the author model the concentration profile from different seasons using their unique function? I'd expect a substantial seasonality on near-road pollutant gradients. Can their unique function account the seasonality and different physicochemical transformation of different pollutants as well? Did they test it? Otherwise, this conclusion might be very misleading.

7) Vertical profile of PM distribution: Did they measure it? Can they evaluate their model results? TSP concentrations in an unpaved road would be highest at ground level that makes sense. But, for traffic emitted pollutants (e.g., ultrafine particles), it could be very different. They should be very careful while reporting different PM fraction. They should not generalize PM without any size information. This is very

confusing throughout the paper.

8) P10, L47: "we used the NR-CFD model to study differences in the dispersion of CO, CO2, NO2 and TSP"- Did they measure these gases? There is no description on that?

9) P5L1: “primary and secondary meteorological variables”- not sure what did they mean by primary and secondary met variable here? Which are primary and which are secondary?

10) “Particles exhibit a Rosin Rambler size distribution with average diameter of $\sim$ 7 μm” – This is again very confusing. What did they mean by particles here? Particle mass or number size distribution? It seems PM mass. However, how relevant is this in context of traffic-emitted particles? I guess, this is only telling something about road-dust, not much about traffic-emitted PM. Clarification is needed.

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