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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

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General remarks

This is an experimental and modelling study of pollutant dispersion from unpaved arterial roads. As written, and as described by the other reviewer, the manuscript is in danger of being misunderstood, and a careful re-write will be required before it can be considered for publication in ACP.

Specific comments

Title and abstract: should prefigure the main work of the paper more accurately. Please

include the word "unpaved" before "arterial roads".

Abstract. Please make it clear that the particle measurements in the study are 24-hour average mass concentrations. I don't see how emission mass rates were measured – please delete.

Abstract, Line 12. Please state whether these "plots of pollutants concentration" are measured or experimental. If they are experimental, please repeat the temporal averaging time.

P2, Line 20. You say "an important number of works" but only cite one work – please amend to make consistent.

P2, Line 30. The diffusivity differences between CO and NOx are trivial with respect to dispersion under turbulent mixing at a roadside. Also, CO and NOx disperse in the same plume, having the same density, not in plumes of different density, so I don't think this sentence is helpful. I suggest you delete.

P2, Line 32. Here, and thoughout, you must make it clear which size fraction you are discussing.

P2, Line 34. Gaussian models are not heuristic, see Seinfeld and Pandis, Atmospheric Physics and Chemistry, 2nd ed., Ch. 18.

P2, Line 37. This paragraph does not add anything to the manuscript and could be read as a criticism of the understanding of fluid dynamics of previous pioneers in the field. I suggest it is deleted.

P2, Line 44ff. There are many more studies of computational fluid dynamics for urban and rural roads than cited here. You should distinguish RANS approaches from large-eddy simulations and provide more citations. Your primary data to evaluate the model are 24-hour averages; please provide a discussion of why "state-of-the-art" CFD is the best method to interpret such long-time averages.

P3, Line 7. If the point of the previous paragraph was to introduce the idea of working with a commercial CFD package, then that package should be named here.

P3, line 16. Please re-write this bullet to state what the model is (not just "state of the art") and what it does (something more useful than to resolve a known issue with the Gaussian solutions).

P3, Line 21. Define symbols or direct reader to a list of symbols.

P3, line 24. Disambiguate TPS and TSP – are these the same or something different? Please provide horizontal scale bounds on the statement about "constant fraction" because as written it appears to break the laws of physics (or those laws conspire to match precisely the different loss processes affecting PM2.5 and TSP).

P3, Line 25. Please provide the reader with some idea of the threshold applied that allows an impact area to be defined.

Figure 1. Horizontal scales are given but not a vertical scale. The caption should draw the reader's attention to the non-uniform length scale.

P3, Line 29. Strictly, vegetation can be a source of primary (mostly coarse) aerosol particles composed of pollen, spores, or plant fragments. This sentence should be written more carefully.

P3, Line30ff. These sentences are rationale for the study and should be in the Introduction. When re-written in the correct place, this paragraph should carefully distinguish between sources which dominate the mass size distribution of roadside aerosol, and those which dominate the number size distribution.

P3, Line 38. Please state at which positions relative to the road which measurements were made, at which temporal resolution, and with which measuring equipment.

P4, Line 4. Please state that you will discuss model calibration in a later section.

P4, Line 28. Explain to the reader what changes to get emissions for TSP and PM10

from equations 1-4.

P5, Line 1. Please provide the temporal resolution of met data. Delete "primary and secondary".

P5, Line 17. Report briefly the definition of diameter derived from the microscopy (e.g., equivalent area, longest axis, etc).

P5, Line 17. Figure 2d reports apparently size in mm, not micrometres.

P5, line 18. Rosin-Rambler (abstract) or Rosin-Rammler?

P5, Line 35. Are these two different references? If so, they should be disambiguated.

P6, section 4.2. Whether an accompanying model description paper is available or not, sufficient detail of the modelling approach should be given to allow the reader to understand the model set-up and experiments. Please describe the model discretisation and turbulent closure as a minimum. Please provide some justification for the size of domain and for the boundary conditions chosen. Please provide details of model spin up to steady state. Please explain how 1 hour steady state models are to be compared to 24-hour average measurements. Please describe what microphysics, if any, is included in the model.

P6, Line 34ff. I don't believe that readers will accept you can model all kinds of vehicle-induced aerosol with a single 'quartz' model tracer following a Rosin-Rammler size distribution. It would be much more persuasive to stick to modelling the suspended silt that makes up the vast majority of the mass concentration in the hi-vol samples.

P7, Line 9. Finally, we learn that the model is FLUENT, set-up with a variety of standard settings. Please completely re-order the description of the modelling to start with the name of the commercial modelling system and describe the important set-up parameters as asked for above.

P8, Line 1. The calibration procedure is not clear. Calibration implies that some parts

of the measured data were used to refine model parameters and then the calibrated model used to simulate a different part of the data. Please explain.

Figure 5b. How long are the long-term averages? Please make all captions self-explanatory.

P8, Line 11. If the measurements are averages please also plot standard deviations (or, better, plot medians and quartiles).

P8, Line 16. Please report numbers using standard scientific notation. RMSE should have associated units.

P8, Line 26, It is a basic property of the Gaussian plume model that downwind concentrations are proportional to the emission rate, so Figure 6a is not needed. Figure 6b is more interesting, but only if some description of the model is provided that would account for non-linear behaviour with emission rate. Since the concentration further downwind is exactly proportional to emission rate for the CFD simulation, it is more pertinent to ask what is causing the spread near the source.

Figure 6b and 6d. I am not sure how "zero" can appear on a logarithmic scale. This will be confusing, especially for junior scientists, and should be removed.

P8, Line 30ff. It is, again, a standard result from Gaussian plume models that the concentration at a point varies inversely with wind speed. This para therefore shows what a good job Gaussian plume modelling does of capturing the time-average concentration profile downwind of a source, which has been demonstrated many times before. Again, the behaviour of the CFD for $x^* < 1$ is more interesting.

P9. If deposition is negligible and coagulation and condensational growth are not applicable/accounted for, then the ratios of size fractions are bound to remain constant.

P10, Line 10. It is not intuitive to expect a Gaussian vertical distribution from AERMOD. This would be the case for a chimney but not for a ground source.

P10, Line 46ff. Please explain why the model results for gas phase tracers are very much smoother than those for TSP.

P11, Line 23. This material should be much earlier on when the concept of 'area affected' is introduced. It is important to state what averaging time is used in the air quality standard you are using, and to compare similar modelled and measured averaging times.

P12. The conclusions should be re-written in light of the revisions suggested by the referees.

References. If Huertas and Prato is "in press" please provide the journal name.

Throughout: please could the font size and line spacing be made consistent.

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