

Interactive comment on “Comparison of the predictions of two road dust emission models with the measurements of a mobile van” by M. Kauhaniemi et al.

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We would like to thank the anonymous Reviewer #2 for his/her comments and suggestions. Our response to the reviewer comments is provided below. The reviewer's comments are numbered.

Response to anonymous Reviewer #2

1. General comments The well written manuscript deals with a comparison of measurements and model results for non-exhaust road dust emissions. This is an interesting topic of increasing relevance since traffic PM emissions will be dominated by

C2623

non-exhaust emissions in the near future. The authors give a detailed introduction to the topic covering lots of previous work and describe both the used measurements and models in great detail (maybe a bit too long). However the attempted comparison of very different type of data has some serious flaws and weaknesses.

There are simply too many unknown parameters and not fully justified underlying assumption involved when comparing 10 second resolution on-road mobile measurements over relatively short periods with modelled 1 hour time series over several years. The measurements are influenced by unaccounted and very local road conditions, variable driving speeds and data with great scatter are averaged to 20-25 hourly averages only. These type of mobile measurements seem to have their strength in studying the dependencies on single parameters as driving speed; type of tires or spatial variation of the road dust suspension, while less suited for long term measurements monitoring day to day variations.

Answer:

We agree with the referee that the low temporal representativity of the measurements is probably the most important limitation of the dataset; we have discussed this in the manuscript. It is also correct that the measurements are influenced by a number of various factors, and it is therefore not so straightforward to conduct such measurement vs. model comparisons in the field. Probably the main importance of this manuscript is, as stated by reviewer 1, "... the most useful outcome of the paper is a better appreciation of the complexity of describing the processes determining the resuspension flux, and the consequent difficulties in estimating it."

2. The presented models are based on meteorological data from a central location and average road and meteorological conditions. The models were developed and validated for reproducing time variations of average fleet re-suspension emission factors on a very well defined location as done e.g. for Hornsgatan in Stockholm. In order to make modelled total fleet average fleet emissions comparable with the measured van

C2624

emissions some assumptions about two additional parameters ($rp_{Car}=0.7$ and $r_{HDV}=10$) have to be made. These parameter taken from the literature might be very uncertain (missing sensitivity study) and could be dependent on road and weather condition and vehicle speed and therefor variable from day to day and in-between seasons.

Answer:

It is true that the use of parameter values, such as those for rp_{Car} and r_{HDV} , to make the modelled total fleet emission factors comparable with the measured van emission factors brings uncertainty to the study; this has been pointed out in the paper. However, the state-of-the-art is that the exact variation of these parameters on factors, such as those listed by the reviewer, are not known; we have therefore simply used the best available numerical values based on experimental data. The variation of the values of these parameters could be studied in a separate study, and we have actually already planned to perform such emission factor measurements for passenger cars and trucks in the future.

3. A fixed permanent monitoring site in Helsinki is missing in the study to bridge the gap between both data sets. Such data are needed in order to calibrate the models to reproduce the temporal variation in emissions correctly under Helsinki conditions. In the moment both models rely on data from Stockholm without knowing if they are applicable in Helsinki; in FORE the reference emission factors; in NORTRIP the road wear rates and the suspension factor. Moreover the mobile SNIFFER results could be calibrated when passing the fixed monitoring site.

Answer:

Both models (FORE and NORTRIP) have been previously used in combination with dispersion models, and the combined modelling system has been evaluated against stationary air quality measurements, e.g., in Kauhaniemi et al. (2011) and Denby et al. (2013a,b); these studies have been mentioned in the manuscript. In these previous studies, no systematic under-prediction of concentrations was detected. In Helsinki,

C2625

there is both a measurement site network maintained by the local council (HSY), and a supersite maintained by the University of Helsinki and the FMI. However, although these measurements are extensive in terms of air pollutants, these do not contain some specific measurement that are important for PM suspension, such as, e.g. detailed measurements of the dust loading and moisture at the road surfaces. The calibration of the SNIFFER measurements also requires a specifically planned campaign, such as the one described on pp. 4275-4276 in the manuscript. Such a campaign has been conducted in Helsinki, and used for the calibration of the SNIFFER measurements, as described in the manuscript on the above mentioned pages, and in more detail in Pirjola et al. (2012).

4. The uncertainty analysis is well done and states a lot of the reasons for the discrepancies between the model and measurements. The conclusion of the authors that "road dust emission models can be directly compared with mobile measurements" is certainly overstating the results in the moment. The presented comparison between the measurements and the two models is very uncertain due to the very few data points. The bias are very high and the correlation partly non-existing. Just the very overall feature of the seasonal variation fits roughly even though there are very few SNIFFER data outside the road dust season. The above mentioned aspects should be reflected in a revised manuscript in case of further publication.

Answer:

After reconsidering the results, we agree with the referee: "road dust emission models can be directly compared with mobile measurements" is an overstatement, and needs to be removed throughout the manuscript.

5. Specific comments Several of the figures need revision. It is misleading to present the total emission factors graphical together with the measurements, both in the time series plots (Fig 3 + 6) and the scatter plots (Fig 4 + 7). Only EF (van) should be presented. Also it is impossible to relate the exact hourly timing of the measurements

C2626

to timing in the models, i.e. several measurements appear at virtually the same time in the plot. Therefore consider to a) plot measurements together with both models in one graph in order to show the differences in-between the models as well and b) to show some shorter time periods zoomed around some measured data points. The plots of the modelled values are hard to read in the figures (especially in Fig. 5.+ 6.) due to the frequent and overlapping vertical lines. Consider other ways of plotting e.g. small symbols instead of connecting lines or expanding x- axis / zoom.

Answer:

We agree that Fig 5 is hard to read and it will be revised. We also agree that Figs 4 and 7 are not necessary, as the same information is shown in Tables 2 and 4 and in Figs 3 and 6; these will be removed.

References

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C2627

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C2628