Atmos. Chem. Phys. Discuss., 7, S1686–S1691, 2007
www.atmos-chem-phys-discuss.net/7/S1686/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation and modeling of the size fractionated aerosol number concentration measurements near a major road in Helsinki" *by* T. Hussein et al.

Anonymous Referee #3

Received and published: 9 May 2007

General Comments

This paper presents dual site measurements of atmospheric particles in Helsinki that were used to investigate the particle size fractionated tailpipe emissions of vehicles in the size range 8-320 nm. A combination of meteorological transport and aerosol processing models was used to predict the particle size distributions downwind the road under investigation.

Neither the type of measurements nor each individual part of the modeling techniques is particularly novel. The interesting aspects of the paper include the comparison between the measurements and the model predictions.

While the paper contains some interesting material on size distribution measurements and elaborate modeling techniques were used, the discussion of the connection between the measurements and the simulations is relatively short, and leads to conclusions of limited use. A major drawback is that the scheme of model calculations is not well documented, so that it will be hard for outsiders to follow up the results obtained.

As a whole, the scientific conclusions achieved in this paper are marginal.

The paper should therefore be published only after efforts have been made to improve the presentation of the data and the model results, and generate more substantial conclusions.

I notably recommend additional quality control of the dual site measurements with respect to the appropriate use of the background station, to strengthen the comparative aspects between measurement and modeling, as well as to explore the explicit behavior of the model system to different constituent and meteorological input parameters.

It has not escaped to me that the Anonymous Referee No. 2 has shown concern about the submission of a second paper on a very similar subject (Pohjola et al., ACPD 7, 2819-2856). It appears to me that this paper (Hussein et al.) makes a substantial use of results (particle emission factors) from that other paper, and that these play a critical role for the entire simulations made here. I therefore agree with the Anonymous Referee No. 2 that the two papers would benefit from a merger without greater loss of information, unless each of them will achieve more substantial conclusions on their own, and their mutual role in the entire project can be clarified.

If it is the case that separate publications need to be made for the sake of the fulfillment of two PhD theses, then each of the PhD students should be allowed to count that joint publication in full.

Specific Comments

Section 2.1. In Figure 1 an overview map encompassing large parts of Helsinki is pre-

ACPD

7, S1686–S1691, 2007

sented. While this map is useful to obtain a general overview, the model calculations of traffic exhaust concentrate on a much smaller environment around the road Itavayla. It is this smaller area which matters for the understanding of the pollutant measurements as well as the simulated results. Consequently, a smaller scale map encompassing the area 500 meters around the roadside measurement site should be added.

Section 2.2.1. You mention *inversion*. Do you mean *multiple charge inversion*?

Section 2.2.2. There is no statement about the absolute uncertainty of the particle distribution measurement. From which concentration difference or ratio can the size distributions at the background and roadside be considered significantly different? What are the uncertainties at the lower and upper size distribution tail?

Section 3.2. This whole section is difficult to follow. Even after reading this section several times I still do not understand how the authors modeled the size distributions. It needs to be made much clearer, how the three models are embedded into each other, or which parameters are passed over from one to the other model.

UHMA is introduced to be an aerosol process model. The authors write, however, that UHMA requires magnitudes such as traffic densities and mixed layer height. How is this possible?

UHMA describes *the condensation of sulphuric acid, organic vapours and water*. Please indicate which values of these fluxes were used to initialize UHMA. The values are among those essential for the understanding of the simulation results, and it is not sufficient to refer to another source of literature.

Section 4: I guess that this results section could be much better structured if subsections were introduced.

As much as 5 full pages of the final print version of the manuscript (Fig. 3-6 and 10) are devoted to show explicit time histories of original data. This is quite a lot compared to the overall length of the actual experiment. Have you considered selecting a few of

ACPD
7, S1686–S1691, 2007

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these graphs or condensing this information towards its salient features?

Figure 8: This figure is very busy. I wonder whether the figure could not be replaced by a table which summarizes the modal parameters in compact statistical form. In addition, it would be worthwhile to provide a sub-set of modal parameters for those episodes compared with simulations, so that other researchers can refer to these values for their own simulations.

Figure 9: Please indicate bars of uncertainty of the correlation coefficient in this Figure.

Questions/Suggestions

Background reference values: Figure 7 (case IV) demonstrates that there are cases when the roadside concentrations were much below those at the background. This feature in the data needs more explanation, since it means that the background site might in fact not always be suitable to serve as a background site. (It might probably be less suitable than can be judged from looking at the few case studies presented. In Fig. 1 the background site is shown to be located closer to the densely populated parts of the city center of Helsinki than the background site, which could be an apparent reason for this). An approach could be to plot the wind-directional dependence of particle concentration at the two stations over the entire measurement period. Distinct wind sectors should then be defined, which warrant an appropriate use of the assumption roadside concentrations $>$ background concentrations. The uncertainty in this assumption should also be discussed in its effect on the results.

One of the major input parameters of the model is the size-dependent particle emission factor. The quality of the comparison between simulation and model will greatly rely on the choice of this parameter. Since this parameter is so important, more direct information is necessary under which circumstances the parameter was obtained. A plot of this size-dependent particle emission factor would be useful as an appendix. In this case, it is not sufficient to refer to another paper.

ACPD

7, S1686–S1691, 2007

The share of heavy duty vehicles (HDV) is only available as an average figure. Do you think that a diurnal variation of this HDV traffic share can be neglected in the discussion of the results?

Although a complete aerosol dynamics model was used, we learn only little about the concrete values of coagulation losses and condensation growth as relevant over the transport distance between road and receptor point. In Fig. 10, it appears that the simulated size distributions have significantly greater mean diameters than in the observations. Can you attribute these deviations to aerosol dynamics processes or dilution processes, or can they again only be explained by uncertainties in the particle emission factors used?

The diurnal cycle of vehicular traffic shows two pointed maxima in the morning and in the afternoon (Fig. 2). The afternoon traffic always exceeds the morning maximum in peak traffic volume. The experimental particle concentrations, however, usually show afternoon values that are lower than the morning values, probably due to diurnal changes in meteorological dilution. Can you check whether the model reproduces the actually observed (average) diurnal trends of particle concentrations? Such aspects of dispersions simulations have seldom been shown.

Technical Issues

Section 5: It is an unfortunate choice to write a separate section out of five lines of text. These results could be integrated easily into a restructured Section 4.

Language: While the overall standard of English in the paper is satisfactory, the manuscript appears to be unnecessarily flawed by grammatical errors (use of prepositions, the tense, the definite and the indefinite article), typesetting errors, and several awkward sentences. Can some of the native speakers among the authors fulfill the appropriate corrections in the text? An incomplete list of examples: Model evaluation exercise aiming to predict, Measurement site locations, Distribution spectra...

ACPD

7, S1686–S1691, 2007

Figure 11 is unacceptable in this form — Major areas of data points are obscured by the legend.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 4001, 2007.

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7, S1686–S1691, 2007