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Atmos. Chem. Phys., 7, 4065-4080, 2007
www.atmos-chem-phys.net/7/4065/2007/

Evaluation and modelling of the size fractionated aerosol particle number concentration measurements nearby a major road in Helsinki – Part I: Modelling results within the LIPIKA project

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Abstract. A field measurement campaign was conducted near a major road "Itäväylä" in an urban area in Helsinki in 17–20 February 2003. Aerosol measurements were conducted using a mobile laboratory "Sniffer" at various distances from the road, and at an urban background location. Measurements included particle size distribution in the size range of 7 nm–10 μm (aerodynamic diameter) by the Electrical Low Pressure Impactor (ELPI) and in the size range of 3–50 nm (mobility diameter) by Scanning Mobility Particle Sizer (SMPS), total number concentration of particles larger than 3 nm detected by an ultrafine condensation particle counter (UCPC), temperature, relative humidity, wind speed and direction, driving route of the mobile laboratory, and traffic density on the studied road. In this study, we have compared measured concentration data with the predictions of the road network dispersion model CAR-FMI used in combination with an aerosol process model MONO32. For model comparison purposes, one of the cases was additionally computed using the aerosol process model UHMA, combined with the CAR-FMI model. The vehicular exhaust emissions, and atmospheric dispersion and transformation of fine and ultrafine particles was evaluated within the distance scale of 200 m (corresponding to a time scale of a couple of minutes). We computed the temporal evolution of the number concentrations, size distributions and chemical compositions of various particle size classes. The atmospheric dilution rate of particles is obtained from the roadside dispersion model CAR-FMI. Considering the evolution of total number concentration, dilution was shown to be the most important process. The influence of coagulation and condensation on the number concentrations of particle size modes was found to be negligible on this distance scale. Condensation was found to affect the evolution of particle diameter in the two smallest particle modes. The assumed value of the concentration of condensable organic vapour of 10^{12} molecules cm^{-3} was shown to be in a disagreement with the measured particle size evolution, while the modelling runs with the concentration of condensable organic vapour of 10^{9}–10^{10} molecules cm^{-3} resulted in particle sizes that were closest to the measured values.

Final Revised Paper (PDF, 1085 KB) Discussion Paper (ACPD)

Citation: Pohjola, M. A., Pirjola, L., Karppinen, A., Härkönen, J., Korhonen, H., Hussein, T., Ketzel, M., and Kukkonen, J.: Evaluation and modelling of the size fractionated aerosol particle number concentration measurements nearby a major road in Helsinki – Part I: Modelling results within the LIPIKA project, Atmos. Chem. Phys., 7, 4065-4080, 2007. Bibtex EndNote Reference Manager