



Population exposure to atmospheric particles (PM) caused by emissions in Stockholm - local and regional/European scale modelling

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Local and regional-scale model calculations have been performed to estimate the effects of emissions in Stockholm on the population exposure to particulate matter (PM) within the city, in surrounding areas, and in the rest of Europe. The impacts of five different emission sources were investigated: Road traffic exhaust, split into Light Duty Vehicles (LDV) and Heavy Duty Vehicles (HDV), Sea Traffic, Power Plants and Residential Heating. The emissions from non-exhaust (mainly road wear due to use of studded tyres) were also treated, in addition to combustion sources.

The calculated impact of the Stockholm emissions on atmospheric concentrations of particles were weighted by the population distribution and the calculated yearly average total European population exposures for the different sources are summarised below (unit: person $\mu\text{g}/\text{m}^3$).

Wear particles:

Road Traffic 2 520 000

Directly emitted PM:

LDV-exhaust 150 000, HDV-exhaust 55 000, Sea Traffic 17 000, Power Plants 87 000, Residential Heating 178 000 - 886 000

Secondarily formed inorganic particles (nitrate, sulphate, ammonium):

LDV 315 000, HDV 117 000, Sea Traffic 70 000, Power Plants 193 000, Residential Heating 26 000 - 70 000

Non-exhaust (road wear) particles dominate the total impact on PM10 exposure, contributing about 60-70% to the total exposure, due to all the studied sources in Stockholm. The calculated population exposure to the wear particles is to a very large extent (87%) occurring within the Stockholm area.

The uncertainties in the emission estimates for Residential Heating using biomass (wood) are very large but it seems to be an important PM source in Stockholm. Two different estimates of the emissions were used; in the lowest estimate, which seems more realistic, the contribution to population exposure of directly emitted combustion particles from residential heating is of similar magnitude (178 000 person $\mu\text{g}/\text{m}^3$) as the contribution from road traffic exhaust (205 000 person $\mu\text{g}/\text{m}^3$). For all sources, except Sea Traffic, the total population exposure to combustion PM is much larger within Stockholm than outside; for shipping the total exposure is about as large outside the city as within.

For all sources, except residential heating, the secondary inorganic aerosol (SIA) exposure is higher than the combustion particle exposure. Most of the SIA exposure occurs outside the Stockholm area.