Black carbon concentration trends at urban site in Helsinki during ten years

L. Järvi\textsuperscript{1}, H. Junninen\textsuperscript{1}, A. Karppinen\textsuperscript{2}, A. Virkkula\textsuperscript{2}, R. Hillamo\textsuperscript{2} and M. Kulmala\textsuperscript{1}

\textsuperscript{1}Department of Physical Sciences, University of Helsinki, P.O. Box 64, FIN-00014, Helsinki, Finland
\textsuperscript{2}Finnish Meteorological Institute, Erik Palménin Aukio 1, 00560 Helsinki, Finland

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Black carbon (BC) is one of the main constituents in particulate matter, especially in particles originating from urban anthropogenic sources. Majority of BC is generated in incomplete combustion of fossil and biomass fuels, includes residential heating and traffic, especially diesel powered (e.g. Watson et al. 1994). BC has an important role in global climate change since it absorbs sun radiation at the atmosphere (Jacobson, 2001). Small carbonaceous particles have also severe health effects including cardiopulmonary and respiratory diseases (e.g. Stoeger et al., 2006).

The purpose of this study is to investigate the BC trends in Helsinki between 1996 and 2005. Measurements were made during three campaigns at the same site, which represents typical urban area in Helsinki. One of the main roads leading to Helsinki center is situated 13 m away from site, and traffic has been identified to be the main source of BC at the site (Pakkanen et al., 2000). All measurements were made with aethalometers (Magee Scientific Aethalometer). The first campaign lasted from Nov 1996 to Jun 1997, the second from Sep 2000 to May 2001 and the third from Mar 2004 to Oct 2005. Same amount of data was selected from all campaigns, total of 82 days.

That, how much of the BC concentration changes can be explained by improved traffic technology and how much by sole meteorology, are studied via multivariable analysis. Hourly traffic rates from the road next to the site are used and the meteorological data (including Obukhov length and mixing height) is computed by meteorological preprocessing model (MPP-FMI, Karppinen et al., 2000).

Table 1. The median BC concentrations and quartile deviations, and average daily traffic rates and standard deviations during different campaigns.

<table>
<thead>
<tr>
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<th>BC \textsuperscript{(µg/m\textsuperscript{3})}</th>
<th>Traffic rates (vehicles/day)</th>
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</thead>
<tbody>
<tr>
<td>Campaign 1</td>
<td>1.11 (0.60)</td>
<td>25 600 (5790)</td>
</tr>
<tr>
<td>Campaign 2</td>
<td>0.93 (0.4)</td>
<td>25 400 (6090)</td>
</tr>
<tr>
<td>Campaign 3</td>
<td>1.00 (0.56)</td>
<td>26 400 (5940)</td>
</tr>
</tbody>
</table>

The BC concentrations have had slightly decreasing trend, from 1.11 to 1.00 µg/m\textsuperscript{3}, between campaigns 1 and 3 (Table 1). However, the concentrations were lowest during campaign 2. At the same time, traffic rates have increased from 1996 to 2005, suggesting decreased emissions per vehicle.

The diurnal cycle of BC showed a clear rush hour related pattern during weekdays (Fig. 1a). Lowest daytime concentrations were measured during campaign 2 and highest during campaign 1, following the mean concentrations in table 1. The deviations of weekend concentrations were smaller between the campaigns with lowest values during campaign 3.

The BC concentrations seem to have decreased between campaign 1 and 3, with lowest concentrations during campaign 2. In the presentation, results from the multivariable analysis are also shown.

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