

## Abstract streamlining

Abstract: In this study, we present results of 12 years of black carbon (BC) measurements at 14 ~~different~~ measurement sites around the Helsinki metropolitan area (HMA) and at one background site outside the HMA. The main local sources of BC in the HMA are traffic, and residential wood combustion in fireplaces and sauna stoves. All the BC measurements were conducted optically and therefore we refer to the measured BC as equivalent BC (eBC). Measurement stations were located ~~at-in~~ different ~~types-of~~ environments that represented traffic environments ~~s-(six sites)~~, detached housing areas ~~s (five sites)~~, urban background ~~(two sites)~~, and regional background ~~sites-(two sites)~~. The measurements of eBC were conducted during 2007 ~~through-~~ 2018; however, the times ~~period~~ and the length of the ~~time~~ series varied ~~byfrom~~ site ~~to-site~~. ~~As expected, t~~The largest annual mean eBC concentrations were measured at the traffic sites ( $0.67 - 2.64 \mu\text{g m}^{-3}$ ) and the lowest at the regional background sites ( $0.16 - 0.29 \mu\text{g m}^{-3}$ ). The annual mean eBC concentrations at the ~~detached~~-housing sites varied ~~in the range offrom~~  $0.64 \text{ to-}$   $0.80 \mu\text{g m}^{-3}$  and the annual mean eBC concentrations at the urban background sites varied ~~in the range offrom~~  $0.42 \text{ to-}$   $0.68 \mu\text{g m}^{-3}$ . The clearest seasonal variation was observed at the ~~detached~~-housing sites, where ~~the~~ residential wood combustion increased the eBC concentrations during the cold season. Traffic rates and wood burning influenced ~~the~~ diurnal and weekly variations of eBC concentration in different types of environments. The dependency was not so clear for the other air pollutants, which were ~~here~~  $\text{NO}_x$  and mass ~~concentration~~ of particles smaller than  $2.5 \mu\text{m}$ . The ~~dependen~~four sites, which had at least four-year-~~long~~ time series available, ~~we observed that~~ the eBC concentrations had statistically significant decreasing trends, which varied in the range of  $-10.4 \text{ to-}$   $-5.9 \%$  yr<sup>-1</sup>. Compared to ~~the~~ trends determined at the urban and regional background sites, the absolute trends decreased ~~the~~ fastest at ~~the~~ traffic sites ~~and~~, especially during ~~the~~ morning rush hour. ~~The r~~Relative long-term trends of eBC and  $\text{NO}_x$  were similar ~~to each other~~, and their concentrations decreased more rapidly than ~~the concentration that~~ of  $\text{PM}_{2.5}$ . ~~These~~ results indicate that especially ~~the~~ emissions from traffic have decreased in the HMA during the last decade. This shows that air pollution control, new emission standards and ~~a~~ newer fleet of vehicles really have an effect ~~in the on~~ air quality.