Did policies to abate atmospheric emissions from traffic have a positive effect on particulate matter in London? Using a large population of monitoring sites to investigate recent changes in ambient concentrations.

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A large number of policy initiatives are being taken at the European level, across the United Kingdom and in London to improve air quality and reduce population exposure to harmful pollutants from traffic emissions. The Euro emission standards were introduced in the early 1990s to reduce exhaust emissions from new vehicles and tighter standards have been introduced in the last two decades. At the more local scale, the London Low Emission Zone was implemented in 2008 limiting the entrance of the most polluting Heavy Good Vehicles (HGVs). These and other local initiatives aimed to reduce the roadside concentrations of air pollutants.

This study was designed to evaluate the success of policies to tackle and reduce the PM concentrations in London with special focus on traffic emissions. Trends in roadside increments in particulate matter ΔPM_{10} (36 monitoring sites) and $\Delta PM_{2.5}$ (12 monitoring sites) and black carbon (ΔCBLK) (3 monitoring sites) were examined for 2010-2014. Changes in roadside increments were related to changes in traffic data and traffic composition and also to specific policies. City-wide trends were calculated using statistical approaches used in epidemiological meta-analysis that consider individual and population-wide variability, that is, the linear Random-Effects Model estimator.

Results

The city-wide trend in ΔPM_{10} had confidence intervals including zero and was not statistically significant. By contrast $\Delta PM_{2.5}$ showed statistically significant downward trend of -28 % year^{-1}; ΔCBLK also observed a general significant downward trend at a rate of –11% year^{-1} (Table 1).

Table 1. Overall trends in ΔPM_{10}, $\Delta PM_{2.5}$ and ΔCBLK for 2010-2014. Brackets denote 95% confidence intervals.

Pollutant	Overall absolute trend (µg m^{-3} year^{-1})	Overall percentage trend (% year^{-1})
ΔPM_{10}	0.1 [-0.1, 0.3]	1.1 [-2.1, 4.3]
$\Delta PM_{2.5}$	-0.7 [-1.0, -0.4]	-28.3 [-14.7, -42.0]
ΔCBLK	-0.6 [-1.0 -0.2]	-11.3 [-3.4, -19.2]

The comparison between trends in $\Delta PM_{2.5}$ and trends in ΔPM_{10} indicates that the majority of sites in inner London (<10 km from the city centre) experienced a downward trend in both PM fractions at similar rates. This downward trend in ΔPM_{10} could be therefore attributed to the decrease in the fine fraction. The majority of sites in outer London (>10 km) experienced an increase in ΔPM_{10} while $\Delta PM_{2.5}$ decreased (sites in the right bottom quadrant in Figure 1A). The decrease in ΔCBLK was consistent with the decrease in ΔPM_{10} and $\Delta PM_{2.5}$ (Figure 1B, C) with trends aligned in the 1:1 line.

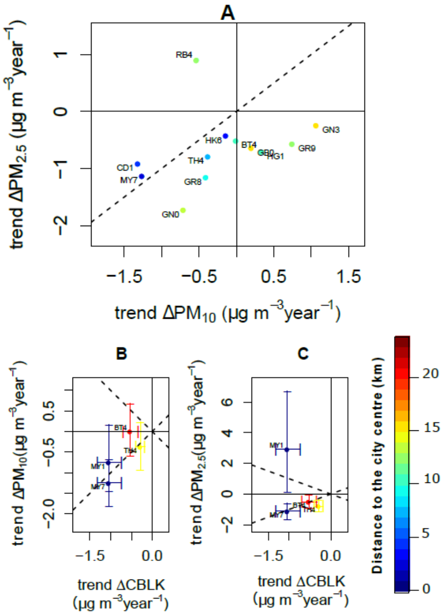

Figure 1. A) Trends in $\Delta PM_{2.5}$ vs trends in ΔPM_{10}; B) trends in ΔPM_{10} and C) trends in $\Delta PM_{2.5}$ vs trends in ΔCBLK. Dashed line indicates the 1:1 line.

Discussion and conclusions

Although city-wide $\Delta PM_{2.5}$ decreased in 2010-2014, ΔPM_{10} remained broadly constant with indications of a slightly positive trend. This suggests an increase in the coarse fraction. PM coarse is associated with non-exhaust traffic emissions such as resuspension from the road, brake and tyre-wear. The increase in the coarse fraction was seen mainly in roads in outer London with increased HGVs. Changes in traffic at these locations therefore counteracted the benefits of emissions control for PM_{10}. Where collocated, CBLK changes confirmed that the decrease in $\Delta PM_{2.5}$ was largely explained a decrease in traffic exhaust emissions. These emissions changes were due to a combination of decreased traffic flows and also an improvement in emission standards by all vehicle categories.

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