

Extended Abstract

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The Black carbon monitoring project of 'Area C', the new Milan city center traffic restriction zone. Results of the 2012 wintertime campaign at urban residential sites.

Background. Many factors contribute to the high particulate matter (PM) levels in Milan, a city located in the Po Valley, Italy, which is one of the most polluted EU areas. Road traffic is an important pollution source, and many traffic restriction interventions have been implemented in the recent years to improve air quality in the city center¹. However, so far the evidence of PM reduction has been scanty².

By January 16th 2012 the Milan Municipality implemented new private traffic restriction scheme called 'Area C', which prohibits the circulation of diesel cars Euro 0, 1, 2, and 3, while a ticket is required for Euro 4 and 5, and for gasoline fuelled cars Euro 1-6 (Fig. 1).

Only electric and hybrid cars, and those fuelled with GPL and methane are allowed to enter Area C for free. Area C is operating on workdays from 07:30 am to 07.30 pm. Such a regulation was introduced in observance to the results of a public referendum indicating that the vast majority (79%) of Milan citizens wanted to potentiate public transports and to limit traffic-related pollution.

The Milan Municipality is currently carrying out an air quality monitoring project to assess the effects of Area C by using black carbon (BC) measurement, which is being proposed as a new metric of particulate pollution more suitable for the assessment of traffic sources than PM10 and PM2.5³⁻⁷. The project will cover air quality measurements in winter, summer and fall with

fixed monitoring sites at urban residential locations and studies of personal exposure to traffic proximity or in pedestrian zones.

In the present report we show the results of the wintertime campaign.

Aims. To compare BC, PM10 and PM2.5 concentrations inside and outside the traffic restriction zone at two urban residential sites in the wintertime.

Methods. Two urban residential sites were chosen, one in the city center inside Area C (Beccaria Street, Fig.2), the other 3 km far away, placed outside the restriction zone (Porpora Street, Fig.3). The monitors were placed on the terrace of two 3rd floor flats, and left operating from Feb 6th to Feb 26th 2012. PM10 and PM2.5 concentrations were measured with two real time optical counters (Aerocet, MetOne, USA), while black carbon concentrations were measured with two aethalometers (Magee Instruments, USA). The instruments have been precalibrated with urban ambient air before operating.

Results. During working days with restriction in force, inside and outside Area C 24h mean (SD) black carbon concentrations were 5.6 (1.9) $\mu\text{g}/\text{m}^3$ and 7.8 (2.5) $\mu\text{g}/\text{m}^3$ respectively ($p < 0.0001$), which represents an absolute difference of 2.2 $\mu\text{g}/\text{m}^3$ (or -28%) in the traffic restriction zone as compared to the outside area (Fig. 4). A non significant difference was observed for PM10 concentrations: 89.4 (25.4) $\mu\text{g}/\text{m}^3$ and 91.1 (27.3) $\mu\text{g}/\text{m}^3$, respectively inside and outside (Fig.5). Similarly, PM2.5 concentrations did not differ significantly, 48.6 (17.4) $\mu\text{g}/\text{m}^3$ and 53.6 (18,0) $\mu\text{g}/\text{m}^3$, respectively (Fig. 6).

Overall BC/PM10 and BC/PM2.5 ratios were 32% ($p < 0.001$) and 25% ($p = 0.014$) lower in the restriction zone as compared to the outside area (Fig. 7 and 8). Figure 9 shows hourly data of Black carbon concentrations, number of vehicles, boundary layer mixing height and heating power plants consumption profile in a typical working day.

It's possible to observe the high influence of traffic on daily BC profile despite the contribution of meteorological dispersive conditions and heating power plants in winter season.

Conclusions. The wintertime air quality campaign showed a significant reduction in mean BC concentrations in the Area C traffic restriction zone as compared to the no restriction zone. No significant differences were observed in both PM10 and PM2.5 concentrations between the two different traffic intensity areas. The reduction of 2.2 $\mu\text{g}/\text{m}^3$ in the mean BC concentrations in Area C represents an improvement in air quality of more than two change unit by an epidemiological standpoint, with an expected relevant reduction in morbidity and mortality⁷. Such data are very encouraging regarding the Municipality programs of air quality control and

mitigation. Black carbon confirmed its higher effectiveness in the assessment of traffic-related pollution as compared to PM.

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Figure 1. Map of Area C surrounding Milan city center.



Figure 2. The residential monitoring site at Beccaria Street, inside Area C.



Figure 3. The residential monitoring site at Porpora Street, outside Area C.



Figure 4. Mean black carbon concentrations outside and inside the Area C traffic restriction zone.

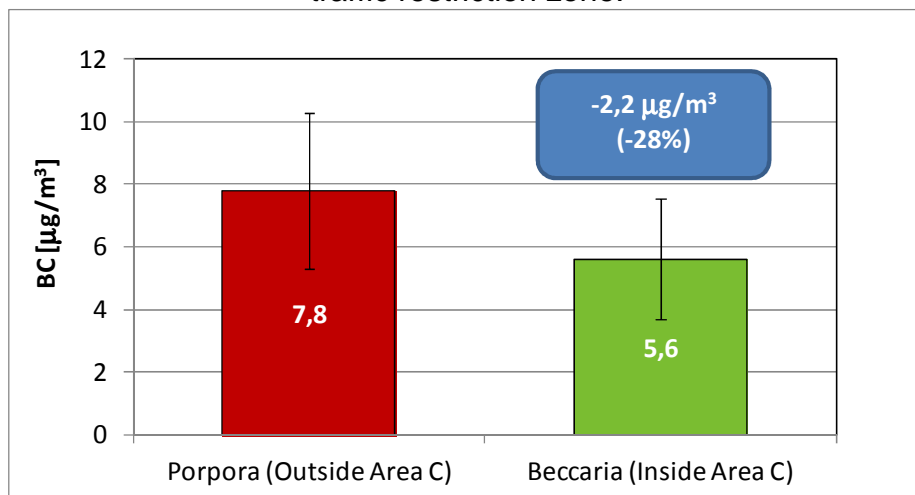


Figure 5. Mean PM10 concentrations outside and inside the Area C traffic restriction zone.

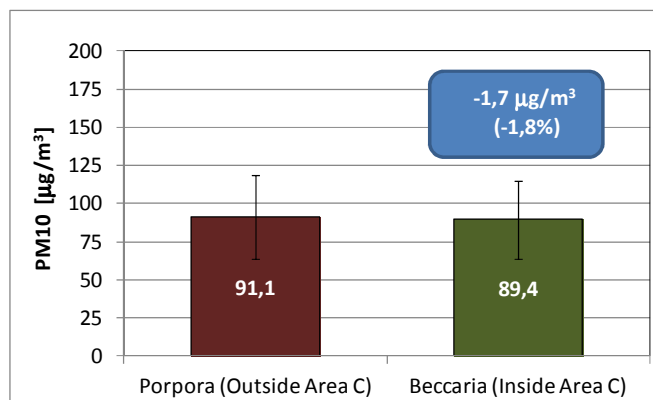


Figure 6. Mean PM2.5 concentrations outside and inside the Area C traffic restriction zone.

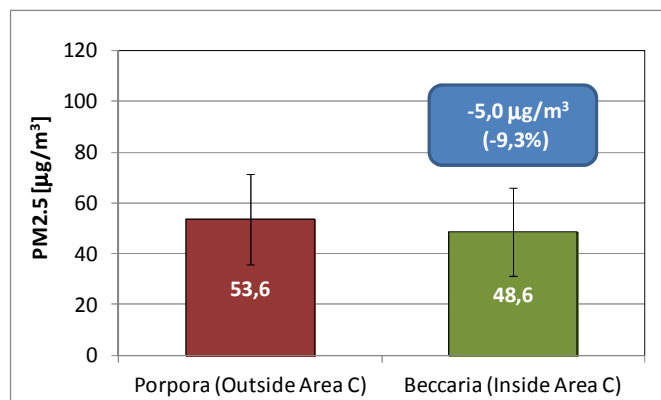


Figure 7. BC/PM10 ratios outside and inside the Area C traffic restriction zone.

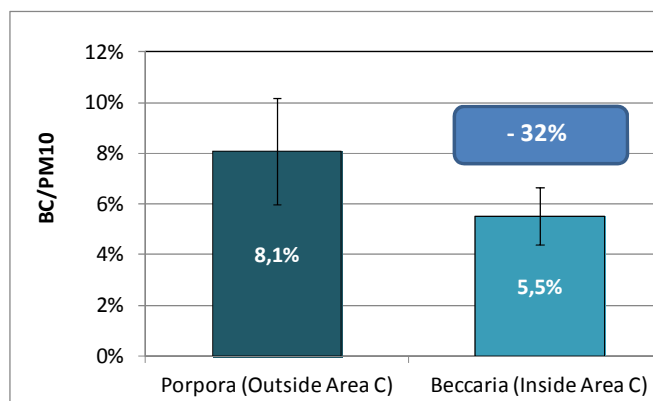


Figure 8. BC/PM2.5 ratios outside and inside the Area C traffic restriction zone.

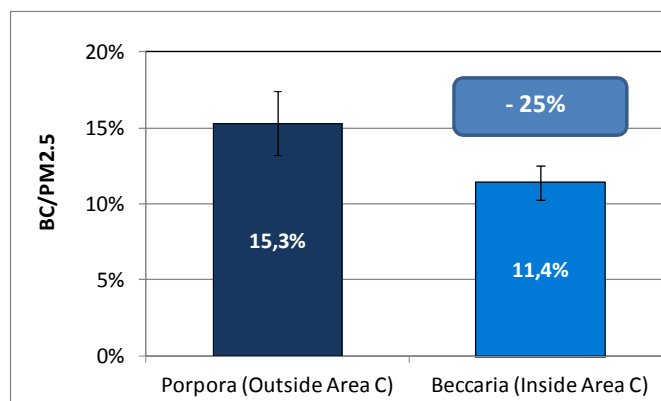


Figure 9. Hourly data of Black carbon concentrations, number of vehicles, boundary layer mixing height *10, and heating power plants consumption profile in a typical working day.

