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Black carbon concentration levels along pedestrian routes in Milan

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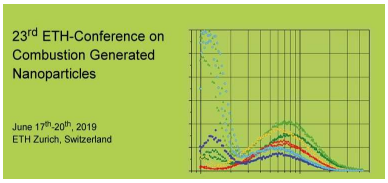


Background

- High concentration levels of black carbon (BC), which have been linked to health problems, are typical for urban environments, as airborne BC is related to vehicular traffic emissions.
- In urban areas the spatial variability of BC concentration reflects changes in both the strength of local sources and in the atmospheric mixing characteristics, which can be strongly influenced by the built environment, especially when buildings flanking the streets on both sides create the so called urban canyons.
- BC concentration levels have been measured at 10-s time resolution (about 10 m space resolution) along three pedestrian routes in Milan.
- Simultaneous field measurement of BC were taken while walking the routes and at an urban background monitoring site in the University campus area by means of two AethLabs AE51 micro-aethalometers.
- The field campaigns, covered both the cold and the warm season with two weekdays sessions (morning and afternoon rush hours), were designed in order to investigate the spatial and temporal variability of the personal exposure concentrations to BC due to the fresh emissions from road traffic.

Monitoring routes

Large ring route

- 10-km route around the University campus area, extending both towards the city centre (West side) and the outskirts of the city (East side)
- 2 consecutive rounds per monitoring session

Small ring route

- 5-km route in the University campus area
- 4 consecutive rounds per monitoring session

Monitoring campaigns were part of the Black CaT (Black CArbon Tool) project funded by Fondazione Cariplo in 2015

City centre transect

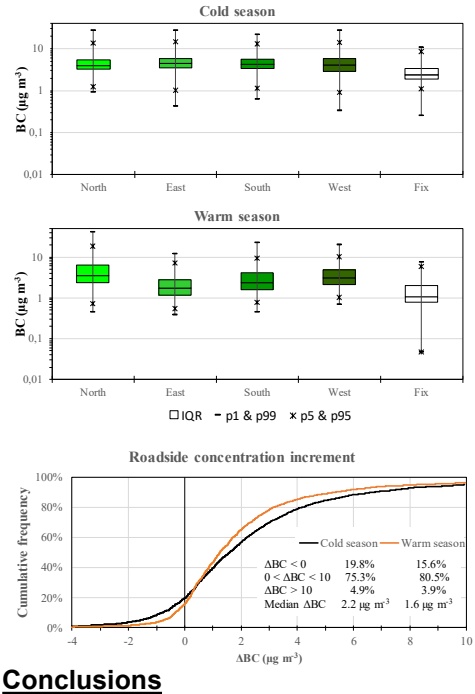
- 8.5-km route in Milan city centre walked forth and back in each monitoring session
- five different urban zones crossed, with different traffic regulation (congestion charge area: Area C)

Zone	Length	Features
OCN	1.6 km	High traffic, Outside Area C
ICN	1.2 km	Heavy traffic, Inside Area C
IPA	1.2 km	Pedestrian zone
ICS	1.8 km	Low traffic, Inside Area C
OCS	2.7 km	High traffic, Outside Area C

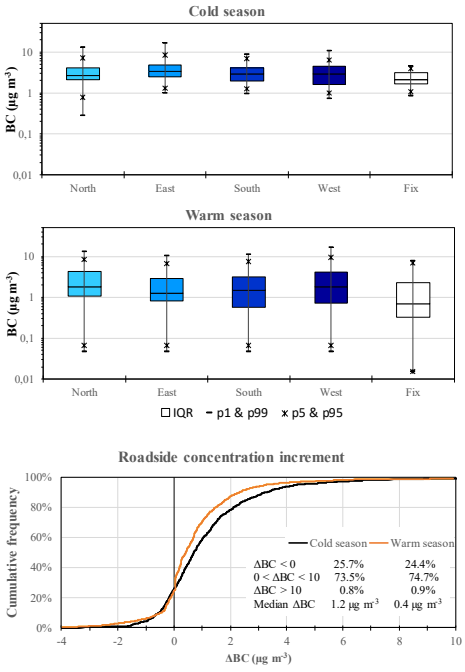
- concurrent particle number measurement (PNC) in the 20-1000 nm range by TSI P-Trak 8525

Results

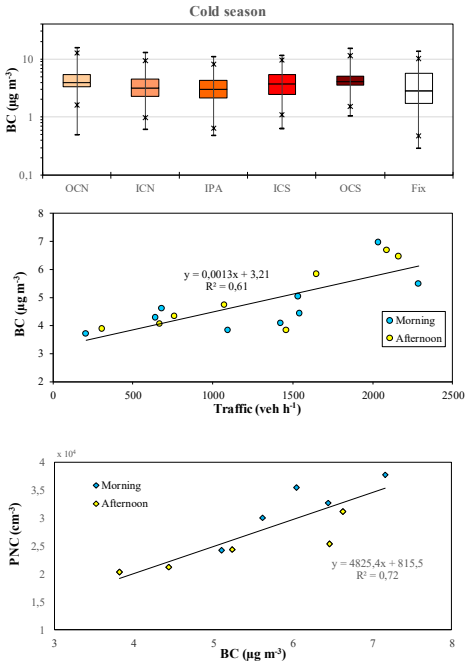
Large ring route (LRR)



Small ring route (SRR)



City centre transect (CCT)



Conclusions

- Seasonal BC levels at the background monitoring station in the orders of 0.7-1 μg m^{-3} (warm season) and 2.1-2.7 μg m^{-3} (cold season)
- Roadside BC increment on 75% of the time on SRR and on 80-85% on LRR: peak increments (ΔBC > 10 μg m^{-3}) almost only on LRR
- ΔBC increment more relevant along the LRR (1.6-2.2 μg m^{-3}) than on the SRR (0.4-1.2 μg m^{-3})
- Good correlation between BC levels and traffic flow rates along CCT
- Good correlation between BC and PNC concentration along CTT: highest BC and PNC levels outside the congestion charge Area C
- BC and PNC levels in the pedestrian area in the city centre slightly higher than at the background monitoring station