

#1104 POSTER

QUANTIFICATION OF BLACK CARBON (BC) AND ITS PHYSICAL FRACTIONATION IN URBAN AND PERIURBAN SOILS ACROSS THE METROPOLITAN AREA OF MILAN (ITALY)

GT 10. Soil Carbon Dynamics and Stabilization / GT 03. Soil Biogeochemistry & Global Change

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ABSTRACT TEXT

Black carbon (BC) is a recalcitrant component of organic carbon, derived from the incomplete combustion of biomass and fossil fuels. In urban environments, BC is mainly associated with vehicular traffic, domestic heating, and industrial emissions, and can accumulate in soils, where it plays a role in long-term carbon sequestration and contaminant dynamics.

In this study, we investigated BC distribution and stabilization in urban and periurban green spaces across the metropolitan area of Milan (northern Italy). Soil samples were collected from 0-10, 10-20 and 20-40 cm depth across various land uses, including public urban parks (UPC and UP, both inside and outside the historical city centre), public periurban parks (PP), periurban reforested areas (PPf), small green spaces (SGS), spontaneous forests - urban woodlands (uW) - developed over former industrial areas inside the city, and mature woodlands (W) in the hinterland of Milan. Forested areas were further grouped by age: younger than 30 years, between 30 and 80 years, and older than 80 years. BC content was determined, following carbonate removal, through the CTO-360 method followed by CN elemental analysis. In addition, surface samples (0-10 cm) underwent physical fractionation into particulate organic matter (POM) and mineral-associated organic matter (MAOM), both for TOC and BC pools. Fractionation is currently being extended to the 10-20 cm layer.

Alongside BC, we also analysed soil pH, texture, total organic carbon (TOC), total nitrogen, and available phosphorus.

Preliminary results indicate that BC represents a significant fraction of TOC (BC_{0-40 cm}:TOC_{0-40 cm} = 10.3 ± 5.7 %). BC is particularly concentrated in the surface horizon (BC_{0-10 cm} = 4.38 ± 0.54 g kg⁻¹), where spatial variability is high, especially due to the presence of mature woodlands (>150 years), which exhibit remarkably elevated values (TOC_{0-10 cm} = 78.43 ± 8.25 g kg⁻¹; BC_{0-10 cm} = 18.91 ± 3.94 g kg⁻¹).

The relative distribution of BC between POM and MAOM varies across land uses and appears related to the distance from the urban centre. Soils from central urban parks, urban parks, and small green spaces show higher proportions of BC associated with the POM fraction (BC_{POM}:BC_{0-10 cm} = 65.9 %), whereas mature woodland soils show greater BC association with the MAOM fraction (BC_{MAOM}:BC_{0-10 cm} = 60.3 %).

This pattern suggests differences in BC stabilization pathways depending on soil management, organic matter dynamics, and time since deposition. In particular, the predominance of BC in the MAOM fraction in mature forest soils likely reflects enhanced stabilization due to higher organic matter inputs, microbial activity, and physical protection, whereas in urban soils, BC remains largely associated with the more labile POM pool due to limited biological incorporation and recent anthropogenic deposition. Notably, urban woodlands exhibit high BC-POM proportions (BC_{POM}:BC_{0-10 cm} = 74.3 %), likely

reflecting legacy pollution from the decades of coal transport and storage in the early 1900s. In fact, in some sampling locations, visible charcoal fragments were observed in the field, supporting the hypothesis of localized BC inputs.

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