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Black Carbon in Paved Urban Soils

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The term "Black Carbon" comprises a broad continuum of substances, which are the result of incomplete combustion of biomass or fossil fuels like char, charcoal and diesel soot. Although urban areas are important sources of black carbon (BC), the sink function of urban soils, especially the paved roadside urban soils has not been assessed yet.

It was the goal of this study, to quantify the BC contents in these soils and to approximate the BC masses stored in urban roadside soils worldwide. Furthermore, we evaluated the sink function of urban roadside soils in Berlin by comparing deposited masses of BC with accumulated masses. PAHs were used as markers to identify the source of the accumulated BC. We were then interested in the sources of the deposited BC.

In this study, paved urban soils of Paris, Berlin and Warsaw have been analysed for BC using benzene polycarboxylic acids as markers. The EPA-PAHs have been analysed using methanol ASE and HPLC-FD. All samples have been analyzed for the magnetic susceptibility. High susceptibilities would indicate certain iron oxides which originate from fossil fuel combustion rather than other sources.

The BC contents for the upper layer show an average of 3.4 g kg^{-1} (SE = 0.3 g kg^{-1}). BC accounts for 17 % of the C_{org} in the upper layer. In the 1 to 5 cm layer below, representing the unaltered construction material, the average BC content is significantly lower (0.5 g kg^{-1}). The concentrations of the sum of the EPA-PAHs varies from 2.3 to 11 mg kg^{-1}.

An approximation of the total masses of BC stored in paved soils on the global scale demonstrates the importance of urban soils for global carbon balances: Although only 15 % of the global urban area has been considered as traffic area and only 30 % of this area has been considered to be open soil surface and only the first 5 cm has been considered to contain BC, a mass of up to 2×10^{12} g is stored. Although this is only around 25 % of the annual BC emissions caused by fossil fuel burning, at certain urban sites the sink function can be much higher. In a Berlin residential area we found accumulated BC which equals 15 % of the BC depositions of the last 60 years.

This demonstrates the high potential functionality of urban soils to act as sinks for contaminants, here the fine dust relevant BC. It further points to the importance of open soil surfaces in the city and contributes to the discussion on the questions how much urban soils do we need and where.