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Sealing changes properties and depletes the bacterial diversity in urban soils

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Urbanisation is driving the expansion of cities, which will inevitably alter the chemical, physical and biological properties of soil in newly developed areas, modifying environmental soil services, as such flood mitigation, reducing the urban heat island effect, capturing air pollution, supporting greenspaces for physical and non-physical health benefits, and keeping the nutrient cycling and carbon storage. Soil sealing – the sealing of soil beneath non-biological strata or structures with limited permeability – is an important consequence of urbanization and has gained attention as it is connected with flooding, loss of soil carbon, loss of soil function and other problems in urban areas. Here we sampled soil beneath three pavement types (concrete, slab and tarmac) and from paired unsealed areas representing four different cover types (bare soil, grass, shrub and tree) in Lancaster/ UK. We used 16S rDNA metabarcoding and analysis of soil properties to understand the impact of sealing and the cover type on the chemical, physical properties, and microbial community structure of urban soils. Specifically, we asked (1) how does soil sealing impact the soil properties and bacterial alpha and beta diversity and (2) do different types of soil seal or unsealed cover type modify these effects?

Sealed soils had lower moisture, total carbon, total nitrogen and microbial biomass, and higher pH than unsealed soils. The bacterial diversity indexes (richness, Shannon, Simpson and α parameter of Fisher's log series) were significantly lower in sealed areas as well. NMDS analysis (beta diversity) showed that sealed soils were highly variable in their bacterial community structure. The variability in community structure was lower among unsealed soil samples. There were no significant differences in C/N ratio and Pielou's evenness index between sealed and unsealed soils. Our results suggest that the sealing has a negative impact on soil properties and critical aspects of microbial community structure.

The type of soil seal (concrete, slab, tarmac) had no significant effect on sealed soil properties and bacterial alpha diversity. However, soil pH varied with cover type in unsealed soil.

These results suggest that sealing leads to a reduction in bacterial diversity and microbial biomass that, in connection to the changes in soil chemical and physical properties, can affect microbial processes related to biogeochemical cycles, impacting the carbon store and the potential for nutrient cycling in soil.