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# Land use influence on 3-D distribution of soil microbiological activity in forest-steppe zone of Central Russia

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Land use is the principal factor influencing soil environmental functions and quality. Quite a few studies on soil quality mainly focus on natural and agroecosystems. Much less is known about urban ecosystems, although the urbanization effect on soil quality can be considerable. Parameters of soil microbiological activity are very sensitive to land-use change. Microbial biomass carbon (Cmic), basal respiration (BR) and microbial metabolic coefficient ($qCO_2$) are among most widely used parameters of soil microbiological activity. They are directly associated with such soil functions as fertility, microorganisms' habitat and participation in carbon cycle.
So far, most of the studies focus on the effect of land-use change on the topsoil (0-10 cm) microbiological activity, averaged for different land-use types. Much less is known about changes in spatial variability and profile distribution of Cmic, BR and $qCO_2$ in response to different land-use. Land-use influence on spatial and profile distribution of soil microbiological activity may differ between bioclimatic zones. Very fertile and rich in carbon Chernozemic soils (depth of the A horizon up to 1 m, carbon concentration up to 7-9%), dominating in forest-steppe zone are among the most sensitive to land-use change. This study aims to improve understanding of land-use influence on 3-D distribution of Cmic, BR and $qCO_2$ in Central Chernozemic region of Russia.
We observed three land-use types (fallow land, natural pasture and meadow) located in Kursk region and three contrast urban functional zone (industrial, residential and recreational) in Kursk city. Soil samples were collected by auguring in five replicas per land-use type, four layers each sampling point (0-10, 10-50, 50-100 and 100-150 cm). Cmic, BR and $qCO_2$ as well as Corg, N and pHKCl were analyzed in all the samples. Cmic ($\mu$g C g-1 soil) was analyzed based on the substrate induced respiration (SIR) approach. $qCO_2$ ($\mu$g $CO_2$–C mg–1 Cmic h–1) was calculated as the ratio of basal respiration to microbial biomass. Spatial variability of parameters were estimated through the coefficient of variance (CV%).
As a result, it was shown that averaged values of Cmic and BR were decreasing in a row meadow-pasture-fallow-urban, whereas the spatial variability was increasing. Moreover, Cmic and BR decrease, following the strengthening of the anthropogenic pressure was found within urban areas with the maximal values in recreational and residential zones and minimal – in industrial. The most significant correlation with the land-use type was found for $qCO_2$. The lowest average $qCO_2$ and CV were found for meadows, whereas the highest - for the urban industrial areas. Profile distribution of soil microbiological parameters also differed between land-use types with rapid decreasing with depth in natural areas and much more smooth (some time even bimodal) profile distribution curves in urban areas. Thus, it was shown that 3-D distribution of soil microbiological activity is a sensitive and informative criterion to analyze land-use influence.