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The effect of urban heat island and other mesoclimatic anomalies on soil C stocks and fluxes in Moscow megapolis

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Urbanization is a global tendency, which social-economic and environmental role will increase coming decades. Urbanization has a multiple effect on climate, vegetation and soils and these effects are interrelated. Specific features urban meteorological regimes including but not limited to urban heat island alters biogeochemical processes in urban vegetation and soils. Natural vegetation in cities is to a large extent substituted by introduced species. Urban soils are dominated by artificial constructions, engineered from substrates rich in organic carbon. A complex effect of the mesoclimatic anomalies in cities alter biogeochemical processes in urban soil-plat-air systems with a crucial effect on carbon balance.

This study aims to study relationships between carbon stocks and greenhouse gases' emissions from urban soils and climatic conditions in Moscow megapolis, considering its spatial heterogeneity and history. Moscow is among the largest cities in the world, Rapid urbanization of recent decades has evoked complex and ambiguous effects on soil C stocks and emissions. Soil sealing resulted from building and road construction directly reduces C stock in topsoils and indirectly effects soil respiration by salinization, pollution and over-compaction. On the other hand, establishment of new green zones brings an additional input of C through adding C-rich materials for engineering urban soils and stimulating production of root biomass by fertilization, irrigation and other practices maintaining urban green infrastructure. The research included several steps. At first, an intensive soil survey was organized in Moscow on summer 2019. Sampling scheme covered all the megapolis area and considered different functional and historical zones. Mixed topsoil (0-20 cm) samples were collected in total 240 locations. Total, organic and inorganic C was measured at the collected samples and C stocks were estimated. Second, microbial respiration in contrast soil moistures (4-5 points on water saturation curve) and temperatures (10, 20, 30 and 40ºC) were measured in standard lab conditions by gas chromatography. The multiple regression equations relating C stocks and microbial respiration to soil temperature, moisture and adjustment soil properties were developed. Finally, a regional climate model COSMO-CLM was adapted to the case of Moscow megapolis to estimate dynamics of soil temperature and moisture regimes. The investigated relationships were used to generate

maps of C stocks and microbial respiration of urban soils in Moscow as affected by mesoclimatic anomalies.

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