Driving factors behind spatial variability of soil carbon stocks in urban and non-urban areas of Moscow region

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Terrestrial ecosystems make a considerable impact on global carbon cycle (GCC) as soon as they can act both as carbon stocks and carbon sources (Ouimet, 2007). Soil organic carbon (SOC) is the largest carbon stock in terrestrial ecosystems (Janzen, 2004) and capacity for carbon sequestration is widely accepted as principal soil function (MEA, 2005; Smagin, 2005; Kudeyarov et al., 2007). SOC is an important indicator, reflecting amount of sequestered carbon on the one hand and soil's potential to emit it on the other hand.

In spite of the fact, that urbanization is one the dominating current land-use change pathways, soil organic carbon (SOC) of urban areas remains almost unknown, at least at the regional scale of analysis. However the set of specific features and processes (soil sealing, functional zoning, settlement history etc) brought by urban environment creates conditions, quite different from ones in natural and agricultural areas. In order to improve understanding of the importance of urban SOC, its variability and driving factors behind it, set of plots (n=160), representing different zonal soils, as well as natural, agricultural and urban land-use types was studied by stratified random sampling in Moscow region(Russia). Samples were taken both from topsoil (0-10cm) and subsoil (10-150 cm), thus 3D variability was observed.

The significant exceeding of urban SOC over non-urban was demonstrated and proved: mean values of 3.27±1.93% and 2.74±1.60% were obtained correspondingly (Fig.1). The same tendency was observed for most of the locations while separate analysis. Thus widely used assumption on negligibly small amount of urban SOC was contradicted.

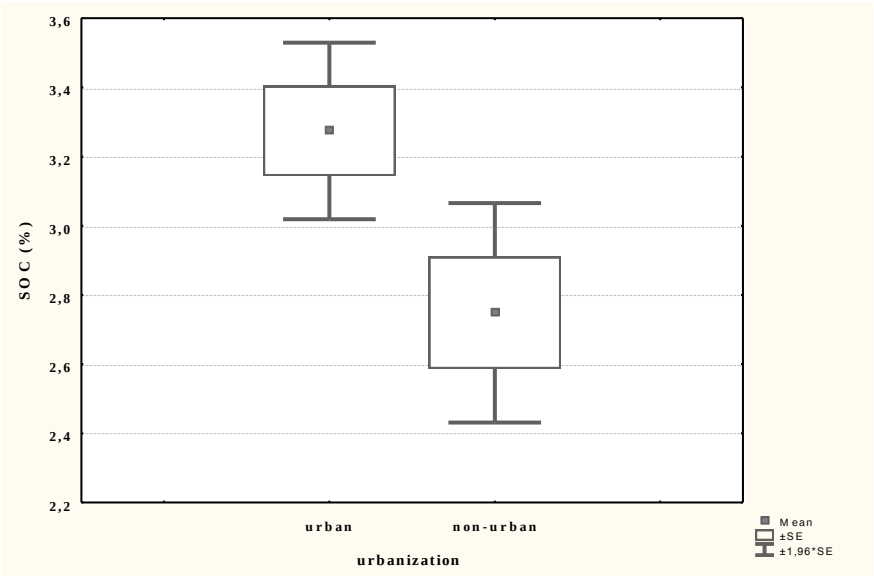

Fig. 1 Box & Whiskers Plot for SOC in urban and non-urban areas.

Influence of subsoil SOC, corresponding to “cultural layer” and correlated with settlement age (r=0.23), was shown to play the predominant role in urban carbon stocks. SOC standard deviation for settlements in different locations was shown to be 2-4 times higher than for non-urban area, which proves the considerable contribution of urban lands to regional SOC variability. Significant influence of depth, zonal soil and land-use factors on SOC variability was proved by ANOVA. These factors determined more than 30% of total variance. Influence of soil type dominated for urban topsoil, whereas for natural and agricultural areas soil type and land-use has demonstrated equal influence. Obtained knowledge on specifics of urban SOC areas enables to reconsider established views on regional SOC assessment, taking into account the significant role of the settlements’ carbon stocks.