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Assessment of soil GHG emission in different functional zones of Moscow urbanized areas

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Atmospheric greenhouse-gas concentrations are increasing rapidly, causing global climate changes. Growing concentrations of CO_2, CH4 and N2O are occurring not only as a result of industry activity, but also from changes in land use and type of land management due to urbanization. Up to now there were not so many studies in Russia that dealt with urbanization effects (functional zoning, land-use type, soil contamination etc.) on GHG emission from the soil in spatial-temporal variability at the local and regional scale. The aim of our study is to provide the analysis of soil CO_2, N2O and CH4 efflux's response to different biotic and abiotic factors, as well as to management activities and anthropogenic impact in different functional zones of the city.

The principal objects of our study are representative urban landscapes with different land-use practices, typical for urbanized area. The varieties of urban ecosystems are represented by urban forest, green lawns with different functional subzoning and agro landscapes (16 sites in total). Forest sites have been studied during 7 years and they are differing in mezorelief (small hill summit and two slopes). Green lawns vary in level of human impact (normal, medium and high) and are represented by managed and non-managed lawns. Agro landscapes are represented by two crop types: barley and grass mixture (oats and vetch) with till and no-till cultivation.

In each plot we measured: soil respiration in field conditions using system based on IR-gas analyzer Li- COR 820, CH4 and N2O emission using the method of exposition chamber. Samples were taken from soil exposition chamber by syringe, and then analyzed on gas chromatograph. The measurements with Li-COR have been done on 10 days base since June till October 2013, and till September by exposition chamber in 5 replicas per plot.

The conducted research have shown high spatial and temporal variability of CO_2, CH4 and N2O fluxes due to functional zoning, slope, vegetation type, land-use practice, soil microclimate characteristics etc. The highest CO_2 emission is typical for green lawns where the CO_2 fluxes reached 13,7 μmol CO_2m-2 s-1 which is 2 times more than the one for the urban forest, and 3 times more than for agro landscapes. The highest CO_2 emission for all plots was noticed at the beginning of measurement season and since the middle of July till August.

In total all analyzed soils are characterized by domination of CH4 uptake and N2O emission. The highest average amount of CH4 uptake is typical for green lawns – 0,66 mg/m2day, the lowest for agro landscapes – 0,1 mg/m2day, urban forest takes average position – 0,42 mg/m2day. The N2O emission of green lawns is 2 times more than emission of urban forest and agro ecosystem soils, the average meaning is about – 0,45 mg/m2day.

Both fluxes were varying strongly during the summer season. Highest N2O emission was fixed in the beginning of summer, during the observation period N2O emission decree, during July N2O uptake in agro ecosystem was noticed. CH4 fluxes (uptake) are highest in July – 0,82, 0,53, 0,38 mg/m2day for green lawn, urban forest and agro landscapes respectively. In June and August emission of CH4 below 0,2 mg/m2day was observed in case of the agro landscapes.

Our data demonstrate that the landscape management type has significant effect on gas fluxes from the soil. Particularly, in case of managed urban lawn (irrigation and fertilization) N2O emission is almost in 2 times greater then soil emission of non-managed lawn. Agro landscape with tillage emits more N2O than no-tillage and less CH4. In case of urban forest the data have shown that the value and type of GHG fluxes change with soil position in relief and soil subtype.

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