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Spatial-temporal variability of soil CO_2 emissions within urban areas in forest-steppe zone of Central Russia

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Global climate change is of the most important environmental problems. It is widely assumed that increasing concentration of greenhouse gases (GHG) is one of the main reasons of global warming. Carbon dioxide (CO_2) plays a key role in climate change because of considerable natural and anthropogenic fluxes. In comparison to all the other GHG CO_2 makes the most considerable contribution to global warming (more than 60%).
Land-use change and following alteration of carbon cycle is one the main reasons of global warming. Land use and management is the key factor distinguishing carbon stocks and fluxes of terrestrial ecosystems. Urbanization is one the most rapid current land-use change trends. Urbanization results in fundamental transformations in matter and energy fluxes, vegetation and soil cover. Urban soil is the key element in urban ecosystems. They are principally different from natural ones in respect of physical, chemical and biological features and fluxes.
Urban soils can play a considerable role in carbon budget. Carbon stocks of urban soil can be considerable, although soil respiration is also high because of intensive mineralization of turf-sand substrates, used for urban soils' construction.
Urbanization effect on soil carbon stocks and fluxes varies between bioclimatic zones. Central Chernozemic region in general and Kursk city in particular provide a promising study, because natural regional soil cover represented by grey forest soils and chernozems. Relative carbon stocks in chernozems and grey forest soils are among the highest in the world, although soil respiration in these soils is also very intensive. The current study aims to study the main factors behind spatial and temporal variability of CO_2 emission from urban soil in forest-steppe conditions of Central Chernozemic region.
We monitored CO_2 fluxes on the three different functional zones in Kursk city: recreational, residential and industrial (15 replicas per each zone). Monitoring plots were chosen considering the following criteria: level of anthropogenic pressure specific for the functional zone; green lawn in soil cover; minimal extent of 15-20 m2. We measured CO_2 emission with infrared gas analyzer Li-820 with the ten days' time step. Monitoring of CO_2 fluxes was followed by measurement of soil temperature and soil moisture.
In result, we obtained the following outcomes:
- average CO_2 flux was changing from 22.49 to 44.25g CO_2 m-1 day-1 within the diurnal trend with the maximum values for the first half of the day.
- CO_2 emission was increasing following increase in the level of the anthropogenic pressure represents by functional zones in a row: reference natural sight<recreational<residential<industrial areas;
- seasonal dynamic in CO_2 emission for was strongly correlated with soil moisture ($r = 0.27\text{-}0.69$, $p<0.05$);
- spatial variability represented by the coefficient of variance (CV %) in the industrial and residential areas (CV=40-45%) were considerably higher than ones in the recreational areas and reference natural sight (CV=33%)