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Soil CO_2 emission of different ecosystems and soil microbial community respiration (European Russia)

Sofia Sushko (1), Nadezhda Ananyeva (1), Kristina Ivashchenko (1,2), and Vyacheslav Vasenev (2)

(1) Institute of Physicochemical and Biological Problems in Soil Science of Russian Academy of Sciences, Pushchino, Russia, (2) Peoples' Friendship University of Russia, Agrarian-Technological Institute, Moscow, Russia

Soil CO_2 emission is mainly provided by soil microorganisms and plant roots respiration. Our study focuses on finding a relationship between soil CO_2 emission of different ecosystems and soil microbial community functioning. Soil CO_2 emission was monthly measured (LI-820) from May to October 2015 in the 5-th spatially distributed points of forest, meadow (steppe), arable (bare fallow), urban of subtaiga and forest-steppe vegetation subzones (Albeluvisol and Chernozems, Moscow and Kursk regions, respectively). Soil microbial biomass carbon (C_{mic}, substrate-induced respiration method), basal respiration (BR), organic carbon content (C_{org}), pH_w and soil C/N ratio were measured in soil samples (0-10 cm, litter excluded, n = 240). Specific respiration of soil microbial biomass (qCO$_2$) was calculated as BR / C_{mic}. Soil CO_2 emission of different ecosystems was ranged 0.2-87.4 and 1.1-87.9 g CO_2 m^{-2} d^{-1} for subtaiga and forest-steppe, respectively. It was reached on average 20.5, 33.5, 3.8, 28.4 and 15.0, 23.8, 3.7, 15.3 g CO_2 m^{-2} d^{-1} for forest, meadow, arable, urban of subtaiga and forest-steppe, respectively. The high soil CO_2 emission was found in grassland ecosystems, the low – in arable, however it was quite high in urban. Soil organic carbon content of different ecosystems was ranged 1.0-3.3% and 1.4-3.7%, pH was 4.7-7.6 and 6.1-8.2, C/N = 10.8-16.0 and 12.0-18.1 for subtaiga and forest-steppe, respectively. Soil C_{mic} of different ecosystems was ranged 60-1294 and 178-2531 μg C g^{-1} for subtaiga and forest-steppe, respectively. The C_{mic} of forest, meadow, arable, urban in subtaiga and forest-steppe was reached on average 331, 549, 110, 517 and 1525, 1430, 320, 482 μg C g^{-1}, respectively. Soil BR of different ecosystems was ranged 0.14-2.23 and 0.15-2.80 μg C-CO_2 g^{-1} h^{-1} for subtaiga and forest-steppe, respectively. Moreover, the BR of forest, meadow, arable, urban in subtaiga and forest-steppe was on average 0.87, 0.92, 0.42, 0.47 and 1.20, 1.42, 0.33, 0.64 μg C-CO_2 g^{-1} h^{-1}, respectively. The qCO$_2$ value was ranged 0.55-8.22 and 0.39-2.64 μg C-CO_2 mg^{-1} C_{mic} h^{-1} for subtaiga and forest-steppe, respectively. The qCO$_2$ of forest, meadow, arable, urban in subtaiga and forest-steppe was on average 3.12, 1.86, 3.84, 0.95 and 0.83, 1.03, 1.08, 1.45 μg C-CO_2 mg^{-1} C_{mic} h^{-1}, respectively. Soil CO_2 emission of subtaiga different ecosystems was correlated with C_{org}, C_{mic} and qCO$_2$ (r = 0.60, 0.59 and -0.64, respectively, $p < 0.01$) and its spatial-temporal variability was explained by 35 and 41% of C_{mic} and qCO$_2$ ($p << 0.001$), respectively. However, soil CO_2 emission of forest-steppe was correlated only with BR (r = 0.57, $p < 0.01$), this was explained by 33% of emission's variation ($p << 0.001$). Thus, soil CO_2 emission in subtaiga different ecosystems might be predicted by C_{mic}, and in forest-steppe it was by BR.

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