3. Impact of soil temperature and soil moisture on GHG flux from an eastern Siberian Taiga soil at Yakutsk, Russia

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Abstract

We observed how atmospheric greenhouse gas (GHG) fluxes from the soil of Taiga forest ecosystem in eastern Siberia which had very dry and cold soil are influenced by changes in climate in the soil during irrigation. The response of the microbial respiration to changes in soil climate was also observed using trenched plots. Both soil and microbial respiration had increased by about 60 mg C m^{-2} h^{-1} immediately after starting the irrigation with increase in soil temperature and moisture, suggesting that the increase in soil respiration was mainly due to the increase in microbial respiration rather than root respiration. We made a multiple regression model of the logarithm of soil and microbial respiration with the reciprocals of soil temperature and moisture and calculated $Q_{10}t$ and $Q_{10}w$ values (the coefficients for the exponential relationship between soil or microbial respiration and soil temperature and moisture, respectively). The $Q_{10}t$ value and the $Q_{10}w$ value of soil respiration was 6.25 and 1.05, respectively, and those of microbial respiration was 1.95 and 2.99, respectively. The lower $Q_{10}w$ value of soil respiration than that of microbial respiration suggests that the root respiration was suffered negative effect from the soil moisture. Little change in root respiration rate due to the irrigation despite the much higher $Q_{10}t$ value of soil respiration than microbial respiration indicates that an increase of the root respiration due to the increase of soil temperature was depressed by the increase of soil moisture. The increase rates of soil and microbial respiration due to the actual increase of soil temperature and moisture calculated from the multiple regression models suggest that the root respiration increased with only the soil temperature and the microbial respiration increased mainly with the soil moisture. The CH_4 absorption decreased from -8.61 ± 3.47 to -4.08 ± 4.83 μg C m^{-2} h^{-1} during the irrigation. The N_2O emission increased from 0.111 ± 0.580 to 1.64 ± 0.42 μg N m^{-2} h^{-1} during the irrigation, suggesting that a long term irrigation may cause a larger change in nitrogen cycling in the Taiga forest ecosystem associated with irrigation.