Geophysical Research Abstracts
Vol. 19, EGU2017-1324-1, 2017
EGU General Assembly 2017

Soil respiration dynamics in the middle taiga of Central Siberia region

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A large amount of carbon in soil is released to the atmosphere through soil respiration, which is the main pathway of transferring carbon from terrestrial ecosystems (Comstedt et al., 2011). Considering that boreal forests is a large terrestrial sink (Tans et al., 1990) and represent approximately 11 % of the Earth's total land area (Gower et al., 2001), even a small change in soil respiration could significantly intensify – or mitigate – current atmospheric increases of CO_2, with potential feedbacks to climate change.
The objectives of the present study are: (a) to study the dynamic of CO_2 emission from the soil surface during summer season (from May to October); (b) to identify the reaction of soil respiration to different amount of precipitation as the main limiting factor in the region.
The research was located in the pine forests in Central Siberia (60°N, 90°E), Russia. Sample plots were represented by the lichen pine forest, moss pine forest, mixed forest and anthropogenic destroyed area. We used the automated soil CO_2 flux system based on the infrared gas analyzer –LI-8100 for measuring the soil efflux. Soil temperature was measured with Soil Temperature Probe Type E in three depths –5, 10, 15 cm. Volumetric soil moisture was measured with Theta Probe Model ML2.
The presence and type of ground cover substantially affects the value of soil respiration fluxes. The carbon dioxide emission from the soil surface averaged 5.4 $\pm$2.3 μmol CO_2 m-2 s-1. The destroyed area without plant cover demonstrated the lowest soil respiration (0.1-5.6 μmol CO_2 m-2 s-1). The lowest soil respiration among forested areas was observed in the feathermoss pine forest. The lichen pine forest was characterized by the intermediate values of soil respiration. The maximum soil respiration values and seasonal fluctuations were obtained in the mixed forest (2.3-29.3 μmol CO_2 m-2 s-1).
The analysis of relation between soil CO_2 efflux and climatic conditions identified the parameters with highest soil efflux rates. The influence of soil temperature on the soil CO_2 efflux showed that an increase of soil efflux was observed from 0 °C to 16 °C. The temperature of more than 16 °C led to the inhibition of soil respiration process. The investigation of relationship between soil CO_2 efflux and soil moisture revealed that the moisture from 0 to 0.3 m-3m-3 resulted in an increase of soil efflux. The moisture of more than 0.3 m-3m-3 led to the inhibition of soil respiration.
Our study suggested that the decline of the rainfall and increase of temperature due to climate change could significantly decrease the CO_2 emission from the Siberian boreal forests.