

Climatic factors influencing soil respiration fluxes in a taiga forest of northeastern Siberia, revealed by 9 years of field measurements

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A large amount of organic matters are accumulated in forest soils, which can be a significant source of greenhouse gas emissions when decomposition is accelerated by increasing temperatures. Understanding greenhouse gas release from the soils is particularly critical in high latitude forests where more organic carbon would be available for microbial decomposition when soil temperature rises and permafrost thaws. The goal of this study is to determine the primary factors influencing soil respiration in the permafrost regions of northeastern Siberia. Soil respiration fluxes were measured using a closed chamber method at Spasskaya-Pad Research Forest Station, near Yakutsk, Russia. Meteorological data were also measured at this research station, including air and soil temperatures and soil moistures. Soil respiration flux and environmental variables were measured at 30-minutes intervals year around. We used a 9 years of soil respiration data from 2004 to 2014 (excluding missing data in 2007 and 2011). A large inter-annual variation was found in the daily soil respiration fluxes over the study period. Simple linear regression showed a strong positive correlations between monthly air and soil temperatures and soil respiration, while no correlation was found with soil moistures. Correlations between temperature and soil respiration fluxes were further examined at different soil moisture levels using daily averages. Temperature effects appeared to be present at any moisture levels, even under very dry or very wet conditions, suggesting that temperature is a strong predictor of soil respiration at this site. We did not detect any moisture effects on soil respiration, possibly because respiration flux data was not obtained in a year of extremely wet event. These results will help to develop soil carbon dynamic models to predict the potential impacts of warming on soil respiration and entire forest carbon fluxes.

キーワード：永久凍土、分解、気候変動、気温、土壌水分

Keywords: permafrost, decomposition, climate change, temperature, soil moisture