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Effects of warming on CO_2, N_2O and CH_4 fluxes and underlying processes from subarctic tundra, Northwest Russia

Carolina Voigt, Richard E. Lamprecht, Maija E. Marushchak, Christina Biasi, and Pertti J. Martikainen
University of Eastern Finland, Department of Environmental Science, P.O. Box 1627, 70211 Kuopio, Finland

Peatlands, especially those located in the highly sensitive arctic and subarctic latitudes, are known to play a major role in the global carbon cycle. Predicted climatic changes – entailing an increase in near-surface temperature and a change in precipitation patterns – will most likely have a serious yet uncertain impact on the greenhouse gas (GHG) balance of these ecosystems. Microbial processes are enhanced by warmer temperatures which may lead to increased trace gas fluxes to the atmosphere. However, the response of ecosystem processes and related GHG fluxes may differ largely across the landscape depending on soil type, vegetation cover, and moisture conditions.

In this study we investigate how temperature increase potentially reflects on GHG fluxes (CO_2, CH_4 and N_2O) from various tundra surfaces in the Russian Arctic. These surfaces include raised peat plateau complexes, mineral tundra soils, bare surfaces affected by frost action such as peat circles and thermokarst lake walls, as well as wetlands. Predicted temperature increase and climate change effects are simulated by means of open top chambers (OTCs), which are placed on different soil types for the whole snow-free period. GHG fluxes, gas and nutrient concentrations in the soil profile, as well as supporting environmental parameters are monitored for the full growing season.

Aim of the study is not only the quantification of aboveground GHG fluxes from the study area, but the linking of those to underlying biogeochemical processes in permafrost soils. Special emphasis is placed on the interface between active layer and old permafrost and its response to warming, since little is known about the lability of old carbon stocks made available through an increase in active layer depth. Overall goal of the study is to gain a better understanding of C and N cycling in subarctic tundra soils and to deepen knowledge in respect to carbon-permafrost feedbacks in respect to climate.