Geophysical Research Abstracts
Vol. 14, EGU2012-8295, 2012
EGU General Assembly 2012

Greenhouse gas balance of a subarctic tundra – importance of carbon dioxide, methane and nitrous oxide from different land cover types

M.E. Marushchak (1), C. Biasi (1), V. Elsakov (2), S. Jokinen (1), S.E. Lind (1), A. Pitkämäki (1), T. Virtanen (3), and P.J. Martikainen (1)

(1) University of Eastern Finland, Department of Environmental Science, Kuopio, Finland (maija.marushchak@uef.fi), (2) Institute of Biology, Komi SC UrD RAS, 197982 Syktyvkar, Russia, (3) Department of Environmental Sciences, University of Helsinki, P.O. Box 65, 00014 University of Helsinki, Finland

The strong warming predicted for the Arctic has increased the need to understand how carbon (C) balance in tundra will respond to climate change. The large C reservoir of northern permafrost soils (50% of global belowground soil C pool; Tarnocai et al. 2009) may be threatened by warming and associated thawing of permafrost, which might lead to increased release of carbon dioxide (CO_2) and methane (CH_4) to the atmosphere. Moreover, the recent findings of high nitrous oxide (N_2O) emissions from permafrost soils (Repo et al. 2009, Elberling et al. 2010) show that the large nitrogen pool in permafrost soils cannot be neglected anymore when predicting the atmospheric impact of Arctic tundra in a changing climate. Here we report the annual landscape scale (GHG) balance of subarctic tundra including all the three most important GHGs: CO_2, CH_4 and N_2O.

The study was conducted in Northeast European Russia in a heterogeneous landscape consisting of upland tundra, fens, willow wetlands and massive peat plateau complexes spotted by thermokarst lakes. Fluxes of CO_2, CH_4 and N_2O were measured during two growing seasons and the cold season between using different chamber techniques at terrestrial ecosystems, and combination of gas gradient method and bubble collectors in thermokarst lakes. The plot scale results were up scaled to the landscape level using a land cover map based on a high-resolution QuickBird satellite image (Hugelius et al. 2011). The land cover types studied represent 97% of the whole area study area of 98.6 km2.

On an annual basis the study area acted as a sink of C, but CH_4 and N_2O emissions caused it to be a net source of GHGs when considering the global warming potential (GWP; 100-year time horizon) of all three gases. Willow wetlands, fens and thermokarst lakes (16% of the landscape) were significant sources of CH_4, while CH_4 emissions from the rest of the landscape were negligible. Bare peat surfaces on peat plateaus, peat circles, acted as strong hotspots of N_2O emissions, thus, being unique among pristine northern soils. The peat circles had also the highest GHG emissions as CO_2 equivalents, in contrast to the vegetated part of the peat plateau that represented the strongest net GHG sink on a unit area basis. Vascular leaf area index explained well the variability in CO_2 fluxes and the total C balance across all soil and vegetation types, the wetland sites being the largest C sinks. The climate change will affect on composition and function of arctic landscape in a complex way, making it difficult to predict the net effect on the landscape scale GHG balance.