Artificial drainage and associated carbon fluxes (CO2/CH4) in a tundra ecosystem

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Ecosystem flux measurements using the eddy covariance (EC) technique were undertaken in 4 subsequent years during summer for a total of 562 days in an arctic wet tundra ecosystem, located near Cherskii, Far-Eastern Federal District, Russia. Methane (CH$_4$) emissions were measured using permanent chambers. The experimental field is characterized by late thawing of permafrost soils in June and periodic spring floods. A stagnant water table below the grass canopy is fed by melting of the active layer of permafrost and by flood water. Following 3 years of EC measurements, the site was drained by building a 3m wide drainage channel surrounding the EC tower to examine possible future effects of global change on the tundra tussock ecosystem. Cumulative summertime net carbon fluxes before experimental alteration were estimated to be about +115 gCm$^{-2}$ (i.e. an ecosystem C loss) and +18 gCm$^{-2}$ after draining the study site. When taking CH$_4$ as another important greenhouse gas into account and considering the global warming potential (GWP) of CH$_4$ vs. CO$_2$, the ecosystem had a positive GWP during all summers. However CH$_4$ emissions after drainage decreased significantly and therefore the carbon related greenhouse gas flux was much smaller than beforehand (475 ± 253 gC-CO$_2$-em$^{-2}$ before drainage in 2003 vs. 23 ± 26 g C-CO$_2$-em$^{-2}$ after drainage in 2005).