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The effects of climate changes on soil methane oxidation in a dry Arctic tundra

Ludovica D'Imperio
(ldi@life.ku.dk)

The effects of climate changes on soil methane oxidation in a dry Arctic tundra.

Ludovica D'Imperio1, Anders Michelsen1, Christian J. Jørgensen1, Bo Elberling1
1Center for Permafrost (CENPERM), Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark

At Northern latitudes climatic changes are predicted to be most pronounced resulting in increasing active layer depth and changes in growing season length, vegetation cover and nutrient cycling. As a consequence of increased temperature, large stocks of carbon stored in the permafrost-affected soils could become available for microbial transformations and under anoxic conditions result in increasing methane production affecting net methane (CH4) budget. Arctic tundra soils also serves as an important sink of atmospheric CH4 by microbial oxidation under aerobic conditions. While several process studies have documented the mechanisms behind both production and emissions of CH4 in arctic ecosystems, an important knowledge gap exists with respect to the in situ dynamics of microbial-driven uptake of CH4 in arctic dry lands which may be enhanced as a consequence of global warming and thereby counterbalancing CH4 emissions from Arctic wetlands.
In-situ methane measurements were made in a dry Arctic tundra in Disko Island, Western Greenland, during the summer 2013 to assess the role of seasonal and inter-annual variations in temperatures and snow cover. The experimental set-up included snow fences installed in 2012, allowed investigations of the emissions of GHGs from soil under increased winter snow deposition and ambient field conditions. The soil fluxes of CH4 and CO_2 were measured using closed chambers in manipulated plots with increased summer temperatures and shrub removal with or without increased winter precipitation. At the control plots, the averaged seasonal CH4 oxidation rates ranged between -0.05 mg CH4 m-2 hr-1 (end of August) and -0.32 mg CH4 m-2 hr-1 (end of June). In the plots with increased summer temperatures the rates ranged between -0.08 mg CH4 m-2 hr-1 (end of August) and -0.40 mg CH4 m-2 hr-1 (beginning of July). Preliminary results show a significant effect of increased winter precipitation ($p<0.01$) over the season as well as a significant warming effect ($p<0.05$) during July and August. These results suggest that in a warmer climate increasing CH4 uptake rates in dry Arctic soils could become an important factor for net CH4 budget.