

Disturbances (fire and grazing by reindeer) and soil methane fluxes – case studies from the subarctic boreal forest of Finish Lapland.

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In aerobic, well-drained environments such as boreal upland forest soils, methane (CH_4) is oxidized by microbes, resulting into the soils acting as a sink of atmospheric CH_4 . The emission of CH_4 is controlled primarily by soil moisture and temperature, but also by the availability of organic carbon.

Forest fires are one of the predominant natural disturbances in subarctic boreal forests that strongly influence soil moisture and soil temperature values and carbon dynamics of the soils. At the same time also the effect of reindeer (*Rangifer tarandus* L.) grazing on soil moisture and temperature regimes in the lichen-dominated Arctic ecosystems has been found to be considerable. By removing the lichen carpet and damaging the secondary vegetation mat, reindeer make patches of bare soil common, and these factors in combination with trampling allow for soil to warm up faster, reach higher temperatures, and reduce the soil moisture content.

We studied the effect of reindeer grazing and forest fire on fluxes of CH_4 in northern boreal subarctic Scots pine forest stands. The study areas are in eastern Lapland, Värriö Strict Nature Reserve, Finland (67°46' N, 29°35' E). The sites are situated north of the Arctic Circle, near to the northern timberline at an average of 300 m altitude.

For studying the effect of fire we have established sample areas (with three replicate plots in each) in a chronosequence of 4 age classes (2 to 152 years since the last fire). The fire chronosequence consisted of four types of areas with different time since the last forest fire: i) 5 years, ii) 45 years, iii) 70 years and iv) 155 years after fire. For studying the effect of reindeer grazing (comparison of grazed and non-grazed areas) we have established the study areas (10 sample plots in total established in year 2013) along the borderline between Finland and Russia. The ungrazed area was excluded from the reindeer grazing already in 1918, to prevent the Finnish reindeer from going to the Russian side and there are not many reindeer on Russian side of the area.

In fire damaged areas there was a slight seasonal pattern in uptake of CH_4 , while the uptake was increasing towards the end of the growing season through all fire chronosequence classes. We also found that the soil was a CH_4 sink through the post-fire chronosequence in all stand ages. The uptake of CH_4 was highest in area where the fire was 5 years ago and lowest on the area where the last fire was 155 years ago. We also found that in areas grazed and non-grazed by reindeer the soil was a CH_4 sink through entire growing season. Surprisingly in June and in August the uptake of CH_4 was significantly bigger in grazed areas compared to non-grazed areas. There was no significant difference in uptake in July. In July the soil moisture content was the lowest and the soil temperature was the highest.