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Effects of wild fires on the emissions of reactive gases from boreal and subarctic soils

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Wild fire has long-term effects on the ecosystem and biological processes of boreal forest, and the frequency of wild fires is increasing as a consequence of climate change. Boreal forests lie largely on permafrost area, and the increase in fire frequency or intensity will affect the depth of the active layer on top of permafrost. The thawing of permafrost soils and increase in the active layer depth could induce significant reactive trace gas emissions.

Biogenic volatile organic compounds (BVOCs) and nitrous acid (HONO) are closely associated with air chemistry in the troposphere. They react easily with ozone, hydroxyl radicals, and the reaction products may condense into aerosol particles or affect the growth of atmospheric aerosols which act as cloud condensation nuclei. Forests, and in particular permafrost soils, could be potentially large sources of BVOCs and HONO, because of the large amount of decomposing litter and soil organic matter. However, the forest soil BVOC emissions are poorly known, in contrast to BVOCs emitted from branch and canopy levels in boreal forests. The production rates of HONO in various soils are also poorly known.

We studied BVOC and HONO fluxes from boreal forest soils and the effects of wild fires and the time since the last fire on them. We measured BVOCs emissions in west Siberia larch forest stands on permafrost soil in a fire chronosequence where the last forest fires had occurred 2, 24, and more than 100 years ago. HONO emissions in northern boreal subarctic Scots pine forest stands in Eastern Lapland in Finland in a fire chronosequence where the last fires had occurred 7, 47, 72 and 157 years ago.

BVOC flux measurements were carried out by drawing air samples from chamber headspace into a steel adsorbent tube containing Tenax TA and carbopack B. The sampling tubes were analyzed on gas chromatography-mass spectrometry (GC-MS). Soil samples were measured for HONO flux in laboratory with LOPAP (Long path absorption photometer). According to our preliminary results the influence and the duration of the impact of forest fires were not observed in HONO emissions. However, the HONO emissions were sensitive to soil moisture. The unexpectedly high rate of release of isoprene measured in the middle age forest sites with warm scenario. Environmental parameters were correlated with the presence of BVOCs. We compared the BVOC fluxes with environmental parameters such as temperature, humidity and PAR, and with ground vegetation coverage and with litter input. The BVOC data is under processing still and more detail results is coming later.