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Growing season hydrocarbon flux dynamics at a subarctic mire, northern Sweden

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Northern latitudes are predicted to undergo the highest rise in mean annual temperature during the next century. It is important to quantify potential feedback processes that climate induced ecosystem changes may have. Northern frozen organic soils have a potential to become an atmospheric carbon source. Higher ground temperatures will increase the microbial activity but also alter the microbial pathways as moisture conditions change with shifting permafrost. Intensified decomposition of the peat organic matter will potentially lead to higher net emissions of the natural greenhouse gases carbon dioxide (CO_2) and methane (CH_4) to the atmosphere.

At the Stordalen Mire in the subarctic, we have studied the interannual variability in growing season hydrocarbon (HC) flux dynamics during 2002-2006 (June –August). The mire is covered by a limited range of plant communities of differing productivities determined by surface hydrology due to differences in the local permafrost. Three representative sites along a moisture and productivity gradient were selected for the study: 1) Dry elevated areas associated hummock/palsa, 2) wet, sphagnum dominated and 3) wet, tall graminoid dominated. We used autochambers for total hydrocarbon (THC) and CO_2 exchange measurements and manual sampling of the same chambers for CH_4 fluxes. We can therefore estimate the non-methane hydrocarbon (NMHC) contribution to THC exchange. A comparison of clear and dark chamber measurements was also made.

The main controlling factors of summer seasonal HC flux are thaw depth, water table, productivity and plant species, with no factor being entirely independent of the other.

Drained palsa areas are sinks of HC of around 60 $mgCH_4$ m^2, Sphagnum sites emit around 2500 $mgCH_4$ m^2 while sites with tall graminoid emit 13 500 $mgCH_4$ m^2. The Sphagnum site has the greatest interannual variability, probably controlled by the water table which is at a critical level for methane oxidation. Emission of THCs from the palsa areas occur at the same time as CH_4 uptake was observed. This biome type can be a significant source of NMHCs to the atmosphere while acting as a net sink of CH_4. For Sphagnum and the graminoid site, NMHC contribution to THC is around 25 % and 15 % respectively. At the ecosystem level in permafrost areas, higher net emissions of reduced carbon gases can occur if the spatial distribution of sub-ecosystem types changes by receding palsa features and expanding wet peat environments.