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Forest floor methane flux modelled by soil water content and ground vegetation – comparison to above canopy flux

Elisa Halmeenmäki (1,2), Olli Peltola (1), Iikka Haikarainen (1,2), Kira Ryhti (2), Üllar Rannik (1), Mari Pihlatie (1,2)

(1) Department of Physics, Division of Atmospheric Sciences, University of Helsinki, Finland (elisa.halmeenmaki@helsinki.fi), (2) Department of Forest Sciences, University of Helsinki, Finland

Methane (CH_4) is an important and strong greenhouse gas of which atmospheric concentration is rising. While boreal forests are considered as an important sink of CH_4 due to soil CH_4 oxidation, the soils have also a capacity to emit CH_4. Moreover, vegetation is shown to contribute to the ecosystem-atmosphere CH_4 flux, and it has been estimated to be the least well known natural sources of CH_4. In addition to well-known CH_4 emissions from wetland plants, even boreal trees have been discovered to emit CH_4.

At the SMEAR (*Station for Measuring Ecosystem-Atmosphere Relations*) II station in Hyytiälä, southern Finland (61° 51' N, 24°17' E; 181 m asl), we have detected small CH_4 emissions from above the canopy of a Scots pine (*Pinus sylvestris*) dominated forest. To assess the origin of the observed emissions, we conducted forest floor CH_4 flux measurements with 54 soil chambers at the footprint area of the above canopy flux measurements during two growing seasons. In addition, we measured the soil volumetric water content (VWC) every time next to the forest floor chamber measurements, and estimated vegetation coverages inside the chambers.

In order to model the forest floor CH_4 flux at the whole footprint area, we combined lidar (*light detection and ranging*) data with the field measurements. To predict the soil water content and thus the potential CH_4 flux, we used local elevation, slope, and ground return intensity (GRI), calculated from the lidar data (National Land Survey of Finland). We categorized the soil chambers into four classes based on the VWC so that the class with the highest VWC values includes all the soil chambers with a potential to emit CH_4. Based on a statistically significant correlation between the VWC and the forest floor CH_4 flux ($r = 0.30$, $p < 0.001$), we modelled the potential forest floor CH_4 flux of the whole area.

The results of the soil chamber measurements show a few areas of the forest floor with significant CH_4 emissions. The modelled map of the potential CH_4 flux is consistent with the measurements of the flux and the VWC, indicating that the wetter areas have potential for CH_4 emissions, while the drier areas have potential for CH_4 uptake. Preliminary results of the vegetation coverage show a positive correlation between the first year forest floor CH_4 flux and the coverage of *Sphagnum* spp. mosses ($r = 0.55$, $p < 0.001$). Furthermore, we will include the vegetation coverage to the analysis, and compare the modelled forest floor CH_4 flux with the measured above canopy flux. This ongoing research will give valuable information about the CH_4 sources and dynamics in boreal forests.