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The effect of soil amendments on the greenhouse gas emissions and soil microbial community composition in cultivated peatlands

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Background

Drained peatlands, especially cultivated peatlands, are significant sources of greenhouse gases (GHG), such as carbon dioxide (CO_2) and nitrous oxide (N_2O). In Finland approximately 13.6% of the total arable land area is made up of organic soils (e.g. peatlands), and therefore it is important to find ways to reduce the GHG emissions from these soils. Previous studies suggest that e.g. wood ash addition to forested peatland has potential to decrease N_2O emissions, but it may also increase CO_2 emissions. Both N_2O and CO_2 emissions originate from microbial processes that can be greatly affected by changes in the chemical and physical composition of the soil. In general, changes in microbial activity and population structure are attributed to changes in soil pH and electrical conductivity. In this study, we aim to test the effect of multiple soil amendment substances in laboratory incubation experiment to see how they change the chemical composition and GHG emission rates from soils gathered from several cultivated peatlands, and if the structure of the soil microbial community can be linked to the GHG emissions.

Methods

The soil amendments that I plan to study in my experiments are gypsum ($CaSO_4 * 2H_2O$), wood ash, lime ($CaCO_3$), biochar, and foundry sand. I have conducted the first set of bottle incubation experiments in laboratory, to determine the GHG emission rates from different soil samples after soil amendment addition. For the experiment, we selected soil samples from several different cultivated peatlands, and to observe the effect of soil amendment addition on soils that come from different stages of the life cycle of cultivated peatlands, we decided to include forested and afforested sites as well. Following this experiment, my plan is to conduct a long-term incubation on packed soil cores, with the intent to further study if the GHG emission rates change during long-term incubation, and to measure possible nitrous acid (HONO) emissions from the soil. In this experiment, I also aim to study if the microbial community structure changes after incubation with different soil amendments.