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Land use effects on Nitrous oxide emission from drained organic soils

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Abstract

Since industrialisation, the atmospheric concentration of greenhouse gases (GHG) has increased significantly. The most important anthropogenic GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). N_2O is of major concern for two reasons; i) it is a potent GHG responsible for 6.2% of the observed anthropogenic radiative forcing and ii) it plays a major role in the destruction of stratospheric ozone. Soil processes are the largest contributor to the atmospheric N_2O, with agriculture as the largest anthropogenic source, accounting for 65% to 80% of total emission. The N_2O emissions are largely influenced by the land use and, due to the long half life time of N_2O in the atmosphere, is it important to find mitigation options that will reduce N_2O from agriculture. This is particularly important for drained organic soils, which are emitting large amounts of N_2O and CO_2. The main processes that produce N_2O in soil are nitrification and denitrification. Several interacting factors control these processes and the magnitude of N_2O emission, such as site fertility, ground water level, pH and competition from vegetation. Thus, because of the complexity of the driving variables, it is difficult to predict N_2O emission from environmental factors.

The articles in this thesis deals with measurements of N_2O, CH_4 and CO_2 fluxes, although I in my summary of these focus on mitigation options for N_2O emissions from organic soils, as these are largely increased after drainage and have a large impact on the national GHG budget for Sweden.

Main findings of my work are that cereals, row sown crops (e.g. vegetables) and forest emit larger amounts of N_2O than pastures. However, due to the many controlling factors, the different soil properties as well as measurement periods it is difficult to generalise the findings for all peat soils. Soil pH was found to be a driving factor for N_2O emission from the forest site, with enhanced N_2O emission from low pH. Increased soil pH due to wood ash addition was found to reduce N_2O emission at a spruce forest site, which might provide a mitigation option for organic forest soils.

Based on the results from the thesis, a suggested mitigation strategy for N_2O emission from drained agricultural peat soils is to avoid cereal and vegetable cultivation in favour of permanent meadows or pastures. Increasing pH by wood ash or lime can decrease N_2O emission from forest soils. Although not a result in this thesis, liming of agricultural drained peat soils could also be an option.