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ATMOSPHERIC IMPACT OF ABANDONED BOREAL ORGANIC AGRICULTURAL SOILS DEPENDS ON HYDROLOGY OF PEAT

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SUMMARY

Peat soils drained for agriculture are significant sources of carbon dioxide (CO_2). Leaving these soils abandoned could be an option to mitigate GHG emissions. We measured net CO_2 exchange and fluxes of CH_4 and N_2O for five abandoned sites during three years. Annually, the sites were either small net sinks or sources of CO_2 and CH_4 (-7.8 - 530 g CO_2-C m^{-2} and -0.41 - 1.8 g CH_4 m^{-2}). The net (CH_4 + CO_2 + N_2O) emissions as CO_2 equivalents were lower than in cultivated peat soils and were lowest in the wet year when photosynthesis was favoured over respiration.

KEYWORDS: carbon dioxide, methane, nitrous oxide, emission, water table

INTRODUCTION

Drained agricultural peat soils are significant sources of carbon dioxide (CO_2) but in general small sinks for methane (CH_4) (Maljanen *et al.* 2010). There is a need to mitigate greenhouse gas emissions from such soils. Leaving these soils abandoned without any cultivation practice, could be an option to mitigate greenhouse gas emissions. To test this hypothesis, we measured with a chamber method, over a three year period, net CO_2 exchange and fluxes of CH_4 for five agricultural peat soils that had been abandoned for 20 - 30 years.

MATERIALS AND METHODS

Weekly measurements during the growing seasons were made with opaque and transparent chambers to measure instantaneous net CO_2 exchange and ecosystem respiration. For calculation of the diurnal net CO_2 balance values, statistical response functions were constructed separately for each site for growing seasons 2002, 2003 and 2004 in order to reconstruct the hourly values for gross photosynthesis and ecosystem respiration on the basis of climatic data (Alm *et al.* 1997).

RESULTS AND DISCUSSION

Annually, the sites were either small net sinks (up to -7.8 g CO_2-C m^{-2} and -0.41 g CH_4 m^{-2}) or sources (up to 530 g CO_2-C m^{-2} and 1.8 g CH_4 m^{-2}) of CO_2 and CH_4 depending on hydrological conditions. The average net annual CO_2 emissions were slightly lower than those from cultivated peat soils. Including N_2O emissions from our previous study (Maljanen *et al.* 2012) the net (CH_4 + CO_2 + N_2O) emissions as CO_2 equivalents were also lower than in cultivated peat soils and were lowest in the wet year when photosynthesis was favoured over respiration. Therefore, high GHG emissions from agricultural soils could be avoided if the water table is maintained at a high level (close to soil surface) after cultivation has ended. The results show the importance of photosynthesis in the weather-driven annual variation in greenhouse gas balances of drained peatland

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