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Does a mineral soil coverage reduce greenhouse gas emissions from agriculturally managed peatlands?

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The agricultural use of organic soils usually requires drainage, resulting in soil subsidence and high greenhouse gas (GHG) emissions, particularly CO_2. One proposed strategy to maintain the productivity of these soils is applying a mineral soil cover. However, the impact on the overall GHG budget is unknown. Herein, we determined the net ecosystem carbon budget (NECB) for a pair of covered (Cov) and uncovered (reference, Ref) organic soils under intensive grassland management in the Rhine Valley, Switzerland, over four years (1 March 2018–29 February 2022). The net ecosystem exchange (NEE) of CO_2 fluxes was measured using the eddy covariance method, in addition to recording additional carbon exports and imports for harvest and organic fertilisers. N_2O and CH_4 fluxes were measured using an automatic time-integrating chamber system over three years. Both of the drained peatlands under agricultural use showed substantial soil organic carbon (SOC) losses of 6.5 to 28.9 t CO_2 ha^{-1} $year^{-1}$ (Ref) and 4.6 to 30.3 t CO_2 ha^{-1} $year^{-1}$ (Cov), driven by the aerated peat carbon stock during summer and accounting for 1.4 %–0.5 % of the total aerated carbon stock. Covering the organic soil with a mineral layer did not significantly reduce the SOC losses relative to the reference site in any of the four years at either site, and CH_4 uptake was marginal. However, soil coverage reduced the contributions of N_2O to total GHG emissions from 28 % (Ref) to 7 % (Cov). Thus, we conclude that mineral soil coverage *per se* has little potential to reduce carbon losses from drained organic soils. However, if combined with a considerable rise in the water table, SOC losses may be effectively reduced while maintaining agricultural productivity.