Carbon budget of a drained organic agricultural soil with mineral soil coverage

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The agricultural use of organic soils usually requires drainage that leads to high Greenhouse Gas (GHG) emissions and soil subsidence. A proposed strategy to maintain productivity of these soils is to cover them with mineral soil. To quantify the climatic impact of this practice, the net ecosystem carbon balance (NECB) was determined for a pair of covered (Cov) and uncovered reference (Ref) organic soil. Our experimental field site is located in the Rhine Valley, Switzerland, and the grassland is intensively managed. The NECB was determined for two full years (1.3.2018-29.2.2020) by accounting for all relevant carbon fluxes entering and leaving the soil-vegetation system. For this purpose, the net ecosystem exchange of CO_2 (NEE), CH_4 exchange fluxes, carbon removal by harvest, and carbon import by organic fertilizers were measured. The gas exchange for CO_2 and CH_4 was determined by eddy co-variance (EC). In both years, NEE was positive indicating an upward net flux of CO_2 to the atmosphere. However, the magnitude of CO_2 fluxes differed considerably between the two years for both sites. For the first year, NEE was around 600 g C m^{-2} yr^{-1}, about 3 to 4 times higher as in the second year. Annual CH_4 emissions were marginal at both sites. Considering the NECB the reference site was found to be a net carbon source with higher emissions in the first year. The NECB of the covered site was similar, indicating a marginal effect of the soil coverage on the NECB in both years. We found the groundwater to be an important driving factor for the observed loss of soil carbon at our site. Based on the two year measurement period, we preliminary conclude that covering organic soils with minerals soil might not be an effective climate mitigation option at the Rüthi site.