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Greenhouse gas fluxes induced by tillage and fertilisation in an organic grass-clover-wheat sequence

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Reduced tillage is technically a challenging task in organic arable farming due to the weed competition but also concerning the destruction of grass-clover leys. Regarding its climate impact, there are hardly any data existing. Soil-derived greenhouse gas fluxes were therefore monitored in a long-term field trial in Frick/CH. The trial is arranged in a strip-split-plot design on a heavy clay soil and compares since 2002 conventional tillage (up to 15 cm deep mouldboard ploughing) with reduced tillage (skim plough 5 cm deep and occasional chisel ploughing). In addition, cattle slurry only (SL) is compared with a slurry/manure compost treatment (MC) at a rate of 90 kg N/year. MC plots received one manure compost and two slurry batches, the latter applied with SL the same day but with half the amount. The overall management is in compliance with the EU organic farming regulation. Nitrous oxide and methane fluxes were monitored in a two-year period including a grass-clover ley, its destruction and a subsequent winter wheat crop. We adjusted the closed chamber sampling method developed by Flessa et al. (1995) with eight replicates for each treatment. Gas and soil sampling took place weekly with additional measurements after fertiliser and tillage management. Soil samples were analysed for mineralised nitrogen, dissolved organic carbon and water filled pore space. Flux calculation included linear and non-linear regression calculated with the HMR-Model after Pedersen et al. (2010) and Fuss et al. (unpublished). N2O fluxes calculated with the non-linear model were 10% higher than calculated with the linear model only. First results for the grass-clover period show no significant differences in N2O fluxes neither between reduced tillage and ploughing nor between slurry and manure compost/slurry application. However, ley destruction induced high N2O emissions which will be discussed with the subsequent wheat period.