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CO_2 emissions from organic soils under agricultural use

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The organic soils of peatlands represent a major global sink for terrestrial carbon. Agricultural use of organic soils requires drainage, changing conditions in these soils from anoxic to oxic. As a consequence, the organic carbon that had been accumulated often over millennia is rapidly mineralized, so that these soils then are no longer a sink but become a source of CO_2. The aim of our study is to analyse the amount and origin of CO_2 emitted from organic soils under three land-use types (forest, arable cropland and grassland). Our study area is located in the Bernese Lakeland (CH). The peatlands of this region were drained in the 1870ies, and the site as well as the surrounding area are now managed by a state prison. Since decades our study site is under the same land-use. In Oktober 2013 we took 4 replicate soil cores of all land-uses with respect to a certain distance from a major drainage ditch. Each core was analysed for its bulk density and carbon content. 9 soil samples from a depth of 20-30 cm were analysed for their F14C and ∂13C values and later divided into 18 subsamples. Half of them were mixed with 0.2-0.4 g of labelled corn stalk enriched in ∂13C (∂13C=2000‰) in order to mimic plant residue inputs in the field. The moisture content of these samples was equilibrated at a pF-value of 2 before incubating the samples in a Respicond VII analyser for several weeks at 20°C. By trapping the respired CO_2 in NaOH and precipitating it as $BaCO_3$ we were able to analyse its F14C and ∂13C value. This enabled us to determine to what extent the CO_2 originated from old peat, young plant residues or the added maize stalk. Generally the cropland samples showed the highest respiration rates, lowest F14C values and highest carbon stocks. The organic soils under the forest were degraded the most and showed low respiration rates. Analyzing the F14C values of the CO_2 revealed that peat contributes most to the respiration and its degradation is fastest in the cropland. Our findings suggest that peat respiration must have been more intense under forest during the past 140 years. The addition of fresh plant material resulted in increased respiration rates but supressed the respiration of old peat in the cropland and grassland (negative priming).