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High CO_2 emissions from drained peat soils that transition to organo-mineral soils: Implications for GHG inventories

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Drained agricultural peat soils are hotspots for biogenic CO_2 emissions, contributing to elevated atmospheric CO_2 levels. Due to microbial mineralization, the organic carbon (OC) content of these soils transitions to that of mineral soils, but it remains unclear how the residual OC content controls the rate of CO_2 emission. This hinders the integration of soils with 6-12% OC into national greenhouse gas inventories. Based on a comprehensive laboratory study with organic soils from 103 sites in Denmark, we show that area-scale CO_2 emissions from soils with >6% OC are not controlled by OC content and OC density, i.e., that soil OC content (wt/wt) is a poor predictor of area-specific CO_2 emissions. The empirical data suggest that CO_2 emission factors for 6-12% and >12% OC soils should be considered the same. On the other hand, the data also suggest that disaggregation of emission factors for soils with even higher OC contents is not necessary. We conclude that a global underestimation of CO_2 emissions from 6-12% OC soils occurs in countries with large proportions of organic soils in transition from organic to organo-mineral soils due to agricultural management. Refining CO_2 emission estimates for 6-12% OC soils is critical for the accuracy of national inventories, but also for recognizing the climate benefits of emerging initiatives to rewet drained organic soils.