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Carbon Greenhouse Gas Fluxes from Fenland Soils Under Intensive Agricultural Use Compared to Seminatural and Restoration Management

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Globally, peatlands represent a large carbon store in the global carbon cycle. In natural conditions they are typically a sink for carbon but constitute a methane source. Today, large fractions of the fens in the midlatitudes are being used for intensive agriculture due to their fertile organic soils. Conventional farming techniques require ongoing drainage leading to soil shrinkage and soil organic carbon loss via fluvial loss as well as decomposition to carbon dioxide. The carbon source-sink relationships - measured by eddy covariance and closed chambers - of three fens in the Fenlands in East Anglia, United Kingdom were compared over a time period of three years; one fen is being used for intensive horticultural production supporting up to two harvests per year, a second is in semi-natural condition and a third is under restoration management for more than 10 years. The fen under agricultural use showed a significant carbon loss year on year (mean $\approx 750\text{gCm}^{-2}\text{yr}^{-1}$) and the semi-natural fen was a small carbon sink, but also a small methane source. The fen under restoration management including blocking of the drainage channels and re-seeding with wetland species was still a small and consistent carbon source to the atmosphere (mean $\approx 110\text{gCm}^{-2}\text{yr}^{-1}$) even 15 years after the end of agricultural use. Methane flux measurements in the seminatural and regenerating fen indicate relevant methane fluxes from ditches and small temporary water bodies. These results highlight the susceptibility of organic soils to disturbance and carbon loss and the complexity of restoration strategies that may lead to renewed carbon storage after a period of intensive agricultural use.