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# Long-term $CO_2$ flux dynamics and soil C stock changes of a drained fen mire under different grassland management practices in Northeast Germany

Juergen Augustin, Michael Giebels, Elisa Albiac Borraz, Mathias Hoffmann, and Michael Sommer
Leibniz-Centre of Agricultural Landscape Research (ZALF) e.V., Eberswalder Str. 84, D-15374 Müncheberg, Germany

Fen mires, widely distributed in Germany and Northern Europe, contain extreme high amounts of carbon (up to 5000 t C per hectare). For this reason, they play an important role in the global cycle of the greenhouse gases carbon dioxide ($CO_2$) and methane ($CH_4$). Currently more than 95% of all fen mires in central Europe are drained. Therefore, they are assumed to represent extremely strong sources for $CO_2$, accompanied by a fast reduction of the peat carbon stocks. For a number of reasons it is not possible to overcome this problem by restoration measures like flooding at the most drained fen sites. Moreover, there are till now just few and contradictory information about the contribution of alternative land use forms like grassland extensification on the reduction of the $CO_2$ source function of these organic soils.

As a contribution to clearing this deficit, we have ongoingly measured the $CO_2$ and $CH_4$ exchange as well as the changes in C stock on a deeply drained fen mire near the village of Paulinenaue from 2007 till 2012. The measurement sites is located within the so-called Rhin-Havelluch, an 80000 ha shallow paludification mire complex in the northwest of Berlin. The investigation included extensively and intensively used meadows (one cut vs. three cuts) on two soil types with different C stocks (Hemic Rheic Histosol vs. Mollic Gleysol). We used transparent chambers for measuring the $CO_2$ flux net ecosystem exchange (difference between gross primary production and ecosystem respiration) and non-transparent chambers for measuring the $CO_2$ flux ecosystem respiration and the $CH_4$ exchange. Determined soil stock changes based on a C budget approach, including cumulated annual net ecosystem exchange, cumulated $CH_4$ exchange, C export by harvest, and C import by fertilization.

All current C fluxes were influenced in a complex way by ground-water level, plant development, land use intensity (cut frequency) and current weather conditions. Averaged over the whole investigation time all combinations of land use intensity and soil types acted as strong $CO_2$ sources and showed high soil C losses (up to 1070 g C $m^{-2}$ $yr^{-1}$). There was a tendency of lower soil C losses in case of extensive grassland compared to intensive grassland use (820 vs. 1070 g C $m^{-2}$ $yr^{-1}$) and grassland at the Gleysol site compared to the Histosol site (538 vs. 946 g C $m^{-2}$ $yr^{-1}$). However, the cumulated C fluxes and the soil C losses are subject to a very strong interannual variability. The actual range varied from 245 to 2092 g C $m^{-2}$ $yr^{-1}$ in case of the soil C losses.

It can be therefore concluded that only long-term measurements ($>$ 3 years) provides reliable information about the C dynamics of drained fen mires. Due to the high interannual variability, there is a high risk to get largely biased results if only short-term measurements will be done.