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Greenhouse gas emissions from short-rotation forestry on a drained and rewetted fen

Martina Schlaipfer, Alicia Fuertes Sánchez, and Matthias Drösler

Chair of Vegetation Ecology, Weihenstephan-Triesdorf University of Applied Sciences, Freising, Germany
(martina.schlaipfer@hswt.de)

More than 95 % of German peatlands have been drained, primarily for agricultural and forestry use. They constitute a significant source of greenhouse gases (GHG) with emissions of approximately 47 million tons per year. Propelled by the German energy turnaround farmers have increasingly converted their cropland to short rotation forestry (SRF), amongst them some who are cultivating drained peatland. In this study GHG emissions from alder and poplar short rotation plantations with differing groundwater levels near Rosenheim, Bavaria, were monitored over the course of three-and-a-half years. Moreover, the effect of ploughing for SRF establishment was investigated as well. Understorey GHG fluxes were measured using closed-chamber approaches. Gas samples were enclosed in vials every second week and analysed for their CH4 and N2O concentrations by gas chromatography at a laboratory. On-site measurements of CO_2 fluxes were carried out over the course of a day every three to four weeks with a dynamic closed-chamber technique. Allometric methods were employed to estimate carbon sequestration into trees. Sheet piling was installed around a set of measurement sites in December 2014 to accentuate the difference between the sites with high and low water tables. As a result the water level around those sites rose from an average of -36.1 ± 6.1 cm in 2013 and 2014 to -20.8 ± 3.7 cm in 2015. The water table outside the sheet piling showed values of -61.8 ± 5.7 cm and -72.1 ± 6.2 cm in those years, respectively. First results suggest a limited effect of ploughing for SRF establishment on understorey GHG emissions. However, there seems to be a distinct impact on tree productivity. CO_2 fluxes in the understorey seem to be strongly influenced by water table, but also land management (mulching of understorey vegetation to reduce weed competition for trees during the first year and for pest control in subsequent years) and shading of the understorey vegetation by trees. There is a clear correlation between CH4 emissions and water table, with higher water levels causing higher emissions. So far it has not been possible to establish any such relationship for N2O emissions as they varied greatly throughout all experimental setups in 2014, and were relatively high in general in 2015. It is expected that the cool and rainy summer of 2016 with its accompanying high water tables inside the sheet piling (-6.8 ± 3.2 cm) led to a reduction of the climatic relevance of the wetter sites.