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Carbon balance of a drained forested bog in southern Finland

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Carbon and greenhouse gas (GHG) dynamics of a drained forested peatland in southern Finland were measured over multiple years, including one with severe drought during growing season. Net ecosystem carbon dioxide exchange (NEE) was measured with an eddy covariance method from a tower above the forest. Soil and forest floor CO_2, CH4 and N2O fluxes were measured from the strips and from ditches with closed chambers. Biomasses and litter production were sampled, and soil subsidence was measured by consequtive levelings of the peat surface. The data were used to estimate the ecosystem C pools and annual fluxes of carbon and GHGs of the peatland and to analyse the impact of periodical drought on the carbon fluxes.

The drained peatland was a strong sink of carbon dioxide in all studied years. Soil CO_2 balance was estimated by subtracting the carbon sink of the growing tree stand from NEE, and it showed that also the soil was a sink of carbon in all studied years. A drought period in one summer significantly decreased the sink through decreased GPP. Drought also decreased the ecosystem respiration, including soil respiration. Decreasing water table thus did not increase, but rather decreased CO_2 efflux from the peat soil. The site was a small sink for CH4, even when emissions from ditches were included. N2O emissions were small from all surfaces. Despite of the continuous carbon sink, peat surface subsided slightly (1.4 mm a-1) during the 10-year measurement period, which is interpreted to mean mainly compaction, rather than oxidation of the peat. It is concluded that this drained peatland acts as a continuous soil C sink similarly to an undrained peatland. The reason may be the relatively small water-level drawdown compared to an undrained situation, the consequently rather small changes in plant community structure and the significantly improved tree stand growth and litter production. The consequences of continuing production forestry vs. restoration of the site on the GHG fluxes and climate impact will be discussed.