Geophysical Research Abstracts
Vol. 21, EGU2019-1759, 2019
EGU General Assembly 2019

The effect of top soil removal and *Sphagnum* spp. spreading on the net greenhouse gas balance of a formerly drained, rewetted bog grassland

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In many European countries, rewetting degraded peatlands has become an important measure to restore ecosystem functioning, providing habitats for rare flora and fauna, reducing non-point pollution, and to mitigate high greenhouse gas (GHG) emissions. However, when degraded peatlands that have been under intensive grassland use are rewetted, high methane (CH_4) emissions are frequently observed, counteracting carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions. In incubation experiments, the removal of the upper degraded peat layer has been suggested as an effective measure to reduce the potential for high CH_4 emissions under inundated conditions. Also, the introduction of *Sphagnum* spp. propagules has been suggested to kick-start C sequestration and possibly even act as a bio-filter for CH_4 due to symbiotic CH_4-oxidizing archaea. Therefore, we installed a field trial with seven plots (ca. 8 x 24 m) representing the current state of a drained peat bog under intensive grassland use (Control) and six different restoration approaches. The six approaches include rewetting at the original surface with and without regular biomass harvesting (OS and OS+mowing), and topsoil removal (TSR) of two depths (∼30 and 60 cm) with and without spreading *Sphagnum* spp. propagules (TSR30, TSR30+Sphagnum, TSR60, TSR60+Sphagnum). The plots represent small-scale ecosystems with different initial preconditions for succession after restoration. During the trial, we measure CO_2, CH_4, and N_2O fluxes bi-weekly for period of three years, using the closed-chamber method on three randomly chosen replicate collars of each plot (7 x 3 = 21).

Here, we present CO_2, CH_4, and N_2O data from the first one-and-a-half years of the trial (Jun 2017 – Dec 2018). Preliminary results show that, both uptake and release of CO_2 follows a gradient towards lower fluxes from the Control to the TSR60 plots. Also, after one year, CH_4 emissions of the Control and the OS plots were in the same order of magnitude as CH_4 emissions from other rewetted sites without TSR found in the literature. In contrast, the TSR plots showed only small CH_4 emissions, reduced by two to four orders of magnitude compared to the OS plots. In addition, the spreading of fresh *Sphagnum* spp. propagules had only little effect on CH_4 emissions although coverage increased to almost 100% after one year. Significant N_2O fluxes were only observed occasionally in the Control and the OS plots. When 2018 data are fully collected, we will determine preliminary net GHG and C balances of the plots including C export from TSR and biomass harvest as well as C import by *Sphagnum* spreading. With this, we aim to discuss the initial climate effect of six different approaches of peat bog restoration.