EGU General Assembly 2024

EGU24-15495, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-15495
EGU General Assembly 2024

Drivers of CH_4 flux quantity and variability in re-wetted European peatlands

Kyle Boodoo and Stephan Glatzel
University of Vienna, Department of Geography and Regional Research , Geoecology, Vienna, Austria
(kyle.boodoo@univie.ac.at)

Peatlands cover ~3% of the global land surface, yet they store 21 – 30% of the world's soil organic carbon. Large areas of pristine peatland have been drained to facilitate traditional agricultural activity, leading to increased levels of anthropogenic greenhouse gas (GHG) emissions from these degraded peatlands. Currently, the ~12% global peatlands that are drained (~0.3% of global land area) account for ~4% of all anthropogenic GHG emissions. Within the EU, more than 50% of peatlands are degraded, with Germany having 92% of its peat soils drained for agriculture and forestry. Rewetting peatlands can reduce, or even reverse GHG emissions. While substantial research has focused on the effects on nutrient from peatland re-wetting in bogs, and within pristine Northern European environments, less work has been conducted on central European fens, and on the effect of rewetting on nitrogen in previously drained and nitrogen rich agricultural sites. We investigated the effect of three different landuses (high-, low-intensity paludiculture, wet wilderness) and two different nitrogen (N) levels on CH_4 emissions from 14 different fens, located in Germany, the Netherlands and Poland, to determine landuse management optima and thresholds for reduction in GHG emissions from rewetted, formerly deeply drained agricultural peatlands. We found the highest CH_4 fluxes to occur during Summer and Autumn, and lowest fluxes during Winter, across all landuses and nitrogen (N)-levels. While CH_4 did significantly vary at some sites on a diurnal basis, there was no clear pattern, or definite driver of diurnal CH_4 fluxes. While CH_4 flux significantly increased with increasing level of paludiculture at both N-levels in Germany, CH_4 flux decreased with higher intensity paludiculture at the lower-N Netherlands sites, and conversely increased with higher intensity paludiculture at high-N Polish sites. These differences in treatment effect on CH_4 fluxes among the different country sites highlight the complex interaction of different drivers responsible for determining CH_4 fluxes from peatlands. Overall, soil phosphorous concentration was linked to higher CH_4 fluxes, while bulk density was inversely related to CH_4 flux. Furthermore, general additive models showed that CH_4 flux increased with soil temperature and moisture, peaking at specific carbon (C):N ratios and bulk densities. This is of relevance for management strategies, as it suggests that there is the potential for manipulation of these 4 drivers within rewetted peatlands in order to reduce future CH_4 fluxes. Our results highlight the importance of maintaining minimum water table levels, and maintaining N-levels below certain thresholds in order to effectively manage CH_4 fluxes, and mitigate against GHG emission contributions to global warming from current and previously drained peatlands.