Drainage impact on N_2O & CH_4 fluxes from grassland on a drained nutrient-rich organic soils – sites, steps and preliminary results

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Introduction

Organic soils are one of the largest natural terrestrial carbon stores, mainly in boreal, temperate and tropical wet climate zones. These environments are deficient in oxygen; therefore, organic matter decomposes slowly and accumulates. In Europe, organic soils account for a very small proportion of the total utilized agricultural area (3%; 4,4 million hectares). However, as a common management practice, drainage turns those carbon-rich soils into a significant greenhouse gas (GHG) source. Drainage causes increased carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions due to increased soil mineralization. Methane (CH_4) emissions, on the other hand, are reduced compared to natural wetlands where no soil drainage and tillage are done. Land use, climate zone, soil nutrient status, and drainage status are closely linked to estimating GHG budgets from managed sites on organic soils.

Drainage impact on GHG fluxes from grasslands and forests on drained nutrient-rich organic soils throughout two full-year is studied in hemiboreal Estonia (EE), Latvia (LV), and Lithuania from 2021. Results of the first full-year period of N_2O and CH_4 fluxes and environmental parameters from grasslands in EE and LV will be presented. Fluxes with different drainage statuses were determined on seven sites in four groups:
(I) two on excessively drained fens soils;
(II) two on moderately drained fens soil;
(III) one on drained fens soil with increased groundwater levels;
and for comparison **(IV)** two non-managed fens as reference sites.

The main objective of our study is to calculate a carbon (C) and nitrogen (N) budget further and adjust GHG emission factors for GHG from drained peatland grasslands in the Baltic countries.

Methodology

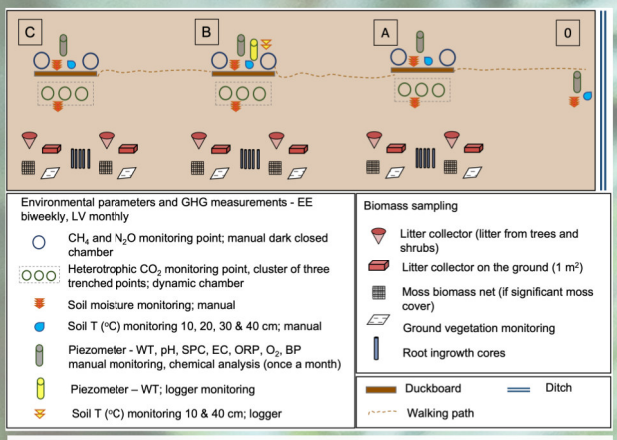

Fig. 1. Study plot, enclosing three subplots for GHG and other data collection (figure modified from Jauhiainen *et al.* (2019))

Results

Nitrous oxide (N_2O)

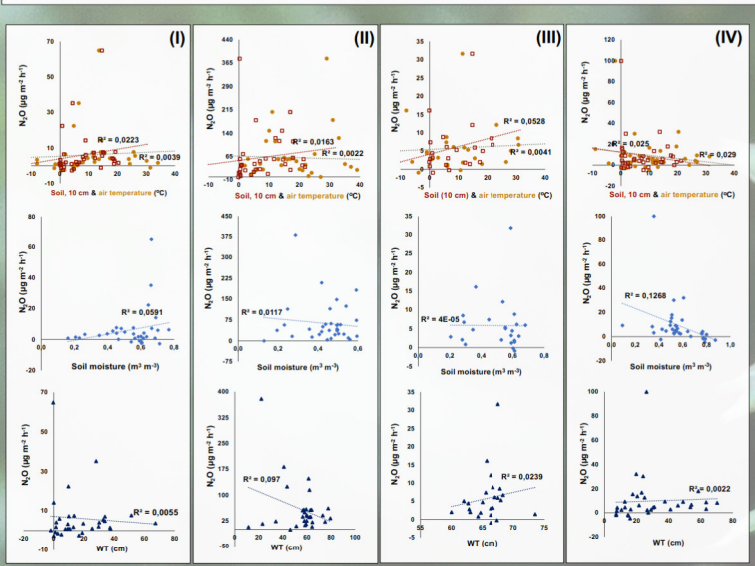

Fig. 2. N_2O flux dependence on environmental parameters (soil T in 10 cm, air T, soil moisture, WT) in the grasslands with different drainage statuses **(I)** excessively drained fens soils; **(II)** moderately drained fens soil; **(III)** drained fens soil with increased groundwater levels; **(IV)** non-managed fens as reference sites) during the measurement period Jan-Dec 2021

Methane (CH_4)

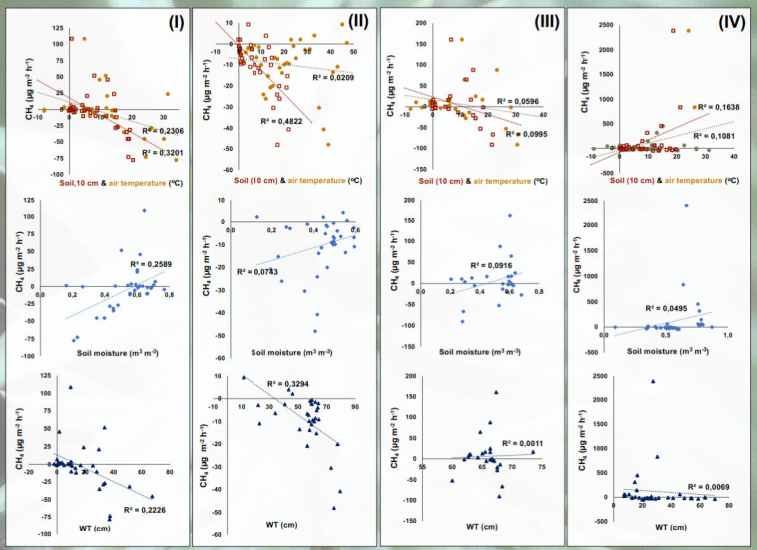

Fig. 3. CH_4 flux dependence on environmental parameters (soil T in 10 cm, air T, soil moisture, WT) in the grasslands with different drainage statuses statuses **(I)** excessively drained fens soils; **(II)** moderately drained fens soil; **(III)** drained fens soil with increased groundwater levels; **(IV)** non-managed fens as reference sites) during the measurement period Jan-Dec 2021

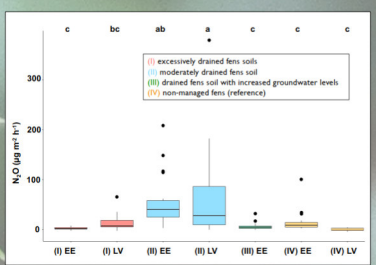

Fig. 4. N_2O variability and statistical parameters (median values, 25th and 75th percentiles, minimum and maximum values)

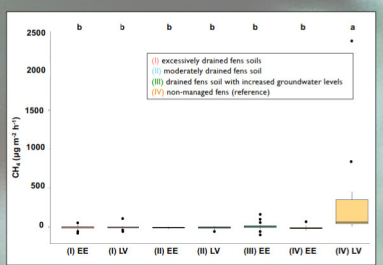

Fig. 5. CH_4 variability and statistical parameters (median values, 25th and 75th percentiles, minimum and maximum values)

Conclusion

- High N_2O and CH_4 fluxes seasonal variability;
- Drained grasslands (I, II) were annual CH_4 sinks (emissions varied from -77.7 to 108.88 μg m^{-2} h^{-1}), while fens soils with higher groundwater levels (III, IV) were a source of CH_4 (emissions varied from -90.54 to 2389.70 μg m^{-2} h^{-1});
- All studied sites were annual emitters of N_2O (emissions varied from -2.45 to 379.31 μg m^{-2} h^{-1}).
- Moderately drained soils (II) were the highest N_2O emitter (61.20 ± 12.15 μg m^{-2} h^{-1}).

Next important steps in our study are the following:

- continue with more in-depth data analysis (multicriteria);
- C and N budget
  - include heterotrophic CO_2 flux;
  - C and N content in above & below ground biomass;
  - litter and biomass production.

Acknowledgements

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