GHG emissions from undisturbed peat soil columns in a drying-wetting cycle

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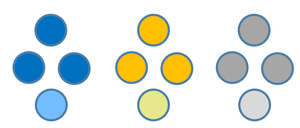
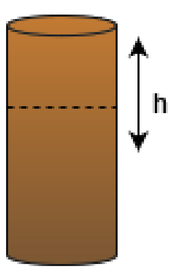
Background

- Drainage of peat soils leads to decomposition of soil organic matter and emissions of greenhouse gases (GHG)
- The relation between soil water level and emissions of CO_2, N_2O and CH_4 is not exactly known.
- In an experiment on undisturbed peat soil columns under controlled conditions, the interactions between soil moisture and GHG emissions are studied.
- GHG emission observations of the first drying-wetting cycle are shown below.

Materials & methods





- Peat soils from three sites (Zegveld, Vlist, Aldeboarn):
  - Unvegetated soil core x 3 replicates
  - Vegetated soil core
- Soil columns were treated with a drying- wetting cycle by changing the hydraulic head at the bottom (as proxy for groundwater level).
- This drying wetting cycle encompassed 11 steps, taking place between 11 January and 29 March 2022

Figure 1. Set up of soil columns in a climate room.

Results

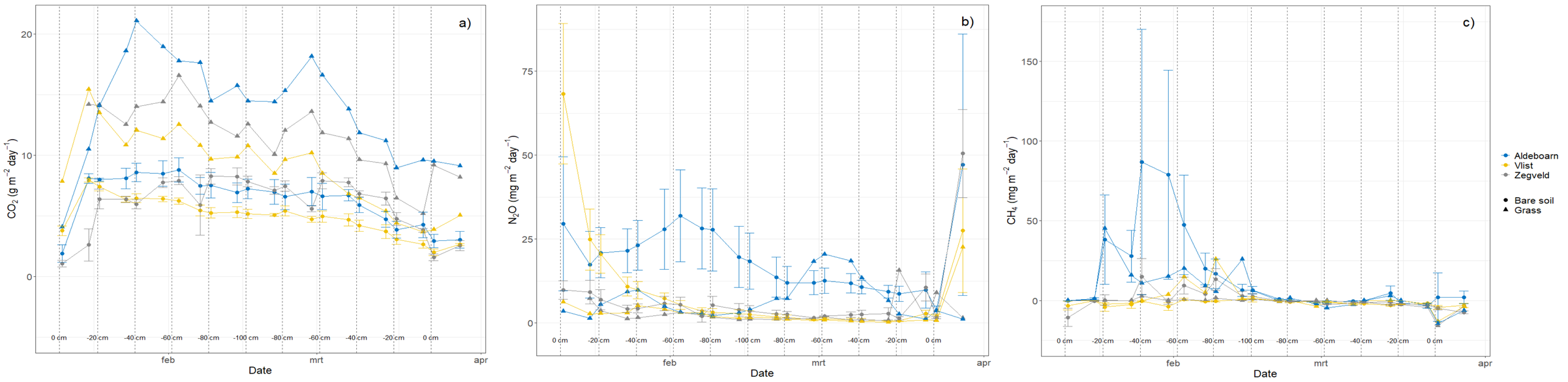


Figure 2. Emission flux observations of CO_2 (a), N_2O (b) and CH_4 (c) from vegetated (n =1) and unvegetated (n = 3) soil columns. Error bars represent the standard errors of emissions from unvegetated soil columns. The vertical dotted lines and accompanying labels indicate the start of a new hydraulic head step, and the corresponding water level depth below soil surface.

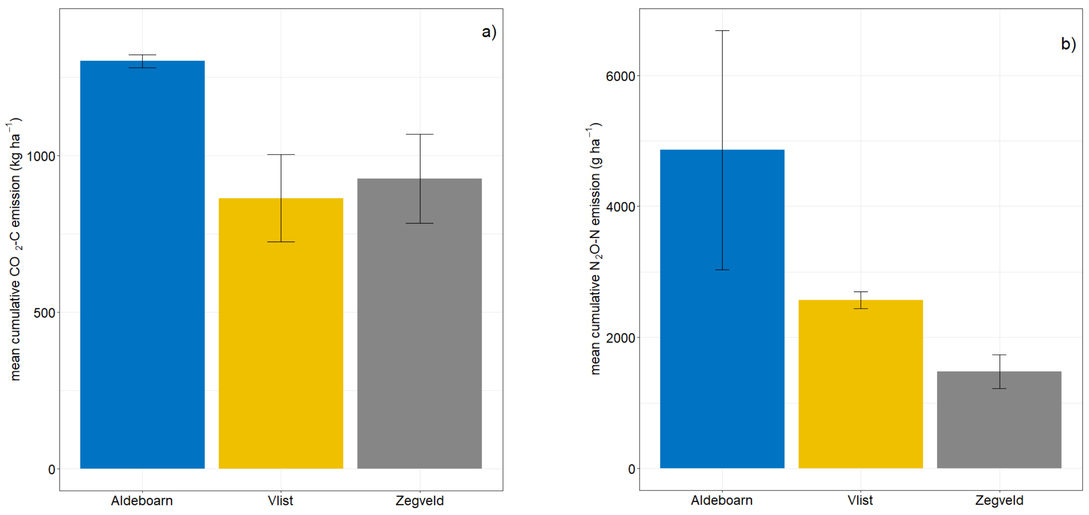


Figure 3. Cumulative fluxes CO_2-C (a) and N_2O-N (b) in the unvegetated soil columns (n =3) during the drying-wetting cycle in Jan. till March 2022. Error bars represent the standard errors.

Preliminary conclusions

- After an initial increase in the first 7-14 days, CO_2 emissions showed a slight decrease as the drying and later rewetting advanced. This may be due to an initial stimulans in mineralization at the start of the experiment, which gradually stabilized.
- N_2O emissions peaked at the highest water levels.
- Cumulative CO_2 and N_2O emissions are highest in the Zegveld soils (not significant, $\alpha = 0.05$).
- CH_4 emissions are generally low, with the exception of some outliers, which may be ascribed to ebullition.

Recommendations for future experiments

- In following drying-wetting cycle(s), water level steps should be longer in time, to allow for conditions to stabilize in each step.
- Dryer moisture conditions than a water level of -105 cm below surface should be explored.

Acknowledgements

The research presented on this poster is part of the project Living on soft soils: subsidence and society (grantnr.: NWA.1160.18.259). This project is funded by the Dutch Research Council (NWO-NWA-ORC), Utrecht University, Wageningen University, Delft University of Technology, Ministry of Infrastructure & Water Management, Ministry of the Interior & Kingdom Relations, Deltares, Wageningen Environmental Research, TNO-Geological Survey of The Netherlands, STOWA, Water Authority: Hoogheemraadschap de Stichtse Rijnlanden, Water Authority: Drents Overijsselse Delta, Province of Utrecht, Province of Zuid-Holland, Municipality of Gouda, Platform Soft Soil, Sweco, Tauw BV, NAM.

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