CCM measures in testing in Latvia – controlled drainage (LVC305)

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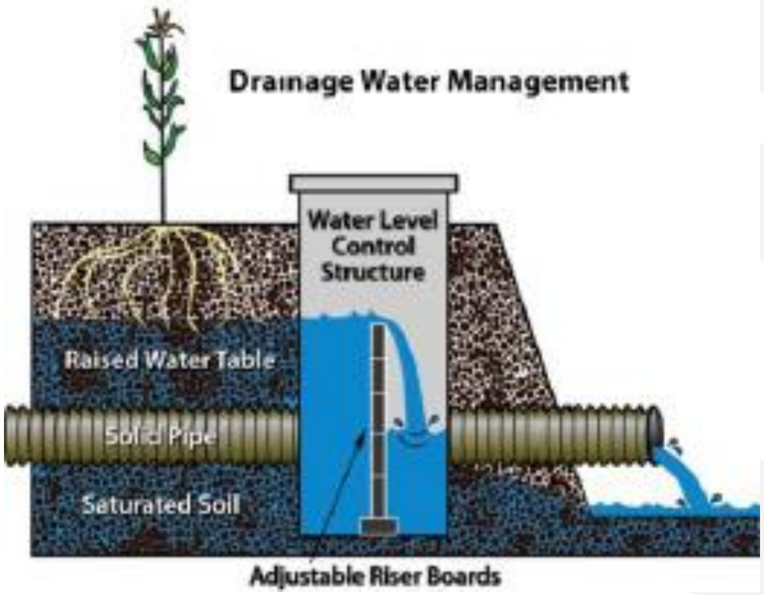
LIFE OrgBalt, LIFE18 CCM/LV/001158

EU LIFE Programme project
"Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland"

State Regional Development Agency Republic of Latvia
SILAVA
Ministry of Agriculture Republic of Latvia
Latvia University of Life Sciences and Technologies
Luke Natural Resources Institute Finland
Lithuanian Research Centre for Agriculture and Forestry
Baltijas krasti
Succow Stiftung
Partner in the Greifswald Mire Centre

Definition

The process of managing the drainage volume and water table elevation by regulating the flow from a subsurface agricultural drainage system



Source of the definition: United States Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standard – Drainage Water Management, Code 554. Available: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026409.pdf
Source of the drawing: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/?cid=nrcs144p2_027166

Purpose

- ✓ Reduce nutrient, pathogen, and pesticide loading from subsurface drainage systems into downstream receiving waters *as drainage volume from leaving subsurface agricultural drainage system is reduced*;
- ✓ Improve productivity, health, and vigor of plants *as additional water can be stored in the soil profile and used by plants later in a growing season*;
- ✓ Reduce oxidation of organic matter in soils *as drainage beyond that necessary to provide an adequate root zone for plants is minimized thus creating anaerobic soil conditions (rewetting of organic soils)*.

Source of the purpose: United States Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standard – Drainage Water Management, Code 554. Available: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026409.pdf

Potential benefits

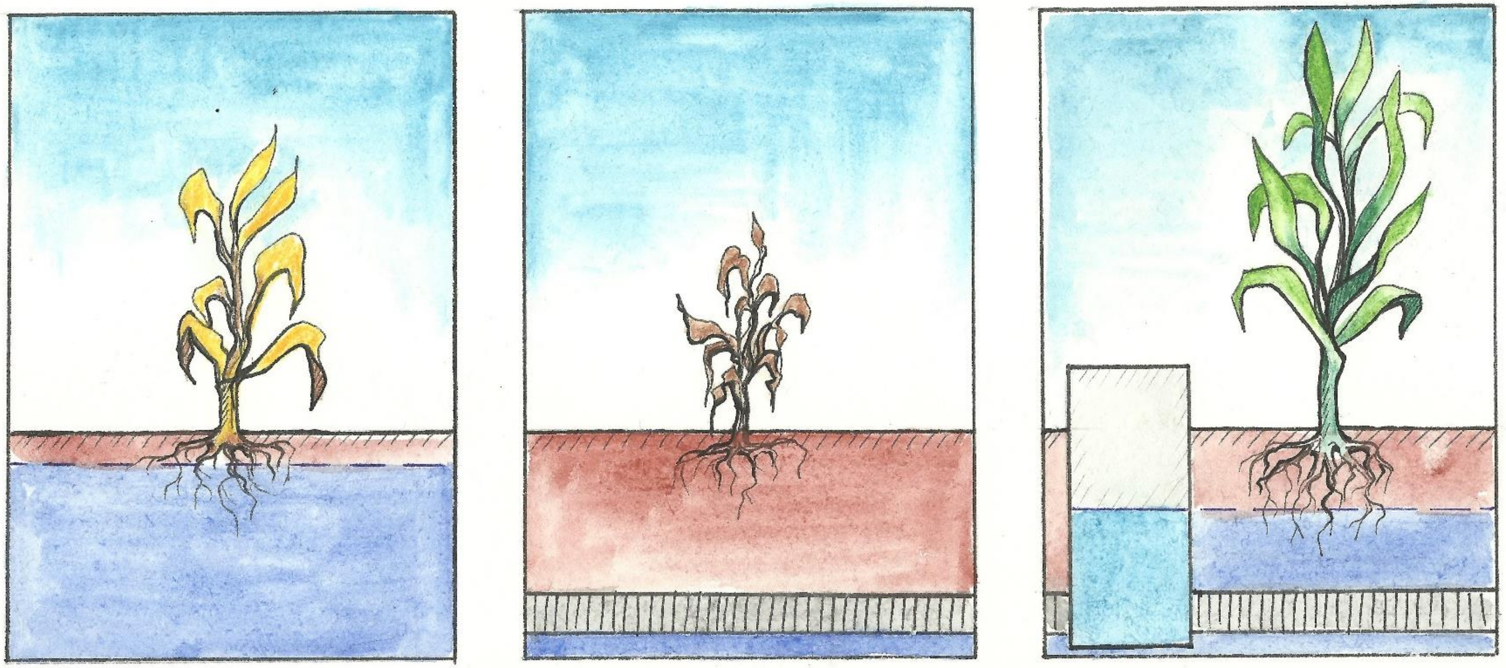
- ✓ Reduced emissions of CO_2 and N_2O from nutrients rich organic soils, variable effects on CH_4 emissions;
- ✓ Reduced drainage and nutrient losses to recipient waterbodies;
- ✓ Additional water might be available to meet crop water requirements during the summer period.

Potential limitations

- ✓ Controlled drainage is generally limited to nearly flat fields with slopes typically less than 1.0 percent;
- ✓ Land owners/managers should take care to maintain a sufficiently aerated root zone so as not to damage plants. Adjustable boards in water control structures have to be maintained properly to raise or lower the water level in agricultural fields depending on field operations and plant demands.
- ✓ The water level in agricultural fields have to be managed in a manner that does not cause adverse impacts to other properties or drainage systems.

Potential limitations

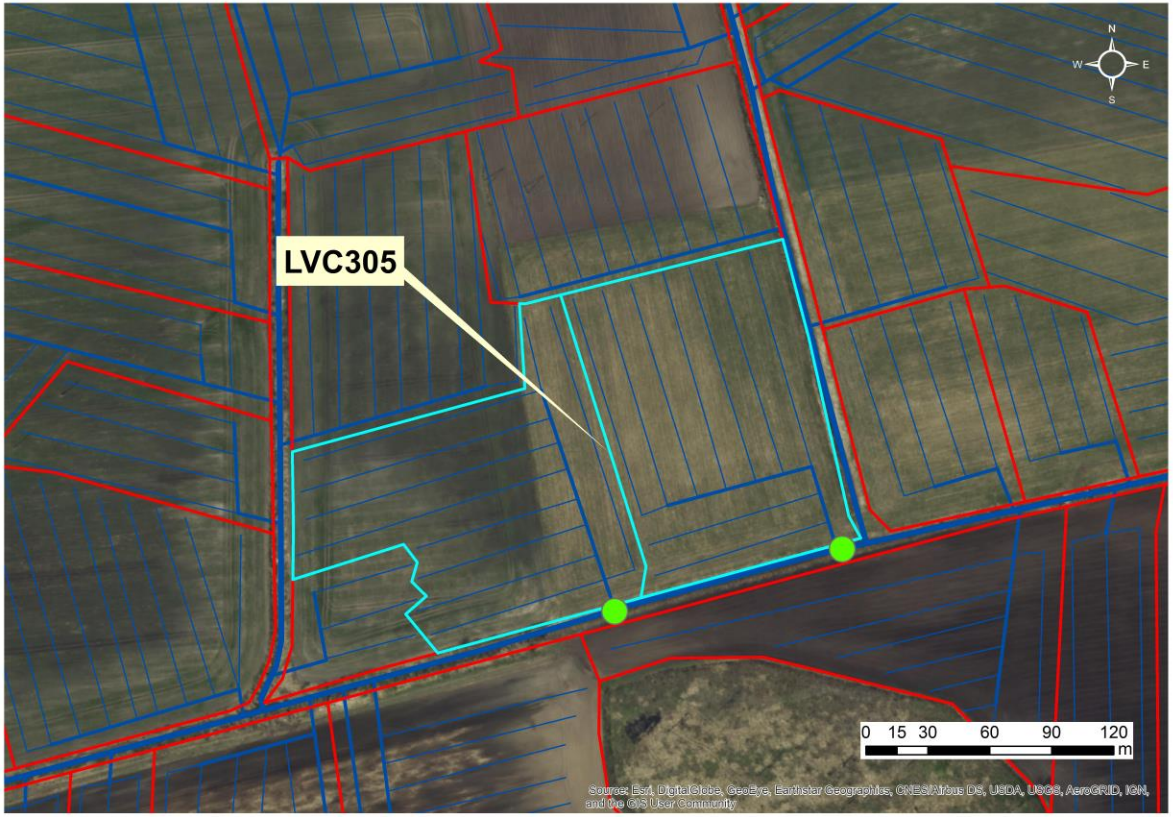
Too much water! Not enough water! As much as needed!



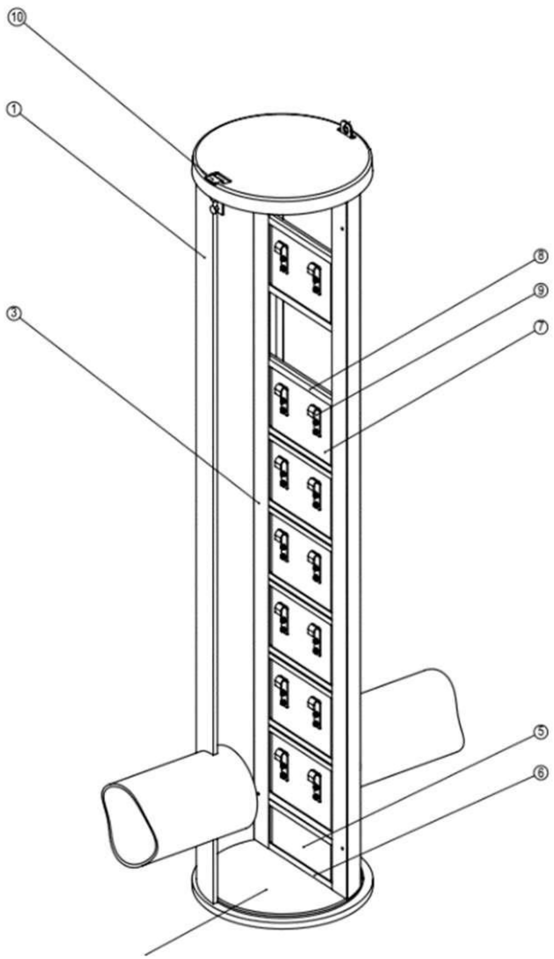
Drawing courtesy of AgriDrain Corporation: Alise Trifane

The demo site in the agricultural fields managed by the Training and Research Farm «Vecauce» – Action C3

LVC305 Controlled drainage of grassland considering even groundwater level during the whole vegetation period



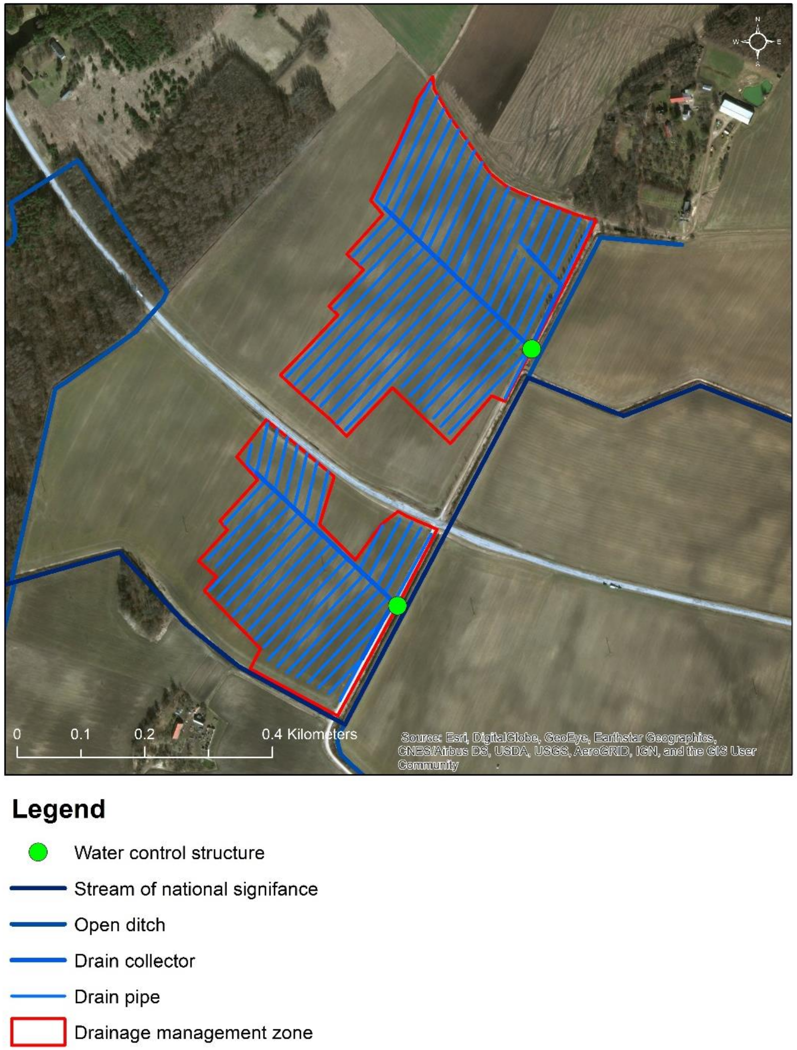
The demo site in the agricultural fields managed by the Training and Research Farm «Vecauce» – Action C3



Two water control structures with manually adjustable boards will be installed at the outlets of the existing subsurface drainage systems including one for controlled drainage mode to store water in the soil and one for free drainage mode.

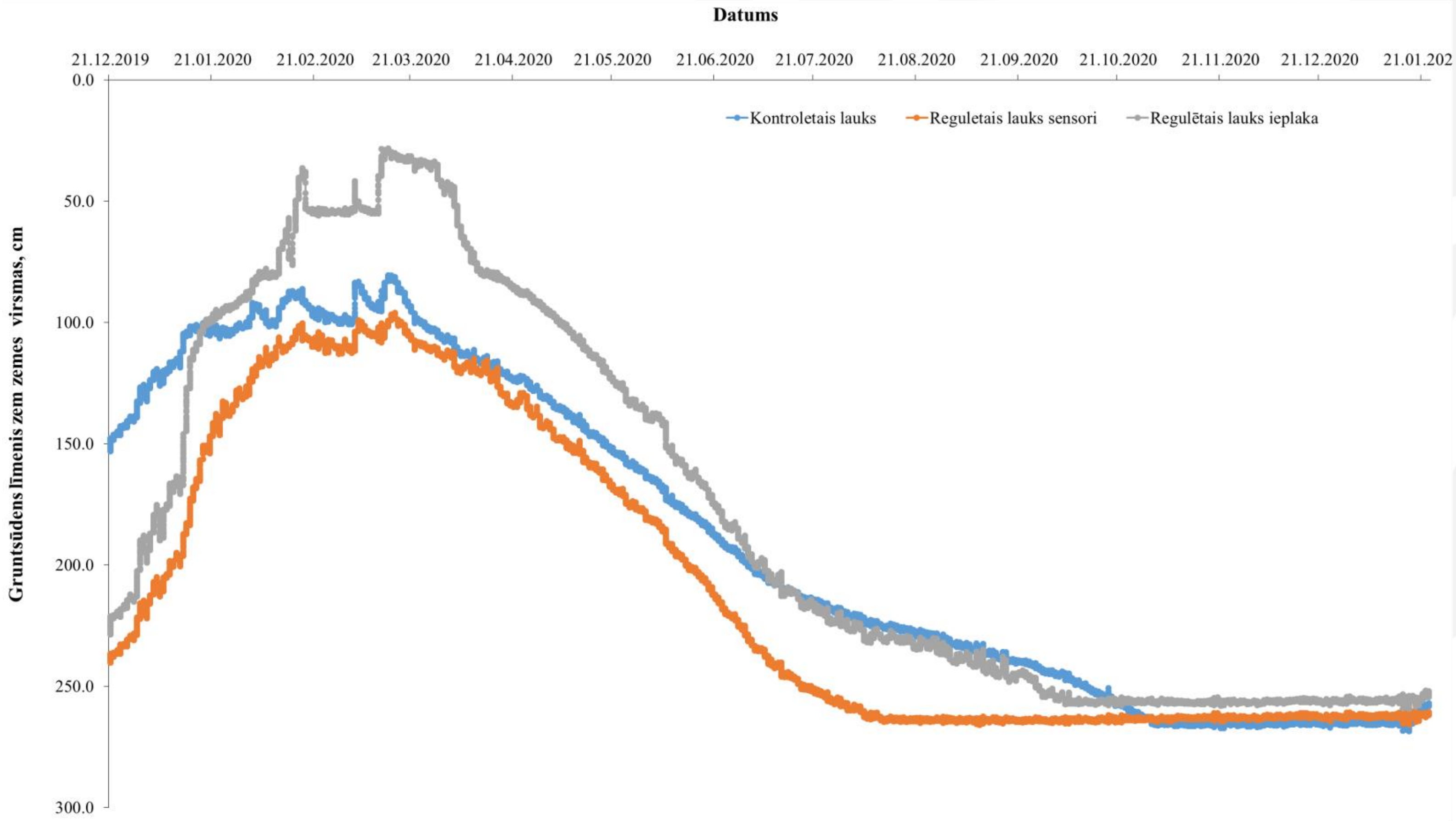
Previous/ongoing experience

The controlled drainage study at the Vilcini-1 farm in Latvia



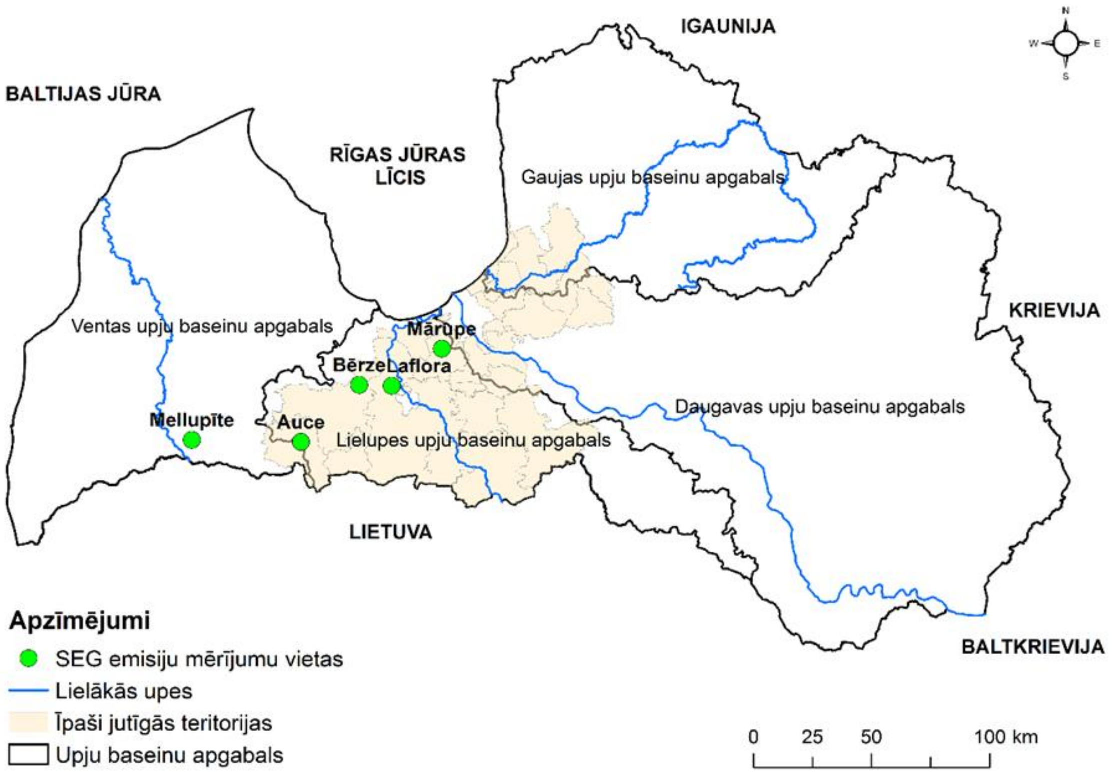
Previous/ongoing experience

Groundwater level fluctuations



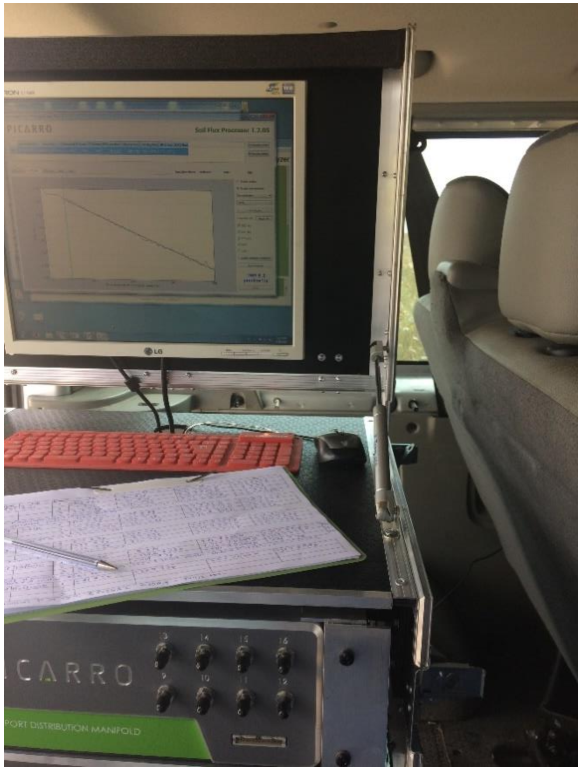
Previous/ongoing experience

Measurements of GHG emissions from mineral and organic soils in Latvia



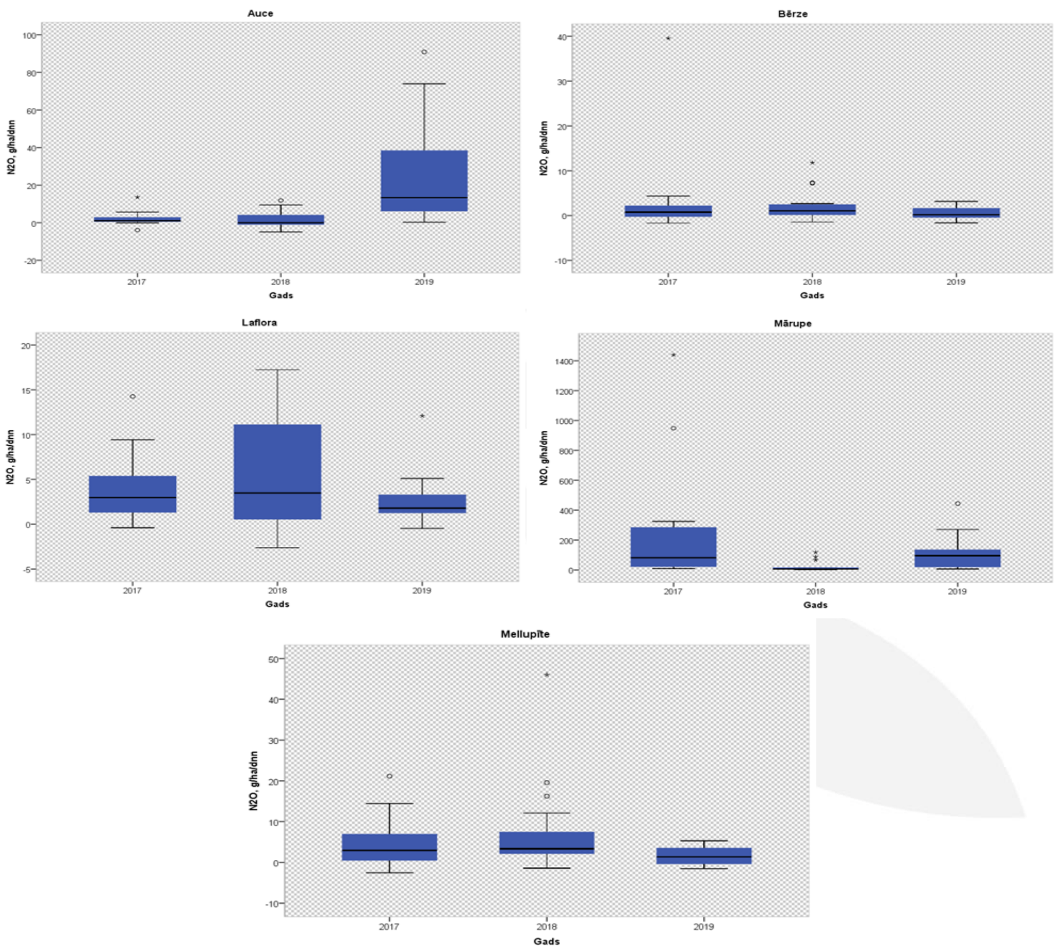
Previous/ongoing experience

Emissions of N_2O, CH_4, CO_2, NH_3 from soil were measured using the cavity ring down spectroscopy device Picarro G2508



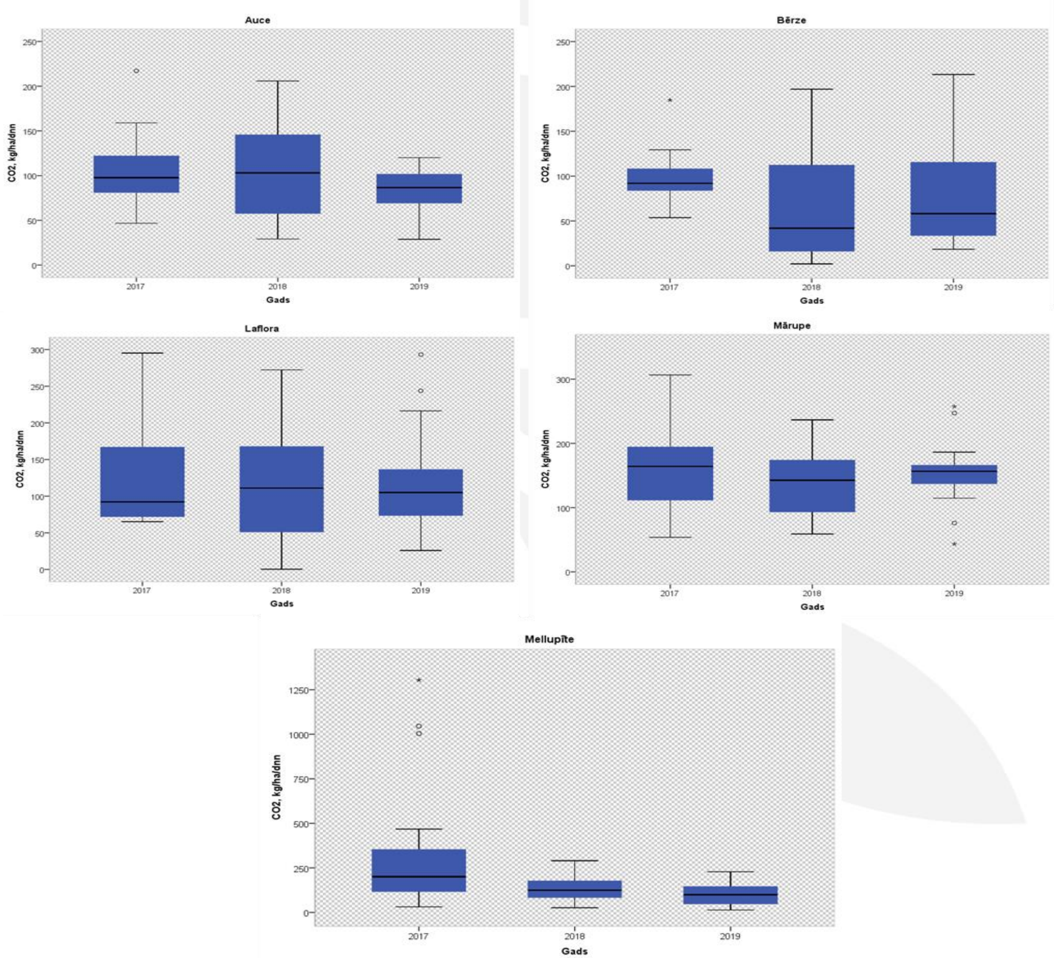
Previous/ongoing experience

The results of nitrous oxide (N_2O) measurements



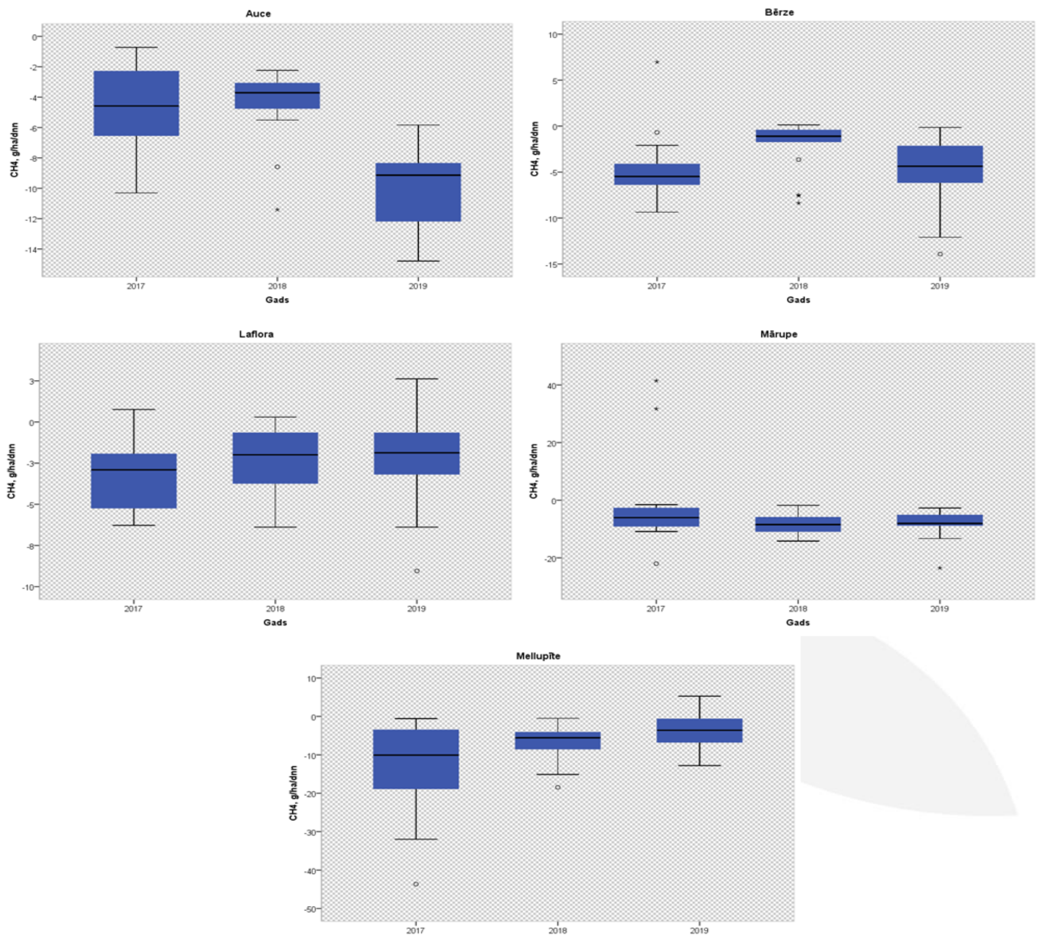
Previous/ongoing experience

The results of carbon dioxide (CO_2) measurements



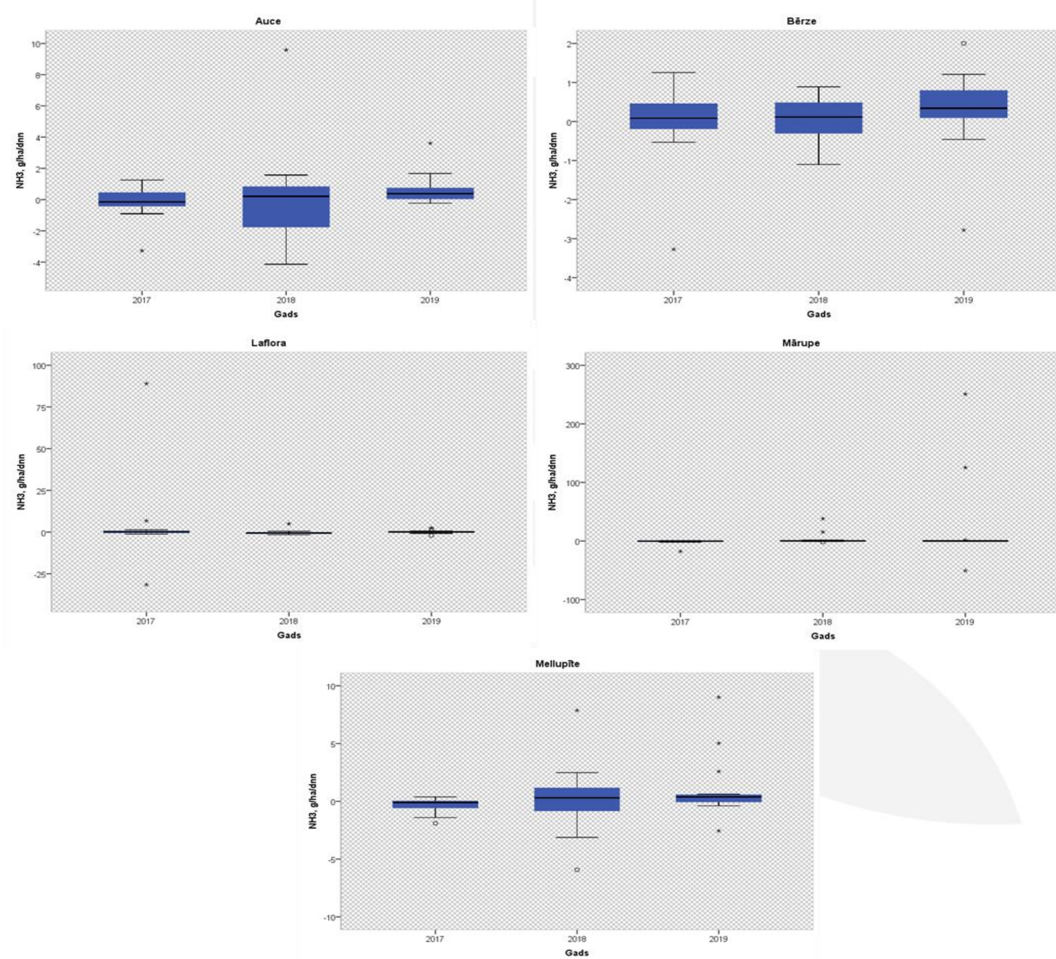
Previous/ongoing experience

The results of methane (CH_4) measurements



Previous/ongoing experience

The results of ammonia (NH_3) measurements



Previous/ongoing experience

Kendall rank correlation coefficients in organic soils in 2019

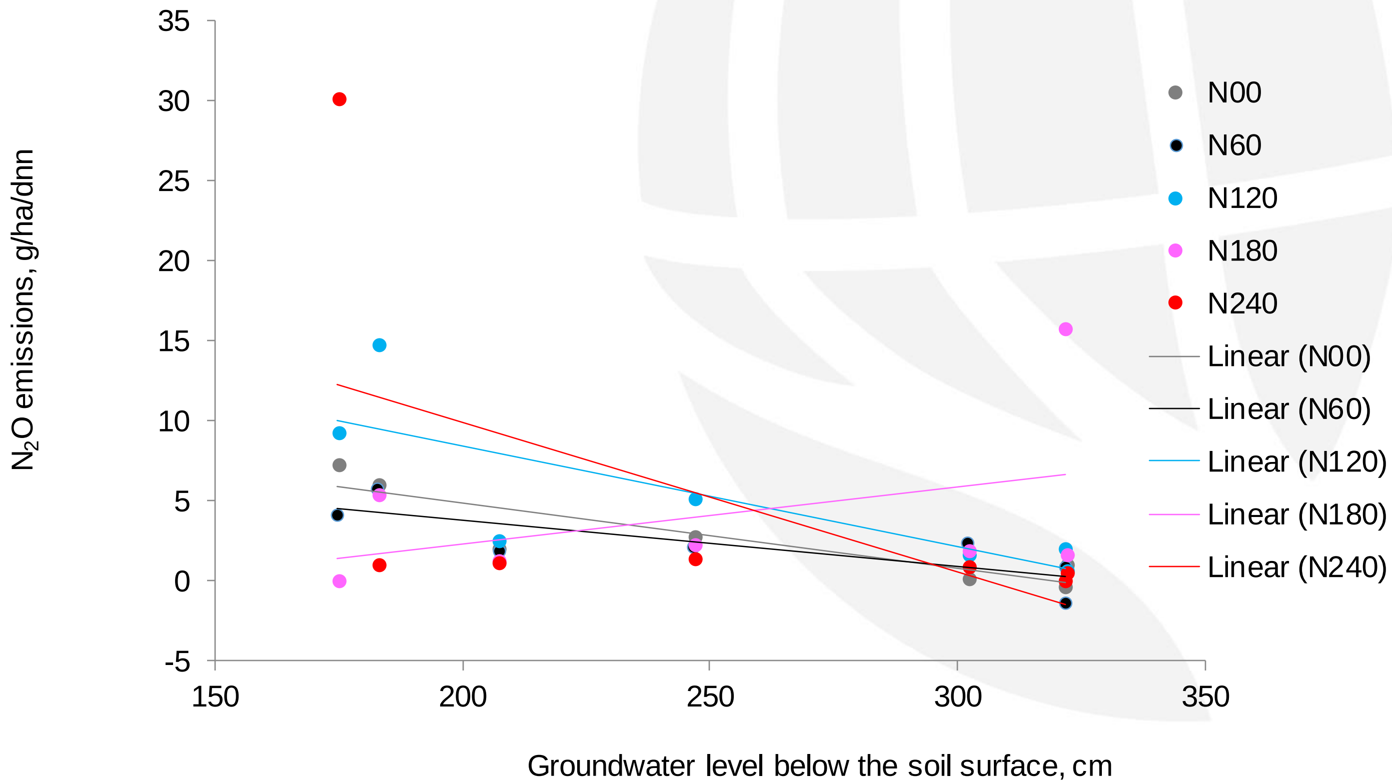
Variables	Soil temperature, °C	Soil moisture, %	N2O, g/ha/dnn	CH4, g/ha/dnn	CO2, kg/ha/dnn	NH3, g/ha/dnn
Soil temperature, °C	1					
Soil moisture, %	0,131	1				
N2O, g/ha/dnn	-0,139	**-0,351****	1			
CH4, g/ha/dnn	-0,122	-0,037	**-0,267***	1		
CO2, kg/ha/dnn	**0,388****	-0,109	0,034	**-0,308***	1	
NH3, g/ha/dnn	0,178	-0,063	0,030	-0,203	0,076	1

The same relationship for mineral and organic soils in 2019

*** p value<0.01; ** p value<0.05; *p value<0.1

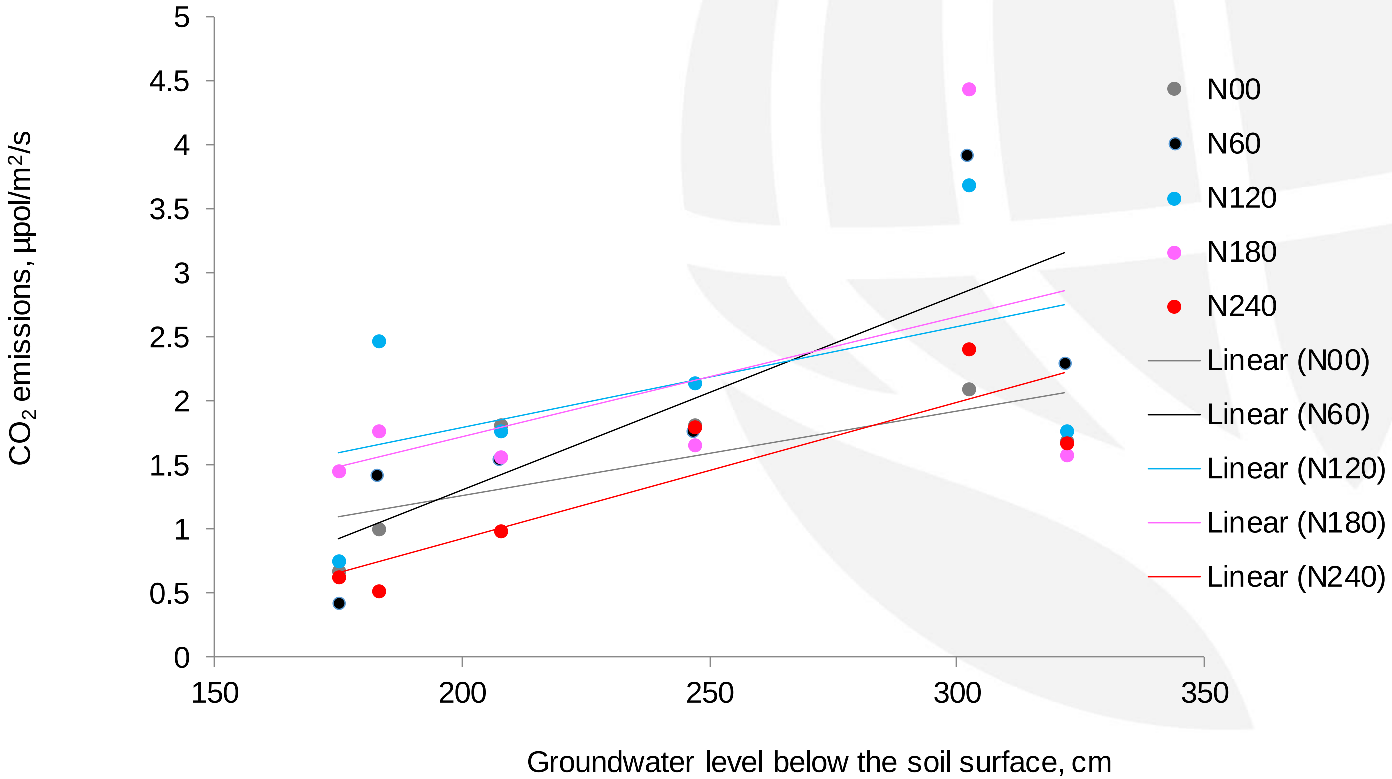
Previous/ongoing experience

The linear relationship between groundwater level and N_2O emissions at the experimental plots in the Mellupite site – 2018



Previous/ongoing experience

The linear relationship between groundwater level and CO_2 emissions at the experimental plots in the Mellupite site – 2018



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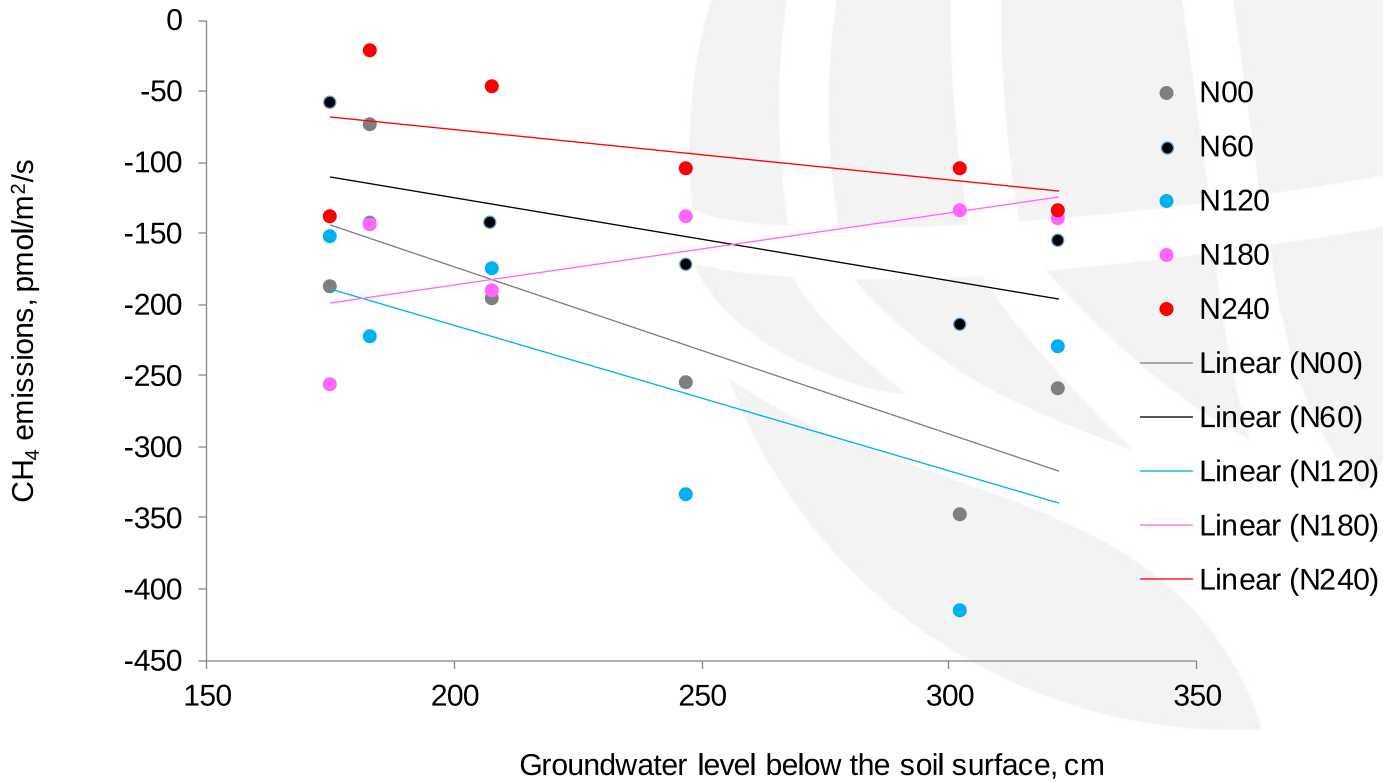
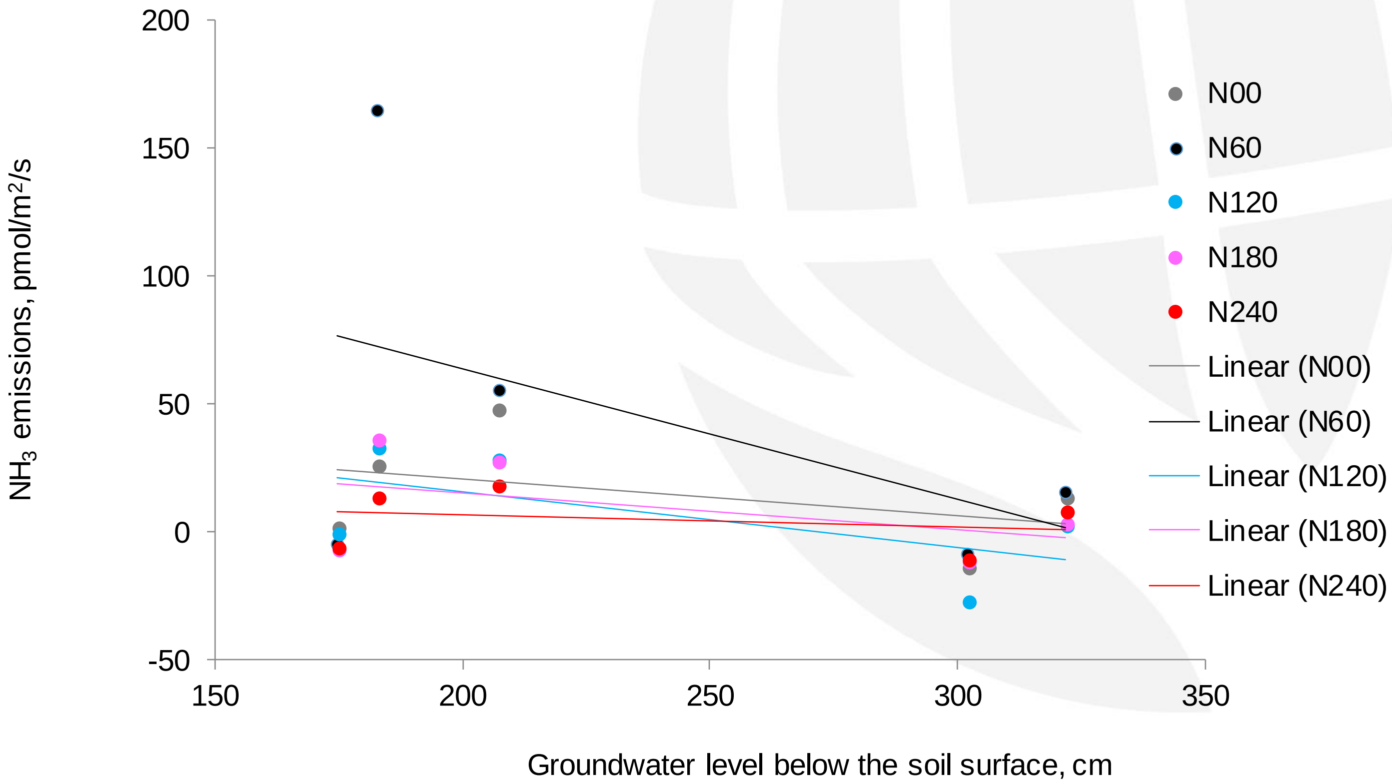


Previous/ongoing experience

The linear relationship between groundwater level and NH_3 emissions at the experimental plots in the Mellupite site – 2018



Conclusions

- ✓ Emissions of CO_2 are favored under aerobic conditions whereas CH_4 is produced under strictly anaerobic conditions, and N_2O is released from both nitrification that requires aerobic conditions and denitrification that requires anaerobic conditions;
- ✓ It will be challenging to reduce emissions of all GHG with implementation of controlled drainage as a climate change mitigation measure. In order to obtain comparable results on the effects of controlled drainage or any other measure on GHG emissions it is necessary to measure emissions of all GHG and recalculate these emissions into CO_2 equivalents.

Thank you for your attention!

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