23rd International Scientific Conference
ENGINEERING FOR RURAL DEVELOPMENT
Latvia University of Life Sciences and Technologies, Jelgava, Latvia, 22.-24. May 2024

METHANE (CH_4) AND NITROUS OXIDE (N_2O) EMISSIONS FROM SURFACE OF DECIDUOUS TREE STEMS AND SOIL IN FORESTS WITH DRAINED AND NATURALLY WET ORGANIC SOILS

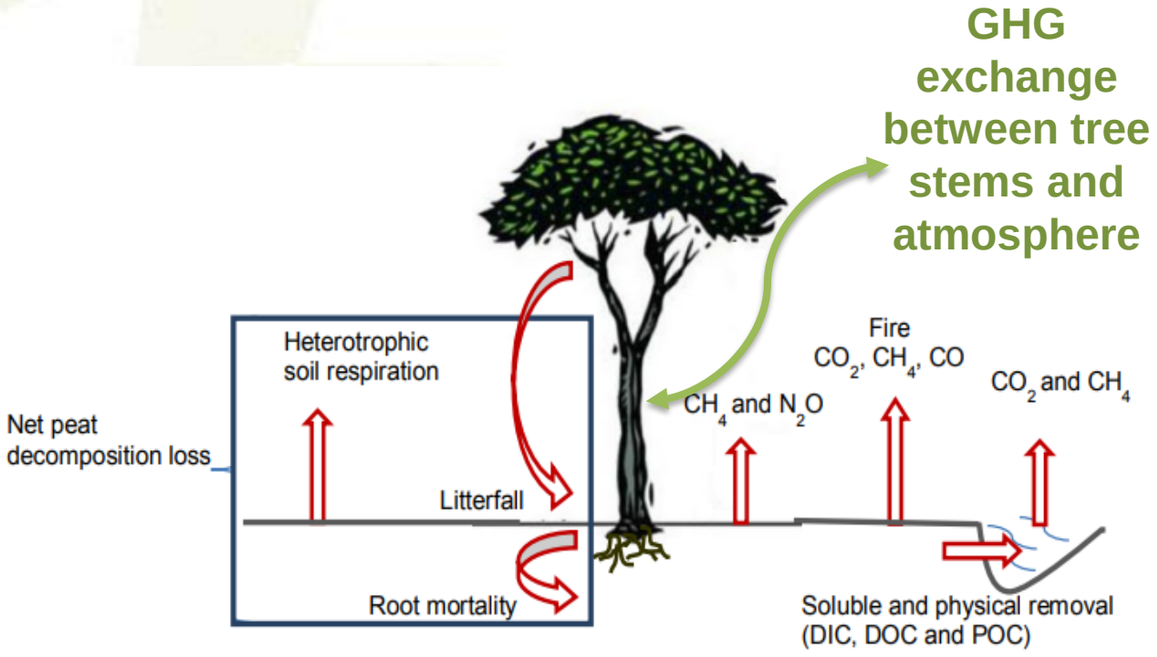
Ilona Skranda, Dana Purvina, ***Arta Bardule, Guna Petaja***
Latvian State Forest Research Institute "Silava"
e-mail: arta.bardule@silava.lv

This study was funded by the project "Evaluation of factors affecting greenhouse gas (GHG) emissions from surface of tree stems in deciduous forests with drained and wet soils", The Latvian Council of Science, Fundamental and applied research projects, agreement No.: LZP-2021/1-0137

LSFRI Silava
Riga street 111
Salaspils, LV-2169, Latvia
Phone: 67942555, e-mail: inst@silava.lv
www.silava.lv

FLPP
FUNDAMENTAL AND APPLIED RESEARCH PROJECTS

Aim of the study



Summary of greenhouse gas (GHG) fluxes in tree-dominated ecosystems (IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands)

- to assess the magnitude of **GHG, (CH_4 and N_2O) fluxes from organic soil and the stem surface** of black alder, silver birch and aspen in forest stands with drained and naturally wet organic soils;

- to examine their correlations with environmental factors (groundwater level, soil temperature).

Materials and methods

10 study sites in forest stands with drained and naturally wet organic soils in Latvia (Europa's hemiboreal zone) dominated by:

- black alder (*Alnus glutinosa* (L.) Gaertb.);
- silver birch (*Betula pendula* Roth.);
- aspen (*Populus tremula* L.)

Tab. 1. *General description of the study sites and sample trees in deciduous tree forest stands with drained and naturally wet organic soils in Latvia (n – number of study sites)*

Soil moisture conditions	Tree species	Study site identifier	Location of study site (WGS84)		Mean tree diameter at 1.3 m height of selected tree species in forest stand, cm	Characteristics of sample trees (range)	
			X	Y		Diameter at 1.3 m height, cm	Height, m
Drained (n=6)	Silver birch (n=2)	OS5	56.67388	25.89674	30.5	27.0-42.3	26.3-29.3
		OS8	56.71001	26.05986	11.7	14.6-20.0	16.6-20.5
	Black alder (n=2)	OS3	56.6847	25.88981	14.8	15.9-21.9	15.9-17.2
		OS6	56.64171	26.01253	32.1	29.8-39.7	30.6-32.5
	Aspen (n=2)	OS1	56.4466	22.85432	12.7	14.6-23.1	18.0-23.1
		OS2	56.42684	22.77874	21.7	13.8-29.4	18.9-28.2
Naturally wet (n=4)	Silver birch (n=2)	OS4	56.68495	25.88707	10.5	11.9-18.8	13.9-20.1
		OS7	56.71074	26.05881	25.0	14.2-36.4	16.9-20.6
	Aspen (n=2)	OS9	57.30307	26.03518	32.5	25.2-49.4	30.9-31.5
		OS10	57.29077	25.99702	21.0	15.8-25.5	20.0-24.7

Materials and methods

- CH_4 and N_2O fluxes from the surface of tree stems were monitored during the frost-free period in 2022 (May-November) and 2023 (April-October).
    - gas samples were taken using manual chambers (volume 2.48-2.86 L) attached to sample tree stems (area 158-280 cm^2) at a height of 1.3 m

- CH_4 and N_2O fluxes from soil were monitored in the period from May 2022 to October 2023.
    - gas samples from soil were taken using closed static opaque chambers (volume 65.5 L) positioned on the permanent circular collars installed in the soil.

Materials and methods

- Gas sampling was conducted once a month.
- Concentrations of CH_4 and N_2O in gas samples were analyzed using gas chromatography (GC) with a Shimadzu Nexis GC-230 instrument.
- During each study site survey, several environmental parameters were monitored: air temperature, soil temperature at 5 cm depth, groundwater level.

Results

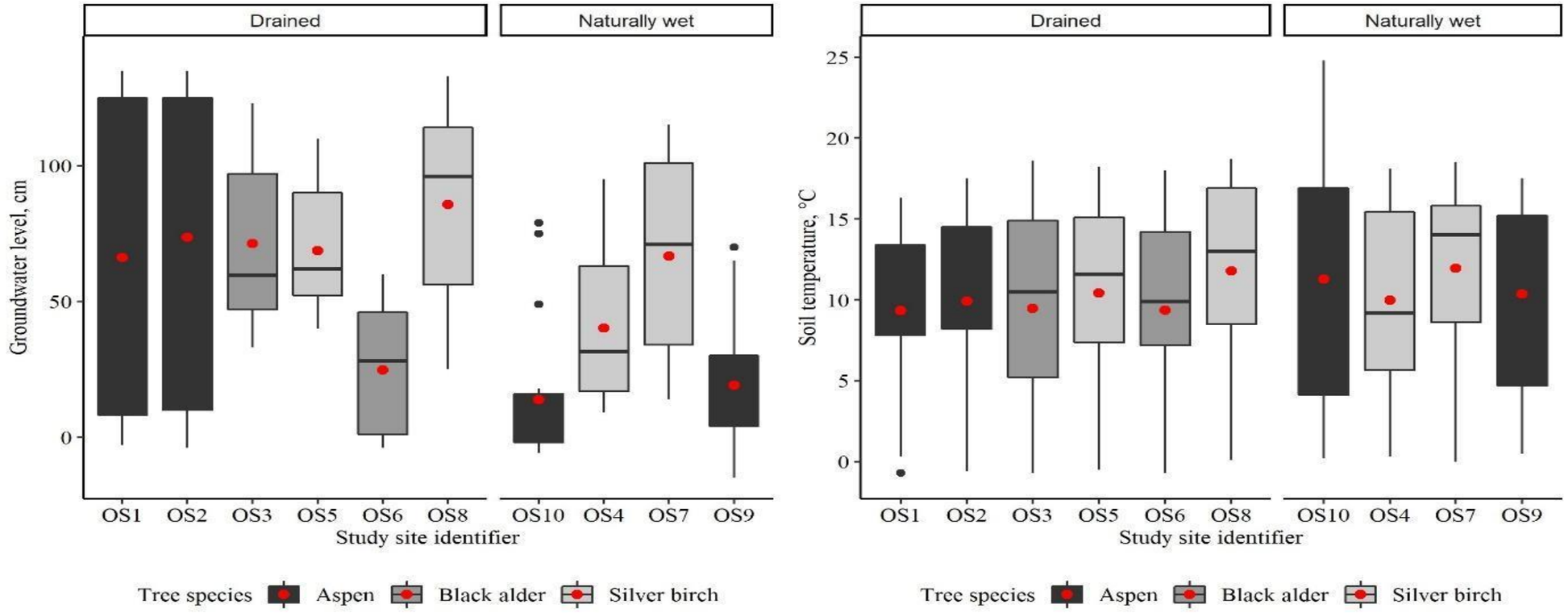


Fig. 1. *Groundwater level below soil surface and soil temperature at 5 cm depth in study sites with drained and naturally wet organic soil (the medians are bold horizontal lines in the boxes, the mean values are red dots, and the black dots are outliers of the datasets)*

Results

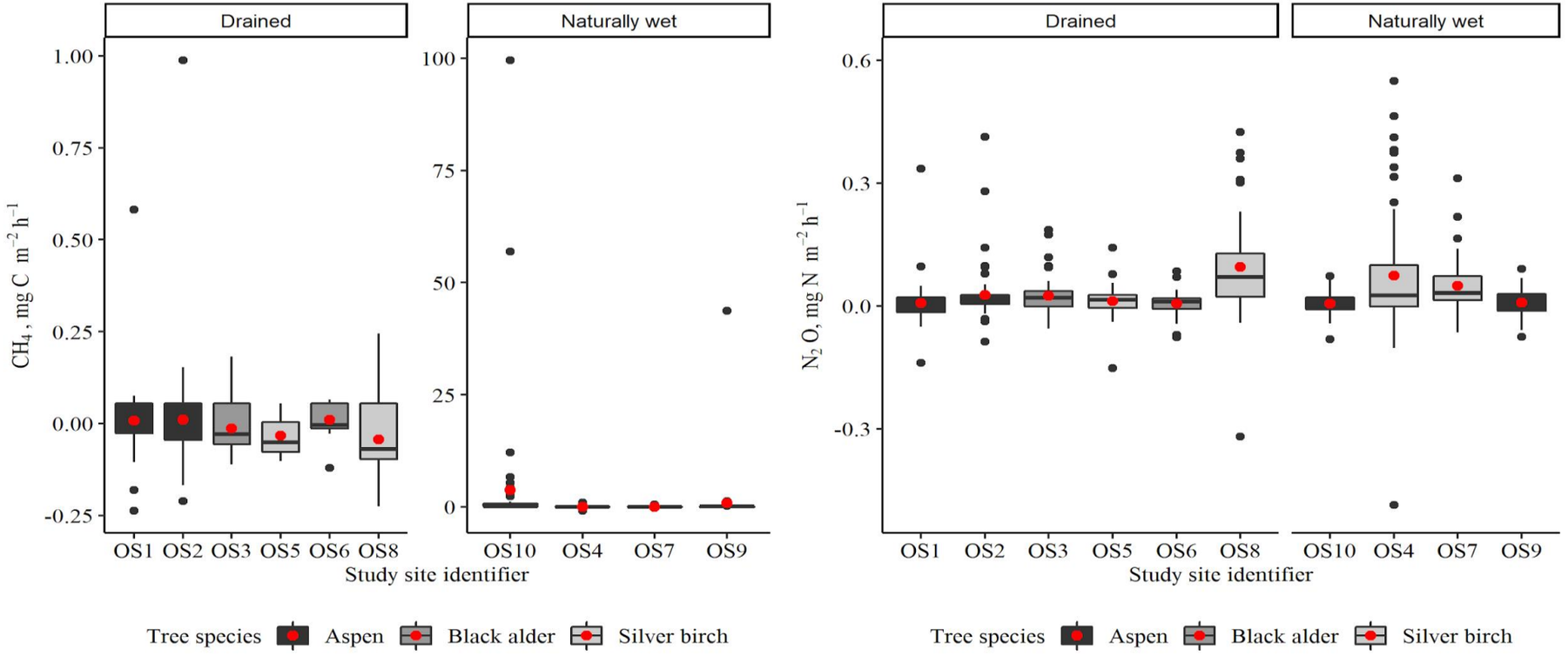


Fig. 2. *Variation of CH_4 and N_2O fluxes from organic soil among study sites (the medians are bold horizontal lines in the boxes, the mean values are red dots, and the black dots are outliers of the datasets)*

Results

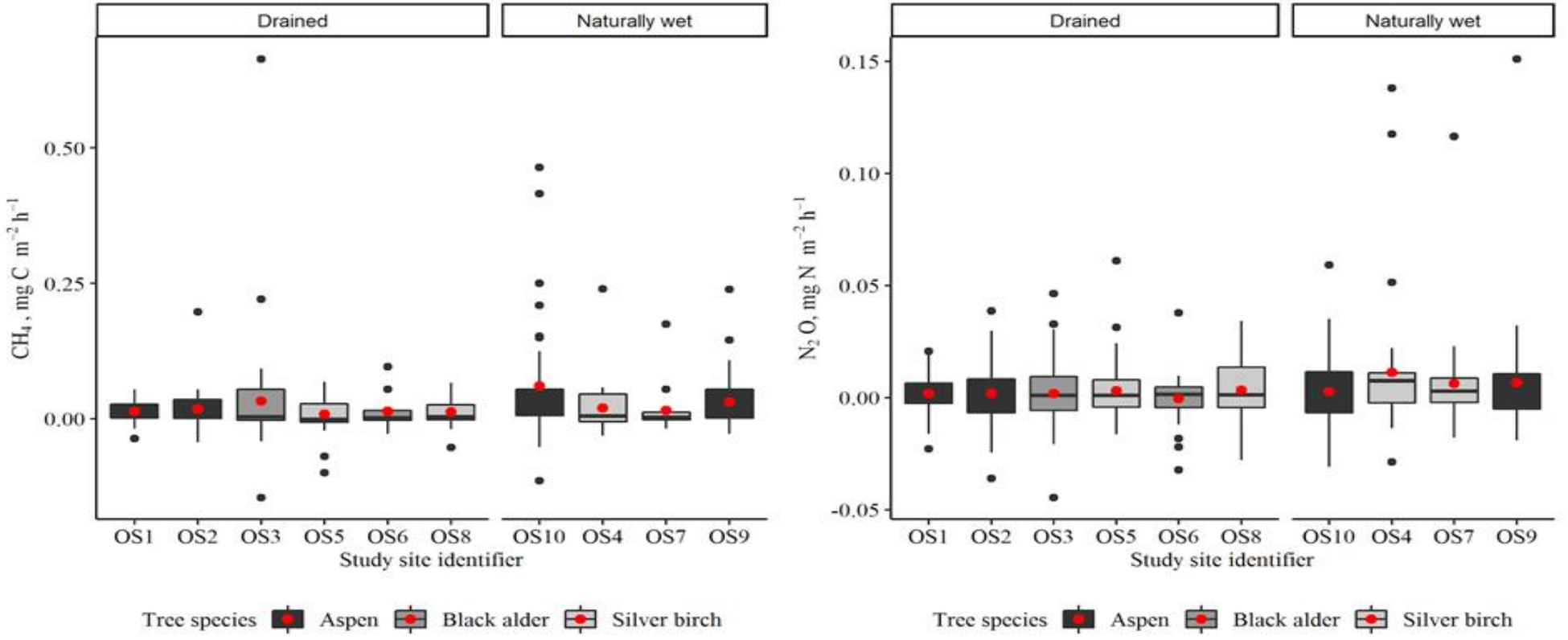


Fig. 3. *Variation of CH_4 and N_2O fluxes from surface of tree stems among study sites (the medians are bold horizontal lines in the boxes, the mean values are red dots, and the black dots are outliers of the datasets)*

Conclusions

- Both drained and naturally wet organic soils were sources of CH_4 and N_2O emissions. In addition to this, drained organic soil also acted as a slight CH_4 sink.

- CH_4 emissions from naturally wet organic soil were higher than from drained soil and the mean CH_4 emissions tended to increase with higher GWL (closer to the soil surface). N_2O emissions from organic soil were similar for both naturally wet and drained conditions and, contrary to the CH_4 emissions, tended to increase with lower GWL.

- Stems of the studied tree species (black alder, silver birch and aspen) were sources of CH_4 and N_2O emissions. Higher CH_4 and N_2O emissions from tree stems were observed in the forest stands with naturally wet organic soil compared to drained conditions.

- Drainage of organic soils in forest land can alter (mostly reduce) CH_4 and N_2O emissions. However, due to high variation in studied GHG fluxes, the number of measurement points should be increased to prove the significance of the difference.

Thank you for attention!

This study was funded by the project "Evaluation of factors affecting greenhouse gas (GHG) emissions from surface of tree stems in deciduous forests with drained and wet soils",
The Latvian Council of Science, Fundamental and applied research projects,
agreement No.: LZP-2021/1-0137