GHG emissions in drained and pristine forested peatlands

Sustainable forest management research in the Nordic/Baltic region,
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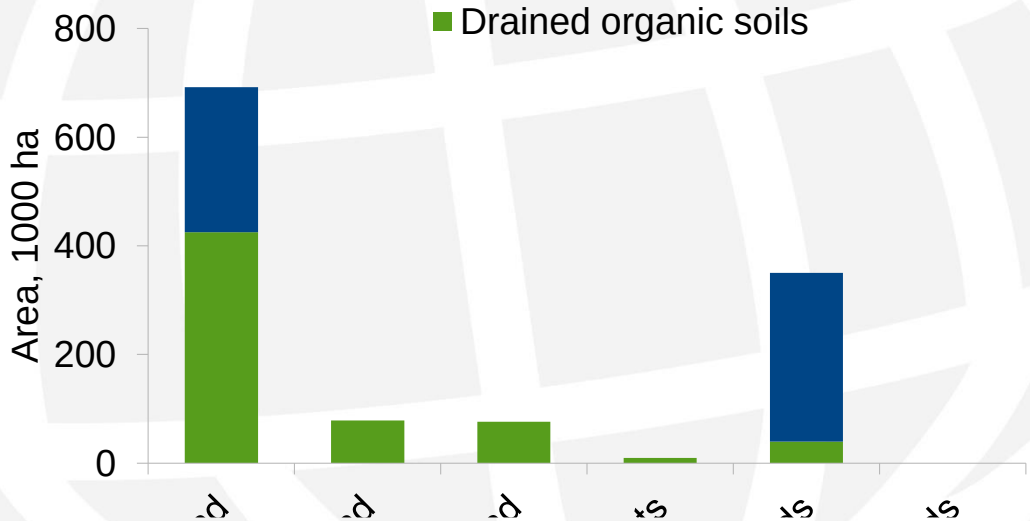
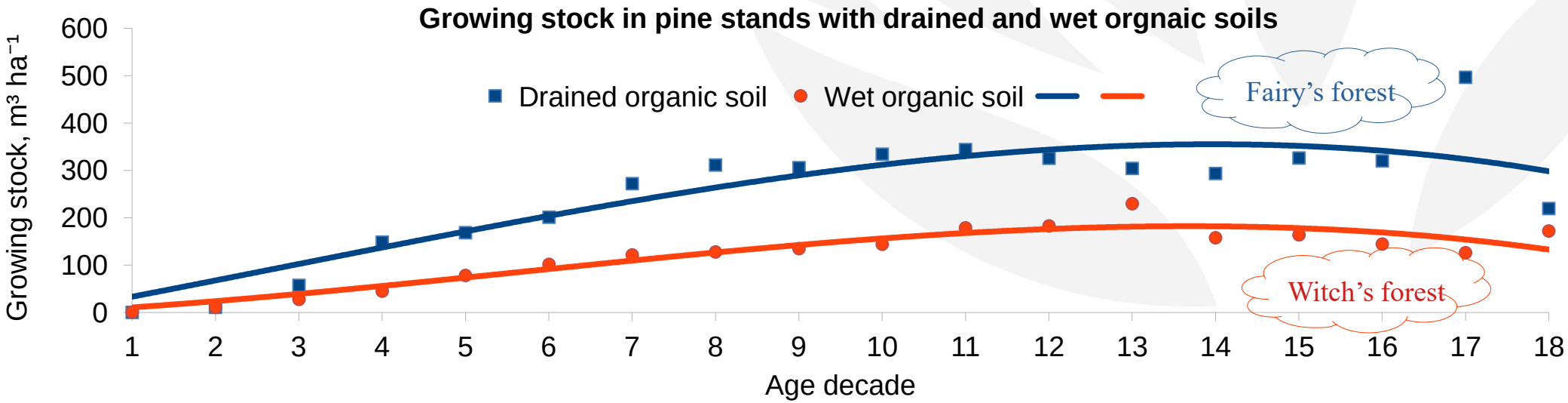
LIFE OrgBalt, LIFE18 CCM/LV/001158

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

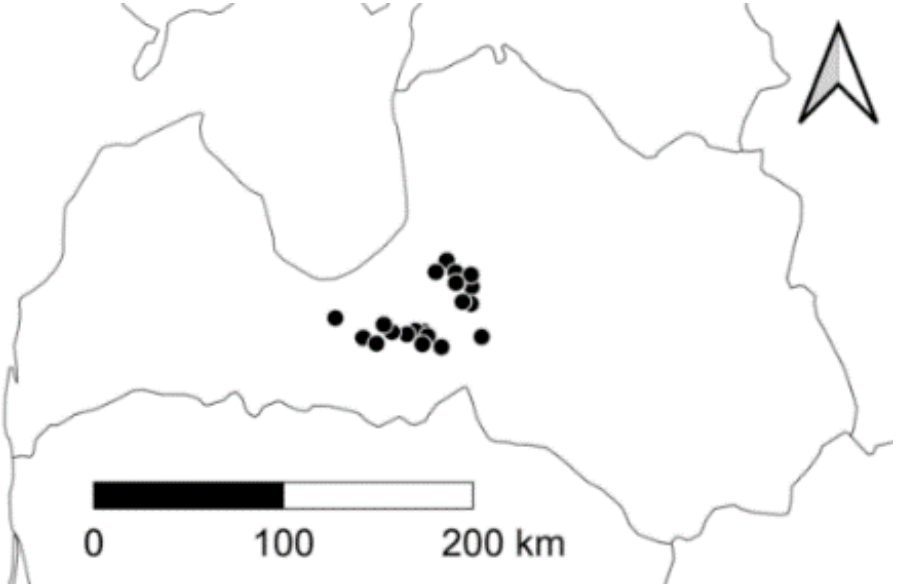
Organic soils in Latvia

- Total area of organic soils in Latvia 1.2 mill. ha *(18% of the country area)*.
- Area of organic soils in forest lands 0.7 mill. ha *(21% of the total forest area)*.
- Area of forests with drained organic soils 0.4 mill. ha *(61% of the total area of forests with organic soils)*.
- GHG emissions accounted in drained and rewetted organic soils in forest lands 1.8 mill. t CO_2 eq. *(18% of the net GHG emissions in Latvia)*.





Study sites



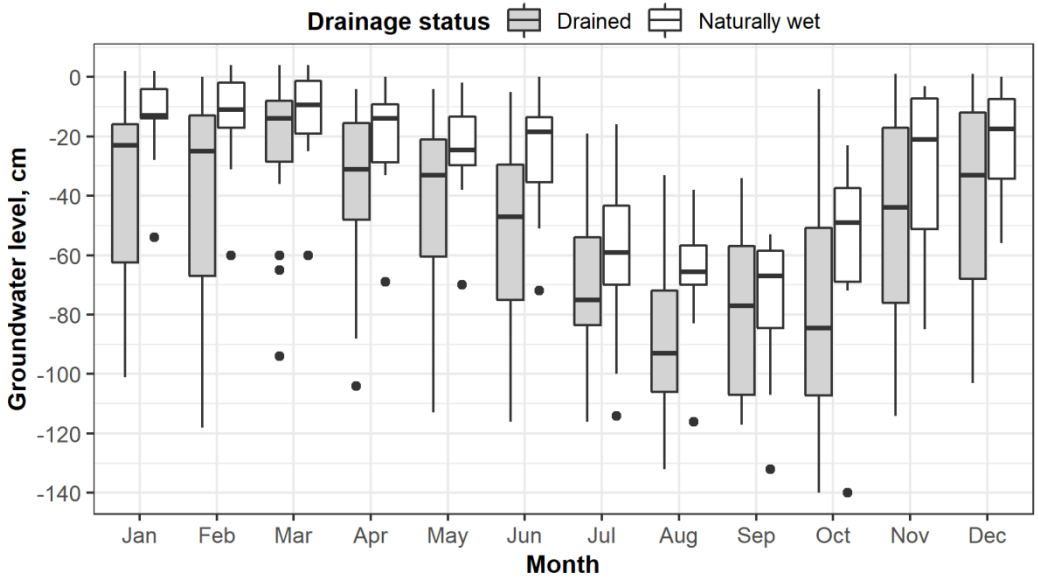
- **31 forest sites with nutrient-rich organic soils.**
- Drained:
  - *Myrtillosa turf.mel.;*
  - *Oxalidosa turf. mel.;*
- Naturally wet organic soils:
  - *Dryopterioso–caricosa;*
  - *Filipendulosa.*

Parameter	Value	Naturally wet forest sites				Drained forest sites			
		Norway spruce	Silver birch	Black alder	Clearcut	Norway spruce	Silver birch	Black alder	Clear cut area
Number of study sites	number	1	3	5	1	12	3	2	4
Age of dominant tree	range (min...max)	67	21-77	10-80	-	14-86	18-60	26-53	-
Peat layer, cm	range (min...max)	-	31-52	23-99	-	37-99	25-75	60-70	63-99

Data gathering

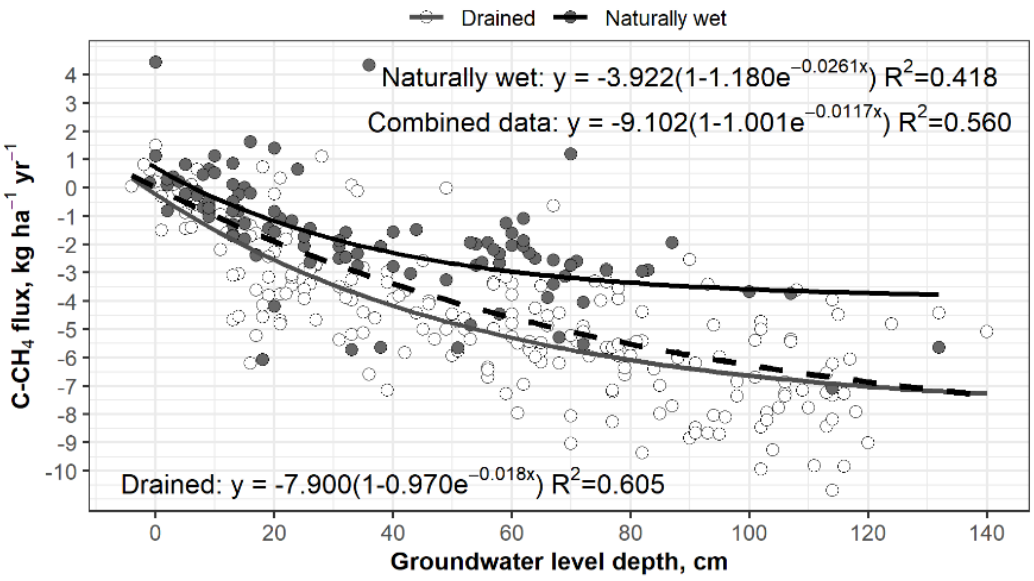
- 3000 soil CO_2, CH_4 and N_2O flux measurements and 12000 measurements of photosynthesis related removals of CO_2:
  - closed opaque manual chamber method;
  - transparent chambers method for photosynthetic removals of CO_2;
  - 5 chambers per sample plot;
  - 4 soil flux samples per chamber collar (0-30 min);
  - samples analyzed by gas chromatograph in Tartu University.
- ~ 3 000 groundwater level un soil temperature measurements and monthly groundwater sampling for chemical analysis.
- Monitoring period – October of 2019 till November of 2020.

Factors affecting GHG fluxes



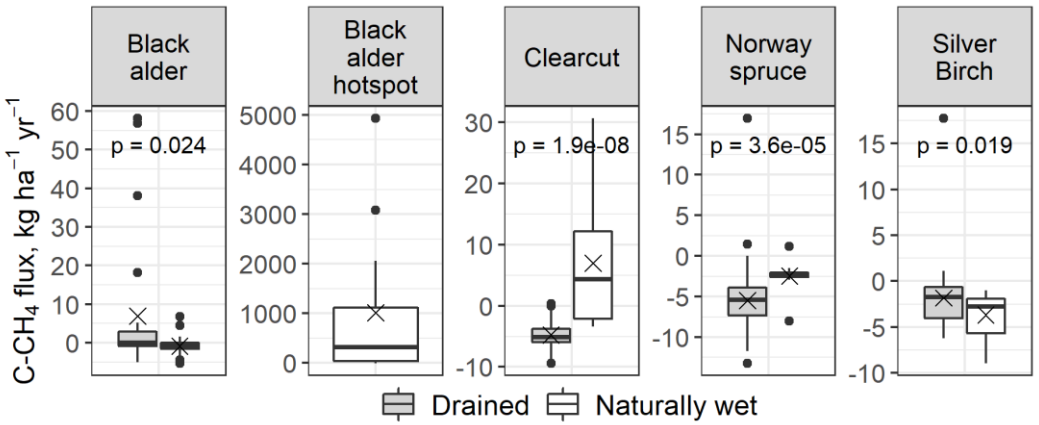
Correlation coefficents	Drainage status	CH_4	N_2O
Soil temperature	drained	-0.32	**0.48**
	naturally wet	-0.37	0.18
Groundwater depth	drained	**-0.73**	0.08
	naturally wet	**-0.69**	0.10
N, NO_3 in groundwater	drained	NO	**moderate**
	naturally wet	NO	low
Ca, Mg in soil	drained	NO	low
	naturally wet	NO	moderate
pH, EC in groundwater	drained	NO	NO
	naturally wet	NO	low

Relationship between groundwater level and soil CH_4 flux



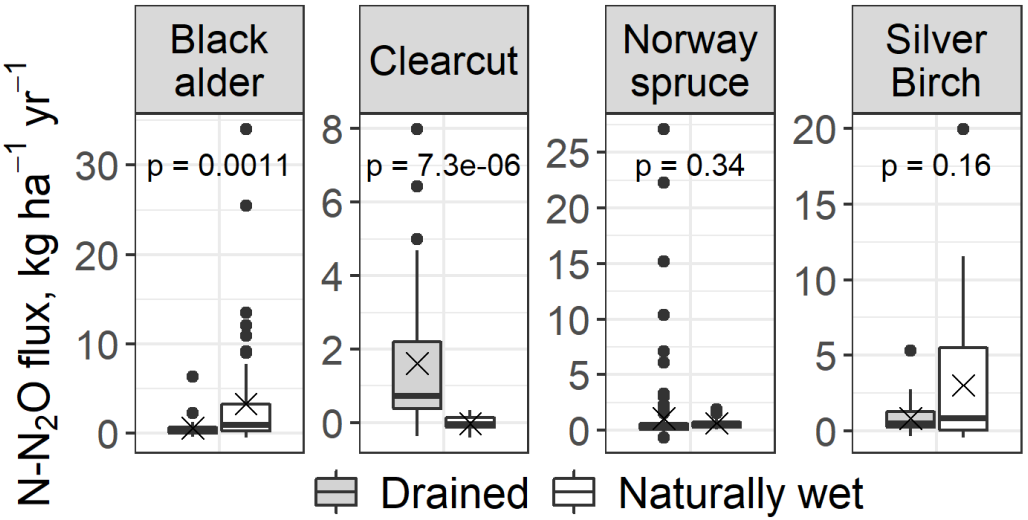
Ground water level, cm	Soil flux kg C-CH_4 ha y^{-1}			
	Drained		Naturally wet	
	All data	All data	w/o hotspot sites	Hotspot sites
Flooded	1.6±0.9	448.1±869.9	12.1±11.9	1025±1184.7
0-9	5.2±3.2	366.1±409.3	2.3±3.7	2233.5±2377.6
10-19	0.4±3.3	20.7±22.5	0.3±1.7	510.2±302.5
20-29	-2.8±0.4	-1.9±1	-1.9±1	-
30-39	-3.8±0.5	-2.7±1.1	-2.7±1.1	-2.1±1.6
40-49	-2.3±2.3	-2.4±0.6	-2.2±0.7	-3.3±1
50-59	-5±0.6	-2.1±1.2	-2.1±1.2	-
60-69	-5.1±0.5	-2.6±0.5	-2.6±0.5	-2.6±0.9
70-79	-5.6±0.5	-2.7±1.5	-2.7±1.5	-
80-89	-6.4±0.6	-3.9±1.2	-3.9±1.2	-
90-99	-7±0.6	-	-	-
100-119	-7.2±0.5	-5.6±1.1	-5.6±1.1	-
120-140	-5.8±1	-7.3±1.7	-7.3±1.7	-

Annual soil CH_4 flux



Dominant tree specie	Drained forest sites	Naturally wet forest sites
	Soil flux kg C-CH_4 ha y^{-1}	
Silver birch	-1,7±2,0	-3,7±2,8
Norway spruce	-5,5±1,0	-2,4±1,2
Clearcut	-4,7±1,0	6,9±6,2
Black alder	6,8±16,6	199,8±393,2
Black alder (hotspot excl.)	-	-0.9±0.4
Black alder (hotspot)	-	1036.7±834.4
Average	-3,47±0,94	100.6±101.0

Annual soil N_2O flux

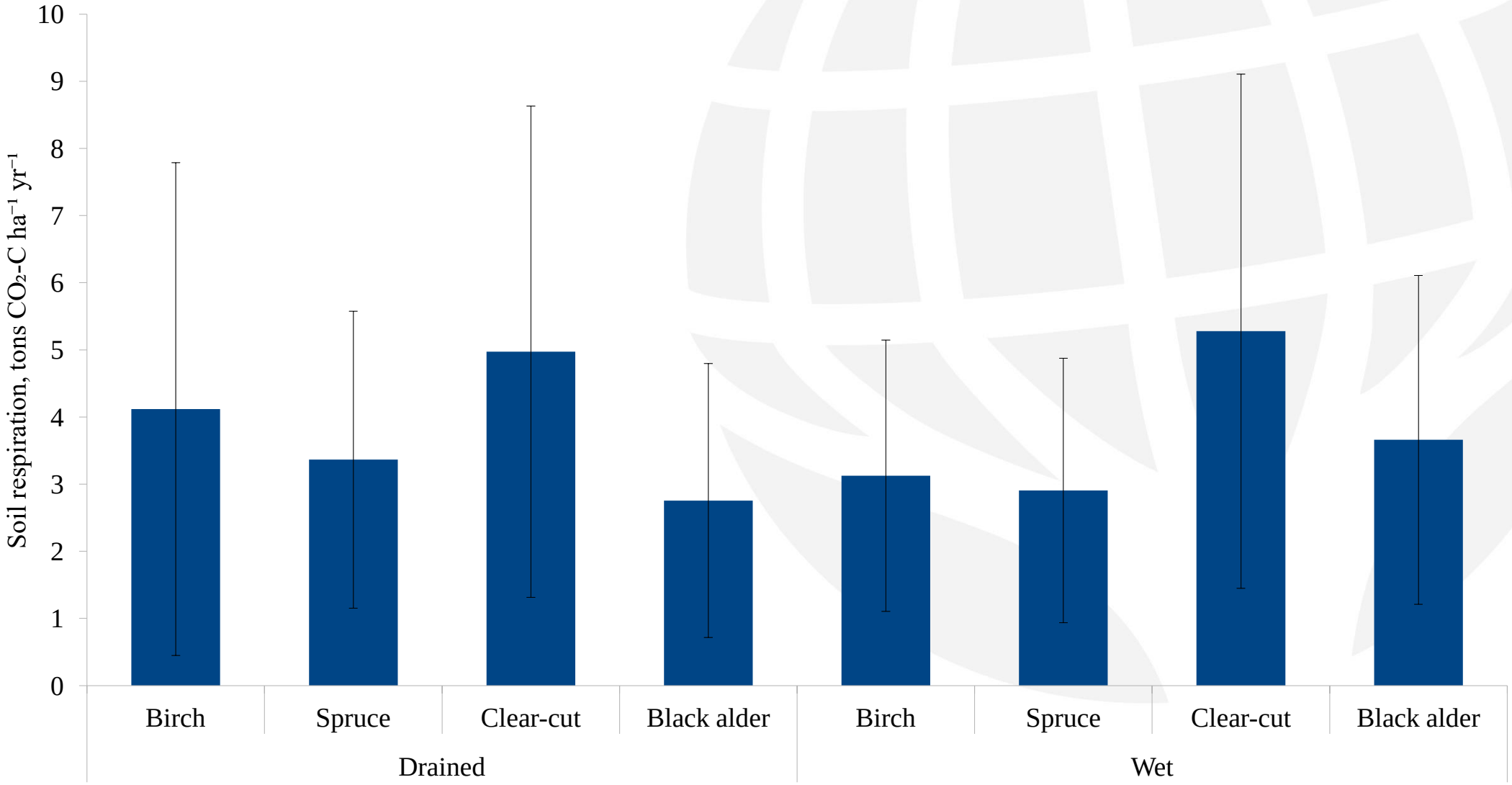


Dominant tree specie	Drained forest sites	Naturally wet forest sites
Silver birch	0.9±0.6	2.7±3.1
Norway spruce	1.0±0.9	0.6±0.3
Clearcut	1.5±1.3	0±0.1
Black alder	0.6±0.6	3.3±4.0
Average	1.1±0.4	2.6±0.9

Comparison of CH_4 and N_2O EFs for nutrient-rich organic forest soils

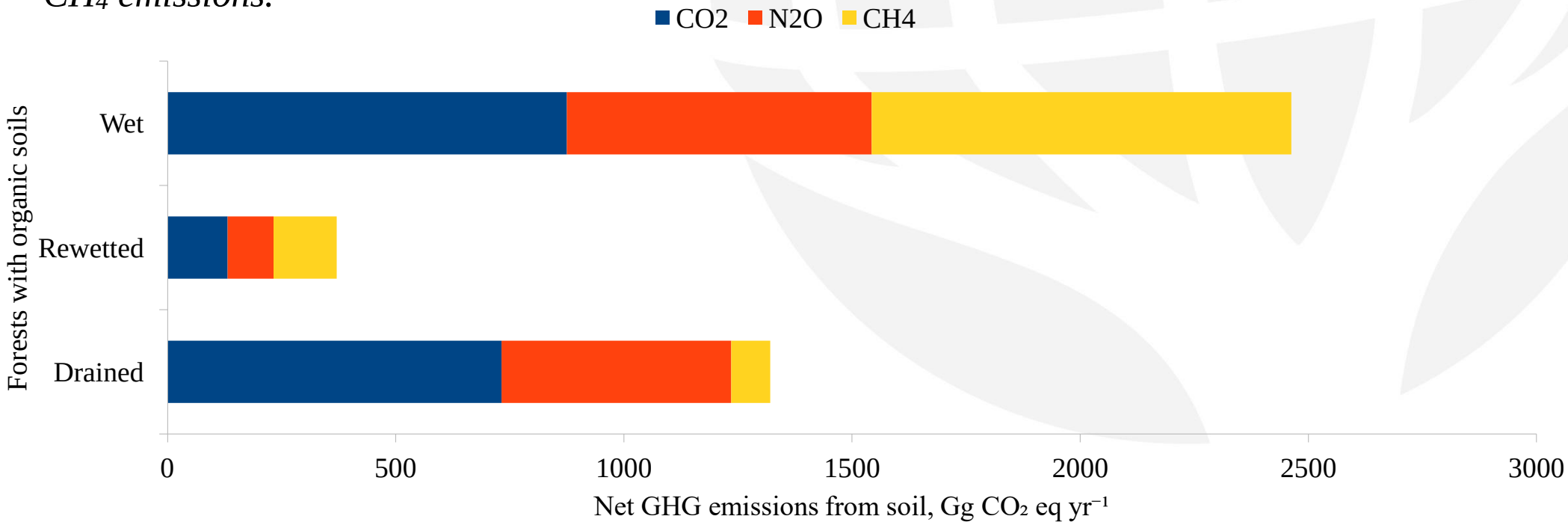
Source	Research results		2013 Wetlands Supplement by IPCC			
Climate zone	**Hemiboreal zone**		**Boreal climate zone**		**Temperate climate zone**	
Drainage status	**Wet**	**Drained**	**Rewetted**	**Drained**	**Rewetted**	**Drained**
CH_4 EF, kg C-CH_4 ha^{-1} yr^{-1}	100.6±101.0	-3.47±0.94	137 (0-493)	2.0 (-1.6-5.5)	216 (0-856)	2.5 (-0.6-5.7)
N_2O EF, kg N-N_2O ha^{-1} yr^{-1}	2.6±0.9	1.1±0.4	Negligible	3.2 (1.9-4.5)	Negligible	2.8 (-0.57-6.1)

CO_2 emissions (soil respiration) from organic soils



Impact on the national GHG inventory *(preliminary assessment)*

- Total GHG emissions from forests with organic soils – 4.2 mill. t CO_2 eq. yr^{-1} *(42% of the total GHG emissions in Latvia).*
- Not estimated emissions from rewetted and wet organic soils in forest land – **2.3 mill. t CO_2 eq. yr^{-1}** *(127% of the currently reported GHG emissions from organic soils in forest land in Latvia).*
- *GHG emissions from drained soils still should be recalculated to avoid overestimation of N_2O and CH_4 emissions.*



Questions, comments!

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