Remote sensing results and GEST types in Latvia

Institute for Environmental Solutions

LIFE PeatCarbon
Latvia, Finland, Denmark & Germany

Co-funded by the European Union

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Project Scientific Group Meeting

14.11.2025.

University of Latvia, Riga

101074396 - LIFE21-CCM-LV-LIFE PeatCarbon

Main activities and results

- Completed GEST type mapping for Lielais Pelēčāres Mire from high-resolution airborne data and tested upscaling possibilities using Sentinel satellite data

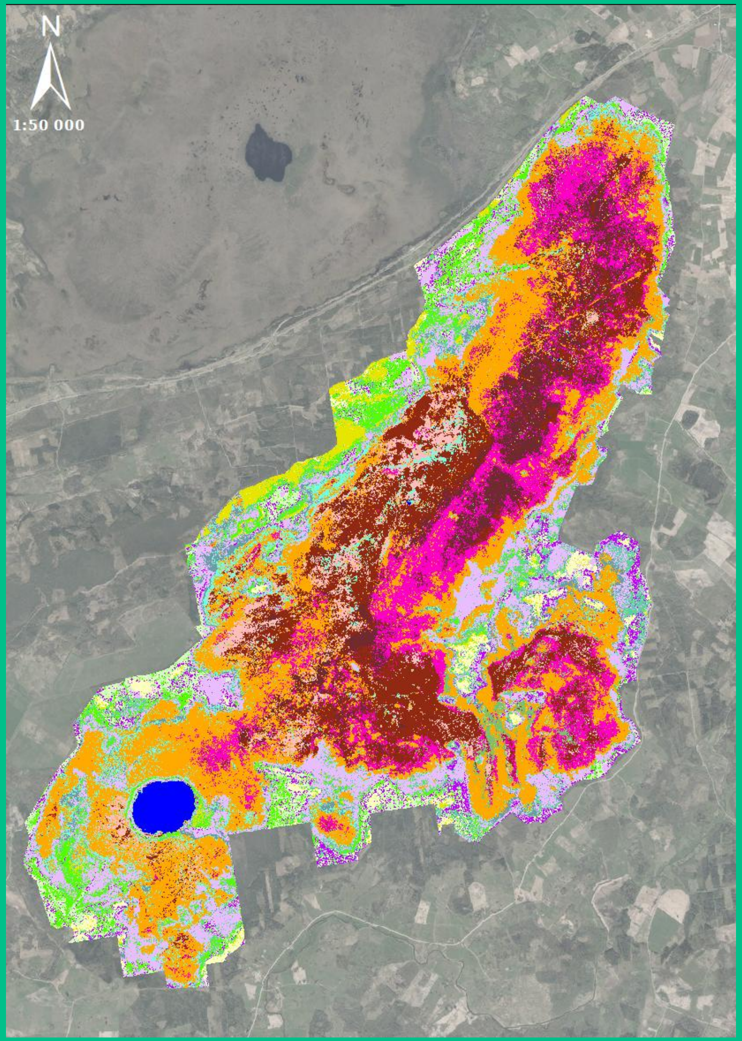
- Two reference data gathering campaigns in Sudas-Zviedru Mire to survey spectrally different areas and detected changes between two observations

- Discussion with Finnish partners about the necessary inputs for GHG flux modelling and work on their preparation

- Testing remote sensing-based moisture regime assessment

GEST type mapping – **Lielais Pelečāre Mire**

Supervised classification (RF)



GEST types

- Bog heath (VM)
- Peat moss lawn (VM)
- Peat moss lawn (W)
- Peat moss lawn (W. pine)
- Peat moss hollows (W)
- Forbs and small sedges reeds (VM)
- Meadows amd forbs (W)
- Forest and shrubberies (ME/EU) (M)
- Forest and shrubberies (OL) (VM)
- Forest and shrubberies (OL) (M)
- Forest and shrubberies (ME/EU) (VM)
- Forest and shrubberies (ME/EU) (MM)
- Forest and shrubberies (OL) (MM)
- Forest and shrubberies (OL) (D)
- Forest and shrubberies (ME/EU) (D)
- Open water

GEST type mapping – **Lielais Pelečāre Mire**

Cross-validation accuracy assessment

Confusion Matrix (Percentage) - Combined Classes
Overall Accuracy: 0.74

True Combined Class \ Predicted Combined Class	Bog heath (VM)	Peat moss lawn (VM)	Peat moss lawn (W)	Peat moss lawn (W. pine)	Peat moss hollows (W)	Forbs and small sedges reeds (VM)	Meadows amd forbs (W)	Forest and shrubberies (ME/EU) (M)	Forest and shrubberies (OL) (VM)
Bog heath (VM)	74%	2%	2%	11%	1%	7%	4%	0%	0%
Peat moss lawn (VM)	5%	86%	4%	0%	0%	2%	3%	0%	0%
Peat moss lawn (W)	4%	2%	72%	2%	0%	1%	19%	0%	0%
Peat moss lawn (W. pine)	7%	0%	0%	75%	10%	3%	2%	2%	0%
Peat moss hollows (W)	1%	0%	0%	19%	74%	0%	1%	3%	1%
Forbs and small sedges reeds (VM)	15%	5%	0%	5%	0%	72%	2%	0%	0%
Meadows amd forbs (W)	7%	3%	15%	5%	3%	1%	67%	0%	0%
Forest and shrubberies (ME/EU) (M)	0%	0%	0%	10%	7%	0%	0%	70%	13%
Forest and shrubberies (OL) (VM)	0%	0%	0%	2%	2%	0%	0%	20%	76%

Classification Report Heatmap (Combined Classes)

Combined Class \ Metric	precision	recall	f1-score
Bog heath (VM)	0.72	0.74	0.73
Peat moss lawn (VM)	0.75	0.86	0.80
Peat moss lawn (W)	0.78	0.72	0.75
Peat moss lawn (W. pine)	0.70	0.75	0.73
Peat moss hollows (W)	0.79	0.74	0.77
Forbs and small sedges reeds (VM)	0.79	0.72	0.75
Meadows amd forbs (W)	0.67	0.67	0.67
Forest and shrubberies (ME/EU) (M)	0.65	0.70	0.67
Forest and shrubberies (OL) (VM)	0.82	0.76	0.79
accuracy	0.74	0.74	0.74
macro avg	0.74	0.74	0.74
weighted avg	0.74	0.74	0.74

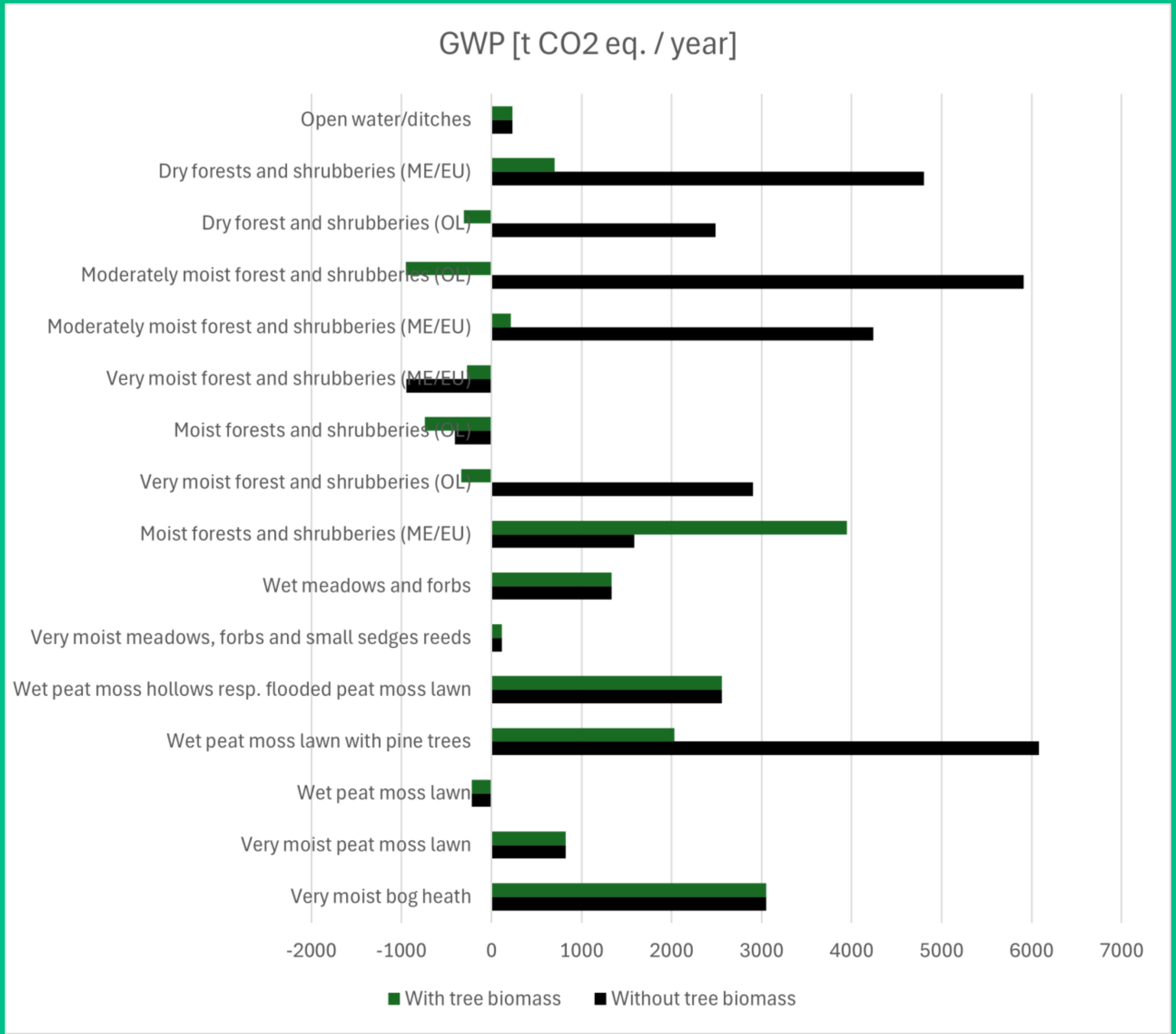
GHG emission budget assessment – **Lielais Pelečāre mire**

GEST types and GHG emission factors [t CO2 eq./ha/year]

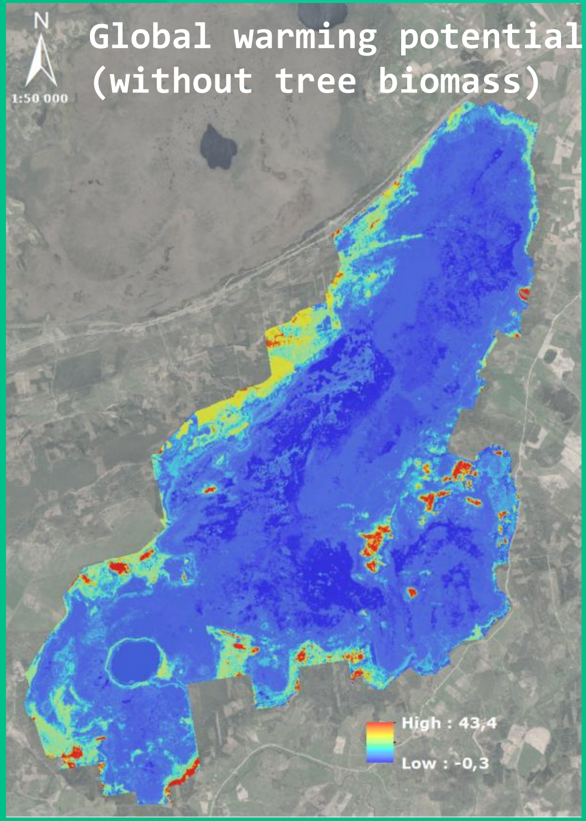
GEST type	Presence in pilot area: Cenas tīrelis	Melnā ezera	Lielās Pelēčāres	Sudas-Zviedru purvs	HG emission factors (without tree biomass: Water level	CO_2	CH_4	GWP	GHG emission factors (with tree biomass): Water level	CO_2	CH_4	GWP
Bare peat wet	X	X			4+	1,5	0,1	1,6	4+	1,5	0,1	1,6
Bare peat moist (OL)		X			3+	6,2	0	6,2	3+	6,2	0	6,2
Bare peat dry (OL)		X			2-/3-	7	0,4	7,5	2-/3-	7	0,4	7,5
Open water/ditches	X		X	X	6+	1,42	2,8	4,22	6+	1,42	2,8	4,22
Very moist bog heath		X	X		4+	1,7	3	4,6	4+	1,7	3	4,6
Moist bog heath	X				3+	9,4	0	9,4	3+	9,4	0	9,4
Moderately moist/dry bog heath	X				2+/2-	13,5	0,1	13,6	2+/2-	13,5	0,1	13,6
Wet peat moss hollows resp. flooded peat moss lawn	X	X	X	X	5+	-3.1	12	8.9	5+	-3.1	12	8.9
Peat moss lawn on former peat-cut off areas	X	X			5+	1,5	0,4	1,9	5+	1,5	0,4	1,9
Wet peat moss lawn	X	X	X	X	5+	-0.5	0,3	-0.3	5+	-0.5	0,3	-0.3
Wet peat moss lawn with pine trees	X	X	X		4+	3,9	0,2	4,1	4+	**1,17**	**0,2**	**1,37**
Very moist peat moss lawn	X	X	X		4+	-1.1	3,4	2,3	4+	-1.1	3,4	2,3
Wet meadows and forbs	X	X	X		5+	0	5,8	5,8	5+	0	5,8	5,8
Very moist meadows, forbs and small sedges reeds			X	X	4+	-0,5	2,3	1,9	4+	-0,5	2,3	1,9
Moderately moist (forb) meadows		X			2+	20	0	20	2+	20	0	20
Wet tall reeds		X			5+	-2.3	6,3	4	5+	-2.3	6,3	4
Very moist forest and shrubberies (OL)			X		4+	1,7	3	4,7	4+	-2,3	1,75	-0,55
Moist forests and shrubberies (OL)	X	X	X	X	3+	9,4	0	9,4	3+	**-2,2**	**-1,8**	**-4**
Moderately moist forest and shrubberies (OL)	X	X	X	X	2+	20	0	20	2+	**-3,1**	**-0,11**	**-3,22**
Dry forest and shrubberies (OL)	X	X	X		2-/3-	26	0	26	2-/3-	**-3,1**	**-0,11**	**-3,22**
Very moist forest and shrubberies (ME/EU)			X		4+	-0,5	2,1	1,6	4+	-10,72-(-5,97)	0,81-4,27	-9,91-(-1,7)
Moist forests and shrubberies (ME/EU)			X		3+	4,6	7,5	12,2	3+	21,59-24,98	0,004-5,35	21,59-30,33
Moderately moist forest and shrubberies (ME/EU)			X		2+	20	0	20	2+	1	**0,004-5,35**	**1,004-6,35**
Dry forests and shrubberies (ME/EU)		X	X		2-/3-	43,4	0	43,4	2-/3-	**1**	**0,004-5,35**	**1,004-6,35**

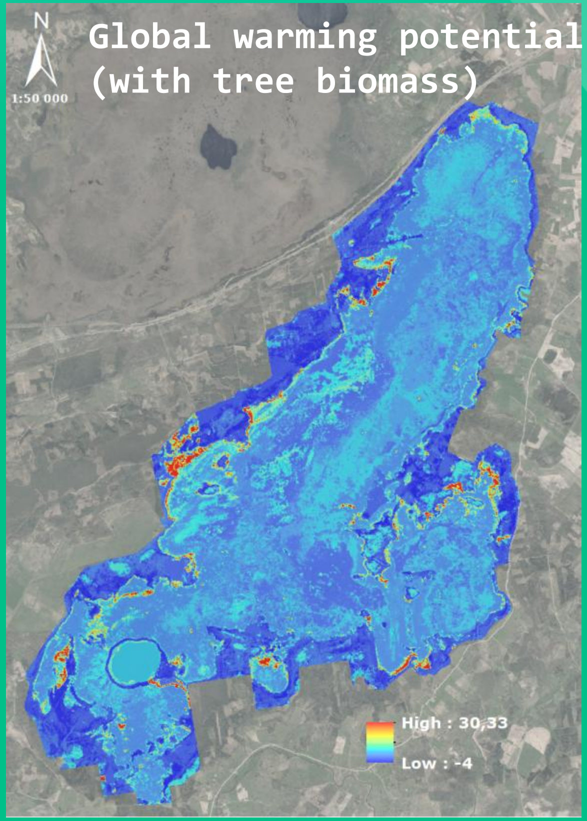
Source: Handbook for Assessment of Greenhouse Gas Emissions from Peatlands

GHG emission budget assessment – **Lielais Pelečare mire**

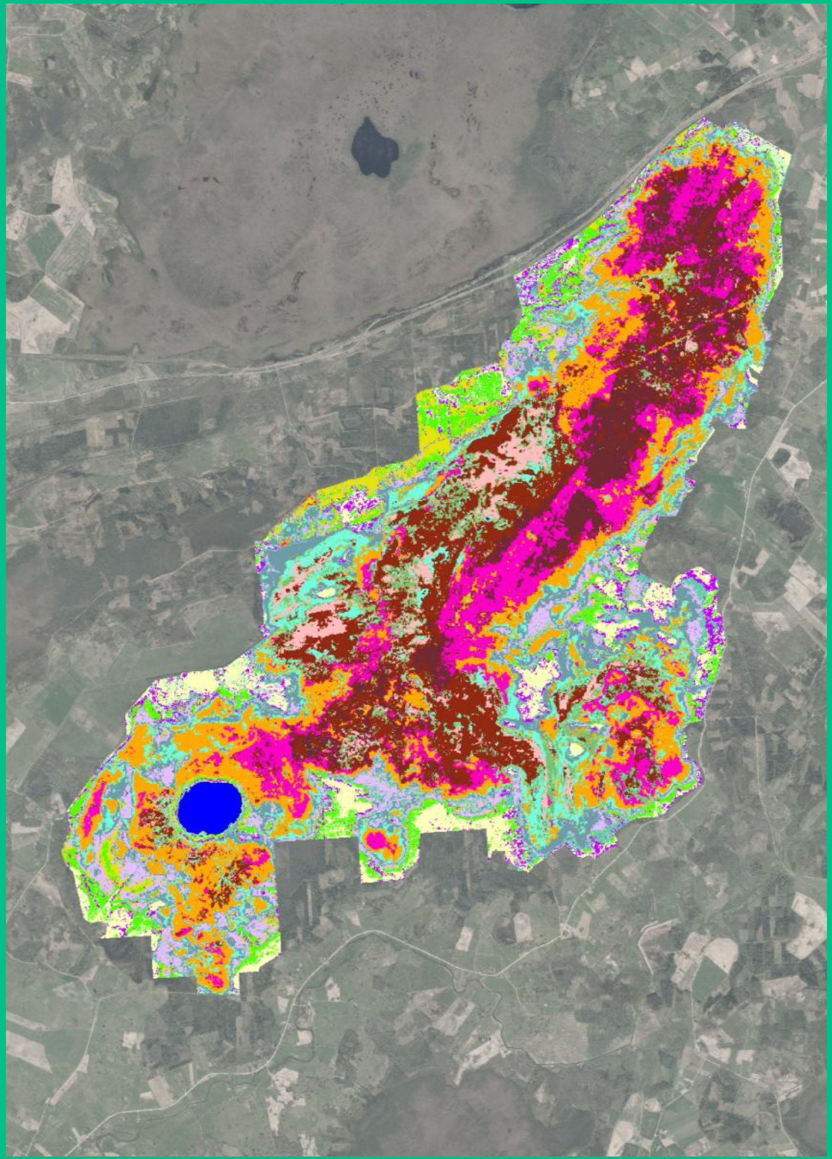


Total GWP:
with tree biomass 12182 t CO2 eq. / year
without tree biomass 34560 t CO2 eq. / year





GEST type mapping from satellite data – **Lielais Pelečāre Mire**



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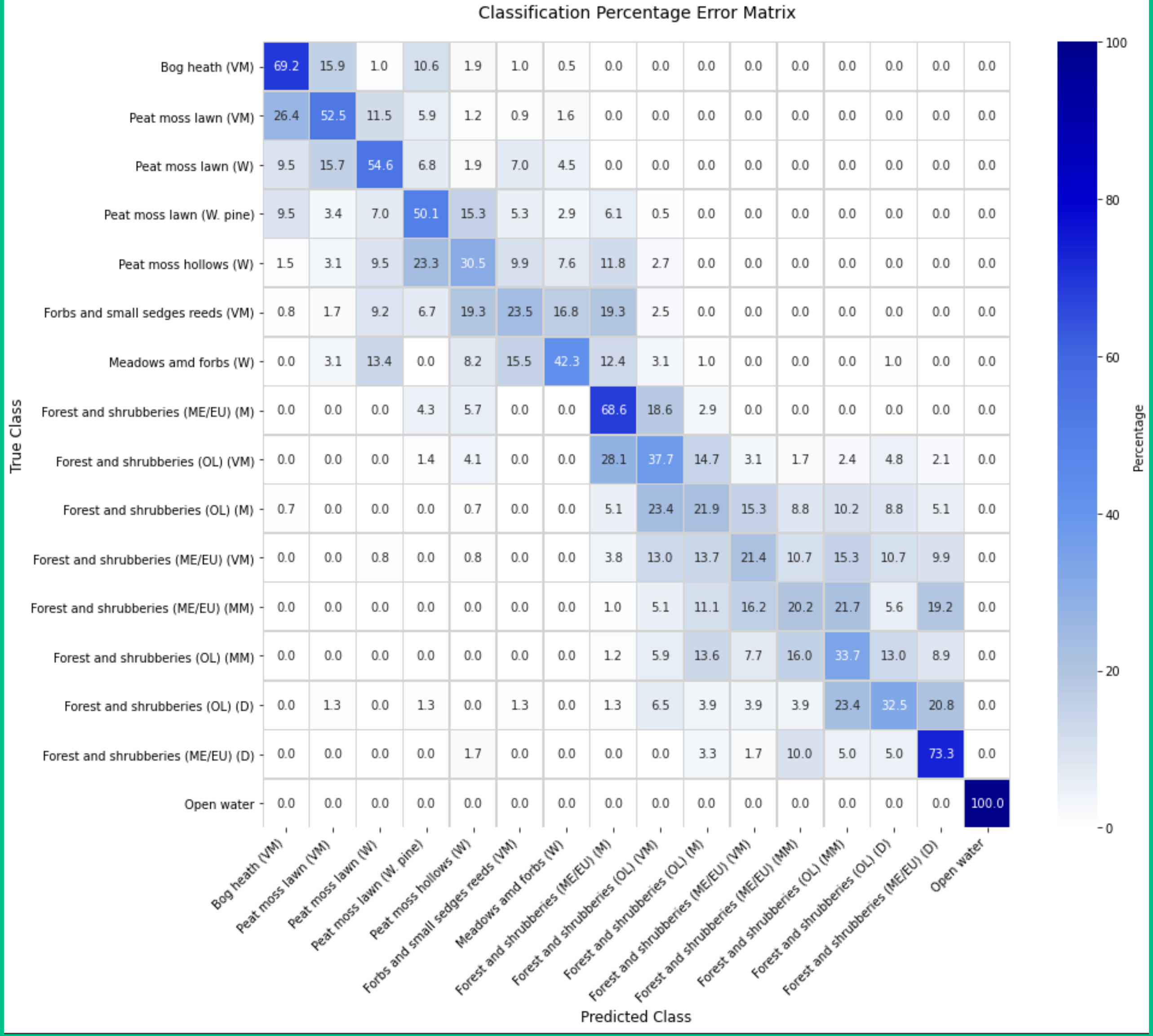
- Open water

GEST type mapping from satellite data – **Lielais Pelečāre Mire**

Cross-validation accuracy assessment



True Class \ Predicted Class	Bog heath (VM)	Peat moss lawn (VM)	Peat moss lawn (W)	Peat moss lawn (W. pine)	Peat moss hollows (W)	Forbs and small sedges reeds (VM)	Meadows amd forbs (W)	Forest and shrubberies (ME/EU) (M)	Forest and shrubberies (OL) (VM)	Forest and shrubberies (OL) (M)	Forest and shrubberies (ME/EU) (VM)	Forest and shrubberies (ME/EU) (MM)	Forest and shrubberies (OL) (MM)	Forest and shrubberies (OL) (D)	Forest and shrubberies (ME/EU) (D)	Open water
Bog heath (VM)	69.2	15.9	1.0	10.6	1.9	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peat moss lawn (VM)	26.4	52.5	11.5	5.9	1.2	0.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peat moss lawn (W)	9.5	15.7	54.6	6.8	1.9	7.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peat moss lawn (W. pine)	9.5	3.4	7.0	50.1	15.3	5.3	2.9	6.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peat moss hollows (W)	1.5	3.1	9.5	23.3	30.5	9.9	7.6	11.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Forbs and small sedges reeds (VM)	0.8	1.7	9.2	6.7	19.3	23.5	16.8	19.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Meadows amd forbs (W)	0.0	3.1	13.4	0.0	8.2	15.5	42.3	12.4	3.1	1.0	0.0	0.0	0.0	1.0	0.0	0.0
Forest and shrubberies (ME/EU) (M)	0.0	0.0	0.0	4.3	5.7	0.0	0.0	68.6	18.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0
Forest and shrubberies (OL) (VM)	0.0	0.0	0.0	1.4	4.1	0.0	0.0	28.1	37.7	14.7	3.1	1.7	2.4	4.8	2.1	0.0
Forest and shrubberies (OL) (M)	0.7	0.0	0.0	0.0	0.7	0.0	0.0	5.1	23.4	21.9	15.3	8.8	10.2	8.8	5.1	0.0
Forest and shrubberies (ME/EU) (VM)	0.0	0.0	0.8	0.0	0.8	0.0	0.0	3.8	13.0	13.7	21.4	10.7	15.3	10.7	9.9	0.0
Forest and shrubberies (ME/EU) (MM)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.1	11.1	16.2	20.2	21.7	5.6	19.2	0.0
Forest and shrubberies (OL) (MM)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	5.9	13.6	7.7	16.0	33.7	13.0	8.9	0.0
Forest and shrubberies (OL) (D)	0.0	1.3	0.0	1.3	0.0	1.3	0.0	1.3	6.5	3.9	3.9	3.9	23.4	32.5	20.8	0.0
Forest and shrubberies (ME/EU) (D)	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	3.3	1.7	10.0	5.0	5.0	73.3	0.0
Open water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0

Overall Accuracy: 44%

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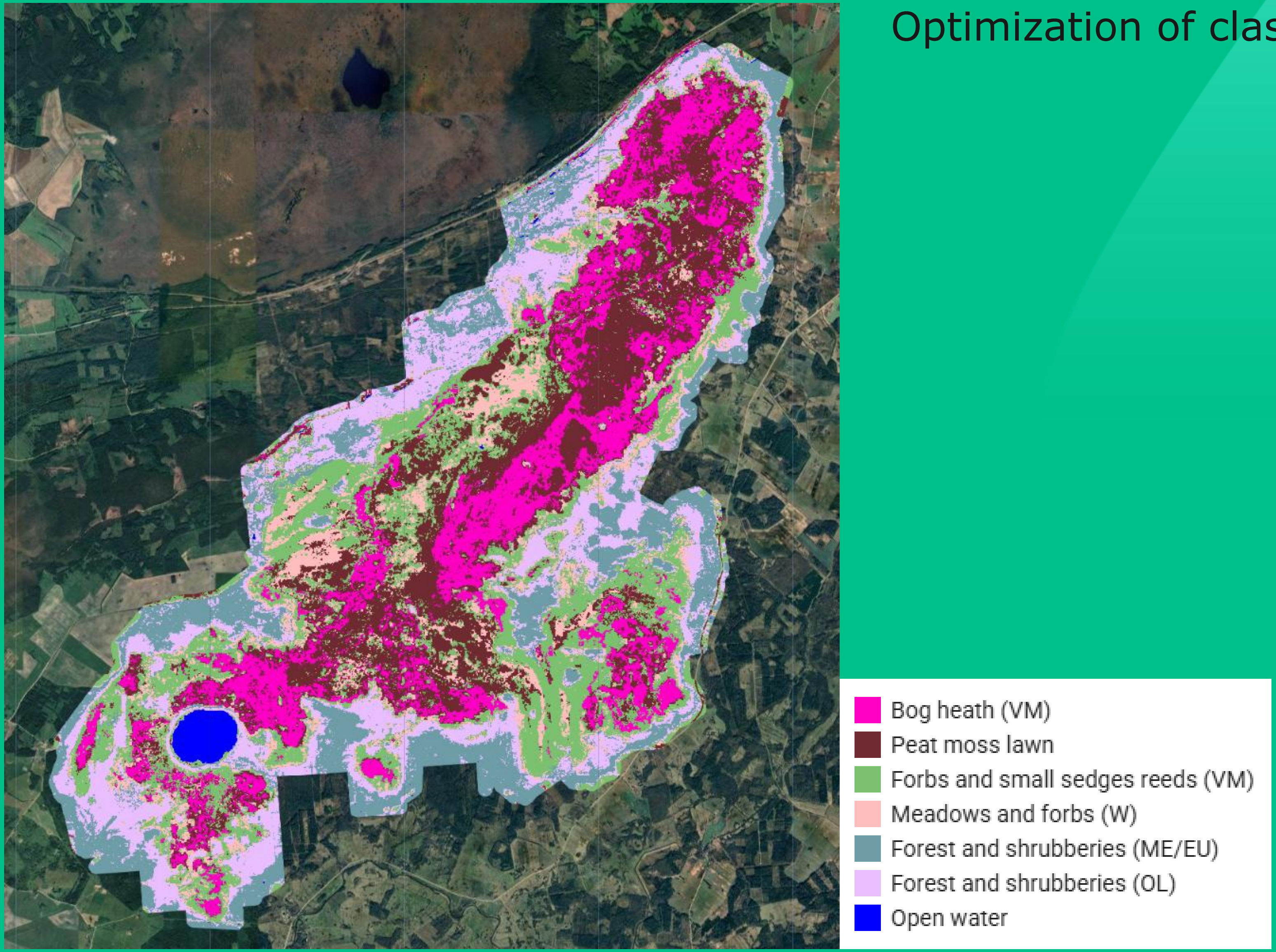
Latvia, Finland, Denmark & Germany

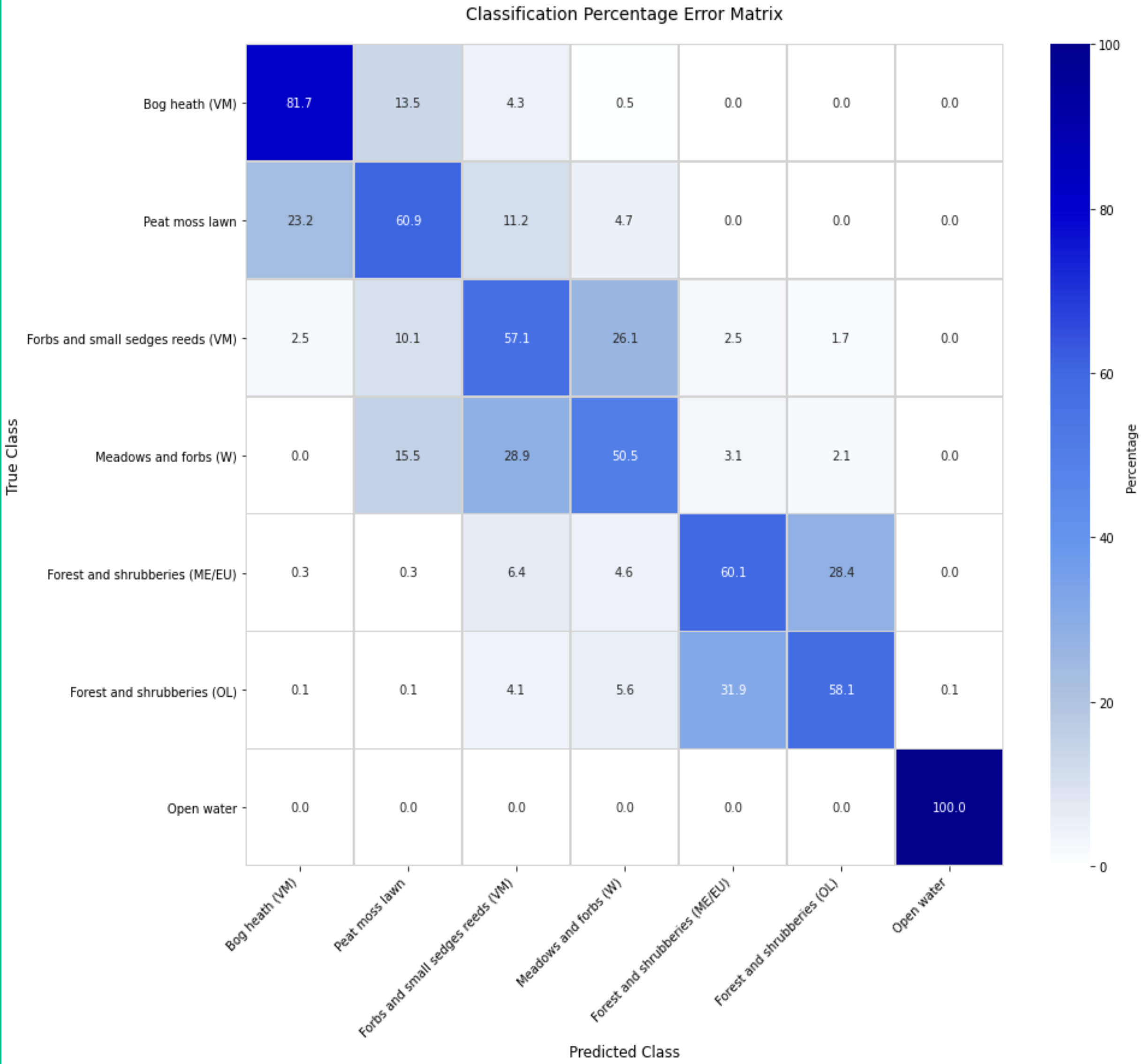
GEST type mapping from satellite data – **Lielais Pelečāre Mire**

Optimization of classification classes



GEST type mapping from satellite data – **Lielais Pelečāre Mire**

Cross-validation accuracy assessment after optimization



Overall Accuracy: 61%

GEST type mapping – **Sudas-Zviedru Mire**

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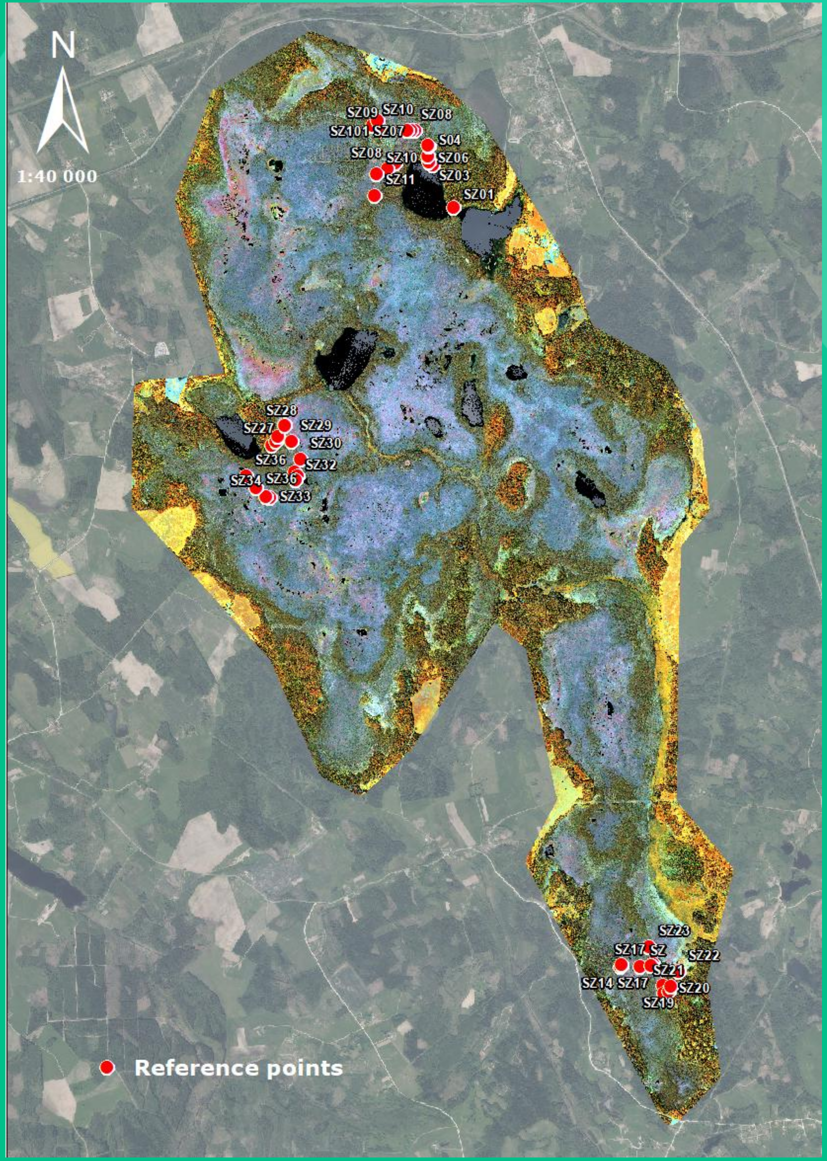
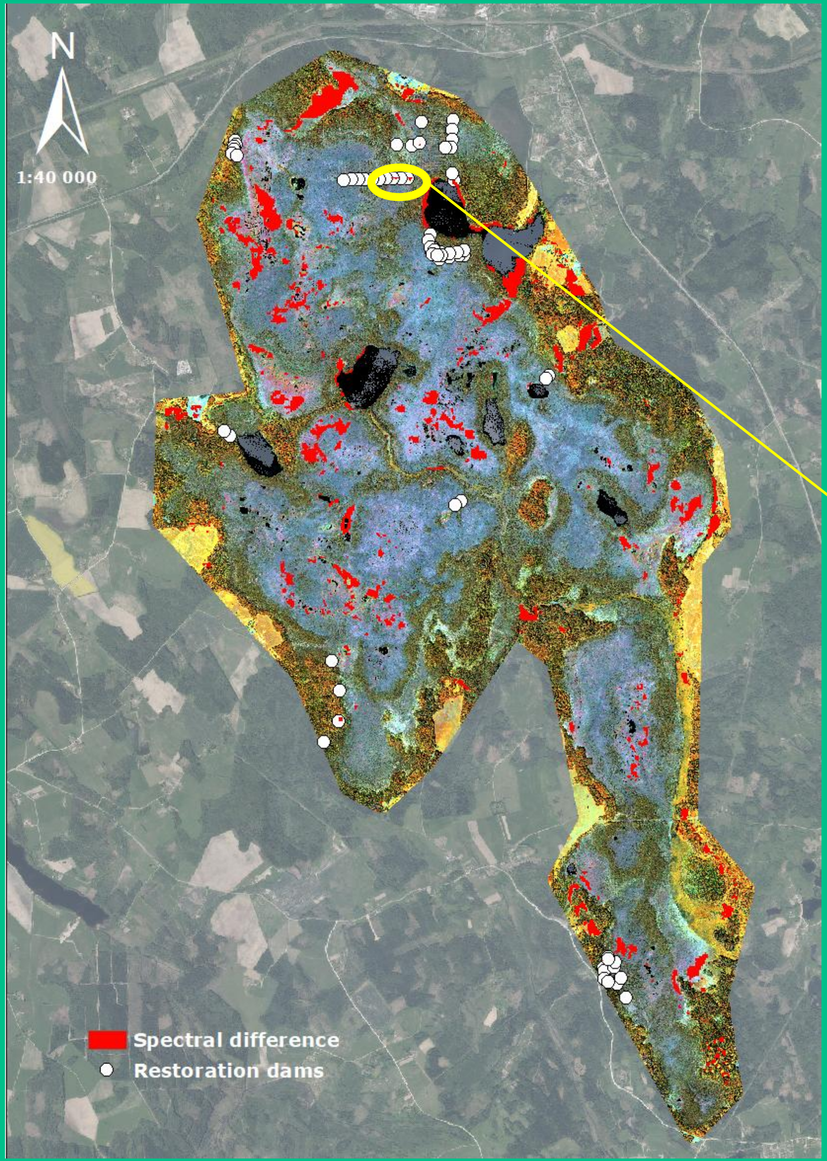


Project sites	Dates of data gathering
Cena Mire	17., 19.10.2023
Melnais Lake Mire	02.11.2023
Lielais Pelečāre Mire	21.-22., 30.-31.05.2024
Sudas-Zviedru Mire	7., 15.10.2025

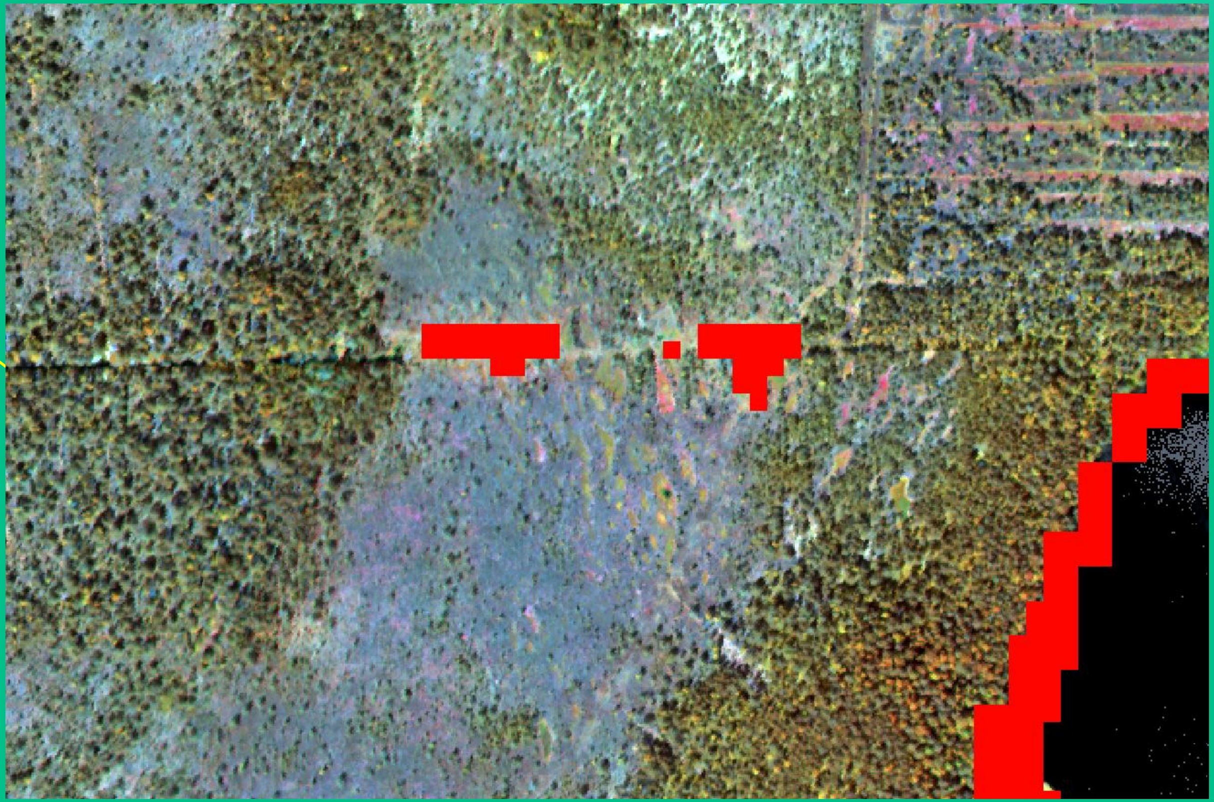
The finalization of the reference points legend will be based on the detailed analysis of peatland vegetation data performed by Līga Strazdiņa.

GEST type mapping – **Sudas-Zviedru Mire**

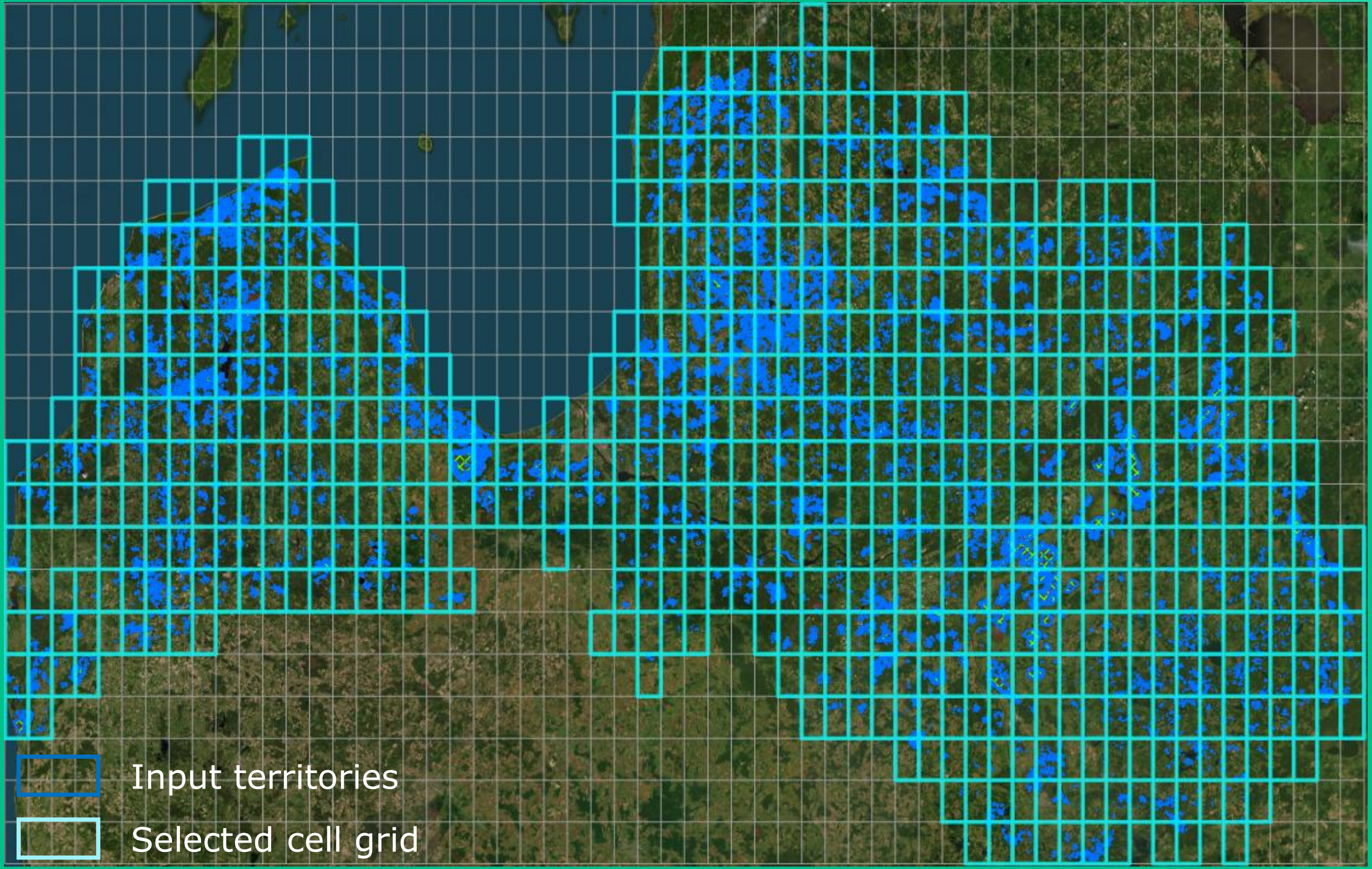


Spectral changes between 2018-06-01 and 2025-06-15

Restoration positive result ~ 1ha



Input preparation for GHG modelling



Input territories:
All bog European significance habitats and forest habitats within 1 km from bogs.

Selected cell grid:
(0,125x1,125 degree) to obtain input statistics for the flux modelling

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