CO$_2$ flux measurements in open waters: Skaists Lake of the Cena Mire and the ponds of the Melnā ezera purvs

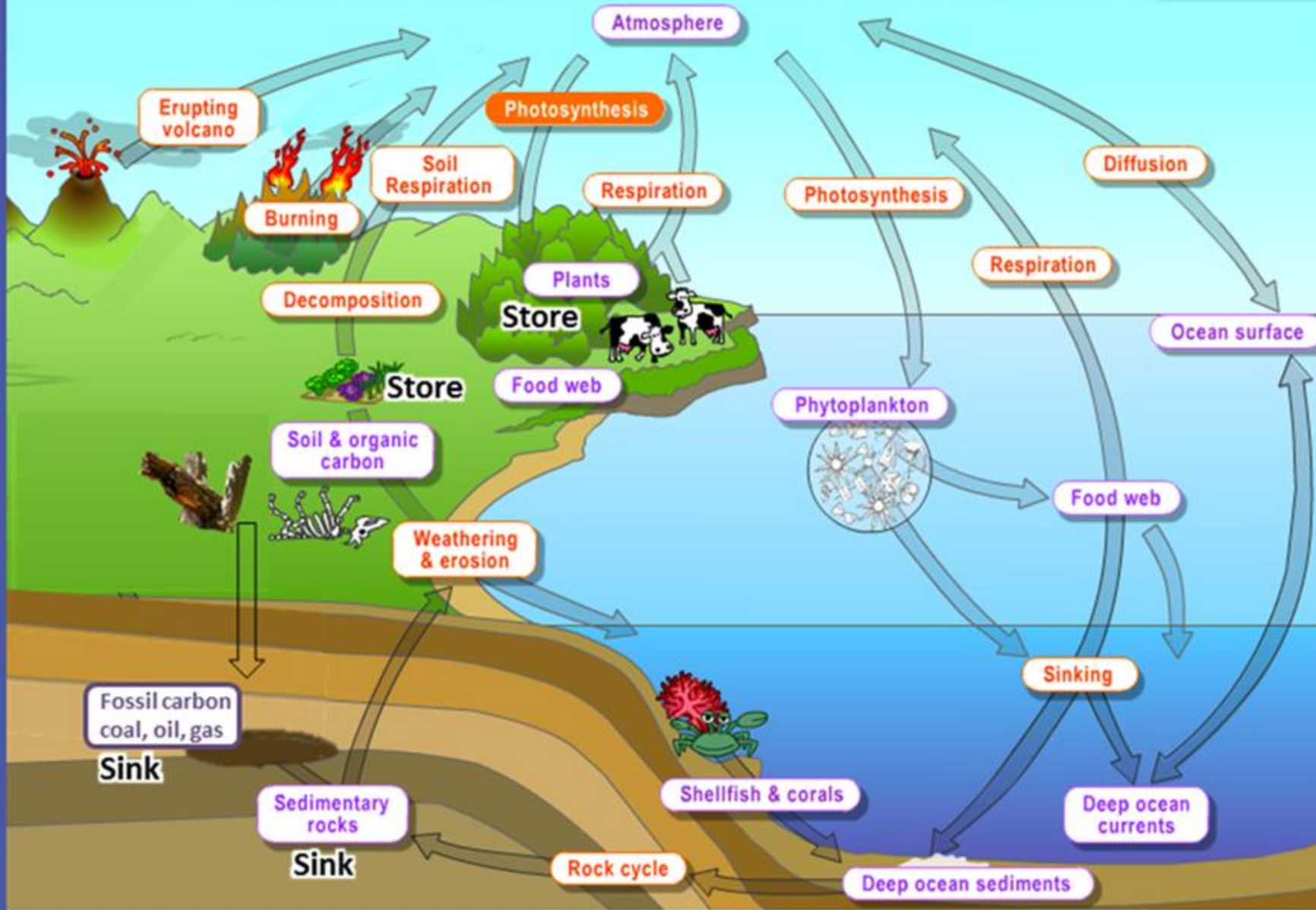**Jānis Bikše, Kārlis Pikšens, Ilga Kokorīte**

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THE CARBON CYCLE

~87% of lakes are supersaturated with CO_2 (Cole et al., 1994).

Globally, CO_2 emissions from lakes contribute $0.14 - 0.32 \times 10^{15}$ g C/year to the atmosphere (Cole et al., 1994; Raymond et al., 2013)

Peatland ecosystems store carbon, but dystrophic lakes can be a source of CO_2 emissions (Whitfield et al. 2010).

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Water level	CO_2 emissions (t CO_2-eq./ha/year)	CH_4 emissions (t CO_2-eq./ha/year)	GWP estimate (t CO_2 eq./ha/year)	Aim/Remarks	References
5+ (4+)	-0.5 (-3.0)	0.3 (5.3)	-0.3 (2.0)	Calibration	Drösler 2013, 3 sites
5+ (4+)	1.5 (2.8)	0.4 (37.3)	1.9 (40)	Calibration	Drösler 2005 Drösler et al. 2013 Bortoluzzi et al. 2006
4+	3.9	0.2	4.1	Gapfilling/Calibration **New GEST** **Data without woods**	Drösler et al. 2013
5+	-3.1 (-4.6)	12.0 (11.8)	8.9 (7)	Calibration	Drösler 2005 Drösler 2013, 2 sites Vanselow-Algan et al. 2015
6+	nd (+-0)	2.8 (3.2)	nd (3.0)	Gapfilling	Van den Pol-van Dasselaar et al. 1999, 3 sites

In the GEST method, CO_2 emissions from open water environments have widely varying emission factors


Handbook for Assessment of Greenhouse Gas Emissions from Peatlands

Applications of direct and indirect methods by *LIFE Peat Restore*

Example-calculations for Cena Mire open water (~1.13 km^2)

Emission factor (t CO2/ha/year)	Total annual emissions (t)
-0.5	-2.79
1.5	8.36
3.9	21.74
-3.1	-17.28

Depending on the chosen emission factor, a completely different result can be obtained.

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3
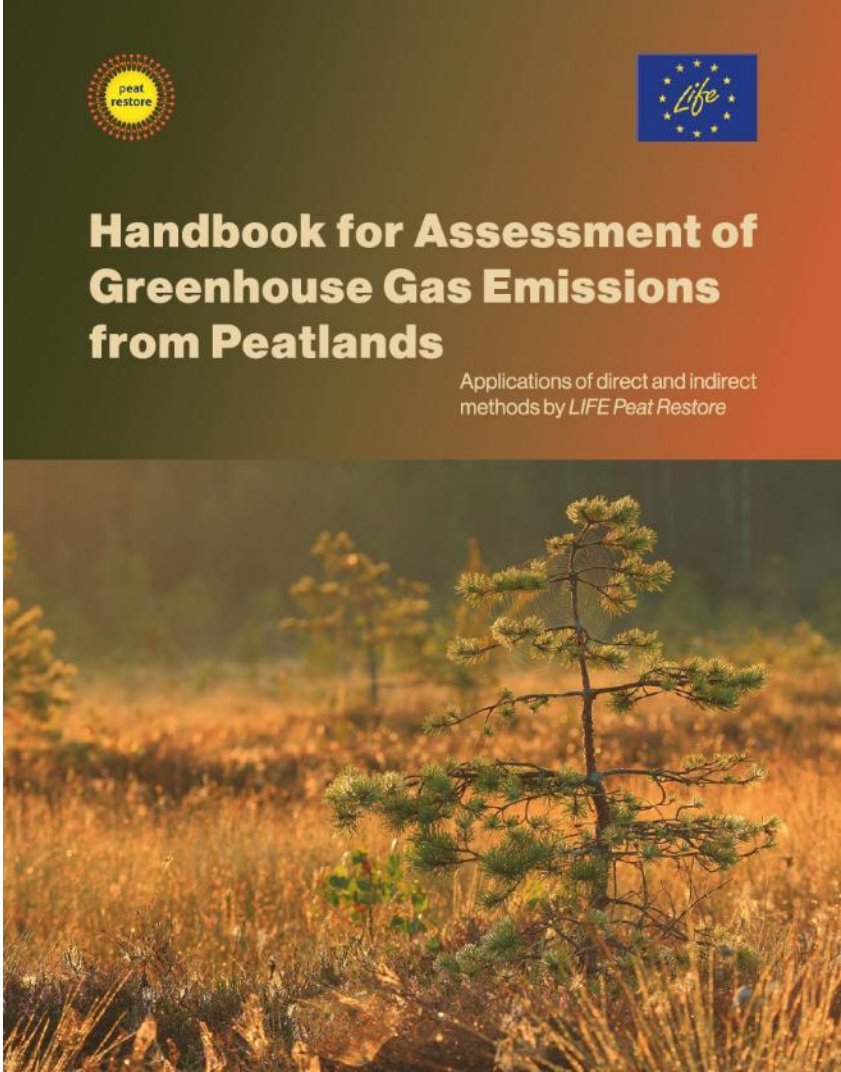
Open water area in the Cenas Mire
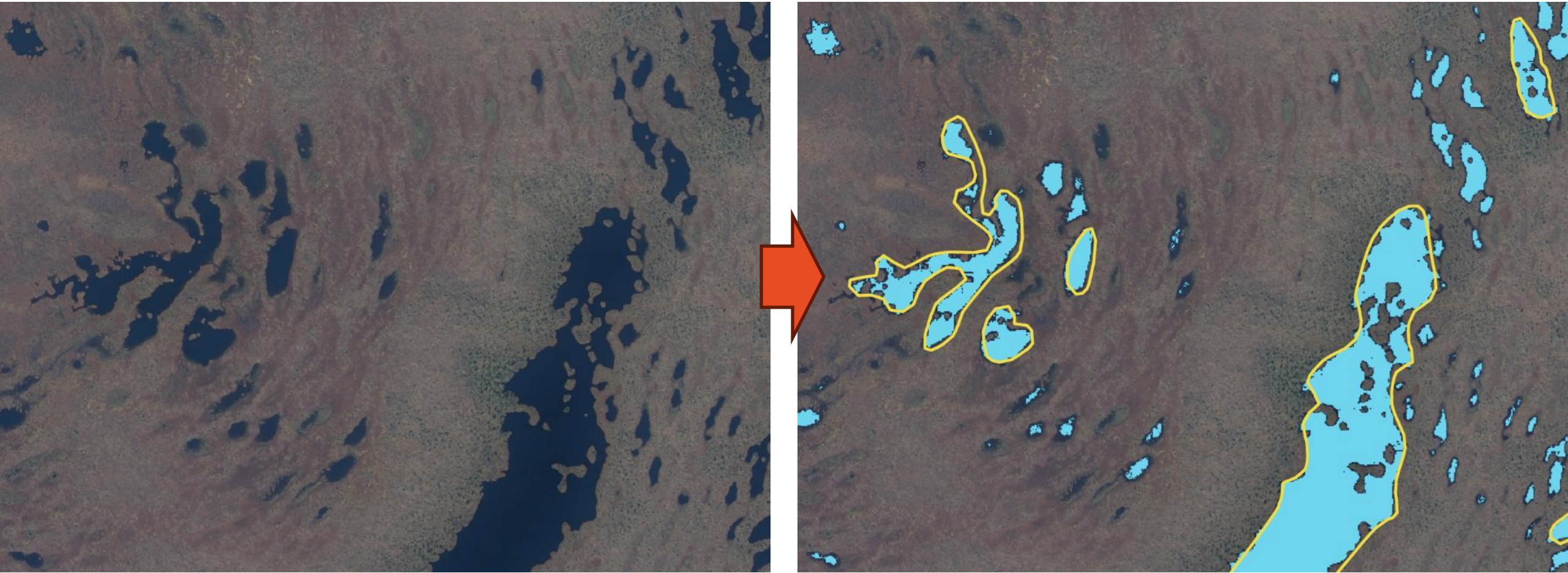
- The topographic map at a scale of 1:50'000 does not mark many ponds. According to it, the open water area in the Cenas Mire is 1.19 km^2
- The classification of the orthophoto map is not perfect, but a larger number of ponds are identified. The open water area according to the initial assessment = 1.13 km^2

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The aim of the study is to use sensors for in-situ pCO_2 measurements and assess CO_2 fluxes in natural and anthropogenic peatland ponds in Latvia.

Equipment for measuring pCO_2:

- low-cost CO_2 sensor - OEM module
- sensor calibration and testing in the laboratory
- attached to a bowl that serves as a CO2 chamber
- accessories, e.g. fan

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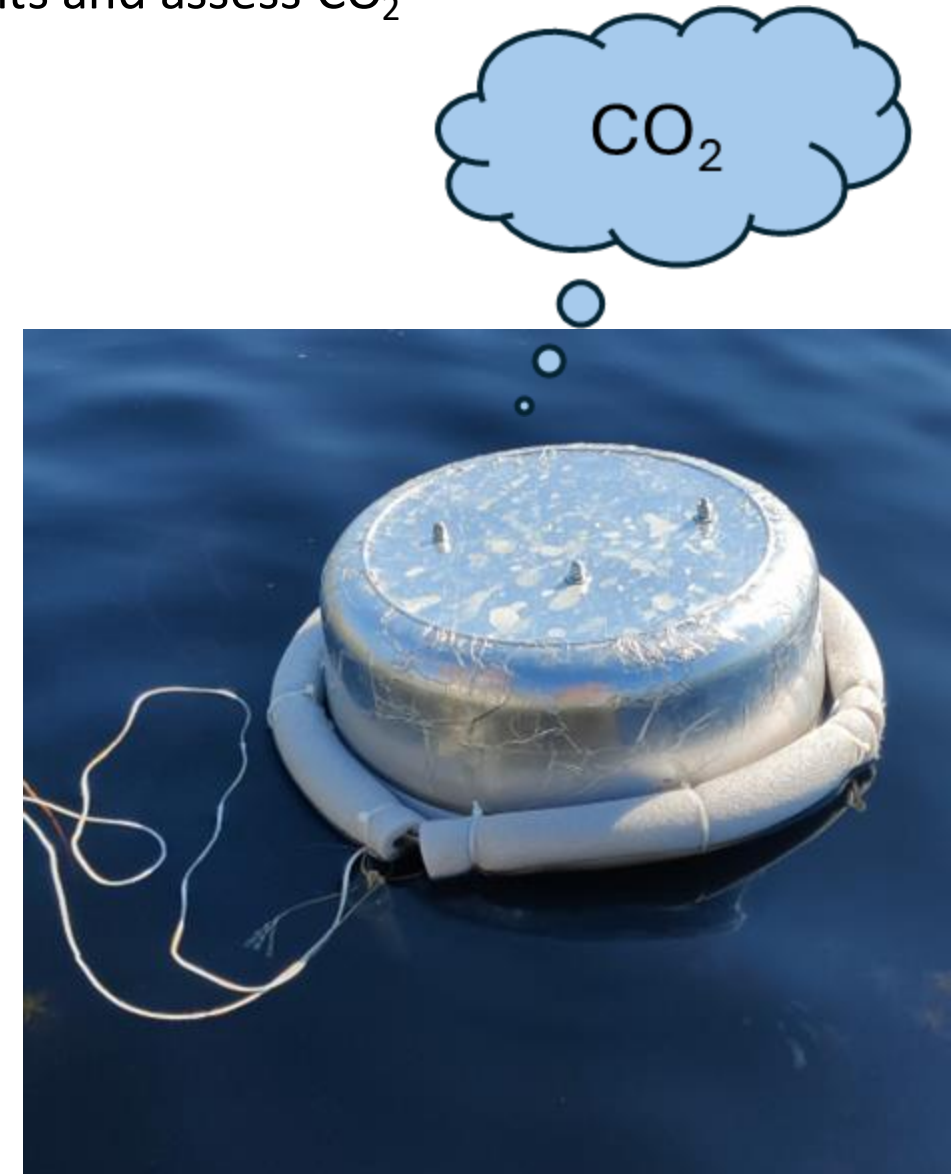
Field work

We aimed to measure for 24 hours to account for diurnal variation.

4 chambers were used:
Two devices constantly (24h) measures pCO_2 in the lake → **for determining CO_2 conc.**

Two devices manually operated:
10 min on water + 2 min ventilation in air x 3 repetitions every 4h for 24 hours → **for estimating flux.**
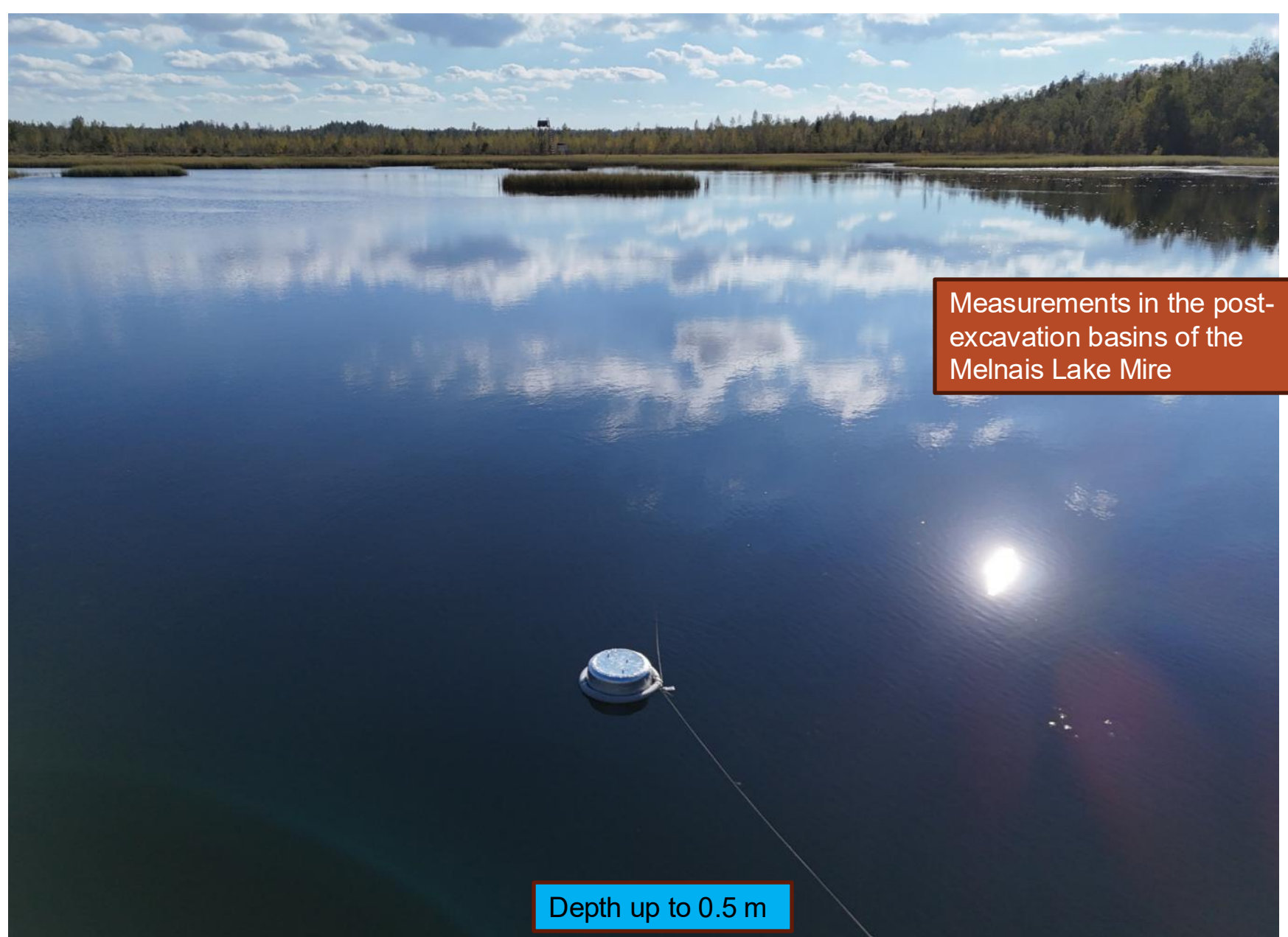
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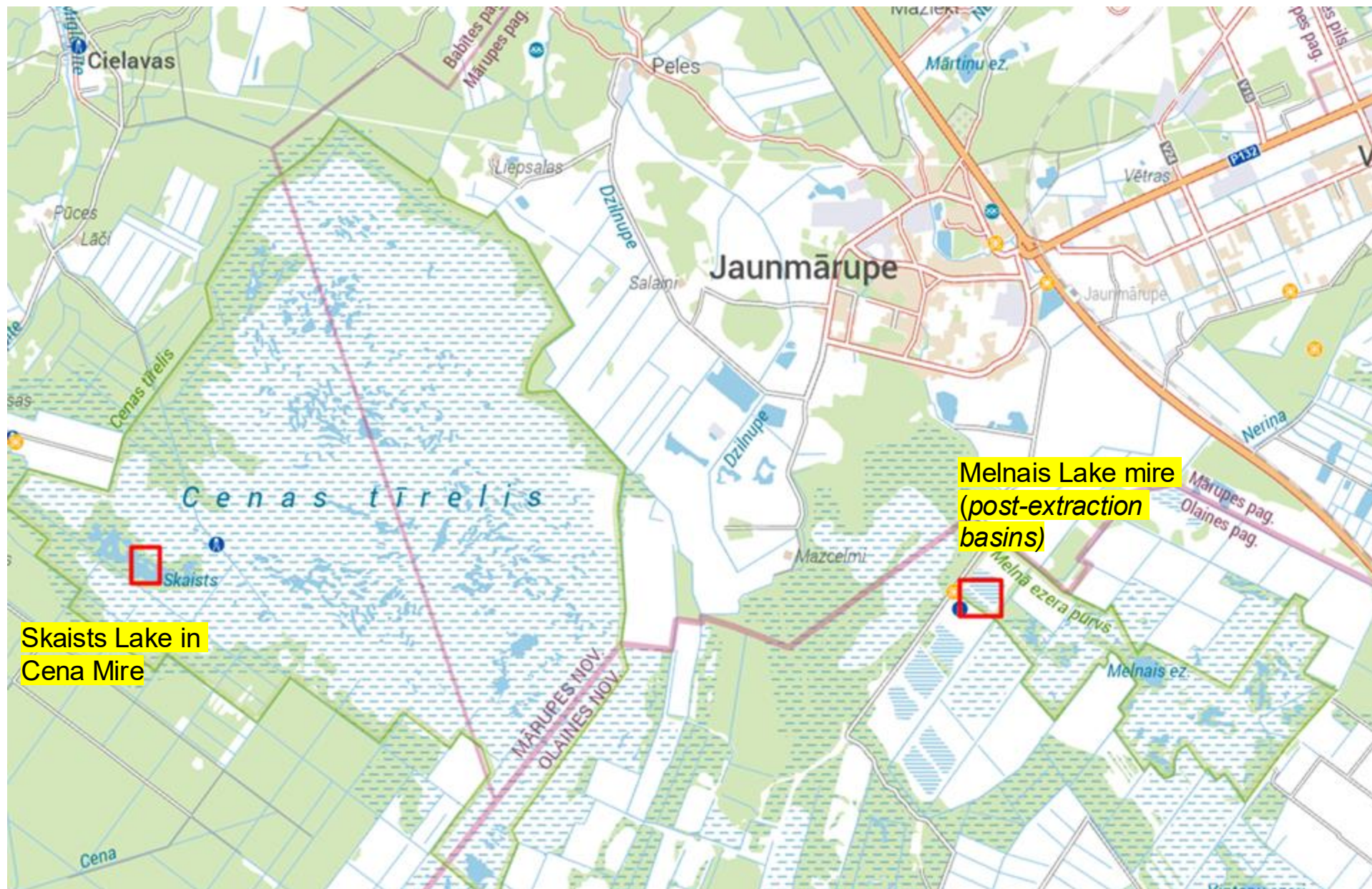
Both study sites 7.7 km apart

Melnais Lake mire (*post-extraction basins*)

Skaists Lake in Cena Mire

Measurements in the post-excavation basins of the Melnais Lake Mire

Measurements in the post-excavation basins of the Melnais Lake Mire

Depth up to 0.5 m

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Depth up to ~2 m

Supporting measurements:
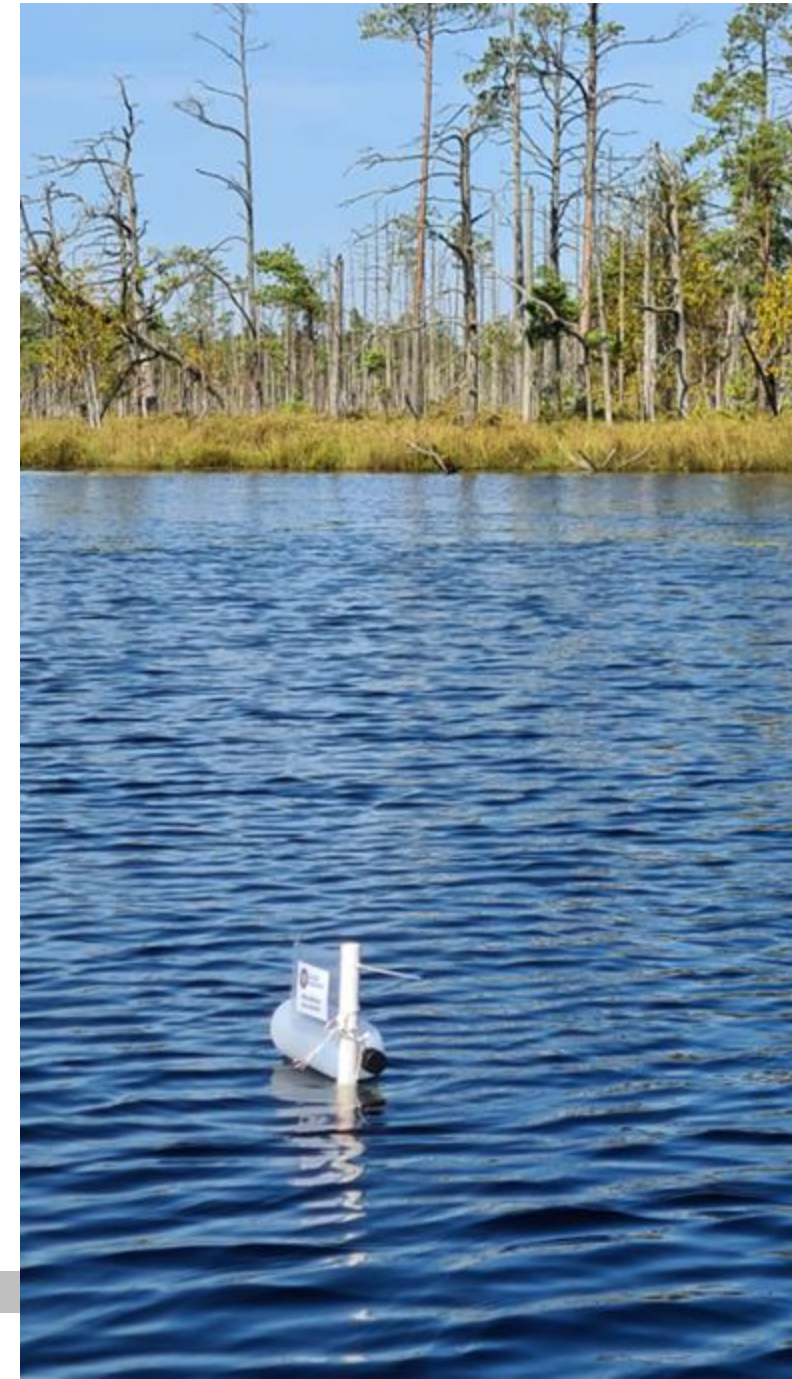In-situ water temperature, conductivity, pH and dissolved O_2 measurements at different depths (every 0.5m).
Air temperature and humidity.
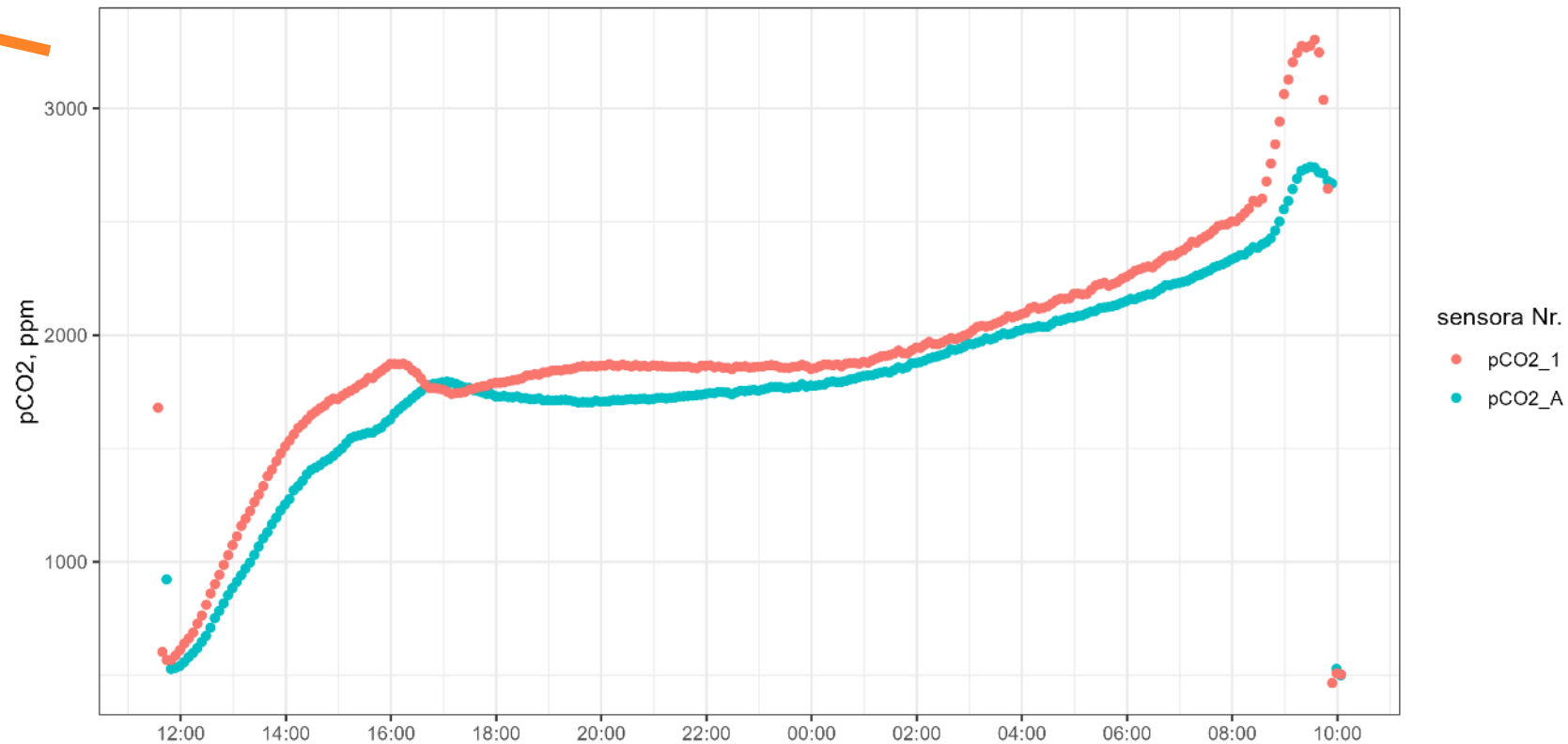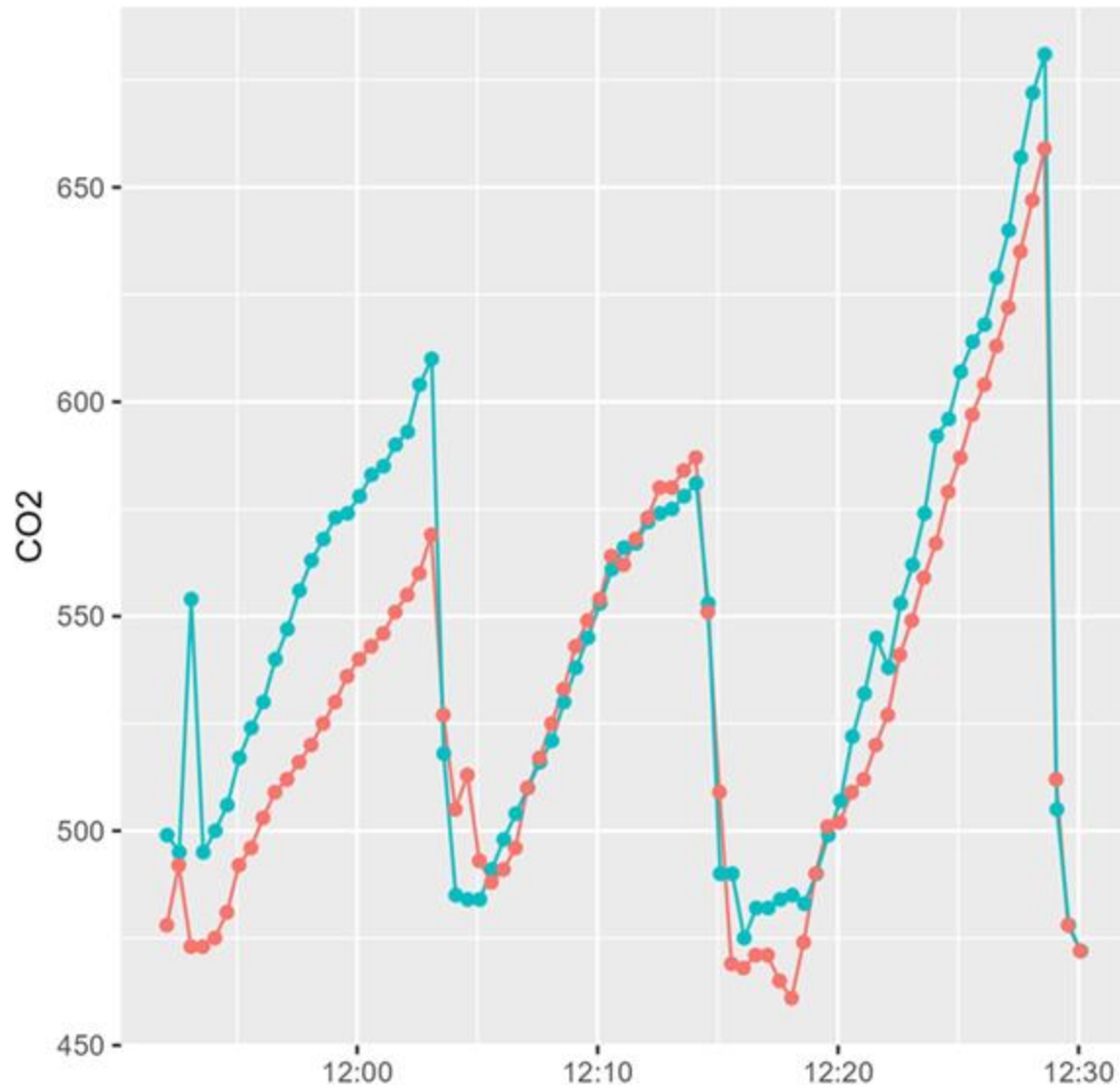Water samples were analyzed for TN, TP, DOC.

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Additional parameters:
Water temperature profile:
5 sensors up to 2 m depth.

Initial results

The pCO_2 concentration in the water of Skaista Lake in the Cena Mire is significantly higher than in atmospheric air.

Initial results
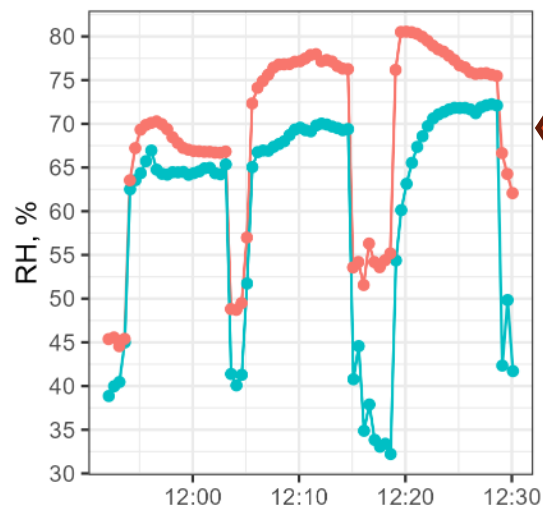CO_2 concentration increase 10min →
dystrophic peatland lake emits CO_2

Problems
CO_2 sensors are sensitive to humidity.
High air humidity interferes with
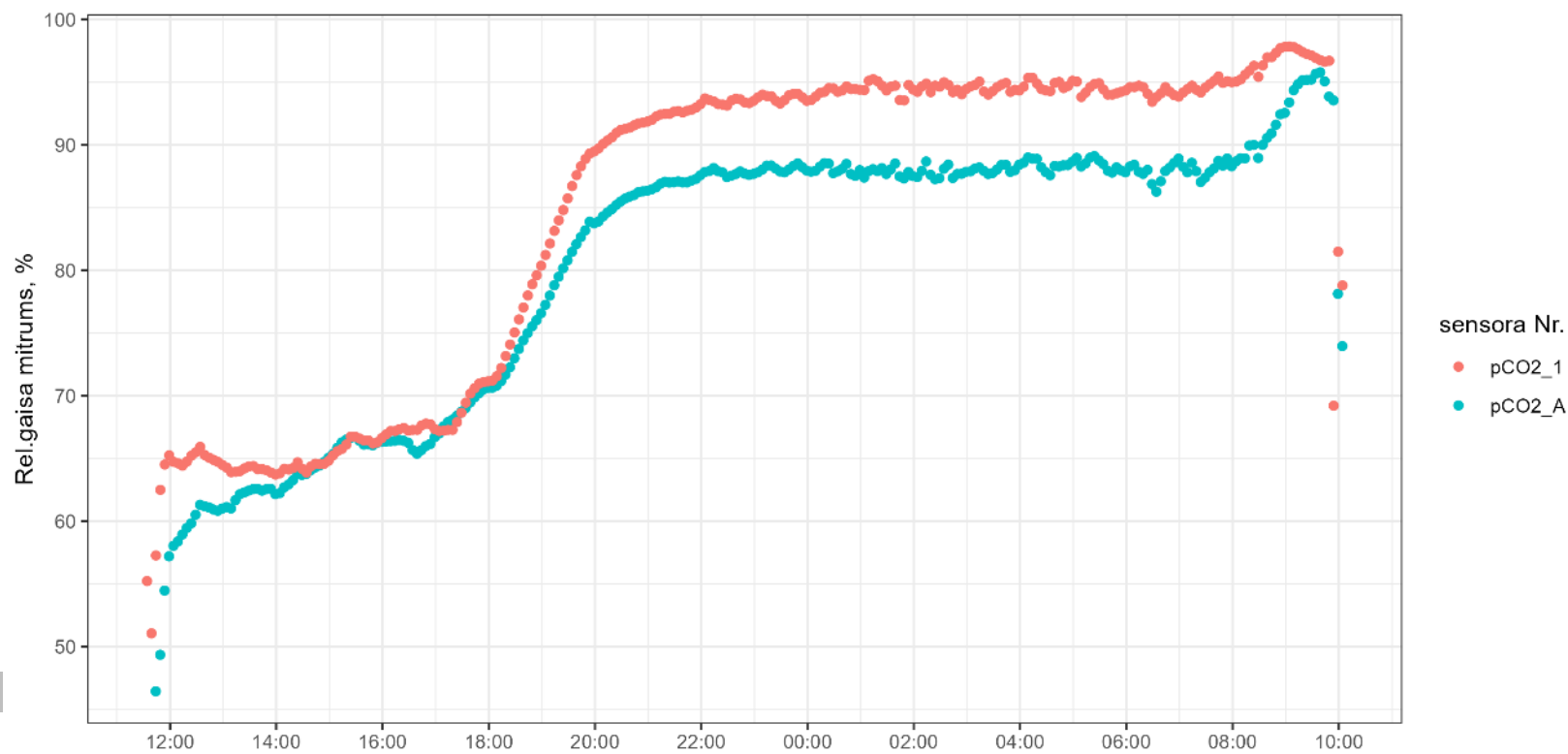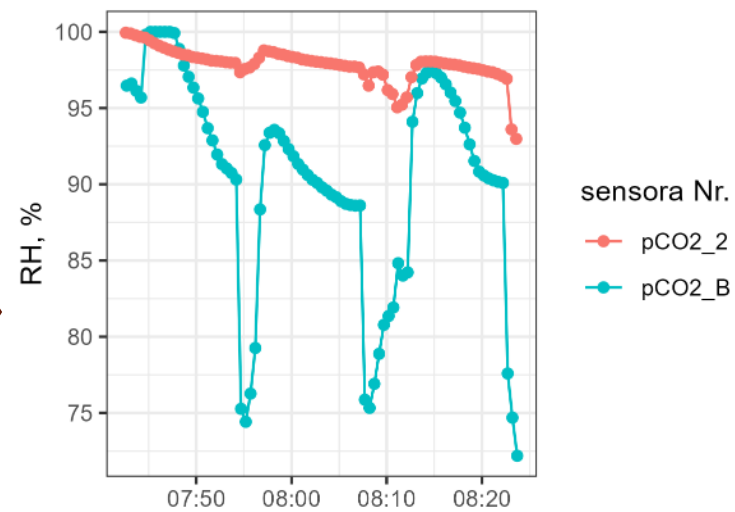measurements - a significant problem at
night

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Negative effects of humidity on sensors
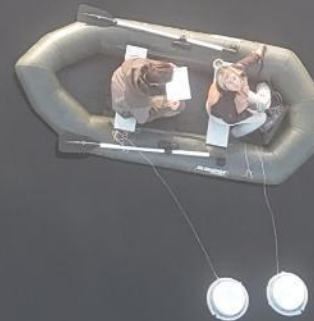
Next steps
- Analyze measurement results, assess uncertainty.
- Continue measurements in spring/summer.
- Assess the reliability of open water surface classification results.
- Assess the total emissions from open water surfaces of Cenas Mire and Melnais Lake Mire.

Testing a new approach "CO$_2$ fishing"

Thank you!

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