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Submerged drains in managed peat soils, effect on CO_2 emissions

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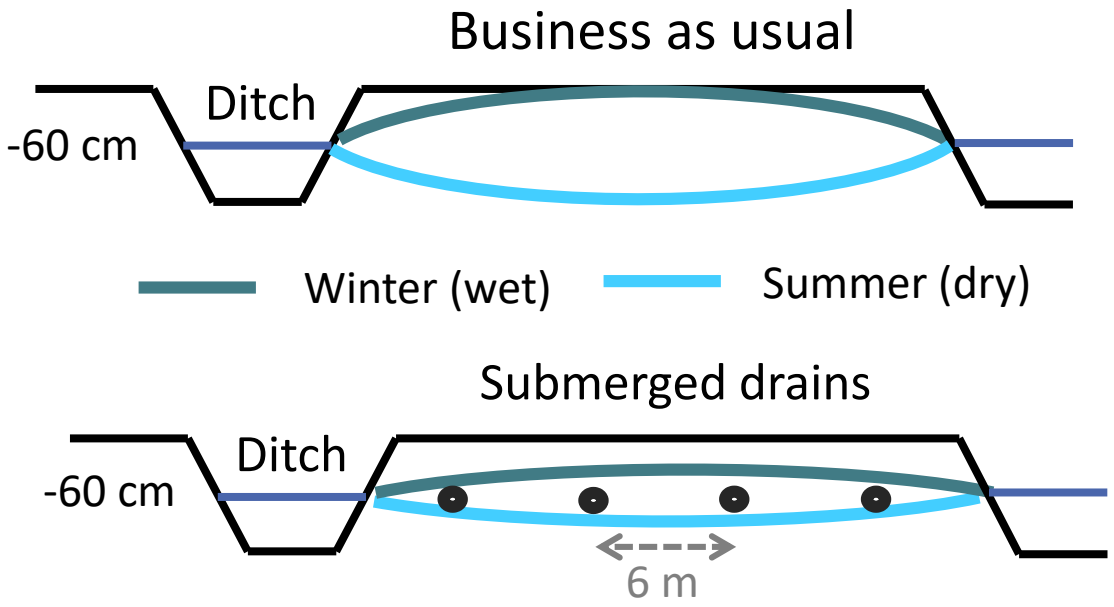
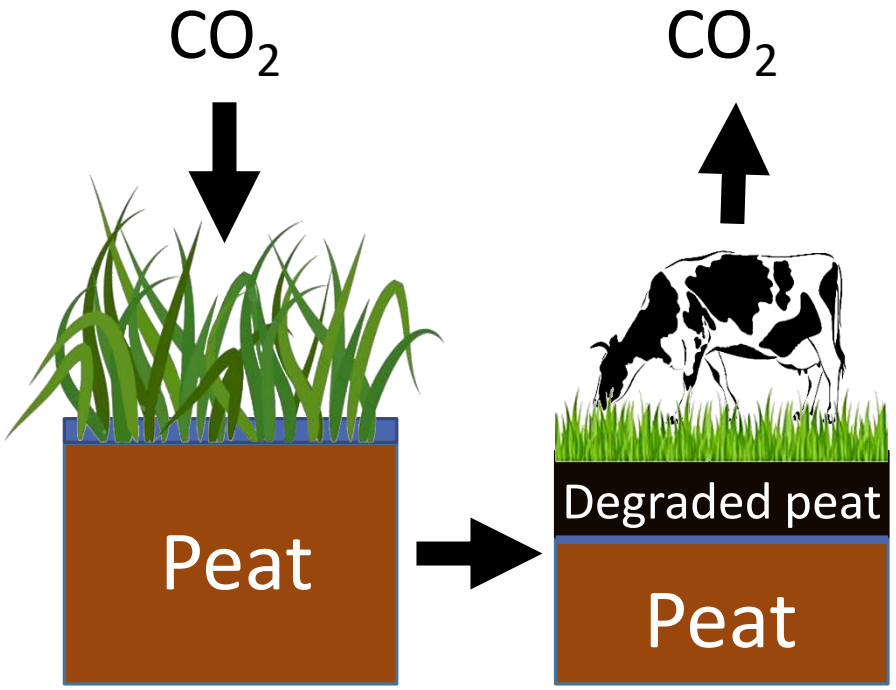
Drained peatlands

Emission Netherlands: 4.2 million ton CO_2

Submerged drains (SMD) a solution?





Research location: Friesland

Peat layer: 0.70-1.50 m Clay layer ~ 30 cm Clay carbon content ~30% Low hydraulic conductivity

Methods

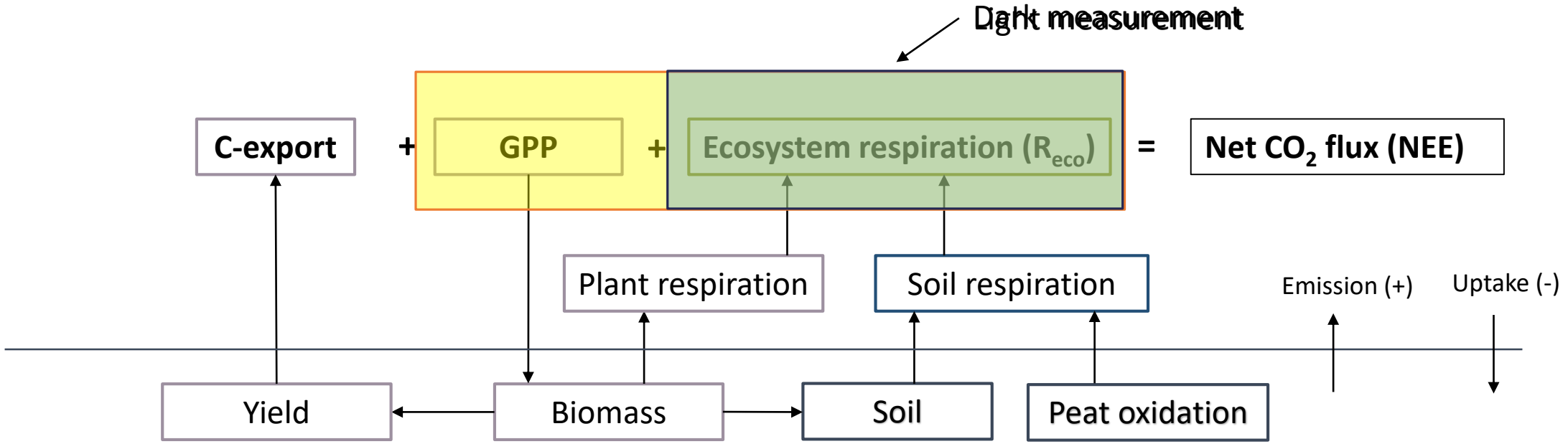
Flux measurements:

- **4 locations**: one field with submerged drains and one control field **= 8 fields**
  3 plots per field **= 24 plots**
- 18 measurement days per year, 3 light and 3 dark measurements per plot per day **= 2592 measurement points /yr**

Other measurements:

- Weather conditions
- Water table
- Field height
- And more….

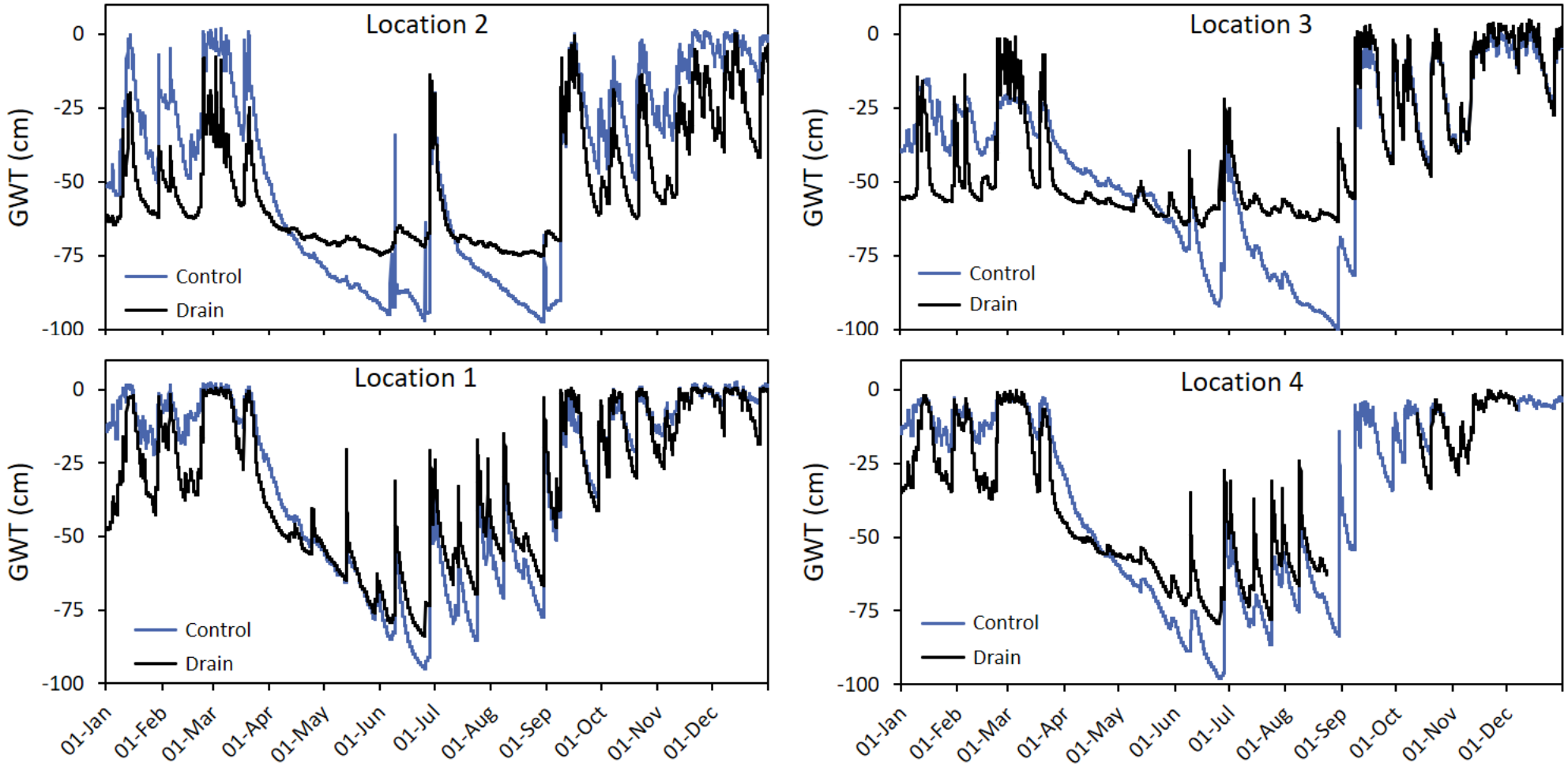
Schematic overview carbon fluxes



Light measurement - dark measurement = GPP

GPP = light dependent (light response curve)
R_{eco} = temperature dependent (Lloyd-Taylor function)

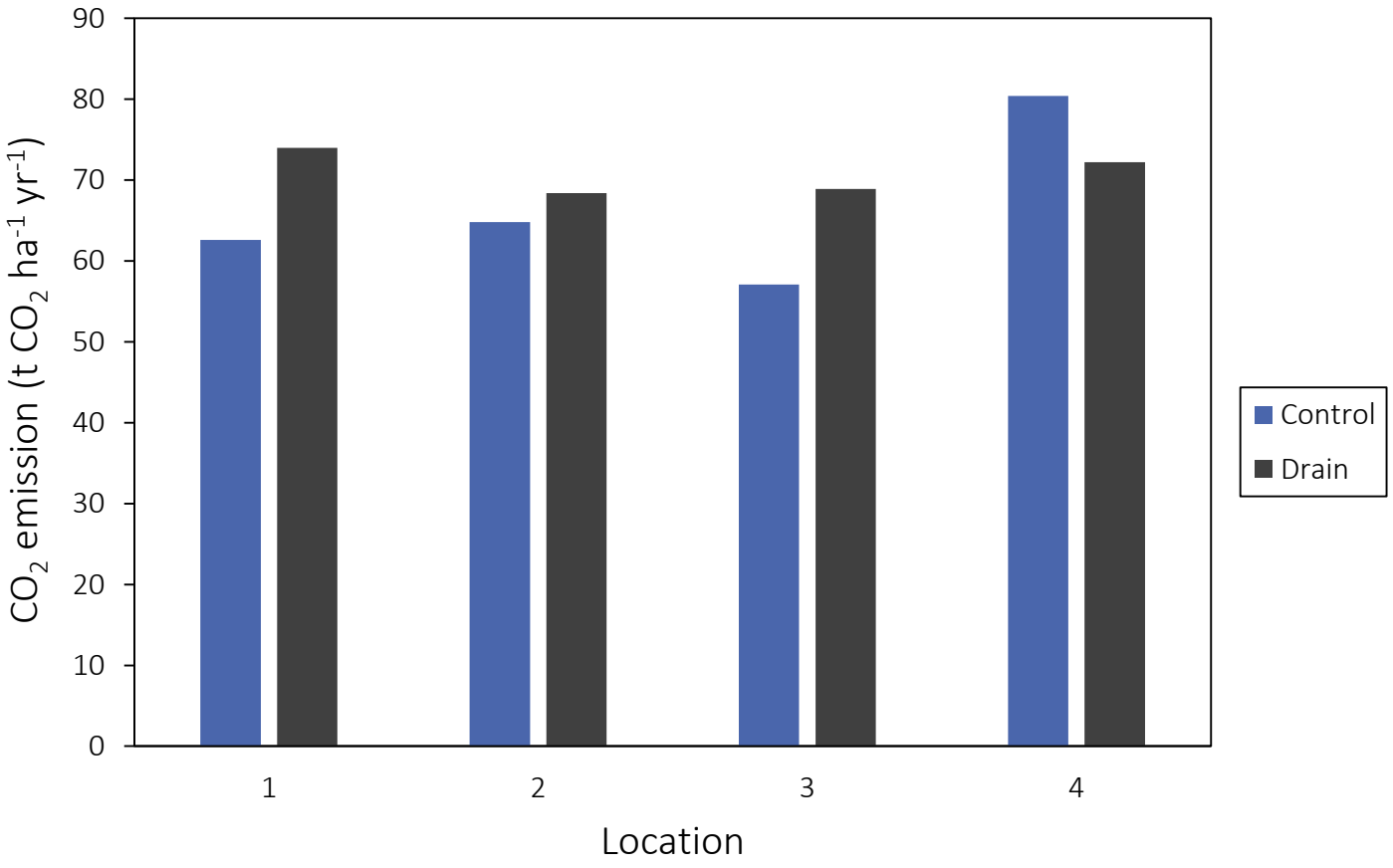
Effect of SMD on groundwater table 2017



Functions well

Little effect

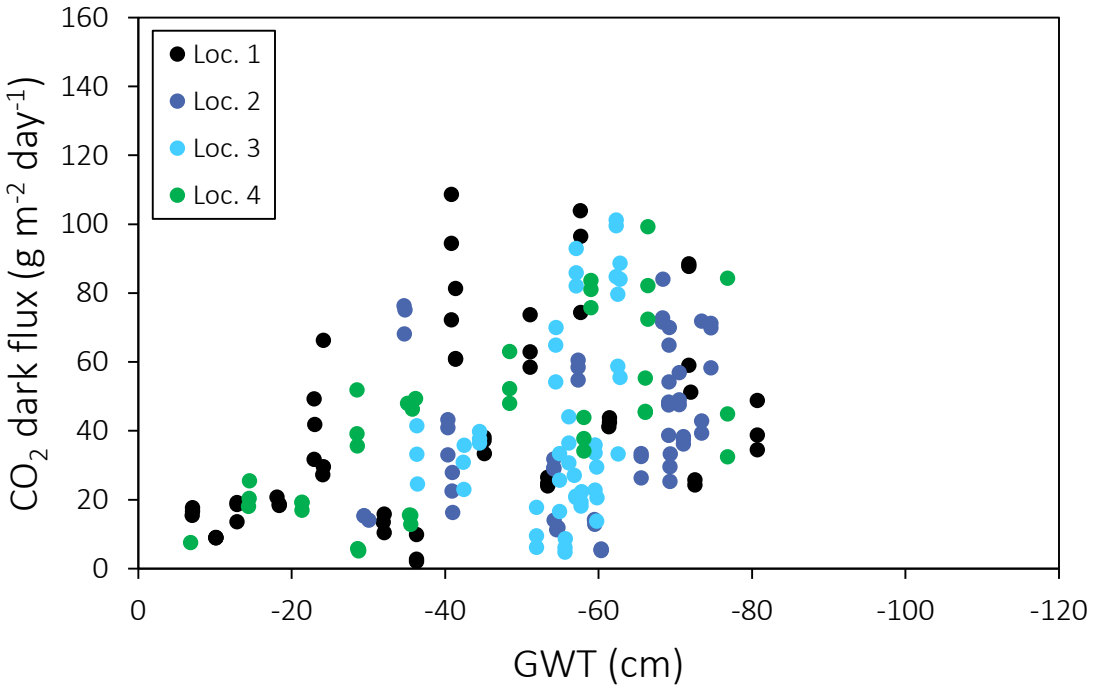
Net effect SMD on CO_2 emission 2017



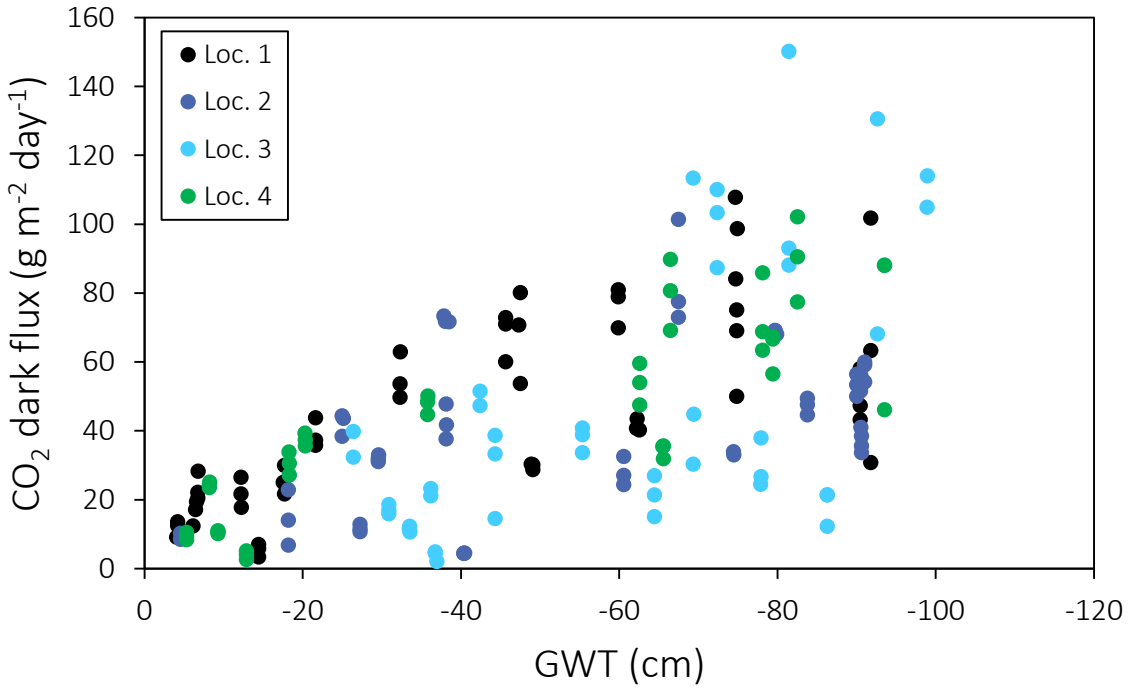
Influencing factors for CO_2 fluxes

Relation groundwater table and R_{eco} 2017

Submerged drain



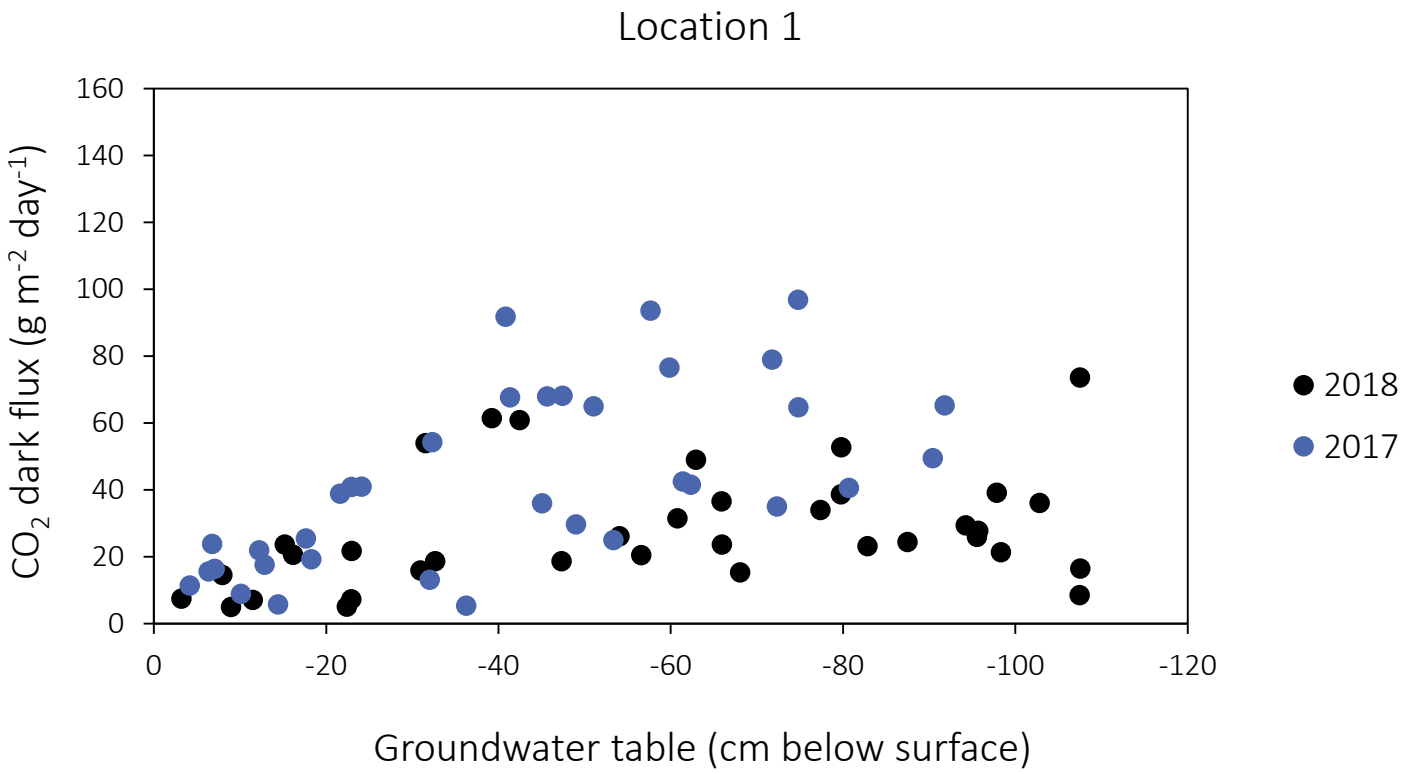
Control



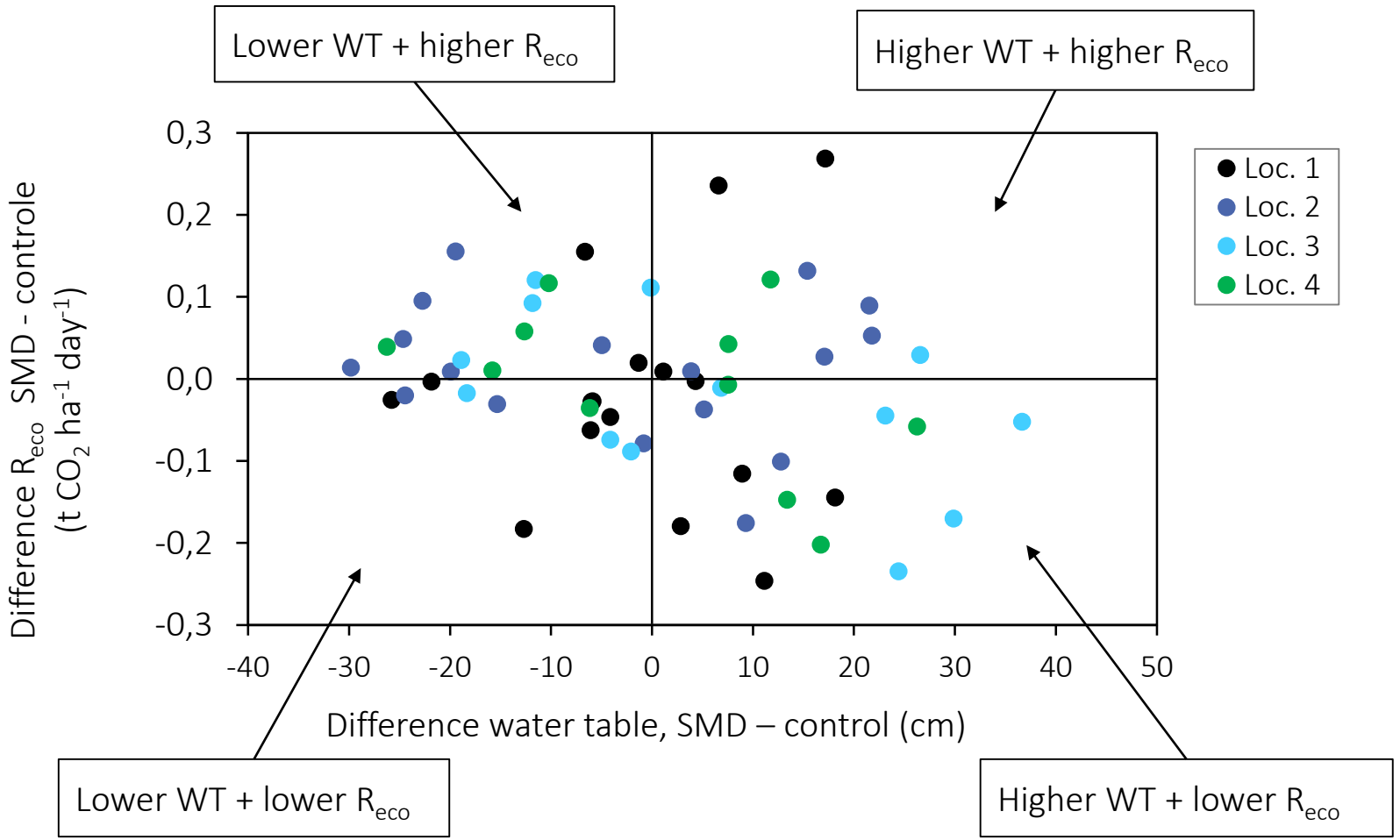
No clear relation between GWT and CO_2 emission in submerged drain fields.

In the control field an increase in CO_2 flux is visible with decrease of GWT.

Relation GWT 2017 vs 2018



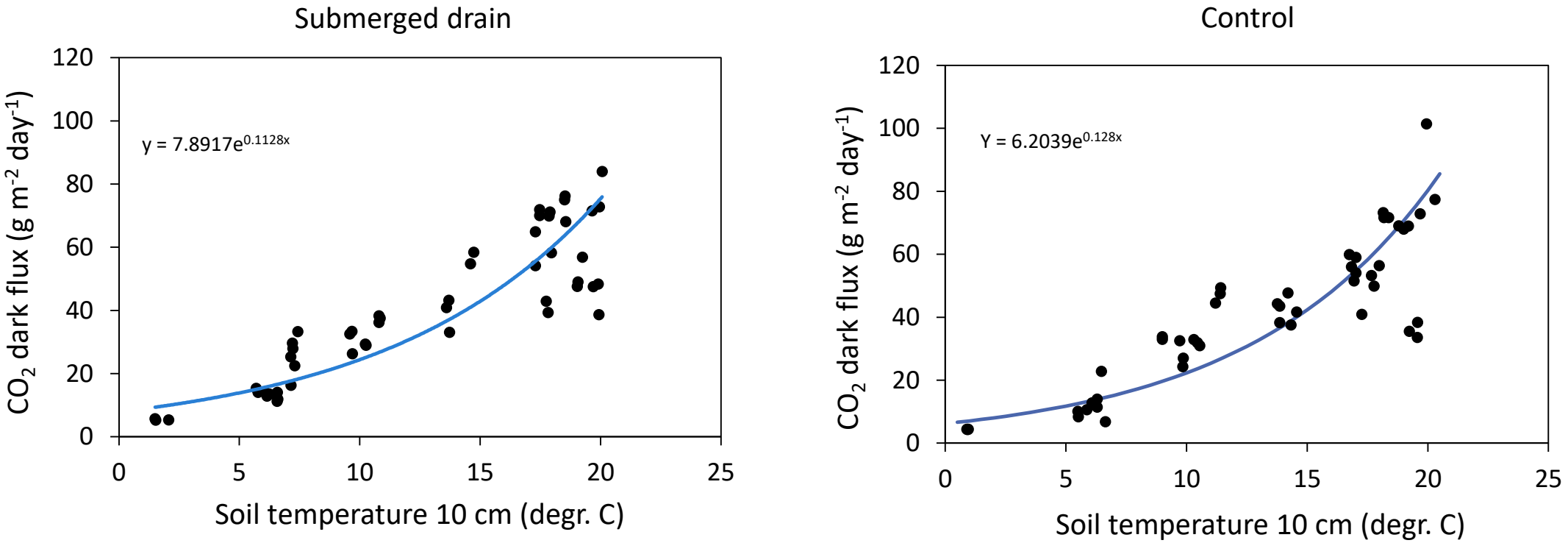
Difference in GWT and CO_2 SMD vs controle



During summer a higher water table resulted in a reduction of R_{eco} between 4 and 12 %.

Relation temperature and R_{eco} 2017

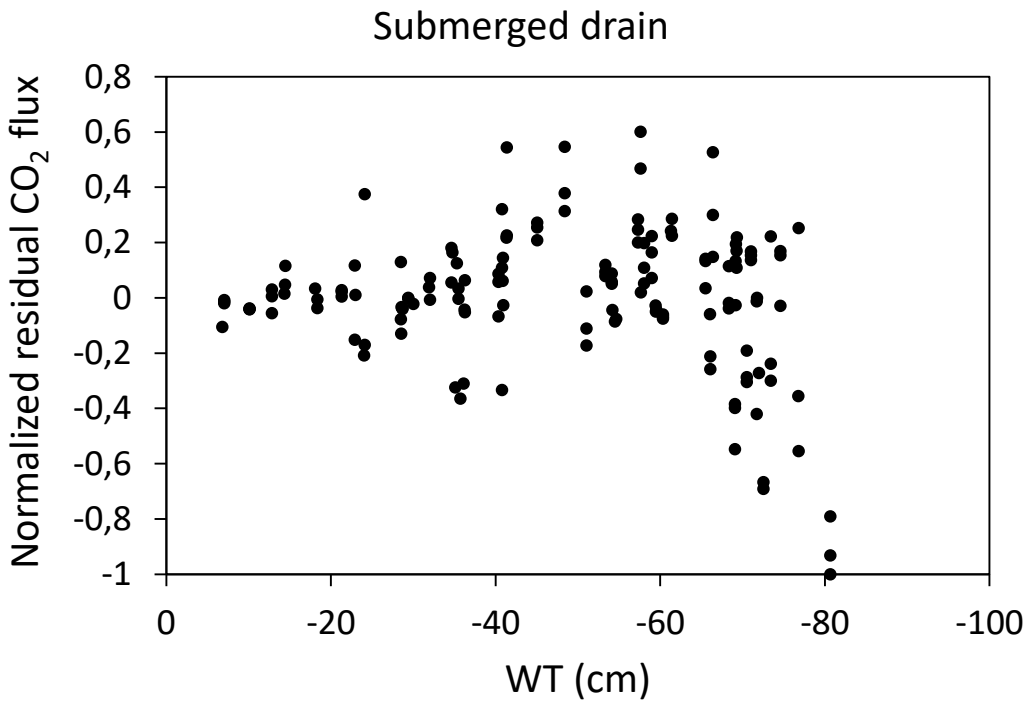
Example location 2

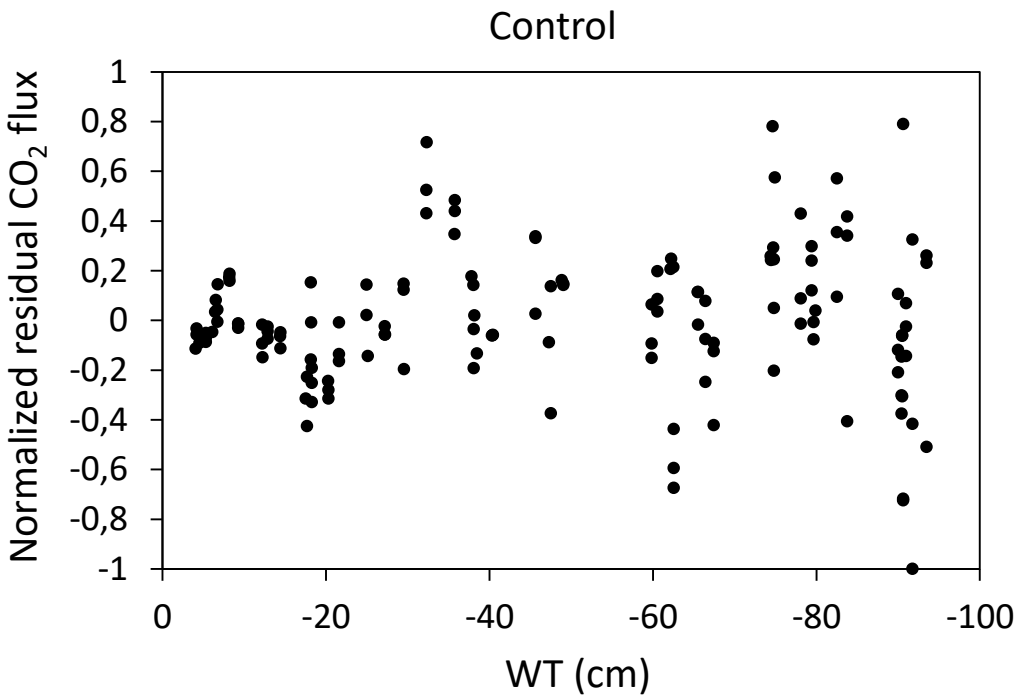


All locations show a clear exponential relation between R_{eco} and soil temperature.

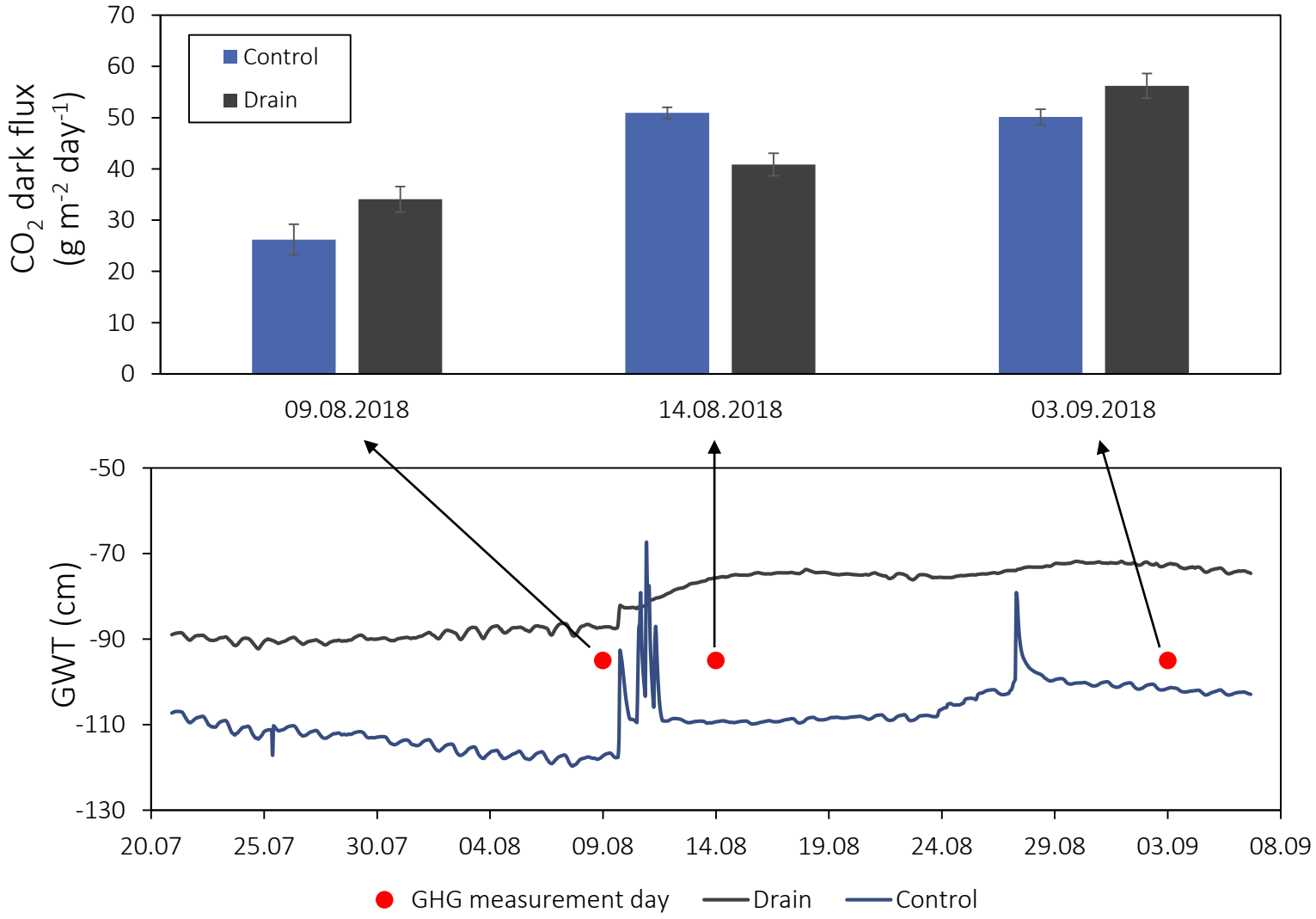
Relation R_{eco} with groundwater table

Relation with temperature removed





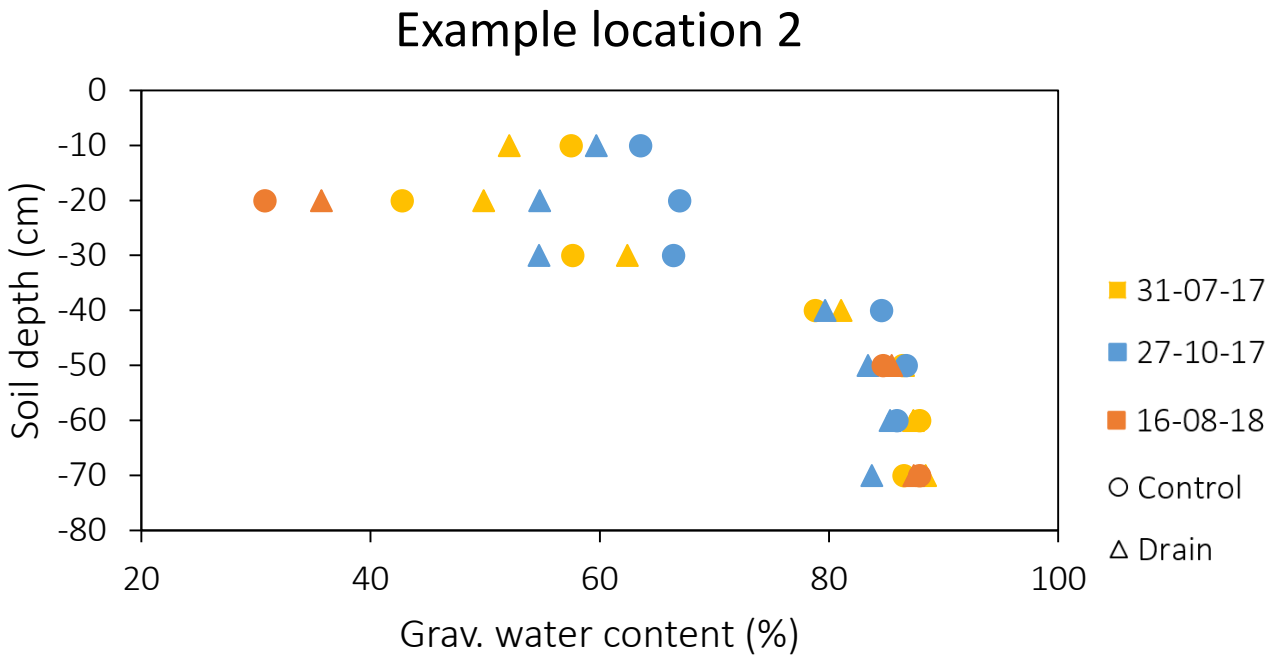
Effect submerged drains in dry period



Example location 2

The CO_2 flux is relative low in the dry period. With a rain event the flux increases, especially in the control field.

Soil moisture in dry and wet conditions



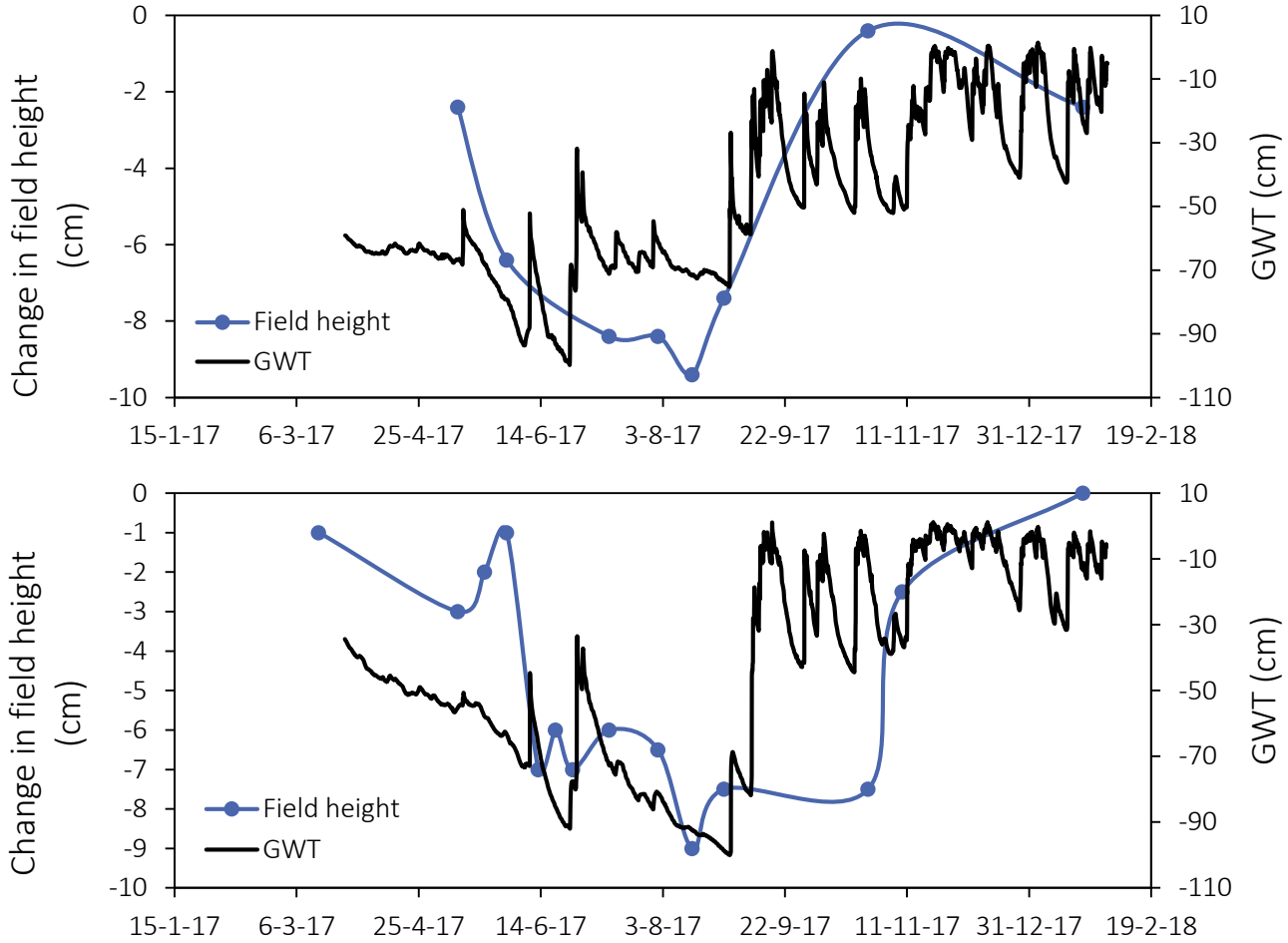
	GWT (cm)	
Date	Control	Drain
31-07-2017	-82	-71
27-10-2017	-15	-40
16-08-2018	-109	-74

From 50 cm depth, the water content hardly changed with fluctuating groundwater table.

Influence of groundwater level on field height 2017

Drain

Control



Example location 3

There is around 10 cm difference within one year due to GWT fluctuation.

Conclusions

There was no difference in CO_2 emission found between submerged drain field and control fields in 2017.

Soil temperature appears to be the best explaining factor for seasonal variation in ecosystem respiration (R_{eco}) (not groundwater table).

Field level fluctuation within a year is a factor 10 higher than the expected subsidence due to peat oxidation.

Questions that follow

When would submerged drains work to reduce CO_2?

- How deep is oxygen intruding into the soil
- What is the relation between GWT → soil moisture → CO_2 flux?

On which time scale can soil subsidence be used as measure for CO_2?

- How long does it take before hysteresis effect is gone?

Thank you for your attention!