Controlled drainage on a cultivated fen

Merja Myllys, Jaakko Heikkinen, Kristiina Regina

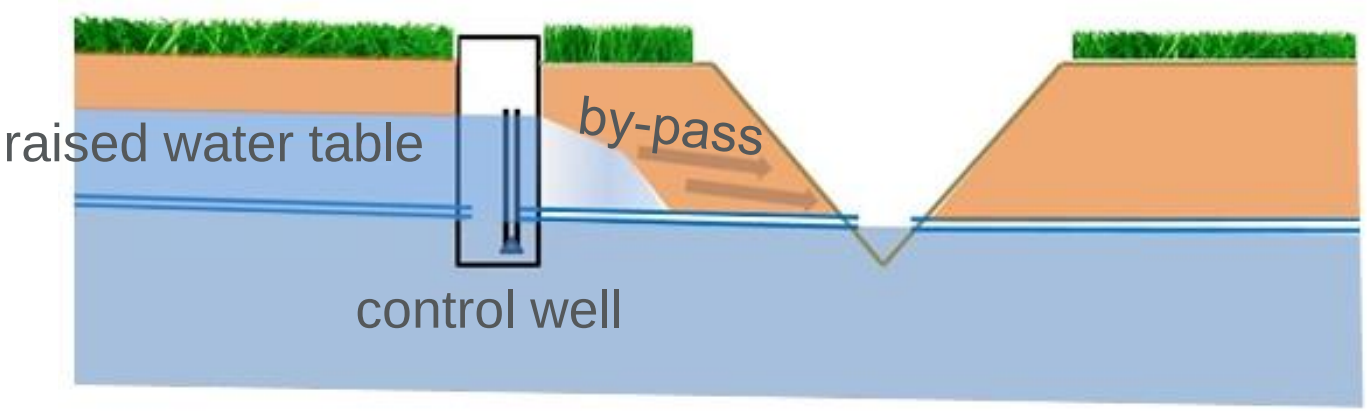
CAOS
Climate Smart Agriculture on Organic Soils

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Why controlled drainage?

- High water table reduces greenhouse gas emissions
- Wetness slows down soil subsidence
- Reduced runoff reduces nutrient leaching

controlled drainage traditional drainage



The questions of the study

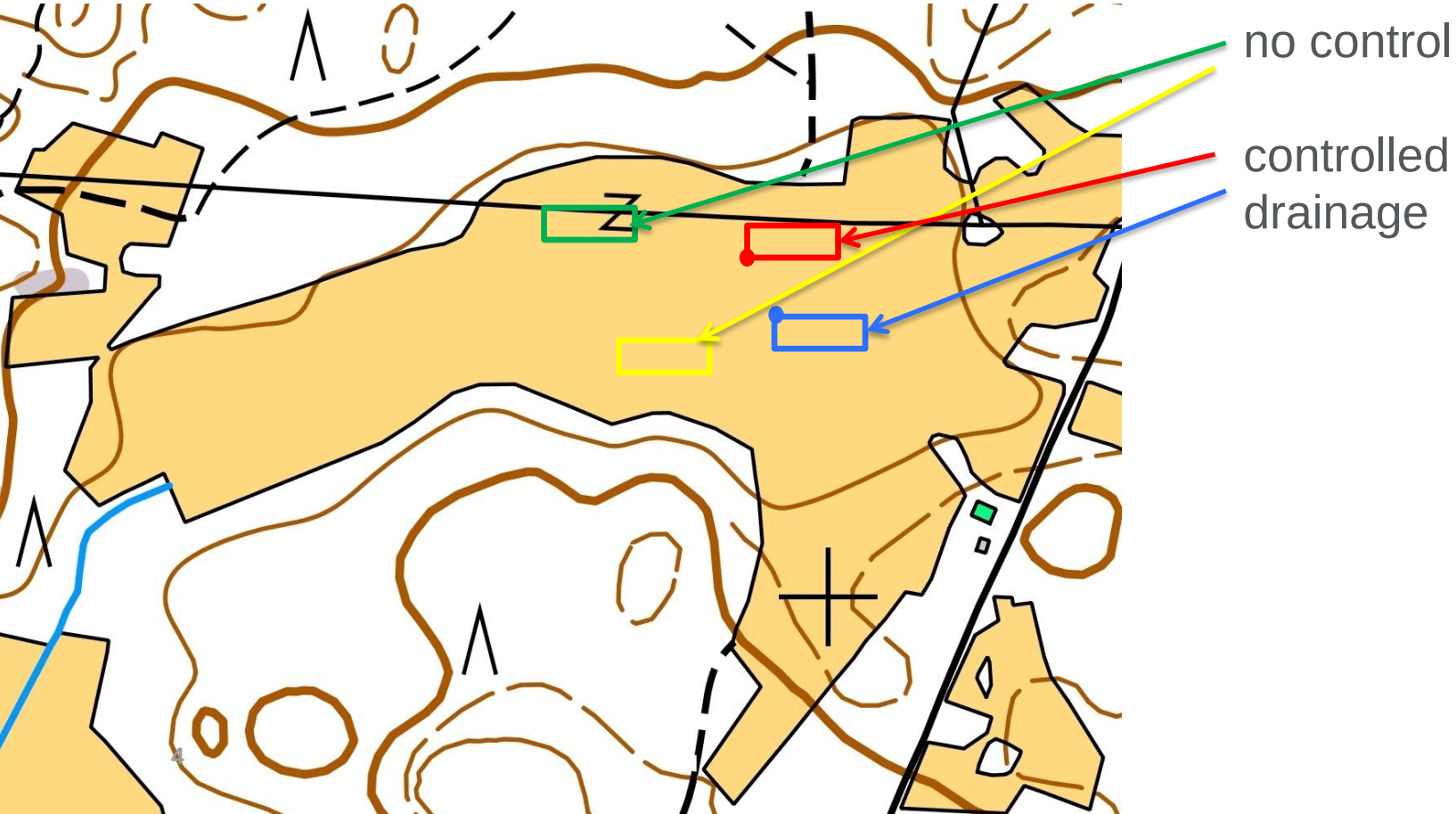
1) Did water table rise when the control level was raised?

2) Did water table sink when the control level was lowered?

3) Did water table stay at the adjusted level?

Experimental site in Mouhijärvi, Finland

- *Carex* peat soil (thickness 40–120 cm)
- topographically in a depression
- four areas, each in separate drainage systems



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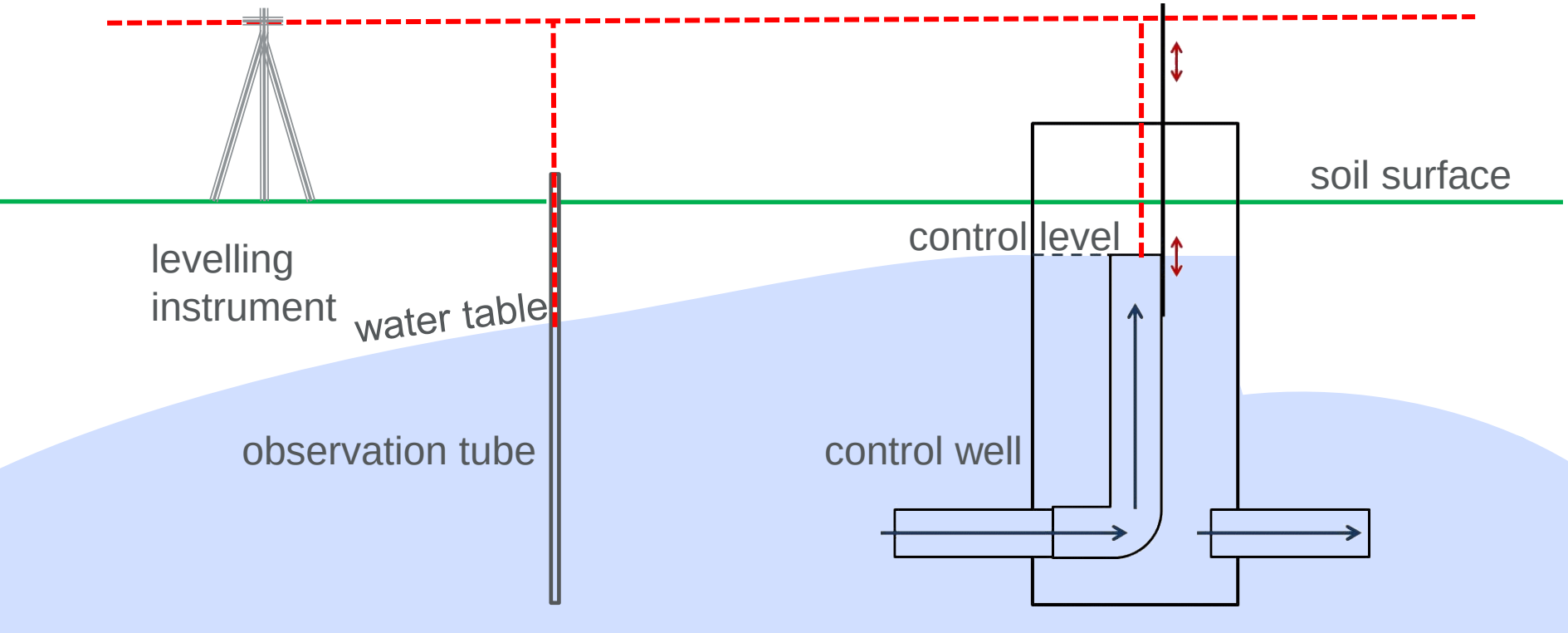
Method

- Reactions of the water table to the adjustment of the control level were observed by levelling
- Measurements were made every second week
- Two observation tubes per area in the middle of the lateral drains



Method

- no modelling
- calculations: differences between the water tables before and after the opening or closing of the locks in the control well
- ” - ” = sinking water table
- ” + ” = raising water table

Data

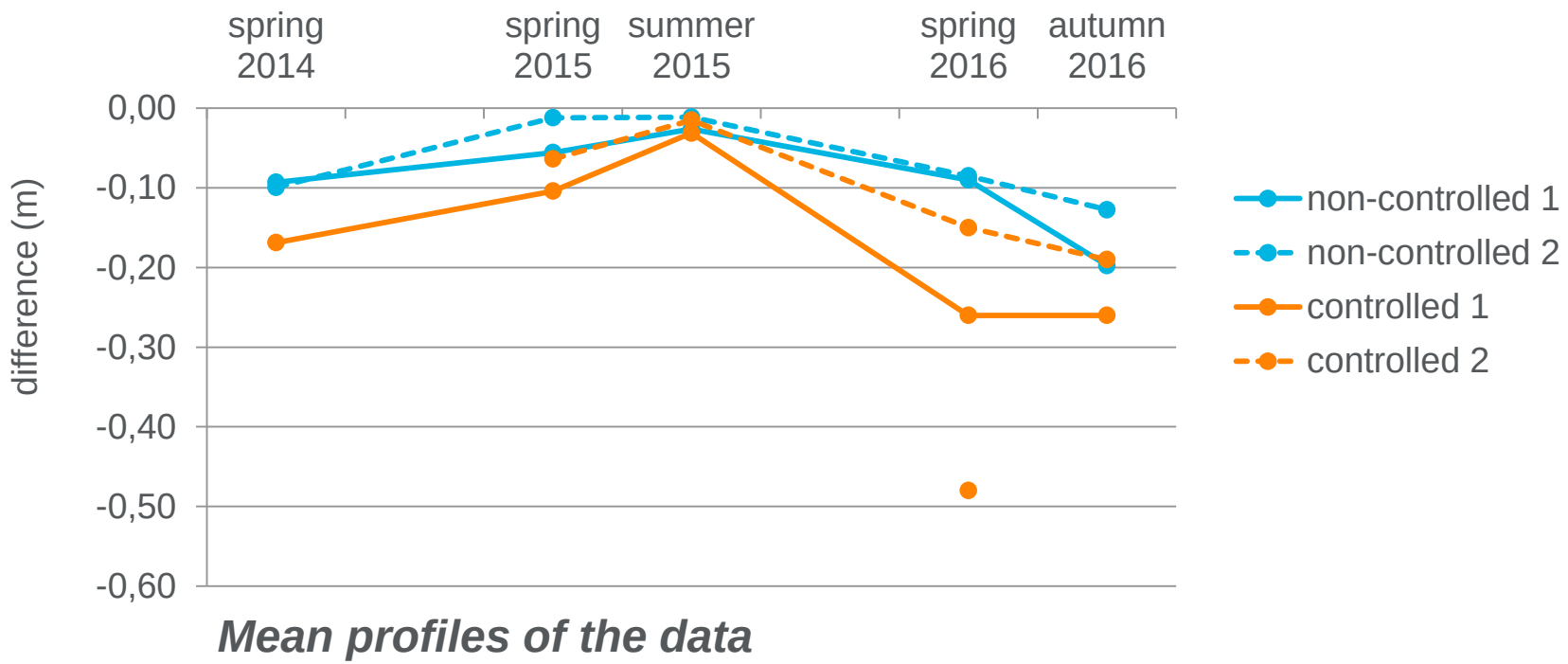
Five occasions of opening the locks = lowering the control level

Four occasions of closing the locks = raising the control level

Four periods of follow-up the constant control level

Results

Opening the locks



Mean profiles of the data

- All five opening occasions occurred when water table was sinking
- Water table sank more on controlled areas indicating raised water table before the opening
- Magnitude depended on moisture conditions before and after the opening

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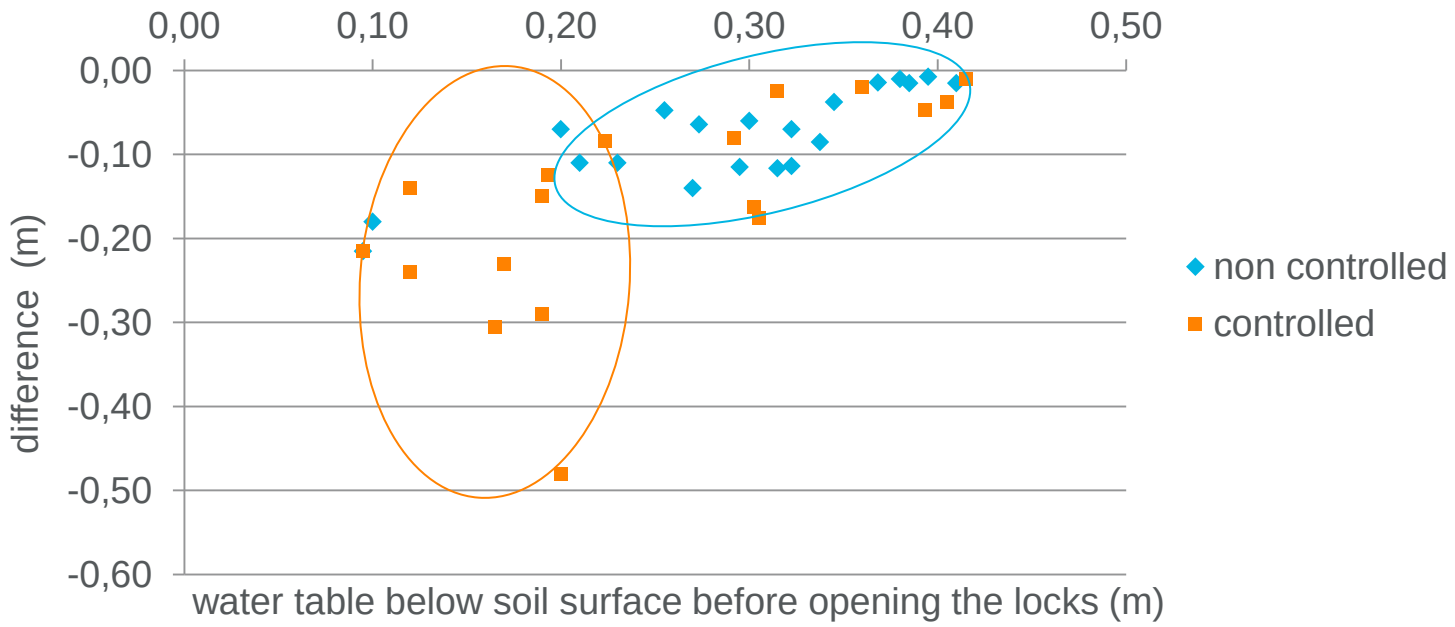
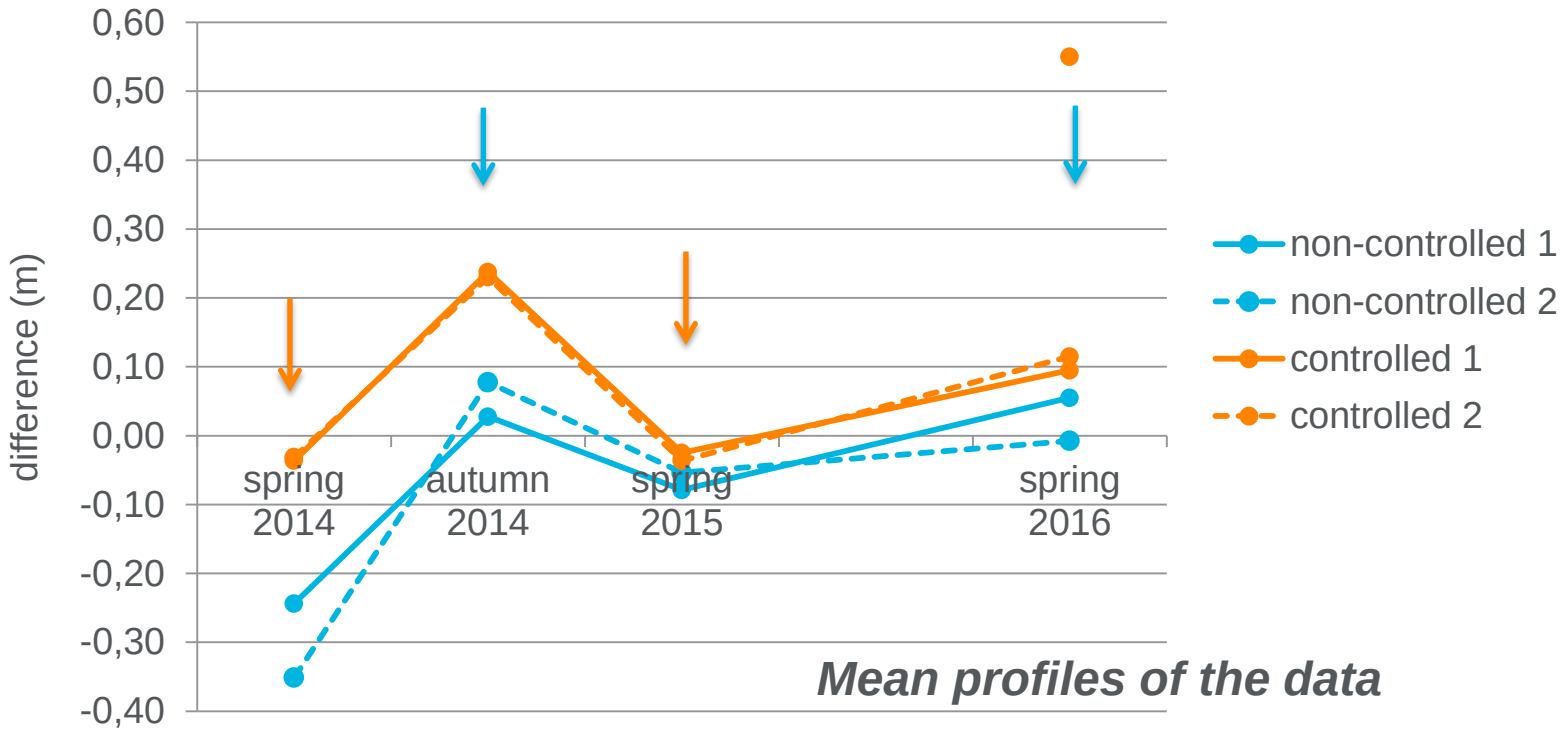
Opening the locks



Water level before opening vs. fall of the water level after opening

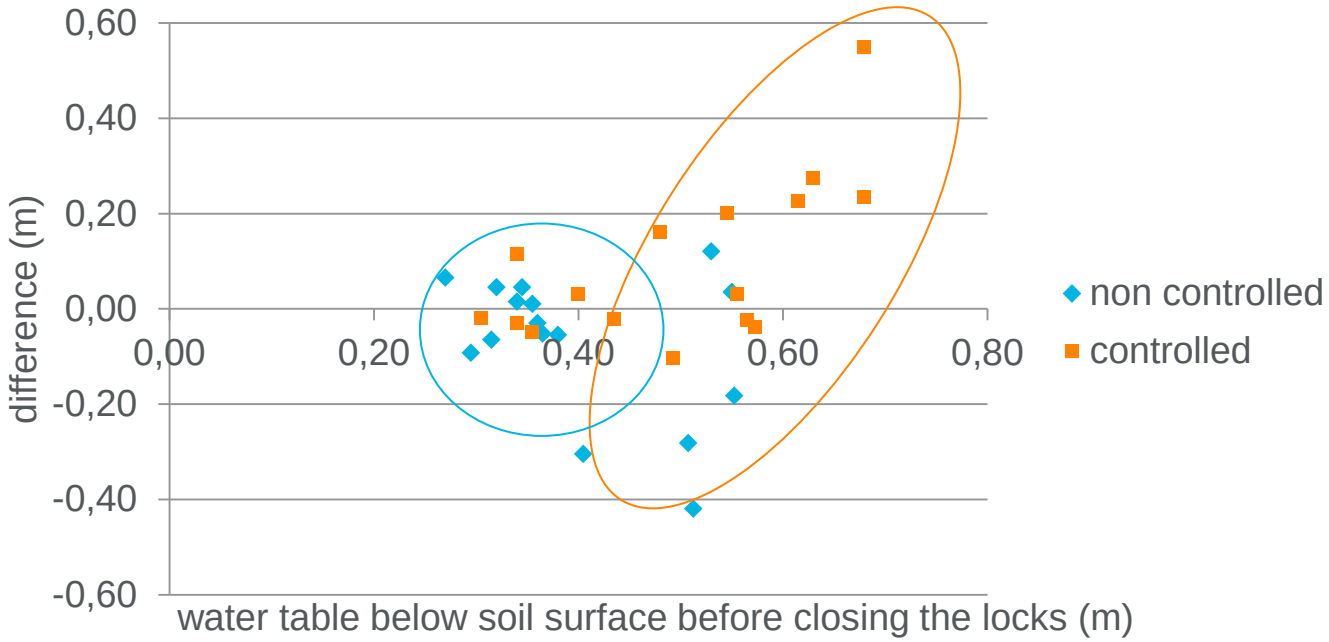
- If water table was close to soil surface – like it often was on controlled areas – it sank considerably after opening – depending on the weather conditions.
- If water table was 20 – 40 cm below soil surface, water table on controlled areas reacted as on non controlled areas

Closing the locks



- If the natural water table was sinking (dry conditions), controlled drainage prevented sinking
- If the natural water table was raising (moist conditions), controlled drainage increased raising
- Differences were clear except for a very wet season.

Closing the locks (after having been open)

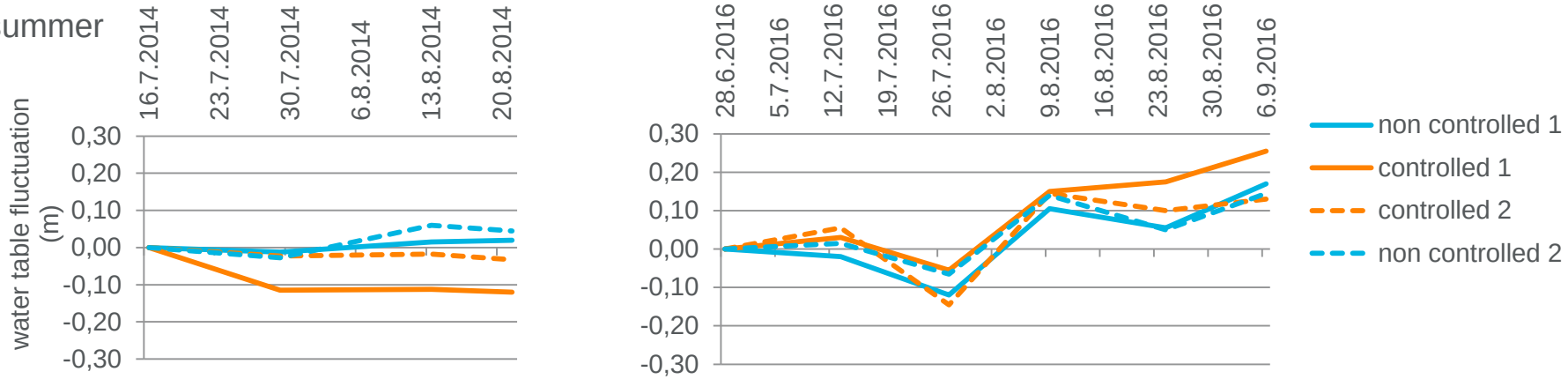


Water level before closing vs. reaction of the water level after opening

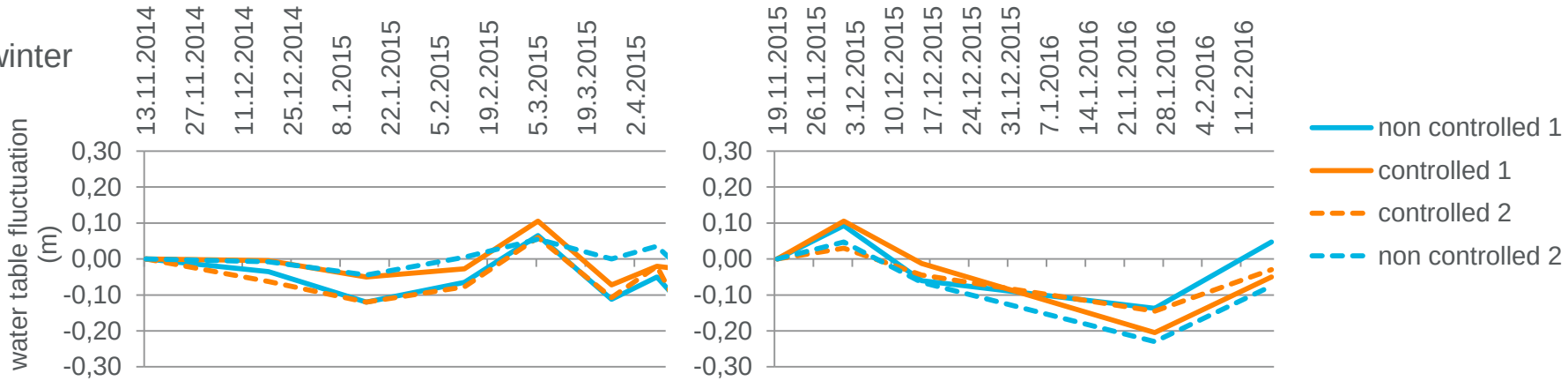
- If high water table, controlled drainage did not have any effect (water table was high anyway)
- If lower water table, controlled drainage raised water table (while it sank on non controlled areas)

Maintaining adjusted level

summer



winter

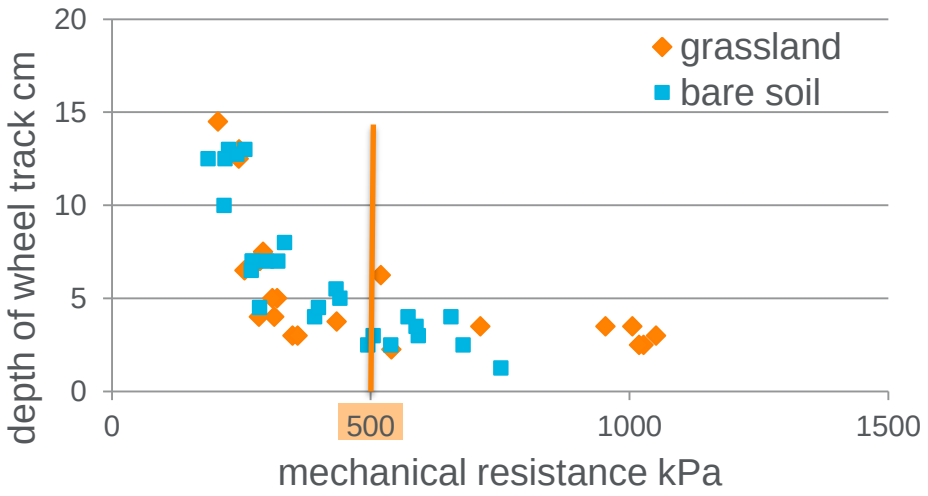


- Water table fluctuated according to the moisture contitions on all areas
- Controlled drainage managed to keep its raised position quite well
- Fluctuation might have been a bit more extensive on controlled areas

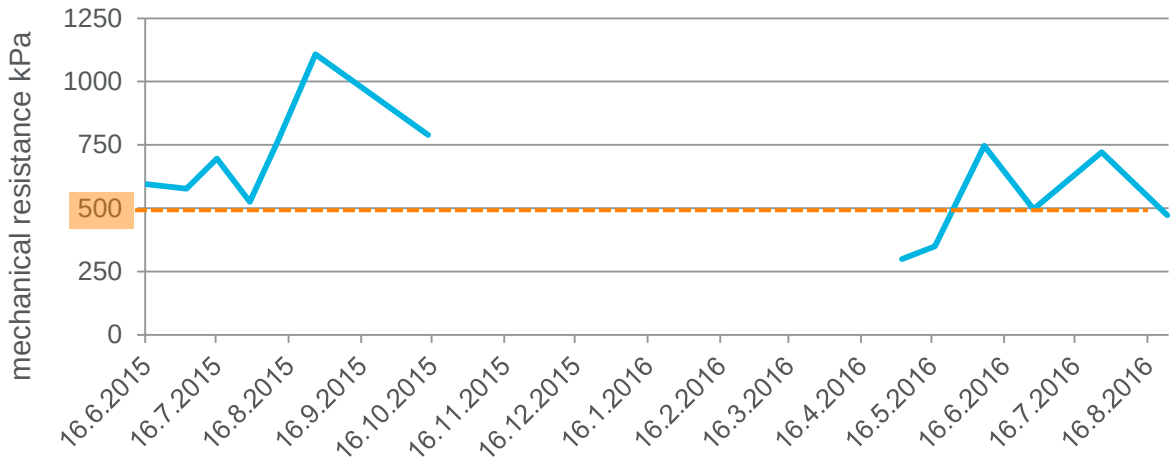
Summary of the results

- Controlled drainage clearly raised water table on a fen
  - if sufficient amount of water was available
  - if water table already wasn’t at a high level
- It was easier to raise water table than to lower it;
  - Opening the locks could only lower a very high watertable
  - Further lowering seemed to be ”natural lowering” (e.g. evapotranspiration, groundwater seepage) as it happened equally on all areas
- When raised, water table fluctuated according to the weather conditions but remained on a higher level.
- These results probably are not valid on raised bogs.

Effect on bearing capacity



Result of a former study:
If the mechanical resistance of the soil is more than 500 kPa, the depth of the wheel track is less than 5 cm.



In this study:
Bearing capacity of the soil was good enough for farm operations for most of the time.

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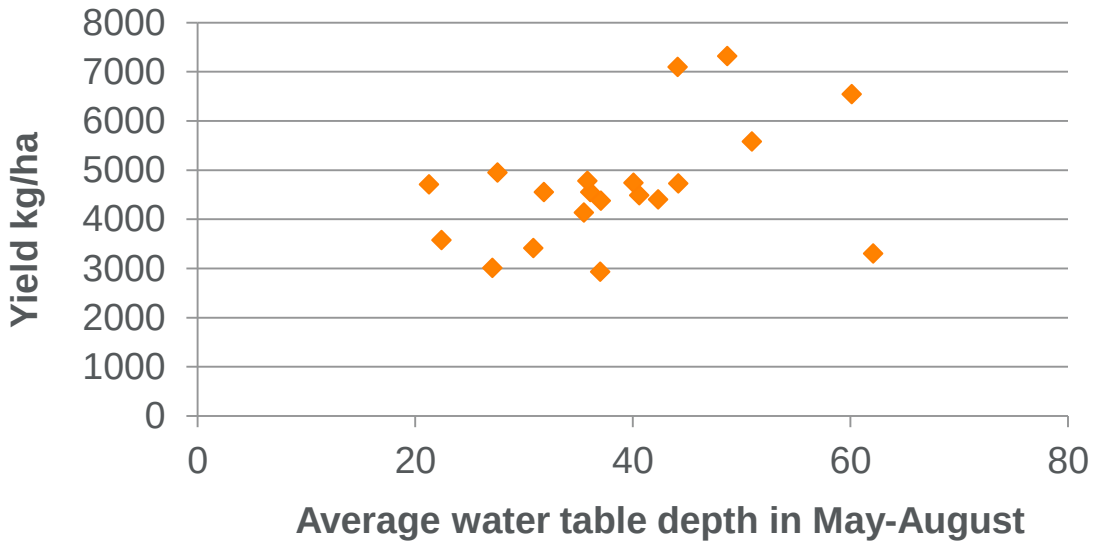
Effect on yield



- The best yields were obtained if water table was (on an average) deeper than 40 cm from the soil surface
- Quite good yields also in wet conditions
- In dry years, controlled drainage increased the yield (not shown here)
- In wet years, controlled drainage reduced the yield (not shown here)

Conclusions

- Controlled drainage can raise watertable – and keep it raised – on a fen where water is available from rain and the surroundings.
- However, success is affected by weather conditions.

Thank you!

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