



# Water levels and dissolved organic carbon in deep-drained peatlands treated with subsurface irrigation

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## Aim of the project and study sites

- Subsurface irrigation was implemented to raise the groundwater level (target: 30 cm below surface) in order to reduce peat mineralization and greenhouse gas emissions, while maintaining intensive grassland management
- Comparing 2 study sites at Gnarrenburger Moor (Northwest Germany), measurements run from 04/2019 to 03/2025:
  1. Reference site (RS): conventional managed deep-drained bog grassland
  2. Treatment site (TS): bog grassland with subsurface irrigation (irrigated with groundwater)

## Methods: Field work and statistics

### Subsurface irrigation (SI):

- Pumping groundwater into a subsurface drainage system to increase the soil water level
- Pumping period took mainly place during the summer months, depending on weather conditions

### Water quality monitoring (selection):

- Continuous water sampling by suction plates (15, 30 and 60 cm soil depth, 3 per depth) and two-week sampling interval
- Water analysis: Dissolved inorganic and organic carbon (DOC), cations, anions, pH, electrical conductivity, Total N, P, Fe

### Statistic methods:

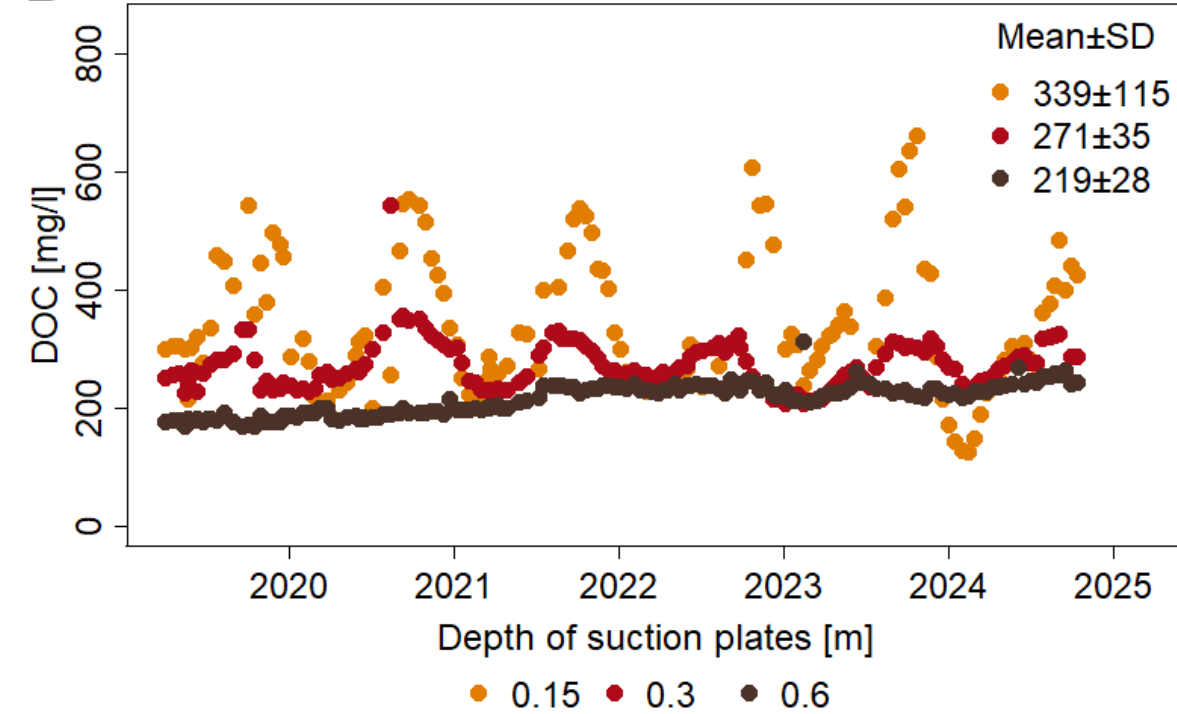
- Ordinary least square regression models with interaction term and month dummies, taking divers levels of dependent variables and seasonal effects into account (Estimations include only complete measurement years 1-5)

## Summary

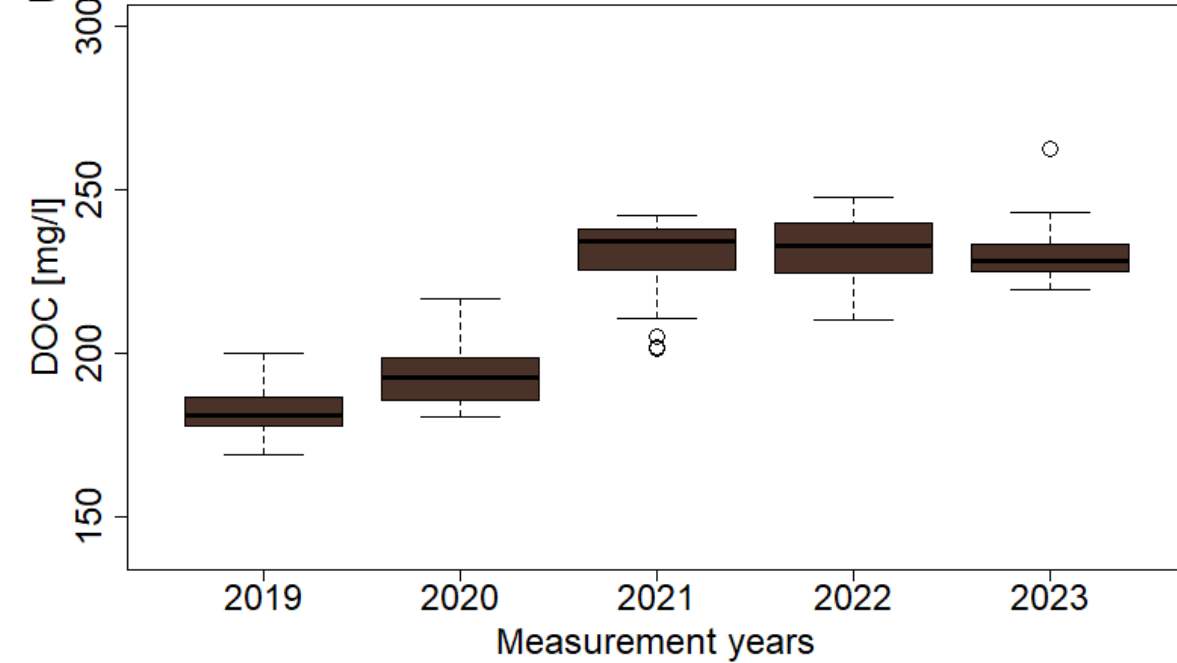
- ❖ Subsurface irrigation run on a deep-drained bog grassland to increase the water level and thus to reduce greenhouse gas emissions
- ❖ Water quality data were collected by suction plates in 3 different depths between 04/2019 and 03/2025
- ❖ SI smoothed the water level and avoid deep drained situations in summer
- ❖ Only the soil water quality in 60 cm depth could benefit from SI where DOC concentration decreased in the long term, despite DOC mobilisation during pumping period
- ❖ DOC concentration in 60 cm sampling depth increased over time on the reference site
- ❖ Constant water level in summer is highly recommended

## Research question: How does subsurface irrigation affect the water level and the water quality?

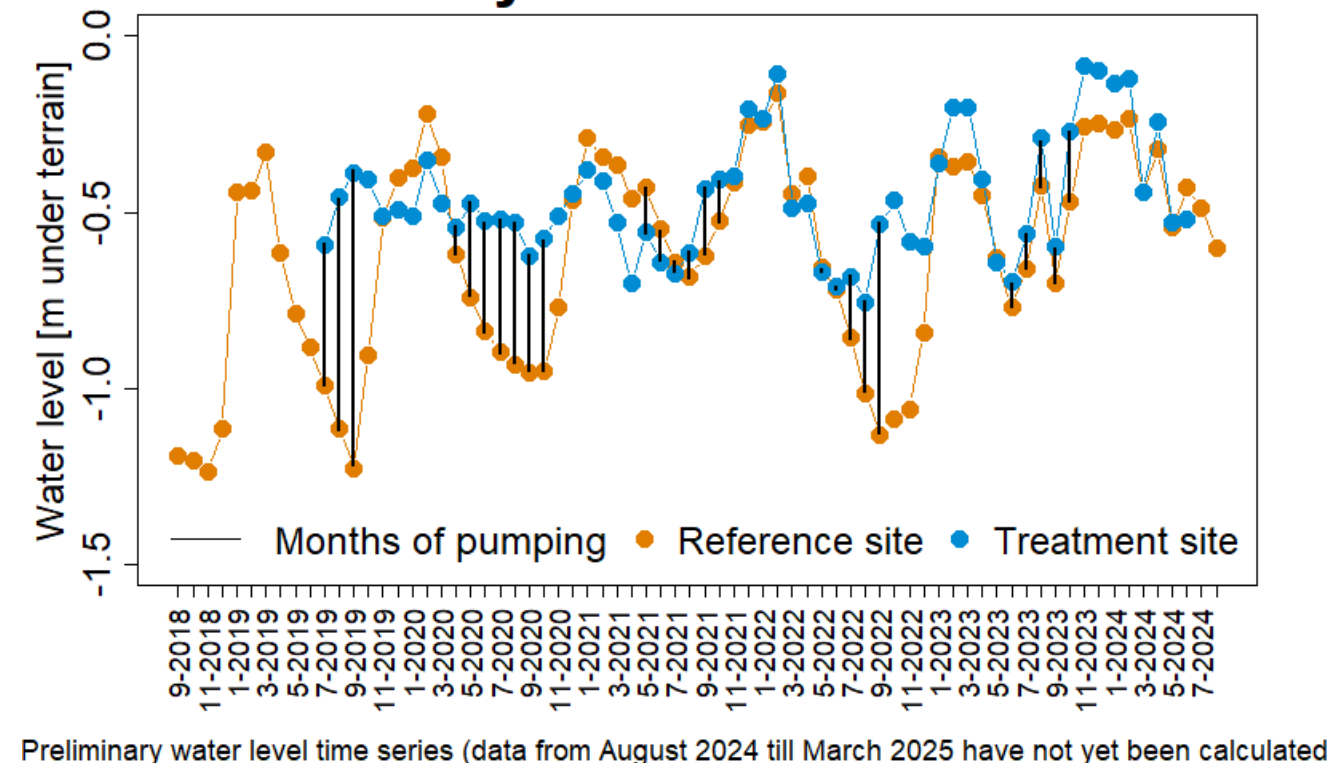
### B RS, Suction plates



### D RS, 60 cm suction plate



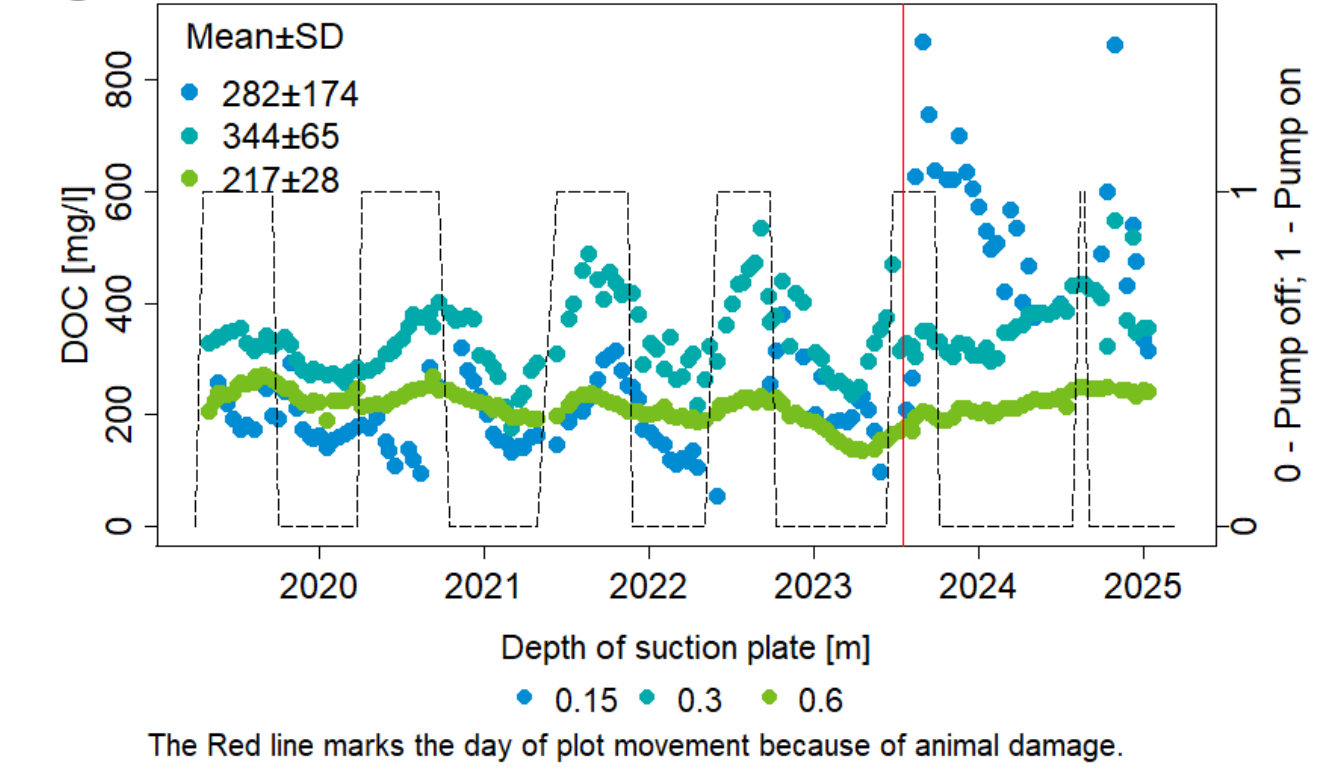
### A Monthly mean water levels



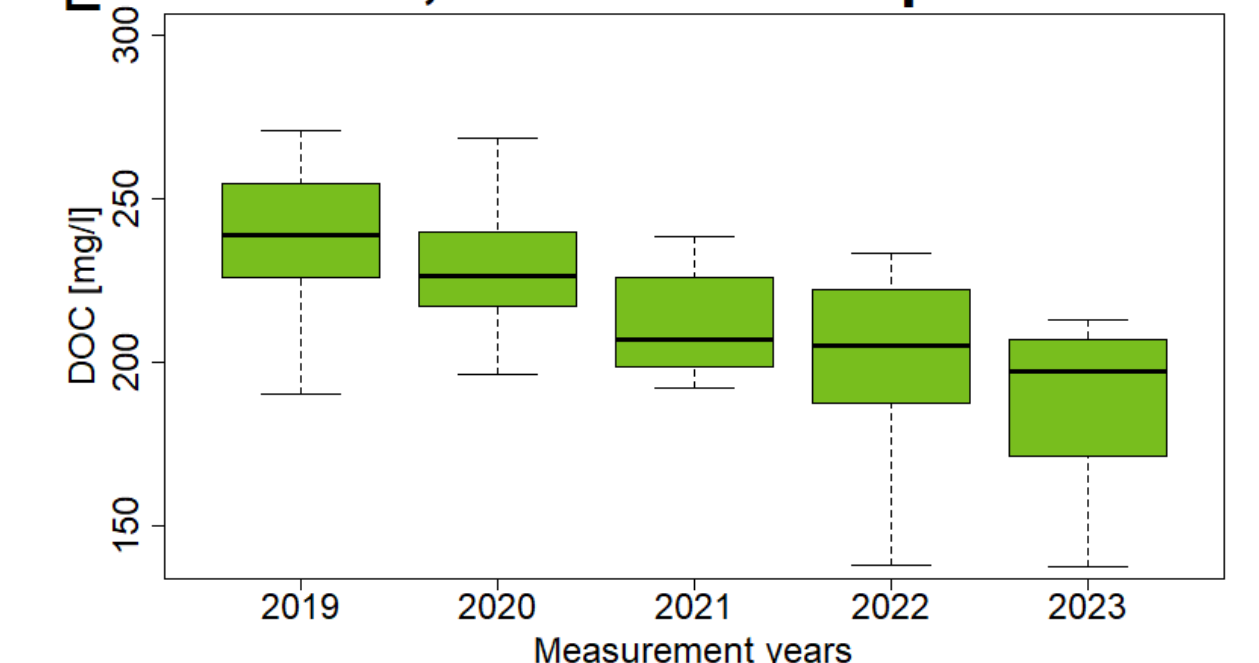
-0.55 cm: Mean water level during pumping periods on the treatment site

Focus on suction plates data below the mean water level

### C TS, Suction plates



### E TS, 60 cm suction plate



## Results

- Water levels decrease during the pumping period at both sites but on average 15 cm less on the TS than on the RS ( $p < 0.001$ ,  $R^2 = 0.42$ ) (Fig. A)
- Suction plates data display the typical seasonality of DOC → High concentrations in summer and autumn at both sites, except in 60 cm depth of the RS (Fig. B+C)
- In 30 cm sampling depth, DOC concentration increases on average 26.7 mg/l more on the TS than on the RS during pumping period ( $p < 0.004$ ,  $R^2 = 0.62$ )
- DOC concentration increases in 60 cm sampling depth on average 28.9 mg/l more during pumping period on the TS than on the RS ( $p < 0.001$ ,  $R^2 = 0.14$ )
- Only on the TS, DOC concentration in 60 cm sampling depth decreases on average by 6 % per year, despite periodical increase during pumping periods (Fig. E), whereas DOC increases on the RS (Fig. D)

## Conclusion

### How does subsurface irrigation affect water level and DOC concentration?

- SI smooths the seasonal water level fluctuation and **avoided deep drained situations** during summer
- Simultaneously, SI results in periodical **DOC mobilisation** but **decreases concentration in long term** if a constant water level in summer is provided
- On the reference site, the DOC concentration increased in the 60 cm deep soil water → that would probably be the same situation at the treatment site without subsurface irrigation