# EMISSIONS FROM ORGANIC SOILS

**ISPRA, ITALY**
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The organic top profile is disappearing
St. Vildmose, Denmark, August 2024
The old Litorina sea botton is visible and is ploughed into the topsoi,l

Photo: Steen Gyldenkærne

# ORGANIC SOILS IN DENMARK

1975: 237,000 ha cultivated

2010: 181,000 ha

2022: 117,000 ha

Denmark is a flat country

Danish organic soils are shallow

- 50 % of the organic soils in rotation has a depth <= 30 cm
- 33 % of the permanent Grassland has a depth <= 30 cm

The organic soils are disappearing
St. Vildmose, Denmark, August 2024
The old Litorina Sea botton is visible and is ploughed into the topsoil

Photo: Steen Gyldenkærne

Areas are converted to mineral soils leading to less emission estimates over time

# ORGANIC SOILS - DANISH APPROACH

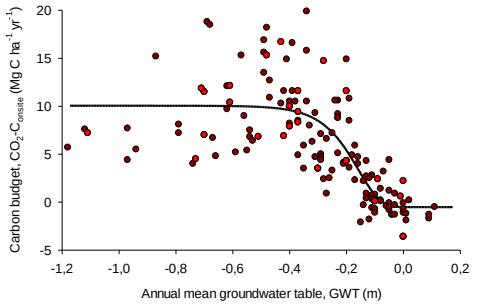
Maps:

- Ground Water Table – 24,000 training data/points
  - Sea level, stream level, wells etc.
- Soil Organic Map, 2022 – 218.000 ha (0-30 cm)
- Soil depth Map – 0-600 cm

+

- Emission function – s-shaped (Gompertz)
  - Combined German and Danish data

Resolution 10*10 m




Source: Beucher et al, 2024, Koch et al. 2023, Elsgaard, 2024, Liang et al. 2024

# EXAMPLE

App. 50 ha in Nothern Jytland

Upper part is ditch drained and permanent grassland

Lower part is in rotation and tile drained

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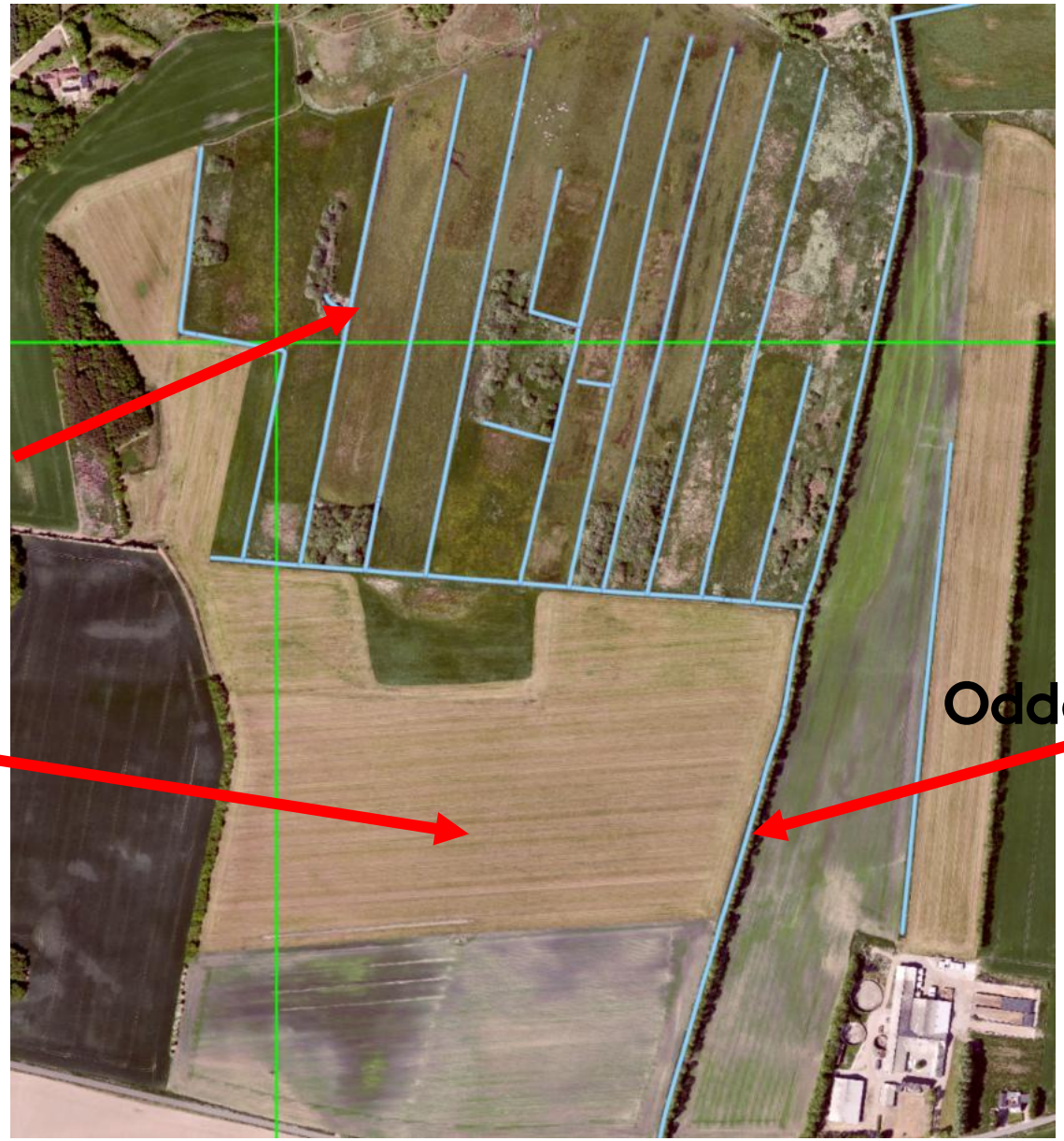
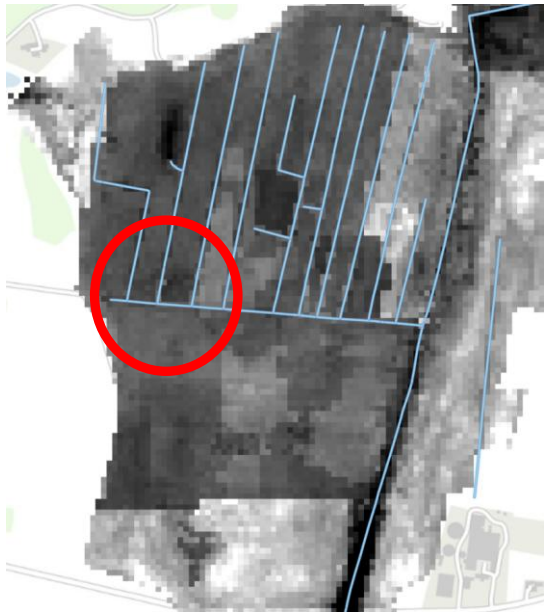
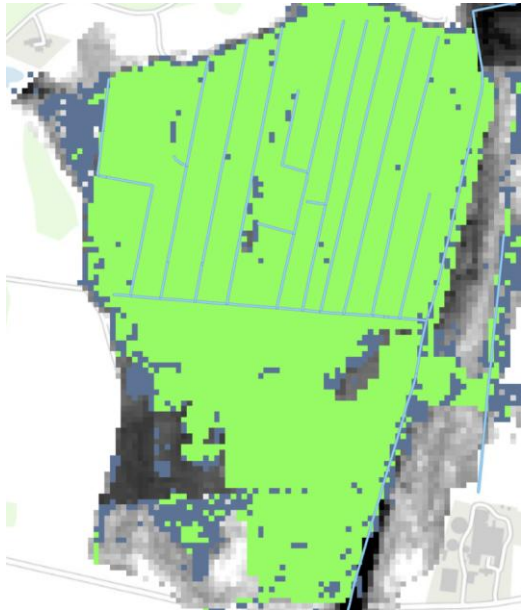


## GWT



Light color: < -1m
Grey: -0,5- -1 m
Black: 0- - 0,25 m

## SOC



Green: > 12 % OC
Blue: 6-12 % OC

## Depth

Black color > 1m
Grey: 0,5-1 m
Light: 0-0,5 m

## Emission

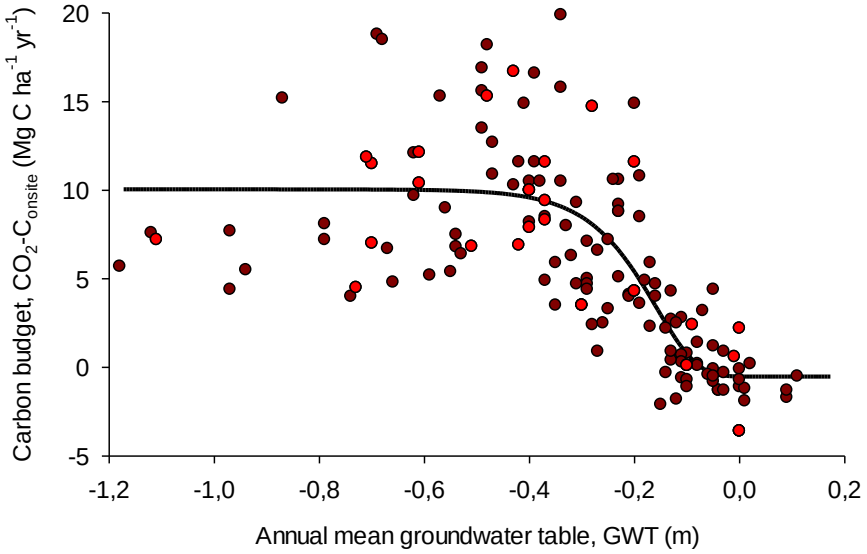
Dark blue: 7-9 ton C $ha^{-1}$ $yr^{-1}$
Light color: 4-5 ton C $ha^{-1}$ $yr^{-1}$

$$Emission, CO_2 - C, _i = \sum_{1}^{n} pixel, _i$$

Peat excavation in early 1950
From Digital Elevation Model

# COMPARISON WITH GERMANY

| | | Cropland | Grassland |
|---|---|---|---|
| DEN | GWT, m | -0.53 m | -0.23 m |
| | Effective, GWT, m (inclusion of peat depth) | -0.39 m | -0.22 m |
| | Emission, t C $ha^{-1}$ $y^{-1}$ | 7.25 | 4.51 |
| GER | GWT, m | –0.60 m | –0.48 m |
| | Emission, t C $ha^{-1}$ $y^{-1}$ | 9.2 (3.8–11.2) | 8.3 (1.4–11.0) |




DEN – modelled GWT is higher than for GER

Same function gives different emissions

# WHERE DOES THE $CO_2$ FORMATION OCCUR ?

## Really difficult –

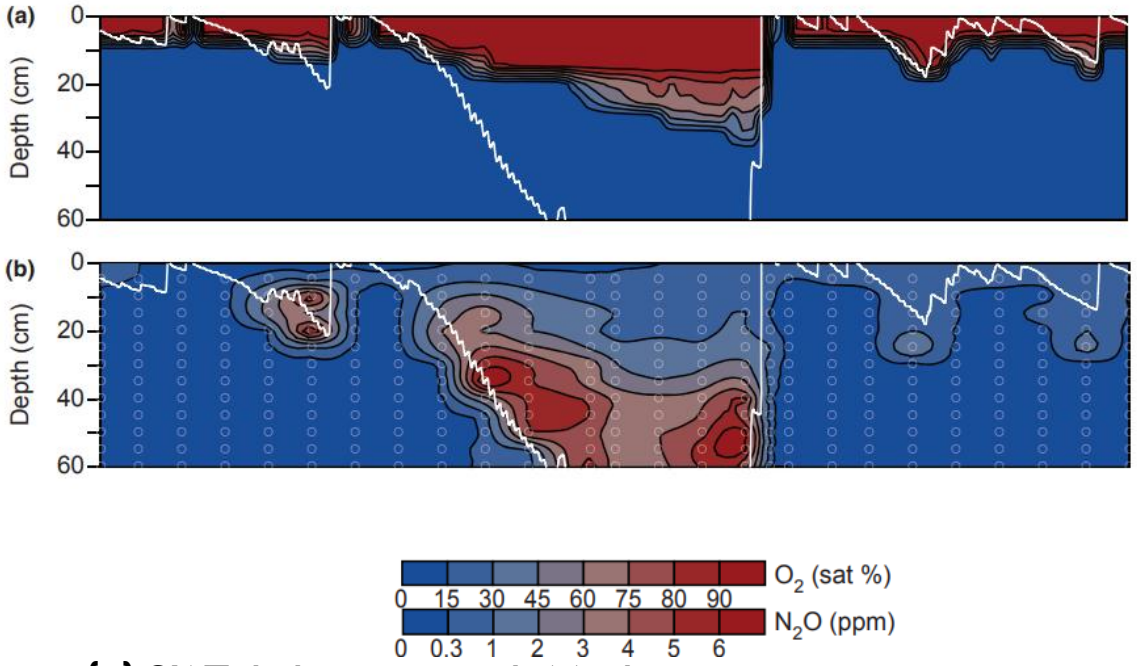
## Large variation in measured data

- Degradation to $CO_2$ needs $O_2$ (if not enough sulfate other) and water
  - $O_2$ concentration decrease with depth

Should give declining degradation with depth and limited below 50-60 cm

Paul et al. ,2024: No effect of putting 42 cm silt/clay on top

Aben et al., 2024: Less emission with clay on top



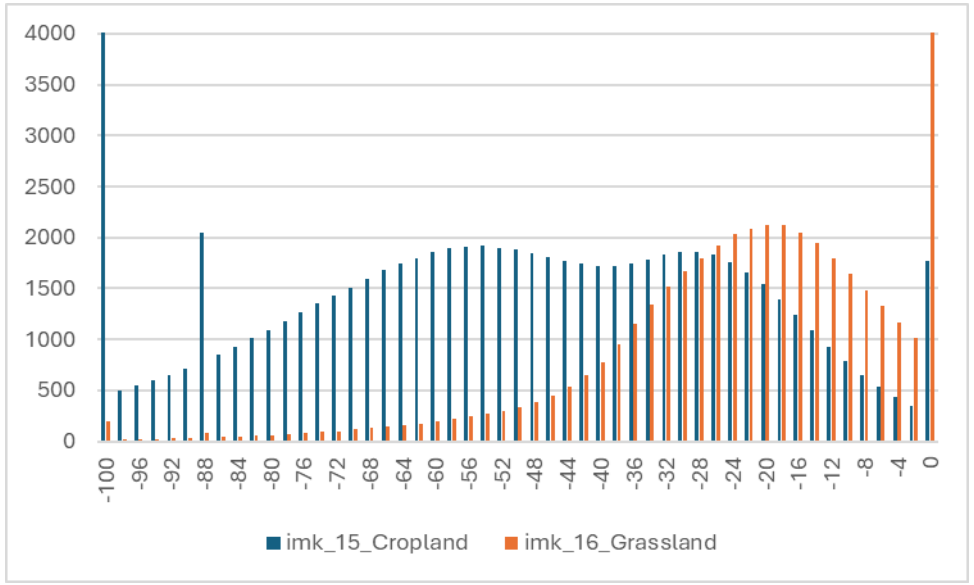

(a) GWT during a season in Maglemosen, Rudersdal, Denmark

(b) N2O Concentration. N2O is only formed in the anaerobic zone where no O2 excist

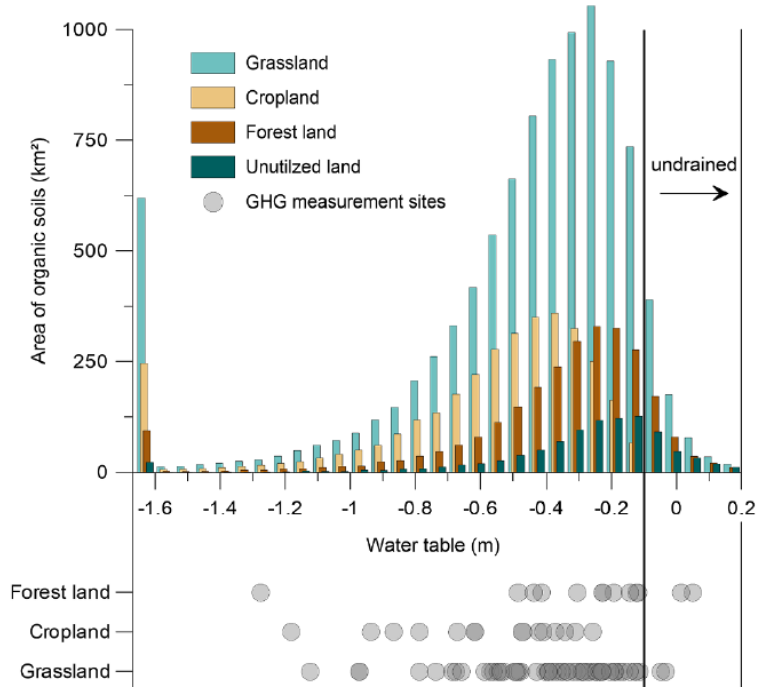
White line indicate GWT

Source: Jørgensen, Struwe og Elberling, Københavns Universitet (2012)

# GWT ALLOCATION ON CL AND GL - DENMARK AND GERMANY

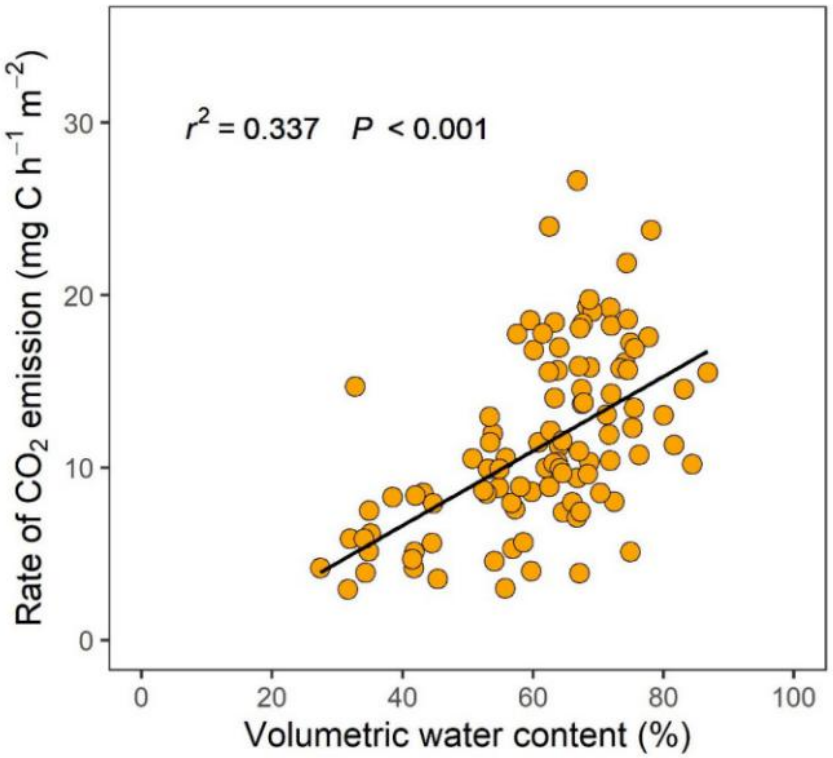



Denmark

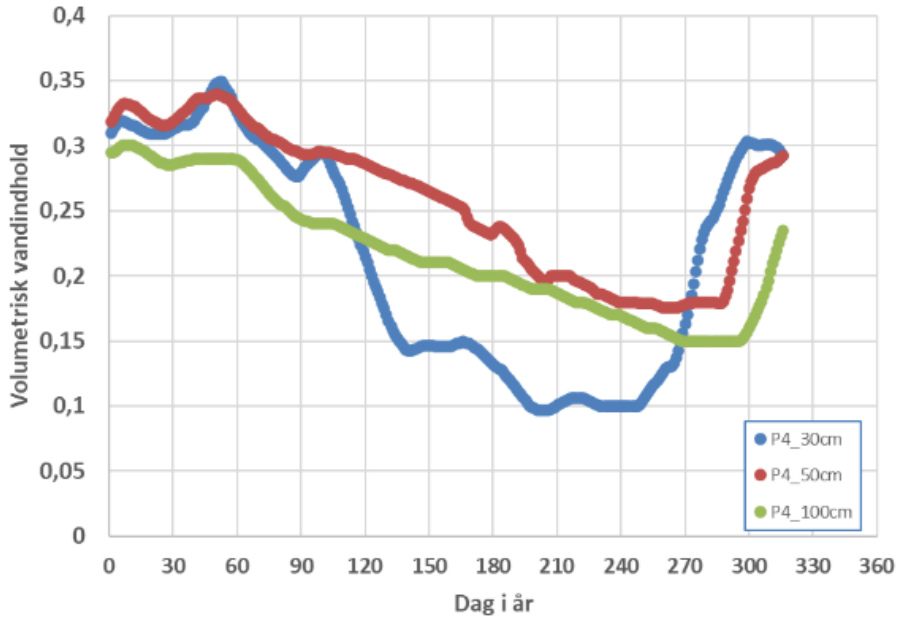



Germany

# EFFECT OF DRYNESS




Degradation in Lab in relation to Volumetric Water Content, Liang et al., 2024




Volumetric Water Contend in a clay soil during a year. The upper profile dries out in deep drained soils. Børgesen et al. Unpublished

# MARVIC DATA

Which measurements should be included ?

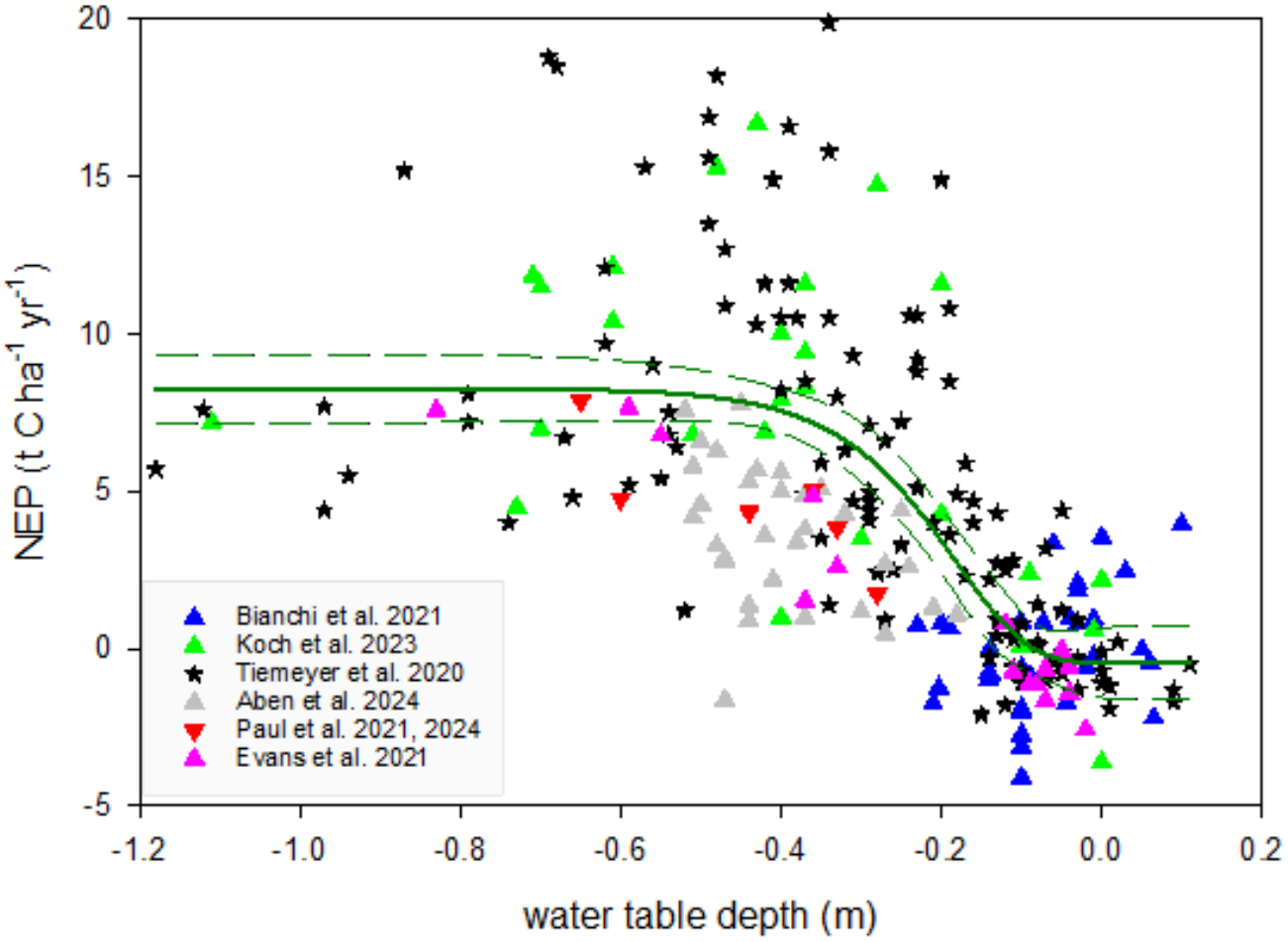
Chamber, EC, soil type .....

Gompertz function: $C_{max}$

MARVIC = 8.3 t C $ha^{-1}$

Germany = 10 t C $ha^{-1}$

Denmark = 10 t C $ha^{-1}$



# WHAT IS THE TASK

Cultivation of organic soils should belong to history

- As long as we have an OK mean EF value –
  then not a big issue to fine-tune the EF values into unknown area/uncertainties

- The Gompertz function is scientifically not optimal but a OK approach on a complex problem