Hydrogeophysical characterization of a peatland hillslope in the Belgian High Fens

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Context

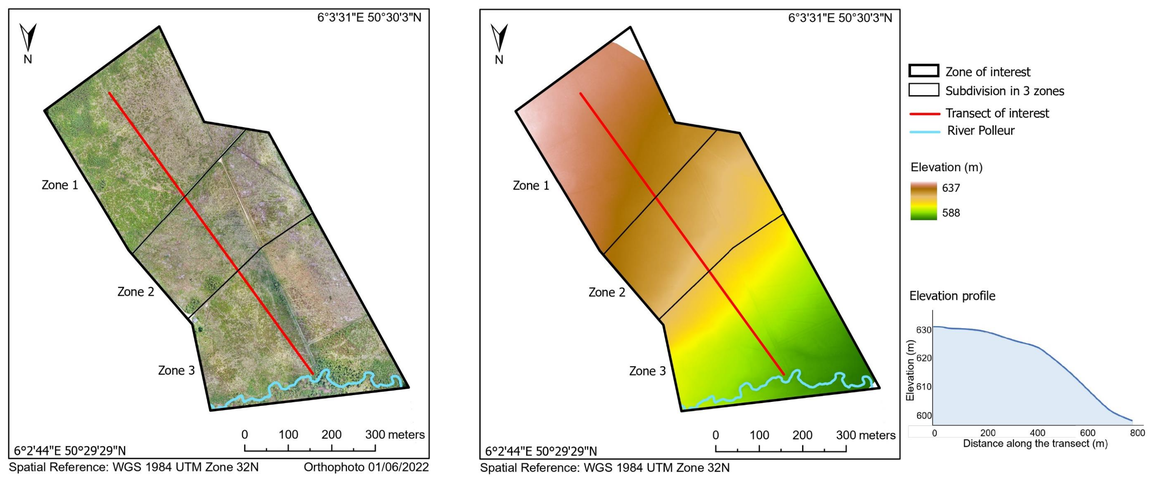
- Peatlands are important water and carbon stores
- Geophysics uses indirect measurements to study the (sub)surface physical properties
- Challenges related to geophysics in peatlands: high spatial and temporal variability, high humidity, rough terrain, need for *in situ* sampling
- Few geophysical studies are focused on disturbed peatlands in central Europe

Objectives

- Characterize and understand the soil (sub)surface long-term characteristics (conditioning the shorter-term hydrogeophysical processes)
- Evaluate the advantages and limitations of combined geophysical measurements to study peatlands

Study site

- High Fens : natural reserve in the East of Belgium
- Site drained for forestry and let since 2017 to natural evolution
- The site presents a topographic gradient



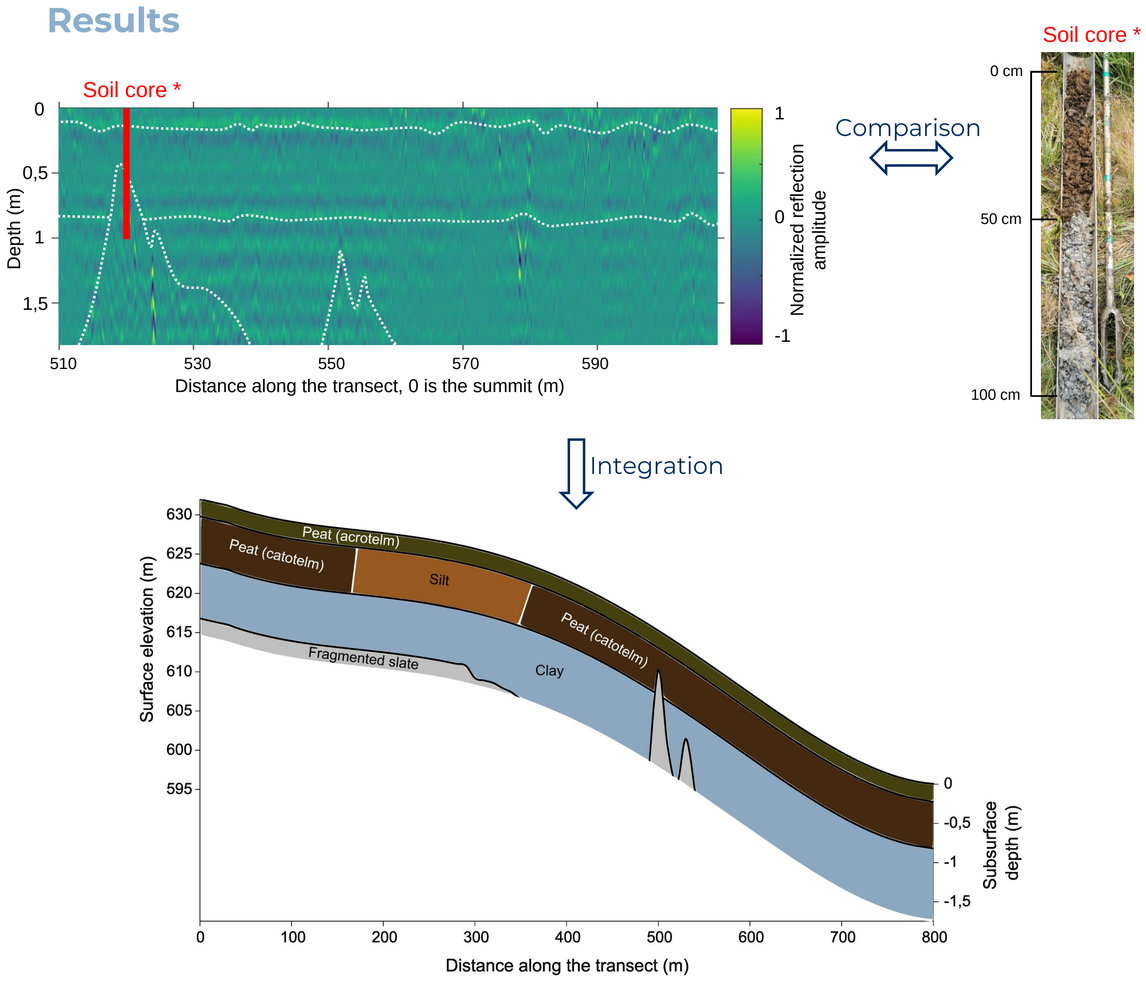
Reconstruction of the soil layering using GPR

Methodology

Ground-Penetrating Radar (GPR) transmits electromagnetic waves into the soil to study its structure

➢ GPR with a 400 MHz antenna on the transect
➢ 10 soil cores to identify the nature of soil layers

Results



A peat layer, divided in acrotelm and catotelm, of about 80 cm is present on most of the profile. The silt zone corresponds to the Walloon soil map. Below there is a gleied clay layer resulting from the alteration of the shale rocks.

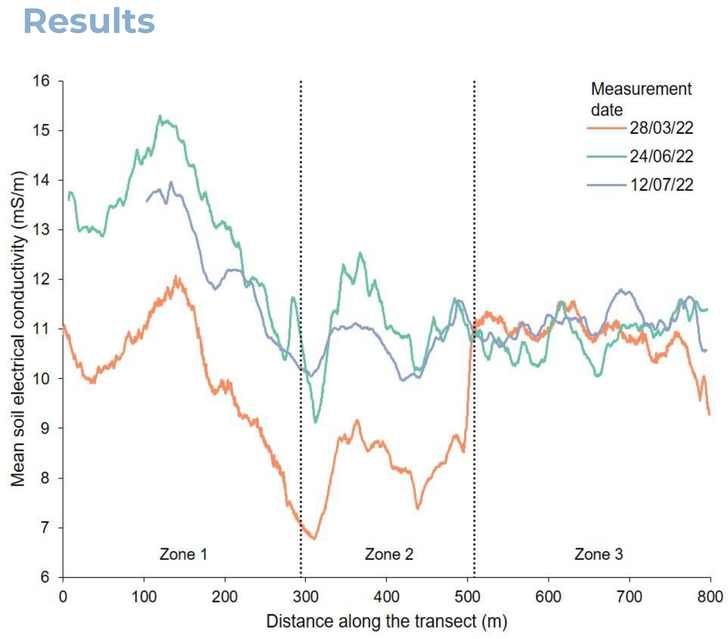
Electrical conductivity dynamics using EMI

Methodology

Electromagnetic induction (EMI) transmits low frequency electromagnetic waves into the soil to measure soil electrical conductivity (EC)

➢ Several EMI measurements on the transect
➢ Water conductivity measurements

Results

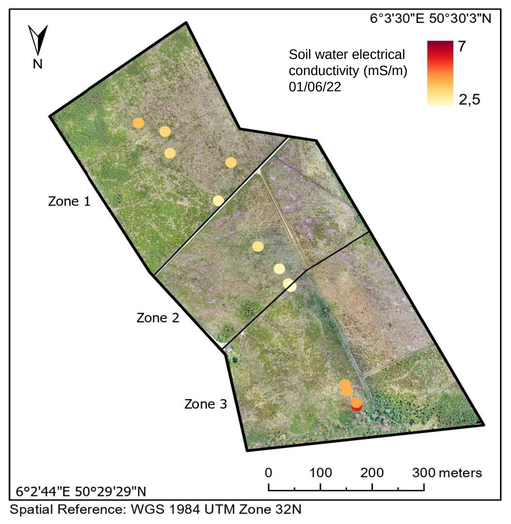


Seasonality

- EC is higher in summer in Zones 1 and 2 because there is less water flow
- EC is constant in Zone 3 because of a more constant hydrological dynamic

Spatial patterns

- No impact of water content (saturated site)
- The soil EC is mainly related to soil water conductivity (ion content), driven by the water flow
- At some specific locations, clay content, water infiltration and bulk density can also influence EC



Conclusions

- Subsurface structure: peat, clay, shale
- The electrical conductivity is related to the ions dynamics
- Difficult to find a correlation between EMI and GPR measurements due to the constant peat depth
- This study will help to spatialize further point measurements and to interpret the continuous monitoring of soil, water and vegetation on this site

Perspectives

1) Soil layering with GPR at a 200 MHz frequency to image deeper, down to the bedrock interface

2) Application of drone-borne low-frequency GPR to map soil electrical conductivity faster and at a larger scale

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LandSense website

Abstract