Mitigation of brownification of lake waters: Ongoing research in the Lagan River system with focus on Lake Bolmen

TINA MARTIN

Problem & causes of brownification

Problem: Brownification of lake water is a major problem for drinking water supply, biodiversity and tourism.

Causes:

- Unfavourable forest management → increase in natural organic matter (NOM)
- Drainage system (e.g. ditches in forests) → direct & fast inflow of NOM into lake
- Climate change: extreme weather events → sudden increase of NOM
- Leakage of NOM from peat bogs

Challenge

Understand the **complex hydrogeological system** of the catchment area (here: at lake Bolmen)

Understand **the flow/pathways of the NOM** (how are groundwater and surface water connected?)

What **measures** are needed **to mitigate the browning**?

How can stakeholder and landowner **encouraged to implement measures** (for example by land use change)?

What is ongoing?

- ***Blue Innovation*** FORMAS Preparatory project → Lagan water council and LU → application for implementation phase
- ***Blue Transition*** – *How to make my region climate resilient*, EU Interreg project: 24 partners from 6 countries

Lagans Vattenråd

LUNDS UNIVERSITET

FORSKNINGSSTATION BOLMEN

FORMAS

SYDVATTEN

SGU Geological Survey of Sweden

sweden water research

Interreg North Sea

Co-funded by the European Union

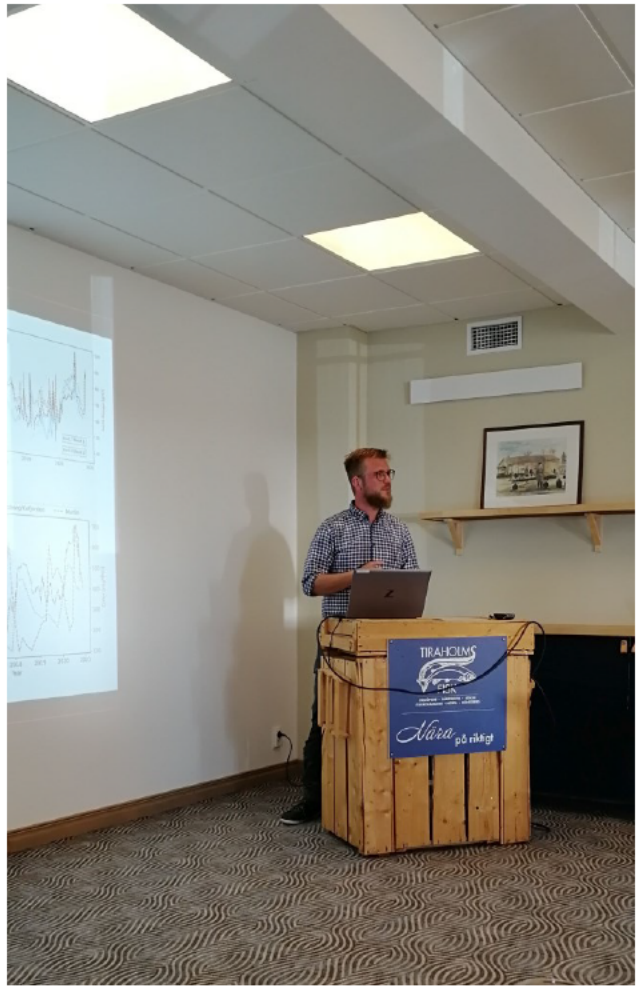
Blue Transition

Blue innovation –preparatory project

AIM: Establishing a **good communication channel** between the involved actors & **identify different surface and underground conditions** on a large scale with the help of geophysics.

- **Get in contact with stakeholder (workshops)**
- **Geophysical reconnaissance measurements**

Stakeholder workshops

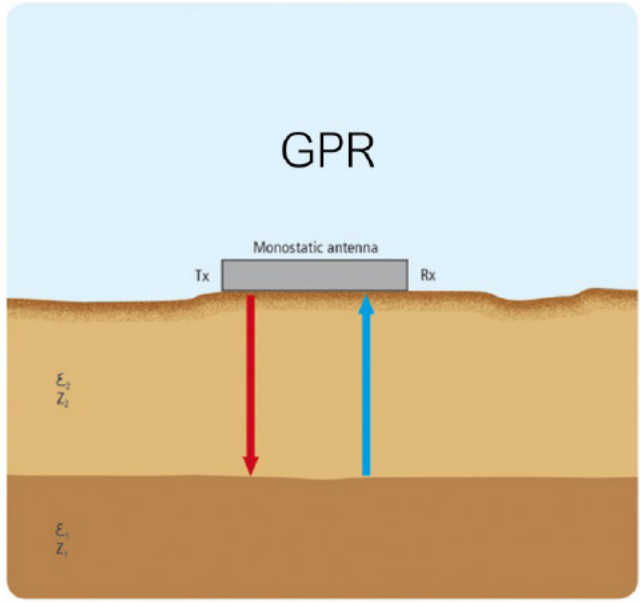


Geophysics

- Geophysics is the application of principles of **physics to study the Earth properties**
- **Different material properties:** magnetical, electrical, density,…
- Usually done (**non-destructively**) on surface but also in boreholes, air-borne, water-borne, via satellites…
- Methods here:
  - ❑ Ground penetrating radar (GPR)
  - ❑ Electrical Resistivity method (ERT) & Direct current Induced Polarisation (DCIP)

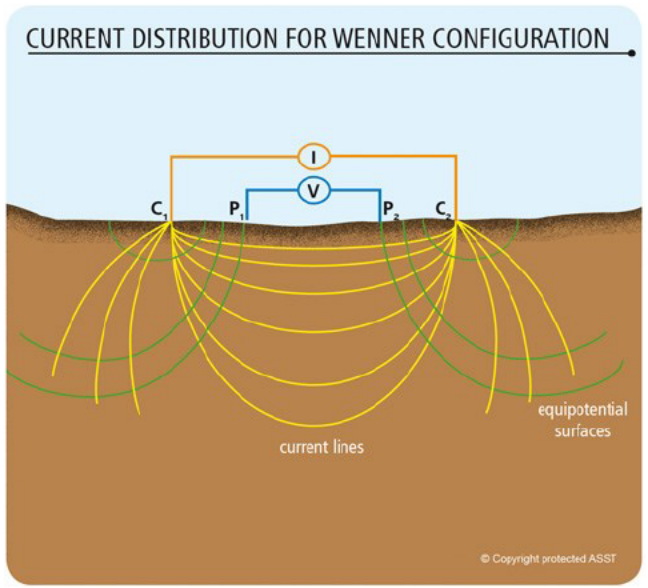
Ground penetrating radar (GPR)

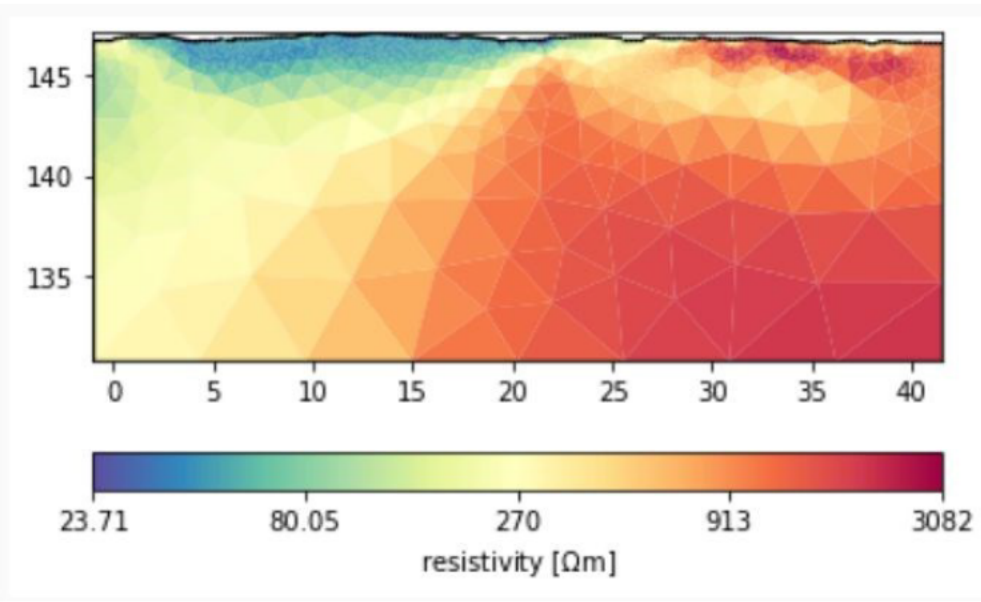
- **Applications:** geological mapping (layer), engineering (cavity), archaeological investigations (buried objects), etc..
- Uses electromagnetic waves with frequencies in MHz to GHz range to detect **changes in the electrical properties**



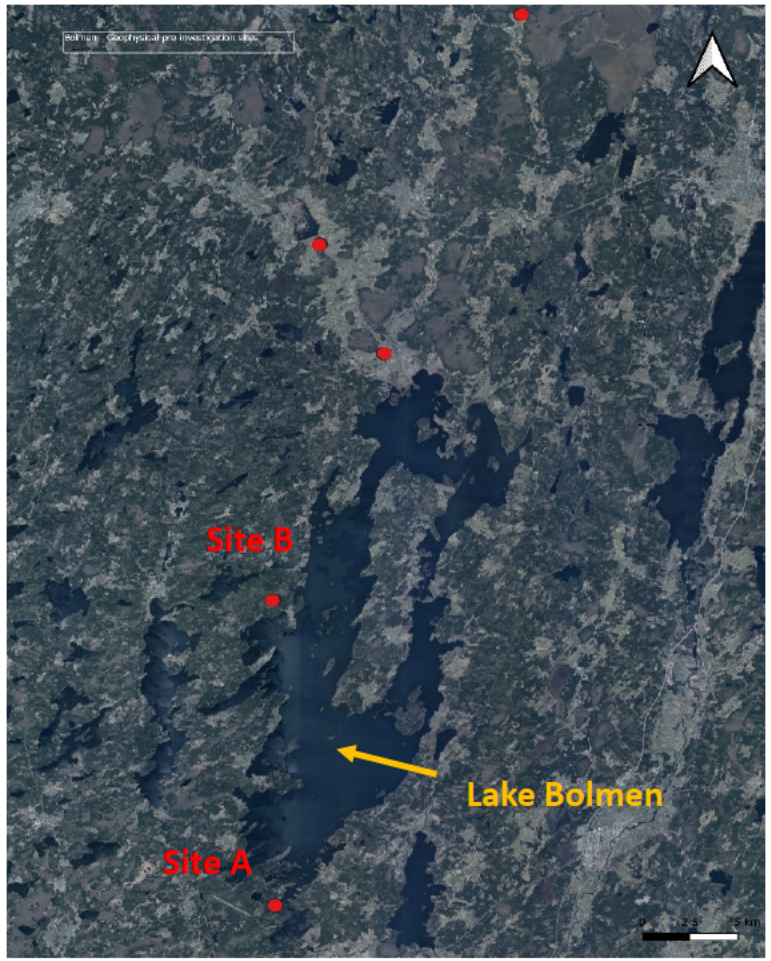
Electrical Resistivity method (ERT) & Direct current Induced Polarisation (DCIP)

- Applications: geological mapping (layers, faults), engineering (rock properties), hydrogeophysics (gw table), mineral exploration (ores),…
- Inject current and measures the voltage potential → electrical **resistivity**
- Chargeability/Phase shift: How chargeable is the underground? Surface charge changes

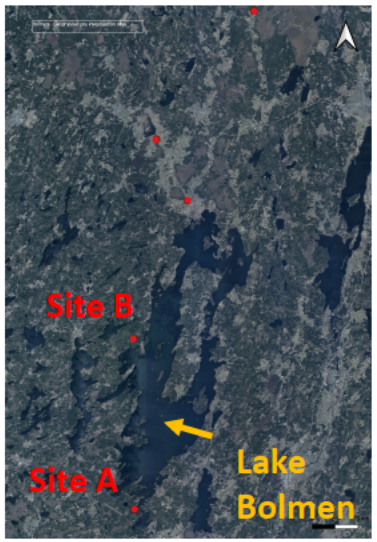


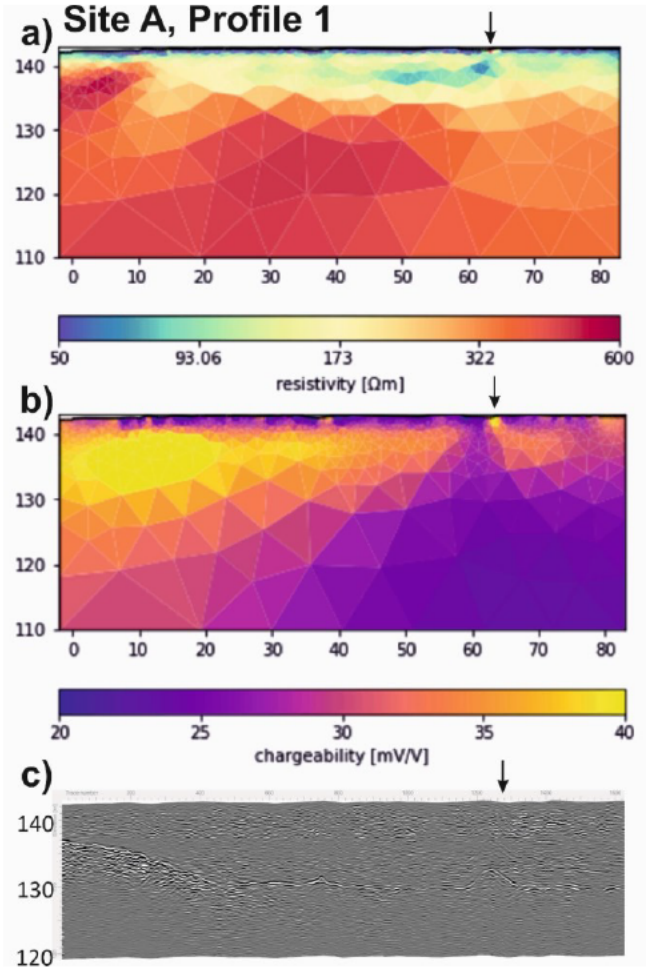


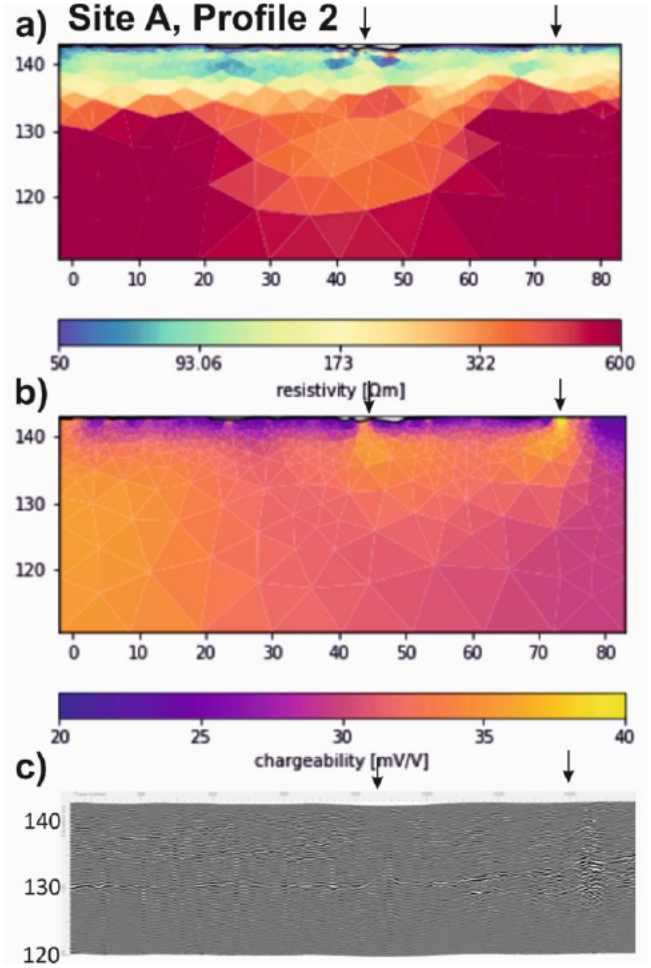
Geophysical measurements



Site A


Site B
Site A
Lake
Bolmen

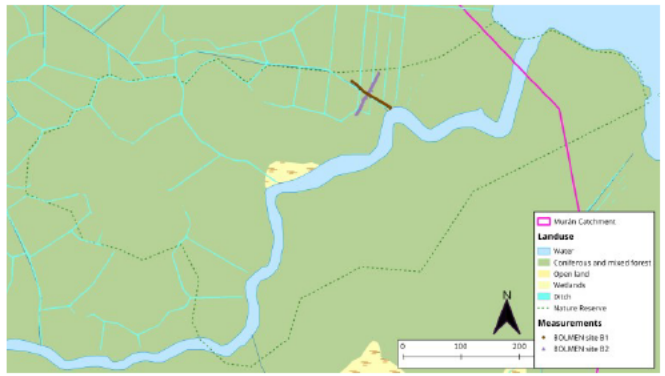

a) Site A, Profile 1
140
130
120
110
0 10 20 30 40 50 60 70 80
50 93.06 173 322 600
resistivity [Ωm]
b)
140
130
120
110
0 10 20 30 40 50 60 70 80
20 25 30 35 40
chargeability [mV/V]
c)
140
130
120


a) Site A, Profile 2
140
130
120
0 10 20 30 40 50 60 70 80
50 93.06 173 322 600
resistivity [Ωm]
b)
140
130
120
0 10 20 30 40 50 60 70 80
20 25 30 35 40
chargeability [mV/V]
c)
140
130
120

What is planned?

EU-Blue Transition: Pilot 1 - Bolmen

- Investigations of ditched areas vs natural/re-established riparian zones (monitoring)
- Hydrogeological modelling of the catchment area
- Development of different mitigation measures
- Workshops/summer schools/recommendation report



DOM content

Geochemical investigations

DCIP

GPR

pH

Weather data

SP

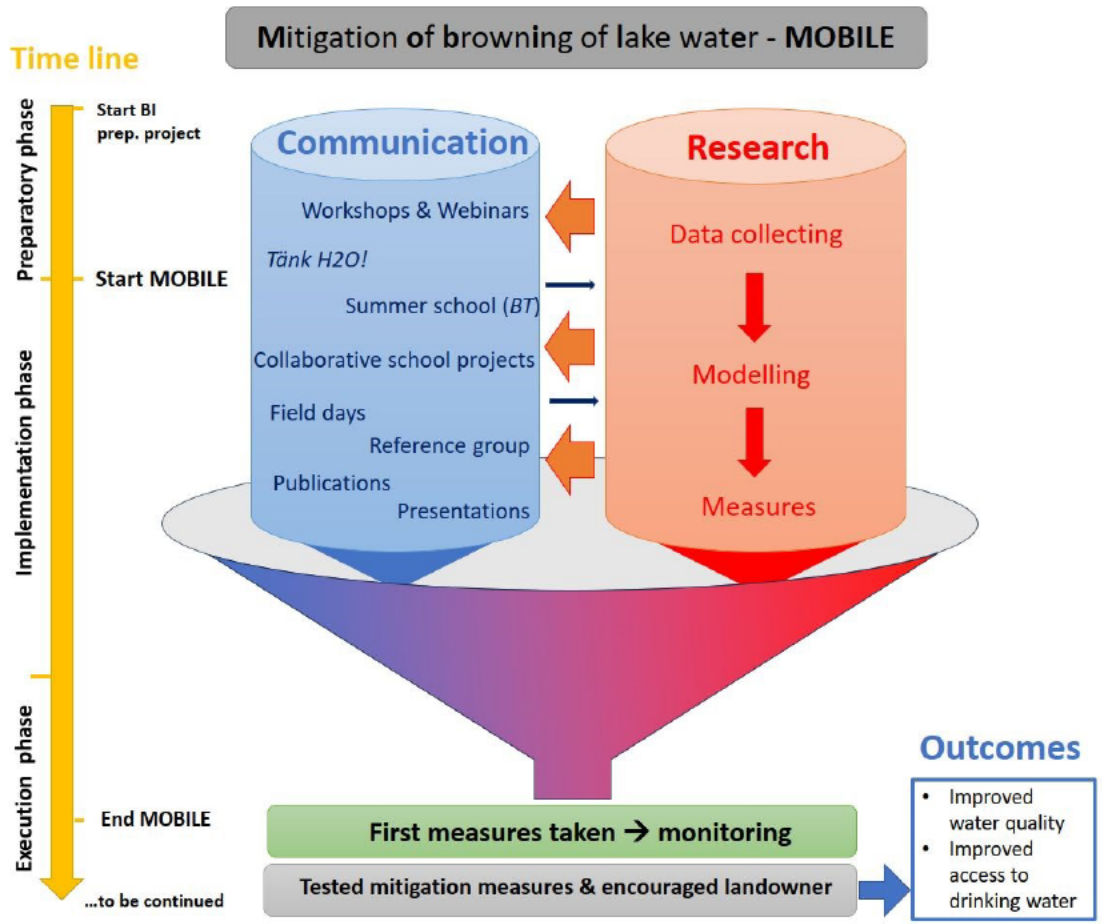
Soil characterisation

Groundwater level

Pumping tests

(Micro)Biological investigations

Application *Blue Innovation* implementation



Monitoring forest areas

Restore wetlands