Resistivity mapping with Geophilus electricus –

information about lateral and vertical soil heterogeneity

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Electrical conductivity (EC, ECa)

- Images spatial soil heterogeneity
- Contains information about stratification

- Can be measured with

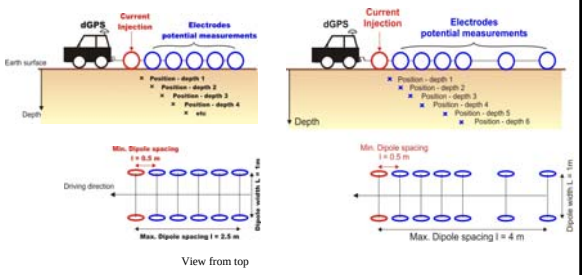
1. Direct current method with galvanic coupling (DC-method)
2. Electromagnetic method
3. Capacitive coupled electrodes

Geophilus electricus

= a soil mapping system with rolling electrodes

5 channels

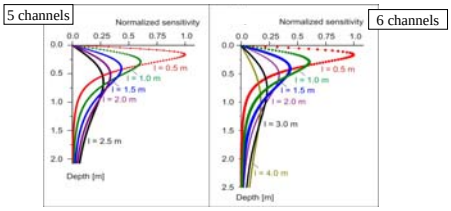
6 channels



View from top

What is new?

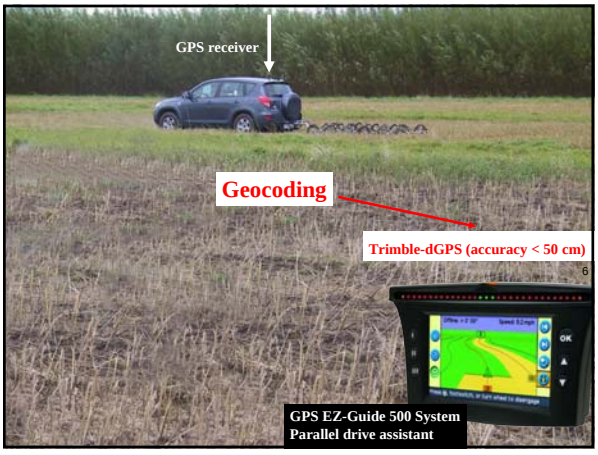
- Five/six channels → five/six depth levels

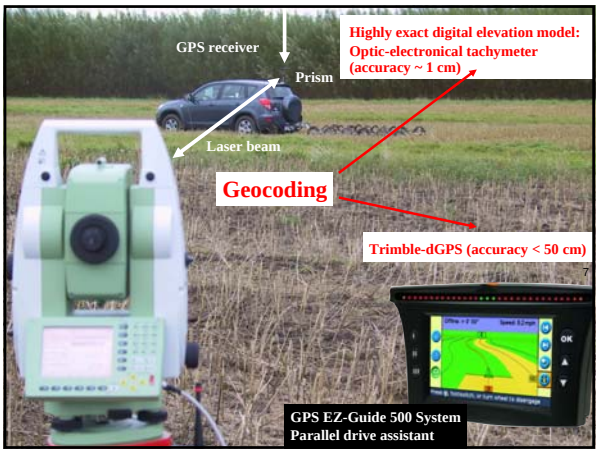


- Modular system allows to change the geometry between the electrodes and therefore the depth of investigation
- Investigation of frequency dependency
- Additional information about phase shift

Geophilus electricus

Maximum power: 50 W
Maximum voltage: +/- 400 V
Maximum current: +/- 125 mA
Frequency range: 1 mHz - 1 kHz
4 frequencies simultaneously





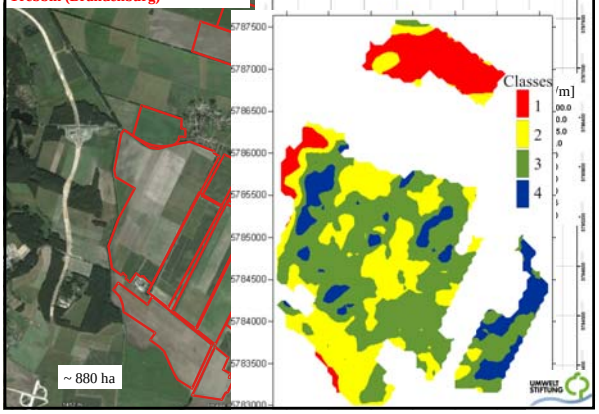
Test sites

- Agricultural land (precision farming)
- long term experiments
  (spatial heterogeneity, compaction, fertilization)
- peat regions
- saline areas (nature conservation)
- post-mining landscape
- archaeology
  (ditches, settlements, park structures)

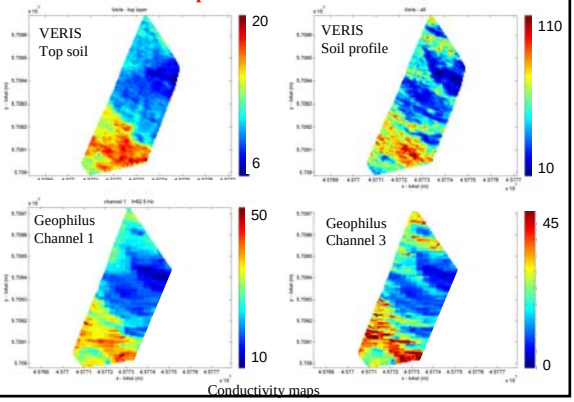
· more than 1500ha (~ 800 km)
· conductivities between 0.2 and 100 mS/m

Project was funded by:

Conductivity mapping on farm scale
Trebbin (Brandenburg)

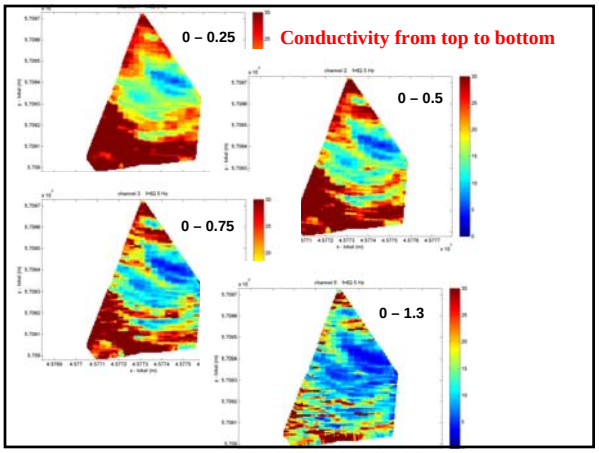


Comparison with Veris-data



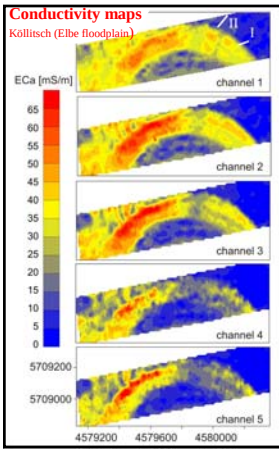
Conductivity maps

Conductivity from top to bottom

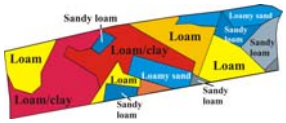


Conductivity maps

Köllitsch (Elbe floodplain)



Soil map
(redrawn after German Land Classification)

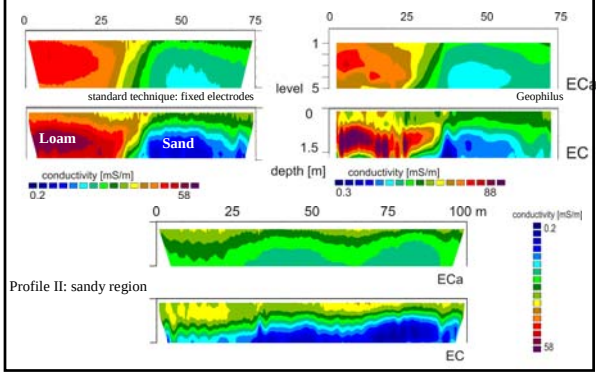


ECa maps have a better spatial resolution than existing soil maps because the higher density of data values.

Project was funded by:

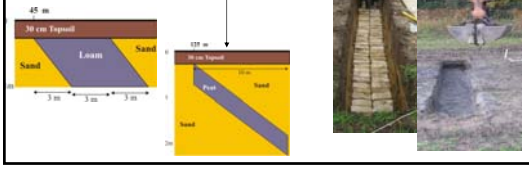
Conductivity-depth-models - Köllitsch

Profile I: Contact between loam and sand

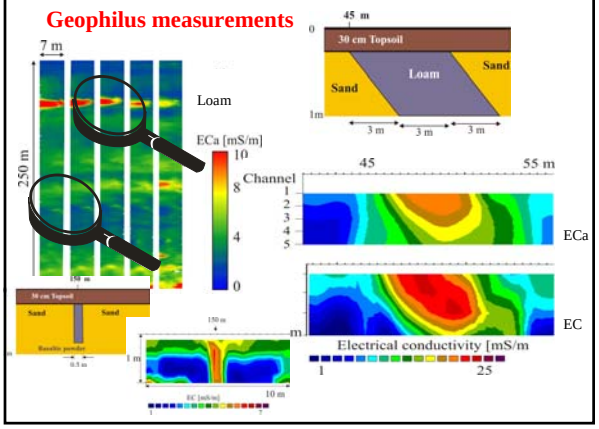


Experimental test site in Großbeeren near Potsdam

- Transect of 200 m length and 3 m width
- Sandy soil
  (78,75 % sand, 18 % silt, 3.25 % clay)
- Man-made structures at several locations
- Loam (autumn 2004) 45-54m
  (52,73 % sand, 38.77 % silt, 8.43 % clay)
- Peat (spring 2005) 125-135m
- Bricks and basaltic powder (autumn 2008)



Geophilus measurements



Why different frequencies?

Frequency dependency of EC due to:

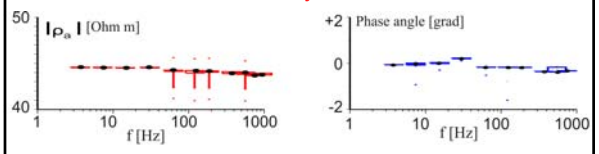
- Induced polarization (f < 100 Hz)
- Resistance between electrodes and soil (f > 100 Hz)
- Electromagnetic effects

→ Spectra depend on soil properties
→ Frequency affects the signal to noise ratio

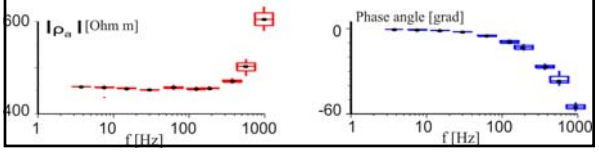
- Different frequency effects for amplitude and phase

Spectra

Loamy soil



Sandy soil



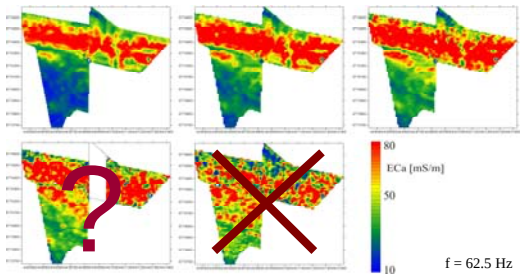
Signal quality

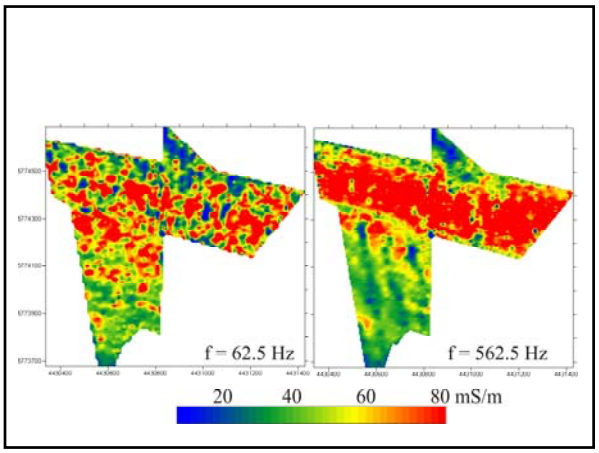
Depends on measured voltage → depends on spacing between electrodes

Dipole spacing [m]	0.5	1.0	1.5	2.0	2.5	3.0	4.0
Configuration factor	2.8	10.7	28	59.5	109.8	183.6	420.8

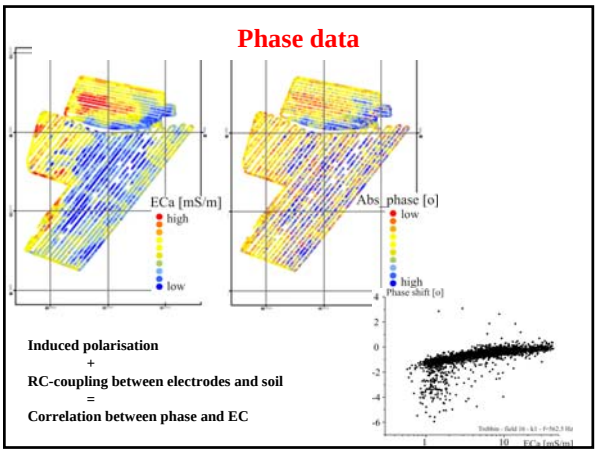
1:40

Ohrsleben (Sachsen-Anhalt), clay content up to 50% → high conductive soil



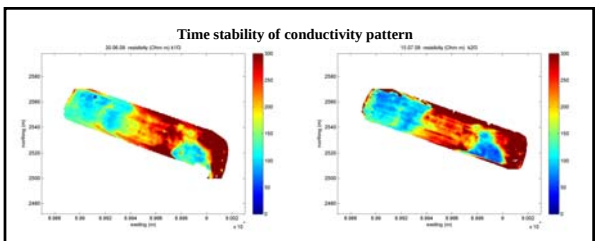


Phase data

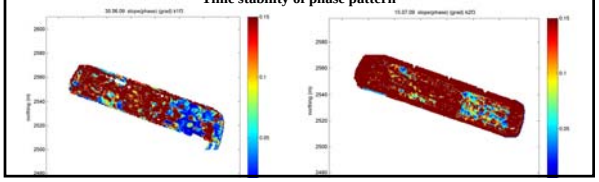


Induced polarisation
+
RC-coupling between electrodes and soil
=
Correlation between phase and EC

Time stability of conductivity pattern

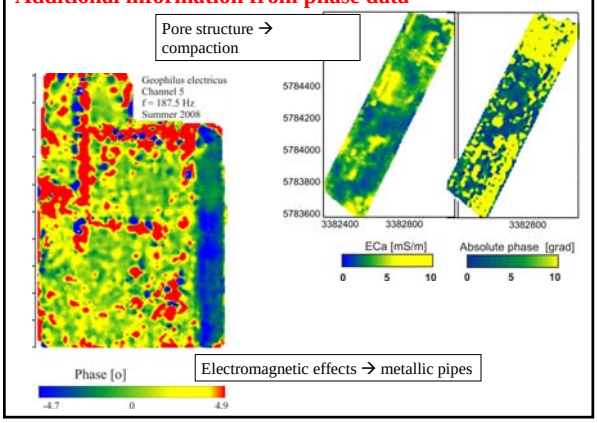


Time stability of phase pattern



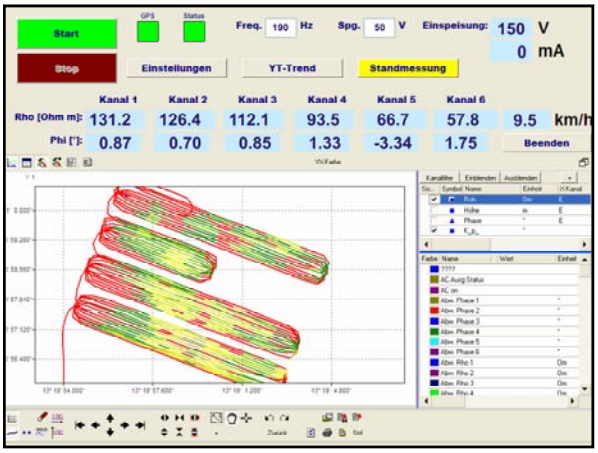
Additional information from phase data

Pore structure → compaction



Electromagnetic effects → metallic pipes

Electronic:
Sinus wave generator
Top-message instrument – Delphin
WLAN – computer controling




Thank you for your attention!
Geophilus Electricus