Large scale mapping of aquifer covering layers using geoelectrical methods

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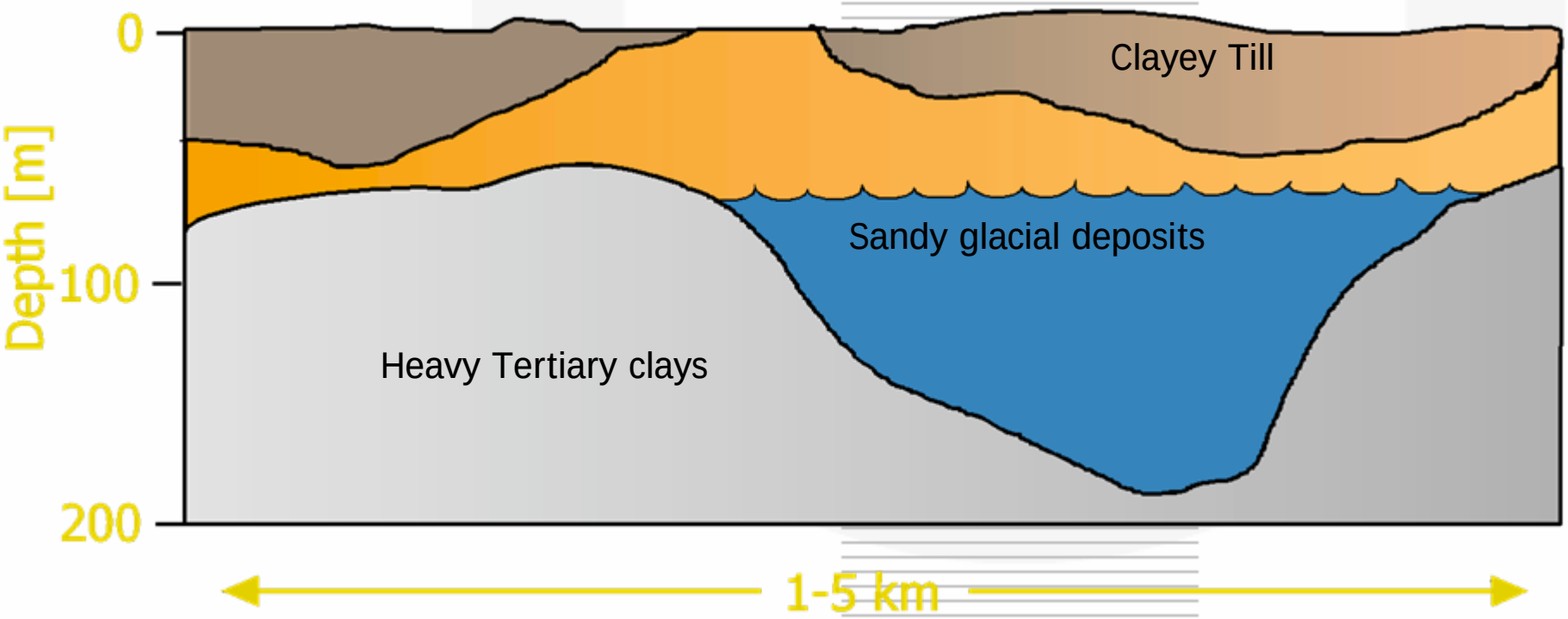
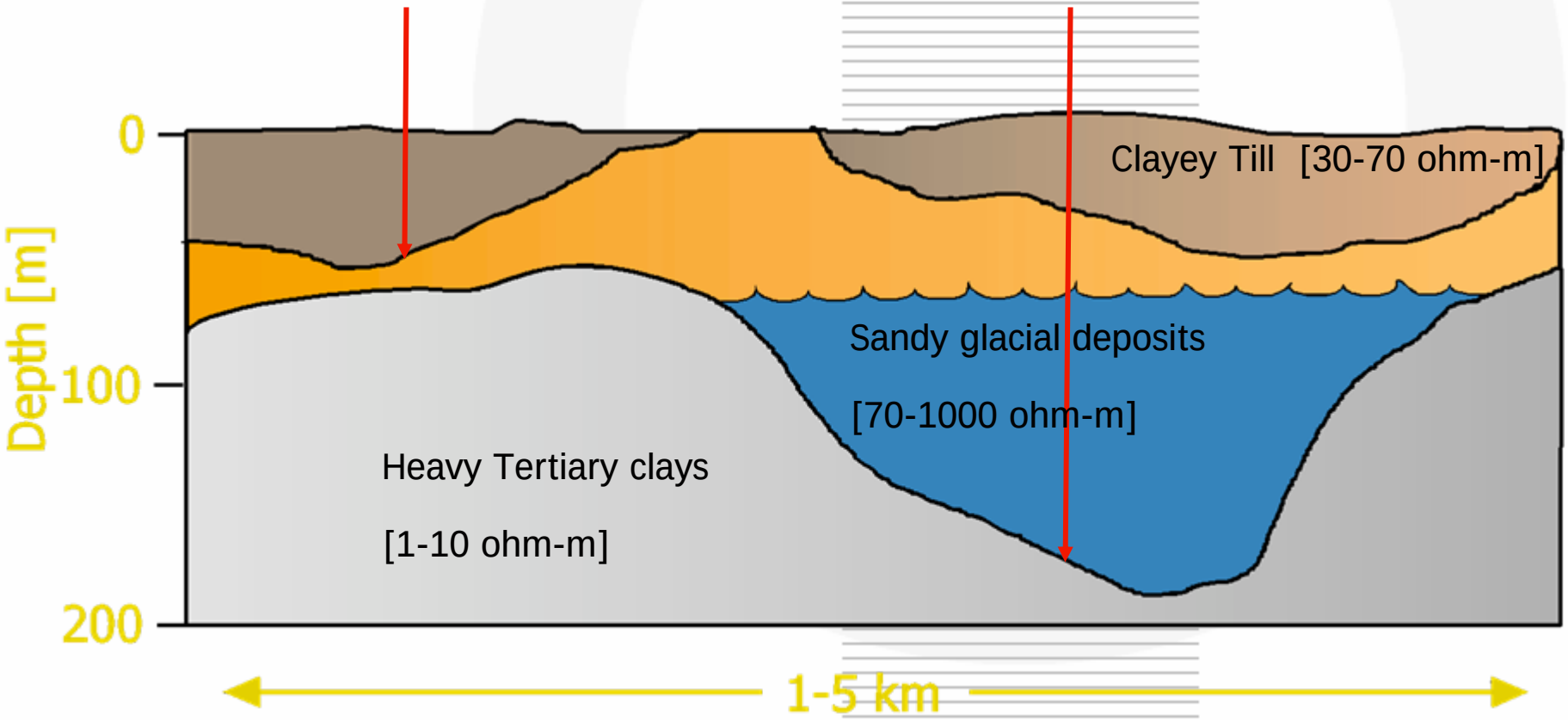
Vulnerability

- Hydraulic properties of protecting layers
- Chemical
- Permability



Related Geophysics

- DC methods for shallow exploration - aquifer protection
- TEM methods for deep exploration - aquifer extent



Geoelectrical methods – strengths and limitations

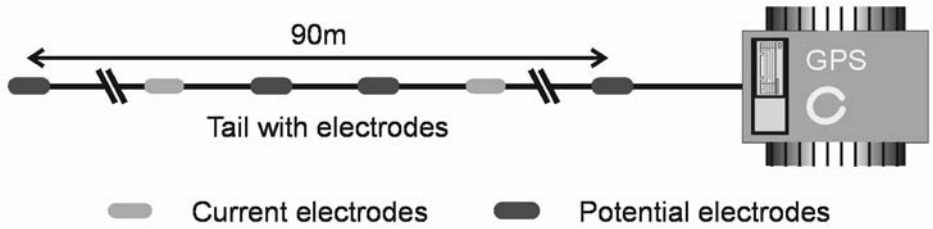
+ Sensitive to high and low resistivities
- Medium depth penetration
- 1D inversion is sensitive to non 1D conditions (near-surface imhomogenieties)
+ Conceptually simple
+ Insensitive to coupling from man-made installations (important)
+ 1D and 2D inversion is available at present state

Geoelectrical methods

- **Methods in use in Denmark**
  - Schlumberger soundings since 1960´ties – is not used more
  - Multielectrode systems (CVES) – since 1995 – more than 5000 km.
- **New developments – higher data quality and model accuracy**
  - PACES system – since 1992 – more than 30 000 km

CVES

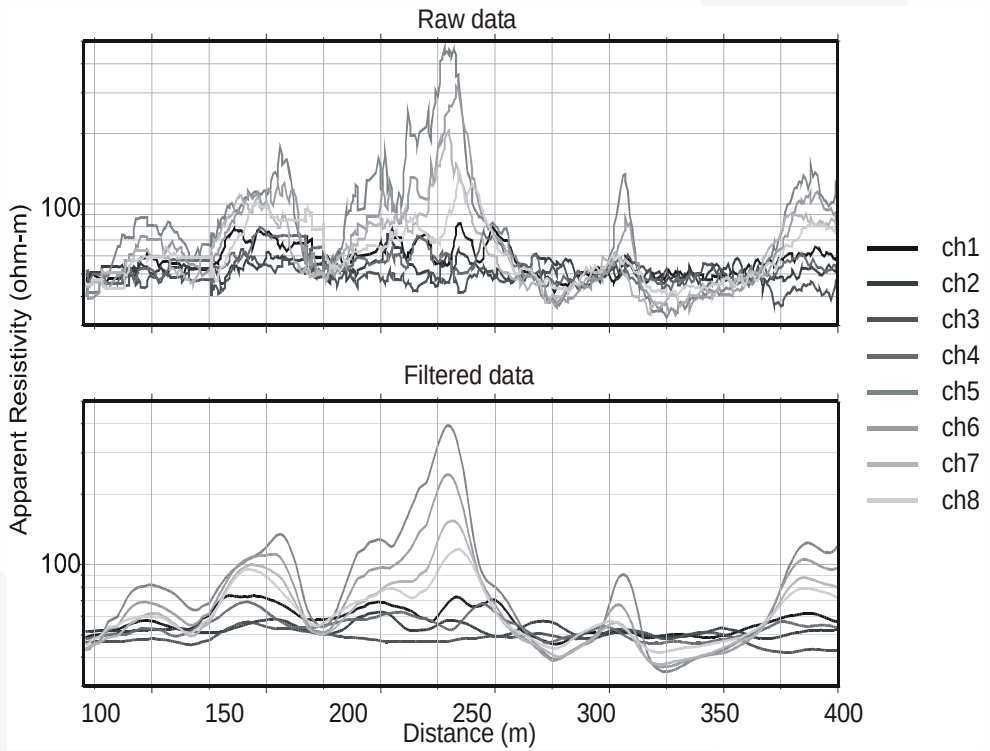
PACES



- 8 configurations 2 – 30 m
- Tail length 100 m
- Electrode weight 15 kg
- Small catapillar with instrumentations etc.
- 2 – 3 km per hour

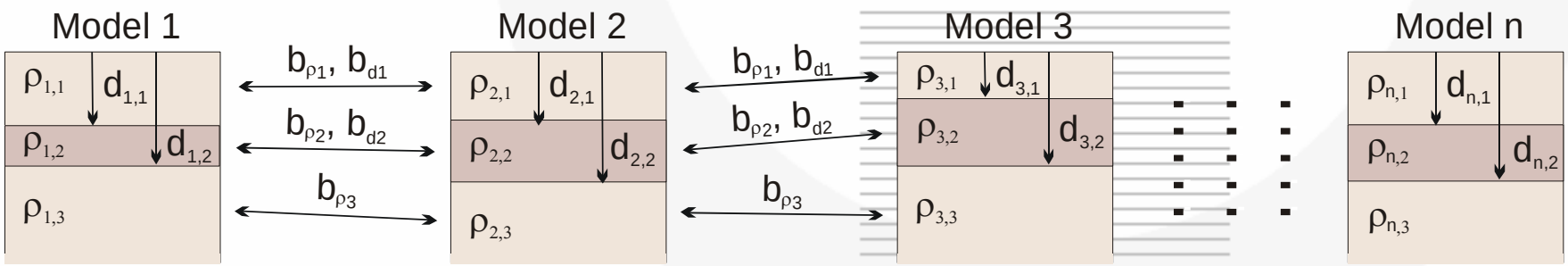
PACES

- 8 channels mesured per 12 millisec.
- Reduced to a filtered dataset per 5 m
- Data quality parameters
  - current
  - voltage
  - potential electrode resistance
  - automatic gain parameters
- Penetration depth approx. 25 m
- Provides very large detailed datasets



Inversion - LCI

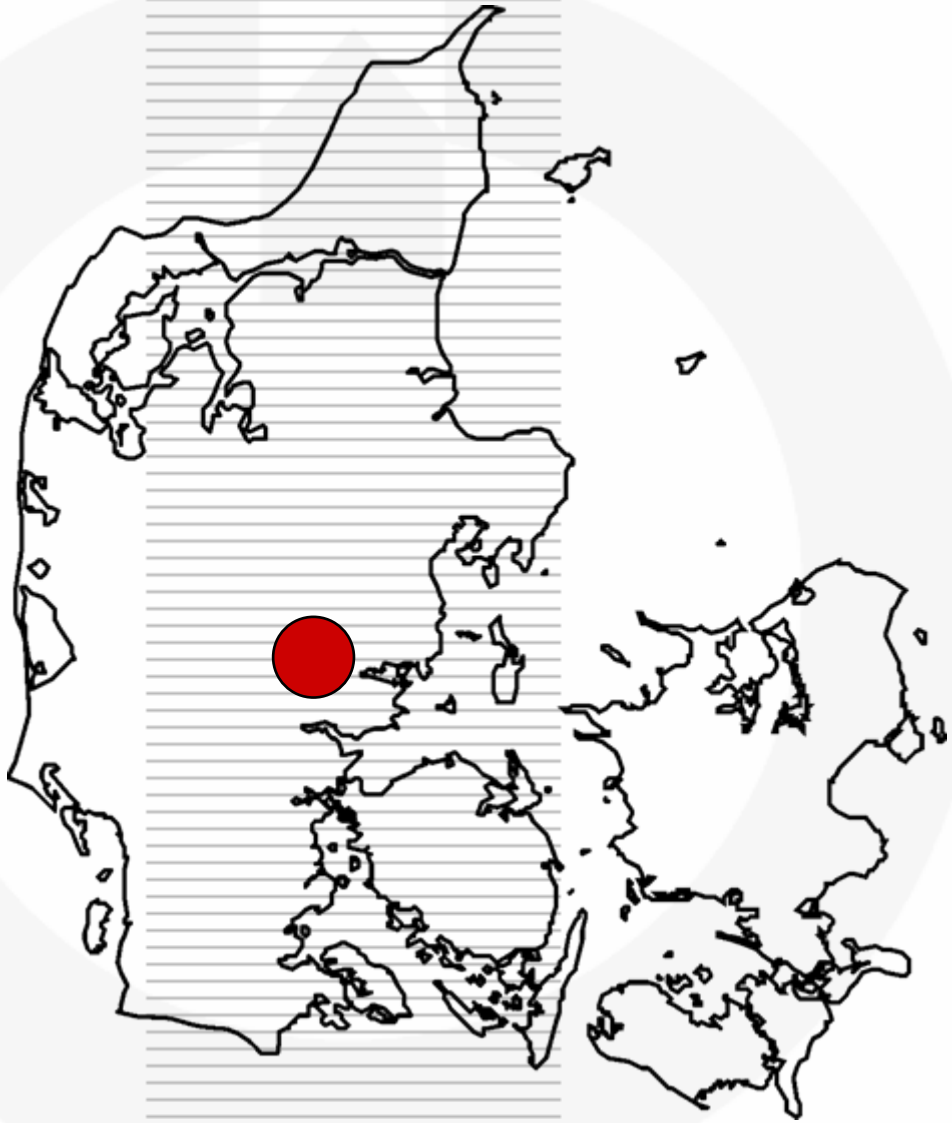
- **Inversion of profile oriented data**
- **Applicable in areas with laterally smooth resistivity variations**
- **Provides sharp boundaries between formations with different resistivities**

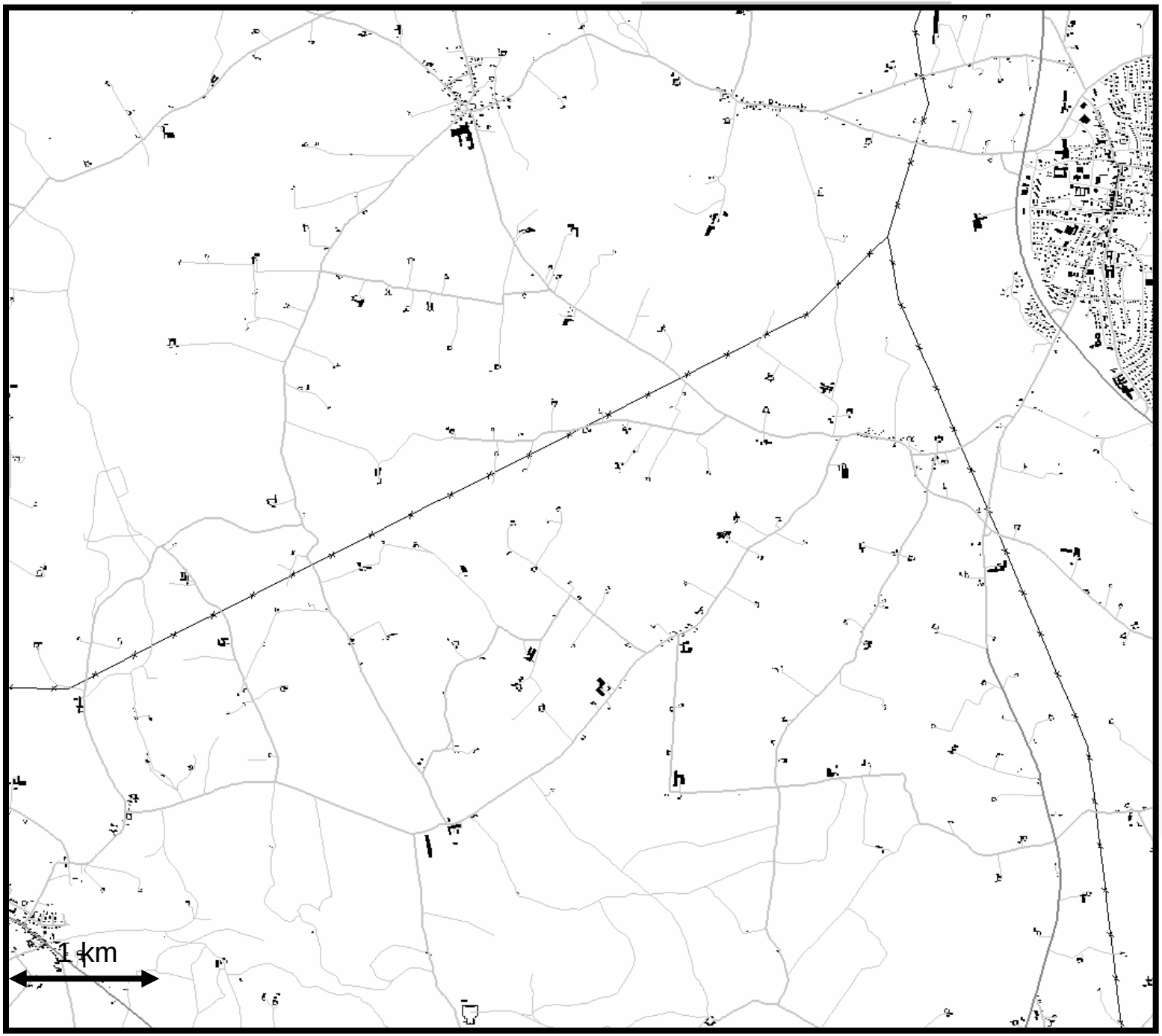


b_ρ=resistivity constraint factor, b_d=depth constraint factor

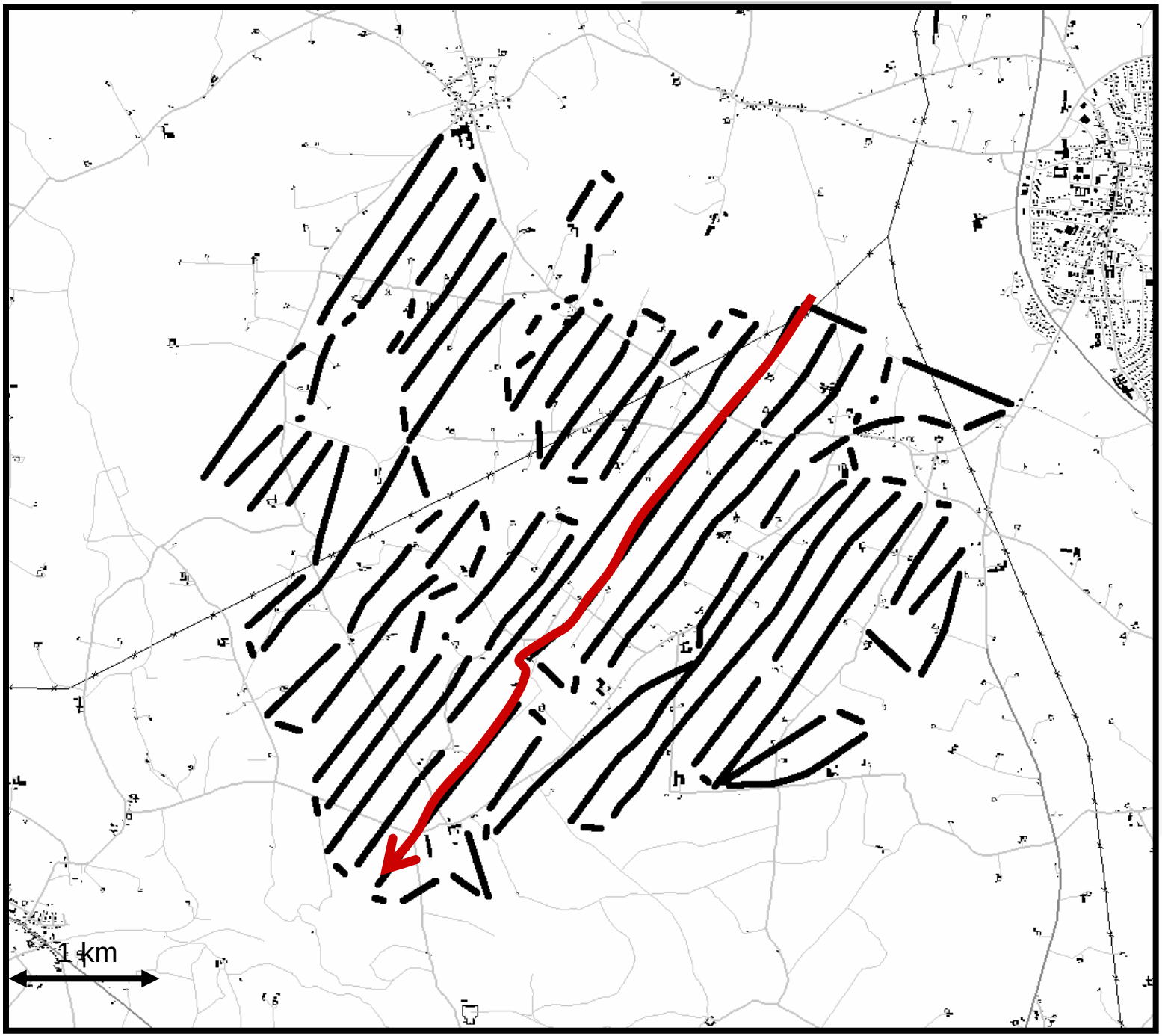
Field example

- 25 km^2
- 85 line km of PACES
- 17,000 1D models
- 64 drill holes (>20 m depth)

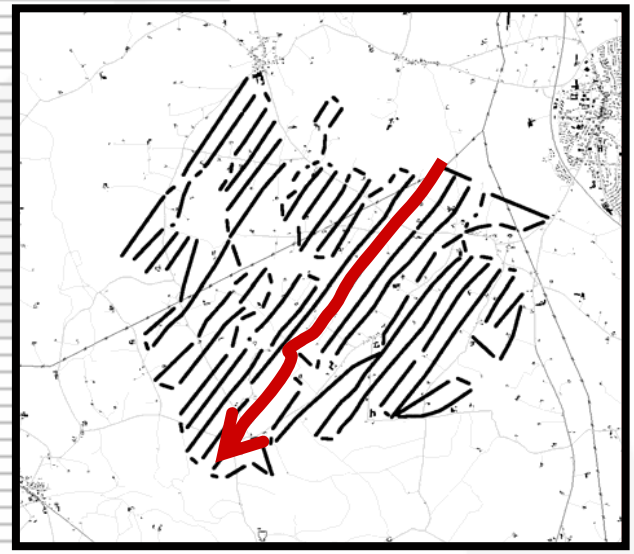


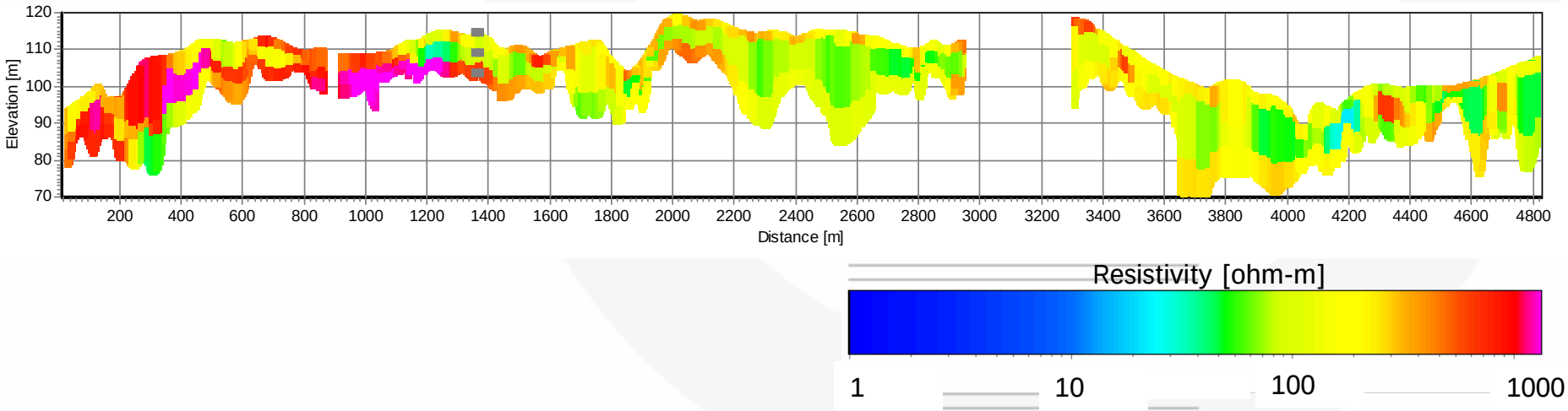

1 km

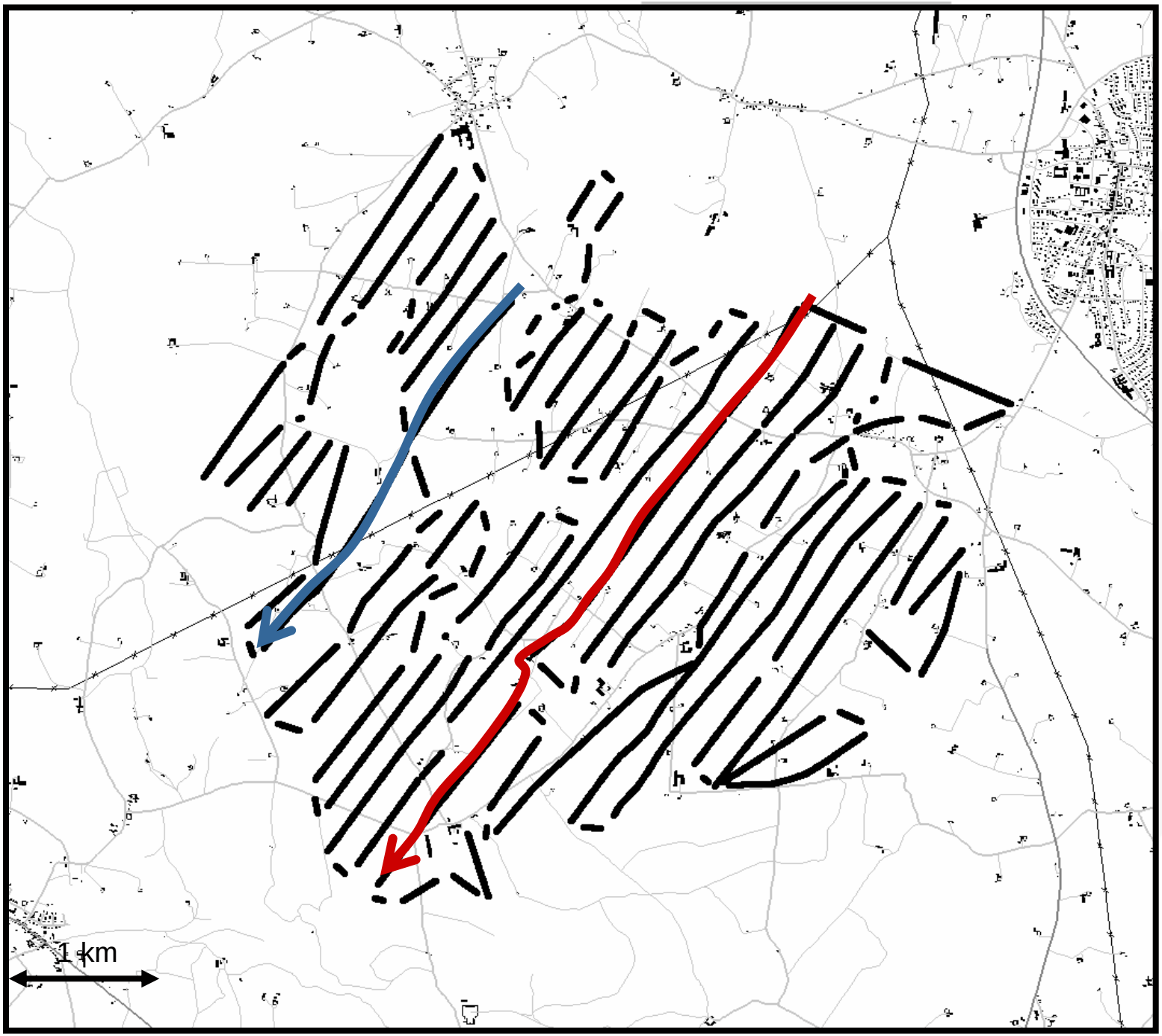

1 km


1 km

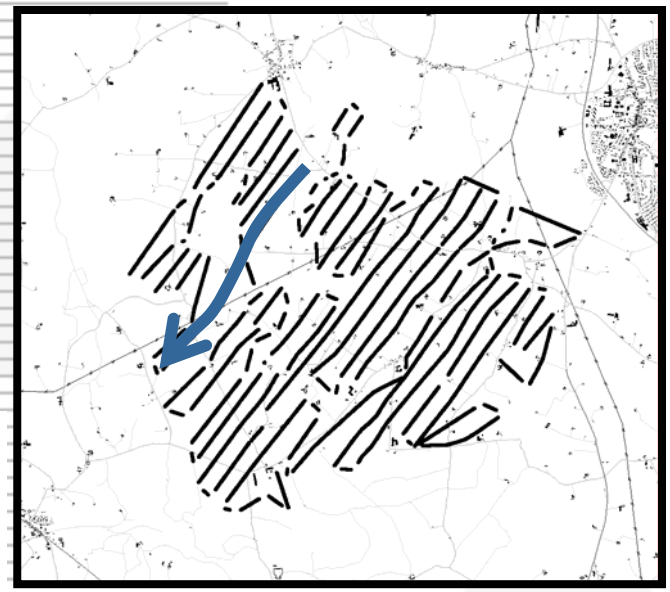
Profiles

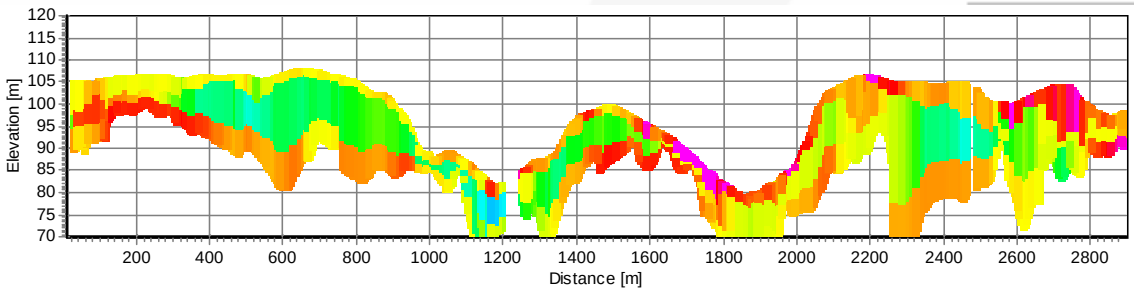


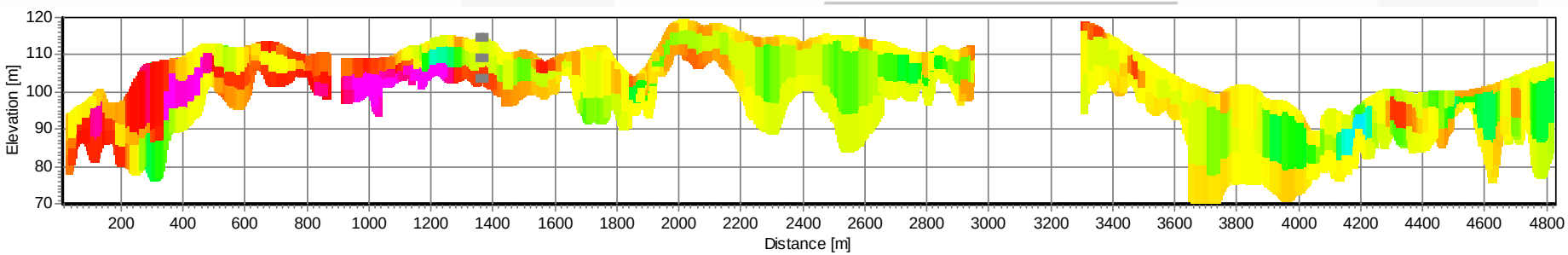

Elevation [m]
120
110
100
90
80
70
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
Distance [m]
Resistivity [ohm-m]
1
10
100
1000

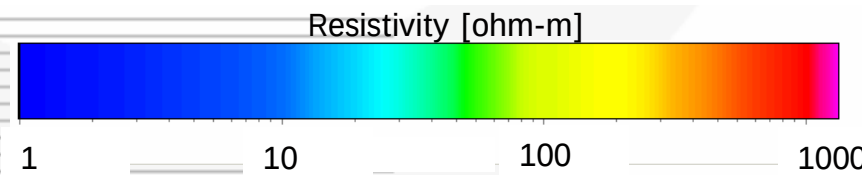

1 km

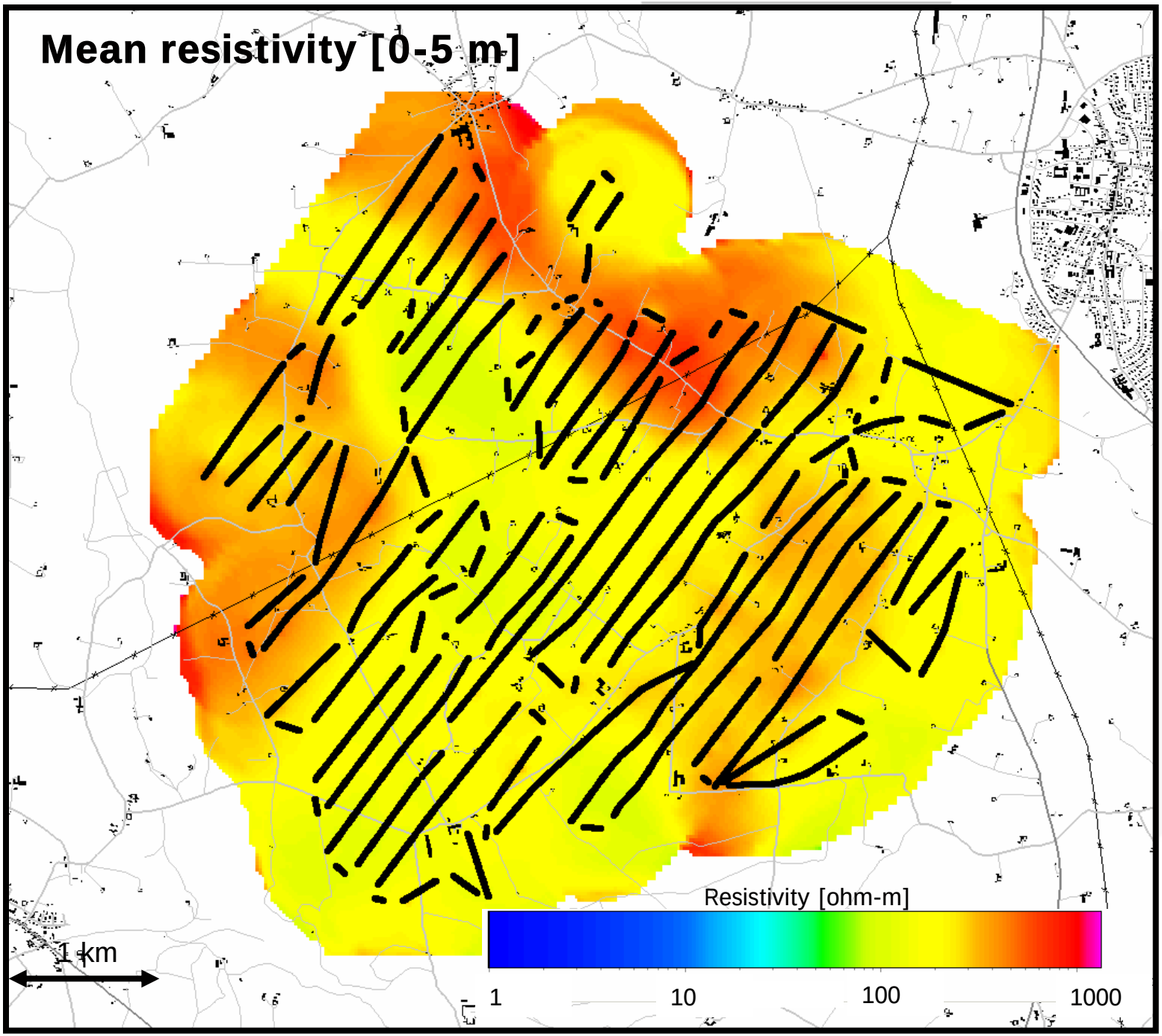
Profiles

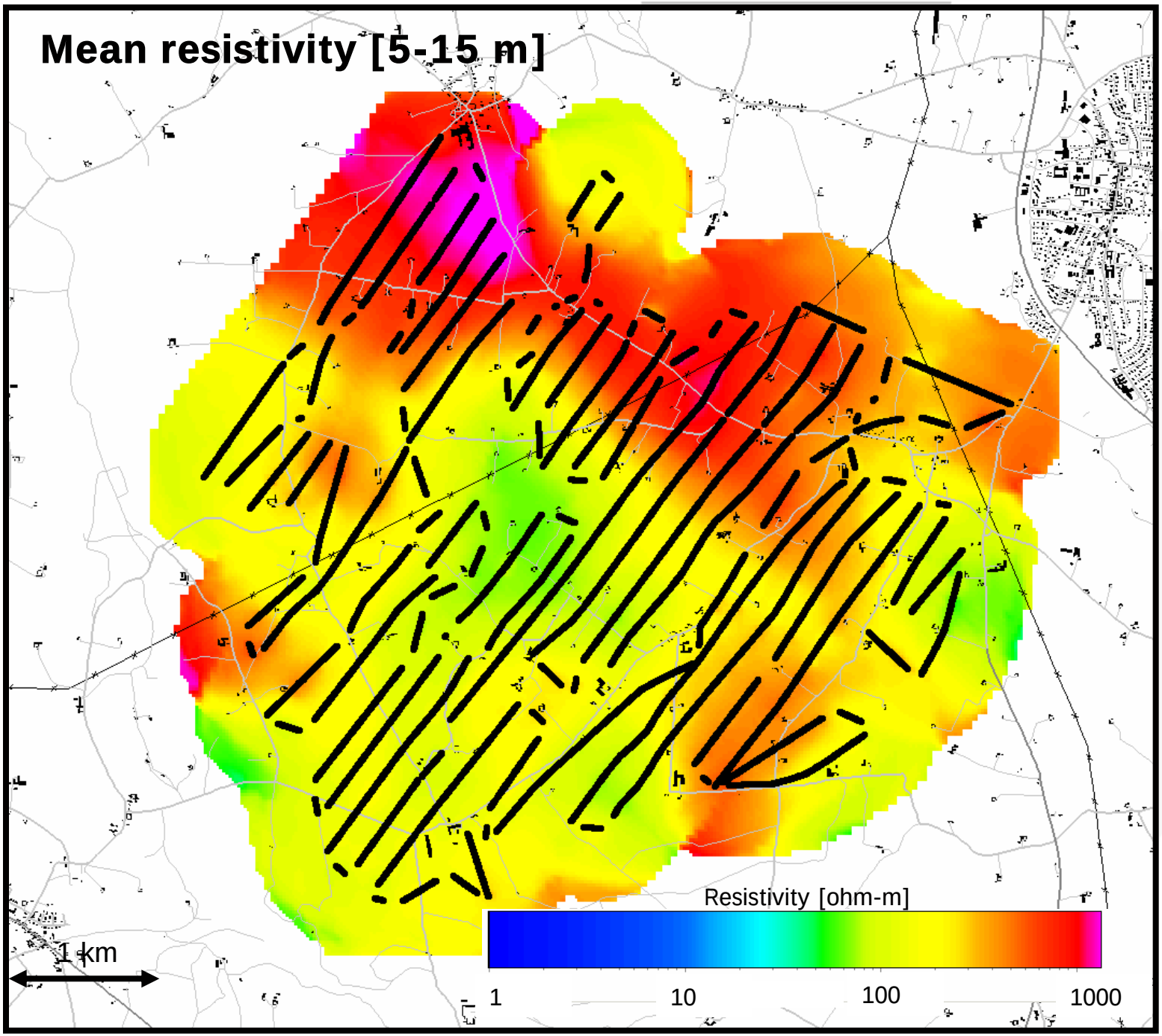


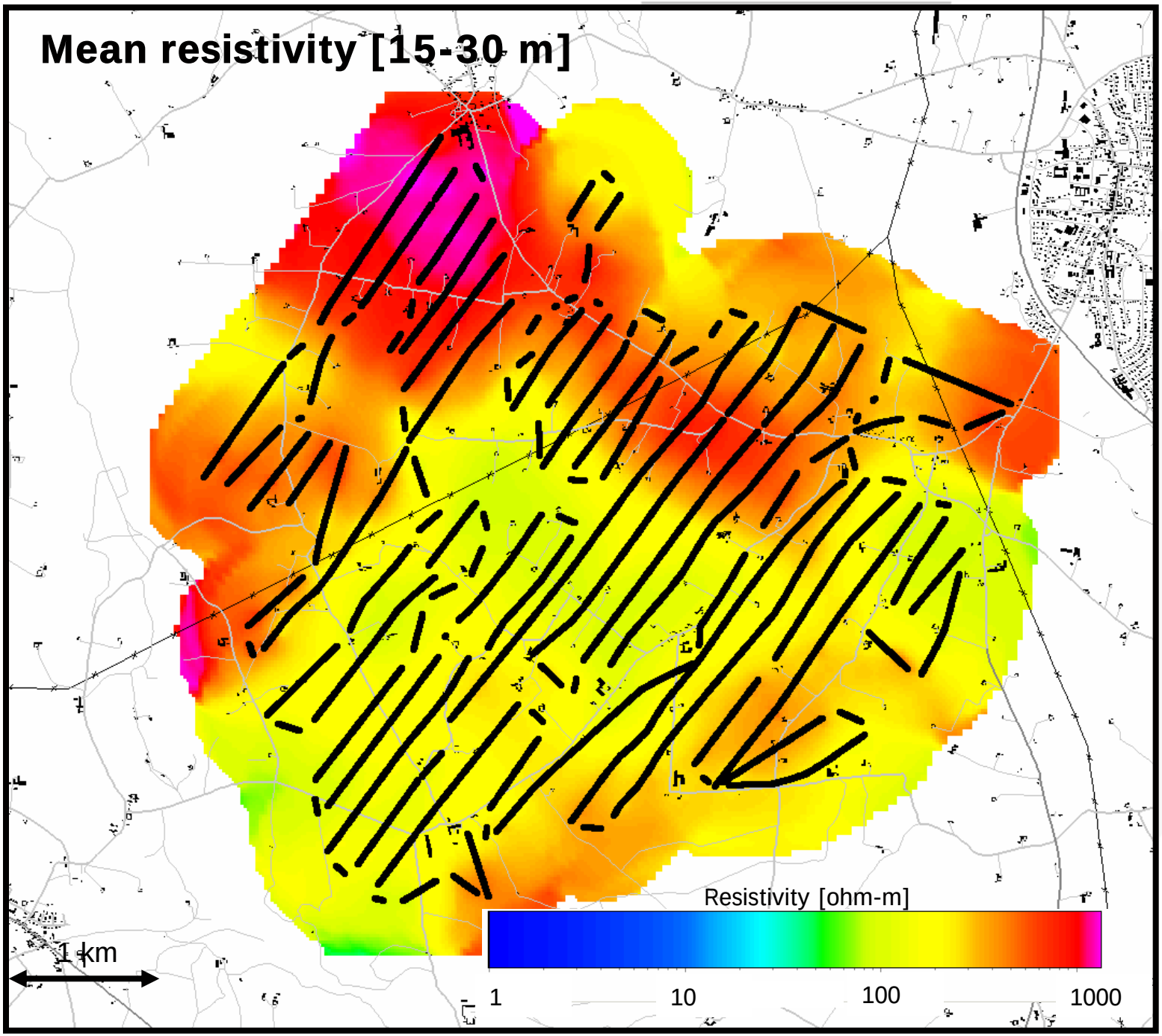

Elevation [m]
120
115
110
105
100
95
90
85
80
75
70
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
Distance [m]


Elevation [m]
120
110
100
90
80
70
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
Distance [m]


Resistivity [ohm-m]
1
10
100
1000


Mean resistivity [0-5 m]
Resistivity [ohm-m]
1
10
100
1000
1 km


Mean resistivity [5-15 m]
Resistivity [ohm-m]
1
10
100
1000
1 km


Mean resistivity [15-30 m]
Resistivity [ohm-m]
1
10
100
1000
1 km

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