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Assessment of 3D geometry effects on 2D ERT data of a permanent monitoring system along a river embankment

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MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

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TECH-LEVEE WATCH

Funded by Fondazione Cariplo grant N. 2016-0785

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DILEMMA

Funded by Ministero dell'Ambiente e della Tutela del Territorio e del Mare

MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

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Monitoring of geohazards

- ERT monitoring has shown efficient for hydrogeological studies to monitor the variations of water saturation.

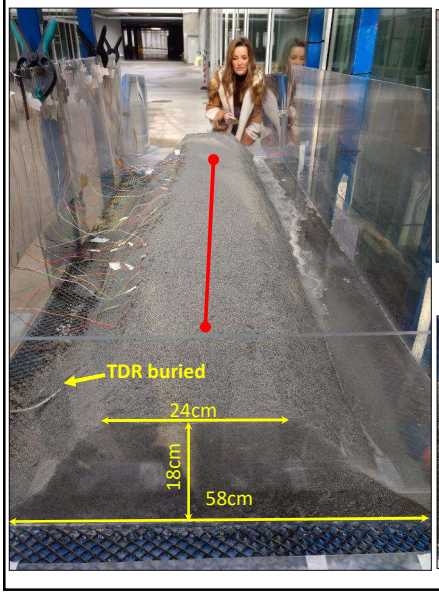
4

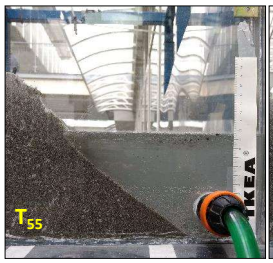
3D effects

The apparent resistivity measurements are affected not only by materials directly below the line, but also by resistivity changes perpendicular to ERT profile (Water and air on one side, and air on the other side).

5

Laboratory tests





6

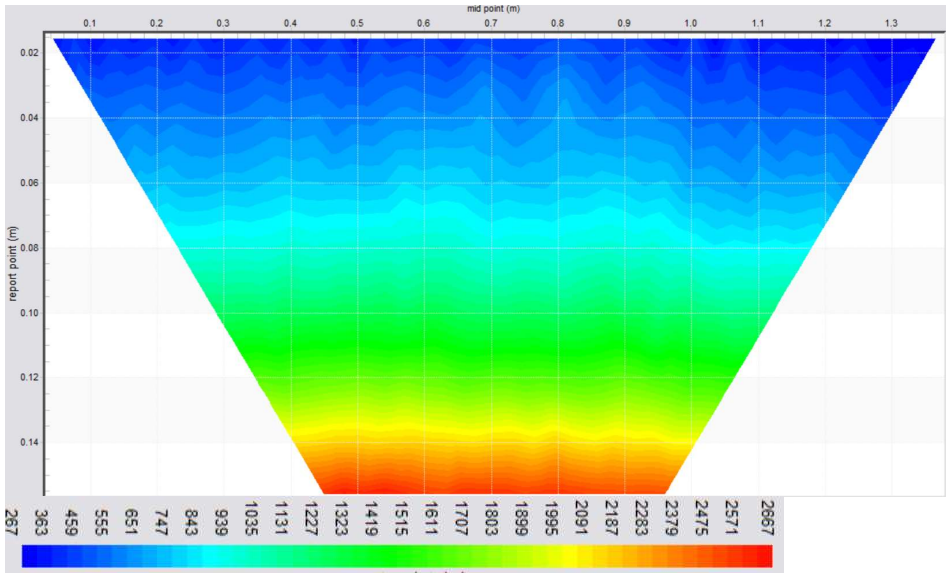
Laboratory tests

T0

Background measurements

7

Laboratory tests



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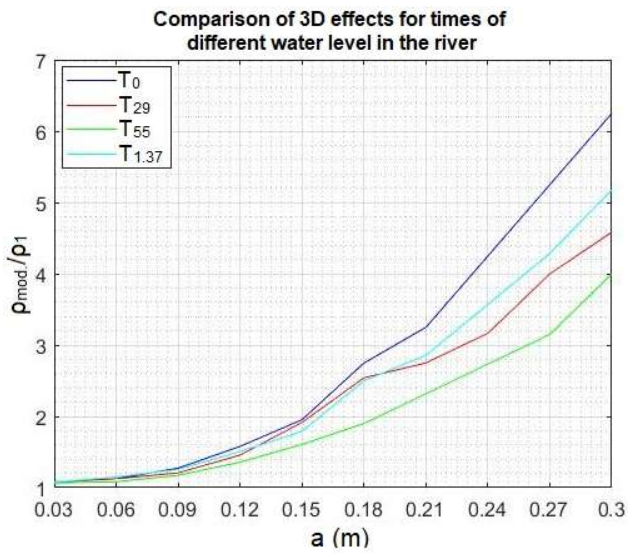
Laboratory tests



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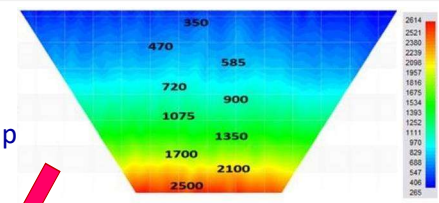
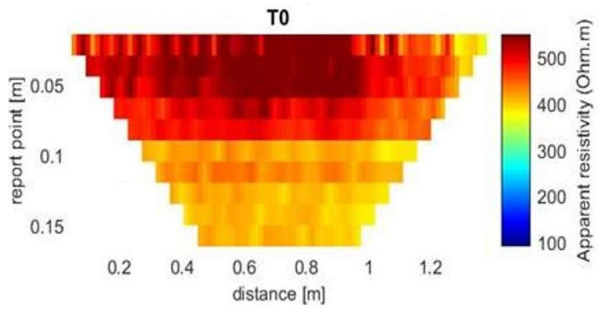
Laboratory tests

Corrections:

1) effect of buried electrodes
2) 3D effects of each experiment setup





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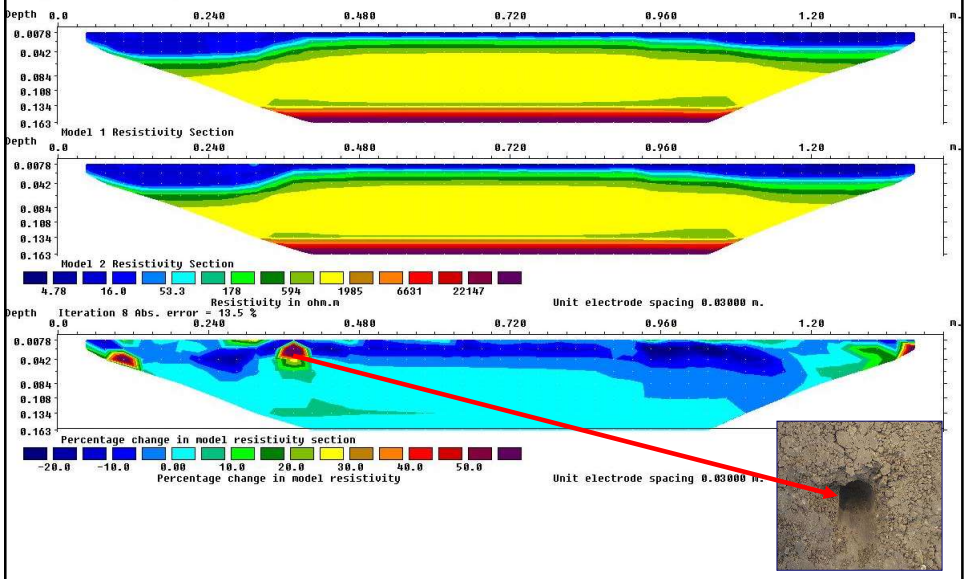
Laboratory tests

11

Laboratory tests



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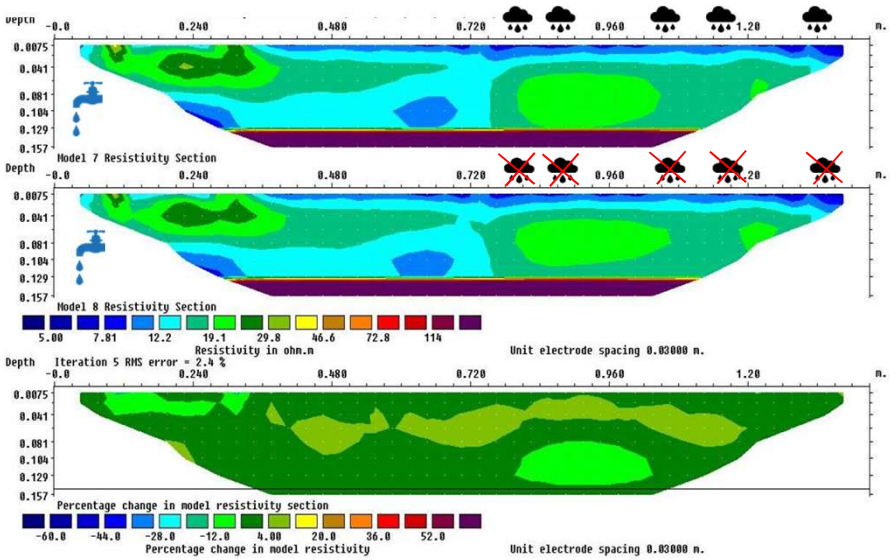
Laboratory tests



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The study area

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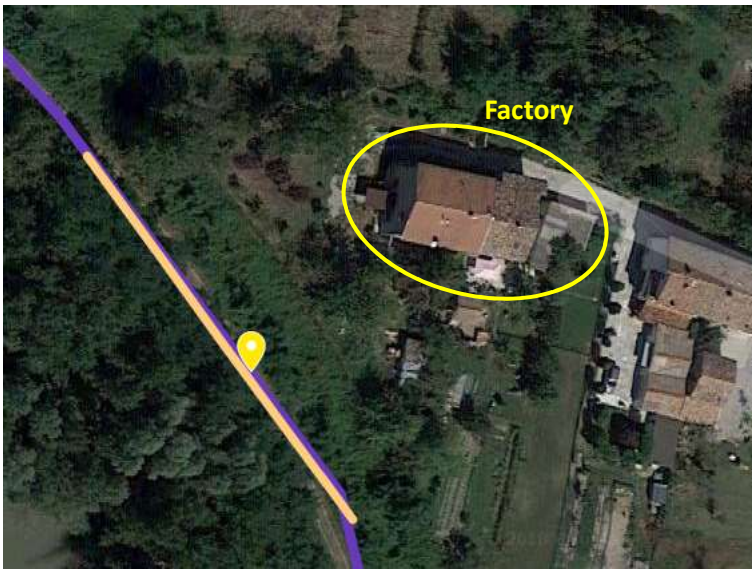
The study area



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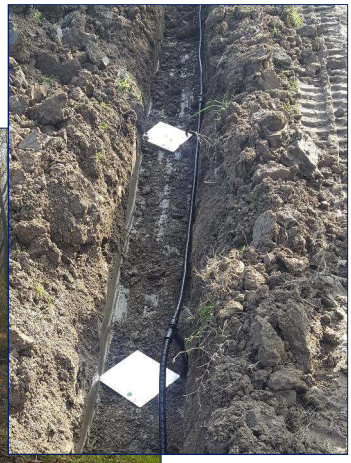
The study area

16

The study area

Wenner array
a=2m
48 plate electrodes (20×20cm)



Installed on 26 November 2018

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3D geometry

Drones

18

3D geometry

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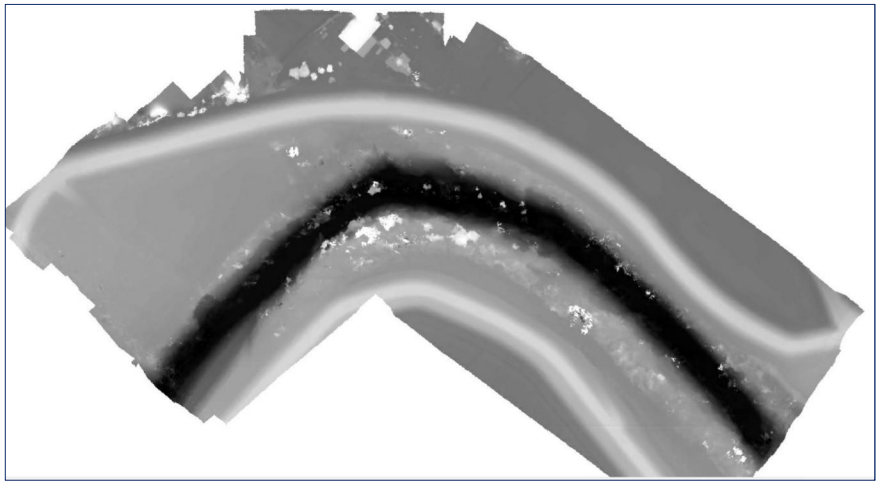
3D geometry



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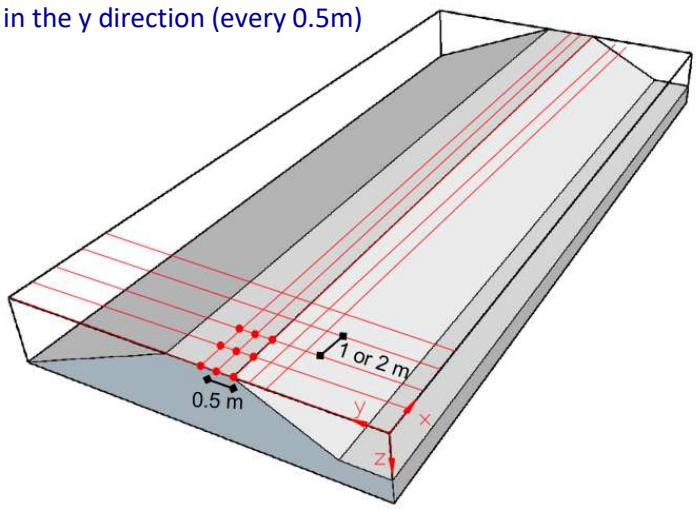
3D geometry

48 electrodes along the x direction (both for a=1m and a = 2m)

Parallel profiles in the y direction (every 0.5m)



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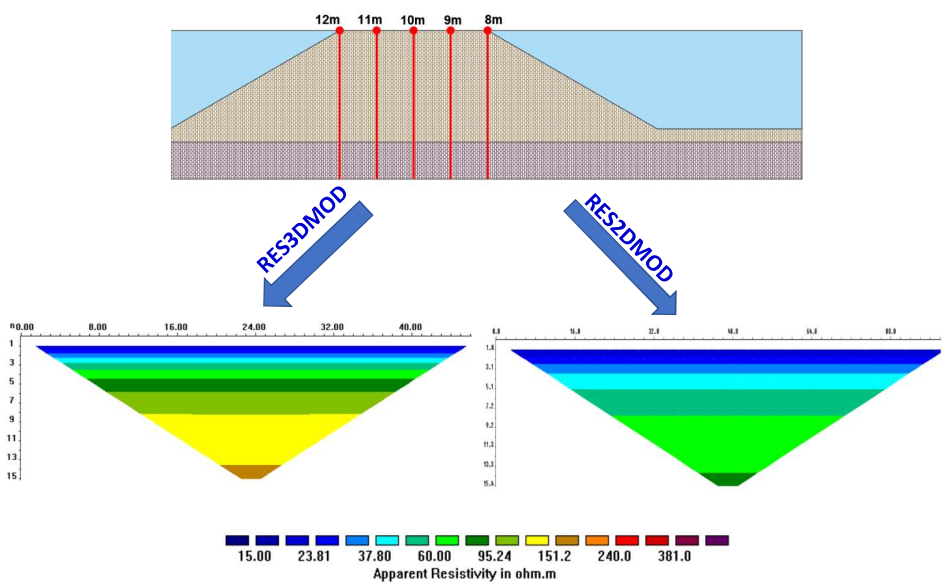
3D effects



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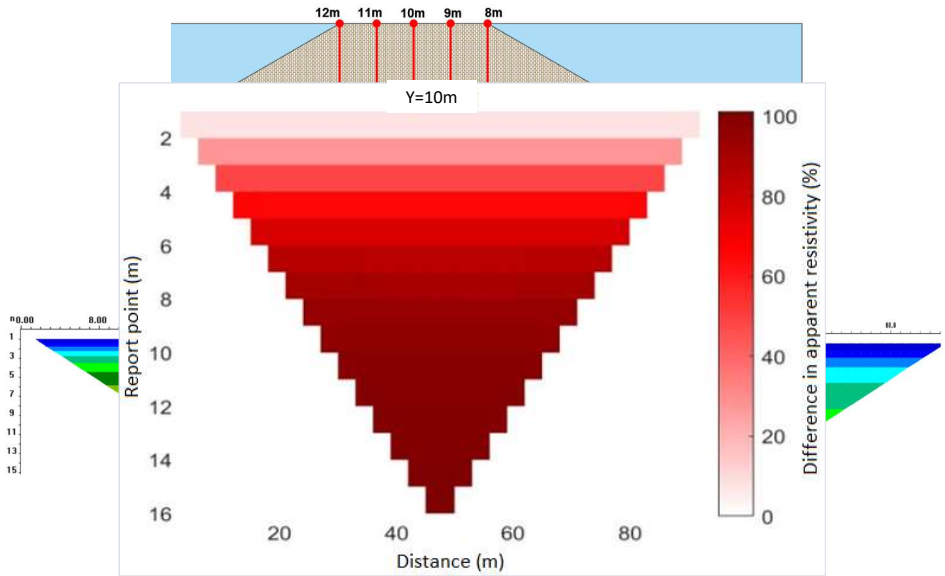
3D effects



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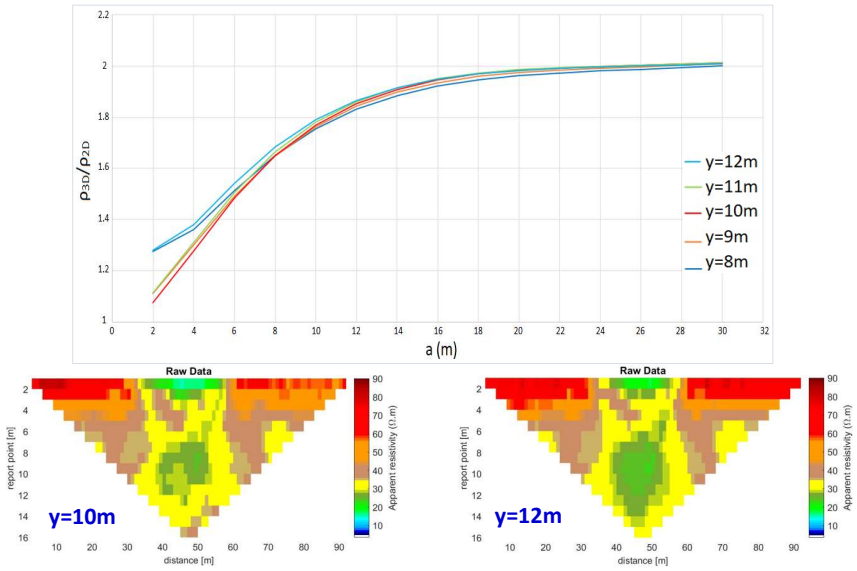
3D effects



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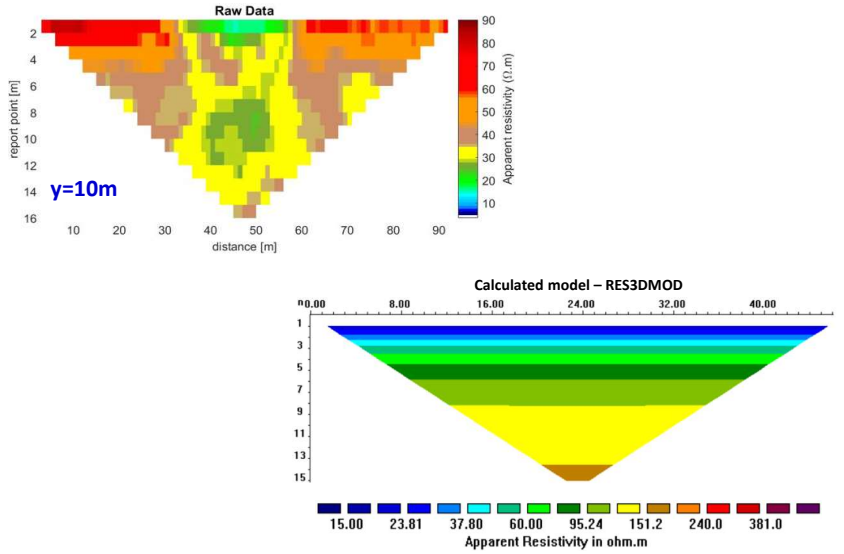
3D effects



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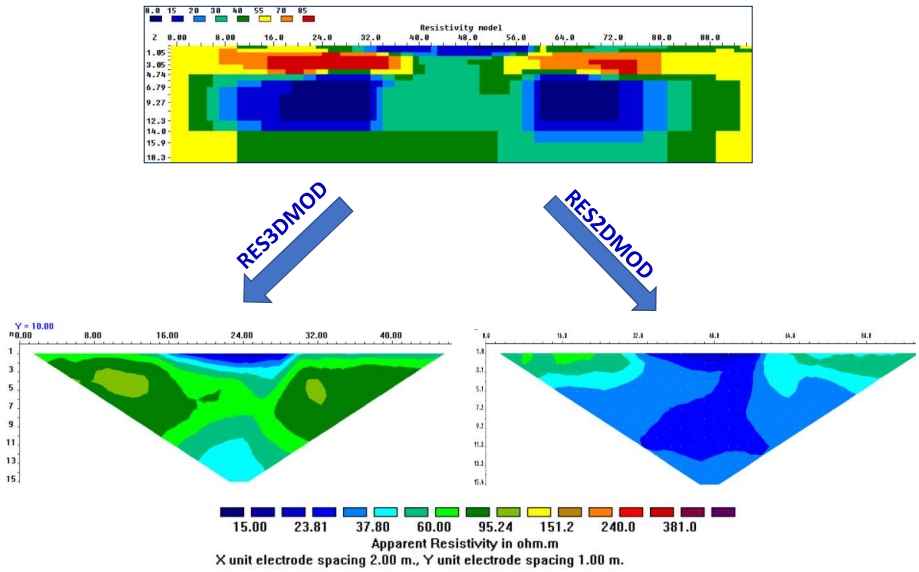
3D effects



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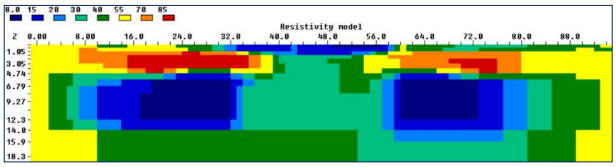
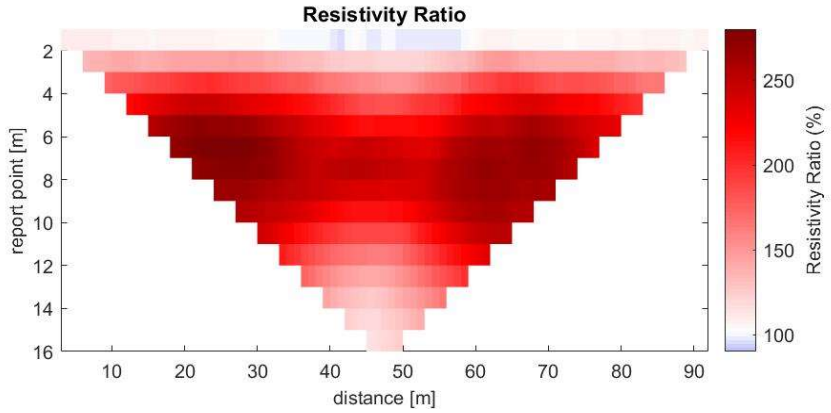
3D effects





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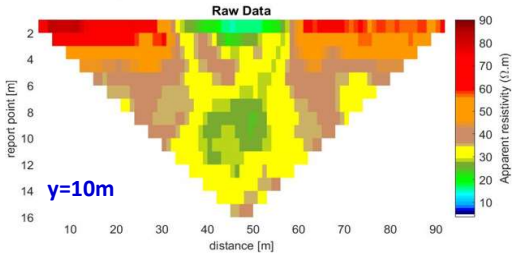
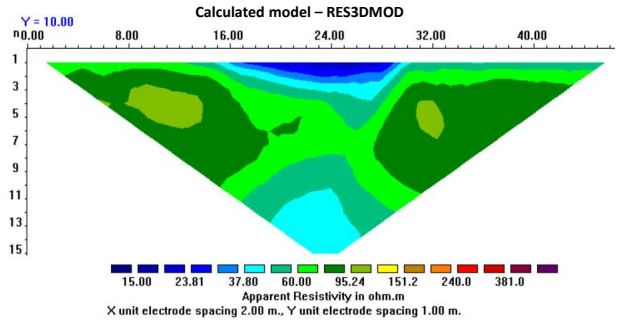
3D effects





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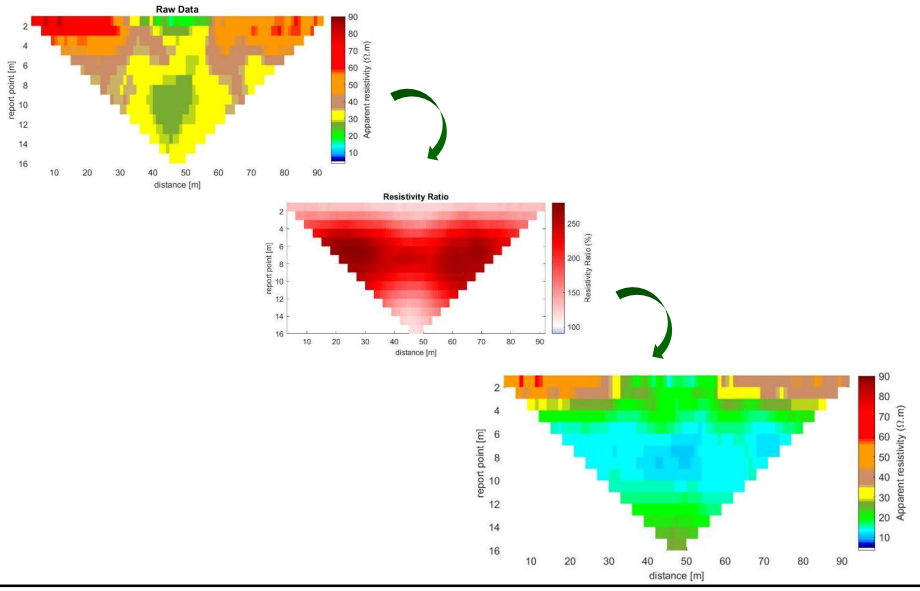
Data correction (y=8m)



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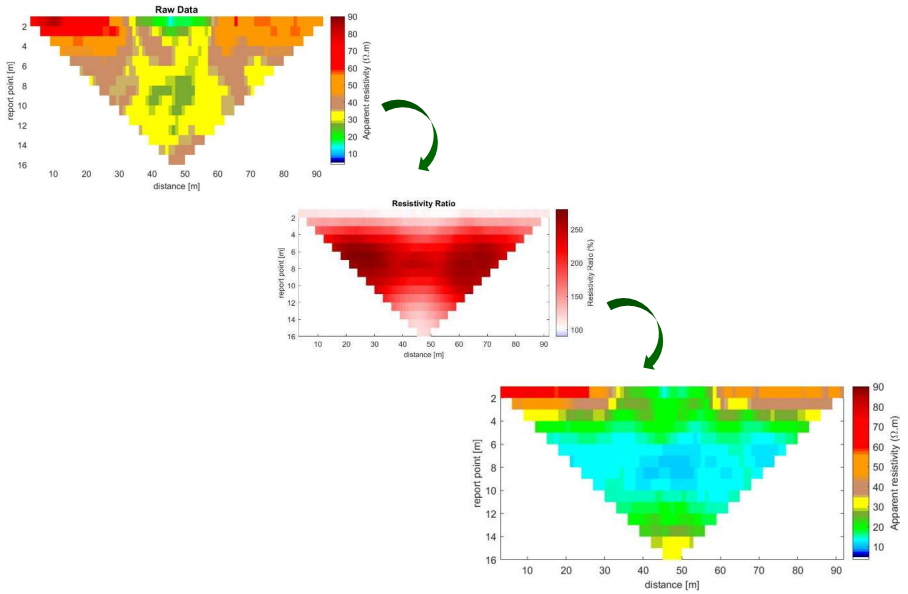
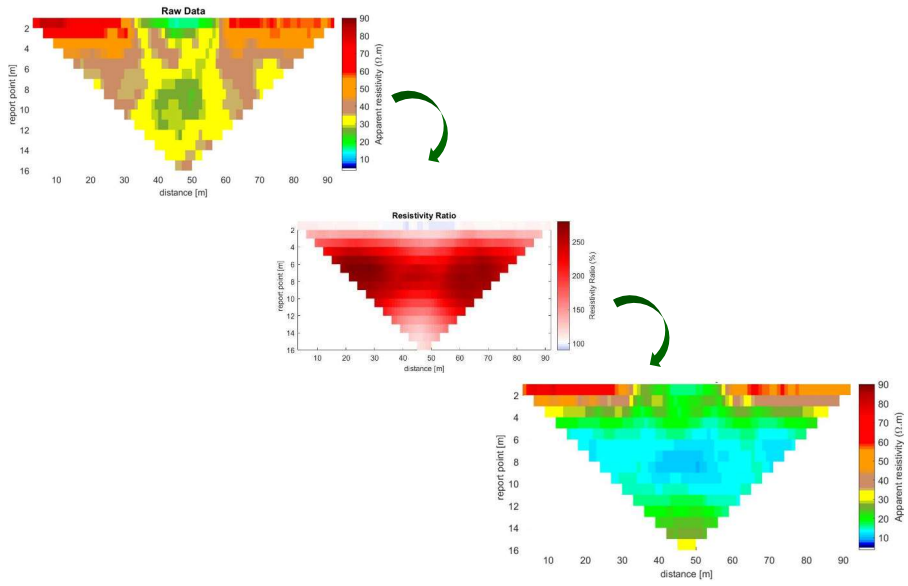
Data correction (y=9m)



30

Data correction (y=10m)



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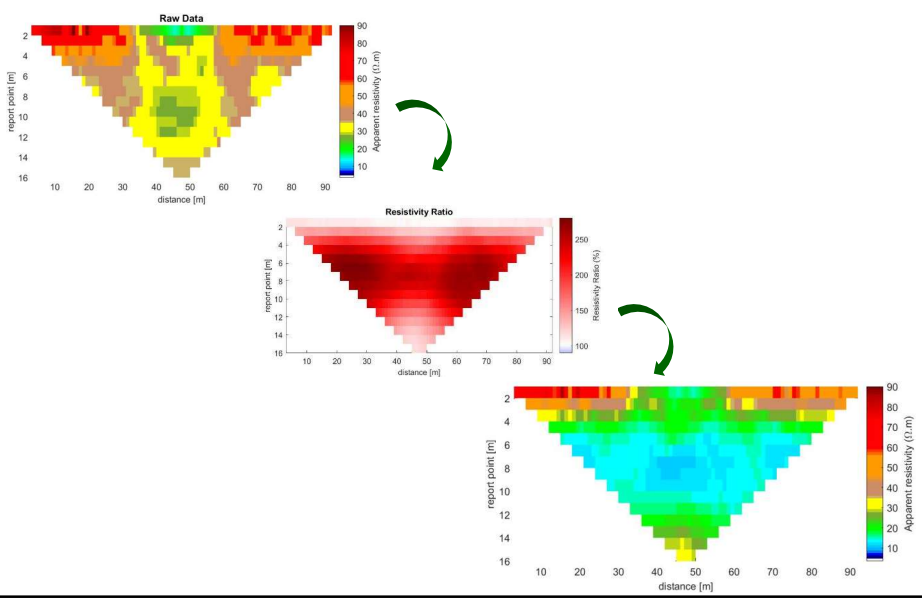
Data correction (y=11m)



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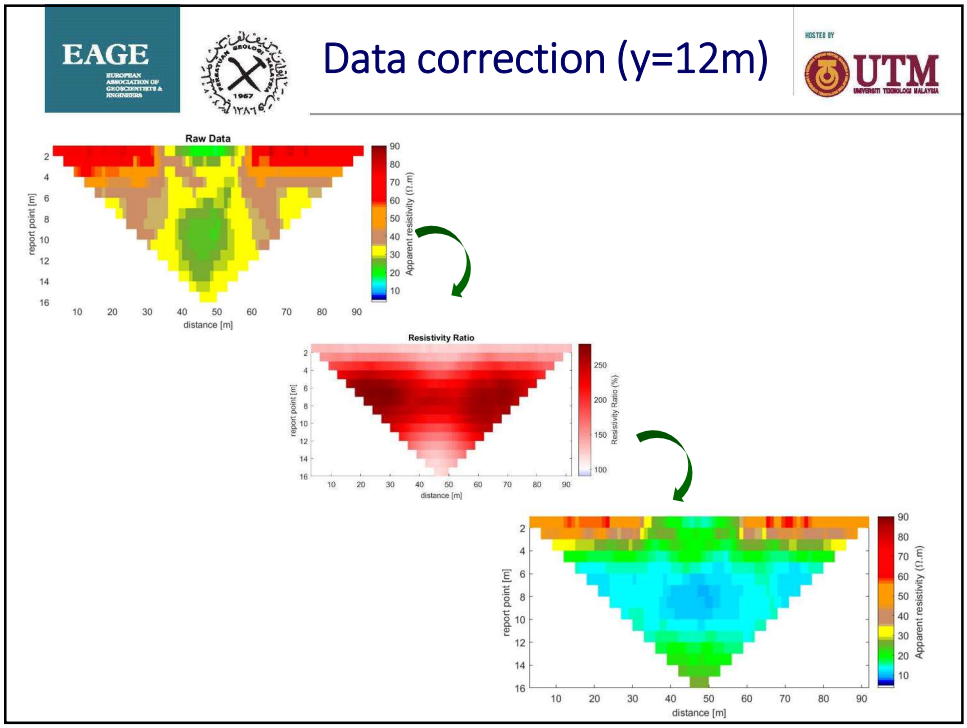
EAGE
Data correction (y=12m)
UTM
Raw Data
report point [m]
distance [m]
Apparent resistivity (Ω.m)
Resistivity Ratio
Resistivity Ratio (%)

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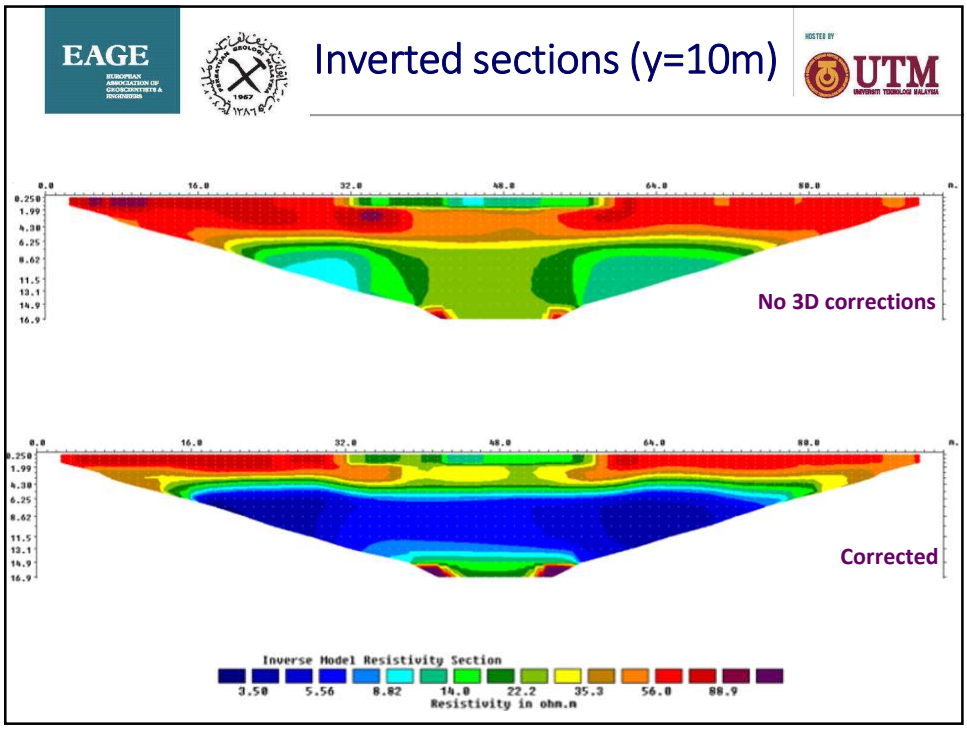
EAGE
Inverted sections (y=10m)
UTM
No 3D corrections
Corrected
Inverse Model Resistivity Section
3.50 5.56 8.82 14.0 22.2 35.3 56.0 88.9
Resistivity in ohm.m

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Conclusions

- 3D geometry significantly affects the 2D ERT data obtained along the embankment.
- Future collecting of samples from the study area will help in reconstructing a more realistic site-specific input resistivity model and more accurate quantification of the 3D effects.
- One interesting perspective is to study the 3D effects on induced polarization (IP) measurements. 3D effects are expected to have almost no effect on 2D IP measurements.

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Thank you for your attention

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Acknowledgements

This research was partially funded by Fondazione Cariplo, grant number 2016-0785, and by Ministero dell'Ambiente e della Tutela del Territorio e del Mare, project DILEMMA – Imaging, Modeling, Monitoring and Design of Earthen Levees. The ERT monitoring system was developed with the technical support of LSI-Lastem.

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