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• UNESCO Chair on the Prevention and
• Sustainable Management of Geo-Hydrological Hazards,
• University of Florence, Italy



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Evaluation of the GPS errors influence on the resistivity in ERT investigation of funeral mounds

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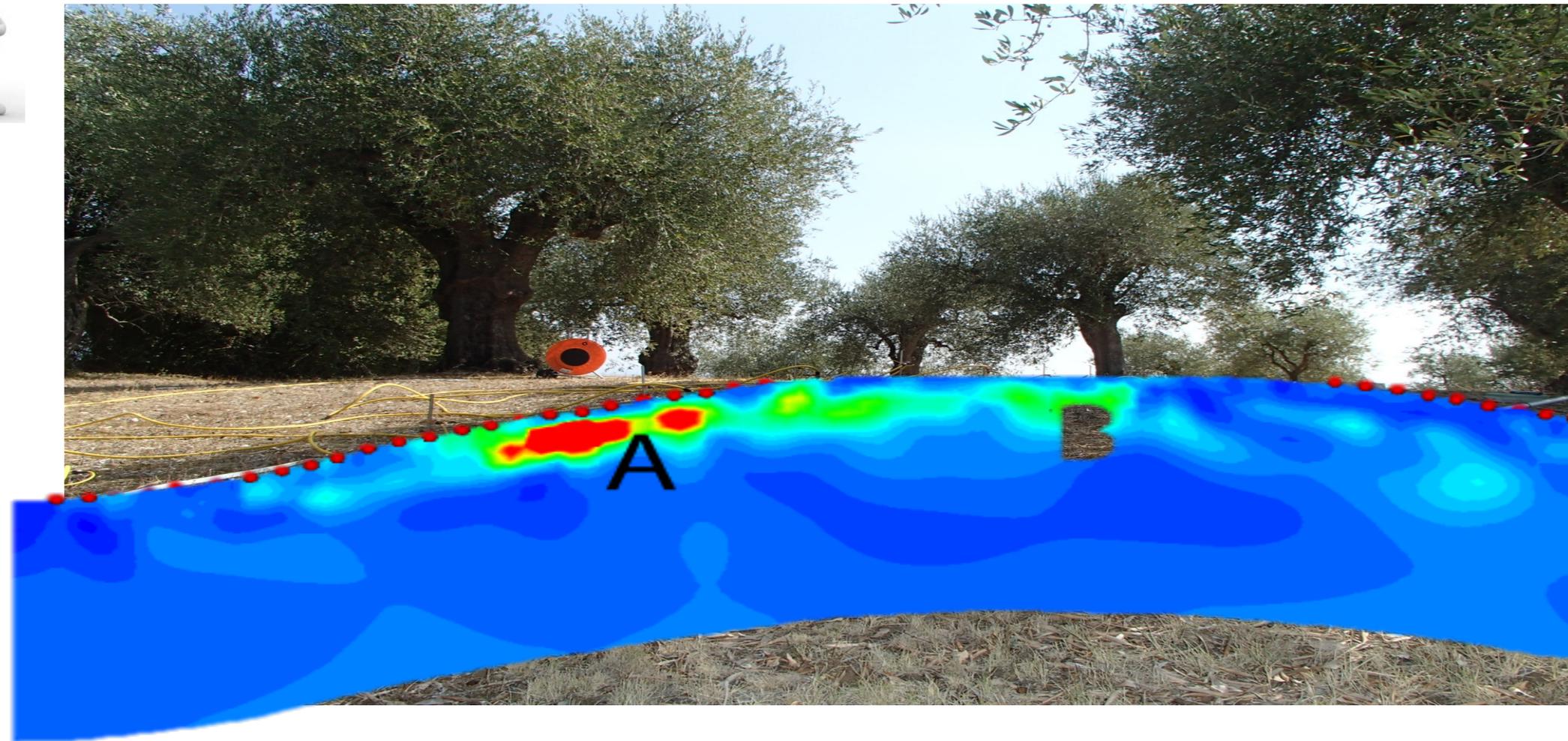
Outlines

- The archaeological “problem” of tumuli
- Case study: the Poggio Pepe Tumulus (Tuscany) - ERTs results
- Analysis of the influence of the GPS errors on the final resistivity
- Conclusions

Archaeological “problem”

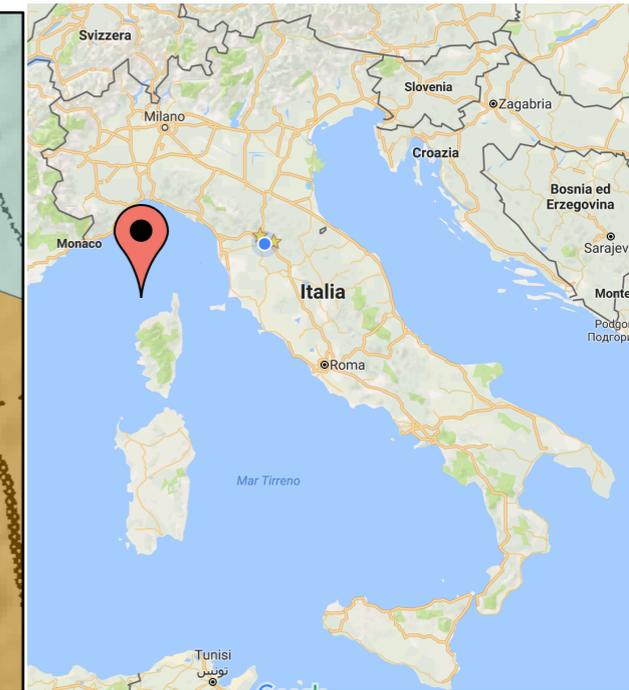
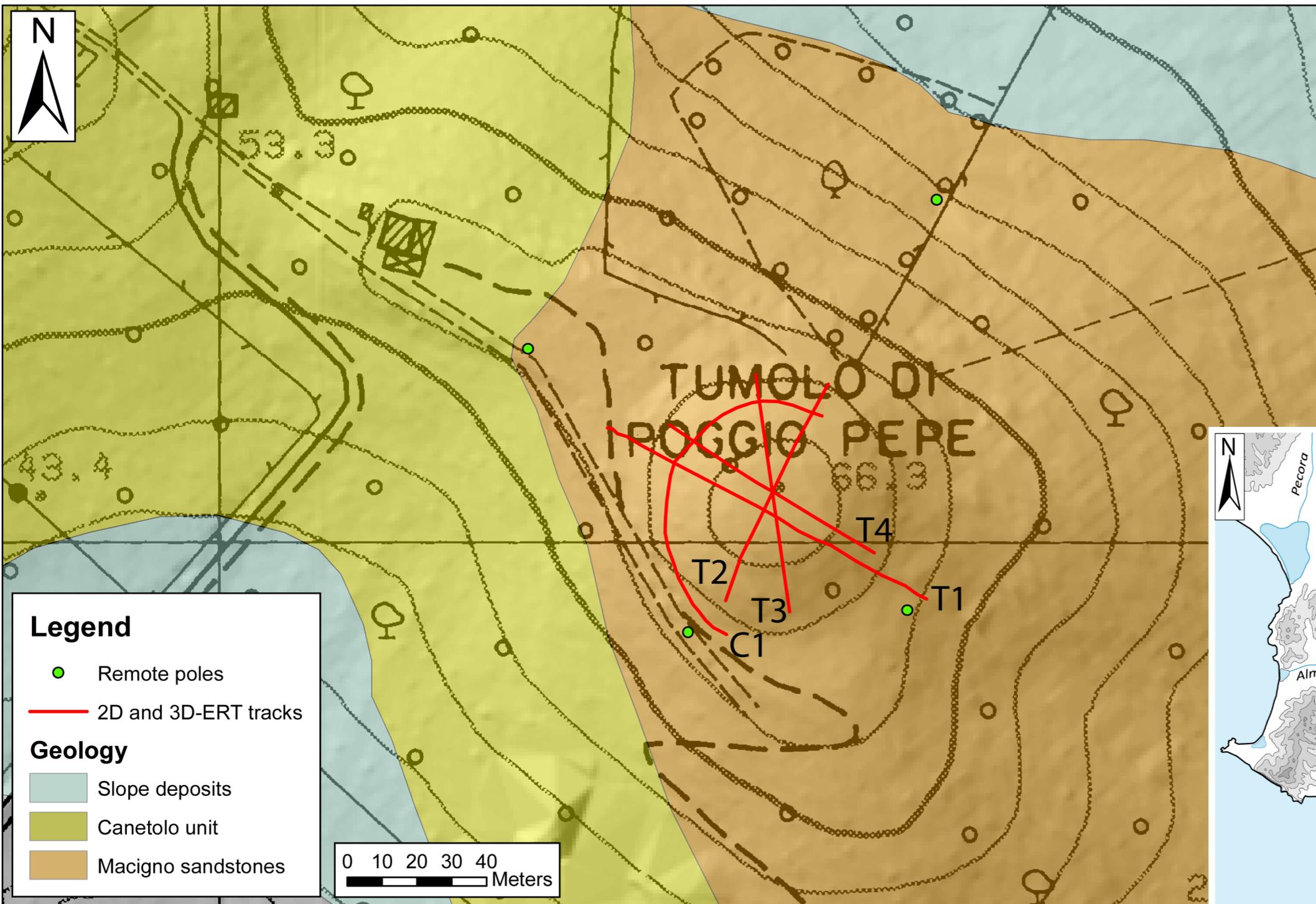


Where is the best place to start digging? Which is the depth?



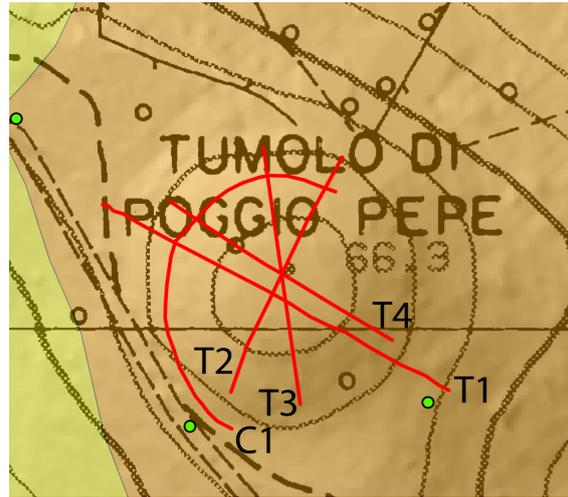
- the complex distribution of the soil physical properties (i.e., 3D distribution of anomalies),
- the rough topography
- the size (sometimes of few meters) and burial depth of anthropogenic constructions (i.e., they are located within the first ten meters)

Poggio Pepe case study



Pazzi et al. (2019) ERT investigation of tumuli: does the errors in locating electrodes influence the resistivity? IMECO TC-4 International Conference on Metrology for Archaeology and Cultural Heritage. 527-532

Poggio Pepe case study



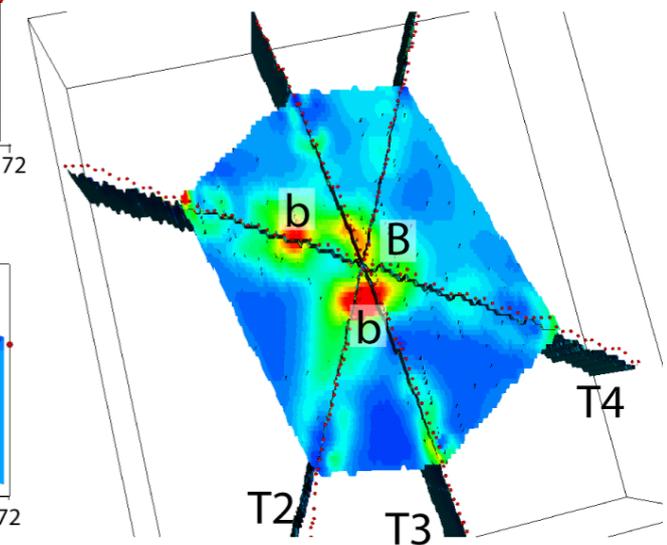
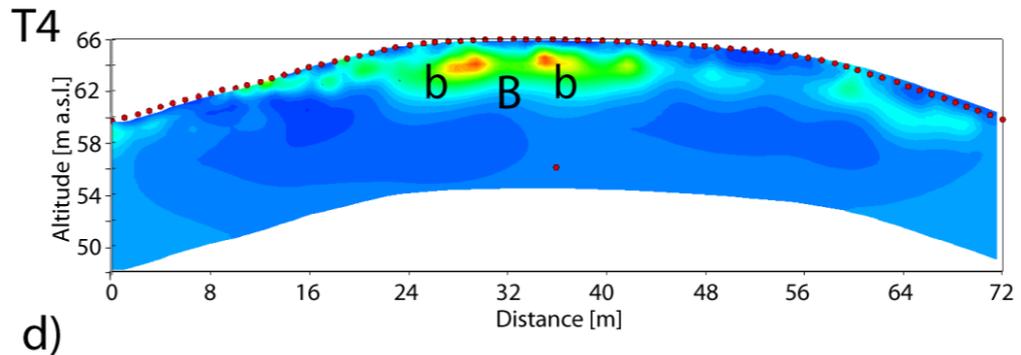
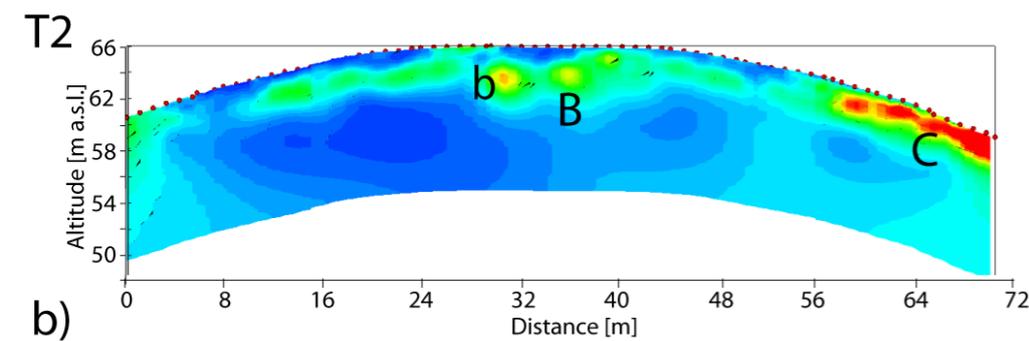
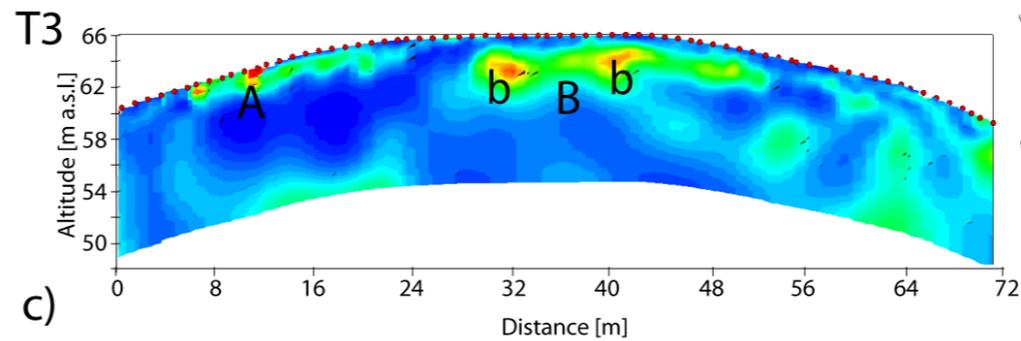
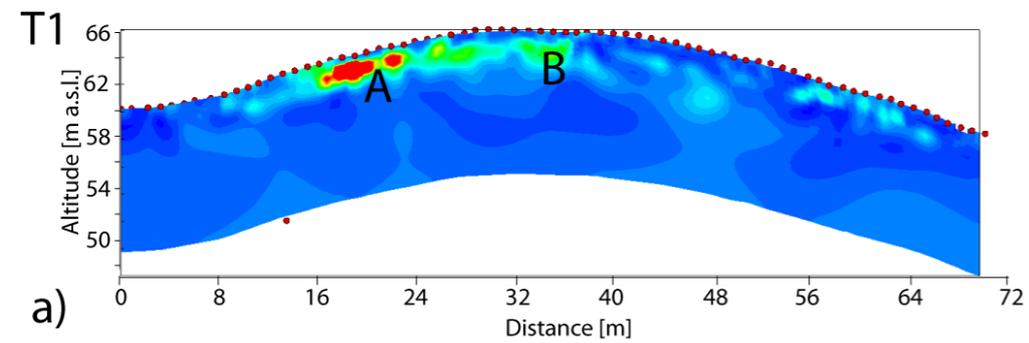
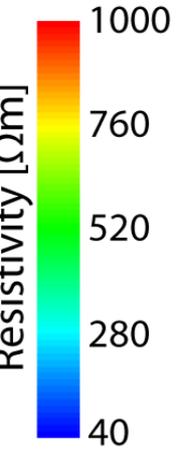
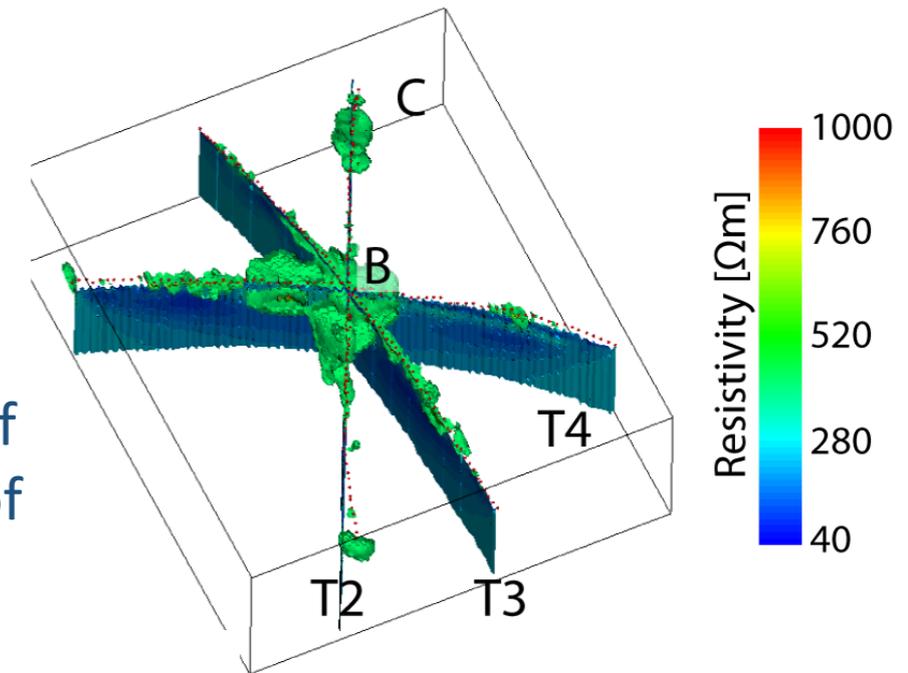
Anomalies:

A – the dromos or to its shadow

B – chamber filled whether with soil or air.

b – walls of the chamber.

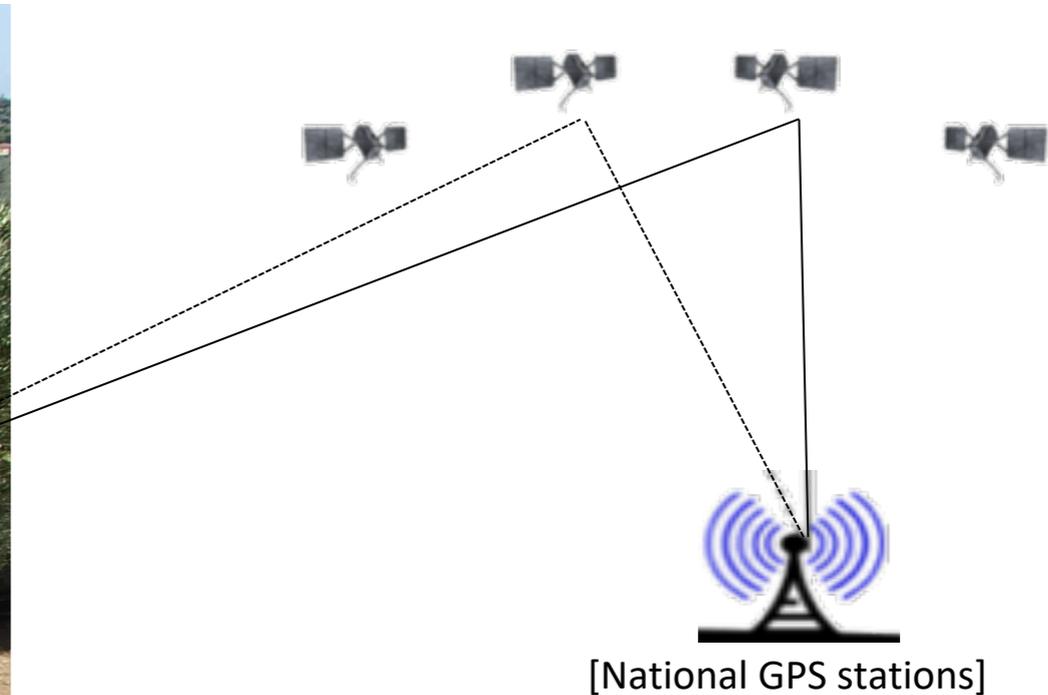
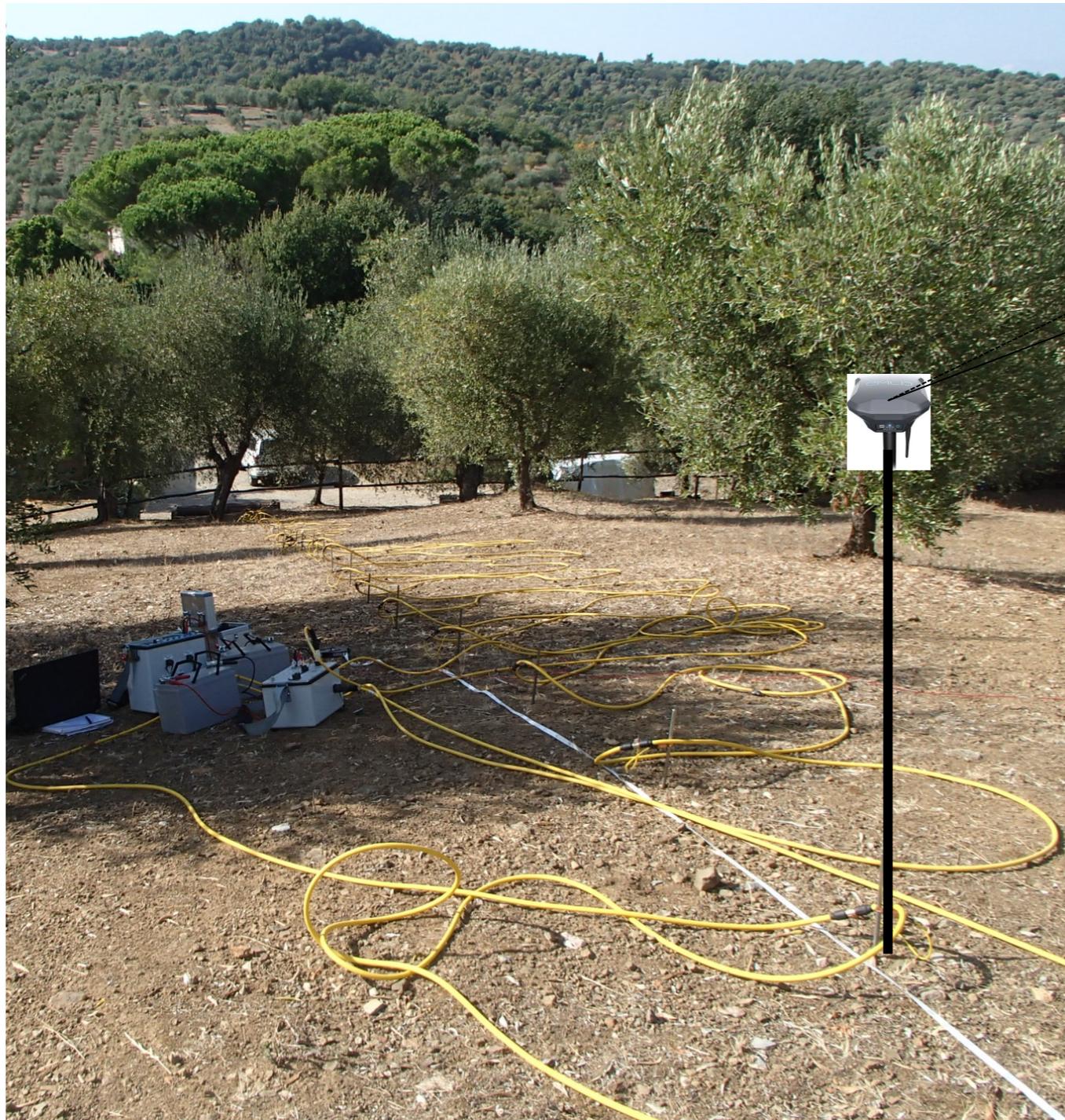
C – lateral tomb (very common in this kind of tumuli) or stone slabs removed from the roof



Pazzi et al. (2019) ERT investigation of tumuli: does the errors in locating electrodes influence the resistivity? IMECO TC-4 International Conference on Metrology for Archaeology and Cultural Heritage. 527-532

GPS error Influence

To evaluate the influence of the GPS errors on the final resistivity results



Point ID	Lat. WGS84	Lon. WGS84	h(ell.)	Coordinate_
1	42.52025243	10.5947305	104.9224	0.6089
2	42.52025171	10.5947367	105.0036	0.6142
3	42.52024677	10.5947428	105.0883	0.5721
4	42.52024446	10.5947488	105.2217	0.7387
5	42.52024402	10.5947549	105.3671	0.663
6	42.52024155	10.5947605	105.5959	0.7055
7	42.52023938	10.5947658	105.9448	0.8568
8	42.52023571	10.5947723	106.2217	0.9665
9	42.52023215	10.5947782	106.6772	0.1103
10	42.52022955	10.5947835	107.1558	0.2491

GPS error Influence

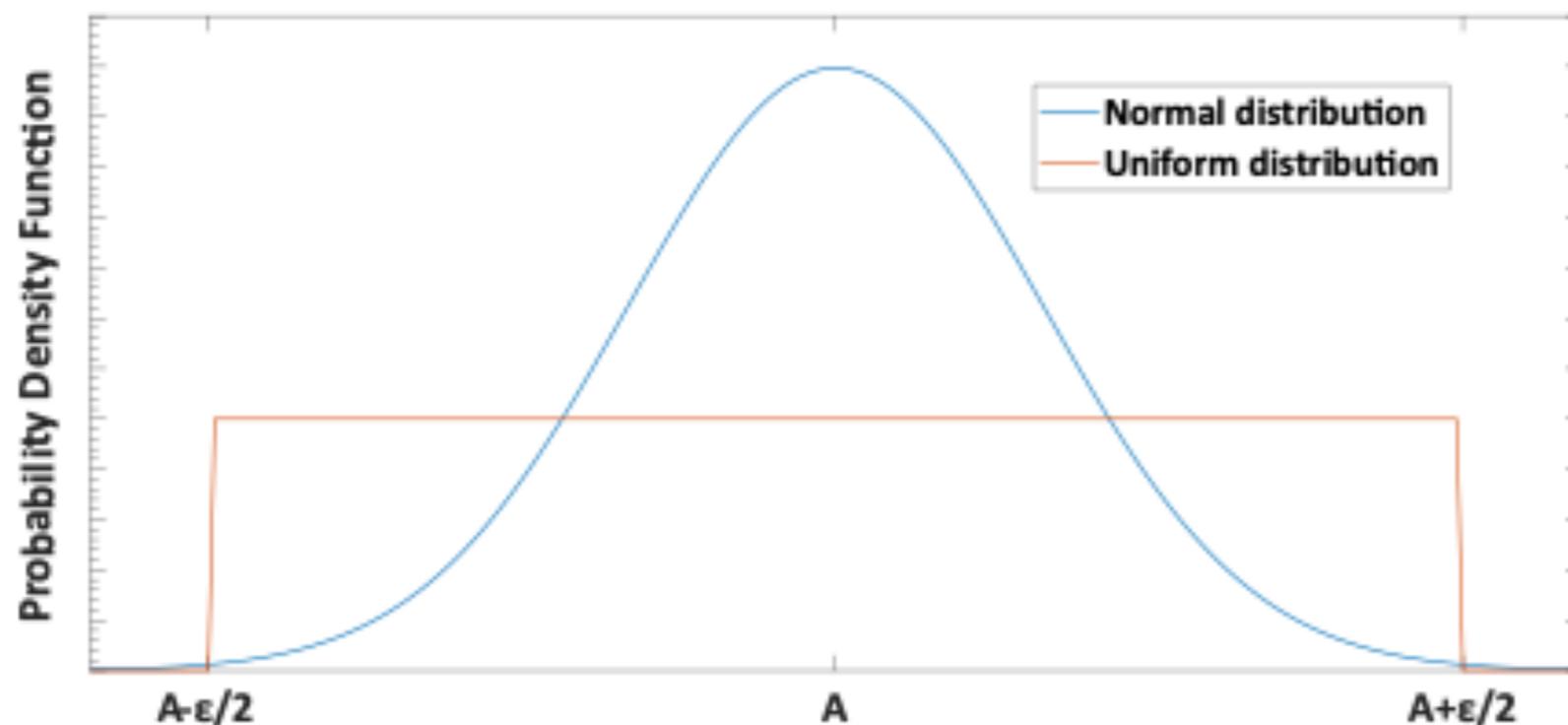
Monte Carlo Simulation

Acquire input data

Construct a domain considering the GPS uncertainty

Generate random inputs over the domain according to a probability distributions

Calculate the geometric factor and the apparent resistivity



Monte Carlo simulation

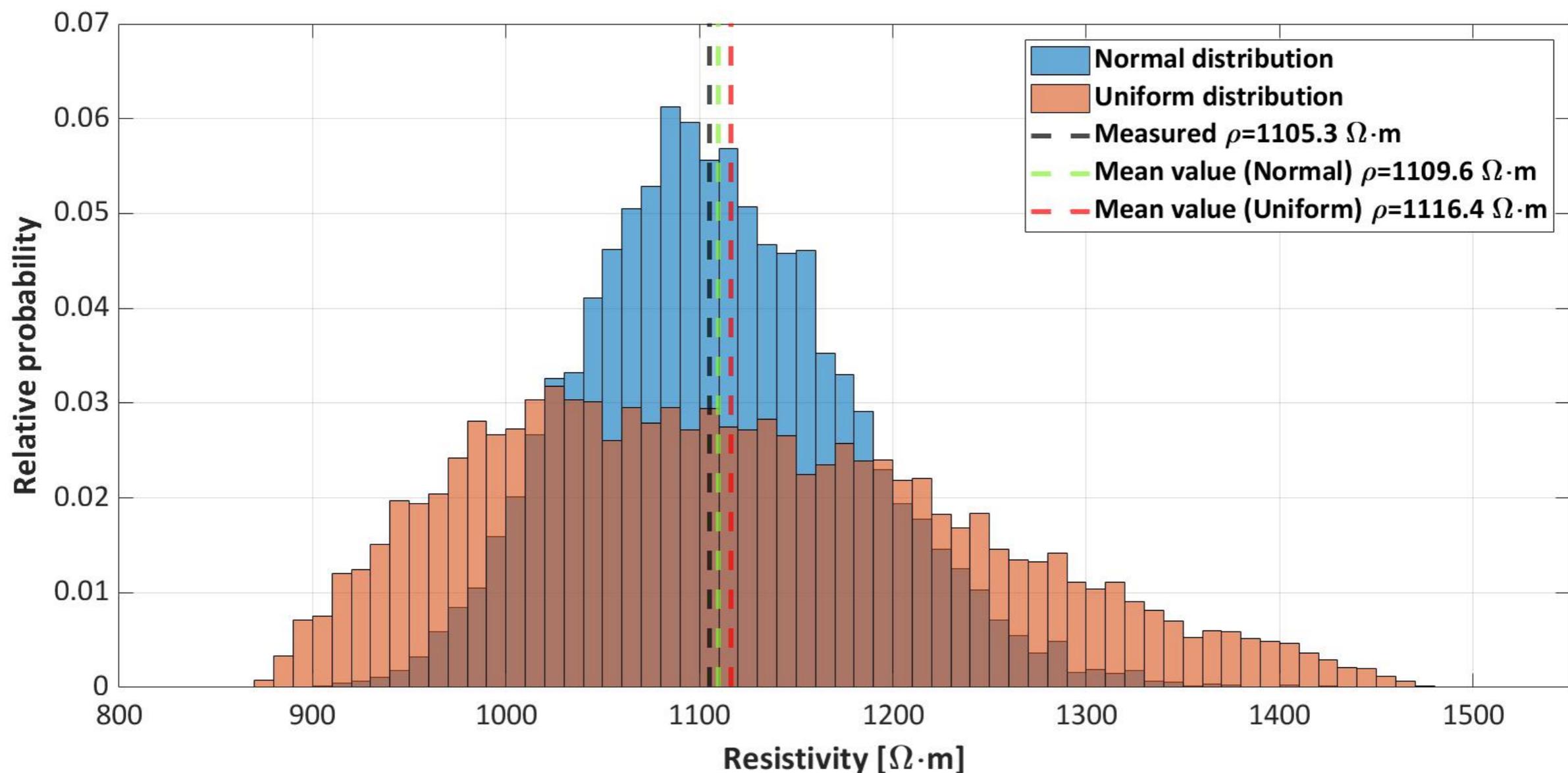


GPS error Influence

Data Dispersion

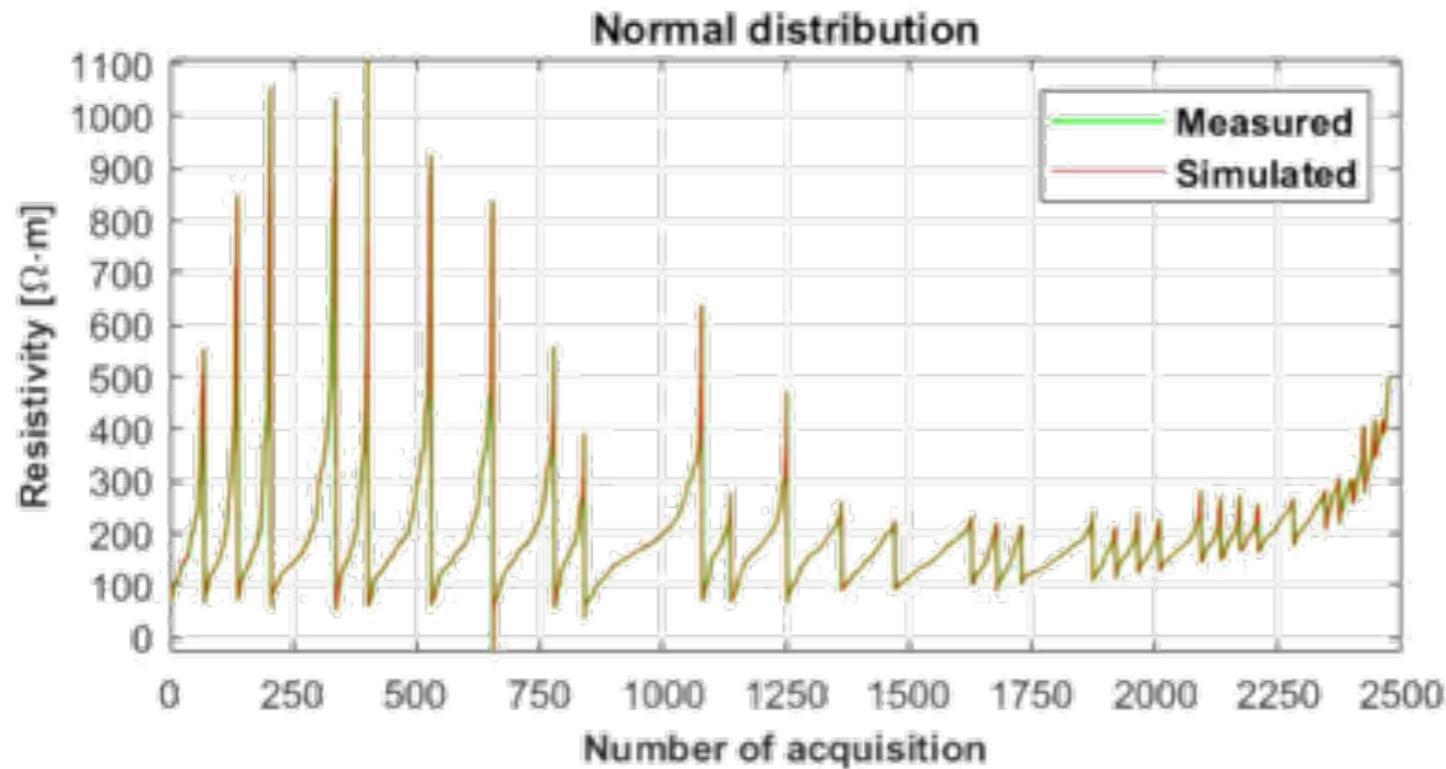
Measured value: $\rho=1105.3 \Omega \cdot m$
Number of samples: $N=10\ 000$

Uniform distribution has a large data dispersion, while normal distribution better fits data



GPS error Influence

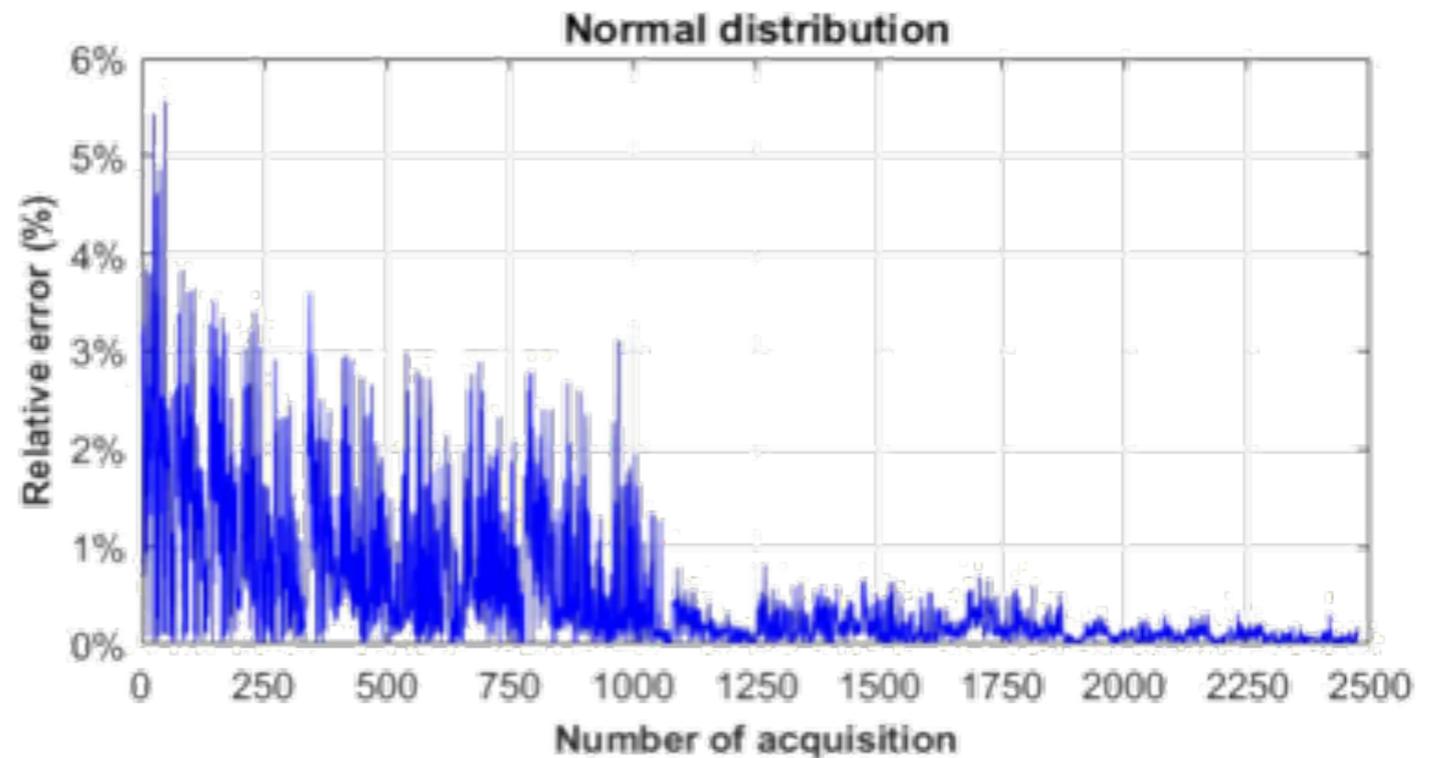
Results comparison



Measured and simulated resistivity are sorted **from the minimum to the maximum length of the dipole-dipole**, investigating deeper points, the relative error decreases



Uncertainty is relevant only for surface investigations, and it becomes negligible for deeper analysis.



Conclusion

- The shallow apparent resistivity is strongly influenced by a wrong deployment of electrodes
- In case of archeological application, the measurement campaign should be rescheduled another day (with different conditions)
- An optimization of apparent resistivity input data will lead to better locate archeological targets and therefore minimize the cost

Papers under review:

Pazzi et al. (under review in Sensors). Analysis of the influence of the gps errors, occurred in collecting electrodes coordinates, on the electrical resistivity of tumuli.

Catelani et al. (under review in IEEE Transactions on Instrumentation and Measurement). Effects of inaccurate electrode positioning in Electrical Resistivity Tomography for the investigation of tumuli.