Monitoring the "pollutant" flow in a supervised test-site using 4-D Electrical Resistivity Tomography in boreholes.

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This work describes the simulation of an environmental scenario where a conductive "pollutant" is slowly concentrated in a confined small area below the ground surface. An apparatus was manually constructed and buried at IMS foundation land (Heraklion, Crete). The "pollutant" was made of salty coloured water with resistivity 0.5 ohm-m. It was slowly introduced in a small area consisted of coarse sandy material through plastic tubes. The area was completely filled with the pollutant after approximately 8,5 hours and electrical tomographic data were collected continuously in regular time intervals for total eight consequent time phases.

Specifically, the target was surrounded by four vertically PVC plastic pipes (named North, South, West, East) and two vertical ones. On each plastic pipe 12 metallic rings were equally spaced every 20cm (72 in total). A multi-strand cable was connected with all the rings with the resistivity meter. For each pair of boreholes (WE, SN) two protocols were selected: (a) full protocol (1608 measurements) and (b) an optimum (507 measurements). Additionally, a 3D full and optimum data set was selected with 9648 and 3042 data set, correspondingly. The optimum data set was based on Jacobian matrix optimisation technique.

The results showed clearly the resistivity change through time, as the "pollutant" gradually was filling the area of the box. Although the whole experiment took place in a controlled small area (excavated pond size was 2x3x2.5m), the results are promising for applying the resistivity optimisation technique for monitoring a real case pollution scenario, since the presence of a conductive pollutant can be identified due to the resistivity contrast with the environmental resistivity values.
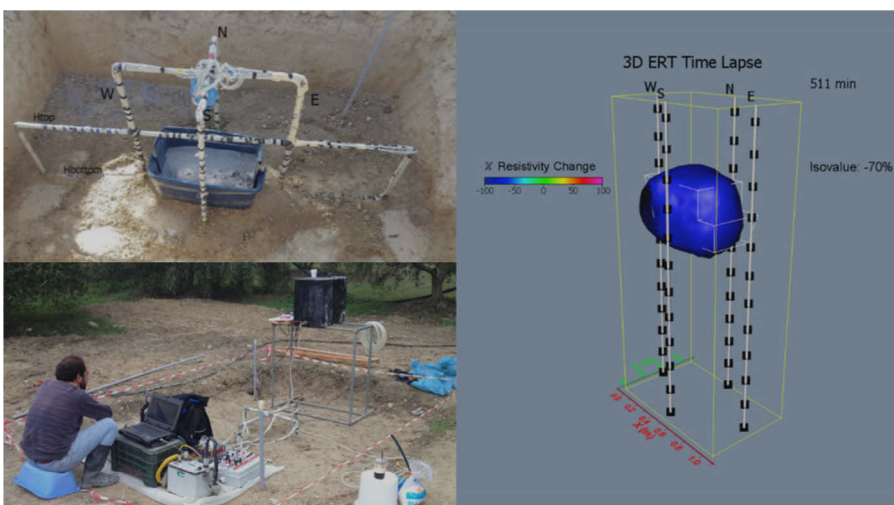

Figure caption: Underground target's position with coarse soil filled slowly with salt water (pollutant) (top left). Monitoring using electrical tomography data acquisition (bottom left). Resistivity data results with the conductive "pollutant" indicated with blue color at the final phase T7 (right).