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Using a new multichannel GPR and ERT method for high resolution archaeological mapping: application to a buried Gallo-Roman site in Normandy, France

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We report on successful geophysical observations above a buried Gallo-Roman theatre in Normandy, France. The main objective of this study was to complete the previous archaeological surveys in order to localize the structure and precise its depth.
The 100 m diameter theatre, lying between 50 cm and 3 m depth, was investigated using 1) a new multichannel Ground Penetrating Radar (GPR); 2) a 2D Electric Resistivity Tomography (ERT) and 3) geotechnical soundings. The multichannel GPR (IDS Stream X) is composed of 7 antennas working at a frequency of 200 MHz and with a spacing of 12 cm. Therefore, such system is well adapted to large-scale high-resolution surveys. In our case, the GPR was able to investigate the entire zone (1600 m2) in few hours. This survey led to the characterization of the subsurface up to 3 m depth.
To complete the information obtained with the GPR, seven ERT profiles were acquired longitudinally and transversally to the structure. A Terrameter LS imaging system (ABEM) was used with a dipole-dipole configuration; as such protocol is sensitive to vertical structures. Three profiles are 32 m with a spacing of 1 m between electrodes, 2 profiles are 16 m with a 0.5 m spacing between electrodes, 1 profile is 19.20 m with a spacing of 0.6 m between electrodes and 1 profile is 64 m with a spacing of 1 m between electrodes. Such approach allowed to inverse the electric data up to a depth in the range 4-10 m.
An excellent correlation is obtained between both methods, allowing us to propose a precise 3D visualisation of the Gallo-Roman theatre, in agreement with a partial model obtained from the previous archaeological surveys. Moreover, this study led to the discovery of other structures (confirmed by geotechnical soundings) and thus to complete the current archaeological model of the site. The Multichannel GPR clearly offers new potentials for the large-scale imaging of the subsurface. Combined with other geophysical and archaeological methods, it is a powerful tool for future 3D characterization of buried structures within the soil.