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High resolution GPR investigation combining different frequencies. The survey of Circus Maximus (Roma, Italy).

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The Circus Maximus (Circo Massimo) is an ancient roman arena located in the city of Roma between the Palatine hill and the Aventine hill in the central archaeological area of the city. The structure, with dimension of 600 m in length and 140 in width, is considered the biggest play arena ever built by men. By a geological point of view the unit was built in the Valle Murcia, a depression 34 m deep under sea water level, today filled up with alluvial deposits and dug in the sea deposits of the Plio-Pleistocene (M. Vaticano Unit). At the sides of the valley Murcia were set down sedimentary deposits of the Paleo Tevere and tuff originating from the volcanic district of Colli Albani, followed by fluvial debris younger than the volcanic age. The whole area is covered by a layer of recyclable materials with a not very deep aquifer layer in between. Since XIX the circus has been used as an agricultural area and in 1900 the Gasometro was built inside the framework; from 1937 to 1940 the National Fascist Party organised textile and mining exhibitions in the area, only after the war the circus became the green area that today still is.
In this complex site a series of GPR surveys employing different frequencies were carried out. For the field measurements two different GPR SIR Systems (GSSI), one equipped with a 400 MHz bistatic antenna and the other employing a 70 MHz monostatic antenna, were used. Acquisition was made using a high-resolution approach in which parallel profiles were recorded very closely across the site. Signal processing, image processing, and visualization techniques have been used in conjunction with data modelling, elaboration, and interpretation of the recorded subsurface amplitudes. Some of the recorded data were synthesized using GPRSIM simulation software to perform forward modelling. In this process we use simulation software in an iterative approach by guessing a model, running the simulation, and then comparing the simulation with a real recorded radargram collected over the site.
With the aim of obtaining a planimetric image of all possible anomalous bodies, the time-slice visualization technique was applied using GPR-SLICE software (v.7, 2017). Time-slices are calculated by creating 2-D horizontal maps of the averaged squared amplitude of the radar wave in a specified time window and spatial window across parallel profiles. Filtering was used to remove the background reflections. Using these spatial averages, interpolated and solid 3D volumes of reflections amplitudes were generated. The preliminary results, after the integration of the images obtained with different frequencies, are presented and discussed.