Detecting infiltration pathways by means of multi-method geophysical interpretation: an urban case study

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Engineering-geophysical tasks in urban environments pose significant challenges for both the collection and interpretation of geophysical data. Typical problems that arise consist of background noise affecting seismic methods (i.e., moving cars or pedestrians), electromagnetic fields due to power lines and other infrastructure distorting electrical and electromagnetic methods and even traffic itself, requiring a thorough planning of fieldwork in order to minimize interruptions. To mitigate such limitations, commonly a combination of several geophysical methods is applied to counterbalance the caused distortions by a careful analysis of the data and combined modelling of the available information. Following this notion, we present a case study conducted in an urban setting in the first district of Vienna, a busy place in terms of both traffic and number of pedestrians. The objective was to delineate possible infiltration pathways of surface water or shallow subsurface water, infiltrating into an ancient cellar complex with a delay of two days after rainfall. The geophysical imaging included seismic refraction (RST) and multichannel analysis of surface waves (MASW), complex conductivity imaging (CCI) and ground-penetrating radar (GPR) measurements to characterize the subsurface architecture below the street (i.e., above the cellar) and CCI and GPR from within the cellar along the outer wall (i.e., below the street). Based on a combined analysis of the datasets from the street and the cellar itself, and incorporating 3D information from LiDAR within the cellar, we propose a model of infiltration pathways, as well as zones in the cellar wall possibly already strongly weakened by continuous high soil moisture.