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Long term ERT monitoring of sinkholes using 3D surface arrays: a laboratory experiment

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Accurate methodologies are required to manage risks linked to land-use planning in covered karst terrains, especially in densely urbanized areas. The main risk lies in the occurrence of sinkholes at the base of buildings or infrastructure. We conducted a laboratory experiment to evaluate the contribution of ERT monitoring in the long term management of such karst risks. After presenting the design of the laboratory experiment, we detail the selected scenarios. The methodology proposed to process the data and manage the inversion results relies on two steps: (1) we estimate the resistivity variations due to measurement and inversion errors based on Monte-Carlo simulations and (2) we define a resistivity changes index for every cell of the 3D model. The methodology is tested on a 3D surface survey including classical array configurations (inline dipole-dipole, equatorial dipole, Wenner-Schlumberger) and optimized survey protocols. Several plastic balls (7, 14 and 21 cm in diameter) are used to model sinkholes of 2.5, 5 and 7.5 m in diameter at depths ranging from the surface to 56 cm, corresponding to a maximum depth of 20 m at the field scale. The PVC tank used for the laboratory experiment was filled with deionized and demineralized water in which NaCl salt was added to reach a 550 ohm.m background resistivity. Variations in water resistivity and temperature during the experiment were monitored using conductivity and temperature probes. Based on the proposed methodology, we draw maps of the deepest detection depths depending on the target size, the array configuration selected and the lateral position of the target (from the centre to the border of the 3D survey).