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3D characterisation of doline-cave coupling zone by using 3D laser scanning and electrical resistivity tomography

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Geoscience has been devoting increased attention to understanding the complex pathways and flows of material, energy, and the multidimensional coupling between various geological systems. This understanding includes the "concept of connectivity", which provides an overall framework better to investigate hydrological systems. So far, the concept has largely been used for fluvial geomorphic systems, whereas we intend to use it within the karst system. In relation to the concept of connectivity between the karst surface and subsurface, hydrological, sediment, and geochemical connectivities are the most relevant from the perspective of geoscience and to measuring human impacts through a long time span.

Our main interest is to study the direct flow between enclosed karst depressions (solution dolines) and near-surface caves (50 m below the surface) that are prone to human influence. The doline-cave coupling zone represents the upper part of a karst aquifer for which specific connectivity characteristics between dolines and near-surface caves can be identified. Polina peč Cave (NW Dinaric Karst) was selected as a case study cave. We used geoinformatic methods (three-dimensional (3D) laser scanning) and available data (Registry of maps, Lidar DEM 1x1m, optical remote sensing data), geomorphometric analyse, geological mapping and surveying. With precise georeferencing (using the GNSS system), we placed the 3D point cloud of the cave in a geographical coordinate system, compared 3D cave map with the surface map (using existing national aero-laser scanning data – Lidar DEM 1x1m), and selected dolines that are most directly connected to cave. The results were controlled and further improved by geophysical methods (electrical resistivity tomography/ERT).