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Revealing hidden karst structures: From geophysical measurements towards predictive modelling

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Shallow caves and karst structures in soluble rocks can be detected from the surface with a variety of geophysical methods. Gravity reveals cavities through the negative Bouguer-anomalies associated with the air- or sediment-filled voids. Electrical resistivity tomography reflects the different infill of cavities, either high resistivities from air-filled voids or dry soft sediments, or low resistivities from saturated sediments. Georadar measurements reveal structural information from the boundaries between cave and rock, and from layered sediment filling the passages. We have surveyed several sites above known shallow karst caves in dolomite and in gypsum with a combination of gravimetry, electrical resistivity tomography, and georadar surveys to detect the signal of the underlying karst objects. We successfully located the caves with at least two of the geophysical methods. Additional information on the structure of the caves could then be revealed by simple two-dimensional forward modelling of selected caves. We further improved the modelling perspective with the development of a new three-dimensional program tool PREDICTOR, which is able to simulate geophysical signatures of the sub-surface voids below a realistic surface located in an aquifer. Results from a first version of this tool will be presented.