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ERT monitoring of the vadose zone of a karst system sounds like a challenge!

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Geoelectrical monitoring has proved its efficiency to provide valuable information in multiple contexts such as active landslides, landfills pollution, dam infiltration or permafrost melting. In other environments, such as karsts, ERT monitoring has not been broadly used.
In karst systems, the vadose zone plays an important role in the water dynamics. In particular, temporary perched aquifers can appear in the subsurface due to changes of weather conditions, reduced evapotranspiration and the vertical gradients of porosity and permeability. Seasonal water variations in the infiltration zone of a karst system should then be observable with ERT. Monitoring these variations may help separate the hydrological signature of the vadose zone from that of the saturated zone. This information is thus required for understanding hydrological processes that occur in a whole karst system. However, such hard rock environments can be very heterogeneous, which makes ERT monitoring quite challenging.
We present a case study where ERT monitoring is being used to track groundwater changes at the Rochefort Cave Laboratory (RCL), located in the Variscan fold-and-thrust belt (Belgium), a region that has many karstic networks within limestone units. Our investigations cover two years of hydrogeophysical monitoring.
The permanent ERT monitoring takes place on a daily basis and is composed of an unconventional combination of a 2D ERT profile with a pronounced topography, and a vertical borehole crosscutting the vadose zone. Recent work on ERT survey optimization applied to this specific case is discussed, and conventional surveys (e.g. dipole-dipoles) are compared with the optimized surveys. Data inversion is performed using BERT.
For validating the assumptions based on ERT data analyses of the RCL site monitoring, we are especially focusing on groundwater changes that can be correlated with microgravimetric monitoring installed at the same site, integrating both vadose and saturated zone signatures. Correlation with direct measurements of dripping within the underlying cave network is also investigated.