Geoelectric monitoring during pumping tests

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In summer 2020, a pumping test lasting for 5 weeks was performed to characterize the hydraulic groundwater conditions. It was accompanied by a geoelectric monitoring profile, several water pressure probes, soil humidity probes and a pluviometer. The pumping test gave us the chance to understand, how a falling or rising water level influences the monitored geoelectric resistivity. The geologic/lithologic situation at the test site is as follows: quaternary fluvial deposits (2 m thick top layer of sand followed by the 6m gravelly aquifer) lying on top of water-impermeable Pannonian silt. The calculated water permeability is $3.5*10^{-3}$m/s.

A total of 260 data sets, consisting of 2344 data points each and gathered at an interval between 1-6 hours, was inverted for selected periods with the 4D-Inversion software developed by KIGAM (Kim et al., 2013). During the 5 weeks lasting pumping test, different pumping rates with pumps located in the vicinity of the geoelectric profile and precipitation events influenced the change of the ground water level. The pumping rates were increased several times, so a stepwise lowering of the ground water level, reaching a maximum change of 2.6m, was monitored with pressure probes. In this period, no significant el. resistivity changes were observed in the corresponding subsurface area. We assume that there is still a significant amount of adhesive water, which takes longer to run off. There are several other effects, such as soil moisture and temperature changes, which had a stronger influence on the el. resistivity in the superficial subsurface area. Moreover, a small leakage in one of the water pipes at profile meter 36.5 shows the influence of water infiltration. So the groundwater level decrease is masked by these effects. On the contrary, when the pumps were turned off at once, the aquifer is flooded within a few hours and causes a significant change of el. resistivity. Yet, the changes are only clearly visible directly at the location of the pumps.

It is obvious that there cannot be a difference in the absolute change of the el. resistivity between the ground water decrease and increase. The only significant difference is the time span for the change. This confirms our assumption from previous landslide monitoring, that you cannot see subsurface soil moisture changes with geoelectric monitoring if the water content does not change rapidly and distinctively.

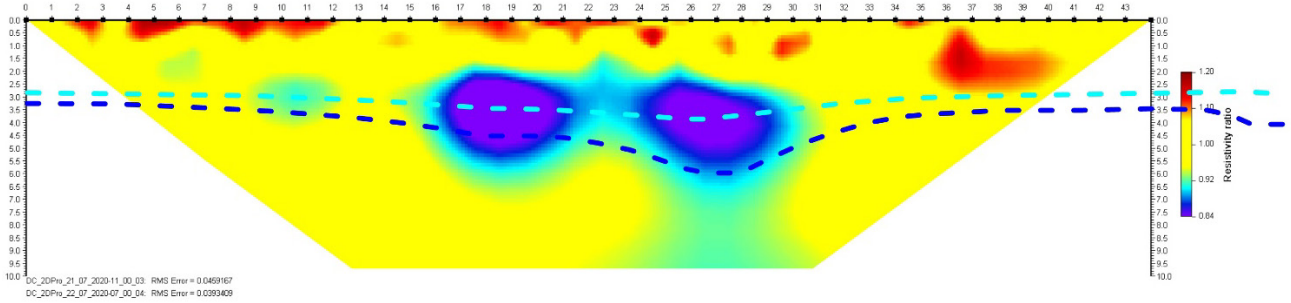

Figure caption: Resistivity ratio of the 4D inversion, before and 20 hours after shut off of the pumps, which are located at 19m and 26m and after the end of the profile. The dark blue line indicates water level before, the light blue level after shut off.

Kim J.H., Supper R., Tsourlos P., Yi M.J. (2013): Four-dimensional inversion of resistivity monitoring data through Lp norm minimizations. – Geophysical Journal International, 195(3), 1640–1656, Doi: https://doi.org/10.1093/gji/ggt324