Joint inversion of electric and seismic data applied to permafrost monitoring

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keywords: permafrost, joint inversion

The non-uniqueness and limited resolution of inverse problems may result in misinterpreted inversion solutions. The improvement of the inversion and its quality check are consequently a basic and crucial step in the data processing. Electrical resistivity tomography (ERT) and refraction seismic tomography (RST) bring complementary information regarding the ice content, as elastic and electric properties are markedly different for ice, water and air. We believe that a joint inversion can help significantly to reduce the uncertainties in the individual inversions and will improve the interpretability of the subsurface model.

A petrophysical joint inversion using pyGIMLI (Rücker et al., 2017) is applied to a mountain permafrost long-term (> 10 years) monitoring site. Both ERT and RST measurements are conducted since 2005 at the Schilthorn monitoring site (Swiss Alps) at the end of summer, i.e. at the time of the year when the active layer thickness is largest (Hilbich, 2010; Hilbich et al., 2008, 2011). Assuming that the lithology and soil structure do not vary with time, changes in resistivity/P-wave velocity can be fully attributed to changes in the unfrozen water/ice content.

In this contribution, we discuss data quality and improvements by joint inversion over individual inversions. Ground truth data are available through temperature measurements within two boreholes along the profile and allow a joint interpretation with the geophysical data.

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