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Highlights from two years of geoelectrical monitoring of permafrost at the Magnetköpfl/Kitzsteinhorn

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Changes of climate parameters due to global warming generate increased permafrost warming and deglaciation in alpine regions. The area of interest is the Magnetköpfl, a peak below the Kitzsteinhorn (3203 m), where scientists observe increasing rock instability due to the probable degradation of permafrost and the rapid lowering of the glacier surfaces adjacent to the rock faces (loss of natural abutment, exposure of rock to atmospheric influences). Geoelectric measurements are an adequate method to measure permafrost, since the underground electric resistivity is highly dependent on temperature and the amount of unfrozen pore water. In October 2011 a geoelectrical monitoring profile with the GEOMON4D was installed on the north facing ridge of the Magnetköpfl. Measurements of soil temperature on the profile support the interpretation of geoelectric data.

Maximum active layer depth at the Magnetköpfl is approximately 3 m. Seasonal variations of ground temperature can be observed up to a depth of 8-10 m below surface. The two year period of data collection allows us to analyse time series of average apparent resistivities compared with the climatic seasons. It can be seen that different temperature periods have a direct correlation to average apparent resistivity. Inversion results of geoelectrical monitoring data are derived from an innovative 4D resistivity inversion approach (Kim et al, 2013). In three selected events (thawing and freezing in spring, thawing in summer, freezing in fall) difference images of the 4D inversion show the depth range of the temperature influence. The temperature sensors at the profile only reach 0.8 m below ground level.The geoelectrical monitoring data is able to deliver far more (thermal) information than single point temperature measurements since the underground electric resistivity is highly dependent on temperature.

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