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Ice content and ice origin of mountain permafrost occurrences using electrical resistivity tomography

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Determining the ice content and the origin of ground ice occurrences in mountain permafrost regions are important tasks for all kind of permafrost related studies, such as geotechnical analyses concerning the stability of frozen rock faces and debris slopes, or periglacial process studies such as the genesis of rock glaciers and moraines. In the absence of boreholes, geophysical methods, and especially Electrical Resistivity Tomography (ERT), are commonly applied.

Due to the strong sensitivity of electrical resistivity to the phase change from unfrozen water to ice, the application of ERT is principally suitable to spatially delineate ground ice, differentiate between ice-poor and ice-rich occurrences and determine the origin of the ice, i.e. buried glacier ice or segregated ice, due to their different ion contents (yielding a reduced resistivity for the latter).

In practice, a number of problems and uncertainties often prohibit the determination of ice content and ice origin from electrical resistivities alone. This concerns espe-

cially the comparability of obtained specific resistivity values between different field sites and their interpretation regarding varying ice contents and origins. The sources of uncertainty are partly based on the necessity to choose a set of inversion parameters for calculating the specific resistivity distribution from the measured apparent resistivity data set. In addition, high contact resistances at the surface, the choice of an initial model for the inversion, the measurement geometry and unknown factors in the material composition of frozen ground, such as high unfrozen water content, big air-filled cavities or the presence of fine material or saline pore water can influence the obtained specific resistivity values at each site.

In this contribution we will compare ERT results from different permafrost occurrences in the European Alps, Scandinavia, Svalbard and Antarctica including rock glaciers, glacier forefields and rock walls. The range of observed resistivity values of similar periglacial morphologies will be compared to the range of specific resistivities resulting from the various uncertainty sources in order to analyse the limitations of ERT-derived resistivity values for the determination of ice content and ice origin of mountain permafrost occurrences.