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Internal Structure of Periglacial Landforms: Assessment using 3D Electrical Resistivity Imaging (ERI)

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The occurrence of internal heterogeneities within periglacial landforms (e.g. frost table topography or varying ice content) is in most cases not inferable from the surface. Hence, to develop an enhanced understanding of the interaction between surface and subsurface processes, it is necessary to analyse the internal structure of different periglacial landforms and landform elements. The assessment of the internal structure is provided by the application of three-dimensional Electrical Resistivity Imaging (ERI). ERI is the technique of merging datum points from several parallel and perpendicular performed two-dimensional ERT (Electrical Resistivity Tomography) measurements and inverting the data set with a 3D inversion algorithm (sometimes also referred to as quasi-3D ERT). The application of this method has proven to be a valuable tool for mapping the spatial extent of isolated permafrost bodies and associated subsurface conditions. In this contribution, we present results from four ERI measurements, carried out in summer 2014 at different investigation sites in the Swiss Alps: Three measurements were performed on pebbly rockglaciers of different size and topographical position and one measurement was performed on a solifluction slope. Each of the 3D survey grids consists of 17 to 32 single 2D ERT surveys (Dipol-Dipol or Wenner-Schlumberger array) and covers an area of between 6000 m^2 and 7000 m^2, depending on the specific survey grid set-up. The inversions of the data sets were performed using the two different inversion algorithms of the software products “RES3DINV” and “BERT” (Boundless Electrical Resistivity Tomography) for a comparative analysis and to further support the geomorphological interpretation of the geophysical models. Each of the resulting resistivity models shows strong small-scale spatial heterogeneities between the investigated landforms but also within landform elements. For the investigated rockglacier sites, these structures include anomalies referred to as embedded snowbanks and ice remnants of sedimentary origin. According to our results, we presume that these structures also influence rockglacier hydrology. With another measurement grid which was stretched over parts of two adjacent pebbly rockglaciers, we could detect a strong contrast between their specific resistivity regimes. This is probably caused by their material composition as the sources of rock fall are from different geological layers. At the investigated solifluction slope, the survey grid contained several solifluction lobes and the resulting model reveals that some of them are influenced by contemporary permafrost occurrences while adjacent lobes do not show any signs of frozen ground in the shallow subsurface.