Geophysical Research Abstracts,
Vol. 11, EGU2009-5302, 2009
EGU General Assembly 2009

Quasi 3D Geoelectrical Imaging as a new application for permafrost investigations: Some methodological aspects

A. Bast and C. Kneisel

Department of Physical Geography, Würzburg, Germany (a.bast@uni-wuerzburg.de)

The two-dimensional electrical resistivity tomography (ERT) application is a common tool to investigate periglacial environments and has evolved rapidly over the last years. The method has been often applied with great success in mountainous systems even though they are characterized by a complex heterogeonous and rough terrain. Despite the development of advanced instrumentation and commercial three-dimensional processing software, in general the two-dimensional approach is used. True three-dimensional measurements in high mountain environments are difficult to realize due to the rough and complex domain. However, up to now, an efficient three-dimensional geophysical mapping of the subsurface characteristics and lithology in alpine environments has not been possible. An auspicious approach is to sound the subsurface with two-dimensional measurements, each of them is routinely being interpreted with commercial software packages and then the results are merged to generate a quasi or pseudo three-dimensional geoelectrical image of the subsurface.

Our study presents first results of two quasi 3D geoelectrical images, located in the Val Muragl glacier forefield, Upper Engadin, Swiss Alps. The site of the first model is in the lower part of the forefield the second in the upper part. They distinguish between the surface material: While the lower part is characterized by coarse blocky but although finer grained surface material, the upper site consists of much more finer grained substrate. At both sites a permanently geoelectrical monitoring survey-line is installed, as well as a borehole, which was drilled in summer of 2006 and extent to a depth of 8m below ground surface. Furthermore, miniature temperature logger, BTS (bottom temperature of snow cover) and seismic refraction data are available for the glacier forefield. Data acquisition has been undertaken with a multi-electrode Iris Syscal Junior Switch equipment, data processing with different commercial software packages, mainly Res2Dinv, Res3Dinv (both Geotomo Software) and Slicer Dicer (Pixotec). The processing software Res2Dinv and Res3Dinv perform a smoothness-constrained inversion using finite difference forward modeling and quasi-Newton inversion techniques to model the subsurface conditions, whereas the Slicer Dicer software is used for visualization of the three-dimensional data.

The first model consists of 22 merged two-dimensional surveys, 10 along the x-axes and 12 along the y-axes. 36 electrodes were involved in each survey-line, the spacing between the electrodes is 5m, the geometric configuration is the Wenner array. The distance between each survey-line in the x- and y-plain is 15m (triple electrode spacing). So a grid of 175m x 175m was built up, with 792 electrode positions and 4356 data points. The second image consists of 17 combined surveys, 10 along the x-axes and 7 along the y-axes. The spacing between the 36 electrodes is 2m, the geometric configuration is the Wenner Schlumberger array. The distance between each survey-line in the x-plain is 8m (quadruple electrode spacing) and range in the y-plain between 24m and 8m, the result is a higher resolution in the central part of the 72m x 72m grid with 612 electrode positions and 4896 data points.

Data acquisition, data processing and problems to generate the quasi 3D images as well as the positive and negative aspects of this new approach in geophysical modeling of the subsurface in mountainous periglacial environments will be the main focus of this contribution.