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Quantifying the ice content in low-altitude scree slopes using geophysical methods

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In partly or permanently frozen ground the subsurface material may constitute of four phases: solid (rock), liquid (unfrozen pore water), gaseous (air-filled pore space) and another solid phase (frozen pore water, ice). The actual constitution of the subsurface can only be determined by direct observations in boreholes (which can be costly in permanently frozen areas) or through indirect geophysical measurements. In order to determine the actual volumetric fractions of the four phases (namely the ice content, air content, water content and porosity) Hauck et al. (2005) proposed a 4-phase model based on 2-dimensional resistivity and seismic velocity data sets. Inversion of resistivity and seismic data was performed using RES2DINV and a refraction tomographic inversion scheme introduced by Lanz et al. (1998), respectively. The model was originally tested on two Alpine rock glaciers with spatially variable ice content and ground truth obtained by boreholes.

In many periglacial applications the detection and quantification of ground ice is the important task. For example low-altitude central European highlands slope sections covered with blocky material may contain ground ice througout the year due to microclimatic conditions that resemble those of high latitude or high altitude periglacial areas. Essential preconditions for this extraordinary microclimatic phenomenon are assumed to be a thick layer of blocks with an open void system, i.e. steep slopes with almost no fine material. Summer ice observations in the near subsurface and the occurrence of cold adapting mosses and different invertebrate groups (e.g. beetles and spiders) normally living in high alpine or polar areas are normally used as indicators for the possible presence of ground ice (Gude et al. 2003, Zacharda et al. 2005). However, the hypothesis whether significant ice occurrences could be permanently present within the scree slopes is still an open question.

In this contribution the 4-phase model is applied to this problem using data sets from a series of geoelectric and seismic surveys on low-altitude scree slopes in Central Europe. First results indicate that the geophysical techniques used and the proposed 4-phase model are indeed capable of visualising possible ice occurrences within these unique geomorphological and microclimatic phenomena. In addition, sensitivity studies will be presented showing the dependency of the model on the inversion routines, the free parameters in the 4-phase model and on uncertainties in the determination of the material constants (e.g. the seismic velocity of the host material).

References:

Gude, M., Dietrich, S., Mäusbacher, R., Hauck, C., Molenda, R., Ruzicka, V. and Zacharda, M. (2003): Permafrost conditions in non-alpine scree slopes in central Europe. In: Permafrost (eds: Phillips, Springman, Arenson), Swets Zeitlinger, Lisse, 331-336.

Hauck, C., Böttcher, M. and Kottmeier, C. (2005): Modellierung von 4-Phasen Gemischen in gefrorenem Untergrund auf der Basis von Geoelektrik und Seismik. Proceedings 65th Jahrestagung der Deutschen Geophysikalischen Gesellschaft (DGG), Graz, Austria, 47-48 (in german).

Lanz, E., Maurer, H.R. and A.G. Green (1998): Refraction tomography over a buried waste disposal site. Geophysics, 63 (4): 1414-1433.

Zacharda, M., M. Gude, S. Krause, C. Hauck, R. Molenda and V. Ruzicka (2005): The relict mite Rhagidia gelida (Acari, Rhagidiidae) as biological cryoindicator of periglacial microclimate in European highland screes. Arctic, Antarctic and Alpine Research, 37 (3): 402-408.