MONITORING THE UNFROZEN WATER CONTENT AT AN ALPINE PERMAFROST SITE

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A geophysical monitoring approach to determine the permafrost evolution at a high-elevation site in the Swiss Alps is presented. Repeated measurements of 2-dimensional electrical resistivity profiles during one full year are used to detect resistivity changes related to freezing and thawing processes and to determine the evolution of the unfrozen water content. A fixed-electrode array allows measurements independent of the snow cover thickness. The 2-dimensional tomographic approach yields information about spatially variable transient processes, like the advance and retreat of freezing fronts or the infiltration of rain water.

Maximum resistivity changes were observed during freezing in autumn before a permanent snow cover has been established and in late spring, when the thawing snow cover and additional water from precipitation greatly increased the unfrozen water content near the surface. In combination with laboratory experiments and borehole temperature data, the degree of water saturation at different depths could be estimated. The temporal evolution of the unfrozen water content showed a strong decrease during the winter months in the near-surface layer and a quasi-sinusoidal behaviour at greater depths. This approach seems promising for future long-term monitoring programmes of the permafrost evolution at low costs.