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Continuous recording of seismic signals in Alpine permafrost

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Over the past years various geophysical methods were applied to study the internal structure and the temporal variation of permafrost whereof seismic is of importance. For most seismic investigations in Alpine permafrost 24-channel equipment in combination with long data and trigger cables is used. Due to the harsh environment source and geophone layouts are often limited to 2D profiles. With prospect for future 3D-layouts we introduce an alternative of seismic equipment that can be used for several applications in Alpine permafrost.

This study is focussed on controlled and natural source seismic experiments in Alpine permafrost using continuous data recording. With recent data from an ongoing project ("Permafrost in Austria") we will highlight the potential of the used seismic equipment for three applications: (a) seismic permafrost mapping of unconsolidated sediments, (b) seismic tomography in rock mass, and (c) passive seismic monitoring of rock falls. Single recording units (REFTEK 130, 6 channels) are used to continuously record the waveforms of both the seismic signals and a trigger signal. The combination of a small number of recording units with different types of geophones or a trigger allow numerous applications in Alpine permafrost with regard to a high efficiency and flexible seismic layouts (2D, 3D, 4D). The efficiency of the light and robust seismic equipment is achieved by the simple acquisition and the flexible and fast deployment of the (omni-directional) geophones. Further advantages are short (data and trigger) cables and the prevention of trigger errors. The processing of the data is aided by 'Seismon' which is an open source software project based on Matlab® and MySQL (see SM1.0). For active-source experiments automatic stacking of the seismic signals is implemented. For passive data a program for automatic detection of events (e.g. rock falls) is available which allows event localization.

In summer 2008 the seismic equipment was used for the three different types of applications. It enabled fast and efficient field work and provided excellent seismic data at two permafrost sites. At Krummgampen Valley (Ötztal Alps, Tyrol) 13 seismic profiles were measured at altitudes ranging from 2400 to 2900 m to assess information on the permafrost occurrences. At the crest of Hoher Sonnblick (3106 m, Hohe Tauern, Salzburg) seismic signals were recorded on 15 borehole geophones deployed in three 20 m deep boreholes for the application of seismic tomography and passive monitoring of rock falls.