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Permanent geoelectrical monitoring in a permafrost region (Mölltaler Glacier)

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Changes of climate parameters due to global warming generate increased permafrost "warming" in Alpine regions, thus involving severe environmental and engineering problems. Underlying processes are still not completely understood. The geoelectrical method could be the method of choice to monitor these processes. Up to now one major problem of geoelectric applications in permafrost areas was that the repetition of the data acquisition had to be done manually – i.e. someone had to accomplish the measurements at the geoelectric profile. Therefore measurements could be performed only every couple of weeks (maximum), depending also on the accessibility of the test site, which could be a problem during winter times. However experience has shown that a high repetition rate is inevitable to monitor short and long periodical changes with high accuracy. An innovative, remote controlled automatic geoelectrical system, GEOMON4D, has been developed by the Geological Survey of Austria to overcome these problems. This system has been tested for monitoring of landslide areas since 2002. From 2007 to 2009 a testing period at the Sonnblick observatory was carried out to evaluate the framework conditions for continuous monitoring of permafrost using the geoelectric method. Based on these results the GEOMON4D system had to be adopted for optimised performance for continuous geoelectric monitoring in permafrost areas. One problem with the expected very high electrical resistivities is that the measured potential could exceed the maximum resolution of the input channel of most commercially available measuring systems. Therefore a constant current source with an automatically adjustable electrical voltage for current input and a high resolution current sensor were added to the system. Additionally the application of fuel-cells for maintenance free long period power supply was tested. In September 2010 an 80–electrode monitoring line was installed at an altitude of 2760 m close to the Mölltal Glacier in Carinthia, Austria, powered by one fuel cell. Since that time the system has been measuring one depth section in gradient configuration each day without interruption. The results are sent automatically to the monitoring centre in Vienna for further processing. The results of this monitoring period show a good correlation of resistivity variations with temperature changes and freezing processes.