



Freeze-thaw cycles and frost shattering potential at alpine rockwalls in the Hohe and Niedere Tauern Ranges (Austria) between 2006 and 2010

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Continuous temperature monitoring in steep alpine rockwalls is currently carried out at seven study areas in the Hohe and Niedere Tauern Ranges, Austria, within the projects ALPCHANGE, PermaNET and permafrost. ALPCHANGE is a project on climate change and its impacts on the alpine environment in southern Austria funded by the Austrian Science Fund (FWF) through project no. FWF P18304-N10. PermaNET is part of the European Territorial Cooperation and co-funded by the European Regional Development Fund (ERDF) in the scope of the Alpine Space Programme. The project permafrost is a first step to create a nationwide permafrost monitoring program in Austria and is funded by the Austrian Academy of Sciences. In this study, results from five study areas with a total number of nine rock wall locations (RWL) with surface boreholes are presented covering the period summer 2006 to summer 2010. Up to three temperature sensors have been installed at each surface borehole at vertical depths of 0/3 cm, 10 cm and 40 cm following set-ups of previous studies. The five study areas are (1) Hochreichart area/HOR at 47°22'N, 14°41'E with one RWL, (2) Dösen Valley/DOE at 46°59'N, 13°17'E with two RWL, (3) Hinteres Langtalkar area/HLK at 46°59'N, 12°46'E with two RWL, (4) Pasterze Glacier/PAG at 47°05'N, 12°44'E with two RWL, and (5) Hintereggen Valley/HEV at 46°55'N, 13°23'E with two RWL. Therefore, analyses on rockwall temperatures at a total number of nine locations at elevations ranging from 1960 to 2725 m a.s.l. were carried out. The collected data cover the period between September 2006 and September 2010 thus allow the comparison of the four periods of October-June 2006/7, 2007/8, 2008/9 and 2009/10. The first studied period of October-June was substantially warmer (+3.2°C) in Central Alpine Austria compared to the standard normal period 1961-1990. The second period 2007/8 was 1°C warmer. In contrast, the third and fourth studied periods were almost normal. Focus in the analyses was laid on mean 4-year values and interannual changes of different temperature related parameters at the rock surface and at depth. These are (a) mean ground temperatures/MAGT, (b) ground freezing index/GFI, (c) snow cover duration/SCD, (d) the number of freeze-thaw cycles/FTC, and (e) number of effective freeze-thaw cycles/eFTC for frost shattering. Results are also discussed in a broader context in particular with considerations regarding climate change.