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Systematic derivation of anchoring forces in permafrost-affected bedrock

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High-alpine environments have been demonstrated to react particularly sensitive to recent climate warming. While the thermal response of mountain permafrost to atmospheric warming is usually lagged and attenuated, it is still widely expected to create major engineering problems for high-alpine infrastructures in the foreseeable future. Degradation of permafrost in high alpine regions potentially causes massive negative changes in bearing capacity of affected bedrock/subsoils. Building structures, which are founded on such permafrost-influenced bedrock/subsoils, can be severly damaged by changes in their support conditions. Piles and anchors are the most common engineering measures for the stabilization of such foundation-systems in bedrock . However, despite their frequent use only very limited long term data are available on the mechanical behaviour of anchors in permafrost affected bedrock.
This contribution addresses the need for continuous, high-quality data on subsurface conditions in high-alpine locations. At the open-air laboratory Kitzsteinhorn (OPAL) three anchor load plates were installed to measure anchor load and temperature. Rock temperatures up to a depth of 30 m are available from two deep boreholes located in the immediate vicinity. Anchor loads vary significantly between summer and winter. During summer anchor loads stagnate at approximately 450 kN. In autumn anchor load values constantly increase until they reach a maximum of 530 kN in January. Seasonal variations are quantified and physical phenomena and their possible order of magnitude are considered to derive a mechanical model of the system anchor in permafrost affected bedrock.