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Permanently frozen ground and related ground movements: new applications in dendrogeomorphology

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The occurrence of permafrost and related landforms (rockglaciers) is a widespread phenomenon in many high mountain geosystems. In the context of changing environments due to the significant warming, there is a need for thoroughly monitoring and analysing the complex response of the considered geosystems. Hence, diverse methods like geomorphic mapping, geodetic survey as well as photogrammetric analyses were applied for the determination of permafrost distribution and rockglacier kinematics in order to understand the sensitivity of periglacial processes to climatic changes. In this study the first-time application of dendrogeomorphological methods in this context is presented.

To determine the impact of permanently frozen ground and the influence of ground movements (by permafrost creep) on plants, wood-samples were taken from active and inactive rockglaciers in the Turtmann Valley, southern Swiss Alps. Due to their typical position above timberline, the occurrence of trees is limited. Therefore, the investigation was restricted to single trees (Pinus cembra) and several shrubs (mainly Salix helvetica). The plants sampled cover a period of 30 to 40 years. Besides the analysis of ring-width variations, the analysis focused on the anatomical structure of the rings and the distribution of vessels in stems and roots.

The findings indicate a probable influence of the ground movement on the plants. The reaction wood in a Pinus cembra stem at the rockglacier front clearly suggests an increase in horizontal velocity in the beginning of the 1990s which is supported by velocities quantified by photogrammetrical analyses. Regarding the Salix helvetica shrubs, no obvious differences in ring width variations between the unstressed and

stressed samples from the inactive and active rockglaciers, respectively, were found. However, a comparison of vessels within individual rings of the stressed and unstressed samples revealed general differences in size. Especially the vessels in roots taken from the inactive rockglacier tend to be larger than those from the stressed site.