

Submitted Abstract

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Title	Mapping Climate-Change Related Processes Affecting Mountaineering Itineraries To Encourage Climbers' Adaptation. Application To The Valais Alps (Switzerland).
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Abstract

Climate change leads to deep modifications of high Alpine environments, especially because of shrinking glaciers and permafrost warming. Associated geomorphological and glaciological processes have significant consequences on recreational mountain activities.

Although a growing number of studies have recently documented the effects of climate change on mountaineering itineraries, they only list the processes affecting them and do not document their characteristics or location. Therefore, the acquired data lacks relevance particularly to disseminate knowledge to mountaineers and to promote adaptive behaviors. In addition, these studies use different methodologies making the comparison and compilation of results difficult. Therefore, the main objective of the present study is to develop a specific legend to map the processes related to climate change that affect high mountain areas and modify climbing parameters. Such a legend should (i) ease data collection, (ii) make the data analysis simpler and (iii) favor the knowledge transfer to the mountaineer's community. More generally, this legend would provide a common methodological basis, destined to be completed and to be relevant out of the European Alps. It would also enable the comparability and compilation of results from different research.

On the basis of the processes identified in previous studies in the Mont Blanc massif and following the UNIL geomorphological legend, 21 symbols were defined to map 23 processes. The later were classified according to the terrain in which they take place: (i) glacier margins, (ii) glaciers, (iii) unglaciated and/or permafrost affected rock slopes, and (iv) ice aprons, hanging glaciers and snow ridges.

In order to evaluate the applicability and interest of the legend proposed, we present a first application on 36 itineraries in the Valais Alps (Switzerland). It is based on 21 semi-structured interviews with local Alpine guides and hut keepers during which they were asked to draw on the most recent topographic map available the long-term modifications of the itineraries they are able to identify. The changes mapped during the interviews were then remapped in QGIS and completed by a diachronic analysis of aerial images, topographic maps and DTMs.

The map then allowed to list the processes affecting each of the itineraries studied and to produce documents that promote the transfer of information to mountaineers and their adaptation. In this sense the map can be used on many occasions and in particular during the training of Alpine guides and conferences as well as being displayed in high-mountain huts.