

Perception and evaluation of natural hazards as a consequence of glacier retreat and permafrost degradation in tourism destinations

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In the cryosphere of the European Alps, glacial ice and permafrost respond sensitively to climate change. In this context, glacier retreat, increasing subsurface temperature, increase of slope instability, and mass movements indicate clearly climate and landscape change in alpine environments. Thus, these processes affect current and future potential of natural hazards to a considerable extent.

The study analysed, estimated and simulated the present and future extents of glaciers and permafrost related to geomorphologic changes. Furthermore, it was focused on impacts on geomorphologic hazards and risks for tourism in the upper Tuxer Valley. The geo-physical part of the study was based on a field survey, remote sensing and GIS. In order to study the risk perception and the expected behaviour of mountain tourists we used a web-based questionnaire.

In 1850 glaciers covered 20.6 km² along the main ridge of the Zillertaler Alps. At present, the glaciated area has been reduced to approx. 7 km² thus reflecting a decrease of 65%. As a consequence, only three glaciers will remain with a limited spatial extent. Mass movement relating to glacier retreat and degradation of permafrost, affects and limits high alpine tourism and recreation. In the meantime, due to the extensive retreat of glacier tongues, respectively to the complete meltdown of glacier surfaces, traditional mountain routes cross morainic debris and hardly accessible mountain flanks. Thus, the traditional mountain routes have now become much more challenging, time consuming and in consequence more risky, especially for hikers with average or below average skills. Many trails are affected by erosion, rock fall, meltdown of the glacier tongues to the exposure of steep terrain, the reduction of glacier thickness to the emergence of cliffs and significant changes to the runs of glacial creeks. In order to reduce or avoid associated risks, many high altitude trails, trails over passes, and access routes to alpine huts, have become more expensive to maintain or must be adapted to these new terrain features. In some cases new infrastructure, such as creek crossings, must be constructed.

A survey of over 300 high alpine tourists and recreationists documented the importance of anticipating these increasing concerns about risk and safety correctly, as well as planning mitigating measures early. One quarter of respondents feel strongly that they want to avoid any risk, while the vast majority (71%) is risk neutral, and only 4% are actually seeking risk. Half of all respondents are highly uncertain about the concept of danger and risk in the alpine environment, and any deterioration of what quickly lead to declining participation. These responses are based on a survey of regular visitors to the mountains, who are fairly familiar with the concepts, and who contribute significantly to the economic basis of the region with their expenses for accommodation and other trip related items.

The routes that should receive the major attentions for monitoring safety and improvements are the ones leading up to peaks, or which offer considerable time savings, as it is those reasons that are the most likely to make hikers take risks. The survey also showed that the preparation of maps is perceived to be primarily as the responsibility of the public sector (provincial and federal governments) and to a lesser extent, as the domain of the tourism sector. On the other hand, the marking of trails and provision of signage is perceived to be the predominant responsibility of the

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alpine clubs. These clubs should also be responsible for guiding and for training, as well as trail maintenance. One quarter of respondents suggested that the local communities be predominantly responsible for trail maintenance and marking, and other protective measures. Finally, the perceived responsibility for major investments, including more sophisticated maintenance of trails is spread more evenly between the provinces (32%), the local communities (22%), the tourism sector (21%) and the federal government (18%).

References

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