

# PERMAQUA: Permafrost and its impacts on water resources and water ecology in high mountain areas

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**Abstract** Permafrost has become an important issue in the European Alps. In South Tyrol (Italy), the area of permafrost covers about 440 km<sup>2</sup>, and in the Austrian Alps about 2000 km<sup>2</sup>. Active rock glaciers are a common feature of high mountain permafrost and due to their location near the lower boundary of permafrost, their mean annual surface temperature is close to melting conditions (Haeberli et al., 2006), which indicates their particular sensitivity to climate warming. Air temperature in the Alps has substantially increased during the past decades and climate warming is projected to become even more pronounced until the end of the 21st century. Increasing instability of slopes, landslides and floods, as well as alterations in the hydrological regime can be anticipated. Up to now, studies on the effects of active rock glaciers on hydrology and water chemistry of adjacent surface waters are still rare (e.g. Williams et al., 2006; Krainer et al., 2007; Thies et al., 2007; Baron et al., 2009). Results from the previous EU-RTD project EUROLIMPACS and the Interreg IV-Alpine Space project PermaNET showed that waters draining from active rock glaciers may contain high concentrations of solutes and at some sites also metals (e.g. nickel, aluminium), which can exceed the limit for drinking water by far. The origin of these metals is yet unresolved. Potential effects of solutes and metals on the ecology and on freshwater biota in high mountain lakes and streams in the Alps are still unknown. The current PERMAQUA project (Interreg IV Italy-Austria, European Regional Development Fund) combines studies on geology, hydrology, contemporary aquatic chemistry and freshwater biota, the analysis of lake sediment cores, peat cores and rock glacier ice cores near selected rock glaciers in South Tyrol (Italy) and North Tyrol (Austria). The PERMAQUA project aims to assess the impact of permafrost melt on high mountain freshwaters. The state-of-the-art knowledge about potential ecological impacts of permafrost melt and its consequence for man and the environment will be transferred to decision makers, managers, local residents and the general public. The present permafrost monitoring system, anchored at international level, will be updated and further developed in order to assure the future recording of permafrost variations due to climatic changes and to release estimation of danger situations arising in permafrost areas. Guidelines for possible risk mitigation strategies will be proposed and their implementation shall be tested in cooperation with public authorities, alpine associations, managers of protected sites, national parks, and of mountain shelters.

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