



## **Changes in glacier and permafrost distribution and natural hazards – Examples from Sulden-, Schnals- and Ultental (South Tyrol, Italy)**

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Due to the ongoing climate change, the spatial distribution of glaciers and permafrost has undergone significant changes, not only during the last 150 years, but also during the last decades.

For several valleys in South Tyrol, the lower boundary of permafrost and the glacier extents have been calculated and mapped for the time of the Little Ice Age as well as for 1990 and 2011. For the permafrost distribution, the results for the Little Ice Age are based on the activity classes of the rockglaciers in the area, which are available from the rockglacier inventory of South Tyrol, and on geomorphologic mapping. In the 1980ies and 1990ies, geophysical research and measurements of the base temperature of the snowpack were conducted to investigate the distribution of permafrost and the elevation of the lower permafrost boundary. For 2011, the rockglacier inventory was updated, based on multitemporal airborne laserscanning data and field work. In addition, new geophysical measurements and measurements of the base temperature of the snowpack were carried out. The results of all those investigations were used to calculate an estimated elevation of the lower boundary of permafrost for the different years depending on the sector of the terrain exposition. Based on high resolution digital elevation models calculated from airborne laserscanning data, the potential permafrost areas were determined.

Glacier extents for the Little Ice Age were mapped based on lateral and frontal moraines, using digital elevation models and hillshades calculated from airborne laserscanning data. For 1990, data from field investigations is used, while the glacier extents for 2011 were mapped based on data from a recent airborne laserscanning campaign.

Multitemporal airborne laserscanning data (2005 and 2011) was also used to map natural hazard processes, such as debris flows, landslides and rock falls, based on the surface changes caused by those processes.

The locations of those processes were then intersected with the newly deglaciated areas and the areas affected by permafrost degradation. This will enable conclusions on the connection between the retreat of glaciers and permafrost and the occurrence of those processes.