Investigations on Permafrost in the Doesen Valley (Hohe Tauern National Park, Austria)

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Abstract

In the past few years multidisciplinary research projects on high-mountain permafrost in the Austrian Alps (Eastern Alps) were carried out in order to obtain information on the distribution, characteristics and dynamics of permafrost. The work involved temperature measurements of springs and of the basis of the winter snow cover as well as other large-scale methods resulting in maps of permafrost distribution for selected test sites. Small-scale mapping of permafrost was mainly based on an inventory of rock glaciers, which comprises some 1450 rock glaciers and allows statements on the morphometric characteristics of these most important morphological expressions of high-mountain permafrost. Regarding all the information available so far the lower limit of discontinuous permafrost is situated near 2300 m in the marginal and near 2500 m in the central parts of the Austrian Alps. These results were also used for modelling the permafrost distribution within Geographical Information Systems.

Special investigations were done at the head of „Doesen valley“ in the Hohe Tauern range (approx. 2200 - 3100 m) using different methods such as geomorphological mapping, ground temperature measurements, refraction seismic survey, electromagnetic transects, and ground-penetrating radar soundings. Thus, realistic estimations of the depth of the active layer, the total permafrost thickness and the volume of the large active „Doesen rock glacier“ ($15.10^6 m^3$) were possible, all of them corresponding well with data from other parts of the Alps. Furthermore, this rock glacier was the subject of geodetic and cartographic work which, for the first time in Austria, provides the basis for detailed permafrost deformation analysis. The results are of great importance in the context of past and future climatic change.

In 1995 a geodetic and photogrammtric monitoring program was established in order to obtain geomorphometric parameters of the Doesen rock glacier for the past, present and future. Precise geodetic measurements within an observation network are acquired on a regular basis applying classical and also navigation satellite-based methods. Complementary information is derived from terrestrial metric photographs. Aerial photographs (1954, 1969, 1975, 1983, and 1993) were photogrammetrically evaluated.

From 1954 to 1993 the snout of the Doesen rock glacier has advanced almost 7 meters. The flow vectors reveal that the mean horizontal velocity observed in the center of the rock glacier has decreased from 29.4 cm/year (1954-1975) to 17.2 cm/year (1975-1993), whereas recent measurements (1995-1996) indicate a significant increase in flow velocity (29.6 cm/year). Furthermore, this analysis also includes an evaluation of volumetric changes of the rock glacier and presentations of principal strain rates.

The presented cartographic work comprises a detailed geomorphometric study map at 1:5,000 scale covering the inner Doesen valley, a stereo-orthophoto map at 1:30,000 scale, two combined image-line maps at 1:10,000 scale, a detailed map of the Doesen rock glacier at 1:5,000 scale, and a set of thematic maps at 1:5,000 scale indicating e.g. the changes in flow velocities (see Figure 1).

References

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