Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04980, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04980
EGU General Assembly 2008

Results from englacial temperature records at Colle Gnifetti since 1983

M. Hoelzle (1), M.P. Lüthi (2), R. Böhlert (1), M. Funk (2), A. Schwerzmann (3), S. Suter (4) and M. Zemp (1)

(1) Department of Geography, University of Zurich, Switzerland, (2) Laboratory of Hydraulics, Hydrology and Glaciology, VAW, ETH Zurich, Switzerland, (3) Swiss Re, Zurich, Switzerland, (4) Section of Landscape and Water, Canton Aargau, Switzerland

Firn temperatures have been measured in the Mont Blanc area (European Alps) since the end of the 19th century. Many other measurements followed in the decades after the 1980's. Today, firn temperature measurements in the European Alps exist for the Mont Blanc area (Mont Blanc summit and Col du Dôme), the Monte Rosa area (Colle Gnifetti, Seserjoch and Colle del Lys), the Fischersattel in the Bernese Alps and Piz Zupò in the Engadin area.

The relevance of such investigations lies in the linking with several related fields of study such as trace elements from ice cores, mass and energy balance, the stability of hanging glaciers and ice flow modelling. One additional objective of such firn temperature measurements is to monitor and document the influence of the current atmospheric warming on remote high-alpine sites. However, to take measurements that can be reliably interpreted, it is necessary to find suitable sites, which are not too much disturbed by flow, melt and high accumulation rates. Currently, there are two sites where such measurements have been made for a longer time. One location is the Col du Dôme in the Mont Blanc area and the other one is the Colle Gnifetti in the Monte Rosa area.

At the Colle Gnifetti site, several boreholes were drilled around the saddle point and measurements made in 1983, 1991, 1999, 2000 and 2007. The comparison of temperature measurements made between 1983 and 1991 at a depth of 22 m, which corre-

sponds roughly to the depth of zero annual amplitude (ZAA), shows no evidence of warming. The period 1991 to 2000 shows an increase of 0.5°C. From 2000 to 2007 a further increase of 0.4°C can be observed. The time period 1991-2007 shows an increasing firn temperature of 0.06°C year-1. These measured temperatures give clear evidence of warming during the last two observation periods. This observed warming can be compared to direct air temperature measurements made in the high-alpine environment as the drilling sites are located in the recrystallisation-infiltration zone and, therefore, only marginally affected by melt water currently. Air temperature measurements made at the high-altitude station of Jungfraujoch (MeteoSwiss-Station) between 1970 to 2006 show an annual increase of 0.05°C year-1. This rate is very close to the observed warming rate at Colle Gnifetti.

The comparison of these measurements with recently published results from modelling studies in the same area shows, generally, very good coincidence. However, still many uncertainties exist concerning important factors influencing the englacial temperatures such as the large basal heat flux variability (mainly influenced by the complex high mountain topography), the horizontal ice/firn advection, the unknown density changes, the accuracy and calibration of the thermistors used and the changing surface energy balance, which is strongly influenced by the local topography (radiation, wind speed, accumulation, etc). Many of these influencing factors are related to the topography and therefore strongly site specific. Repeated firn temperature records at the same location with suitable glacier geometry are useful to monitor changes of the thermal regime of cold high altitude alpine glaciers.

It can be concluded that such measurements, as presented mainly from the Colle Gnifetti site, allow for monitoring the evolution of englacial temperatures in high altitude alpine glaciers. The Cryospheric Commission of the Swiss Academy of Sciences has, based on these findings, decided to include such firn temperature observations into the existing national glacier observation network.