



## **Current warming of mountain permafrost in southern Norway**

**K. Isaksen**

Norwegian Meteorological Institute, Oslo, Norway (ketil.isaksen@met.no / Phone: +47 22963267)

The first deep (> 10 m) mountain permafrost borehole ever drilled in Scandinavia for climatic studies is located at Juvvasshøe (1893 m a.s.l., 61deg 40min N, 8deg 22min E), southern Norway. Drilling and instrumentation of the borehole were completed in September 1999. The borehole is 129 m deep and constitute part of the recently established PACE borehole network, which forms a European long-term permafrost monitoring contribution to the worldwide Global Terrestrial Network for Permafrost (GTN-P).

Permafrost temperature profile in Juvvasshøe show significant near-surface warm-side deviation from linear, with thermal gradient increasing down to 60 - 70 m depth. The deviation is most likely associated with past changes in ground surface temperatures. Analyses indicate a ground surface temperature increase of 0.7 - 1.0 degrees over the last 30-40 years. Results from more than five years continuous ground temperature monitoring in Juvvasshøe indicate that the permafrost has warmed considerably. Since 1999 ground temperature have increased by nearly 0.3 degrees at 15 m depth (corresponding to the depth of zero annual amplitude) and observed warming is detectable down to at least 40 m depth. The present trend seems to be an accelerated warming during the last few years or decade. In addition depth of active layer shows significant response to warm summers. The summers of 2002 and 2003 were among the warmest on record (warmest and fourth warmest respectively) in Norway. Active layer depths were 20 % greater in theses summers than previous years.

A close relationship is observed between air, ground surface and ground subsurface temperatures, which forms a good base of using the Juvvasshøe permafrost-data for climate and climate-impact studies. The reported ground warming is compared with

long-term series of air temperature for southern Norway. It is evident that if the observed ground warming proceeds or even accelerates, major changes in mountain permafrost distribution in Norway will be anticipated through the 21st Century.