Geophysical Research Abstracts
Vol. 17, EGU2015-13413, 2015
EGU General Assembly 2015

Thermal conditions within the supraglacial debris cover of Pasterze Glacier, Austria, and its effects on glacier ablation between 2006 and 2014

Andreas Kellerer-Pirklbauer and Simon Hirschmann
University of Graz, Department of Geography and Regional Science, Graz, Austria (andreas.kellerer@uni-graz.at)

A supraglacial debris cover of a few centimetres is thick enough to lower the amount of ablation of the underlying ice by shielding it from insolation and atmospheric heat. In this study continuous ground temperature data taken at different depths at two sites (PAG-SD-LO and PAG-SD-UP) at the supraglacial debris cover of Pasterze Glacier, Austria, have been analysed and compared with ablation data from adjacent ablation stakes provided by the Central Institute for Meteorology and Geodynamics, Vienna. Additionally, near-surface ground temperature data from a proglacial outwash plain site (PAG-FI) have been used in this study for comparison reasons. The studied glacier is a valley glacier and the largest glacier of the entire Eastern European Alps (c.17.3 km^2) located at 47°05'N, 12°44'E. Pasterze Glacier has a c.3.8 km^2 large glacier tongue which is mostly covered (c.72 % of the surface area in 2009) by a rather thin (up to some tens of cm) supraglacial debris cover. The supraglacial debris cover consists of prasinite (greenschist) and calcareous mica schist. Both study sites are characterised by a superficial openwork layer of coarser clasts and a lower mixed layer with coarser material of different size set in a matrix of fine grains. Debris thickness is about 20 cm at PAG-SD-LO and 15 cm at PAG-SD-UP. Sieving analyses of the fines revealed for all three sites a dominance of coarse sands. At the two glacier sites, ground temperature was monitored at 0, 10 and 15 (for PAG-SD-UP) or, respectively, 20 cm (for PAG-SD-LO) depth. We used PT1000 sensors connected by cables to a 3-channel miniature temperature datalogger (M-Log6, GeoPrecision, Germany). Problems in the data acquisition arose due to the creeping of the supraglacial debris cover during the ablation season. Glacier melt and glacier recession caused the abandonment of site PAG-SD-LO in 2010. Contrary, monitoring is ongoing at sites PAG-SD-UP and PAG-FI. Our analysis of the ground temperature data at the three sites focussed on (a) mean temperature values (annual, monthly), (b) temperature ranges, (c) thawing degree days, (d) freezing degree days, (e) snow cover duration, (f) snowpack ripening date, and (g) duration of the zero curtain period. Results indicate for instance that the mean annual ground temperature (MAGT) at the surface of the supraglacial debris cover was positive (or at the most slightly negative) during all glaciological years with available data. In contrast, the MAGT at 10 and 15/20 cm depth was commonly negative with minimum values of -2.6°C. Furthermore, the cumulative thawing degree days (TDD) and glacier ablation show a statistically significant negative correlation allowing a quantitative assessment of total glacier ablation. This indicate for instance that in order to melt 4 m of glacier ice under a 15 cm thick debris layer a cumulative value of c.100 TDD is necessary at 15 cm depth, a value of c.500 TDD at 10 cm depth and a value of c.1000 TDD at the surface of the supraglacial debris cover.