Geophysical Research Abstracts
Vol. 13, EGU2011-12999, 2011
EGU General Assembly 2011

Thermal regime of ground surfaces in different alpine areas of Central and Eastern Austria between 2006 and 2010

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Permafrost research in high alpine areas of Central and Eastern Austria was substantially intensified since 2006 by launching the project ALPCHANGE. ALPCHANGE is a project on climate change and its impacts on the alpine environment in southern Austria funded by the Austrian Science Fund (FWF) through project no. FWF P18304-N10. In 2008, the permafrost research activities were widely integrated in the European project PermaNET, focusing on the long-term monitoring of permafrost in the European Alps. PermaNET is part of the European Territorial Cooperation and co-funded by the European Regional Development Fund (ERDF) in the scope of the Alpine Space Programme. Finally, in 2010 the project "permAfrost – Austrian Permafrost Initiative" was launched (funded by the Austrian Academy of Sciences) using the previously established study areas. permAfrost is a first step to create a nationwide permafrost monitoring program in Austria. Field research within ALPCHANGE, PermaNET and permAfrost is carried out at seven study areas in the Hohe and Niedere Tauern Ranges. One focus is the monitoring of the thermal regime of ground surfaces by applying continuous measurements of ground surface temperature (GST) by using miniature temperature dataloggers (MTD) logging at 1 h interval. In this contribution, data and analyses based on GST are presented from four study areas: (1) Hochreichart area/HOR at 47°22'N, 14°41'E (3 locations with MTD data at elevations between 1920 and 2416 m a.s.l.), (2) Dösen Valley/DOE at 46°59'N, 13°17'E (6 MTD locations between 2407 and 3002 m a.s.l.), (3) Central Schober Mountains/CSM at the Hinteres Langtalkar Rock Glacier/HLK at 46°59'N, 12°46'E (6 MTD locations between 2485 and 2696 m a.s.l.) and (4) Pasterze Glacier/PAG at 47°05'N, 12°44'E (3 MTD locations between 2509 and 2932 m a.s.l.). In total, analyses of GST from 18 locations at elevations ranging from 1920 to 3002 m a.s.l. are presented covering the period September 2006 to August 2010. Focus in the analyses was laid on 4-year mean values of days with permanent frost (FD), days with freeze-thaw cycles (FTC), days with positive temperature (DPT), thawing degree days (TDD), freezing-degree days (FDD) and ground freezing index (GFI). Additionally, the elevation of the zero-degree isotherm (ZDI) as a proxy for permafrost occurrence was calculated for each location. Finally, the influences of the snow cover duration (SCD) and the potential short wave radiation (PSWR) on the thermal regime were assessed. Results show that the study locations are very heterogeneous in terms of e.g. MAGST (+2.9 to -2.6°C), calculated ZDI (between 2185 m a.s.l. at a cold location with long lying snow cover and 2961 m a.s.l. at a warm location with little snow influence), annual PSWR (780 to 3387 kWh/m^2/yr) or days with a considerable snow cover damping daily temperature fluctuations/SCD (5 to 274 days/yr). Despite the heterogeneity in the data, significant correlations between parameter pairs are frequent. Of special interest are the following results: MAGST and TDD decrease with elevation even if the changeable influence of the winter snow cover on the ground thermal regime is not excluded. This suggests that in general the elevation has a greater influence on the ground temperature and ground thawing than the characteristics of the winter snow cover (e.g. duration, thickness). The number of annual FTC decreases with reduced annual PSWR indicating higher potential for frost shattering at locations with higher solar radiation. Locations with long lasting winter snow cover experience also a low number in TDD, obviously due to shorter snow free periods. As a next step, the point analyses with significant correlation results will be used to estimate the regional thermal regime and as a consequence regional permafrost occurrence.