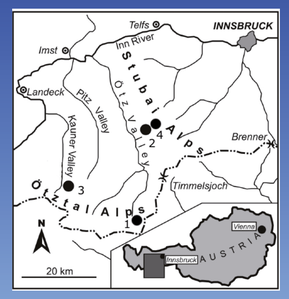
Vegetation on alpine rockglaciers in relation to surface change and surface structure

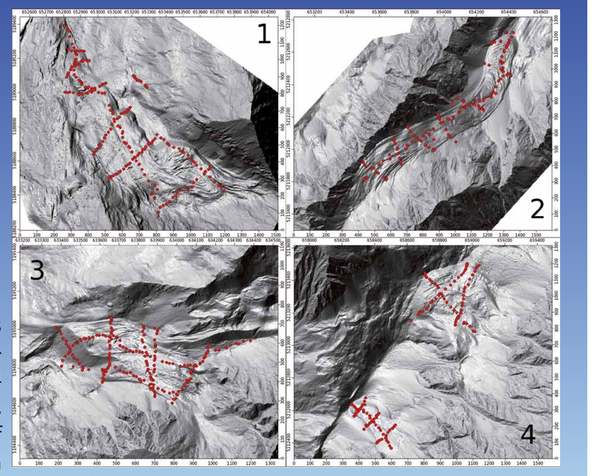
GEOGRAPHIE INNSBRUCK

Introduction

Active rockglaciers are regarded as reliable indicators for the occurrence of permafrost. The movement patterns on rockglacier surfaces are of heterogeneous intensity, which results in the formation of a differentiated surface relief on active rockglaciers. Both, surface movement and the complex micro-relief have a strong influence on vegetation patterns on rockglaciers, which has only been quantified in small scales, due to the scarce availability of reliable spatial data on surface velocity. Multitemporal airborne laser scanning technology provides spatial data of high accuracy and can be used to calculate surface changes or surface movement.

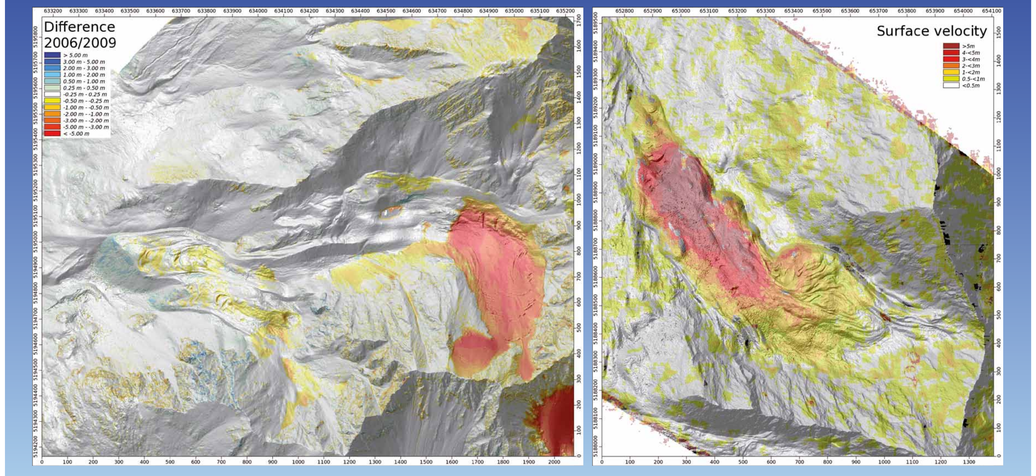
Study areas and field work





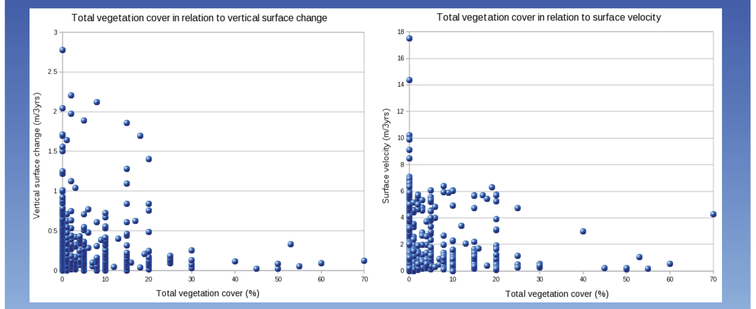
In four study sites in the Stubai and Ötztal Alps in Tyrol, Austria (1 Äusseres Hochebenkar, 2 Inneres Reichenkar, 3 Innere Ölgrube and 4 Schrankar), vegetation cover, plant species, grain size of the debris and the percentage of fine grained material were assessed in 3x3m squares at roughly all 15m on several transects along and across the rockglaciers. Total vegetation cover and the cover of each distinct species was estimated visually, while the percentage of fine grained material and the mean grain-size of the debris in the squares were also assessed. In total, over 600 squares were mapped.

Calculation of surface change



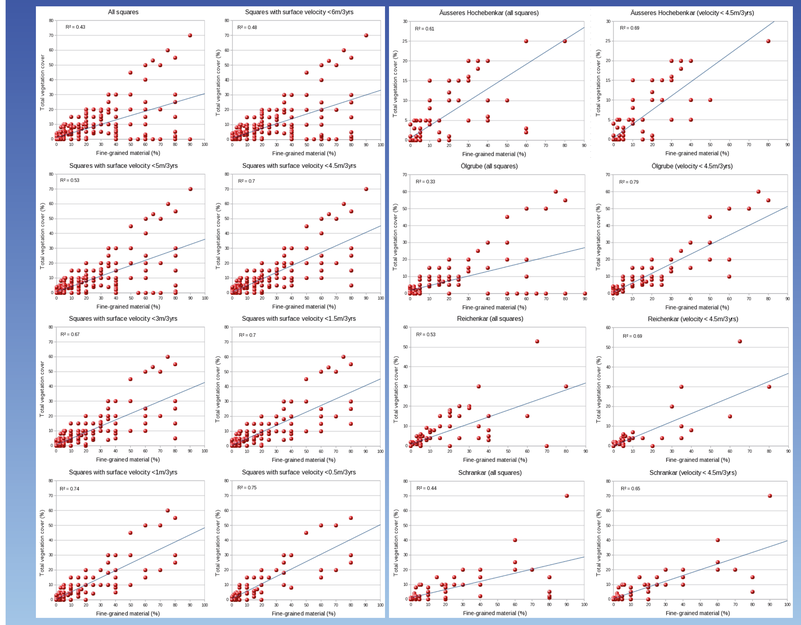
Digital elevation models of the years 2006 and 2009, derived from airborne laser scanning point clouds, were used to calculate vertical differences in the surface of the rockglaciers. Hillshades were used to determine surface velocities.

Vegetation in relation to surface movement



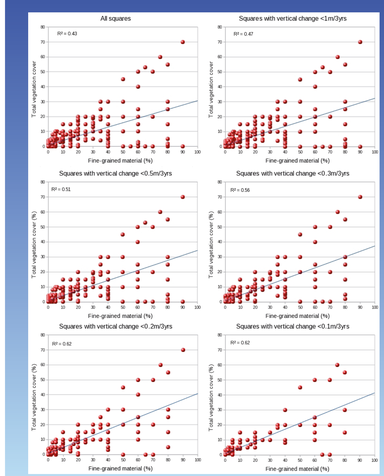
Surface movement is regarded as a key feature for the limitation of plant growth on rockglaciers. While very high surface movement certainly prevents plant growth, vegetation covers of up to 20% were found in squares with surface movement values of 6m&3yrs and vertical surface change of 1.5m&3yrs. No vegetation at all was only found in squares with velocity rates over 8m&3yrs.

Surface velocity, vegetation and substrate



A relation between total vegetation cover and fine-grained material could be proven. The correlation ist good for the squares with surface velocities below 4.5m/3yrs (respectively 1.5m/yr), while vegetation in squares with highe velocities seems to be more affected by surface movement than by the availability of fine grained substrate.

Vertical change, vegetation and substrate



Vertical surface change affects the relation of total vegetation cover and fine-grained substrate in a different way. When squares with high absolute values for vertical surface change are excluded, the correlation of fine grained material and total vegetation cover gets slightly better.

Results

Results show an increase in vegetation cover with a higher percentage of fine grained material, but a decreasing vegetation cover with higher rates of surface velocity. Those effects are overlaying each other, which complicates an interpretation. Nevertheless, conclusions on the relation of vegetation patterns and surface movement and structure on rockglaciers are possible.

Acknowledgements

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