Geophysical Research Abstracts
Vol. 15, EGU2013-3528, 2013
EGU General Assembly 2013

Decadal Cold Layer Thickness Change on Midtre Lovénbreen, Svalbard

Clemens Schannwell (1), Tavi Murray (1), Bernd Kulessa (1), and Antoine Saintenoy (2)

(1) Department of Geography, College of Science, Swansea University, Swansea, United Kingdom (714491@swansea.ac.uk), (2) Département des Sciences de la Terre, Université Paris Sud, Orsay, France

Ground Penetrating Radar (GPR) has been widely used to derive information on thermal properties of polythermal glaciers. The thermal properties have far reaching ramifications on the flow behavior of glaciers. Ice at the pressure melting point (temperate ice) which contains inter-crystalline water exhibits much higher strain rates than cold ice where no water is present. Furthermore, the thickness change of the cold surface layer provides strong indications on what are the controlling factors of the thermal state of the glacier. Picking the boundary between cold and temperate ice in radargrams has required a labor intensive manual method. In this study, GPR data from 2000, 2008, and 2011 are used to analyze the thickness change of the cold surface layer on Midtre Lovénbreen, Svalbard. In order to improve on the manual picking method, an automatic picking method for the boundary between cold ice and warm ice has been introduced and validated. This new picking method uses mean power values of a noise window, a cold ice window, and a temperate ice window for each trace. Each window is randomly selected. Subsequently, the signal-to-noise ratio (SNR) of the respective windows is calculated. The percentage of single values above the SNR of the cold ice window is then determined for each window. Finally, a moving window is run on each trace from the manually picked bed reflector to the point where both conditions - the threshold percentage and the mean power value - are fulfilled. This method significantly facilitates the comparison of GPR lines acquired in different years and the results of the boundary pick are easily reproducible. Applying this approach to the data of Midtre Lovénbreen reveals a significant thinning trend of the glacier over the last decade. Thinning rates are nonuniform but exhibit high variability in space. This variability also applies to the depth change of the cold temperate transition surface (CTS). Despite the observed thinning, the CTS has experienced thickening in the vast majority of the cases which even increases when removing the glacier thinning trend from the data. In contrast, the temperate ice which forms the core of the glacier shows the opposite trend, having thinned considerably over the last 10 years. The thinning pattern is also variable in space with maximum thinning rates occurring at the glacier margins and in the lower reaches of the glacier.