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Degradation and daily backwasting rate of an ice-cored lateral moraine in Kongsfjorden, Svalbard

Danil Borisov (1), Harald Hiesinger (1), Dennis Reiss (1), Ernst Hauber (2), and Frank Scholten (2)

(1) Westfälische Wilhelms-Universität, 48149 Münster, Germany, (2) Institut für Planetenforschung, Deutsches Zentrum für Luft- und Raumfahrt (DLR), 12489 Berlin, Germany

To understand and quantify processes by which ice-cored lateral moraines degrade we propose a methodology, which derives daily backwasting rates from georeferenced High Resolution Orthoimages (HRO) and correlates them with in situ meteorological data. This approach aims to increase the accuracy of backwasting rate measurements and seeks to identify relevant parameters for the degradation rate of ice-cored moraines. This study further compares daily backwasting rates to the exact area of scarp retreat to investigate which measurable parameter is best suited to determine the rate of the degradation process.

A thaw slump on the southwestern side of Kongsfjorden (Svalbard) was analyzed between 2 and 6 August 2014, which is during the melting season. We determined daily backwasting rates between 0.04 and 0.33 m/day (0.20 m/day on average) during the four day long observation period. These results are normalized values, which consider the overall size of the thaw slump. The area of scarp retreat varied from 1.51 to 4.37 m2/day (3.00 m2/day on average). On the basis of Time Lapse Imagery (TLI) and the analysis of in situ meteorological data, we observed positive correlations between backwasting and increasing ground temperatures and the occurrence of precipitation events. We revisited the study area in the beginning of August 2016 and documented an area of scarp retreat of 186 m2 and ∼13 m of backwasting within two years, which equals to a minimal daily backwasting rate of about 0.07 m/day. The average value is estimated to be higher, because our observations indicate that thaw slump activity already ceased before we revisited the study area.

Our methodology requires longer observation periods in order to draw firm conclusions, but its results have a low relative error of about 4 % and are normalized to the thaw slump size. Therefore, we suggest this as an appropriate approach to document and quantify degradation ice-loss processes in periglacial environment.