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The effect of rainfall events with changing frequency and magnitude on reworking conditions of proglacial moraines

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The consequences of the ongoing temperature rise in alpine regions force glaciers to rapid melting and thus new surfaces are exposed to generate numerous geomorphic processes. Steep Little Ice Age (LIA) moraines and other glacial depositional landforms contain huge masses of sediments, that are subject to progressive (re-)mobilization by gullying, slope wash, debris flows and other mass movements. The material is frequently re-deposited in secondary storage landforms; these storages themselves are then subject to depletion. Increased morphodynamics with a maximum shortly after deglaciation, and a slow decrease afterwards, are predicted by the conceptual model of paraglacial response. In addition to these "self-organising" changes following deglaciation, our study area has been experiencing changes in precipitation and (meltwater) discharge for decades; these climatic factors are known to influence morphodynamics, e.g. by triggering mass movements and by driving slope wash and fluvial erosion. While overall precipitation appears to decrease, heavy rainfall events become more intense, and discharge rates of glacial melt water channels show a significant increase.

The PROSA joint project (High-resolution measurements of morphodynamics in rapidly changing PROglacial Systems of the Alps) uses terrestrial and airborne LiDAR data and digital Photogrammetry to monitor surface changes in the Upper Kaunertal, Austrian Central Alps (64 km^2). These are related to the deglaciation since the end of the LIA and to changes in hydrometeorological parameters since several decades ago.

The aim of this study is to investigate a possible relationship between climate change signals and erosion rates in the proglacial area of the Gepatschferner. The morphodynamics of steep LIA moraines are assessed on multiple temporal scales: Long-term changes are analyzed based on multitemporal airborne images dating back to 1953. The recent development is measured using digital elevation models (DEM) generated from multitemporal airborne (2006, July 2012, September 2012) and terrestrial (July 2010, August 2010, September 2011, July 2012, September 2012) LiDAR surveys. Seasonal climate data of more than 40 years are analyzed to detect trends. Precipitation and discharge data of two extreme events in 2011 and 2012 that triggered slope-type debris flows are examined in detail. The moved sediment masses are quantified and related to the precipitation record.