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Reciprocal relationships between geomorphic and vegetation changes on lateral moraines in the Turtmann glacier forefield, Switzerland

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Rapid deglaciation leads to paraglacial adjustments in glacier forefield systems. The glaciofluvial floodplains as well as lateral moraines have been identified as most active areas. The latter often constitute the most significant sediment storage and source. They are reworked by a variety of slope processes, including debris flows, slope wash, linear gully erosion, creep and cryogenic processes. Simultaneously, these landforms are colonized by plants, proceeding into vegetation succession. This process, as well as exhaustion of paraglacial sediment storages, leads to decreasing geomorphic activity and the completion of the paraglacial adjustment. Recent biogeomorphological research highlights the co-dependent development of vegetation and geomorphic forms and processes and their strong feedbacks. These feedbacks are significantly mediated by particular plant species termed geomorphic-engineer species. This indicates that relationships exist between the type of vegetation and the spatial geomorphic development of lateral moraines, resulting in specific biogeomorphic patterns. Probably, these patterns and their underlying interactions are important controls on sediment dynamics in glacier forefields.

The aim of our study is to investigate the relationships between geomorphic and vegetation changes on lateral moraines of the Little Ice Age and their relation to current biogeomorphic patterns. Our study area is the Turtmann glacier forefield (Valais, Switzerland) where lateral moraines show highly heterogeneous geomorphic activity and vegetation patterns, which are partly independent of the moraine age (Eichel et al., 2013). To investigate the relationships between these patterns and their development, we analyzed digital elevation models (DEMs) and multispectral image data from 2001 and 2013. 2001 data were acquired by an airborne High Resolution Stereo Camera (HRSC), while 2013 DEM and orthophotos were derived using terrestrial photogrammetry. Based on DEM differencing for geomorphic change detection, we relate geomorphic changes with vegetation changes which are obtained from digital image analysis and vegetation indices. Results are evaluated and interpreted using existing empirical field data of vegetation, geomorphic landforms and processes and geomorphic maps.

References:
Eichel, J., Krautblatter, M., Schmidtlein, S. & R. Dikau (2013): Biogeomorphic interactions in the Turtmann glacier forefield, Switzerland. Geomorphology 201, p. 98 -110.