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# Sediment reworking of Little Ice Age lateral moraines in the Italian Alps: A morphometric and morphodynamic analysis using multitemporal aerial images and current UAV-data

Sarah Betz, Verena Croce, Florian Haas, and Michael Becht
Catholic University Eichstätt-Ingolstadt, Department of Physical Geography, Germany (sarah.betz@ku.de)

The rapid glacier recession in the European Alps exposes high amounts of unconsolidated sediment, especially in the form of moraines, which is reworked subsequently by processes such as gullying, slope wash and debris flows. The temporal development of the morphodynamics depends both on the abundance of loose sediment after deglaciation and on morphometric properties such as the altitude a.s.l., the aspect and slope gradient of the respective slopes. Apart from slope adjustment due to reworking of sediment, the moraine slopes can also be stabilized by vegetation succession, depending on the geomorphic activity and climatic conditions.
To date, there is only limited understanding of the morphodynamic activity since deglaciation after the Little Ice Age (LIA) and the factors influencing it. To gain deeper insight into the processes and factors involved as well as their connections, our research focuses on the following key questions: (1) What differences in morphodynamic activity appear on the lateral moraine tracts of cirque and valley glaciers deglaciated since the LIA? (2) Which geomorphological characteristics, as for example the degree of gully incision, can be detected and how are they related to the altitude a.s.l. and to morphometric parameters like the slope gradient? (3) Are there differences in the morphodynamic activity between slopes well connected with fluvial systems and those, which are hardly connected? (4) Can differences in vegetation succession be noted, depending on the altitude of the respectable glacier? (5) Does vegetation cover have a detectable influence on morphodynamics or vice versa? We address these questions with a strong focus on the general altitude of the respective moraine tract in comparison to moraines of other glaciers. Moreover, the time since deglaciation, which varies along the moraine tract in accordance with the progressively melting glaciers, is considered thoroughly.
For our analyses, moraine tracts of 10 glaciers in the German, Austrian, and Italian Alps were selected, of which the latter are presented here. These glaciers not only differ in their location within the Alps, but also regarding the altitude of their tongues and their size. This enables a correlation analysis of the morphometric, morphodynamic and vegetational properties depending on these general characteristics of the glaciers.
For the long-term detection of sediment reworking and changes in slope morphometry, we use a series of historical aerial images, dating back to 1959, to generate Digital Elevation Models (DEM) by photogrammetric analyses. In order to detect recent geomorphological processes and to analyse vegetation cover and morphometry, we derive highly accurate DEMs from our own UAV-surveys conducted in summer 2017.