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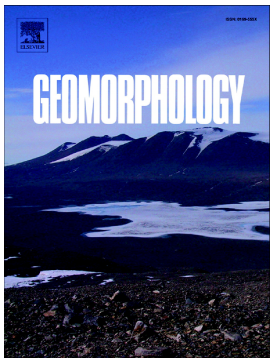

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An assessment of landform composition and functioning with the first proglacial systems dataset of the central European Alps

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ABSTRACT

Proglacial systems are enlarging as glacier masses decline. They are in a transitory state from glacier-dominated to hillslope and fluvially-dominated geomorphological processes. They are a very important meltwater, sediment and solute source. This study makes the first quantitative, systematic and regional assessment of landform composition and functioning within proglacial systems that have developed in the short term since the Little Ice Age (LIA). Proglacial system extent was thus defined as the area between the LIA moraine ridges and the contemporary glacier. We achieved this assessment via a series of topographic analyses of 10 m resolution digital elevation models (DEMs) covering the central European Alps, specifically of Austria and Switzerland. Across the 2812 proglacial systems that have a combined area of 933 km^2, the mean proportional area of each proglacial system that is directly affected by glacial meltwater is 37 %. However, there are examples where there is no glacial meltwater influence whatsoever due to complete disappearance of glaciers since the LIA, and there are examples where > 90% of the proglacial area is probably affected by glacial meltwater. In all of the major drainage basins; the Inn, Drava, Venetian Coast, Po, Rhine, Rhone and Danube, the proportions of the combined land area belonging to each landform class is remarkably similar, with > 10 % fluvial, ~35 % alluvial and debris fans, ~50 % moraine ridges and talus/scree, and ~ 10 % bedrock, which will be very helpful for considering estimates of regional sediment yield and denudation rates. We find groupings of the relationship between proglacial system hypsometric index and lithology, and of a slope threshold discriminating between hillslope and fluvial-dominated terrain, both of which we interpret to be due to grain size. We estimate of contemporary total volume loss from all of these proglacial systems of 44 M m^3a^{-1}, which equates to a mean of 0.3 $mm.a^{-1}$ contemporary surface lowering. Overall, these first quantifications of proglacial landform and landscape evolution will be an important basis for inter- and intra-catchment considerations of climate