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Contemporary geomorphological activity throughout the proglacial area of an alpine catchment

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Quantification of contemporary geomorphological activity is a fundamental prerequisite for predicting the effects of future earth surface process and landscape development changes. However, there is a lack of high-resolution spatial and temporal data on geomorphological activity within alpine catchments, which are especially sensitive to climate change, human impacts and which are amongst the most dynamic landscapes on Earth. This study used data from repeated laser scanning to identify and quantify the distribution of contemporary sediment sources and the intensity of geomorphological activity within the lower part of a glaciated alpine catchment; Ödenwinkelkees, central Austria. Spatially, geomorphological activity was discriminated by substrate class. Activity decreased in both areal extent and intensity with distance from the glacier, becoming progressively more restricted to the fluvially-dominated valley floor. Temporally, geomorphological activity was identified on annual, seasonal, weekly and daily timescales. Activity became more extensive with increasing study duration but more intense over shorter timescales, thereby demonstrating the importance of temporary storage of sediment within the catchment. The mean volume of material moved within the proglacial zone was 4400 m3.yr-1, which suggests a net surface lowering of 34 mm.yr-1 in this part of the catchment. We extrapolate a minimum of 4.8 mm.yr-1 net surface lowering across the whole catchment. These surface lowering values are approximately twice those calculated elsewhere from contemporary measurements of suspended sediment flux, and of rates calculated from the geological record, perhaps because we measure total geomorphological activity within the catchment rather than overall efflux of material. Repeated geomorphological surveying therefore appears to mitigate the problems of hydrological studies underestimating sediment fluxes on decadal-annual time-scales. Further development of the approach outlined in this study will enable the quantification of geomorphological activity, alpine terrain stability and persistence of landforms.