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Quantifying proglacial morphodynamics and sediment budgets - the PROSA approach

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The recession of alpine glaciers since the end of the Little Ice Age (LIA), which has been accelerating in the past decades, has exposed stores of glacial sediment to the activity of paraglacial processes. Following deglaciation, an increase in sediment (re-)mobilisation within and export from proglacial areas (i.e. the area within the LIA terminal moraines) can be expected which may affect the downstream channel network, including potential threats to settlements and infrastructure. Slope aquatic and fluvial processes and mass movements (including debris flows, slides and falls) within the proglacial area have received comparatively little attention in previous studies of the (pro)glacial sediment budget that have been focused mainly on suspended and bedload sediment transport in proglacial streams. Hence, there is a need for research concerning the relative importance of non-glacial and glacial contribution to the sediment budget. Additionally, the connectivity of proglacial sediment cascades needs to be assessed in order to address the consequences of enhanced geomorphic activity on sediment export from the proglacial system.

The PROSA joint project (High-resolution measurements of morphodynamics in rapidly changing PROglacial Systems of the Alps) is determined to tackle these problems through a quantification of sediment fluxes effected by the aforementioned geomorphic processes within the forefield of the Gepatschferner glacier (Central Alps, Austria). In this paper, we present an outline of ongoing and planned research activities of the interdisciplinary PROSA project group which encompasses the expertise of geomorphologists, geologists, glaciologists and geodesists. On the local scale, field measurements and high-resolution digital elevation models from multi-epoch ground-based LiDAR data are combined to map and quantify sediment (re-)mobilisation, erosion and deposition. Measurement plots are arranged in chronosequences in order to estimate the influence of time since deglaciation on morphodynamics. The catchment scale sediment budget will be established by multi-epoch high-resolution aerial LiDAR data and by upscaling of local findings using geomorphological models including the appraisal of slope-channel coupling. A combined dam and power plant directly downstream of the catchment outlet provides a good opportunity to close the sediment budget through measurements of delta aggradation when the reservoir level is artificially lowered.