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Glacial, fluvial and geodynamic controls on the hypsometry and morphology of glaciofluvial terraces. Results from the North Alpine Foreland.

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Quaternary glacial maxima are generally associated with enhanced sediment production in mid- to high latitude mountain ranges. These distinct climatic deteriorations are commonly linked to short fluvial aggradational events characterized by coarse-grained lithofacies. Deposits may therefore depict clear stratigraphic and geomorphic markers, especially if deposits were distributed over a wide range, which is the case in unconfined settings, such as foreland basins. If glaciers grow large enough to extend to foreland areas, the depositional area is even markedly increased by promoting radial sedimentation and elevation of glaciofluvial sediment sources. Foreland basins affected by surface uplift or base-level lowering may then promote terrace preservation at geological timescales. Terraces may thereby not only host common environmental information (from sedimentological, biological or chemical proxies) but record key information on glacial, fluvial and mountain range dynamics by its geomorphologic expression and elevation distribution.

To systematically unravel factors controlling the hypsometry and geometry of glaciofluvial outwash terraces we analysed digital elevation data together with existing geodata. We chose the North Alpine Foreland being home of abundant geological information and a series of glaciofluvial terraces relating to several peak glacial periods of the Quaternary. An important motivation was also to develop a consistent range scale stratigraphic model integrating local observations. We utilized geological maps and related DEM data from Switzerland, Germany and Austria whereas DEM resolution ranges between 0,5 and 50 m. Elevation data of terraces were then compiled and collapsed into 2D profiles. Terrace data were plotted in relation to the modern stream and statistically evaluated using the software R.

Relative terrace age is well manifested in elevation but from generated data we suggest that age determinations must be locally revisited. We show that outwash plain hypsometry is sensitive to the distance, source to base-level, being a function of the glacial extension at outwash formation. This is also well observable for receding glaciers successively increasing the distance to its base level thereby lowering the source of meltwater streams. Surface tilting arising from a decreasing uplift signal away from the mountain front plays a surprisingly low role even though we recognize that terraces extending into the mountain range cumulate more uplift as shown by the vertical distance of terraces. Relative terrace age is not only manifested in elevation but also in the increased scatter within a given elevation bin, induced by gully incision and solifluction processes. We furthermore show that rather low resolution or noisy DEMs can be utilized to allow meaningful analyses.