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Late Holocene hillslope dynamics in two paraglacial valley systems, Western Norway

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Glaciers in different mountain environments around the world (e.g. Rocky Mountains, European Alps, Norwegian fjord landscapes) showed a significant advance during the Little Ice Age (LIA) period. While a lot of existing studies focus on the dating of the different LIA glacial fluctuations there is a comparably smaller number of quantitative studies on geomorphic and morphometric effects on hillslope systems within paraglacial systems. This study addresses the morphometric influences and geomorphic consequences of the LIA glacial advance on hillslopes in two paraglacial valley systems in western Norway. Studying hillslopes as sedimentary source, storage and transfer zones and analyzing surface processes acting on hillslopes since the end of the deglaciation are of importance in order to gain a better understanding of the complex sedimentary source-to-sink fluxes in cold climate environments (paraglacial systems). This study presents first outcomes of a PhD project, which is part of the NFR funded SedyMONT-Norway project within the ESF TOPO-EUROPE SedyMONT (Timescales of sediment dynamics, climate and topographic change in mountain landscapes) Programme.

The investigations on morphometric influences and geomorphic consequences of the LIA glacial advance are concentrated on four distinct headwater areas of the Erdalen and Bødalen valleys in the Nordfjord valley-fjord system (inner Nordfjord, Western Norway). Both valleys can be described as steep, U-shaped and glacier-fed, subarctic tributary valleys.

The main aims of this study are (i) to analyze and compare the morphometric characteristics of lower hillslope segments (beneath rock faces) being located inside and outside of the LIA glacial limit, (ii) to detect possible changes of storage volumes due to glacial removal and / or deposition in these lower hillslope areas, (iii) and to identify the type and intensity of Post-LIA denudative hillslope processes.

The applied process-based approach includes orthophoto- and topographical map interpretation as well as hillslope profile surveying in field for morphometric analyses, high resolution process monitoring and detailed geomorphological mapping for process analyses, and GIS and DEM computing as well as geophysical measurements (georadar) for storage analyses.

Results show that hillslope systems located inside of the LIA glacial advance limit are characterized by both a more complex hillslope morphometry and a more complex composition of the material covering lower hillslope segments as compared to hillslope systems being located outside of the LIA glacial advance limit. It is found that hillslopes inside of the LIA glacial advance limit have steepened lower hillslope segments due to a negative net balance of removal and deposition of material by the advancing and retreating LIA glacier. The more complex material composition of hillslopes inside of the LIA glacial advance limit originates from a combination of debris from gravitational processes and lateral moraine ridges. Consequently, the combination of modified slope morphometry and altered composition of the material covering lower hillslope segments (with a higher percentage of fine grained sediments) has generated a higher intensity of Post-LIA denudative hillslope processes resulting in higher sediment delivery rates from hillslopes being located inside of the LIA glacial advance limit as compared to hillslopes being located outside of this limit. The removed and reworked material has been re-deposited by secondary transfers like fluvial processes further downstream within the valley systems.