Geophysical Research Abstracts
Vol. 12, EGU2010-1321, 2010
EGU General Assembly 2010

Geomorphic (de-) coupling of hillslope and channel systems within headwater catchments in two subarctic tributary valleys, Nordfjord, Western Norway

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Hillslopes occupy large areas of the earth surface. Studying the characteristics, development and interaction of hillslopes as components of the geomorphic hillslope-channel coupling process-response system will improve the understanding of the complex response of mountain landscape formation. The rates of hillslope processes are exceptionally varied and affected by many influences of varying intensity. Hillslope-channel coupling and sediment storage within slopes are important factors that influence sediment delivery through catchments, especially in steep environments. Within sediment transfers from sources to sinks in drainage basins, hillslopes function as a key element concerning sediment storage, both for short term periods as between rainstorms as well as for longer periods in colluvial deposits.

This PhD project 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 focus of this study is on geomorphic hillslope-channel coupling or de-coupling and sediment transport within four distinct headwater areas of the Erdalen and Bødalen catchments in the Nordfjord valley-fjord system (inner Nordfjord, Western Norway). Both catchments can be described as steep, U-shaped and glacier-fed, subarctic tributary valleys. Approximately 14% of the 49 km2 large headwater area of Erdalen is occupied by hillslope deposits; in Bødalen hillslope deposits occupy 12% of the 42 km2 large headwater area.

The main aims of the study are to present preliminary findings on (i) the identification of possible sediment sources and delivery pathways within the headwater areas of the catchments, (ii) to analyze the development of hillslope-channel coupling / de-coupling from postglacial to contemporary timescales as well as (iii) to investigate the current degree of geomorphic hillslope-channel coupling within the different headwater catchments and (iv) to determine differently acting mass movement processes. A process-based approach is applied to assess the importance of hillslope sediment production, storage and transport throughout the catchments, including orthophoto-interpretation, hillslope profile surveying, photo monitoring, geomorphological mapping, GIS and DEM computing as well as a combination of different field techniques for bed load monitoring. Appropriate hillslope test sites within the headwater catchments are selected in order to fulfill the main aims of this study as well as to monitor contemporary rates of hillslope fluxes. The designed monitoring instrumentation of the slope test sites includes nets, stone tracer lines, wooden sticks, peg lines, slop wash traps and remote site monitoring cameras. Hillslope profile surveying, geomorphological mapping and measurements of solute yields from the slope systems are carried out at each test site. Channel longitudinal- and cross profiles are measured in defined test stretches of the first order streams, located downhill of the slope test sites. Within the same channel test stretches extensive pebble counts (grain size, grain shape) are conducted seasonally and tracer lines are installed in order to trace different bed load components.

The four selected headwater areas are characterized by different intensities of hillslope-channel coupling, mainly due to the distinct valley morphometries affected by the glacial inheritance of the Nordfjord region. Where hillslope-channel coupling exists, primary coarse material is delivered from the hillslopes into the channels via snow avalanches. These coarse grained and angular components can be traced within the channel test stretches.

Research on the complex evolution of hillslope-channel (de-) coupling over time and contemporary sediment transfer fluxes contributes to a better understanding of possible trends of mountain landscape development.