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# Quantification of fluvial bedload transport in glacier-connected steep mountain catchments in western Norway

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Contemporary fluvial bedload transport rates are still very difficult to measure and, as a result of this, in many sites only quantitative data on fluvial suspended and solute transport are included in sediment budget studies carried out for defined drainage basin systems. During the years 2010-2013 detailed field measurements with portable impact sensors as a non-invasive technique for indirectly determining fluvial bedload transport intensity were conducted in two instrumented drainage basin systems (Erdalen and Bødalen) in the fjord landscape in western Norway. The collected impact sensor field data were calibrated with laboratory flume experiments, and the data from the impact sensor field measurements and the flume experiments were combined with field data from continuous discharge monitoring, repeated surveys of channel morphometry and sediment texture, particle tracer measurements, Helley-Smith samplings, underwater video filming and biofilm analyses. The combination of methods and techniques applied provides insights into the temporal variability and intensity of fluvial bedload transport in the selected mountain streams of both drainage basin systems. The conducted analysis of fluvial bedload dynamics in different defined subsystems of Erdalen (79.5 km2) and Bødalen (60.1 km2) provides information on (i) detectable relevant sediment sources, (ii) instream channel storage of bedload material, (iii) spatiotemporal variability and controls of bedload transport rates and bedload yields, and (iv) the absolute and relative importance of fluvial bedload transport within the sedimentary budgets of these steep cold climate mountain catchments. Rockfalls, snow avalanches, stream channel bank erosion, and fluvial transfers through small tributaries draining slope systems are relevant sediment sources for fluvial bedload transport in the main stream channels, whereas the main outlet glaciers in both catchment systems are not of importance as all bedload material delivered directly from these outlet glaciers is trapped within proglacial lakes. Snow avalanches are the most important sediment source in Erdalen, whereas fluvial transfers through small tributaries followed by snow avalanches are most important in Bødalen. Narrow valleys within both drainage basin systems are characterized by a higher intensity of slope-channel coupling and display higher rates of sediment supply from slopes into main stream channels than wider valleys. Longer-term, instream channel storage is not of great importance in the steep Bødalen catchment but currently plays an important role within the Erdalen drainage basin, which is characterized by a stepped longitudinal main valley bottom profile favoring deposition of bedload material within the less steep main channel reaches. The computed mean annual bedload yields (2010-2013) are 2.4 t km-2y-1 for the entire Erdalen and 13.3 t km-2y-1 for the entire Bødalen, which are comparably low values for steep and partly glacierized catchment systems. Because of supply-limited conditions, the intensity of fluvial bedload transport is generally more related to the availability of sediments than to channel discharge. Fluvial bedload transport accounts for about one-third of the total fluvial transport in both drainage basin systems.