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Spatio-temporal variability and rates of fluvial bedload transport in steep mountain catchments in western Norway

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The timing and rate of fluvial bedload transport are of central importance within sediment budget studies and in many applications in river science and engineering. Bedload transport rates are very difficult to measure and, in many sites, only suspended load and solute data are included in sediment budget studies.

During four years (2010 - 2013) detailed field measurements with portable impact sensors as a non-invasive technique for indirectly determining fluvial bedload transport intensity were conducted at several selected channel stretches within two instrumented and supply-limited drainage basin systems (Erdalen and Bødalen) in the steep fjord landscape in western Norway. The selected stream test stretches where impact sensor field measurements were conducted were located (i) downstream of steep channels in headwater areas of the two drainage basin systems Erdalen and Bødalen, (ii) downstream of selected stream channel segments with temporary in-channel storage of bedload material in Erdalen and Bødalen and (iii) at the outlets of the two drainage basin systems Erdalen and Bødalen. The collected impact sensor field data were calibrated with laboratory flume experiments and were combined with field data from continuous discharge monitoring, repeated surveys of channel morphometry and sediment texture, particle tracer measurements, Helley-Smith samplings, underwater videofilming and biofilm analyses.

The combination of methods and techniques applied provides detailed insights into the spatio-temporal variability and rates of fluvial bedload transport within Erdalen and Bødalen. Fluvial bedload transport in steep headwater streams is strongly related to sediment delivery from slopes, especially through fluvial transfers in small creeks draining the slope systems and through snow avalanches in spring and debris flows in fall. Channel reaches with temporary in-channel storage of bedload material in the middle parts of the Erdalen and Bødalen drainage basin systems can modify this temporal pattern of fluvial bedload transport. The measured bedload yield in Bødalen is five times higher than the bedload yield in Erdalen which reflects a valley-morphometric determined higher level of slope-channel coupling in Bødalen than in the Erdalen drainage basin system.