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Field-based analysis of sediment sources, spatiotemporal variability and rates of fluvial bedload transport in the cold climate and mountainous upper Driva drainage basin in central Norway

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The upper Driva drainage basin in central Norway (Oppdal-Hjerkinn) is situated in a cold climate and mountainous environment and ranges with a total drainage basin area of 1630 km^2 from 220 to 2286 m a.s.l. The mean annual air temperature at Oppdal (545 m a.s.l.) is 4.3°C, and mean annual precipitation at Oppdal amounts to 532 mm. The lithology in the drainage basin is complex and varied, and is dominated by metamorphic rocks (mostly gneisses and schists). Vegetation cover varies between tundra vegetation in the high and rather flat areas of the uppermost drainage basin area, situated at elevations around 900-1200 m a.s.l., tree vegetation (mostly birch and pine) in the lower parts of the incised tributary valleys of the Driva main river and grasslands in the agriculturally used areas close to the lower sections of the main river Driva. Relevant geomorphological processes include chemical and mechanical weathering, rockfalls, snow avalanches, debris flows, slides, wash processes, fluvial erosion, fluvial streambank erosion and down-cutting, and fluvial solute, suspended sediment and bedload transport.

This ongoing GFL research on sediment sources, controls and spatiotemporal variability of fluvial bedload transport includes detailed field-based studies with extensive granulometric and shape analyses of bedload material, and high-resolution bedload transport measurements applying different tracer techniques, Helley-Smith samplings, and underwater video filming together with impact sensor measurements. Specific focus is on selected stream channel stretches in the six tributary systems Svone, Kaldvella, Stølåa, Tronda, Vinstra and Ålma, and on three selected stream channel stretches of the Driva main river in the upper Driva drainage basin system. Stationary hydrological stations are monitoring runoff continuously as discharge occurs in all tributary systems year-round. The runoff regime is nival with mean annual runoff amounting to 576 mm for the entire upper Driva drainage basin.

The temporal variability of fluvial bedload transport is largely controlled by thermally and/or pluvially determined runoff events. The selected tributary systems display varying grain-size compositions and shape characteristics of bedload material together with different bedload transport rates and yields. These detected spatial variations are explained by different lithologies, different levels of sediment connectivity and spatially varying sediment availabilities in the different tributary systems. The activation of sediment sources is generally strongly determined by thermally and/or pluvially induced events. The clearly highest share of annual bedload transport occurs during the snowmelt period in spring. Altogether, fluvial bedload transport is of high relevance for the total fluvial transport in the upper Driva drainage basin. However, within the different selected tributary systems the relative importance of fluvial bedload transport, as compared to suspended sediment transport

and solute transport, ranges from very low in Ålmadalen to very high in Vinstradalen.