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Climate and anthropogenic impacts on denudation and sedimentary source-to-sink fluxes in the boreal mountain basin of lake Selbusjøen in central Norway

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Denudation, including both chemical and mechanical processes, is of high relevance for landscape development and the transfer of solutes and sediments from headwater systems through main stem of drainage basin systems into sinks like lakes or the sea. Denudation is controlled by a range of environmental drivers and is in most environments and landscapes worldwide significantly affected by anthropogenic activities.

In the boreal mountain environment of central Norway the regulated lake Selbusjøen, situated at ca. 160 m a.s.l. with an area of 58 km² and connecting the upstream main mountain river Nea and the downstream main river Nidelva, forms a significant sink for sediments being transferred from its drainage basin area of in total 2876 km². The significant sediment trapping efficiency of lake Selbusjøen is causing a sediment deficit and locally increased fluvial erosion and down-cutting in the downstream river Nidelva which drains into the Trondheim fjord.

This ongoing GFL research on natural and anthropogenic drivers and the spatiotemporal variability of contemporary chemical and mechanical fluvial denudation rates and sedimentary source-to-sink fluxes in the boreal mountain basin of lake Selbusjøen is based on statistical analyses of high-resolution meteorological data, detailed field and remotely sensed mapping, computing of morphometric catchment parameters, and year-round process geomorphological field work. Geomorphological field work includes detailed field observations, repeated photographic documentations of selected stream channel stretches and slope surface areas, and field monitoring and frequent measurements with snow, rain water, stream-water and bedload samplings for the analysis of solute and suspended sediment concentrations and the study of atmospheric solute inputs, and the quantification of fluvial solute and sediment transport. Field work is carried out in a number of defined catchments/drainage areas draining into Selbusjøen. The selected catchment/drainage area systems are all characterized by large surface areas with a nearly closed and continuous vegetation cover mostly composed of boreal forests and bogs, and represent a range of different catchment sizes, catchment morphometries, orientations/aspects, and sediment sources and availabilities. In addition, different types and intensities of anthropogenic impact like, e.g., agriculture, forestry and modifications of natural stream channels (e.g., dams, steps, bank protection) and channel discharge for water power purposes are found in various catchments.

Runoff is occurring year-round and the natural runoff regime is nival. Annual runoff in the area amounts to 684 mm. Most fluvial transport is occurring during peak-runoff events generated by snowmelt, rainfall events or combinations of snowmelt and rainfall. Altogether, chemical denudation is moderate but dominates clearly over mechanical fluvial denudation. Both chemical and mechanical

fluvial denudation show a significant spatial variability which can be related to the varying characteristics of the selected catchment/drainage area systems. Agriculture and forestry are generally increasing mechanical fluvial denudation rates whereas anthropogenic stream channel and channel discharge modifications are leading to reduced fluvial bedload transport rates into lake Selbusjøen. Ongoing and accelerated climate change is expected to increase both chemical and mechanical fluvial denudation and sediment transport rates into lake Selbusjøen, particularly in the surface areas that have been modified by anthropogenic activities.