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Fluvial sediment transport in a glacier-fed high-mountain river (Riffler Bach, Austrian Alps)

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High-alpine environments are strongly affected by glacier retreat since the Little Ice Age (LIA). Due to ongoing climate change the hydrology of proglacial rivers is also influenced. It is expected that the growing proportions of snow melt and rainfall events will change runoff characteristics of proglacial rivers. Additionally, the importance of paraglacial sediment sources in recently deglaciating glacier forefields is increasing, while the role of glacial erosion is declining. Thus complex environmental conditions leading to a complex pattern of fluvial sediment transport in partly glaciated catchments of the European Alps.

Under the umbrella of the joint PROSA-project the fluvial sediment transport of the river Riffler Bach (Kaunertal, Tyrol, Austria) was studied in 3 consecutive ablation seasons in order to quantify sediment yields. In June 2012 a probe for water level and an automatic water sampler (AWS) were installed at the outlet of the catchment ($20km^2$). In order to calculate annual stage-discharge-relations by the rating-curve approach, discharge (Q) was repeatedly measured with current meters and by salt dilution. Concurrent to the discharge measurements bed load was collected using a portable Helley-Smith sampler. Bed load samples were weighted and sieved in the laboratory to gain annual bed load rating curves and grain size distributions. In total 564 (2012: 154, 2013: 209, 2014: 201) water samples were collected and subsequently filtered to quantify suspended sediment concentrations (SSC). Q-SSC-relations were calculated for single flood events due to the high variability of suspended sediment transport.

The results show a high inter- and intra-annual variability of solid fluvial sediment transport, which can be explained by the characteristics of suspended sediment transport. Only 13 of 22 event-based Q-SSC-relations show causal dependency. In 2012, during a period with multiple pluvial-induced peak discharges most sediment was transported. On the contrary the importance of snow melt for sediment transport was indicated during the ablation season 2013. In total 3582 t of sediment were exported out of the Riffler Bach catchment in 2012, which is almost twice the solid sediment load of the ablation season 2013 (1953 t). Total solid load of the Riffler Bach River was 3511 t in 2014 Suspended sediment load was dominant in all ablation seasons.

The result of additional DEM analysis reveals that 37 % of the catchment do not contribute or only contribute to a lesser amount to the fluvial sediment export out of the catchment. The findings of the grain size analysis imply glacigenic origin of the transported particles. Thus, the results indicate that solid sediment transport is not only a function of discharge. Also availability of sediment and the systems state of (dis-)connectivity, e.g. coupling of sediment sources to the river, need to be considered.