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# Temporal Variation of Bedload Transport studied by Integrative and Innovative Bedload Measurement Systems

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This work deals with the investigation of bedload transport processes in the free flowing section of the upper Drau, a large alpine gravel-bed river, its most important tributary Isel River as well as the Rofenache, a mountain torrent in the Ötztal Valley, all situated in Austria. For this purpose the specified gauging stations and measuring sites are equipped with direct and surrogate bedload measurement techniques.
In general, techniques for measuring transported bedload in natural streams can be classified in two different groups, namely the direct collection of moving particles (slot traps, basket samplers) and the indirect determination of transport intensity (e.g. geophones). The integrative bedload measuring systems at the large gravel-bed rivers Drau and Isel and the gauging station at the mountain torrent Rofenache include both methods as well as additional devices to collect hydrological, meteorological and other related data. In this way, the complementary on-site arrangement of different instruments enables the compensation of individual shortcomings inherent in each measurement technique.
Special attention is paid to the data obtained by the geophones. These automatic and continuous recordings do not only allow for investigation of the spatio-temporal distribution of the transported material over the entire cross-section, but also for assessment of the transport process behaviour itself. For reliable interpretation and calibration of the output and for determining the bedload yield, direct sampling of bedload is essential, however.
Moreover, geophones and fixed bedload traps are robust enough to withstand even the forces of floods; consequently they are capable to measure and take bedload samples at distinct discharge levels, e.g. flood peaks.
The complementary deployment of geophones and slot traps proved the counted number of geophone impulses per unit time and its associated flow discharge to be proportional to the trapped sediment volume.
Furthermore, it was possible to verify the supposed spatial and temporal variability of bedload movement. Another interesting investigation result was the determination of distinct periodic fluctuation in bedload movement, which was almost independent from the water stage. The observed temporal wavelengths were quite similar, although geophone measurements were taken in completely different flow regimes. Only during flood peaks stochastic processes overlaid the regular bedload waves.
In conclusion the results of the investigation highlight important aspects for the understanding of bedload transport processes. The complementary application of geophones and hydraulic liftable slot trap helps to observe bedload transport processes also during flood events.