



Innovative Bed Load Measurement System for Large Alpine Gravel-Bed Rivers

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The aim of the work is to figure out the bed load transport processes using direct and surrogate measurement methods for the free flowing reach of the Drau River and its most important tributary Isel River, both large Alpine gravel-bed rivers, situated in the south western part of Austria.

There are some techniques for bed load measurements in natural streams; we used collecting moving particles and indirectly determining transport intensity at the study sites.

Former measurements in the study reach were performed also using mobile bed load samplers and fixed bed load samplers. Individually they all are adequate bed load measurement instruments - used in combination they are complementing one another, whereas each applied separately leads to specific deficits.

The investigation payed special attention on results out of the geophone installations, whereas steel plate vibrations (the plates are mounted on top of concrete structures even with the river bed surface) caused by bed load particles with a diameter larger than about 20 mm are inducing a signal into the geophones. The signal above a defined threshold voltage than is recorded in a computer system as the sum of impacts during one minute intervals.

The spatio-temporal distribution of the transported bed load material, its amount and the transport processes itself could be figured out for the first time out of continuous data collection since 2006 for large alpine gravel-bed rivers.

Before building up the gauging stations there were no continuous recordings of bed load transport processes in large alpine rivers over their entire cross section, hence the investigation promises a better process understanding and the possibility to determine bed load transport rates and a rough approximation of the grain size distributions of the transported bed load material under different flow conditions. A relation between detected geophone records, the flow discharge and direct bed load sampling methods (Large Helley Smith Samplers, Birckbeck-type bed load traps, etc.- in this regard used as a calibration technique but in general independent and throughout accepted bed load measurement methods) could be obtained.

Finally in 2006, the measurement equipment was enlarged to an integrative and innovative bed load measurement system by installing Geophones. In addition hydrological, geological, meteorological and other related data are collected. For further investigations there is a chance to test new measurement techniques under well known boundary conditions at the fully equipped gauging stations.

The instrumentation will allow observing transport processes in detail within the study reach. Calibration Measurements take place during the rainfall and snow melting season from May to August, furthermore in November due to Genoa depressions causing heavy rainfall in the catchment area of the Drau River.

Especially the initiation of motion, the bed load transport rate and bed load transport processes (cross sectional variation, periodicity in bed load movement) are analysed. Moreover, for understanding bed load transport processes the initiation of motion is of central importance.

As a result it could be shown that the counted number of geophone impulses per unit time is proportional to the transported sediment volume, calculated out of direct bed load measurements and the associated flow discharge. The scatter between geophone impulses, caused by bed load transport fluctuations, and flow discharge can be reduced if the sum of geophone impulses is averaged over longer time intervals (time lag between moving gravel sheet maximums is about 25 minutes).

Furthermore, the assumed spatial and temporal variability of the bed load movement could now be proven. In addition it could be proven, that commonly used bed load predictors underestimate the measured bed load transport.

In conclusion the results of the investigation are showing new aspects for understanding bed load transport processes. The installed bed load measurement system will be improved and enlarged year by year.