Geophysical Research Abstracts
Vol. 14, EGU2012-7853, 2012
EGU General Assembly 2012

Sediment mobility and bedload transport rates in a high-elevation glacier-fed stream (Saldur river, Eastern Italian Alps)

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The assessment of bedload transport in high-gradient streams is necessary to evaluate and mitigate flood hazards and to understand morphological processes taking place in the whole river network. Bedload transport in steep channels is particularly difficult to predict due to the complex and varying types of flow resistance, the very coarse and heterogeneous sediments, and the activity and connections of sediment sources at the basin scale. Yet, bedload measurements in these environments are still relatively scarce, and long-term monitoring programs are highly valuable to explore spatial and temporal variability of bedload processes. Even fewer are investigations conducted in high-elevation glaciarized basins, despite their relevance in many regions worldwide.

The poster will present bedload transport measurements in a newly established (spring 2011) monitoring station in the Saldur basin (Eastern Italian Alps), which presents a 3.3 km2 glacier in its upper part. At 2100 m a.s.l. (20 km2 drainage area), a pressure transducer measures flow stage and bedload transport is monitored continuously by means of a hydrophone (a cylindrical steel pipe with microphones registering particle collisions) and by 4 fixed antennas for tracing clasts equipped with PITs (Passive Integrated Transponders). At the same location bedload samples are collected by using both a "Bunte" bedload trap and a "Helley-Smith" sampler at 5 positions along a 5 m wide cross-section. Bedload was measured from June to August 2011 during daily discharge fluctuations due to snow- and ice- melt flows. Samples were taken at a large range of discharges (1.1 to 4.6 m3 s-1) and bedload rates (0.01 to 700 g s-1 m-1).

As expected, samples taken using the two samplers are not directly comparable even if taken virtually at the same time and at the same location across the section. Results indicate that the grain size of the transported material increases with the shear stress acting on the channel bed and with the bedload transport rate. The coarsest particles collected reached the median diameter of the bed surface (around 100 mm), and exponent of the relationship between the dimensionless critical shear stress and the relative transported size is about -0.80. This indicates that size-selective mobility conditions dominate within the range of explored discharges, and this evidence is confirmed by the analysis of the fractional transport rates of the collected sediment samples.

The mobility of coarser (from 50 to 500 mm) sediment particles was explored using 360 PITs; the passage of 176 of them (from 50 to 250 mm in size) have been recorded by the fixed antennas. However, clasts up to about the D84 of the bed surface were seen mobilized after the larger snow/ice melt flows, but relevant morphological changes were observed only after a rainfall flood (favored by a preceding high ice-melt flow) featuring a peak discharge of about 14 m3s-1 (above bankfull stage). A preliminary analysis of PITs data shows a lesser degree of transport selectivity, suggesting that at medium to high flow rates sediments are transported at conditions closer to equal-mobility.