Geophysical Research Abstracts
Vol. 16, EGU2014-4558-1, 2014
EGU General Assembly 2014

Monitoring bedload entrainment and transport in snowmelt-dominated forest streams of the Columbia Mountains, Canada

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We monitor bedload transport and water discharge at six stations in two forested headwater streams of the Columbia Mountains, Canada. The monitoring network of sediment traps is designed to examine the effects of channel bed texture, and the influence of alluvial (i.e. step pools, and riffle pools) and semi-alluvial morphologies (i.e. boulder cascades and forced step pools) on bedload entrainment and transport. Results suggest that patterns of bedload entrainment are influenced by flow resistance while the value of the critical dimensionless shear stress for mobilization of the surface D50 varies due to channel gradient, grain sheltering effects and, to a less extent, flow resistance. Regardless of channel morphology we observe: (i) equal-threshold entrainment for all mobile grains in channels with high grain and/or form resistance; and (ii) initial equal-threshold entrainment of calibers $\leq$ 22mm, and subsequent size-selective entrainment of coarser material in channels with low form resistance (e.g. riffle pool). Scaled fractional analysis reveals that in reaches with high flow resistance most bedload transport occurs in partial mobility fashion relative to the available bed material and that only material finer than 16mm attains full mobility during over-bank flows. Equal mobility transport for a wider range of grain sizes is achieved in reaches with reduced flow resistance. Evaluation of bedload rating curves across sites identifies that grain effects predominate with respect to bedload flux whereas morphological effects (i.e. form resistance) play a secondary role. Application of selected empirical formulae developed in steep alpine channels present variable success in predicting transport rates in the study reaches.