Analysis of Bedload Mobility in an Andean Stream

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**Abstract.** High gradient streams form the majority of the mountain drainage network and the sediment dynamics that occur here influence the features of sediment delivered to downstream channels, particularly by controlling the timing of sediment fluxes and the amounts and size of material released to the lowland rivers. In this sense, the bedload is the transport process that regards the coarser particles, which are mobilized by rolling, sliding and saltation on the channel bed. In mountain streams, bedload can be the main sediment transport process, particularly, during flood events. Therefore, its analysis and quantification is crucial for several aspects, including hazard assessment, understanding the morphodynamics of higher order channels and managing reservoir sedimentation. However, the importance of bedload contrasts with the fact that it is difficult and impractical to monitor, especially in steep mountain streams, due to its impulsive nature. To cover this gap, different direct and indirect methods were used to investigate the bedload. One of these is the bedload tracing, which starting from the assumption that bedload transport may be understood as the result of random individual particle displacements, permitted to obtain precious data concerning sediment dynamic in mountain streams during the last decades. In this work, bedload was analyzed in an Andean stream by the use of tracing method. The site is the Estero Morales, a high-gradient stream located in the Metropolitan Region (central Chile). The streambed exhibits boulder-cascade, step-pool and plane bed morphologies with an average slope of about 9.5% and a D50 = 59 mm. The basin (27 km2) extends between 3815 and 1850 m a.s.l., hosting the San Francisco glacier (1.8 km2) that strongly affects the hydrological regime. In particular, during the melt period (December-March) the glacier ensures daily discharge fluctuations with highly variable associated bedload transport rates. In January 2016, 197 clasts equipped with Passive Integrated Transponders were seeded along the Estero Morales and their mobility monitored along a reach 745 m long. Specifically, 11 surveys were realized between January and March 2016 using a mobile antenna in conjunction with a laser rangefinder, obtaining a mean recovery rate of 25.9 %. During the study period, the tracers experienced a maximum and mean water discharge equal to 4.28 and 2.59 m3 s-1, respectively. This hydraulic forcing conditions induced the transport up to a maximum diameter of 280.0 mm, while the average diameter mobilized and average transport distance were equal to 95.0 mm and 12.0 m. The mobility observed resulted not clearly related to the hydraulic forcing, stressing the complex transport dynamics of mountain stream.