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Relating coarse sediment transport dynamics with sediment sources in a glacier-fed Andean basin: Are sediments traceable from sources to sink?

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Sediment transport yield and dynamics in mountain rivers are the result of complexes interactions between geology, landscape, catchment and channel geometry, and runoff regime. Sediment connectivity and sediment coupling interact to deliver sediments from different sources to the channel network and transported downstream. In high altitude mountain environments, especially glacierized ones, sediment coupling could vary in time and space, depending the agent that acts over the sources: water, snow or ice. This became relevant due climate change, because glaciers are retreating and precipitation patterns have been altered, affecting snowfall regime and distribution. The aim of this work is to relate sediment transport dynamics to change of sediment sources in a high altitude glacierized basin. The study was carried out in Estero Morales, a glacier-fed Andean basin extended for 27 km2 in central Chile. Bedload was constantly monitoring every 10 minute using a calibrated 0.5 m-long Japanese acoustic pipe during the 2014-2015 ablation season (October to March) at the outlet of the basin. Also bedload samples were collected using Bunte traps in the monitoring station and 600 meters downstream the glacier, from late snow melt period (December) to late glacier period (March). At the monitoring station, water level, water temperature and electrical conductivity were also measured in order to separate water sources. Results show that bedload yield increase from snowmelt to early glacier melt period, reaching 500 tons Km-2 month-1. Then, sediment yield progressively is reduced until late glacier melt. In the same way, bedload transport rate-water discharge relationship, increase from November to January and the decrease until March. Furthermore, bedload efficiency (sediment volume per unit of water volume) also show shifts, from a constant behave during October to December, to high efficiency in January (early glacier melt). These results suggest a shift in sediment availability during the different periods of the ablation season, where January, or early glacier melting period, is the period with highest availability of sediment. Hysteresis is also present between bedload transport and water discharge, and could reveal some processes in the basin. Sediment travel time from sources to the outlet catchment was also computed using scaling function (process scaled response function) to determine the where the sediments are originating and the period that are delivered into the channel network according to coupling factors.