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Dynamics of daily fluctuations of suspended sediment discharge in a glacierized Andean basin

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Sediment transport during flood events often reveals hysteretic patterns. Hysteresis can be clockwise (when flow discharge peaks after the peak of bedload) or counterclockwise (when flow discharge peaks before the peak of bedload), and recent indexes have been developed in order to quantify the degree of hysteretic patterns. Hysteresis patterns and degree can be used to infer the dynamics of sediment availability, as counterclockwise and clockwise hysteresis have been interpreted as representative of limited and unlimited sediment supply conditions, respectively. This work focuses on the temporal variability of suspended sediment transport measured in the Estero Morales, a 27 km^2 Andean catchment located in central Chile. The elevations range from 1850 m a.s.l to 3815 m a.s.l., and the basin host glaciers with a current extent of 1.8 km^2. Runoff is dominated by snowmelt in late spring, and glacier melt from December to March. Liquid discharge and turbidity have been measured continuously from October 2013 to March 2014 and recently from October 2014 on. The analysis of the regressions between liquid discharge and turbidity reveals that a higher discharge is progressively needed to transport the same concentration of suspended sediments as the glacier melting season progresses. In fact, the coefficient a of the regressions (NTU=a*Qb) reduces, whereas the exponent b of the regressions increases overtime. The analysis of hysteretic loops of daily discharge fluctuations of spring and summer using three indexes are quite consistent in showing that patterns are mostly clockwise during snowmelt and early glacier melt period, and counterclockwise during late glacier melting. This tendency suggests a progressive reduction of sediment supply conditions overtime. Alternatively, this tendency could be interpreted as a proxy for the type and location of the main sediment source, that is likely to be the main channel and tributaries draining snowmelt in spring, and then only proglacial areas during late glacier melting.

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