Highly seasonal suspended sediment and bed load transport dynamic in tropical mountain catchments

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ABSTRACT

Hydrology and sedimentology development have been very limited in Peru in comparison to other sciences due to a lack of reliable suspended sediment data. A new national suspended sediment yield (SSY) dataset (1948-2012) has been collected and processed. Nevertheless, to understand erosion rates across the continent it is important to quantify the total sediment load (TSL) leaving the basin; also, a good knowledge of the transport processes for hydraulic design is required. Unfortunately, in Peru there is no current measurement of bed load, which could represent from 0% to 100% of the TSL. Field measurements of bed load transport are notoriously difficult and have large uncertainties, because it is both spatially and temporally highly variable in mountain catchments. This study aimed to quantify and characterize the TSL from the west-central Andes Mountains.

The Puyango-Tumbes (PT; 4708 km^2) and Zarumilla (ZA; 762 km^2) are two binational (Peru-Ecuador) adjacent catchments. These mountain catchments were monitored at El Tigre (45 m a.s.l.) and La Coja (22 m a.s.l.) stations respectively. Water discharge monitoring (1963-2015), suspended sediment samples (2004-2015) and bed load samples (2013-2014) were carried out in both stations. One monitoring strategy for total sediment load was established by combining: i) the most used bedload sampler called Helley-Smith; ii) the ADCP (Current Profiler Acoustic Doppler) device which was used to characterize changes in both local flow hydraulics and bedload transported across the vertical section; and iii) suspended sediment samples ~~was~~ taken at the surface of the river using a handle bottle. TSL was estimated from **Figure 1**. Results show marked seasonal variability at the PT and ZA; 98% and 99% of the whole total sediment load is transported during austral summer (Jan-May), respectively. The PT and the ZA transport are 340 $t.km^{-2}.year^{-1}$ and 136 $t.km^{-2}.year^{-1}$, respectively; 98% and 75% are transported as suspended sediment, respectively, and the rest of the TSL is transported as bed load. High degree of spatial variability in TSL is observed in adjacent mountain catchments; also, the bed load fraction is highly variable in relation to TSL. Differences are attributed to special hydraulic characteristics (granulometry and the energy delivered for water discharge volume).

Estimating the bed load transport has been a central concern in mountain catchments during floods events, since most of them appear in a very short period of time. Highly accurate quantification of TSL supply requires continuous bed load monitoring. However, some limitations appear under these conditions, where strong turbulence surrounded by trees and pales frequently occurs. There is a clear need to complete the TSL rating curve for high water discharge. This abstract should be considered as being preliminary. Current monitoring (2014-2016) with advanced devices will improve understanding of total sediment load processes and mechanics associated with flood events.

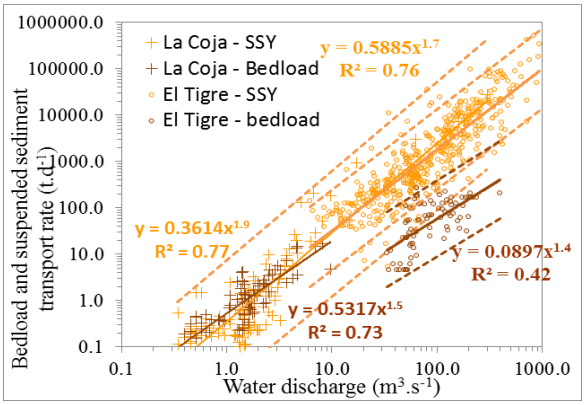

Figure 1. Bi-log. plot of daily suspended sediment (brown) and bed load (orange) rating curve, over 10 years (1182 data points).

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