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Discharge variability along a climate gradient in Chile: seasonality and (eco)hydrological modulation by catchment attributes.

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The incision of rivers into bedrock is considered as one of the most important processes driving long-term landscape evolution. River incision is non-linearly dependent on river discharge, because river discharge must exceed a certain threshold to be able to transport bedload sediment and expose the riverbed to erosion. Fluvial erosion efficiency is, therefore, strongly controlled by the frequency and magnitude of flood events. In this study we hypothesise that catchment attributes, such as regolith thickness, lithology and vegetation cover, modulate the discharge response after a precipitation event, which has implications for the fluvial erosion efficiency.

We present preliminary results from a study, in which we exploit daily discharge records from 322 river gauging stations on a large climatic gradient in Chile (18˚S-55˚S). The studied rivers have catchment areas of 15 km^2 to 24200 km^2, which differ in topography, lithology, regolith thickness, vegetation cover and snow and glacier cover. First, we studied discharge variability (i.e. magnitude-frequency distribution of flood events) and the occurrence of different discharge regimes as result of seasonal variations, by obtaining the best fit of a weighted sum of two inverse gamma functions to the data (Scherler et al., 2017). Each of the distributions is interpreted to correspond to one flow regime. When the weighted sum of two inverse gamma functions performed better than one, and each flow regime lasted at least 3 months, we interpret the different flow regimes to reflect seasonal variation in a catchment. Results reveal large variations in discharge variability along the climate gradient and strong seasonal variations around 30˚S-40˚S which is mainly driven by climatic forcing and snow melt.

We are currently studying discharge variability by obtaining the flood flashiness parameter, the variability index and hydrologic response time from fitting the streamflow recession model to the daily discharge records (Deal et al., 2018 after Botter et al., 2007). We will focus on the differences between seasons and El Niño, La Niña and normal years and will compare all parameters with calculated topography and datasets of climate, vegetation density, regolith thickness, lithology and snow and glacier cover to disentangle their controls on flood flashiness, variability index and hydrologic response time.

References:

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