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What tools do we have to study the morphological effects of hydroelectric plants in developing countries? The Chilean case

Hernan Alcayaga (1), Diego Caamaño (2), Sebastian Palma (1), and Karla Contreras (2)

(1) Diego Portales University, UDP, Civil Engineering, Santiago, Chile (hernan.alcayaga@udp.cl), (2) Universidad Catolica de la Santisima Concepcion, UCSC, Civil Engineering, Concepcion, Chile

Countries growing rates are directly related to energy production. Therefore, developed and developing nations are focused on hydropower and dam construction; on the contrary dam removal practices are significantly different among nations, demonstrating the former group a lesser interest on removing structures. Chiles hydropower generation corresponds to 50% of the current grid, having a potential capacity to double the current situation. Thus: ¿What tools can we apply to assess the potential impacts on our rivers?

The goal of this project is to study two different reaches located in two separates streams in Central Chile. The Aconcagua River represents a mountain stream (i.e. steep, narrow, and confined) subject to the operation of a hydroelectric system composed by five diversion hydropower plants built during the 90‘s. The Rapel River reach corresponds to the last 10km upstream to the outlet; it is a mild and wide stream that includes the gravel-sand transition. The Rapel dam operates about 25km upstream this second reach that is characterized by an 112m wall built in 1968.

The Aconcagua hydropower system was characterized within a GIS environment and a morphological response conceptual model applied. The model uses two indexes to evaluate changes in i) channel forming discharge and ii) sediment supply. The provided response shows the trends and magnitudes of the changes, based in eighth possible directions for ten morphological responsible variables. The Rapel river system was evaluated differently and sampling of sediments characteristics (D50 and armour index), discharge index for both before and after the dam operation, Morphological Quality Index (IQM) and an analysis of aerial photography time series were performed.

Results showed that the hydrology indicator impacts for the Aconcagua system were more severe than the impacts on sediments transport (typically the case for diversion type hydropower). A fine armour layer was found within the Rapel river site, also the IQM method classified it as poor quality, and the analysis of aerial photos showed three areas with significant changes in sinuosity. Although, both reaches indicated aggradation, attenuation in width, and an increment in slope.

The amount and the quality of the available data on both reaches allowed assessing the basic morphological changes for the current rivers morphological stage. The next step is to transfer these methods and results to other systems that lack of these level of information, thus we could somehow diagnose and quantify impacts before the construction of the structure, and not as it is done today that impacts are not corrected within the project, but mitigated once the dam is in place and operating.