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Pilot study on the potential impact of climate variability on sedimentation in Andean reservoirs, based on data from the Cañete catchment, Peruvian Coastal Range.

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The global water storage capacity of hydroelectric reservoirs is decreasing annually while the economic activity, the hydropower industry and the world population continue to grow strongly. The boom in hydropower development in Andean river basins was identified as one of the top 15 global conservation issues. For this region, the electricity generation might increase by 550% from 2005 to the year 2050, thereby needing an increase in water volume from 70.5 billion m³ to 150.7 billion m³. Of the Andean countries, Peru has the highest numbers of existing and proposed hydropower projects, because of its rapidly evolving energy demands (estimated at 8% growth per year) and regulatory framework that aims at promoting renewable energy. Despite initial efforts, studies that describe the impact of changing sediment transfer due to climate change to the hydroelectric infrastructural system are still limited.

This paper evaluates the potential impact of climate variability on the water storage capacity of hydroelectric reservoirs in Andean countries, via a case study of the Cañete River in the Peruvian Coastal Range. It houses the 220 MW El Platanal hydroelectric plant and the Capillucas reservoir that provide the surrounding areas with water and energy. We used a hydrological model (HEC-HMS) coupled with a sediment transport model (HEC-RAS) to simulate future changes in river discharge and sediment load. Ten scenarios were developed, a combination of two different precipitation patterns and five different precipitation rates.

The average sediment load of the Cañete River was estimated at 981 kTon/yr upstream of the Capillucas reservoir, which is in agreement with published erosion rates for the area. Our results show that the lifespan of the Capillucas reservoir ranges from 7 years for the most pessimistic scenario to 31 years for the most optimistic scenario. This is much shorter than the projected lifespan of 50 years. This pilot study illustrates the vulnerability of Andean hydroelectric reservoirs against future climate change.