Geophysical Research Abstracts
Vol. 19, EGU2017-15672, 2017
EGU General Assembly 2017

Damages to Himalayan hydropower projects by the 2015 Gorkha earthquake

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The 2015 Mw 7.8 Gorkha Earthquake in Nepal killed ∼9000 people, destroyed several hundred thousand houses, and wreaked havoc to infrastructure. Hydropower projects (HPP) sustained particularly serious damage by structural failures and impacts of landslides and rockfall as well as postseismic sediment surges. More than 15 HPP were inoperable for months or completely destroyed, and the country's hydropower generating capacity dropped by ∼30%. Why were damages so severe?

We mapped HPPs in Nepal and classified damages according to their severity based on newspaper reports and information made available by officials, company websites or other assessments. Moreover, we used available peak ground acceleration (PGA) data and characterized the topographic setting of the HPP locations using numerous geomorphometric attributes.

We analyzed this data using a linear discriminant analysis and show that the severity of damage is only partly related to PGA but also to the topographic setting quantified by river steepness. The combination of coseismic ground shaking and the siting in a tectonically active and transient landscape prone to the mobilization of sediments significantly determines expected losses to HPP in the wake of strong earthquakes.

Assessments of seismic risks to hydropower facilities largely rely on the analysis of structural damage due to ground shaking but apparently have underestimated coupled and cascading hazards that characterize high mountain areas. Our results show that tectonic geomorphology can make a vital contribution to assessing these risks by employing their landscape metrics for hazard assessment.