Assessing the predictive capacity of hillslope projected channel steepness for rockslope instability in the High Himalaya of Bhutan

Larissa de Palézieux*, Kerry Leith*, Simon Loew*

*Geological Institute, ETH Zurich, Sonneggstrasse 5, CH-8092 Zurich (larissa.depalezieux@erdw.ethz.ch)

With large alluvial planes, narrow gorges, prominent knickpoints, and chains of terraces or cut-off ridges, the deeply-incised valleys below 3000 m a.s.l. in Bhutan record distinct changes in rates of spatial and temporal fluvial incision. In regions with little geological knowledge, excess topography has been shown to be a good predictor for landslide distribution (Blöthe et al., 2015). The authors suggest this indicates a structural control, specifically that topogaphy which exceeds a specific threshold angle will attain static equilibrium via gravitational slope movements. Since 2016 the engineering geology group at ETHZ has been working on cataloguing active and dormant slope instabilities in NW Bhutan using a combination of satellite-based remote sensing, 5m-resolution digital elevation models, and field observations. Here, we compare the predictive capacity of the excessive topography approach to a method in which we relate relative stream energy through the normalized channel steepness index (k_{sn}) to landslide occurrence. Initial observations indicate that regions of excess topography generally coincide with those of increased channel steepness, hinting at a causal relationship. While further work is required, an assessment of enhanced erosional power using hillsope extrapolated k_{sn} values may provide an additional means of characterizing the spatial distribution of landslides in such environments. This supports the notion that slope instabilities are the result of a combination of structural bedrock control and surface erosional activity.

REFERENCES

Blöthe, J. H., Korup, O., & Schwanghart, W. (2015). Large landslides lie low : Excess topography in the Himalaya- Karakoram ranges, 43(6), 523–526. https://doi.org/10.1130/G36527.1