

New insights into the failure and runout of rock slopes derived from field observations and numerical modelling

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Keywords: *Keywords list.*

Abstract:

Flow-like landslides in rock are among the most damaging landslide types, as they can impact people and property over large spatial areas. Since these events can emplace in a matter of minutes, managing their risk requires forecasts of catastrophic failure probability and runout extent, which can inform land-use planning and emergency scenarios. Numerical models are one tool that can be used to make these forecasts, however, the selection of appropriate input parameters has made their application challenging in practice. In this talk, we first provide an overview of the diversity of behaviour that can occur during the failure and runout of rock slopes. Next, we combine high quality field data with GPU-accelerated numerical modelling to show how site-specific factors can explain some of the variability between events. We partially validate these findings using the results of LiDAR scanners installed in-situ, which collect field data of moving flow-like landslides at a frequency of 10 frames per second. We further show how GPU computing enables regional-scale calibration and prediction using mechanistic numerical models. We then present a probabilistic prediction framework, and show how forecasts of catastrophic rock slope failures can be parameterized. These forecasts have substantial variability due to unknown site-specific factors, such as soil saturation, which are accounted for by running hundreds to thousands of simulations per event. We conclude with a discussion of the most important remaining uncertainties, as well as promising directions for future work.