THE FUTURE OF SHALLOW LANDSLIDING

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ABSTRACT

Four questions can be asked about shallow landslides: 1) Can we predict where shallow landslides occur; 2) Can we predict when these landslides will happen, 3) Can we predict shallow landslide size, and 4) How do we alert society about shallow landslide risk. Landslide location is most commonly predicted from empirical correlations based on landslide inventories. I suggest that most maps of landslide occurrence are not sufficiently accurate, and do not provide sufficient local information to gain much insight about controls and mechanisms. The timing of landsliding, a crucial element in rapidly developing hazard warning systems, in most studies relies on local empirical thresholds for rainfall intensity and duration. While such empirical approaches have proven useful, there is a paucity of data on rainfall characteristics at the actual sites and specific times of failure. Fully dynamic hydrologic models which may overcome the use of empirical thresholds can explore important issues including the role of pressure waves, suction change, lateral versus vertical flow, and the exfiltration from bedrock on slope stability. If such hydrologic models are used, however, to drive simple infinite slope models, they may be of limited value. This is because shallow landslides are strongly influenced by wall effects, making the infinite slope model a crude approximation at best for instability conditions. I would argue that the use of the infinite slope model only warrants simple hydrologic models to drive it. Landslide size prediction will require the use of a three-dimensional slope stability model and efficient search algorithms to detect areas of instability across a landscape. This is a challenging problem about which only limited research has been done. Field observations suggest that local variations in topography, soil depth, root strength and bedrock flow exfiltration may strongly control shallow landslide size. Not only, then, do we need models for predicting size, but we need new tools for quantification of these controlling attributes across the landscape. One problem in issuing warnings about landslides is that all models greatly over-predict the extent of landsliding for any particular precipitation event. More mechanistic models with reliable, field-based parameterization can reduce the area of predicted instability. All four questions I have listed here must be addressed as we explore how landslide frequency and magnitude might change in response to anticipated climate change. It is suggested that future shallow landslide modeling would greatly benefit from shared high-quality field data sets on landslide location, timing, size and controlling parameters. This will require considerable effort, but the benefits to advancing the field would be significant.

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