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Predicting landslide failure mechanisms using advanced mathematical models

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Understanding the process of landslide failure is crucial for predicting and minimizing the consequences of landslides. Landslide failure can be caused by a variety of factors, including geology, topography, and soil conditions, while environmental triggers such as precipitation and earthquakes initiate the movement. We can better understand the risks associated with landslides and apply appropriate steps to decrease those risks by disclosing the precise mechanisms that contribute to landslides in a specific location. To reveal these mechanisms, we use an advanced mathematical model called the Topological Data Analyses (TDA) that decodes the landslide's shapes and configurations as it includes factors such as the slope of the failures, the presence of cliffs or other steep terrain features, and kinematic propagation of the failures. Then we use these features to categorize the different landslide failure mechanisms such as slides, flows, falls, and complex landslides. Our study paves the way to classify existing and past inventories that miss these failure type information. This information will help the landslide predictive community in general and in the different stages of the landslide risk cycle as pertinent information of failure mechanisms are important for effective forecasting, susceptibility, hazard, and risk modelling.