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A new model for integrated multi-hazard modelling of flooding and mass movements in mountainous watersheds.

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Forest areas take direct impact from a variety of hazardous land surface processes. For example, slope failure and mass movements remove significant amounts of vegetation on slopes and can alter the sediment budget of large areas. When modelling the impact of these processes, they are often viewed in an isolated manner. In reality, hazardous processes such as landslides, flooding and erosion can share a common trigger: hydrological processes. To provide new insights in the behavior of multi-hazard events, and to predict behavior of hydrology related multi-hazard events and their impact on forest areas, new tools are required. In this presentation, we present the methods behind the new multi-hazard model OpenLISEM. We implement a new iterative method for regional assessment of slope failure depths to link a full catchment-hydrology model to physically based estimates of slope failure volumes. Runout is simulated use two-phase flow equations from Pudasaini (2012). The model was tested on a multi-hazard event that took place in the area of Scaletta, Eastern Sicily. Here, a 2009 convective storm caused over 390 shallow landslides in a 6 km2 coastal catchment (Lombardo et al., 2015). Using the developed model, we simulate the full event, hydrology, slope stability, slope failure, two-phase runout and flooding, and finally coastal deposition of the material. The results of the simulation show satisfactory accuracy in recreating the behavior of the event. As with most slope failure prediction, challenges arise in data accuracy. The general patterns of failure are however well-predicted. Furthermore, the model showed good accuracy in estimating the combined behavior of debris flow runout and flooding. By performing a sensitivity analysis, we were able to see how the addition of hydrology changed the results of the simulations. In particular, in multi-hazard events like these, an integrated approach to simulating these processes was necessary for an accurate prediction.