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A Stochastic Monte-Carlo Model to Study the Impact of Large Triggered Landslide Events on Road Networks

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Triggers such as earthquakes or heavy rainfall can result in hundreds to thousands of landslides occurring across a region within a short space of time. These landslides can in turn result in blockages across the road network, impacting how people move about a region. Here, we show the development and application of a semi-stochastic model to simulate how landslides intersect with road networks during a triggered landslide event. This was performed by creating "synthetic" triggered landslide inventory maps and overlaying these with a road network map to identify where road blockages occur. Our landslide-road model has been applied to two regions: (i) the Collazzone basin (79 km^2) in Central Italy where 422 landslides were triggered by rapid snowmelt in January 1997, (ii) the Oat Mountain quadrangle (155 km^2) in California, USA, where 1,350 landslides were triggered by the Northridge Earthquake (M = 6.7) in January 1994. Initial results show reasonable agreement between model output and the observed landslide inventories in terms of the number of road blockages. In Collazzone (length of road network = 153 km, landslide density = 5.2 landslides km^{-2}), the median number of modelled road blockages over 100 model runs was 5 ($\pm$2.5 standard deviation) compared to the mapped inventory observed number of 5 road blockages. In Northridge (length of road network = 780 km, landslide density = 8.7 landslides km^{-2}), the median number of modelled road blockages over 100 model runs was 108 ($\pm$17.2 standard deviation) compared to the mapped inventory observed number of 48 road blockages. As we progress with model development, we believe this semi-stochastic modelling approach will potentially aid civil protection agencies to explore different scenarios of road network potential damage as the result of different magnitude landslide triggering event scenarios.