EGU22-11746, updated on 02 Aug 2022
https://doi.org/10.5194/egusphere-egu22-11746
EGU General Assembly 2022

2D simplified landslide models inferred by statistical analyses on existing landslide databases for multi-hazard analysis: an application to the Campotosto Lake basin (Central Apennines, Italy)

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Landslides are among the most frequent secondary effects related to seismic events. The prediction of the expected displacements of landslides activated by seismic shaking (1^{st}-time failures and reactivated landslides) is therefore a substantial feature for the hazard assessment in high seismicity regions. Several databases collecting geological and geometrical information on worldwide landslides events are available in literature. This study presents the result of statistical analyses on morphometric, topographic and geotechnical parameters extracted from existing landslide databases (Domej et al., 2020; Martino et al., 2019; Tanyas et al., 2019). The aim is to define a procedure to generate 2D step-like-slope landslide models representative of the most common landslides in terms of failure mechanism (divided into two main categories: purely rotational and translational landslides), volume, and geotechnical properties. Rock falls and toppling, flow-like landslides and deep-seated landslides were excluded from the initial dataset, because they are associated with peculiar physical processes during the failure and the propagation. The performed statistical analysis allowed to identify the most frequent values of depth/length ratios, volume and slope angle, from which other geometrical measurements were analytically derived. In addition, various landslide locations along the slope were considered to cover most of the real cases. This resulted in 36 different landslides/slopes shapes. Landslides dynamic/geotechnical parameters (shear wave velocity, density, strength) were selected to be consistent with those inferred for rocks, cohesive soils and granular soils by statistical analysis. The representativeness of the inferred models is assessed by comparing the theoretical geometries with the real ones detected in the Campotosto Basin (Central Apennines, Italy), a high seismicity area very close to the Amatrice village, which was strongly hit by the recent 2016-2017 (M 6.5) Central Italy seismic sequence as well as by the 2009 (M 5.9) L'Aquila earthquake. The simplified landslide models represent the first part of a major study on the prediction of seismically induced landslide displacements. The aim is to improve the existing Newmark's approach–based PARSIFAL (Probabilistic Approach to pRovide Scenarios of earthquake-Induced slope FAiLures) method (Martino et al., 2019) to assess the earthquake-induced displacements at a

regional scale, by introducing corrective factors derived from parametric dynamic numerical simulations on the simplified geometries; such factors should incorporate some aspects of the complex seismic waves/landslides slopes interaction. Such a procedure will allow to overcome the Newmark's method limitations and to extend the advantages of the numerical analyses, the use of which is generally limited to studies at slope scale, over larger areas.