

Rock slides, rock avalanches and deep seated gravitational slope deformation at the orogeny scale: the case of European

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An orogen scale inventory of large landslides (mainly rockslides), rock avalanches and deep seated gravitational slope deformations (DSGSD) in the European Alps has been prepared by the authors (Crosta et al., 2013, 2014) and results of the analysis are presented in this contribution. The inventory includes: over 2000 large landslides, ranging in area between 0.1 and 17 km², about 300 rock avalanches, ranging between 0.09 and 15.5 km², and a total of 1033 DSGSDs, ranging in size between 0.03 and 108 km². The inventory covers an area of about 110,000 km² extending over the alpine territories of Italy, France, Switzerland, Austria and Slovenia, and was prepared by using available satellite imagery (multitemporal, Google Earth, Google, Inc.) and topographic data at different resolutions (DEMs from 1 m x 1m up to 20 m x 20 m for different areas). The inventory was validated against local and regional landslide inventories already available at different scales. Geometrical features and geomorphological parameters have been collected and related to the different phenomena and local settings in order to assess the control of local slope morphology on the occurrence and the geometry of these large instabilities. The frequency/area relationship for the different classes of mapped features is presented. The inventory shows that large landslides are widespread in the Alps with clustering in some sectors of the orogen. Their spatial distribution has been analysed through bivariate and multivariate analysis (mainly Principal Component Analysis and Discriminant Analysis) against a variety of factors, including: lithology, proximity to tectonic structures, seismicity, uplift and exhumation rates, position within the mountain belt and along main and tributary valleys, slope morphometry (e.g. relief, elevation, gradient), ice thickness of glaciers during LGM, and mean annual rainfall. The analysis allowed a preliminary assessment of conditions favourable to the onset and development of large landslides and DSGSD. The occurrence of foliated metamorphic rocks, LGM ice thickness, local relief (and related parameters), slope size, drainage density and river stream power are the local parameters most positively correlated to DSGSD occurrence. Finally, a comparison between the distributions of different phenomena is presented and discussed.

Keywords: landslides, deep seated gravitational slope deformation, rock avalanche, inventory, orogen, European Alps