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Alpine inventory of Deep-Seated Gravitational Slope Deformations

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Deep seated gravitational slope deformations (DSGSDs) have received proper credit only from a relatively small number of researchers interested in slope stability (e.g. Zischinsky, 1966; Beck, 1967; Nemcok, 1972; Tabor, 1971; Mahr, 1977; Mortara and Sorzana, 1987; Radbruch-Hall, 1978; Bovis, 1982; Forcella, 1984; Savage and Varnes, 1987; Crosta, 1996; Miller and Dunne, 1996; Ambrosi and Crosta, 2006). This resulted in equivocal definition of DSDGS features and mechanisms, and in an underestimation of the impact of DSGSD phenomena in the post-collisional evolution of mountain belts. In this contribution we aim at demonstrating the diffusion of such phenomena at the scale of a mountain belt. For this reason we started and completed a first DSGSDs inventory map at the scale of the entire western and central European Alps. We mapped and differentiated DSGSDs according to their size, geometry/morphometry, degree of evolution, and possible attributable origin. In this context we classified them as large landslides, mixed landslides-DSGSDs, DSGSDs (with or without dominating tectonic features), and finally as structures related to neotectonic or active tectonic processes. Mapped features have been classified according to a variety of criteria, including: size with respect to the slope and valley size, inferred thickness, capability to influence the local morphology, relationships with different landforms and deposits, possible confinement (absence of a clearly developed toe), occurrence of different types of morpho-structures, continuity through major topographic features (ridges, channels, etc.), relationships with main tectonic features, evidences for the gravitational reactivation of tectonic features (i.e. larger structure relief with respect to other conterminous areas along the same or similar slopes), fresh-

ness and amount of displacement along mapped morpho-structures, availability of displacement indicators (e.g. displaced glacial and periglacial deposits, displacement of the slope toe and deviation of the valley bottom and rivers, remotely sensed displacements). A total of about 1700 elements has been mapped. The 650 DSGSDs range in area between 0.2 and 100 km2, 125 mixed landslides-DSGSDs ranges between 0.3 and 6.2 km2, 93 tectonic features ranging in size between 0.1 and 85 km2. Finally, large 540 landslides range in size between 0.02 and 6 km2. Length and width, as well as other geometrical features and geomorphological parameters have been collected and related to the different phenomena and different typologies distinguished within the same class of phenomena. The spatial distribution of DSGSDs has been analysed against a variety of factors, including: lithology, proximity to tectonic structures, seismicity, uplift and exhumation rates, distribution of other large slope instabilities, position within the mountain belt and along main and tributary valleys, geometry of the valley bottom profile, slope morphometry (e.g. relief, elevation, gradient, etc.), and distribution of glacial features. The analysis allowed a preliminary assessment of conditions favourable to the onset and development of DSGSDs and to discuss the role of active tectonic processes on the post-glacial evolution of mountains slopes in the area. Because of their size and relationships with the drainage network these phenomena can play a major role in slope erosion, sediment availability and yield both at the catchment and mountain belt scale. In fact they can be or have been in the past (during past glaciations and inter-glacial periods) between the main sources or controls for the erosion, transport and deposition of enormous amounts of material.

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