



## **The landslide inventory as the basis of susceptibility and hazard assessment**

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Landslide inventory involves the location, classification, volume, activity and others characteristics of the landslides in an area (Fell et al, 2008). Landslide inventory can include also the location of lithologies prone to instability, structural conditions and silent witnesses (affected vegetation, damaged buildings, etc). This high quality information about landslides requires the use of images acquired from remote sensing and the field observation. Landslide inventory is the basis for susceptibility, hazard and risk assessment (Fell et al., 2008) because supplies information contrasted on the field. Unfortunately, landslide inventory has limitations so it usually is not totally complete or landslides boundaries mapped are influenced by the techniques used, resources and the ability of the field geologist. These usual errors included in the landslide inventory are difficult to estimate but are crucial to know since can create greater errors on results of susceptibility, hazard and risk assessed by further approaches including heuristic, empirical and deterministic ones.

In many cases it is not possible to make an inventory including all the landslides occurred in the past because morphology of older landslides could be extremely eroded, or they are partially or totally covered by younger vents. Moreover, several external factors (like extreme forestation, urbanization or erosion) do not allow their identification or difficult their delimitation.

Our work focuses on: (i) the establishment of a procedure for gathering data to complete a landslide inventory, and (ii) the determination of the error included in the landslide inventory whichever the field geologist. These issues are useful for administrations for: (i) undertaking landslide inventories across the country by several geologists, and (ii) managing hazard knowing limitations of the hazard zoning obtained from the landslide inventory.

For accomplishing our purposes we have selected an area located about 40km<sup>2</sup> in Tremp (Catalan Pyrenees). The selected area is dominated by a large synclinorium and two main lithologies can be considered inside: (i) the "Garum" Formation composed by plastic clays susceptible to instability, (ii) and a calcareous rock forming rockcliffs faces from ten to hundred meters high where primary rockfalls occurs. Several types of landslides are present in Tremp: rockfalls, topples, slides, earth flows, large lateral spreads and slow earth flows in a large part of slopes. Older events dated reveal an active instability over the Pleistocene with main reactivations during the glacial periods. Nowadays, small landslides affect the superficial colluvium are present during large rainfall periods. These characteristics reveal Tremp like a complex area affected highly by landslides.

Two qualified field geologists from different institutions have created two different landslide inventories at a scale 1:10.000 over the same area in Tremp. One of the inventories, which is created by an earth scientist experienced in geomorphological techniques, represents the pessimistic interpretation considering large instabilities affecting large parts of the slope. The other inventory, which is created by a professional geologist experienced in landslide mapping, considers a more optimistic interpretation of the landslides identified. Commonly, parameters considered are the morphology of terrain surface, the lithology of rock outcrops and quaternary deposits, presence of damaged vegetation, and structural patterns. Data has been obtained by using air photographs and field observations.

Inventory maps have been compared in order to contrast the existing differences and to detect limitations. Usually, both inventories represent the same large events despite their boundaries can be particular. However, smaller events mapped are sometimes different on both inventories.

Results obtained allow us to contrast the use of parameters considered during the completion of landslide inventory

and to propose a procedure performed in the surrounding area.

#### References

Fell, R., Corominas, J., Bonnard, C., Cascini, L., Leroi, E., and Savage, W.: Guidelines for landslide susceptibility, hazard and risk zoning for land use planning, *Eng. Geol.*, 102, 85–98, 2008.