Abstract

Debris flows are one of the most important vectors of sediment transfer in mountainous areas. Their hydro-geomorphological behaviour is conditioned by geological, geomorphological, topographical, hydrological, climatic and anthropic factors. European research in torrential systems has focused more on hydrological processes than on geomorphological processes acting as debris flow triggers. Nevertheless, the identification of sediment volumes that have the potential to be mobilised in small torrential systems, as well as the recognition of processes responsible for their mobilisation and transfer within the torrential system, are important in terms of land-use planning and natural hazard management. Moreover, a correlation between rainfall and debris flow occurrence is not always established and a number of debris flows seems to occur when a poorly understood geomorphological threshold is reached.

A pragmatic methodology has been developed for mapping sediment storages that may constitute source zone of bed load transport and debris flows as a preliminary tool before quantifying their volumes. It is based on data directly derived from GIS analysis using high resolution DEM's, field measurements and aerial photograph interpretations. It has been conceived to estimate sediment transfer dynamics, taking into account the role of different sediment stores in the torrential system applying the concept of "sediment cascade" in a cartographic point of view.

Sediment transfer processes were investigated in two small catchments in the Swiss Alps (Bruchi torrent, Blatten bei Naters and Meretschibach torrent, Agarn). Thorough field geomorphological mapping coupled with complementary measurements were conducted to estimate sediment fluxes and denudation rates, using various methods (reference coloured lines, wooden markers and terrestrial LiDAR). The proposed geomorphological mapping methodology is quite innovative in comparison with most legend systems that are not adequate for mapping active and complex geomorphological systems such as debris flow catchments. The interest of this mapping method is that it allows the concept of sediment cascade to be spatially implemented but only for supply-limited systems. The map cannot be used directly for the creation of hazard maps, focused on the deposition areas, but for the design of correction measures and the implementation of monitoring and warning systems.

The second part of this work focuses on geomorphological mapping. An analysis of a sample of 146 (extracts of) maps or legend systems dating from the middle of the 20th century to 2009 – realised in more than 40 different countries – was carried out. Even if this study is not exhaustive, it shows a clear renewed interest for the discipline worldwide. It highlights the diversity of applications, techniques (scale, colours and symbology) used for their conception.