EXTREME TORRENT EVENTS IN THE HAZARD MAPPING AND LANDUSE PLANNING IN THE AUTONOMOUS PROVINCE OF TRENTO

THE AUGUST 15, 2010 DEBRIS FLOW IN THE VAL MOLINARA TORRENT (CAMPOLONGO DI PINÈ – TRENTINO – ITALY)

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INTRODUCTION

Extreme torrential events, characterized by out-of-scale magnitude, are often hardly predictable with the use of the standard historical hydrometeorological time-series. They often occur in mountain streams characterized by dormancy phases (sediment recharge) that can continue for many decades. Normally, if the torrent has been involved in torrential phenomena in the recent history (last 50 years), it is very probable that it's classified as dangerous (high or medium level) in the hazard maps currently used for the land use planning (Synthetic Geological Map introduced only in the '80s).
The hazard planning has often excluded or neglected many mountain streams or small gullies because they are usually without runoff or with ephemeral runoff, are characterized by very episodic extreme torrential phenomena (secular or ultra-secular), without historical memories, "mute witnesses" and torrent control works. This explains why some urban areas and infrastructures, in some cases ancient, can be involved in extreme torrent events.

THE CASE STUDY: THE AUGUST 15, 2010 DEBRIS FLOW IN THE VAL MOLINARA TORRENT

In this report we analyze in detail the August 15, 2010 extreme debris flow event occurred in the Val Molinara torrent (Campolongo di Pinè – Trentino – Italy). This event is one of the greatest happened in the last 20-30 years in the Province of Trento both for cumulative rainfall, erosion processes and sediment volume involved. A very interesting issue is that the event has happened in a mountain stream that hasn't been considered relevant in terms of hazard (in the Synthetic Geological Map and by the "hazard index" evaluated by a new methodology adopted by the Torrent Control Service) and priority of mitigation actions.
For this event, that fortunately has not caused loss of human being but only material damages, we first conducted a post-event documentation based on the collection of field data. This operation permitted us to reconstruct the peak discharge of the debris flow as precise as possible and to evaluate the overall sediment volume mobilized and deposited. This analysis has been carried out for all the return periods fixed by the provincial law for the torrent hazard zoning in alluvial fan areas (30, 100 and 200 years) with the aid of numerical tools and models currently used by the Torrent Control Service of the Province of Trento. This approach that requires an analysis based on return periods and hydrological and hydraulic modelling, is a new methodology, actually in progress, for the Torrent Control Service of the Province of Trento.
The analysis has highlighted the exceptionality of the event, both for characteristics of the triggering rainfall and sediment volume mobilized. In a second analysis step we have evaluated if the new tools and methodological approaches used for the torrent hazard evaluation would have succeeded in foreseeing the hazard zoning and event intensity as those really happened. This hazard analysis,

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carried out without knowing the real event magnitude (out-of-scale), has underlined that we wouldn't have reached intensity values (rainfall, peak discharge, sediment volume, velocity, etc.) measured in field. Nevertheless, the hazard zoning obtained from the application of the 2D modelling tools was quite satisfactory considering the characteristics of the debris flow event occurred in 2010 both for maximum inundated area and intensity values (depth, velocity, deposits, etc.). These results underline that the tools and the actual *modus operandi* of the Torrent Control Service can be considered sufficiently precautionary for a correct hazard zoning, landuse planning and torrent phenomena prevention carried out through the realization of suitable structural and non-structural countermeasures. These new methods and tools have become the technical standard used by Torrent Control Service only in the last years. For this fact, many situations in which the hazard is more hidden, as the Val Molinara torrent, haven't been discovered and analyzed yet. The results show once more time, in evident way, the importance of controlling the extreme torrent events not only by the realization of imposing structural countermeasures, but using the so-called "residual hazard" already in the hazard zoning phase which is directly connected to a prudent urbanization planning. In fact, for unpredictable and very impulsive torrent phenomena such as debris flows, alert and emergency plans seems to be not so effective.

Fig. 1 Deposition area of the Aug. 15, 2010 debris flow event in the Val Molinara

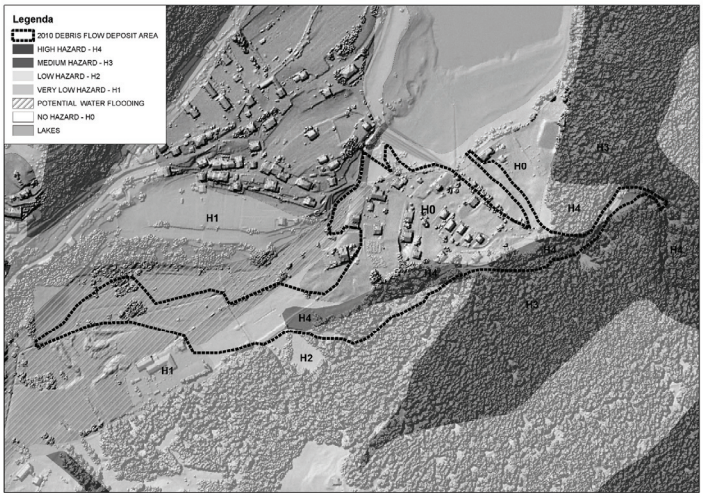

Fig. 2 Overlap of the deposition area of the Aug. 15, 2010 debris flow and pre-event Synthetic Geological Map

Keywords: extreme event, debris flow, hazard planning, countermeasures