Precipitation data analysis for hazard mapping in the Autonomous Province of Trento.

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INTRODUCTION

The Autonomous Province of Trento covers a mostly mountainous territory, characterized by a wide variety of morphological, climatic and environmental conditions. It goes from the Alpine valleys placed at the bottom of the most important mountain ranges (with severe climate, presence of glaciers and abundance of water) to the sub-alpine valleys, highlands and small plains (with sub-Mediterranean climate).

With specific reference to the Alpine part of the Autonomous Province of Trento, the territory is typically characterized by small basins with a high elevation difference from the head to the valley, which are often the site of convective precipitation. This kind of event may be very critical for alpine basins, as may be responsible for the triggering of debris flows and/or flash floods (Caine, 1980). In this context, extreme events are difficult to predict by standard historical hydrometeorological time-series obtained from raingauges (Nikolopoulus et al., 2014). In fact, in the study area the raingauges are available in limited number and are mostly located in the valleys, so extreme precipitation which occurred in the upper part of a alpine basin are often not detected. Consequently occurs that Province's technicians field inspections frequently highlight debris flows phenomena, which don't have a correspondence with the rainfall events detected by traditional raingauges.

A potential solution to the observational limitations posed by raingauges lies on remote-sensing observations, and more specifically on weather radar rainfall estimates (Borga et al., 2014). In this regard, the objective of this work is to present how the Autonomous Province of Trento evaluates the integration between different sources of precipitation data analysis necessary for drafting or updating the hydrogeological hazard map and for land management (planning, prevention hydraulics structures, ...).

METHODS

In this section we present a case study as an example of many similar situations in which the integration between rain-gauges and weather radar precipitation data results necessary for individuating the relation between meteorological event and the corresponding result on the territory.

We consider a summer extreme precipitation occurred in Primiero valley (north-western Province of Trento), which caused debris flow phenomena. In this case the raingauges located in the valley were unable to detect the peak of precipitation, instead of weather radar.

In Fig.1 we can see a radar precipitation map where no one of the present raingauges (red crosses)

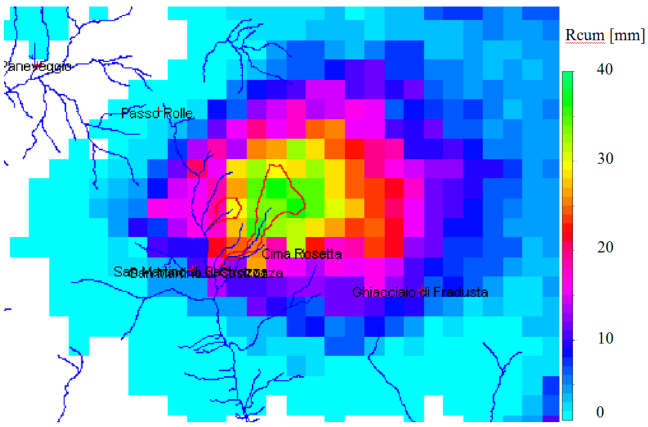

Fig. 1 Radar precipitation map for a mountain basin (red polygon) and rain gauges (red crosses) located in the valley (Primiero valley, Italy).

around the basin (red polygon) recorded the peak of the precipitation.

This case study highlights the importance of the integration of traditional precipitation raingauges and weather radar data, specially when a modelling approach is required for a correct land management and for hazard mapping. In fact it is clear how difficult is to correctly observe and evaluate these phenomena basing only on precipitation intensity-

duration frequency Curves obtained from valley rain gauges.
Operatively, the Autonomous Province of Trento developed a structured geodatabase with the aim to relate the forcing weather to a direct effect on the territory, to connect cause and effect of an event. This database is composed of two connected tables: one contains the hydrological events data, other table contains information about the effects of the event on the territory. In this way, it is possible to use this collection of field data and precipitation intensity in order to conduct back-analysis. This approach is useful to reconstruct the event and compare the results of mathematic simulations with the hazard map draw up. Another useful application might be related to the assessment of the basin resilience, even in relation to hydraulic structures present in it.

CONCLUSION

The main objective of this work is to obtain a precipitation dataset representative of the events that occur on the territory. This aspect is in fact extremely relevant in the Alpine areas of the province, where, due to the climatic conditions, most of the events is not properly detected by the traditional raingauges.
With this goal, the Autonomous Province of Trento developed a method based on the integration between different sources of precipitation data analysis and field inspections data, useful for drafting/updating the hydrogeological hazard map, for land management (planning, prevention hydraulics structures, ...) and for reducing the uncertainty involved in the estimation of triggering conditions of debris flows/flash floods events. To improve this structured procedure, the next step could be to set up a field test small basin equipped with flowmeters to develope inflow-outflow models in addiction to a systematic use of weather radar.

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KEYWORDS

weather radar; extreme precipitations; hazard mapping.

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